# Chronica Horticulturae

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## Symposia and Workshops

Fruit Breeding and Genetics • Euro Berry Symposium • Saffron Biology and Biotechnology • Temperate Zone Fruits in Tropics and Subtropics • Irrigation of Horticultural Crops

## Horticultural Highlights

Horticulture? For the Love of Life • Improved Plantain and Banana • China's Energy-Saving Greenhouses

ISHS

# CHRONICA HORTICULTURAE

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Cover photograph: Strawberries by Dr. B. Mezzetti, see p. 21

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

ISHS

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# ISHS Membership
# Access to World Horticulture

Uygun Aksoy, ISHS Board member

Uygun Aksoy

The International Society for Horticultural Science (ISHS) has been a unique platform in world horticulture for more than 40 years. The objective of ISHS is *"to further all sectors of horticulture by improving international co-operation in the scientific study and exchange of knowledge of biological, technical, ecological, environmental, sociological, educational and economic issues as they affect horticulture."* The scientific structure is composed of commodity-based Sections and cross-commodity Commissions. Their outputs are based on symposia, workshops and congresses which are published in *Acta Horticulturae* and *Chronica Horticulturae.* These publications are available in various research libraries and include nearly 650 *Acta* containing over 32,000 articles. These are all now available online on the ISHS website (www.ishs.org) or directly at www.actahort.org. They represent a tremendous resource of horticultural information. The world-wide network formed through ISHS develops information on horticulture and facilitates the exchange of information required to advance horticultural science. Membership in this international forum is open to all individuals, organizations, countries or states. The main aim of ISHS is to provide efficient networking among stakeholders in various fields of horticulture throughout the world.

## INDIVIDUAL MEMBERSHIP

The main body of the ISHS is formed by the individual members. Currently, there are nearly 6000 individual members from 125 countries. The numbers are increasing each year. The privileges of individual membership include:

- Four issues of *Chronica Horticulturae*
- A list of members and their contact information by country
- Reduced registration fees at ISHS symposia and the International Horticultural Congress (IHC)
- Free download of a prescribed number of *Acta Horticulturae* articles from Acta on-line
- Reduced cost of ISHS publications
- A certificate and card of membership

Data on membership between 1986 and 2003 are presented in Figure 1. Since 1995 there has been a steady increase reflecting increased services provided by our Society. Individual members come from 125 countries, the largest number from Europe followed by Asia and Oceania, and North America. The proportion of the membership coming from Europe and North America decreased slightly from 1998 to 2003 whereas that from other continents is increasing. The highest rate of increase was in the members from Central and South America, 4 fold, and from Middle East and Africa, 3.5 fold, (Figure 2).

Increasing the number of members from developing countries has been a priority for the Society. Starting from 1996, the annual fee paid by members coming from developing countries is valid for two years, essentially halving the membership fee. Members from developing countries are encouraged to organize ISHS symposia. The World Conference on Horticultural Research, co-sponsored by ISHS and the American Society for Horticultural Science, held in Rome in 1998 was a milestone in the development of strategies to improve horticultural research in developing countries. An ISHS Committee for Research Cooperation (CRC) has been established to provide greater reach of the Society into the developing world. However, individual membership from developing countries still needs to be promoted. One way could be through organizing "twinning" programs with members from developed countries. I am convinced that many members, if approached, will support individual membership to their colleagues in the developing world who are constrained by bureaucratic or financial realities. This is essential since membership now provides 10 downloads to *Acta Horticulturae* online, helping to build linkages with counterparts in other parts of the world.

ISHS symposia are organized regularly, now over 30 per year. They are announced in *Chronica Horticulturae*, received quarterly by each member. Early announcement permits ISHS members to plan and participate in these narrowly focused symposia. Participants at these symposia include researchers, farmers, academics, and industry personnel. As an example, The First International Conference on Turfgrass Management and Science for Sports Fields was organized in June 2003 in Athens (Greece) exactly a year before the Olympic Games. By participating in these symposia, horticulturists working on a specific commodi-

**Figure 1. Evolution of individual membership in ISHS between 1986 and 2003.**

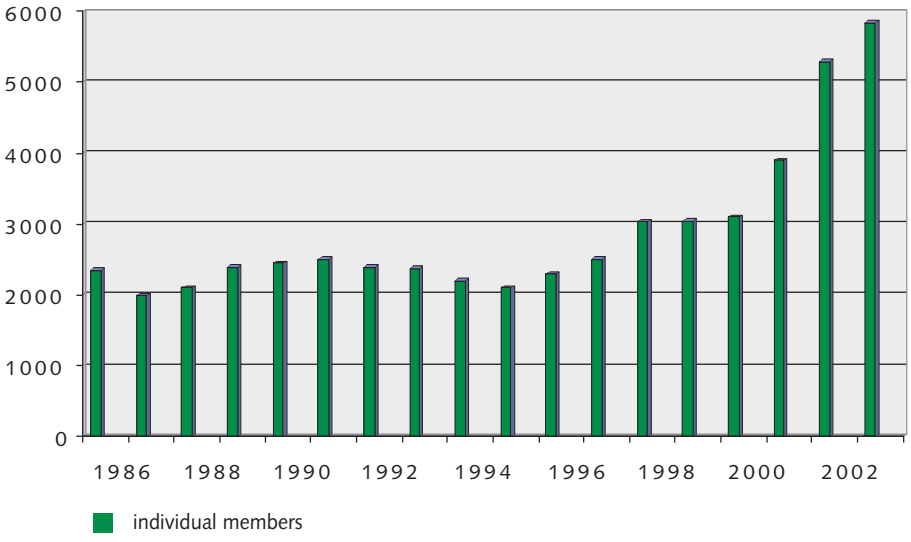
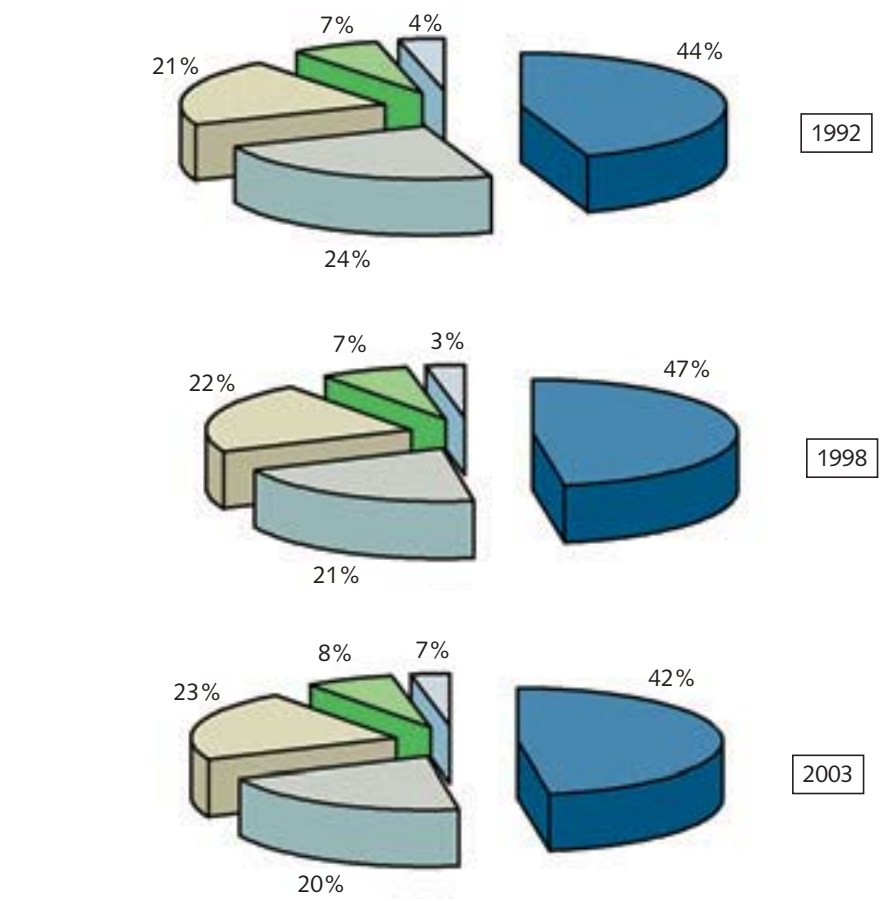


**Figure 2. Geographic distribution of individual ISHS membership in 1992, 1998 and 2003.**




ty or discipline can find a group with similar interests. Furthermore members may initiate a new working group and, provided there is sufficient interest, organize an international symposium on a unique theme. Past experience has shown that the number of members increase in the country where an ISHS symposium is organized.

ISHS members pay a reduced fee to participate in an ISHS symposium or congress. The additional amount for non-members entitles them to annual membership. We have found that about 70 % of these new members continue their membership.

Students also have reduced membership fees. The involvement of younger generation of horticulturists is vital to ISHS. Special programs for students are available such as awards for best student posters during the International Horticultural Congress held in 2002 in Toronto, Canada.

The International Society for Horticultural Science provides equal opportunities to all members. Although the number of female members is still far less than of male members, reflecting the male domination of research in all parts of the world, this situation is changing. This can be seen by the presence of one woman on the 5-person Board and women serving as chairs of a commission and of several working groups. Active involvement of women within the scientific structure and other ISHS organs is actively promoted.

## COUNTRY/STATE AND ORGANIZATION MEMBERSHIP

The representatives of the country/state members form the Council, the final decision making body of the Society. Each country/state has a single vote although many have up to three council members. Country/state membership enables ISHS activities to be held in that country. Presently there are four categories of country/state membership. The bodies paying the membership fee are free to choose the appropriate category of dues but the privileges offered in the four categories are the same. Today, the number of country/state members is approximately 50. In the past, ministries paid country dues but during the last decade many national horticultural societies have taken over this responsibility. The country membership fee can be shared by more than one institution or agency.

Organization members are generally libraries, universities, or research institutes. The number of organization members has been decreasing: 210 in 1992, 155 in 1998 and 131 in 2003. This reduction in the number of organization members may be associated with higher number of individual members as well as financial problems of libraries and other state organizations. Another important reason is that the WorldWideWeb is increasingly taking over the task of the traditional library.

ISHS membership is a win-win situation. It opens the gate for more activities and leadership in horticultural science and, above all, permits members to be part of a large close family of colleagues. Be a member, promote and support ISHS membership!

# Horticulture? For the Love of Life

E.O. Wilson

**I wish to address what might be thought of as the intersection of botany and aesthetics as an expression of human nature. In short, at the risk of being called a biological determinist, what draws us here to discuss horticulture and life quality is in our genes. I will follow that with a discussion of the biodiversity conservation imperative, an imperative that horticulturists will do well to address.**

**(This article was presented as Plenary Lecture, August 12, 2002 at the XXVIth IHC)**


## ON HUMAN NATURE

So let me start with a definition of the fundamental idea of what is going on in the human mind when we embrace nature and its extension in horticulture. Human nature, it is becoming clear from many lines of research, is not the genome (all the genes together) - the genome only prescribes human nature. Nor is human nature simply cultural universals such as the incest taboos and rights of passage that occur in practically all human societies. These are products of human nature. Rather human nature resides in the hereditary epigenetic rules of mental development. These rules are the genetic biases in the way our senses perceive the world, the symbolic coding by which we represent the world, the options we open to ourselves by deliberate action, and the responses we find easiest and most rewarding to make.

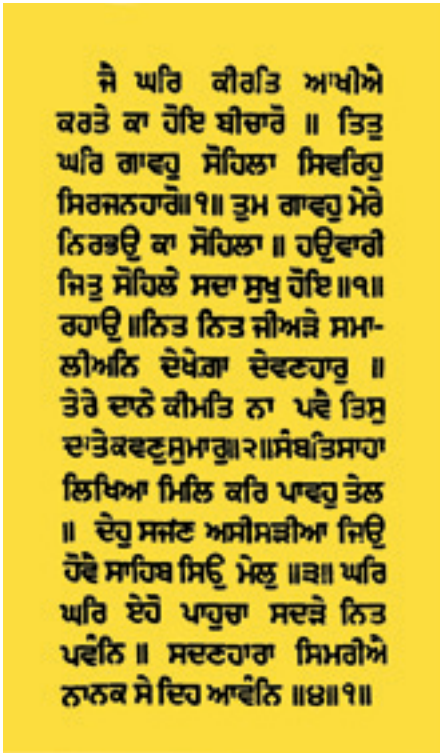
Good examples of these rules of mental development controlling human nature can be found in the way we see and linguistically classify color and how we evaluate the esthetics of artistic design according to elementary abstract shapes and degree of complexity. Both the practice and appreciation of horticulture reflect, even require, the expression of these deep-seated rules.

Other epigenetic rules lead us to differentially acquire fears and phobias of certain kinds, particularly to dangers in our environment like snakes or heights; to communicate with certain facial expressions and body language to bond with infants; to bond conjugally; and so on across the many categories of behavior and thought. Most are evidently very ancient, dating back millions of years in mammalian ancestry, while others, like linguistic development, are uniquely human and probably only hundreds of thousands of years old.

We now know, for example, the basis of color perception in some detail. We know the basis of that phenomenon right down to the sequence of the DNA in the human genome that determines the formation of the sensitive pigments in the color cones of the retina. We know the chemistry of it. We know the pathway of the neurons from the retina to the thalamus to the visual cortex at the rear of the brain and finally down to the special area in the lower part of the visual cortex where color is integrated and signals are passed to the rest of the brain for association. We don't know everything about color but we know quite a lot. The way we see color is a very important component of human nature. The further expression of this epigenetic rule in how we describe color is another fascinating story.

Experiments have been performed where native language speakers, representing over twenty languages differing greatly phylogenetically, such as Sioux and Zulu, are asked to look at the Munsell Color Array and point to the positions that correspond to color names

Figure 1. Punjabi script as an example of the level of complexity in abstract shape and design universally found to be attractive by human beings (from K. Katzner, The Languages of the World, 1995).


ਜੈ ਘਰਿ ਕੀਰਤਿ ਆਖੀਐ
ਕਰਤੇ ਕਾ ਹੋਇ ਬੀਚਾਰੋ ॥ ਤਿਤੁ
ਘਰਿ ਗਾਵਹੁ ਸੋਹਿਲਾ ਸਿਵਰਿਹੁ
ਸਿਰਜਨਹਾਰੋ॥੧॥ ਤੁਮ ਗਾਵਹੁ ਮੇਰੇ
ਨਿਰਭਉ ਕਾ ਸੋਹਿਲਾ ॥ ਹਉਵਾਰੀ
ਜਿਤੁ ਸੋਹਿਲੈ ਸਦਾ ਸੁਖੁ ਹੋਇ॥੧॥
ਰਹਾਉ ॥ਨਿਤ ਨਿਤ ਜੀਅੜੇ ਸਮਾ-
ਲੀਅਨਿ ਦੇਖੇਗਾ ਦੇਵਣਹਾਰੁ ॥
ਤੇਰੇ ਦਾਨੈ ਕੀਮਤਿ ਨਾ ਪਵੈ ਤਿਸੁ
ਦਾਤੇਕਵਣੁਸੁਮਾਰੁ॥੨॥ਸੰਬਤਿਸਾਹਾ
ਲਿਖਿਆ ਮਿਲਿ ਕਰਿ ਪਾਵਹੁ ਤੇਲ
॥ ਦੇਹੁ ਸਜਣ ਅਸੀਸੜੀਆ ਜਿਉ
ਹੋਵੈ ਸਾਹਿਬ ਸਿਉ ਮੇਲੁ ॥੩॥ ਘਰਿ
ਘਰਿ ਏਹੋ ਪਾਹੁਚਾ ਸਦੜੇ ਨਿਤ
ਪਵੰਨਿ ॥ ਸਦਣਹਾਰਾ ਸਿਮਰੀਐ
ਨਾਨਕ ਸੇ ਦਿਹ ਆਵੰਨਿ ॥੪॥੧॥

in their language. They tend to concentrate in consistent ways the intuitive position of the color and this appears to be true across all languages.

One classic experiment on the subject involved native New Guinea highlanders, who have only two color terms - essentially black and white. They were divided into two groups and given color terms (new words to them) in a standard color array. One group was given the color terms falling right in the middle of the primary color wave lengths. The other was given terms applied to those ambiguous middle areas between the primary colors. The first group learned these new words more quickly and displayed better retention of what they

had learned. The second group, given the choice of where to place their terms, placed them, as you might expect, right in the middle of the primary colors.

This is a connection we can make between genetic evolution and cultural evolution that is pretty solid, but here is something that is even more remarkable. When one studies the color vocabularies of societies all around the world, it transpires that there are just eleven semantically interchangeable color terms, that is, where a term from one language can be mapped onto the term from another language, one on one, one on many, or many on one, so that they can be translated. Some languages have only two terms. Others, like English, have all eleven.

Anthropologists have found that when the gradations and number of color terms are used as a kind of evolutionary scale there is an astonishingly regular sequence. If there are only two terms, they are almost always black and white; light and dark. If there are three, it's black, white and red. If four, it's black, white, red, green or yellow; five, all five of those terms, and so on. Of 2,036 possible pathways of evolution from two to eleven semantically interchangeable color terms, only 22 describe the pattern in the great majority of these aggregates, indicating there is something going on in the brain that is characteristic of the human mind.

We are talking here about very important elements of human nature - the way we see the world and the way we form language. It helps explain what attracts us, why we are attracted, and, of relevance to this Congress, what attracts us to the whole domain of horticulture.

Human preferences relating to shape and design provide another example of the development of the mind that we are now beginning to understand more clearly. The human response to levels of complexity in abstract design can be measured by a damping of the alpha wave, an indirect but quite reliable measure of arousal. Which images arouse people the most? They lie near the low end of possible complexity, in the area of about 20 percent redundancy. We get a spike at about this level that is roughly comparable to the amount of complexity found in a simple maze, an asymmetric cross, or two turns of a logarithmic spiral.

So why do I bring these phenomena up at a Congress dealing with the art and science of horticulture? Because they strongly suggest an innateness in how we are aroused by design in plant forms, landscapes, and cultural artifacts based upon perception and choice.

Let me move on, closer to home as a matter of fact, to mention biophilia. Biophilia is the innate affiliation people seek with other organisms and especially with the natural world. Studies have shown that, given complete freedom to choose the setting of their homes or offices, human beings across cultures move toward an environment that combines the following three features: a) they want to be on a height looking down; b) they prefer open savannah-like terrain with scattered trees and copses; and c) they want to be near a body of water such as a river or a lake. Even if all these elements are purely aesthetic and not functional they will pay enormous prices to combine these qualities in their habitation.

They then look for two other cross-cutting elements in the environment. They want a retreat in which to live and desire something solid to their back. Secondly, they want a prospect of fruitful terrain on which to forage and, in that prospect, they like distant, scattered large animals if they can have them, or iron replicas if not, and trees with low nearly-horizontal branches. Incidentally, there is also a strong preference for trees with deeply divided leaves - perhaps it's not going too far to suggest that this is why some of us consider the Japanese maple to be the world's most beautiful tree.

So, in short, if you will allow me to take a deep breath and then plunge where you may not wish to follow, people want to be in the kind of environment in which our species evolved over millions of years. That is, hidden in a copse or against a rock wall looking out over a savannah and transitional woodland, at acacias and similar dominant trees of the African savannah and, if that sounds like a far-fetched idea, why not? Is that such a strange idea really? All mobile animal species, ones that select their environment, have a powerful, often highly sophisticated inborn guide for habitat selection. It's the big part of their instinctive repertory. It's amazing how precise and complex the guidance system can be - even in an insect that has a brain the size of a salt grain. So why not a residue, at least, in human beings?

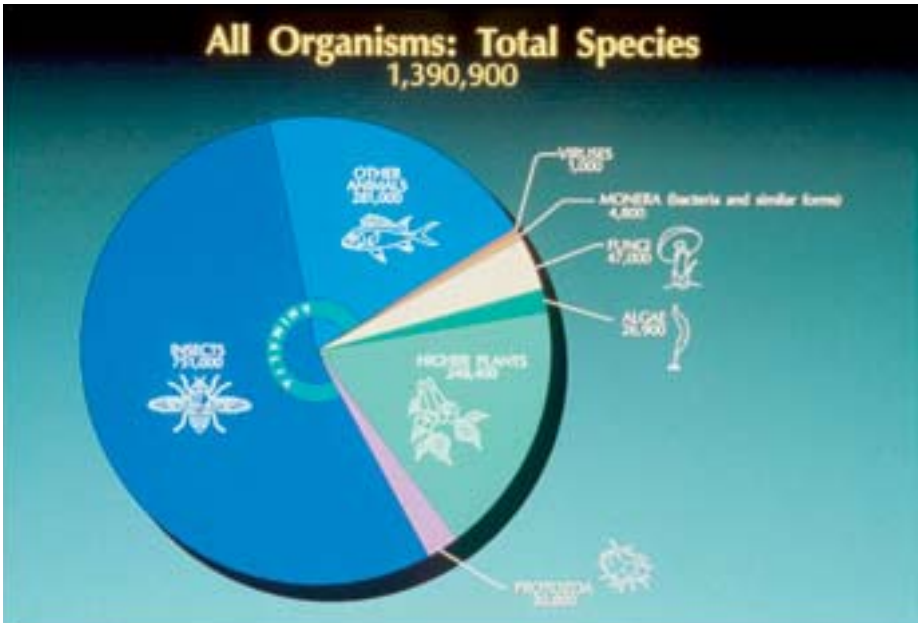
When I addressed the annual meeting of the American Association of Landscape Architects a couple of years ago the response to these suggestions was very favorable; in fact, a number of delegates said to me "We knew that." I doubt, however, that they had thought about the neurobiology or genetic history of it.

So let me summarize briefly these thoughts about human nature with particular relevance to the science and practice of horticulture. I think we instinctively appreciate an optimal degree of geometric complexity. We move toward an optimum environment, rearranging it out of forest, desert and so on to resemble savannah with certain types of vegetation. We move toward certain presentations of color and combinations of color, and I think it is fair to say that we move toward diversity, surprise and delight. We do not favor, no matter how beautiful, homogeneous gardens of a single species. As, in the extreme, the tropical rain forest appeals to us - the source of so much biological diversity, including the ornamental, medicinal and of course edible plants and plant parts that are your stock in trade.

## THE CONSERVATION IMPERATIVE

Let me turn, then, to a brief exposition of the subject of biological diversity (biodiversity) as it is seen by a scientist who has dedicated a lifetime to this subject. Horticultural science and industry, and orchardists and gardeners

**Figure 2. An estimation of the distribution of species across major orders of life forms.**



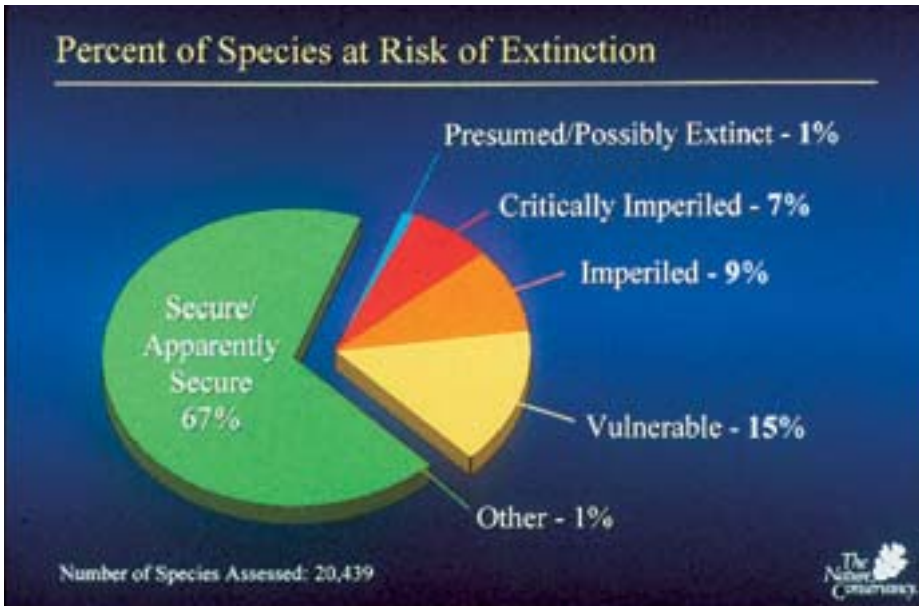
everywhere should have more than a passing interest in maintaining a richly diverse flora on planet Earth. But even this enlightened segment of society may fail to fully understand the consequences of habitat destruction - especially destruction of the tropical rainforest.

Biodiversity is the totality of all the hereditary variation of life on earth. It is the creation. Scientists understand and study biodiversity within three levels or domains. It is studied in ecosystems like marshes, shallow marine assemblages, wetlands, forests, and grasslands. Secondly, it is studied by trying to identify the species of plants, animals and microorganisms that inhabit each ecosystem. The totality of the species assemblages are what we study most, the species being the most favored unit for the study of biodiversity, but we always have in mind how these species live together in the ecosystem. And finally, biodiversity is studied at the level of genes, the diversity of genes in the genome of each species in turn. These three levels can be related one to the other, the ecosystem, the species, and the genetic diversity within a species in a way to make a complete study of biodiversity, particularly its measurement.

How much diversity is there? Figure 2 is based on data about 15 years old but still illustrates the general proportionality of species. At that time I estimated that about 1. 4 million species had been described - today the figure is thought to be between 1.5 and 1.7 million overall. Clearly, we don't know the exact number of species that have been given a scientific name and described, but among those *known* to science it is insects among the animals and flowering plants among the photosynthetic organisms that dominate in our slice of geologic time. This has been the case since the late Mesozoic when the flowering plants arose, diversified and flourished in partnership with the insects. We are living in a kind of symbiotic partnership of insects and flowering plants on land - together they have produced more diversity at the species level than anywhere else, including the sea.

But this way of representing biodiversity can be misleading since we don't know how many species actually exist on earth. We don't even know the nearest order of magnitude. Estimates range from about five million to as many as 100 million species. We just know that the great majority of organism species on earth remain undiscovered and the reason why it could reach 100 million is that the microorganisms, the archeans and bacteria, prokaryotic single-cell microscopic organisms, are largely unknown. A single gram of healthy forest or garden soil contains in the vicinity of four to five thousand species of bacteria among the actual ten billion bacteria in that pinch of soil. Virtually all are unknown to science because we have been unable to diagnose them!

**Figure 3. Species report card (from Bruce A. Stein, The Nature Conservancy, 1997).**




We are, however, beginning to progress rapidly in this field because of the advances in base pair sequencing. I believe that within just five years or so the microbial geneticists will be in a position to identify bacteria so rapidly that we can start to seriously explore the world of micro-organisms. We will be able to actually see what is in a gram of soil and have a feel for it, as though walking through a woodland with binoculars and listing the species of birds. Genome diversity is even less known - we have only begun to get complete genomes of species. By early 2002, complete DNA base pair maps of about 60 species of bacteria had been produced but, as already mentioned, we can expect rapid progress in the near future.

But to give you an idea of how much information is in a genome, consider the human genome. The genetic information in the several billion base pairs in the human genome (now nearing completion) might be visualized in the following way: Take out the DNA of a single cell (i.e., the complete human genome; four strands in a typical diploid cell), and put these strands end to end. You have, *in real space*, a molecule that when unwound is about one meter long but invisible because it is only two billionths of a meter thick. But if you could magically increase that strand until you can see it clearly - to about the thickness of wrapping string - and lay it down on the ground, that wrapping string would stretch 2930 kilometers, the distance from New York to Dallas! And as you walked along it reading off the DNA, you would be reading about 40 base pairs a centimeter.

That is how much information is in an organism, a typical eucaryotic organism. Plants, if anything, contain even more information. That is what we lose - that amount of information, that encyclopedia of a million-year history, when we lose a plant species. Bear that in mind.

And where is biodiversity located? Everywhere there is liquid water or the potential of liquid water, pole to pole from the peak of Mt. Everest to the Challenger Deep of the Mariana Trench 10,800 meters below sea level. At the very least, in practically every square meter of the earth's surface there are bacteria and other micro-organisms. Some of them are thriving in water that is at or above boiling. These are the so-called 'extremophiles' which include the thermophiles.

There can be no doubt that this planet contains an immense wealth of biodiversity that is far from being described or analyzed in any depth. Yet we risk losing a huge proportion of these riches in our lifetime. The tropical rainforests, the richest of all terrestrial environments, are disappearing worldwide at a rate of half a percent to one percent a year. The remaining cover of these forests is about equal to the coterminous 48 states of the United States, and the rate of destruction is equal to about half or all of the state of Florida every year. This translates to as much as a quarter of one percent of all species extinguished or doomed to early extinction each year.

This situation is magnified in ecosystems everywhere by the reality that simply reducing the size of a habitat puts many species at risk. As the area of an island or a habitat patch declines, the numbers of species that can live there indefinitely also declines by the third to the sixth root of the size of the habitat. A typical example is the fourth root and the rule of thumb is that when you reduce the habitat

area by 90%, you reduce the number of species that can live there indefinitely to half. So just protecting a reserve doesn't necessarily mean that you're going to save all the species in it.

Around 1900, the Philippines were covered by one of the great lush rainforests of the world, a very rich fauna and flora. Now there is less than 10% remaining. When habitats are taken to that level, with approximately 50 percent of the species at risk, it is easy to eliminate the rest in one shot. It can be done in a few places in a matter of days by just a team of bulldozers and chain saws and their operators. That is the peril that much of the world biodiversity is in right now - the source of so much of the plant materials important to horticulture in the present and the promise of the future.

How fast are species going extinct? This can be estimated by several different measures, including our knowledge of the reduction of habitat just mentioned. Another is by observing the rate at which species are dropping through the International Union for the Conservation of Nature red-data list that spans 40 years of identifying vulnerable to critically endangered to extinct species. And there is a third way using population biology to estimate the rate of species extinction. These estimates reveal that the extinction rate is 100X to 1,000X higher than it was before the coming of humanity and we may be approaching the 10,000X rate because of this final elimination of so many great strongholds of the world's biodiversity.

To conclude, I wish I had more time to tell you why there is a ray of hope - what can be done, what is being done, and how much it will cost. Here is just one estimate of the latter.

At the present time, about six billion (US) dollars a year is put into conservation all over the world - this is from all sources. This is absurdly low. An estimate made two years ago by a team of biologists and economists is that just 28 billion dollars in a single payment, a single investment in saving land and building non-invasive economic programs for the people in and around the 25 hottest of the 'hot spots' in terms of preserving biodiversity and securing preserves in the Philippine Islands where the danger is greatest of ongoing mass extinction, and in the last remaining wilderness of the Amazonian, Congolian and New Guinea tropical rainforests, would protect the future of nearly half of the world's species of plants and animals found only in these areas.

Twenty-eight billion dollars would be enough to secure these habitats and thus cover nearly half of the species of plants and animals of the world that are found nowhere else!

Half of the plant and animal species could be put under an umbrella, held for a while anyway while we get our act together.

Now if 28 billion dollars in a single application seems like too large an amount, consider that it is just one part in a thousand of the annual gross world product - the combined gross national products of all the countries of the world combined. Just one thousandth of that amount in just one payment could turn everything around. I think we have the science and we have the methods to do it but the impulse, the belief in its importance has yet to take hold. If it had, I'm certain that this money would have already been available.

The central problem of the new century, in my opinion, is how to raise the poor in these countries and regions containing this treasure of biodiversity, the 80 percent of the people of the world living in developing countries, to an endurable quality of life while preserving as much of the natural world as possible. Both the poor, and the rich but endangered pools of biological diversity of which I speak are concentrated in the developing world. The solution to the problem has to flow from the recognition that both depend on the other. The poor, including the nearly one billion people that are absolutely destitute, have little chance to improve their lives in a devastated environment. Conversely, the natural environments where most of the biodiversity still hangs on, many places by a thread, cannot survive the press of land-hungry people who have nowhere else to go.

I hope that each of you in this audience, a Congress of scientists and others who fully understand and appreciate the important place that horticultural plants have in human nutrition, human health, and human culture, will share my conviction that this great problem can be solved. The resources to do so exist. Those who control these resources have many reasons to achieve that goal; not the least is their own security.

Biologists of all persuasions, including those assembled here, should make themselves heard about this issue. At the end of the day, the actions we take will be both fact-based (and science is supplying that) and an ethical decision. A civilization able to envision God and an afterlife and to embark on the colonization of space will surely find a way to save the integrity of this magnificent planet and the life it harbors.

## About the Author

E.O. Wilson

E.O. Wilson is the Pellegrino University Research Professor Emeritus and Honorary Curator in Entomology, Museum of Comparative Zoology, Harvard University, USA. He has written over 20 books, won two Pulitzer prizes, and discovered hundreds of new species. Considered to be one of the world's most famous living scientists, Dr. Wilson has been called both The Father of Sociobiology and The Father of Biodiversity.

Plantain and Banana

# Progress in Breeding and Delivering Improved Plantain and Banana to African Farmers

A. Tenkouano and R.L. Swennen

## INTRODUCTION

Banana and plantain are important cash and subsistence crops in most tropical and subtropical regions of the world (Fig. 1, 2). The varieties that are used for commercial or subsistence production are predominantly triploid ($2n = 3x = 33$) cultivars that are evolutionary derived from crosses within and between diverse accessions of two diploid ancestor species, *Musa acuminata* Colla (A genome) and *M. balbisiana* Colla (B genome). The existing cultivars are usually classified into three genome groups, i.e., predominantly AAA for dessert and highland bananas, AAB for plantains, and ABB for cooking bananas. There is wide consensus about the attributes conferred by A or B genomes in interspecific natural or artificial hybrids of *M. acuminata* and *M. balbisiana*. For example, edibility of mature fruits arose from mutations causing parthenocarpy and female sterility in diploid *M. acuminata*, whereas, hardiness is contributed by the B genome since *M. balbisiana* clones thrive abundantly in areas experiencing pronounced dry seasons alternating with monsoons. Also attributed to the B genome are fruit characteristics such as starchiness and acid taste, causing AAB plantain to be starchier but less sweet and less palatable when raw than the AAA dessert bananas.

**Figure 1. Plantain grown in backyard in southeastern Nigeria.**

**Figure 2. Local trade of plantains in Nigerian markets.**

Because of biotic stresses such as black Sigatoka (caused by *Mycosphaerella fjiensis* Morelet), considerable efforts have been made to breed for resistance, as well as to broaden the genetic base of these crops (Fig. 3). The aim is to produce seedless varieties, preferably in the triploid background that is common to the majority of existing cultivars. This usually involves crossing 3*x* cultivars to 2*x* accessions that are donors of resistance genes, selecting 4*x* and 2*x* primary hybrids from the 3*x* - 2*x* progenies, and crossing 4x - 2x hybrids to produce secondary 3*x* hybrids.

The International Institute of Tropical Agriculture (IITA) carries out plantain and banana improvement research with three predominant themes: (1) advancement of breeding methodologies to increase the efficiency of hybrid development in plantains and East African Highland bananas, (2) development of superior plantains and East African Highland bananas with focus on nematode resistance, dwarfism and fruit quality, and (3) technology transfer and human resource development to enhance NARS (National Agricultural Research System) capacity for plantain and East African Highland banana research and production in sub-Saharan Africa.

This research agenda is largely implemented in partnership with the Katholieke Universiteit Leuven (KULeuven) in the framework of the Strategic *Musa* Improvement Project (SMIP) funded by the Directorate General for Development and Cooperation (DGCD) of the Government of Belgium. IITA also collaborates with the John Innes Center (JIC) with financial support from the Gatsby Charitable Foundation (GCF), United Kingdom. Additional support for this agenda is provided by the United States Agency for International Development (USAID).

Contributions to this agenda are also provided by other research institutions such as the Centre Africain de Recherches sur Bananiers et Plantains (CARBAP, Cameroon) and the Fundacion Hondurena de Investigacion Agricola (FHIA, Honduras) while advantage is taken of the networking schemes provided by the International Plant Genetic Resources Institute (IPGRI) through its International

**Figure 3. Black Sigatoka resistant tetraploid plantain hybrids (second and fourth from left) bred at IITA by crossing diploid cultivars (left) or wild banana species (right) and the susceptible African triploid plantain cultivar (middle).**

Network for Improvement of Banana and Plantain program.

Over the past few years, scientific advances in understanding the *Musa* genomes and their interaction in producing hybrids of the various post-harvest utilization classes have been achieved while enhancing breeding efficiency through a successful combination of quantitative genetics and molecular and cytological techniques (Fig. 4). In-vitro DNA manipulation methodologies have been developed to facilitate incorporation of resistance to diseases and pests into genotypes that are intractable to conventional cross-breeding, with particular focus on black Sigatoka, nematodes, and banana streak virus. Hybrid delivery projects to farmers are now possible and have started in several countries in sub-Saharan African to distribute, in collaboration with national agricultural research systems (NARS) and non-governmental organizations (NGO). The most promising improved varieties of banana and plantain are distributed along with technology packages allowing for rapid farmer-to-farmer spread of the varieties and income generation through value-adding processing of the fruits.

**Figure 4. Improved banana hybrid performing well under farmer's condition near Patani village in Delta State of Nigeria.**

## BREEDING METHODOLOGIES

One predominant thrust of Phase I of SMIP (1996-2000) was on developing breeding methodologies by exploring and integrating cellular and molecular biology techniques to conventional methods of genetic analysis and cultivar development. In this regard, research at KULeuven led to the establishment of embryogenic cell suspensions via meristem-derived scalps, the production of protoplasts from embryogenic cell suspensions, and the establishment of genetic transformation protocols (protoplast electroporation, particle bombardment, Agrobacterium-mediated), culminating in the production of transgenic plantains expressing genes with anti-fungal activity. Major breakthroughs were also obtained in cryopreservation of germplasm and development of in-vitro screening methods for identification of nematode resistance.

Research at IITA led to the identification of PCR-based molecular markers (RAPD, AFLP) that discriminate between the A and B genomes and, together with flow cytometry for ploidy analysis, facilitate early selection of hybrids with putative banana or plantain labels. Another breakthrough is the development of cytogenetic protocols using silver nitrate staining to analyze cell division and understand the physical basis of inheritance in crosses, which, together with predictive models for quantitative analysis supported by molecular genetics, have significantly increased breeding efficiency. A method for rapid in vivo screening for nematode resistance was also developed.

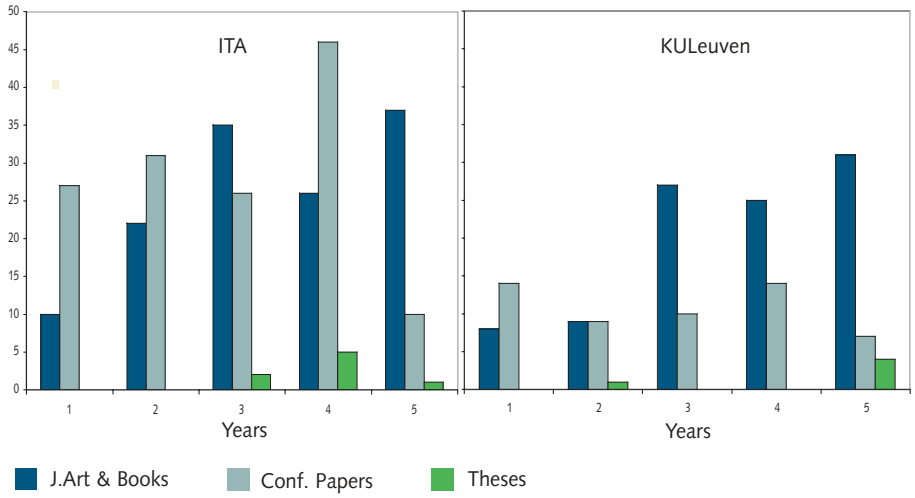
These scientific breakthroughs have been documented in a large number of publications in refereed journals, communications at international conferences, and student theses (Fig. 5).

With this background, it became possible to further explore issues related to parental selection based on combining ability while (i) improving on breeding efficiency with molecular markers and (ii) expanding breeding frontiers with non-conventional gene introgression techniques.

### Combining Ability and Heterosis

The majority of edible banana and plantain cultivars are triploids ($2n = 3x = 33$), justifying the aim of breeding programs to develop high yielding and disease resistant hybrids in the triploid background, usually through crosses between diploid and tetraploid accessions. We established that such crosses produce predominantly triploid progeny in the $4x$ - $2x$ direction and predominantly diploid progeny in the $2x$ - $4x$ direction (Fig. 6). This was confirmed by direct estimation of parental contribution to progeny based on analysis of microsporogenesis, ploidy segregation in progeny, and relative similarity between parents and segregating offspring using RAPD and AFLP markers.

**Figure 5. Number of scientific publications by IITA and KULeuven from 1996 (Year 1) to 2000 (Year 5) under SMIP-I.**

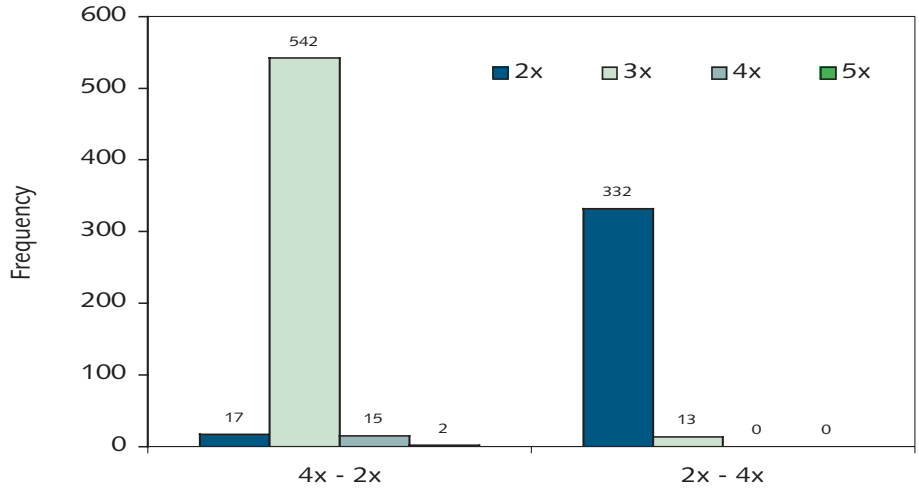



This roughly suggests a pattern of unequal contribution of the parents with respect to the progeny (2/3 + 1/3), but equal contribution with respect to the parents (1/2 + 1/2, each donating half of its endowment) in 4*x* - 2*x* crosses. The reverse is observed in 2*x* - 4*x* crosses where parental contribution is equal with respect to the progeny (1/2 + 1/2) but unequal with respect to the parents (1/2 + 1/4, since the 2x parent donates half of its endowment whereas the 4*x* parent donates a quarter of its endowment). In both cases, parental contribution is unequal with respect to the parent. This indicates that microsporogenesis is the key factor in ploidy determination for offspring from inter-ploidy crosses. Thus, 4*x*-2*x* breeding constitute the best way of developing 3*x* hybrids of banana and plantain (compared to several alternative possibilities) and will now form the core of the *Musa* breeding strategy at IITA.

Since > 20% of 2*x* breeding lines produce 2*n* pollen, minor emphasis will be devoted to unilateral sexual polyploidization (USP)-based 2*x*-2*x* breeding (inter-diploid crosses where one parent produces 2*n* pollen) for production of 3*x* hybrids via a 3-step strategy including (i) population improvement at the diploid level to accumulate favorable alleles in the diploid background, (ii) screening of the diploid breeding populations for 2*n* pollen production, and (iii) setting crossing schemes that would allow pollination to coincide with periods that are favorable for 2*n* pollen production.

Genome background does not appear to be determinant for expression of resistance and phenology in recurrent diploid *Musa* breeding, but banana-banana (BB) crosses produce more fruits while banana-plantain (BP) crosses produce more hands. Also, maternal performance appear to be more predictive of progeny value for yield than paternal phenotype (reverse of 4*x*-2*x* breeding).

**Figure 6. Ploidy segregation in 4x - 2x and 2x - 4x crosses. Note that the former produces mainly 3x progeny while the latter produces mainly 2x progeny.**




An examination of genetic by environment interaction (G _ E) effects on heritability and inter-correlations of phenological and yield traits showed that (i) yield components can serve as indirect selection criteria for yield, (ii) selection should be carried out in the second crop cycle, and (iii) different selection indices may be constructed to identify ideotypes best suited to specific agro-ecological niches.

### Molecular Markers

RAPD fragments specific for the A and B genomes of *Musa* have been identified, isolated and cloned. The RAPD markers are useful in preliminary genome classification, but they are not subspecies specific markers. Hence, more robust markers were developed using AFLP analysis of total DNA and PCR-RFLP of the ribosomal DNA internal transcribed spacer (ITS) regions, allowing for quantitative determination of genome composition and inferences on phylogenetic relationships.

Thus, we established that *M. acuminata* may comprise 3 genetic subspecies (*burmannica*, *malaccensis*, and *microcarpa*) while *M. balbisiana* contains 2 forms (Singapuri, I-63), suggesting that there might be at least 3 A genomes and 2 B genomes. Furthermore, it seems that the A genomes in the plantains come from the subspecies *microcarpa* while the B genome comes from the I-63 form of *M. balbisiana*. Of practical importance to breeding is that the genome composition of all breeding lines and native accessions available at IITA has now been determined.

The development of molecular markers to assist selection of traits that are expressed late in the plant cycle was pursued. A large mapping population of approximately 400 individuals was developed from the cross *M.a.* subsp. *microcarpa* 'Borneo' *x M.a.* subsp. banksii 'SF247'. So far, a putative AFLP marker for fruit parthenocarpy (distinguishing between low and high pulp content) and seedlessness was identified, subject to confirmation when phenotyping for three crop cycles is completed at Onne and at Ibadan.

### Regenerable *In Vitro* Cultures

Shoot-tip cultures and regenerable embryogenic cell suspensions (ECS) of different plantain genotypes, including 'Orishele', 'Obino l'ewai', 'Agbagba', and 'Bise Egome', have been successfully initiated at KULeuven with particular emphasis on deriving cultures from virus-indexed materials (Fig. 7). The induction period has been reduced from 18-30 months to approximately 6 months, using cytokinins. Problems continue to be experienced with East African highland bananas (blackening arising from polyphenol oxidation).

### *In Vitro* Breeding Methodologies

Transgenic plant materials have been generated at KULeuven via combined introduction of two or three gene constructs that encode antifungal proteins (AFP) with different modes of

**Figure 7. Embryogenic complex on an Obino l'ewai scalp after 5 months incubation (1a, 12x), 6 weeks after transfer to fresh ZZ medium (1b, 12 x). Young Orishele embryogenic cell suspension with peripheral transparent zone of high mitotic activity (2a, arrow, 100 x). Embryogenic cluster in same suspension (2b, 200 x).**

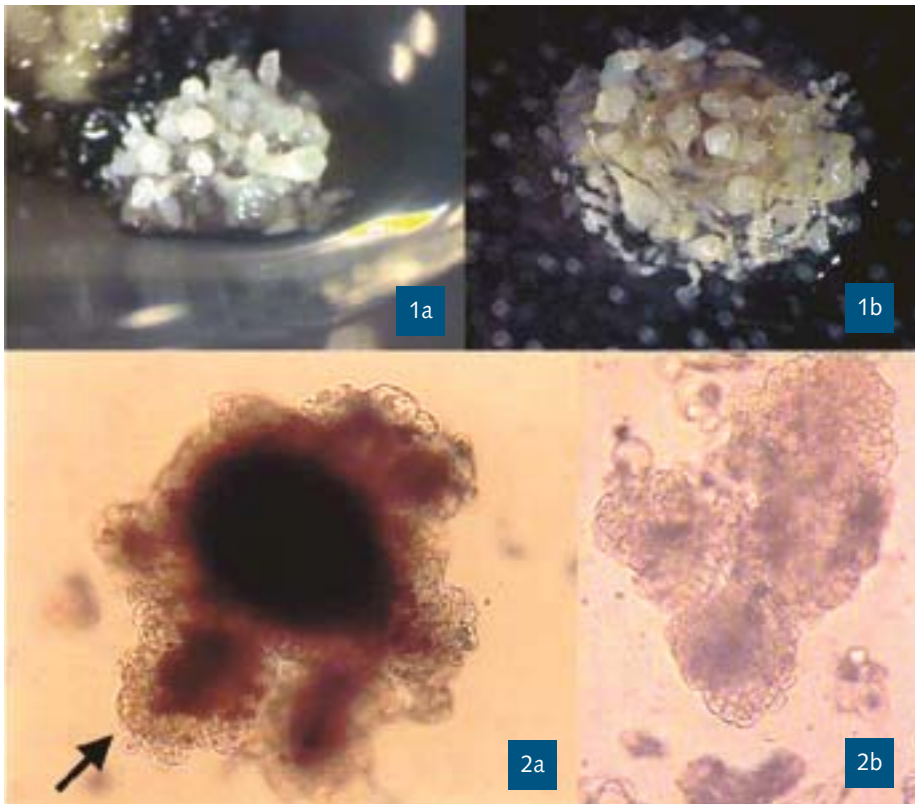
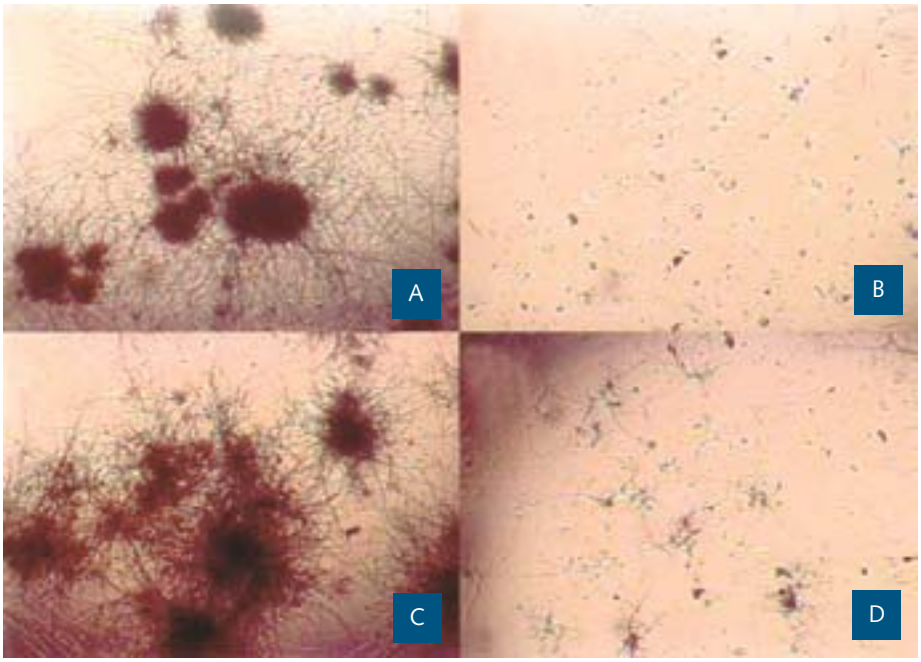



**Figure 8. In vitro fungus inhibition assay of control and transgenic plant extracts. Test fungus growth in the presence of (A) water, (B) purified antifungal protein, (C) extract from untransformed control plant, (D) extract from transgenic plant (necrotic index = 3.5) expressing the same antifungal protein as tested in (B).**




action. It is likely that such plants will provide a longer-term resistance to pathogens than plants expressing a single AFP would, as evidenced by *in vitro* fungus inhibition assays (Fig. 8). It can be seen that an extract from a transgenic plant (Fig. 8D) exerts a comparable inhibition on test fungus growth as the purified AFP alone (Fig. 8B), while extracts from an untransformed control plant (Fig. 8C) allow fungus growth similarly to that in water (Fig. 8A). This observation indicates that the specific expression of AFP provides the inhibitory character for transgenic plants, which is a promising indication in view of engineering resistance into disease-susceptible banana and plantain cultivars via the expression of antifungal genes in transgenic plants. On the basis of these results, the most promising double transgenic plants have been micropropagated and these lines are now available for field testing.

## SUPERIORS CULTIVARS

### Improved Cultivars and Populations

Seven high-yielding diploid hybrids (25283-S3 [2829-62 *x* 1448-1], 25291-1 [2829-62 *x* 9128-3], 25291-S4 [2829-62 *x* 9128-3], 25291-S26 [2829-62 *x* 9128-3], 25291-S32 [2829-62 *x* 9128-3], 25291-S62 [2829-62 *x* 9128-3], and 25447-S7 [2829-62 *x* 9128-3]) that are also resistant to black Sigatoka and nematodes were selected for use in recurrent diploid breeding and 4*x*-2*x* crosses. These hybrids have been virus-indexed for international distribution and use at other IITA locations in Cameroon and Uganda. Three other diploid hybrids (26365-3 [9839-3 *x* 8075-7], 26383-1 [8084-2 *x* 2829-62], 26533-2 [15035-2 *x* 8084-2] are in the pipeline for release.

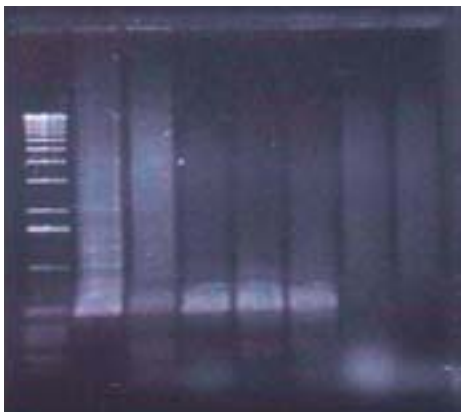
Similarly, a pool of seven secondary triploid hybrids (PITA 21 [1658-4 *x* 2829-62], PITA 22 [2796-5 *x* 4400-8], PITA 23 [4698-1 *x* 5105-1], PITA 24 [7152-2 *x* 9128-3], PITA 25 [4698-1 *x* Dwarf French Plantain], PITA 26 [548-9 *x* 1297-3], and BITA 7 [612-74 *x* Calcutta 4]) with excellent agronomic and fruit processing characteristics were selected and are now being distributed to farmers in Nigeria. Virus indexing of these hybrids has been completed in readiness for international distribution. Two other promising triploid hybrids were obtained, one plantain (26285 [6930-1 *x* 2829-62] and one cooking banana (30456 [612-74 *x* 8075-7]).

Nematode resistant progenies (TMHx660K-1 and TMHx917K-2) from crosses between 'Enzirabahima' (susceptible) and 'Calcutta 4' (resistant) were identified, increasing prospects for breeding resistance to nematodes in East African highland bananas.

Pyramiding of genes for resistance to black Sigatoka in 2*x* background was attempted with selection and field establishment for clonal evaluation of four multiple-parentage popu-

**Figure 9. Transient expression of GUS reporter gene in banana.**

Transient GUS expression



Amplified internal fragment of GUS gene

lations: Long Tavoy *x* 7197-2 (SH 3362 *x* Long Tavoy), Malaccencis Holotype *x* 1297-3 (Agbagba French Reversion *x* Calcutta 4), Selangor *x* 7197-2, Selangor *x* 9719-7 (Manang *x* Calcutta 4).

**Prototype Plants for Nematode Resistance**

A strategy to control plant parasitic nematodes is the transfer into plant host species of genes encoding nematicidal proteins. Lectins or lectin-related proteins, for example, are proposed to have toxic and/or repellent effects on nematodes. As a host for migratory and sedentary nematodes and a species considerably easier to be transformed than most plants, *Arabidopsis thaliana* has been used at KULeuven as an *in vitro* system to rapidly express transgenes and evaluate their effect on nematodes. Eight to ten weeks following inoculation with *Radopholus similis, Pratylenchus coffeae* and *Meloidogyne incognita*, reproduction ratios of 16.3, 11.9 and 24.0, respectively, were observed. This in vitro system enables preselecting transgenes or their combinations with the great potential for nematode control. Seven transgenic *A. thaliana* lines containing different lectins or lectin-related genes have been characterized for root expression via Western blot hybridization and agglutination tests. The most promising candidate genes will be introduced into banana cultivars.

**Prototype Plants for Resistance to Banana Streak Virus**

In prelude to developing lines with resistance to banana streak virus (BSV), emphasis was given to developing an efficient transformation protocol. Progress was made at IITA in establishing such a protocol for *Agrobacterium*-mediated transformation using apical shoot tip with plant construct pCAMBIA 1201 harbouring hygromycin resistance gene as selection marker and GUS-INT gene as reporter marker. The integration of GUS gene was confirmed with PCR and Southern Blot analysis. The expression of transgene was checked by GUS histochemical assay (Fig. 9).

## TECHNOLOGY TRANSFER AND HUMAN RESOURCE DEVELOPMENT

**Improved Hybrids**

One conspicuous achievement of SMIP is the development of disease-resistant hybrids with appropriate agronomic characteristics. The development of these disease resistant and high yielding plantain and banana hybrids constitutes a most significant scientific achievement in recent history in terms of the impact they could have on the alleviation of hunger in Africa and elsewhere. The tremendous impact of these high yielding, disease-resistant plants on food security would be evident in a relatively short time. This is because the improved hybrids are more than two to five times more productive than the traditional plantain landraces, under natural conditions with no chemical control of black Sigatoka.

These hybrids are now being introduced into farmers' fields via on-farm demonstration plots backed by training in rapid multiplication techniques and post-harvest processing, with funding from several development investors, in several countries.

In Nigeria, a USAID-sponsored project was launched in September 2001 to mass-propagate and distribute seedlings of 10 IITA-bred hybrids (BITA-3, BITA-7, PITA-14, PITA-17, PITA-21, PITA-22, PITA-23, PITA-24, PITA-25, PITA-26) and 7 hybrids introduced from other research institutes (FHIA-17, FHIA-18, FHIA-20, FHIA-21, FHIA-23, FHIA-25, CRBP-39). More than 20,000 farmers (households) are expected direct beneficiaries of this 3-year project that builds upon a series of ad-hoc distributions of improved hybrids via numerous public or non-governmental public extension services. Furthermore, six pilot propagation centers were established at nodal locations across the Nigerian Plantain Belt to ensure continuous dissemination of healthy seedlings beyond the lifetime of the project, using simple high throughput propagation methods (http://www.iita.org/info/inew5/inew5.htm#4).

In Ghana, another major hybrid dissemination process begun in 1998 with financial support from the U.K.-based Gatsby Charitable Foundation (GCF) is entering its second phase. Three primary plant multiplication plots were established with BITA-2, BITA-3, PITA-2, PITA-5, PITA-11, PITA-13, and FHIA-21 in three regions (Ashanti, Central, and Eastern). Secondary sites were also established in these regions and extended to the other three plantain-producing regions (Brong Ahafo, Volta, and Western) of Ghana. Phase two will now mass-propagate and disseminate from the secondary sites the improved hybrids to farmers during 2002-2004. GCF-sponsored activities will be strengthened by a grant from USAID under the TARGET initiative (jointly operated by IITA and IPGRI) that will promote distribution of another set of hybrids, including PITA-16 to those areas not covered by the GCF project, in 2002-2003. Other West African countries targeted for mass distribution of improved hybrids are Cameroon (USAID/TARGET) and Côte d'Ivoire where preparation for distribution of PITA-3 and PITA-14 have started.

Similarly, hybrid dissemination with GCF support was undertaken in Uganda with five IITA-bred hybrids (BITA-2, BITA-3, PITA-8, PITA-14, and PITA-17). The hybrids BITA-2 and BITA-3 were also included in the largest scale hybrid distribution scheme ever undertaken in eastern Africa, culminating in the distribution of nearly 2.5 million seedlings of improved varieties since 1997 in northern Tanzania under the Kagera Community Development Program (http://www.agr.kuleuven.ac.be/DTP/TRO/_data/onfarmactivities.htm#Tanzania) implemented by the Belgian Technical Cooperation in collaboration with KULeuven and with financial support from the DGDC. As in Ghana, this dissemination scheme will be boosted by additional support from USAID/TARGET in 2002-2003, which also targets Mozambique.

Outside Africa, IITA-bred hybrids have been reaching farmers in Latin America (e.g., BITA-2, BITA-3, PITA-8, PITA-10, PITA-14, PITA-17, distributed to farmers in the departments of Leon and Chinandega in Nicaragua in the framework of a KULeuven coordinated project with possible spillover into neighboring countries). The hybrid BITA-3 is being produced for chips in the Kerala State of India where it compares favorably with the local cultivars.

Thus, funding from development investors has permitted IITA and KULeuven, in collaboration with other research institutes, to generate fruits that are making a difference in the livelihoods of people in Africa and beyond, a clearly high return on investment that we will strive to assess in quantitative terms in the years to come.

*Capacity Building (Training)*

Training activities are built in all preceding activities in the form of studentships. Short-term attachments (3-12 months) have proven to be a valuable mechanism to train on-the-job research technicians and graduating students from African and European Universities. Thus, more than 30 African and 10 European students have received training at IITA locations in Nigeria and Uganda.

Similarly, more than 10 NARS researchers and technicians have spent from 3 weeks to 2 months working with IITA scientists in Nigeria and Uganda, providing unique opportunities for the NARS partners to carry out components of their research portfolio that they could not implement in their own location. In addition to degree-oriented research, specific hands-on learn-by-doing training on crop management, rapid plant multiplication, and value-adding post-harvest processing was provided to farmers in the areas where improved hybrids are being disseminated.

## FUTURE OUTLOOK

Beginning in 2000, a major reorganization of the operational framework for IITA Musa improvement research was undertaken. In essence, it became necessary to re-deploy the team previously based at Onne to take into account IITA's shift towards multidisciplinary research in benchmark sites. Hence, the Western and Central Africa (WCA) team has expanded its operations into Cameroon to benefit from the pool of resource and crop management scientists based at the Humid Forest Ecoregional Center (HFC) of IITA.

Biotechnology support to breeding is now primarily consolidated at IITA headquarters at Ibadan (Nigeria) where expertise from molecular virology, tissue culture, and genomic manipulation are housed. Biotechnology support is also being developed at Namulonge (Uganda) to strengthen conventional approaches to the improvement of the East African highland banana.

Two reviews of VVOB (Flemish Agency for International Cooperation) support to SMIP activities were carried out during 2001, following which, Nigeria-based positions were phased out, and backing of nematology and agronomy in Uganda were retained.

It is anticipated that contributions to scientific advances in *Musa* improvement will be sustained in the development of both (i) conventional breeding methodologies assisted by molecular and cytological techniques and (ii) in vitro breeding technologies for genetic transformation of genotypes that are recalcitrant to conventional breeding. At the same time, we will continue to disseminate available improved varieties to farmers in partnership with various stakeholders.

## ACKNOWLEDGMENT

The information provided herein is primarily the result of teamwork at IITA and KULeuven. The IITA team has evolved with time, but recent contributors include: A. Tenkouano (breeder & geneticist), M. Pillay (cytogeneticist), G. Ude (molecular biologist - genetic diversity), J. Hughes (virologist), L. Tripathi (molecular biologist - genetic transformation), C. Dochez (nematology), D. Coyne (nematology), R. Ortiz (breeder & geneticist), the late J. Hartman (breeder & geneticist), the late P. Speijer (nematology), G. Dahal (virologist), the late D. Vuylsteke (breeder & agronomist), M. Ayodele (plant pathologist), R. Bandhyopadyay (plant pathologist), F. Moonan (molecular genetics), J. Crouch (molecular genetics), M. Tshiunza* (agricultural economist), J. Lemchi (agricultural economist), G. Blomme (agrophysiologist), F. Gauhl (plant pathology), C. Pasberg-Gauhl (plant pathologist), S. Hauser (agronomist), B. Niere (mycologist), S. Okech (agronomist), T. Dubois (nematologist), A. Auwerkerken (nematologist), S. Gilis (agronomist), B. DeSchutter (nematologist), C. Gold (entomology), C. Nankinga (entomologist), S. Ferris (post-harvest processing), P. Austin (farm operations) and many dedicated students and support staff, short term trainees, extension collaborators, and farmers. The KULeuven team consists of B. Panis (in vitro specialist), Hannelore Strosse (in vitro specialist), Hilde Schoofs (in vitro specialist), Guoyu Zhu (biochemist), Sebastien Carpentier (biochemist), Laszlo Sagi (molecular biologist), Serge Remy (molecular biologist), Iris Engelborghs (molecular biologist), Juan Bernando Hernandez (molecular biologist), Katrien Carlens (nematologist), Nathalie Wuyts (biochemist/nematologist), Dirk De Waele (nematologist), Annemie Elsen (nematologist/ mycologist), Karen Reyniers (tissue culturist), Edwige André (tissue culturist), Rony Swennen (breeder/physiologist) and many dedicated students and support staff, short term trainees and farmers.

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# China's Energy-Saving Greenhouses

Weijie Jiang, Dongyu Qu, Ding Mu, and L.R. Wang

Protected horticulture is a labor-intensive industry which provides a great opportunity for Chinese horticulture products to satisfy increasing local demand and expanding overseas markets, especially after China's entry into the World Trade Organization. The plastic greenhouse industry grew rapidly in the 1980s (Table 1) and China is now the leading country for protected horticulture including multi-span greenhouses, plastic tunnels, and a specially devised, energy-efficient, lean-to greenhouse. (Jiang et al. 2004). This latter structure was developed in Liaoning province of northeast China and adapted for vegetable production without heating. This greenhouse is now found in all of north China from 33° to 47° and in 2002 area exceeded 342,000 hectares. The greenhouse (300 to 800 $m^2$) is essentially a half Quonset in which the curvature and orientation is designed for maximum light penetration in the winter. In winter afternoons, where the air temperature inside the greenhouse falls below 17° to 18° C, an insulating mat is rolled down the plastic cover to prevent heat loss. This greenhouse can grow vegetables without supplemental heating when outside temperatures dip to -20° to -10° C since the continental climate of northern China receives high winter solar radiation.

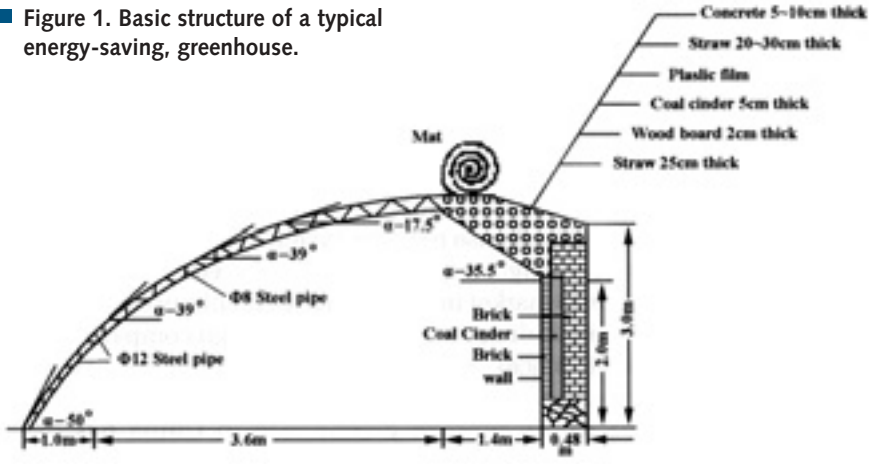
## GENERAL INFORMATION

Since the mid-1980s, the energy-saving greenhouse (also referred to as an "energy-saving, solar, lean-to greenhouse") has developed very rapidly in north China (33°N to 47°N) with total area reaching 200,000 ha in 1999 (Zhang and Li 1999). The energy-saving greenhouse (Fig. 1) was developed from the Chinese traditional lean-to greenhouse in Anshan, Liaoning Province of north China in the mid-1980s (Chen 1991, 1994, 2001). It is composed of a north (or back) wall, and east and west gable

**Table 1. Area of protected horticultural production in China. Source: Z.H. Zhang, National Agricultural Technique Extension & Service Center.**

| Year | High tunnel | Low tunnel | Greenhouse area (ha) | | | Total (ha) |
|---|---|---|---|---|---|---|
| | | | Heated | Solar lean-to | Energy-saving solar lean-to | |
| 1981 | 1,253 | 4,940 | 300 | 706 | — | 9,180 |
| 1985 | 11,766 | 46,473 | 2,296 | 6,760 | 420 | 69,700 |
| 1990 | 30,273 | 98,213 | 3,800 | 18,380 | 8,286 | 160,942 |
| 1995 | 186,620 | 333,893 | 4,793 | 69,413 | 104,413 | 701,127 |
| 1997 | 190,580 | 424,160 | 6,806 | 78,200 | 141,340 | 843,083 |
| 1999 | 459,773 | 568,586 | 14,660 | 152,293 | 200,000 | 1 397,311 |
| 2002 | 753,000 | 714,000 | 29,000 | 125,000 | 342,000 | 1 963,000 |

**Figure 1. Basic structure of a typical energy-saving, greenhouse.**




walls for insulation against the cold outside wind. The walls are constructed with bricks and thermal-preservation materials. The front roof has a transparent plastic film for receiving sunlight. During the night, the plastic film is covered by a mat made of insulating materials. In the morning, once the air temperature inside the greenhouse rises, the mat is rolled up. In the afternoon, when the air temperature inside greenhouse goes below 17°-18°C, the mat is rolled down over the front roof to prevent heat loss. A "cold-proof" ditch (0.5-1.0 m deep, filled with insulating materials, such as straw and manure) reduces heat exchange through the soil between the inside and outside of the greenhouse. The ridge of the greenhouse is usually 3 to 4 m high, the span is 6 to 8 m wide, and the length is 40 to 100 m long. The back wall is 0.5 to 1.2 m thick. The unit area is about 300-800 m$^2$.

**Figure 2. China's energy-saving greenhouse ranges. A. Note straw mat on ridges. B. A cluster of energy-saving greenhouses showing headhouses. C. Energy-saving greenhouse in mountainous area.**


The energy-saving greenhouse is a special type of structure (Fig. 2). The heat energy resource comes from the solar radiation and depends on structural and heat conservative technology (Sun 1993; Yang and Chen 1994). Even in the severe cold winter season of north China, air temperature inside the greenhouse, even without supplemental heating, is sufficient for cool-season leafy vegetables such as celery and Chinese chive and also warm-season vegetables such as tomato, cucumber, sweet pepper, eggplant, and even watermelon (Fig. 3). In general, capital costs and operational expenses are much lower than that of a modern multi-span greenhouse.

In the winter on a clear day, the greenhouse can receive sunlight for 6 hours with light intensity averaging 20-40 klx. The maximum temperature inside the greenhouse can be higher than 25°C, sometimes even up to 30°C, and can last 3-5 hours. Temperatures at night are not lower than 10°C, and on cloudy days, not lower than 6°C. Night temperature differences between inside and outside of the greenhouse can reach 30°C. In this microclimate condition, certain cultural practices improve plant growth. These include adoption of low temperature resistant cultivars, grafting to cold resistant rootstocks, multi-layer polyethylene film covering, irrigation, and temporary supplementary heating for warm season crops such as tomato and cucumber. Leafy vegetables perform well in the greenhouse, even in unexpected cold and cloudy days.

Why can the energy-saving greenhouse without a heating system grow vegetables when outside winter temperatures dip to -20° to -10°C, even -25°C, in the north of China? The answer is that the continental, monsoon climate of China receives high solar radiation in winter despite the very low temperatures in northern zones. While winter sunlight intensity is only 50%-60% of summer radiation, the solar radiation provides enough heat that can be stored by heat-conservation strategies (Chen 2001).

## STRUCTURE

In the earlier developing stage of the energy-saving greenhouse, the greenhouse was built based on farmers' experiences only, using cheap and simple materials. In the Beijing district the internal growing space of the greenhouse was small with a span of 5.0-6.0 m at a ridge height of 2.6-3.0 m. The wall was built of dry earth, brick, and concrete; the front roof frames were made of bamboo or wood, and the outside covering mat made of straw or cattail. Since the late 1980s considerable research work has been conducted to improve heat preservation and progress has been rapid. As a result, horticultural crop production in the energy-saving solar greenhouses is rapidly increasing.

**Dimensions.** Based on 20 years of research, the span of the greenhouse has been gradually enlarged, based on local climatic conditions. In Northeast and Northwest China, the span is 6.0-7.0 m where the lowest winter temperature is below -17°C. In North China the span is 6.5-7.5 m where the lowest winter temperature is between -17° to -12°C. However, if the lowest temperature does not reach -12°C, the span can be 7.5-8.0 m.

Greenhouse length is site dependent. The back (north) wall is about 2.0-2.4 m high, the ridge is 3.2-3.5 m high, which depends on the span and local climate. At latitude 40°N, the span can be 7.0, 7.5, or 8.0 m, and the ridge 2.9, 3.2, or 3.5 m, respectively. In warmer locations, the span and ridge are wider and higher.

**Front Support and Wall Body.** The front support is made of bamboo or steel pipe covered with 0.1 mm thick polyethylene film. The east, west, and north walls of the greenhouse are 0.5 to 1.0 m thick and made of bricks. During temperature warm-up during the day inside the greenhouse, the wall is an endothermic body, and during cool-down at night, the wall body is exothermic. Therefore, the reasonable structure of the wall is a double layer. Between the two brick layers is a thermal-protective insulation material such as perlite, coal cinder, sawdust, or polystyrene in order to prevent heat loss.

**The Back Roof.** The back roof of the greenhouse is a multi-layered structure composed of wood, straw, coal cinder, polystyrene, and cement board. The roof consists of water-

**Figure 3. Crop production in energy-saving greenhouses: A. hot pepper, B. watermelon.**


resistant, load-bearing, heat-preserving and water-resistant layers from the bottom to top. The elevation angle of the back roof is 35° to 40°, and is more than the local solar elevation angle at noon on the winter solstice to ensure that sunshine can reach the back wall throughout the winter.

**Covering Materials.** During the day, sunlight is transmitted into the greenhouse through polyethylene film in the front (south) roof of the greenhouse. At night the polyethylene film is covered with a 5 cm thick mat in order to keep the greenhouse warm in cold seasons. When the sun rises in the morning the mat is rolled up and kept on the back roof. Before the mid-1990s, the mats were made of straw or cattails but these were very heavy and difficult to roll up manually. At present, new kinds of mats made from chemical fibers which are waterproof, heat-conserving, and easily carried, are widely used as covering materials. Mats made of synthetic fibers can be easily handled by machine.

## OVERVIEW

The advantages of this type of greenhouse are twofold: (1) it has good thermal-preservation properties, and makes the cost of energy for growing flowers quite low during the cold season; and (2) the cost of greenhouse construction is only US$6 to $18/m$^2$, much less than that of a modern multi-span greenhouse, making it affordable for most Chinese farmers. From the early 1990s, many vegetable growers began to switch to flower production because greater profits could be achieved. By 1998, there were over 1230 ha of energy-saving greenhouses used for growing flower crops in China. The disadvantages of this type greenhouse cannot be ignored. The first is the difficulty of controlling environmental conditions in the greenhouse. The second is that land-utilization ratio is rather low, because this type of greenhouse usually needs 0.5 to 1.0 m thick walls for thermal preservation, and there must be a space between the two greenhouses. The width of the space is at least twice the height of the greenhouse ridge in order to ensure that the front greenhouse will not block sunlight entering the one behind it. Thus, the land between the two greenhouses cannot have good crops due to the shortage of sunlight. The third disadvantage is that the non-standardized structure of the energy-saving greenhouse makes it difficult to install modernized facilities for controlling conditions within the structure. However, the energy-saving greenhouse concept represents an example of China's innovative solution to horticultural problems.

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# Parboiled Fresh Rice Hulls Can Replace Perlite in Horticultural Growing Media

Studies by Dr. Michael Evans of the Department of Horticulture at the University of Arkansas, USA have shown that parboiled fresh rice hulls (parboiled hulls) can serve as an alternative to perlite in horticultural growing media. Parboiled hulls are available in many parts of the world and are lower in cost than perlite. Unless the parboiled hulls have been contaminated from outside sources, they were found to be free of viable weed seeds. All types of fresh rice hulls have typically been avoided as a growing media component because of concerns that they would cause nitrogen depletion in the growing medium. However, rice hulls are composed primarily of lignin, cutin and insoluble silica and decompose very slowly. No significant nitrogen depletion occurred in growing media amended with parboiled hulls. Additionally, plants grown in *Sphagnum* peat-based substrates containing equivalent amounts of perlite or parboiled hulls had similar tissue nitrogen concentrations. Parboiled hulls had a similar bulk density as perlite. Growing media amended with up to 20% parboiled hulls had similar total pore space, air-filled pore space and water-holding capacity as growing media containing equivalent amounts of perlite. Growing media amended with 30% - 80% parboiled hulls had higher total pore spaces, higher air-filled pore spaces and lower water-holding capacities than growing media containing equivalent amounts of perlite. Shoot and root growth of annual bedding plant species as well as tomato were similar in growing media containing up to 40% parboiled hulls as compared to plants grown in media containing equivalent amounts of perlite.

Rice hulls.

Vinca grown in 40 perlite (left) or 40% rice hulls (right).

Section Pome and Stone Fruits

# Eucarpia Symposium on Fruit Breeding and Genetics


Participants at the Eucarpia Symposium, Fruit Breeding and Genetics.

Angers, France was the venue of the Eucarpia Symposium on Fruit Breeding and Genetics held 1-5 September 2003. The symposium was hosted by the Institut de la Recherche Agronomique (INRA) Angers Center. After an opening ceremony welcome by Dr. Y. Lespinasse, on behalf of the President of INRA Angers Centre and an inaugural address by Mr Lardeux, President of Anjou Council, Dr F. Laurens, chairman of the symposium gave some introductory remarks to the 250 researchers coming from 35 countries from five continents. Dr Marianne Lefort, Head of the INRA Plant Genetics and Breeding Department then presented an excellent review entitled "Genetics and Fruit Breeding: Main Features and Prospects."

A total of 71 oral presentations and 144 posters were presented. They were divided in 8 topics displayed in various oral and poster sessions: New Approaches in Fruit Genetics; Genetic Advances in Disease and Pest Resistance; Genetic Advances in Fruit Quality Traits; Genetic Advances in Tree Architecture; In vitro culture and Genetic Transformation; Management and Research of Genetic Resources; New Developments in Fruit Breeding; Cultivar and Rootstock Testing and Releasing.

The main goal of the organizers has been to take into account the recent changes in fruit genetics and breeding in the last few years, in particular the huge development of biotechnology. Most of the papers in the previous symposia on this topic focused mainly on conventional breeding. At Angers, a good balance has been reached between papers dealing with new methodologies (genetic transformation, genomics) and presentations of conventional breeding programmes or new cultivars descriptions (posters). Oral and poster sessions alternated to allow scientists working on different areas to meet and hold discussions.

Symposium attendees toured the stunning Château de Brissac castle.

The use of molecular markers is now widespread on all fruit species and for many purposes. The symposium started with the session "New Approaches in Fruit Genetics" which underlined the importance of codominant molecular markers, microsatellites to develop syntenic and consensus maps both in pome and stone fruits. A new pedigree-based approach has been developed to identify quantitative trait loci (QTL) more accurately. The comparison of genetic and physical maps in plums proved to be very successful to localize the *Ma* gene for resistance to *Meloidogyne*.

The first oral session on "New Developments in Fruit Breeding" was introduced by a keynote lecture of Dr E. Legg (Head of the Molecular Marker Development Lab Syngenta Seeds, St Sauveur, France). His talk was very informative, illustrating the integration of new technologies in commercial vegetable breeding programmes. After an introductory historical review by Prof. J. Janick (Purdue University, IN-USA), various aspects of conventional breeding presented through many oral presentations and posters including: general aspects including the new policy of the Community Plant Variety Rights for the fruit sector, development of new breeding and selection methodologies, including marker assisted selection (MAS) and the exploitation of biodiversity for breeding.

"Management and Research of Genetic Resources" was one of the "richest" topics of the symposium displaying a large diversity of fruit crops and a wide range of approaches. A special point has been made on the results of phenotypic and molecular evaluation of *Malus sieversii* seedling populations collected in Central Asia in the last decade. The authors verified that *M. sieversii* is very diverse and has all the qualities present in *Malus _domestica*. Many other phenotypic, biochemical and molecular studies were presented on a large range of wild and cultivated species from various genera: *Ficus, Malus, Olea, Prunus, Rosa, Vaccinium, Vitis.* Special emphasize was also put on studies on incompatibility in pears and cherries.

Two oral and one poster sessions were dedicated to the latest results obtained in genetic transformation. Current gene transfer strategies are now efficient to improve important agronomic traits in many crops; advanced models have been developed on disease and pest resistance. Nowadays, many studies investigate new strategies involving clean vector technologies.

A large part of the symposium was dedicated to disease and pest resistance (4 oral sessions and 2 poster sessions). Conclusions of the European project DARE (Durable Apple Resistance in Europe) were presented through oral papers and posters. A combination of knowledge in apple genetics and pathology permitted good progress in the understanding of the interactions between apple and the two most serious diseases: scab, caused by *Venturia inaequalis* and powdery mildew, caused by *Podosphaera leucotricha*. Molecular markers have also been widely used in other interaction studies either to localize resistance genes (Woolly apple aphid for apple; *Colletotrichum* and *Phytophtora* for strawberry) or to better understand resistance mechanisms (Fireblight for apple; *Tristeza* virus for *Citrus*).

In the sessions focused on "Genetic Advances on Fruit Quality Traits," classical genetic studies on inheritance of the main fruit traits were presented on various species as well as recent genomic approaches on apricots, pears, apples and strawberries. Two papers dealt with genetic factors of allergens in apples.

A special session was focused on the "Genetic Advances in Tree Architecture." Oral papers and posters dealt with quantitative genetic studies on various species (apple, apricot, peach, almond), molecular studies on apples and first genomic approaches to graft compatibility on peach.

Social events were as rich as the scientific program. Lunches and gala dinner allowed exhibiting various facets of "French Cuisine." Wednesday was dedicated to visits including the Institut National de la Recherche Agronomique (INRA) center and two famous apple nurseries, Davodeau Ligonnière and Du Valois. It was also an opportunity to enjoy tourist attractions including the "Château de Brissac" as well as to taste very good wines from this famous region: "Le Pays de la Loire."

The conference thanked Prof. M. Fischer from the German Fruit Genebank Dresden Pillnitz for chairing the section the last 4 years and elected Dr F. Laurens from INRA Angers as the new chairman of the Eucarpia fruit breeding section for the next 4 years period up to the next symposium which will take place in Spain. Dr F. Laurens was very honoured to receive the ISHS medal from Prof. Jules Janick (Purdue University, IN-USA). The proceedings of the symposium will be published in an issue of *Acta Horticulturae*.

**Discussions were spirited at the poster sessions.**

## Contact

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**François Laurens**

# COST836: A European Cooperation on Berry Research - Euro Berry Symposium

## INTRODUCTION TO COST - EUROPEAN COOPERATION IN SCIENCE AND TECHNOLOGY

A major aim of COST is to promote and support European research networks in basic and pre-competitive subjects. Since 1971, when COST was founded, an increasing number of networks have been established in the Agriculture, Biotechnology and Food Science domain. The Technical Committee of this domain has recommended proposals on different topics for financial support based on the assessment following the evaluation criteria. Although there are differences regarding the research activities proposed for the Actions (from basic and very innovative research to applied and technology transfer), the TC has taken as a major selective criterion the quality of the science involved.

COST has been playing a key role in European non-competitive research, in pre-competitive co-operation and in solving environmental and cross-border problems. It has contributed to European synergy and added value in research and thus to European integration. The recent link with European Science Foundation will strengthen the COST contribution to launch the Cooperation of European Research.

## COST ACTION 836 'INTEGRATED BERRY PRODUCTION'

In 1998, COST Action 836 started: *Towards an Organisation of the Integrated Research in Berries: Model for a Strawberry of Quality, in respect with the Environmental Rules and Consumers' Requirements' (...Integrated Berry Production...)*

The action has the main objective to use strawberry as a model applicable to all berry fruits in order to improve fundamental knowledge. The project focuses on strawberry and aims to promote the development of systems for production and crop protection that will guarantee a reliable production in Europe, secure in economic terms for the producer and in terms of safety and quality for the consumer.

Twenty-two countries signed the Memorandum of Understanding: all 15 EU countries plus Bulgaria, Lithuania, Norway, Switzerland, Poland, Turkey, and Romania. The action focussed initially on strawberries, with five working groups, but since 2000 a new working group (number 6) co-ordinates research and development on cane and bush fruits, including raspberries, currants and blueberries. COST Action 836 has been very successful in achieving the objectives set out in the Memorandum of Understanding (MoU) and has made significant progress in improving the integration of interdisciplinary research and experimental programmes in Europe. The action focussed mainly on the following topics:

- WG1. Genetic Improvement and Genetic Resources
- WG2. European Strawberry Variety Network
- WG3. Plant Physiology
- WG4. Plant Nutrition
- WG5. Pest and Disease Management
- WG6. Cane and Bush Fruits

The 6 working groups achieved several important results mainly on the following topics:

- Creation of a European genetic resources database for strawberry (3010 accessions, 1049 cultivars) and a core collection of 106 strawberry cultivars, each maintained on at least two sites in Europe.
- Comparison and improvement of breeders' evaluation methods for disease resistance and fruit quality traits. Standardization of methods for screening on some resistances.
- Participation by 17 countries and 30 members in variety trials located on 26 sites by using a standardised design and criteria for observations and measurements.
- Publication of results on the Internet, linked to COST 836 web pages.
- Improvement of strawberry plant quality for different seasons of production and out of season production.
- Physiological studies on carbohydrate production and partitioning, dormancy and chilling, flower induction and differentiation.
- Optimisation of nutrition in substrate culture and effects of nutrition on fruit quality.
- Laboratory methods for nutrients and nutritional status in soil and substrate. Nutritional schemes for different cultural techniques.
- Progress in reaching agreement on the health standards of planting material and the certification schemes for strawberry runner production in different European countries.
- Information compiled on the extent of sustainable production systems in Europe, the quality of national Integrated Production (IP) guidelines and the obstacles to increased IP and organic growing.
- Agreement amongst breeders to co-operate on the development of new cane and bush fruit cultivars that suit the modern integrated crop management programmes.
- Mutual exchange of information on systems for out-of-season production of cane and bush fruits, aiming to increase the availability of berries over longer periods of the year.

The large participation in COST Action 836 demonstrates the interest in berry cultivation throughout Europe. These berry crops have wide adaptability to different soil and climatic conditions and are readily consumed either fresh or in processed form by consumers of different traditional backgrounds. Furthermore, the different techniques for berry cultivation

now enable growers to obtain a stable yield in almost all relevant conditions of climate, soil and production systems. Berry crops are widely adaptable and important for diversification, providing alternatives for both growers and consumers.

There is potential to increase berry cultivation and utilisation in the COST countries by development of better-organized production systems based on programmed cultivation using the most appropriate varieties and cultural techniques. Furthermore, exchanging and improving knowledge of production factors can increase the quality standards across Europe, as now required by consumers, combined with sustainable production systems having minimal adverse environmental impact.

The Final Workshop regarding the 5 years activities of the Action was held at the Marche Polytechnic University (Ancona, Italy), from 9-12 October 2003, supported by the COST Secretariat and co-sponsored by ISHS as 'Euro Berry Symposium'. It was an open symposium with a large participation of European experts (over 130). A poster session was organized for the experts involved in the Action and others interested to present results of specific investigations.

The program included a first session on the COST organization followed by the scientific sessions (oral and posters) presenting the contribution of the 6 working groups on promoting cooperation on berry research in Europe. A session with two invited lectures on berry genomic and on berry nutritional value was also organized. A discussion on the European berry production system was promoted with the contribution of delegates from nurseries, growers and consumer associations and from scientific and technical journals.

Information on the activities of the COST Action 836, including also the abstract booklet, is available on the WebPages of the meeting (http://www.agr.univpm.it/ricerca/prog_ric/cost836.htm or http://cost.cordis.lu/src/action_detail.cfm?action=836). Selected oral and poster presentations are published in *Acta Horticulturae* n° 649.

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**Bruno Mezzetti**

Section Medicinal and Aromatic Plants

# First International Symposium on Saffron Biology and Biotechnology

**Prof. José Antonio Fernandez, Chairman ISSBB-2003**

1st INTERNATIONAL SYMPOSIUM ON SAFFRON BIOLOGY AND BIOTECHNOLOGY

The 1st International Symposium on Saffron Biology and Biotechnology was held in Albacete, Spain, on October 22-25. The Symposium was organized by the Institute for Regional Development of the University of Castilla-La Mancha (UCLM), under the auspices of the International Society for Horticultural Science (ISHS). Prof. Jose Antonio Fernandez (UCLM) and Dr. Fikrat Abdullaev (National Institute of Paediatrics, Mexico) chaired the Symposium that was held in the UCLM Paraninfo.

The Denomination of Origin "Azafran de La Mancha" as major sponsor, the Castilla-La Mancha Government, and the Spanish Ministry of Science and Technology financially supported the symposium.

More than 90 scientists and other interested people from 15 different countries (Iran, Spain, Mexico, India, Japan, Greece, France, Italy, Switzerland, Canada, UK, Denmark, Hungary, Turkey, USA) attended this first symposium. This circumstance allowed the organization to

**Participants at the Symposium**

prepare three days of full first-rate scientific communications, 25 oral and 43 posters, which will be published in the Proceedings (*Acta Horticulturae*).

The symposium commenced with a welcome address by the convener Prof. Jose Antonio Fernandez, followed by the Chairman of the ISHS Medical and Aromatic Plants Section Prof. Lyle E. Craker, and the UCLM Vice-Chancellor of Research Prof. Francisco J. Quiles. The mayor of the City of Albacete, Mr Manuel Perez Castell, gave a reception to the ISSBB attendants at the Municipal Museum (former Mayor Hall), a XVIII century palace.

The scientific programme consisted on four sessions including lectures and invited presentations, poster exhibitions and discussions, and table-talks about hot topics on saffron technology. The first session, chaired by Professor Maria Grilli from the University of Rome 'Tor Vergata' focussed on Saffron Biology and included topics related with botany, reproductive biology, physiology, genetics, molecular biology and biochemistry of saffron. Of particular interest were the recent advances in the elucidation of the biosynthesis of saffron carotenoids using molecular biology tools, the enzymological characterization of saffron corm, the advances in genomic and molecular genetic analysis and the botanic and physiological studies in *Crocus sativus* L. and allium species.

Dr. Imtiaz Khan of the Government Fruit Research Centre of Pithoragarh in India, chaired the second session, which covered studies on Saffron Crop Techniques, Breeding and Tissue Culture. Amongst the various topics on ecophysiology and phytotechnology of saffron, the development of novel thermal-based treatments to programme saffron flowering under greenhouse conditions was of particular interest for agronomists and producers. Various communications dealt with the application of *in vitro* technologies for both micropropagation and genetic improvement of this crop. This session concluded with a table-talk on "Agronomical and Biotechnological approaches for saffron improvement" moderated by Professor Hasan Vurdu from the Gazi

**Crocus sativus**

**Opening session**

University in Turkey. Much information was contributed by scientists and agronomists of Iran and Spain, the leading and the former leading producing country, respectively. In the dialogues the different perspectives of both types of agriculture were evident: the Iranian currently very competitive on the basis on low incomes and salaries and the Spanish (and others of the Mediterranean area) that requires urgent technological changes in order to survive.

The relevance of "Food Technology and other Industrial Applications" was discussed in the third session chaired by Professor Moschos Polissiou from the Agricultural University of Athens in Greece. Scientific communications dealing with the technical basis of commercial quality, new methods of analysis for detection of adulterations and geographical differentiation. Other subjects presented were decontamination, harvesting effects, flower separation techniques, saffron by-product valorisation, development of new saffron products in health and cosmetics, and even marketing and ethnohistorical approaches. Certainly, this session was of main interest for the business sector. The session ended with a table-talk on "Industrial Perspectives" chaired by Jean Marie Thiercelin from Tradimpex, France. Delegates of saffron trade and manufacturing companies from Iran, Spain, India, and Switzerland participated in a passionate colloquium, where quality, adulteration, traceability and saffron benefits to human health were the spotlights of discussions.

Last but not least, session 4 dealt with different aspects of saffron biomedicine, such as the effects of saffron on senile dementia, retinadegeneration, immunomodulation, and antimicrobial, antidepressant or antitumor activities. Dr. Hiroshi Saito, Professor Emeritus of the University of Tokyo, chaired this last session.

Finally, Dr. Abdulleav gave the concluding remarks of the symposium.

On Saturday afternoon the attendeese went to the nearby town of Santa Ana for its Saffron Festival, to witness the annual harvesting of the saffron flower and to discover the roots of La Mancha Saffron. The symposium ended with a saffron-based dinner in the XVI century cloister of the former Monastery of the Incarnation.

The Executive Board of the 1st ISSBB agreed to organize a Working Group on Saffron within the ISHS Section on Medicinal and Aromatic Plants and to propose the celebration of the second ISSBB in October 2006 at Mashhad (Iran).

## Contact

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**José Antonio Fernández and Fikrat Abdullaev**

# Seventh International Symposium on Temperate Zone Fruits in the Tropics and Subtropics

The VIIth Symposium on Temperate Zone Fruits in the Tropics and Subtropics was organized at the Y S Parmar University of Horticulture and Forestry under the auspices of the International Society of Horticultural Science from 14th to 18th October, 2003 at Solan, India. Dr. K.K. Jindal, Director of Research of the University as convener was responsible for the organization. The symposium was opened with a welcoming address by Prof. S.S. Negi, the Vice-chancellor of the University, and an inaugural address by His Excellency the Governor of Himachal Pradesh, India, Mr. V.S. Kokje.

Present were 271 participants from 12 countries, of which 253 from India representing 28 national institutes and universities, 3 each from Iran and China, 2 each from Italy, Nepal and Turkey and one each from Brazil, South Africa, Thailand, Australia, Bhutan and Vietnam.

Ninety-three oral presentation and 117 poster presentations were subdivided in 14 broad sub-themes:

- Scope of growing temperate fruits in the tropics and subtropics
- Plant genetic resources, breeding and improvement
- Impact of changing climate on production of temperate fruits under Tropics and Subtropics
- Biotechnology
- Propagation techniques and rootstocks
- Soil, water and orchard management
- High tech production technology
- Crop regulation and fruit quality
- Pest and disease management
- Post harvest management, value addition and food processing
- Marketing, trade and technical co-operation issues
- Temperate fruits as an industry
- Pollination issues in Temperate Zone Fruits
- IPR in Horticulture

In the plenary session of the symposium two keynote lectures were delivered, one by Dr. Ayzin B. Kuden, Chairperson of ISHS-TZFTS Working group, on "Global overview of Temperate Zone Fruits in Tropics and Subtropics" and the other by Dr. J.V. Possingham, representative of ISHS, on

Participants of the Symposium visiting the University Campus.

"Growing of Grapevines in the Tropics". Some highlights of these deliberations on future research are:

- There should be increased collaborations and co-operation between the countries of temperate zone fruits in the tropics and the subtropics for expansion of the cultivation of these crops.
- New characteristics such as region of origin of cultivars, chilling requirements, heat units, rootstocks, harvesting season and shelf life should be added to the existing descriptions of temperate fruits for the tropics and subtropics.
- For growing grapes successfully in North Indian conditions early ripening varieties, which ripen before the onset of the monsoon period, should be introduced and tested. The rest period in grapes can be broken by use of chemicals like calcium cynamide or thiourea. Girdling and thinning the crop can increase sugar contents.

In the session on 'Scope of growing temperate fruits in the tropics and subtropics' the suitability of different temperate fruits for the tropics and subtropics was discussed. Low chilling cherry cultivars as well as other stone fruits can be adopted for growing in these countries. The strawberry cultivars Chandler and Etna, which produce large sized fruits, can be successfully grown in the subtropics and tropics. The cultivar Shimla Delicious, which is less susceptible to leaf spot, can be used in breeding programmes.

In the 'Plant genetic resources, breeding and improvement' session stress was laid upon conserving and evaluating temperate fruit germplasm and their wild relatives suited for tropical and subtropical cultivation. Apart from in situ and on farm conservation of low chill requiring germplasm, in vitro and cryogenic methods need to be intensified.

In the session 'Impact of changing climate on production of temperate fruits under Tropics and Subtropics' deliberations concluded that a technique of evaporative cooling along with chemicals have a synergistic effect in supplementing winter chilling. In the session 'Biotechnology' it was emphasized that work needs to be done on molecular characterization of existing diversity in micro and macro organisms and that specific gene(s) may be isolated for bringing about improvements in the existing cultivars and rootstock spp. The benefits and shortfalls of transgenics need to be educated to the farmers of developing countries.

In the session on 'Propagation techniques and rootstocks' most of the papers dealt with the suitability of rootstocks in high density plantations The highlights of the session 'Soil, water and orchard management,' were efficient use


**Dr. J.V. Possingham, representative of ISHS delivering his talk (Sitting from left to right: K.K. Jindal, Convener, S.S. Negi, Vice Chancellor, His Excellency Mr. V.S. Kokje, Governer of Himachal Pradesh and Prof. Ayzin Kuden, Chairperson, ISHS-TZFTS working group).**

of fertilizers through plant tissue and soil analysis as well as higher water use efficiency. Drip irrigation at 100 % evapotranspiration compensation saved 32.1 % water and gave 20 % quality yield over traditional basin method. Development of database software for nutrient deficiency and measures to overcome the same were stressed. Training systems and high-density plantations in peach, pear and apple constituted the main deliberations in the 'High tech production technology' session. In the session 'Crop regulation and fruit quality', the use of different growth regulators and girdling techniques have been suggested to improve fruitset, enhance maturity and improve fruit quality

In the 'Pest and disease management' session was stated that temperate fruits grown in the sub tropical and tropical areas are open to more severe problems due to congenial and warm environment. Most of the papers emphasized non-chemical methods of pest and disease suppression, mainly by biocontrol agents and soil solarization. Since many pests and diseases get introduced in orchards with infected nursery plants, these techniques should be used to raise healthy, disease and pest free planting material. Therefore, proper nursery management practices in developing countries are required. Strategies need to be devised so as to minimize the risk of development of pesticide resistance.

In the 'Post harvest management, value addition and food processing session the speakers paid attention to the food laws of countries that restrict the use of post harvest chemicals. Most papers emphasized the need of increasing the shelf life of the harvested fruits, the maintenance of quality of the temperate fruits grown in warmer climates and value addition. The suitability of pits of stone fruits left after processing for extraction of oil was evaluated. In the session 'Marketing, trade and technical co-operation issues' the financial institutions like National Horticultural Board and export agencies emphasized the need for quality production of temperate fruits grown in subtropical and tropical areas to make them more competitive and remunerative in the world market and for development of market intelligence.

In the session on 'Temperate fruits as an industry' papers on the problems and prospects of temperate fruit management, research and development and efficiency of resource management were presented. In densely populated areas like in India, where the population poses pressure on cultivable land, high density plantations should be promoted for better land use and improving productivity. The planting material of the present orchards, in most cases being of seedling origin, need replacement by clonal rootstocks for better results. The local genetic material of temperate fruits should also be fully utilized for breeding purposes.

In the special session on 'Pollination issues in Temperate Zone Fruits' papers presented different aspects of pollination like fruit setting problems, pollinator diversity, the use of pollinizing varieties, role of honeybees in increasing apple productivity and incompatibility in temperate fruits.

In the 'IPR in Horticulture' session the chairman read a key paper on the present scenario of Intellectual Property Rights (IPR) and the World Trade Organization. He emphasized the need to strengthen the IPR cells in different research organizations. The general discussion was about the protection of the biological diversity in India where 20 % of the total of 45,000 plant species in the Indian subcontinent is endangered.

In the sessions of the poster presentations authors explained their findings to a committee of five scientists of various disciplines. The quality of the papers was graded from very good to excellent. The three posters presented by postgraduate students were also adjudged by the committee and were given certificates of honour.

The participants were taken around the various departments of the University including the University Museum and Library and the high density plantations of peach, apricot and Chinese gooseberry in the experimental orchard of the Department of Pomology. They went to the stone fruit research at the Horticultural Research Station at Kandaghat and to RHRS Mashobra located in high hills for appraisal of research and development in pome fruits. Furthermore, a special excursion for spouses, two cultural nights depicting art and culture of Uttaranchal and Himachal Pradesh (Himalayan States), a special welcome and concluding dinners were arranged. Besides, the conference venue gave memorable moments to the participants, since it was organized in misty mountain Resorts Hotel Pinewood.

The symposium ended with a good note of appreciation by the participants. Dr.K.K. Jindal was awarded the ISHS Medal in recognition of his meritorious service to the Society as convener of this International ISHS Symposium. The symposium was fruitful and has created a good atmosphere for further exchange of experiences among scientists from different countries.

The authors are grateful to Dr. Norman Looney, President of ISHS, Ir. Jozef Van Assche, ISHS Executive Director, and his secretariat colleagues, Prof. Ayzin Kuden, and Dr. J.V. Possingham for help and guidance in organizing this mega event of ISHS for the first time in the Indian subcontinent.

**Dr. K.K. Jindal and colleague showing Kiwi plantations to foreign participants Dr. G. Finneto and Dr. Gabriel Leite.**

## Contact

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K.K. Jindal and A.S. Rehalia

Section Vegetables - Section Vine and Berry Fruits

# Fourth International Symposium on Irrigation of Horticultural Crops

About 131 participants representing twenty countries attended the ISHS - Fourth International Symposium on Irrigation of Horticultural Crops from 1-6 September 2003. The symposium was held at the beautiful campus of the University of California at Davis (UCD). This campus is well known for its outstanding academic achievement of environmental and agricultural science.

Three working groups (1) *Water Supply and Irrigation*, (2) *Water Relations of Woody Crops* and (3) *Water Relations of Grapevines* of the Section Vegetables and Section Vine and Berry Fruits of ISHS were involved in the symposium. The symposium was organized by researchers in these fields from different departments of the *College of Agriculture and Environmental Science* and by scientists involved in earlier symposia from France, Italy and Portugal. The convenor of the symposium was Dr. Richard L. Snyder, Biometeorology Specialist for the University of California *Division of Agriculture and Natural Resources*.

The symposium mainly dealt with aspects related to the management and economics of irrigation of fruit and nut trees, grapevines, field and ornamental crops. A scientific committee selected 135 submitted abstracts: 84 as oral and 51 as poster presentation. Those contributions were classified into the topics (1) crop water requirements (measurements, modelling, soil-plant-atmosphere processes, and scaling transpiration) (2) plant water relations (ecophysiological interactions), (3) irrigation scheduling (scaling effects, applicability of methods), (4) water quality and environmental impact of irrigation (environmental impact of irrigation on water quality and vice versa), and (5) economics of irrigation (water transfers, economic optimization).

After the welcoming addresses by the convener and the Vice Chair for the UCD *Department of Land, Air and Water Resources*, Professor Kyaw Tha Paw U, Dr. Melvin Tyree from the USDA Forest Service presented the first keynote speech entitled "*Drought Resistance: A concept without a measure! Where do we go from here to understand drought performance of ecosystems to crops*? The second keynote speech entitled "*FAO activities to develop agro-climatic datasets and tools for the needs of irrigation management*" was presented by Dr. Michele Bernardi from the United Nations Food and Agriculture Organization in Rome.

**The Delegates.**

Each day the symposium started with a joint session including one or two keynote speeches followed by parallel sessions during the late morning and early afternoon. A poster session was held each afternoon from Tuesday through Friday. The keynote speakers and their topics included Dr. Theodore Hsiao "*Selected aspects of crop water relations and evapotranspiration - What is known and what is not known?* ", Dr. Richard Howitt "*Economics of Water use in Agriculture*", Dr. Ramon Aragues "*Challenges of conducting salt tolerance studies under field conditions*", Dr. Amos Naor "*Practical implications in scheduling irrigation of deciduous trees*" and Dr. Kyaw Tha Paw U "*Evapotranspiration: Measuring and Modelling*".

Poster sessions and exhibitions by participating vendors were held in the same room with the coffee breaks to facilitate participation by attendees and communication with exhibitors. This arrangement seemed to be well received by all participants.

A technical trip was held on Saturday, September 6, 2003. The tour began with a visit to the UCD lysimeters, which were extensively used by W.O. Pruitt to develop reference evapotranspiration (ETo) and crop coefficient information used by the FAO and throughout the Western USA. The lysimeters were also used by J. Monteith to develop the Penman-Monteith equation and by T.C. Hsiao for many of his plant water relations studies. Besides, a visit was paid to the Davis CIMIS (California Irrigation Management Information System) weather station, which was the first electronic weather station set up for delivery of ETo information to California growers. After that Larry Glashoff at the Hines Nursery near Winters, California explained a state-of-the-art irrigation system for a large nursery designed to have minimal losses of drainage water. Subsequently, the tour group went to the Wolfskill Pomology Research Farm near Winters, California to see the germplasm research plots. In the afternoon, the tour continued with a visit to one of the RH Phillips Winery vineyards, where an experiment to study air temperature cooling effects on wine grape quality is being conducted. High pressure fog lines are used to elicit evaporative cooling in the plots. In addition, a station for measuring evapotranspiration using the surface renewal method at the research site was

Dr. M. Tyree, keynote speaker of the Joint Session in Water Relations and Weather Data Sources.

shown. The tour continued to the Nickels Ranch, where considerable research is conducted on irrigation management and water relations of tree crops. W. Krueger, Farm Advisor from Glenn County, discussed his research on walnuts at the Nickels ranch and K.A. Shackel demonstrated his hand pump pressure chamber for measuring stem water potential. Then L. Schwankl, UC Irrigation Specialist, discussed his research on low volume irrigation systems.

In the evening of the first day, a reception was held on the UCD campus to welcome participants. The social program included a banquet on Wednesday evening with a live American folk rock performance by Jennifer Berezan with Nina Gerber, Chris Webster, and Anthony Costello (http://www.edgeofwonder.com).

During the afternoon of the last day, the participants met for a final discussion. For each topic, the convener summarized the most important results and highlighted the aspects that are likely to be significant in the future for irrigation management at different scales, for water saving, and economics of irrigation.

**Plant water relations**

An excellent review of the current knowledge of plant water relations emphasized the differential sensitivity of leaf and root growth to water stress, as well as the underlying mechanisms to the responses and its importance for adaptation, the role of stomata in controlling canopy transpiration and coupling of the canopy and atmosphere. Other important points of discussion were the photosynthetic water use efficiency in relation to variations in intercellular CO2 concentration and recent evidence of the importance of changes in CO2 concentration with humidity gradient in determining crop coefficients. These presentations, while giving a broad background on the current status of water relations research, also showed the need for further research on partial root-zone drying/deficit irrigation (PRD), regulated deficit irrigation (RDI) and plant-based measurements to characterize water status. RDI was a common and much discussed topic for a wide variety of crops. Generally, these studies investigated withholding water during phenological stages to determine, if the water stress can reduce water use while maintaining and improving marketable production. Most of the RDI papers and many other presentations discussed the use of plant-based measurements (e.g., leaf and stem water potential, trunk diameter fluctuations, etc.) to quantify water stress in order to improve marketable crop production. Presentations on PRD irrigation were mainly related to apples, pears and grapevines. Some authors emphasized the importance of accurate water status monitoring in conjunction with both RDI and PRD. In general, PRD irrigation is still a somewhat controversial procedure. While some scientists reported water savings with few adverse effects, others found little or no benefit by using PRD.

**Crop water requirements**

Evapotranspiration measurement for a better assessment of the crop water requirements was discussed in relation to the interaction between biology and physics showing that ET depends on storage and transfer of energy in the soil, plants and air. This session showed that significant advances have been made in the ability to monitor or estimate ET and other scalar fluxes using a variety of techniques. In many examples, ET estimates were related to crop canopy conditions, which provide useful information for modelers who are trying to improve crop water use estimates in irrigation schedules and water resource planning.

**Irrigation scheduling**

Several presentations dealt with water balance scheduling and soil monitoring for irrigation scheduling and its relationship to production. Two computer programs (SIMETAW and CUP) for planning of water demand were presented. They use climatic data to compute reference ET and crop coefficients that account for rainfall, irrigation frequency, crop immaturity and ground cover crops to estimate crop evapotranspiration. In addition, the SIMETAW program simulates weather data and calculates effective rainfall. This session showed that estimation of evapotranspiration and soil water monitoring both may be used to time irrigation and depths of application.

**Water quality and environmental impact of irrigation**

Effects of saline and waste water were discussed with emphasis on field response of crops to salinity. An approach for precise determination of variability of soil salinity and an effective design for tolerance trials using geo-referencing and salt-tolerance response models were presented. Considerable research on salinity effects on crop production was also

Visiting the CIMIS weather station at the Wolfskill Pomology Research Farm near Winters, California.

Wolfskill Pomology Research Farm.

reported, showing that new findings may sometimes not be totally in accordance with earlier recommendations. Sensitivity of olive trees to salts was found to increase with time of exposure to salty conditions, but in another experiment pistachios were relatively insensitive.

**Economics of irrigation**

The economics of irrigation in California in relation to water transfers and economic optimization was a relevant topic. It was pointed out that there is a shift towards planting higher value horticultural crops, thus increasing profits and using water more efficiently. It is likely that additional water needs will come from trades and water transfers, which are profitable for both the buyer and seller. However, restrictions on the amount of water transferred are needed to protect regional economies. Moreover, water quality may soon be a bigger issue than water quantity because of the high cost for leaching of salts. As water values increase in California and around the world, horticultural production will change with growers making tradeoffs to increase water efficiency.

**Conclusion**

What a pleasant surprise for the participants to have the Convener concluding the final session with a guitar performance and a song entitled 'Weather Song' (lyrics by R.L. Snyder).

All participants contributed to the success of the symposium. It was an important opportunity to exchange information and start new cooperation in the pleasant atmosphere of UC Davis Campus.

The symposium summary including the programme of presentations, abstracts, photographs and other detailed information are provided on the symposium homepage: http://biomet.ucdavis.edu/ISHSsummary/SummaryPage.htm Oral and poster communications will be accepted as equal for publication in the special issue of Acta Horticulturae. The papers will be published following a review and editing process

**Business Meeting**

A business meeting was held at the end of the Symposium to elect new Chairs of two working groups. Dr. Ben Ami Bravdo chaired the election of new chairs for working groups and the selection of the next Symposium site. The new Chair for the Water Supply and Irrigation Working Group is Dr. Adriano Batillani, CER, Bologna, Italy and the new Chair for the Water Relations in Woody Crops Working Group is Dr. Ian Goodwin, Institute Tuchura, Victoria State, Australia.

There was a close vote on the location of the next symposium. The first choice was at or near Melbourne, Australia (Convener: Ian Goodwin) and the second was at or near Talca University in Talca, Chile (Convener: Samuel Ortega-Farias). Therefore, the Fifth International Symposium on Irrigation of Horticultural Crops will be held in Australia. The Sixth International Symposium is tentatively scheduled for Chile.

## Contact

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Donatella Spano



# Polish Society for Horticultural Science (PSHS)

Horticulture has long been an important branch of crop production in Poland. Its continuous development has been influenced by the high scientific activity of research centres grouped in agricultural universities and institutes. The establishment of the Polish Society for Horticultural Science (PSHS) in 1987, was a natural consequence of this situation. Prof. Tadeusz Wojtaszek, one of the founders of the Society, was elected its first president. After his death in 1990, Prof. Andrzej Libik assumed the presidency for two terms, until 1999.

The main objective of PSHS is to support and stimulate its members in their activities in all branches of horticulture related to scientific, education, and outreach. To accomplish its objectives, the Society organizes lectures, conferences, and symposia of regional, national, and international character, thus popularizing and promoting horticultural knowledge. During its relatively short history, the Society organised over 60 scientific conferences; published the biennual journal *Folia Horticulturae* (in English) and *PSHS Information Bulletin*, devoted to current activities of the Society and its members.

At present the Society has 425 members. The title of honorary member, so far conferred 15

**Joint photo of all participants of Ist Congress of the Polish Society for Horticultural Science - Krakow 9-11 September 2003.** (Photo by Mieczyslaw Kolasilski)

times, is granted to individuals who are distinguished in their activities on behalf of horticultural science and PSHS. PSHS is an organisation member of the International Society of Horticultural Science (ISHS).

The General Assembly of Delegates, the highest authority of the Society, held every 4 years, evaluates the Society's activities, lays out directions for further development and chooses the Board, consisting of the president, two vice-presidents, a secretary, a treasurer, and ten members. The activities of the Board are evaluated by the Main Revisory Committee and the Main Arbitrary Body.

Since its founding the seat of the Society has been in Krakow, an important centre of science and culture in Poland, with a long traditions of agricultural studies originating from the Jagiellonian University. There are 6 Regional Branches located in horticultural research centers (Krakow, Lublin, Poznan, Skierniewice, Szczecin, and Warsaw). The address is: Polish Society for Horticultural Science, Al. 29 Listopada 54, 31-425 Krakow, Poland; fax: 04812 4111300, e-mail: ptno@bratek.ogr.ar.krakow.pl. More information concerning the Society may be obtained from the website: www.ptno.ogr.ar.krakow.pl (in Polish and English).

The Ist Congress of the Polish Society for Horticultural Science was held September 9-11, 2003 in Krakow, under the auspices of the Minister for Science, Michal Kleiber and the Minister for Agriculture and Rural Development, Wojciech Olejniczak. The General Assembly of PSHS Delegates met on the first day and discussed the activities of the Society, laid out the objectives for the near future, and chose the new governing bodies. Prof. Stanis_aw Cebula was elected president of the Society for the second term. Honorary memberships were awarded and the Society's Medal to the most outstanding members was bestowed.

The Scientific Conference *Contemporary Horticulture and the Standard of Human Life* convened on the second day. There were over 370 participants from all disciplines of horticulture, as well as many honoured guests and sponsors. The plenary session of the Conference began with the lecture *Horticulture: An Essential Life Science* delivered by Dr. Norman E. Looney, ISHS President. Four subsequent lectures covered important aspects of horticulture and related disciplines, indicating their role in affecting human life. Prof. Janusz Lipecki from the University of Agriculture in Lublin and Prof. Andrzej Libik from the University of Agriculture in Krakow spoke on *Components of Vegetables and Fruit of High Biological value*; Prof. Zbigniew Janeczko from Collegium Medicum of the Jagiellonian University presented *Fruit and Vegetables as the Source of Health Promoting Substances of Anti-oxidising Properties*; Prof. Katarzyna Niemirowicz-Szczytt from Warsaw Agricultural University discussed *Genetically Modified Organisms in Horticulture - Pros and Cons*; Prof. Joanna Nowak from the Research Institute of Pomology and Floriculture in Skierniewice focused on the theme *Ornamental Plants: Possibilities of Developing Production and Their Impact on the Quality of Life*.

The results of 265 investigations representing various disciplines of horticulture were then displayed in a poster session. In the evening, the participants met at a reception organized in the underground chambers of the famous Wieliczka Salt Mine.

**Congress materials have been published in PSHS periodical *Folia Horticulturae - Suplement.***

The third day of the Congress was devoted to oral presentations grouped in the following 5-thematic workshops:

Section I - Plant Breeding as a Source of Health and Beauty;

Section II - Horticultural Plants and Human Health;

Section III - Environment-Friendly Horticulture;

Section IV - Ornamental Horticulture in Shaping Life Quality;

Section V - Modern Technologies and the Quality of Horticultural Products.

All presentations and posters, have been published in a two-volume, 1094 page supplement to *Folia Horticulturae*.

The Ist Congress of PSHS was a very significant event in the 16-year-long history of the Society. It evoked considerable enthusiasm among all participants including scientists, honorary guests, and sponsors, integrating the scientific community connected with horticulture in Poland. However, the most significant result of the Congress was a broad overview on Polish research related to horticulture. It has been decided that subsequent congresses will be held every 4 years. The next one will take place in 2007 at Poznan, the seat of one the Regional Branches of PSHS.

**Official opening of the Congress by PSHS president, Prof. Stanislaw Cebula. The trumpeter dressed in regional costume plays the traditional tune.** (Photo by Edward Kunicki)

**Stanislaw Cebula, President of the Polish Society for Horticultural Science**

# Use Biotechnology to Solve African Problems: Scientists Call for Increased Capacity in Africa

African researchers attending a major biotechnology conference have decried the lack of African capacity to conduct leading-edge biotechnological science. While many African problems, especially in agriculture, may be solved using biotech tools, too often scientists in the developed world with access to more modern facilities must be called in to do the real work. For many African researchers, that is just not good enough.

In Ibadan, more than130 delegates from all parts of Africa with leading researchers and development assistance partners from the United States have attended the three-day conference at the International Institute of Tropical Agriculture (IITA). The United States Agency for International Development (USAID), with support from the Federal Government of Nigeria and the Agricultural Biotechnology Support Program, phase 2 (ABSP 2) of USAID along with IITA sponsored the meeting. It was the third in an annual series designed to highlight the USAID-Africa partnership in biotechnology. The United States has greatly increased its support to biotechnology in Africa (as well as to other parts of the developing world) in the past several years.

African research teams have welcomed that support but point out that there are still major gaps to be filled in both technological infrastructure (laboratories and modern equipment) and in human scientific capacity. To address such concerns and help close the biotech gap in Nigeria, IITA with USAID has just begun a major biotech capacity building program.

The meeting also discussed recent progress in several biotech research areas as well as the policies and legal frameworks that must be in place (for example, effective laws on biosafety and legislation on intellectual property rights) for countries to take full advantage of biotechnological tools. Delegates deplored the lack of accurate information available to both the general public and to African policymakers about genetic enhancement in food products. They agreed they had an important job to do in countering with truth any ill-informed anti-GMO campaigns. It would be unfair if Africans, especially the rural poor, did not have the chance to take advantage of the potentially huge benefits that genetically enhanced crops could provide.

IITA is a center of excellence for agricultural research for the development of Africa. Its goal is to enhance, in a sustainable and environmentally friendly way, the livelihoods, wellbeing, and food security of millions of Africans.

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# The International Organisation of Vine and Wine

The approval by the French Parliament of the Agreement of 3 April 2001 establishing "The International Organisation of Vine and Wine" constitutes the 31st instrument for the coming into force of this International Agreement on 1st January 2004.

Georges DUTRUC-ROSSET, Director General of the OIV personally declared that he was very satisfied to see this Agreement coming into force at the moment he was terminating his mandate to the Office of Director General of the OIV on 31 December 2003. He recalled that "his seven-year mandate at the head of the International Office of Vine and Wine was largely dedicated to the management of the Office's revision, to holding diplomatic negotiations enabling to conclude the International Agreement, to motivating Member States for a quick ratification and for getting the new Internal Rules of Procedure of the new organisation under way". He also mentioned "that obtaining 31 ratifications of an International Agreement in just two years was certainly a record that reveals the interest of the producing and consuming countries for the rapid implementation of an intergovernmental institution in a sector where international trade has greatly expanded in the last few years."

The new Agreement was signed on 3 April 2001, after more than five years of work with the aim of modernising missions and human and materiel means of the current International Office of Vine and Wine established on 29 November 1924.

At the time of its creation the International Office of Vine and Wine had eight producing member countries. Today there are forty seven members. Their vision and interests concerning the sector are sometimes divergent. Therefore, it is essential that the O.I.V. be able to take into account these new stakes in a balanced approach between all these members.

The missions of the New Organisation are modernised and adapted in order to enable it to pursue its objectives and perform its duties as an intergovernmental body of a scientific and technical nature, of recognised competency in the sector of vine, wine, wine-based beverages, table grapes, raisins and other vine-based products.

Consensus will be the normal decision-making process of the General Assembly of the new Organisation for the adoption of proposals of resolutions of a general, scientific, technical, economic and legal scope, as well as the creation or termination of commissions and sub-commissions.

The Agreement creates new dynamics in the world vitivinicultural sector by the setting up of a modern, specific, intergovernmental Organisation, whose functioning methods make it an international forum for exchanging views and reconciling points of view. This results in the adoption of resolutions and scientific and technical recommendations in the sector of vine, wine, wine-based beverages, table grapes, raisins and other vine-based products, and pursues the international harmonisation of practices and regulations essential to the development of international trade in the interest of producers, distributors and consumers.

Info: http://www.oiv.int/fr/oiv/accord.html

# The California Seed Growers Isolation Pin Map System

Cross-pollinated vegetable and field crops require isolation to assure no undesired cross-fertilization between different varieties of the same species, and between different crops in different species.

Crop isolation can be achieved either by spatial (distance) or temporal (time) factors. This Internet isolation or "pinning" map is designed to allow seed growers to identify the location and the planting date of seed crops produced in California. Seed production personnel can electronically mark or "pin" fields from their offices to allow "real time" tracking of seed production activities.

This map is available for all seed companies and/or growers to use in order to help coordinate seed production efforts. It was developed as a result of the financial support and advice of numerous vegetable and field seed companies. The map is not intended to be used to enforce field isolations, but rather to be used as a tool to help companies and growers work cooperatively to place and plant seed fields to assure high genetic purity. Users only have the ability to enter and change data on their own fields by use of confidential login ID's and passwords.

For an extensive overview of the map developed by the California Crop Improvement Assn. and the Seed Biotechnology Center, visit: SeedQuest http://seedquest.com/spotlight/i/isolationpinmap/default.htm or visit the map site http://ccia.ucdavis.edu Info: Sue Webster, Seed Biotechnology Center, (530) 754-7333, scwebster@ucdavis.edu.

# Society of American Florists (SAF)

Terril A. Nell, Ph.D., AAF, a University of Florida professor has taken the helm of the Society of American Florists (SAF), an influential group of floral-industry business owners. Dr. Nell became the first academic to assume the presidency of SAF last September, during its 119th Annual Convention in Boca Raton, Florida. SAF is a national association of more than 15,000 members who represent all segments of the US floral industry. Nell, a horticulturist, will lead the group's public relations and governmental affairs efforts through 2005.

# New books, websites

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

## BOOK REVIEWS

**The Origins of Fruits & Vegetables. Jonathan Roberts 2001. Universe Publishing, 300 Park Avenue South, New York 228p. illustrated, ISBN:0-7893-0656-5.**

The origins of our domestic fruits and vegetables has long been of interest to horticulture. The first book in this subject was Alphonso De Candolle's great work, *Origin of Cultivated Plants*, published in 1882, still a valuable work. Pre-cytological and Pre-genetic it correctly located the origins of most domesticated crops, largely through the presence of wild relatives, historical evidence, and linguistics. Modern evidence for the origin of cultivated plants has been summarized in a scholarly work entitled *Evolution of Crop Plants* (1976; Longman, London and New York) edited by the late N. W. Simmonds and recently updated in 1995 under the editorship of J. Smartt and N.W. Simmonds. A popular work, in this area but now hard to find was entitled *The World in Your Garden* by Wendell H. Camp, Victor R. Boswell, and John R. Magness based on articles in National Geographic and published in 1957 by The National Geographic Society.

The English writer, Jonathan Roberts, in *The Origins of Fruit and Vegtetables* has put together a wonderful work, aimed at a non-technical audience, but that needs to be on the bookshelf of all horticulturists amateur and scholarly alike. The book is stunningly illustrated with colored plates of cuneiform tables, ancient mosaics, artifacts, and painting, all in color. The writing is first rate and the facts accurate. The 36 chapters cover fruits from apple to Worcesterberry (*Ribus divaricatum*) and vegetables from asparagus to zucchini (illustrated but not mentioned). This book is very reasonably priced at US$22 and I urge you to buy it as a gift for yourself and your students. There is one inaccuracy that needs correction. On page 146 there is a still life of a basket with grapes cucumber, and pumpkin, along side a citron and cabbage, and crab apple with a basket of flowers that is attributed to Michelangelo Merisi da Caravaggio, but Spike Lee, the Caravaggio expert assures me it is a misattribution and that the painter is by Bernardo Strozzi.

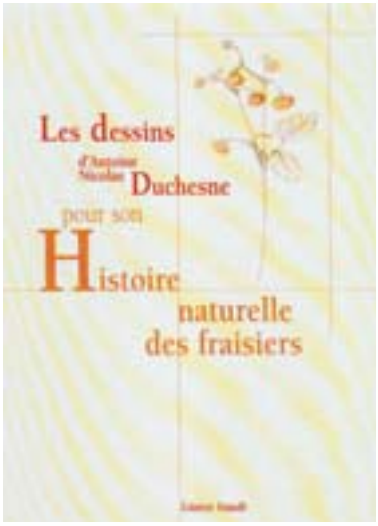
**Practical Applications of Chlorophyll Fluorescence in Plant Biology. Jennifer. R. DeEll and Peter M.A. Toivonen (eds.). 2003. Kluwer Academic Publishers, Boston/Dordrecht/London. 259p. ISBN 1-4020-7440-9.**

The eight chapters of this multi-authored work discuss development in the instrumentation and approaches for use of chlorophyll fluorescence as a probe to plant adaptation to an environment or as an indicator of stress. The advantage of chlorophyll fluorescence is that is provides a rapid nondestuctive measure. The first two introductory chapters introduce the topic while the last six provide applications in forestry and ecophysiology, the study of light temperature and drought stress, ecotoxicology (heavy metals, herbicides and air pollutants), aquatic environments, postharvest quality assessments of fruits and vegetables, and finally to fruit breeding. To horticulturists, this small volume provides a review of all you wanted to know about chlorophyll fluorescence but were afraid to ask.

**Floral Biology, Pollination and Fertilisation in Temperate Zone Fruit Species and Grape. P. Kozma, J Nyéki, M Soltész, and Z Scabó (eds.). 2003. Akademiai Kiado, Budapest (Member of Wolters Kluwer Group). 621p.**

This is the second volume of a series; Volume 1 (*Floral Biology of Temperate Zone Fruit Trees and Small Fruits*) appeared in 1996 edited by József Nyéki and Miklós Soltész. A third volume is planned. The present volume is a multi-authored work consisting of 25 chapters. After a brief introductory chapter, there is a review of hormonal aspects of flower formation and fruit set (T. Bubán), three chapters on floral morphology, a chapter on frost injury of floral organs, a brief chapter on orchard implications, followed by 14 chapters (9 to 23) on individual fruits: apple, pear, quince, sweet cherry, sour cherry, plum, apricot, peach, almond, walnut, chestnut, hazelnut, *Ribes, Rubus*, and strawberry. The chapter on apple by M. Soltész is quite extensive with much information on compatibility groups. The last two chapters review insect pollination. Most remarkable is the 146 page Chapter 7, [Exploration of flower types in grapes (*Vitis vinifera*)] by P. Kozma that contains 273 figures (!) most of than photomicrographs of floral anatomy. The book also includes 32 color photographs in a special insert. In general this reference must be considered a classic treatment and review of the subject with little new information on genetics or physiology. It provides the rationale for successful planning of orchard layout to accommodate cross pollination, so essential to successful fruit culture.

**Les Dessins d'Antoine Nicolas Duchesne pour son Histoire Naturelle des Fraisiers. Gunter Staudt. 2003. Museum National d'Histoire Naturelle, Paris 370p. ISBN : 2-85653-555-0 / 55,92 † HT/59†TTC. available at CIREF, Service de Documentation, Lanxade. Email: documentation@ciref.asso.fr or memoires@mnhn.fr**




Les Dessins - l'Histoire Naturelle des Fraisiers

The Museum National d'Histoire Naturelle in Paris has published the collection of Antoine Nicolas Duchesne's drawings for his **Histoire Naturelle des Fraisiers (Natural History of Strawberries)**. Antoine Nicolas Duchesne, a remarkable 18th century gardener and a renowned specialist who corresponded with the greatest naturalists of his time, was also a gifted artist. This volume makes available the hitherto unpublished plates of this pioneer in methods and ideas that were to develop in the following century and revolutionise not only botany but also the way the organisation and functioning of the living world were conceived. Duchesne's drawings are published along with his own comments, plus remarks by Professor Günter Staudt, an acknowledged specialist in strawberry biogeography, genetics and systematics. who has devoted his research to the study of the growth, history and genetics of cultivated plants.

**Plant Evolution and the Origin of Crop Species. 2nd ed. J.F. Hancock. 2004. CABI Publishing. ISBN 0-85199-685-X**

This textbook written for advanced undergraduates and graduate students is the 2nd edition of a book originally published by Prentice-Hall, but now richer in crop evolution and includes biotechnological techniques. It reads as a textbook and will not be a book for light reading or serve as a reference sourcebook for various crops. Citations are provided for most statements, which will be helpful to students but has the negative effect of making the reading somewhat dense. Although Jim Hancock is a horticulturist, agronomic crops are covered substantially. The book is arranged in two sections. The first five chapters cover genetic mechanisms associated with plant evolution, while the last seven deal with crop domestication.

**Above books were reviewed by Jules Janick**

## NEW TITLES

Benbi, D.K. and R. Nieder (eds.). 2003. Handbook of Processes and Modeling in the Soil-Plant System. Food Products Press, The Haworth Press, Inc. New York. 762 p. ISBN 1-56022-914-4 (hardback). $149.95. ISBN 1-56022-915-2 (paperback). $89.95. www.haworthpress.com

Brun, R. and Mary. L. (eds.). 2003. La Rose sous Serre pour la Fleur Coupée. INRA Editions, Versailles cedex, France. 252 p. ISBN INRA 2-7380-1096-2, INRA Astredhor 2-912664-13-6. †42.

Childers, Norman F. (ed.). 2003. The Strawberry. Dr. Norman F. Childers Publ., 3906 N.W. 31st Place, Gainsville, FL. 246 p. ISBN 0-938378-11. $29. Purdy@pupress.princeton.edu

Cranshaw, W. (aut.). 2004. Garden Insects of North America. Princeton University Press, Princeton. 672 p. ISBN 0-691-09561-2 (hardcover) $29.95, ISBN 0-691-09560-4 (hardcover) $99.50.

Goyal, Sham S., Surinder K. Sharma and D. William Rains (eds.). 2003. Crop Production in Saline Environments: Global and Integrative Perspectives. Food Products Press, The Haworth Press, Inc. New York. 427 p. ISBN 1-56022-096-1 (hardback). $129.95. ISBN 1-56022-097-x (paperback). $69.95. www.haworthpress.com

Jana, B.B. and Carl D. Webster (eds.). 2003. Sustainable Aquaculture: Global Perspectives. Food Products Press, The Haworth Press, Inc. New York. 365p. ISBN 1-56022-105-4 (hardback). $59.95. ISBN 1-56022-104-6 (paperback). $34.95. www.haworthpress.com

Kang, Manjit S. (ed.). 2003. Handbook of Formulas and Software for Plant Geneticists and Breeders. Food Products Press, The Haworth Press, Inc. New York. 348 p. ISBN 1-56022-948-9 (hardback). $69.95. ISBN 1-56022-949-7 (paperback). $39.95. www.haworthpress.com

Kavalali, Gusel M. (ed). 2003. Urtica. Taylor and Francis, London. 99 p. ISBN 0-415-30833-X. $90.

Metz, Matthew (ed.). 2004. *Bacillus thuringiensis*: A Cornerstone of Modern Agriculture. Food Products Press, The Haworth Press, Inc. New York. 242p. ISBN 1-56022-108-9 (hardback). $89.95. ISBN 1-56022-109-7 (paperback). $59.95. www.haworthpress.com

Ogihara, Yukio and Masaki Aburada (eds.) 2004. Sho-Saiko-To. Taylor and Francis, London. 280p. ISBN 0-415-30837-2. $120.

Ploetz, R.C. (ed.). 2003. Diseases of Tropical Fruit Crops. CABI Publishing. 527 p. ISBN 0-85199-390-7 (hardback). £99.50 ($175). www.cabi-publishing.org

Roubelakis-Angelakis, K.A. (ed.). 2002. Molecular Biology & Biotechnology of the Grapevine. Kluwer Academic Publishers, Dordrecht. 500 p. ISBN 0-7923-6949-1 (hardback). †192.50.

Sasson, Albert (ed.). 2000. Biotechnologies in Developing Countries: Present and Future. Volume 3: Regional and Subregional Co-operation, and Joint Ventures. UNESCO Publishing, Paris. 1103p. ISBN 92-3-103792-7.

Wojtkowski, Paul A. (ed.). 2004. Landscape Agroecology. Food Products Press, The Haworth Press, Inc. New York. 330 p. ISBN 1-56022-252-2 (hardback). $79.95. ISBN 1-56022-253-0 (paperback). $49.95. www.haworthpress.com

Wolf, Benjamin and George H. Snyder (eds.). 2003. Sustainable Soils. The Place of Organic Matter in Sustaining Soils and their Productivity. Food Products Press, The Haworth Press, Inc. New York. 352p. ISBN 1-56022-916-0 (hardback). $69.95. ISBN 1-56022-917-9 (paperback). $49.95. www.haworthpress.com

Scientific Journal of Food, Agriculture & Environment. The Journal of Food, Agriculture & Environment (JFAE) publishes peer-reviewed, original research, critical reviews or short communications in food science & technology, human nutrition & human health, agriculture and Environment, with particular emphasis on interdisciplinary studies on the food, and agricultural, and environmental interface. The journal also considers manuscripts on biotechnology, ethical and socioeconomic issues related to modern agricultural or environmental sciences. The Journal offers advertisement space for special announcements from, and employment opportunities. For details we kindly invite you to visit our website www.world-food.net.

## WEBSITES

http://www.reviewscience.com: an updated database on antimicrobials. AMICBASE (-EssOil) displays the antimicrobial spectra of drugs, antibiotics, compounds produced by higher plants etc. in detail. It is available as CS Chemfinder (CambridgeSoft Corp.) or MS Access (Microsoft, Corp.) database and as SD-file. Volume in November 2003: > 160.000 data records, 7420 compounds (+ 15% since Feb. 2003) No. references cited: > 3400 microbiology references including > 1500 patents + > 5000 toxicology references

http://seattletimes.nwsource.com/pacificnw/2003/1102/plant.html: Flora the Gardeners bible (1600 pages and 12,000 photos, 20,000 plants) launched in September 2003.

http://www.biology.uoc.gr/gvd: The Greek Vitis Database by François Lefort and Kalliopi A. Roubelakis Angelakis

http://www.iita.org/info/virology.htm "Plant Virology in Sub-Saharan Africa"

http://www.archibio.it: Construction of Therapeutic Gardens by Marco Nieri

http://www.wkap.nl/prod/b/0-7923-6949-1: Molecular Biology & Biotechnology of the Grapevine

# Courses and Meetings

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

Total Food 2004, Exploiting Co-products - minimise waste. Norwich Research Park, UK, April 25-28, 2004. Info: Dawn Barrett. Phone: (44)1603255328, Fax: (44)1603255168, email: dawn.barrett@bbsrc.ac.uk.

3rd International Specialised Conference on Sustainable Viticulture and Winery Wastes Management, 24-26 May 2004, Barcelona, Spain. Info: http://www.winery.ub.es.

Growth and Develoment of Plants: Theoretical and Practical Problems, June 7-9, 2004, Babtai, Lithuania. Info: Dr. Au_ra Brazaitute, Lithuanian Institute of Horticulture. Phone: (370)37555476, fax: (370)37555176, email: ausra@lsdi.lt

International Applied Science Conference "Small Fruit Production nowadays", devoted to the 100th Anniversay of the Belarusian Breeder 'Biol. Dr. Prof. A.G. Voluznev', July 13-15, 2004, Belarus. Info: Dr. Vyatcheslav Samus, Institute for Fruit Growing of the National Academy of Sciences of Belarus, Str. Kovalev, 2, settl. Samokhvalovichy, Minsk region, 223013, Republic of Belarus. Phone: (375)175066407 (Dr. A.M. Dmitryeva), (375)175066578 (Dr. A.M. Krivorot), (375)175066474 (Dr. L.I. Nosevich), email: belhort@it.org.by.

International Conference on Horticultural Ph.D. Study Systems and Conditions in Europe, November 17-19, 2004, Lednice, Czech Republic. Info: Ass. Prof. Robert Pokluda, Prof. Frantisek Kobza, Mendel Univ. of Agriculture and Forestry, Faculty of Horticulture, Lednice. Phone: (420)519367234 or 232, Fax: (420)519340159, email: pokluda@zf.mendelu.cz and www.zf.mendelu.cz.

## JOB OPPORTUNITY

Agricultural/Horticultural Engineer at the Federal Agricultural Research Station 'RAC Changis' of Nyon, Switzerland. Duty: 'Responsible for Protected Cultivation'. Info: Claude Yerly, Head Resources and Administration, claude.yerly@rac.admin.ch, www.racchangis.ch



# New ISHS Members

**We are pleased to welcome the following new members:**

## NEW ORGANISATION MEMBERS:

**United Kingdom**:Scottish Crop Research Institute

## NEW INDIVIDUAL MEMBERS:

**Antigua & Barbuda**: Mr. Grant Joyce; **Australia**: Dr. Ian Goodwin, Dr. Nick Costa, Dr. Peter Taylor, Ian Collins, jason smith, Johannes Geurtsen, Mr. Andrew Mathews, Mr. David Herbert, Mr. Garry Langford, Mr. Jeff Peterson, Mr. Mark O'Connell, Mr. Matthew Griffiths, Mr. Oleg Nicetic, Mr. Peter Lamb, Mr. Peter O'Brien, Mr. Scott Ward, Mr. Stewart Field, Ms. Elisabeth Smith, Ms. Lee-Anne McInerney, Ms. Marcello Fabretti, Ms. Nuala Hiscock, Ms. Patricia Meagher, Prof. Dr. Daryl Joyce, Prof. Stephen Frost, Wayne Murphy; **Austria**: Dr. Eva Wilhelm, Dr. Markus Hohenegger; **Bahamas**: Simeon Pinder; **Belgium**: Jacques Paquot, Mr. Ben Wuyts, Mr. Hubert Masses, Mr. Martin Raeymakers, Philip Lieten; **Brazil**: Mr. Claudio de Pauli, Mr. José Mariano Pessôa de Queiroz, Mr. Newton Matsumoto, Mr. Thue Barfod, Regina Oliveira; **Bulgaria**: Prof. Dr. Ivan Iliev; **Canada**: Binette Andre, Dr. H.P. Vasantha Rupasinghe, Katreen Ms. Gradowska, Majid Ahmadi, Mr. Bert Visscher, Mr. Dale Cowan, Mr. Frédérick Laforge, Mr. Gene Stampfer, Mr. George Collier, Mr. Jim Olsthoorn, Mr. Mark Roberts, Mr. Matt Mavety, Ms. Adrina Ambrosii, Ms. Bonnie Borkenhagen, Ms. Catherine Knoblauch, Ms. Guylaine Lemieux, Ms. Nadia Ariff, Robert Hansen, Robin Young, Stephane Labelle; **Chile**: Barbara Schilling; **Colombia**: Dr. Alejandro Velez, Dr. Mauricio Salamanca; **Croatia**: Babulj d.o.o., Dr. Bozena Mitic; **Czech Republic**: Mr. Miroslav Dorazil; **Denmark**: Mr. Andreas Bloch, Mr. Ole Stauning, Mr. Per Hansen; **Egypt**: Karim Donato, Mr. Karim Hwaidak; **Estonia**: Mr. Madis Seersant; **Finland**: Mr. Kai Männik; **France**: Dr. Jean-Charles Michel, Mahesh Venkataramaiah, Mr. Eric Bellet, Mr. Xavier Dufour; **Germany**: Dr. Juergen Kuesters, Gerhard Kast, Margret Will, Mr. Cord Kracke, Mr. Michael Georgi, Ms. Frauke Engel, Wolfgang W. Schaefer; **Greece**: Mr. Yannis Matsoukas; **Guinea Bissau**: Mr. Sidones Gomes; **Hong Kong**: Dr. Jennifer Anderson; **India**: Dr. Jagvir Yadav, Dr. Tarsem Singh Dhillon, Mr. Balvinder Singh, Mr. Jagbir Singh, Mr. Kuldeep Singh, Mr. Paramjeetsingh Singh, Mr. Philip Collison, Tarseem Singh Dhillon; **Iran**: Dr. kambiz Baghalian, Ms. fatemeh mastouri; **Ireland**: Mr. Patrick Heaney; **Israel**: Dr. Idit Ginzberg, Haya Friedman; **Italy**: Dr. Alberto Valier, Dr. Anna Mirotti, Dr. Giuseppe Sorrentino, Dr. Marco Sciortino, Dr. Maria Emilia Malvolti, Dr. Roberto Miravalle, Ms. Emanuela Fontana, omar bernardi, Patrizia Lotti, Stefano Cerchiai; **Japan**: Dr. Koichi Shoji, Dr. Toshiyuki Morikawa, Fujio Tagawa, Mr. Takatoshi Matsuno, Ms. Midori Hashizume,

Prof. Dr. Kiyoshi Banno; **Jordan**: Ms. Bassam Aledwan; **Korea - South**: Ahn Young Jik, Ass. Prof. Hye-young Sang, Mr. Hee Ham, Mr. Oe Seok Ku, Ms. Joonseon Yoon, Prof. Dr. Jong Myung Choi, Sang Kwon Lee; **Malaysia**: Ass. Prof. Siti Hajar Ahmad; **Mexico**: Dr. Francisco Garcia Barrientos, Dr. Rosa Maria Escobedo, Leonardo Crespo, Mr. Dennis Hitzigrath, Mr. Rene Franco Gutierrez; **Morocco**: Dr. Radouani Abdellah; **Netherlands**: Dr. Huub Schepers, Dr. Jan Hassink, Lia Pijpers, Mr. Henny Balkhoven, Mr. Huibert Spoorenberg, Mr. Jan-Kees Luijerink, Mr. Jeroen van der Hulst, Mr. Ton Rijsdijk, Ms. Vanessa Koster, Ronaldt Thoen; **New Zealand**: Dr. John Simpson, Dr. Wendy Schotsmans, Lydia Huggard, Mr. Earnscy Weaver, Mr. Jerome Hardy, Mr. John Haliday, Mr. John Penny; **Nigeria**: Mr. Charles Duru; **Norway**: Anders Sand, Ass. Prof. Jorunn E. Olsen; **Palestina**: Mr. Abdel Karim Awwad; **Peru**: Hugo Villachica; **Portugal**: Dr. Eurico Pais, Jorge Sofia; **Puerto Rico**: Ilan Oliver, Mr. Maximo Lacourt; **Russia**: Ms. Tatiana V. Galaktionova; **Saudi Arabia**: Mr. Adil Al -Issa; **Serbia and Montenegro**: Ms. Sladjana Savic, MSc; **Slovenia**: Ir. Bostjan Godec, Ms. Missa Pusenjak; **South Africa**: Dr. James Fulton, Ian Hurst, Mr. Andre van Heerden, Mr. Edward Molteno, Mr. John-Michael Bion, Mr. Mark Dando, Mr. Mias Pretorius, Mr. Moses Jumo, Mr. SO Meyer, Mr. Willem Schmidt; **Spain**: Bruno Govaerts, Dr. José Ramón Viruega, Dr. Pia Pujol Galofre, Mª Victoria Moruja Martínez, Manuel Mateo, María M. González-Real, Mr. Jerónimo Cuenca Molina, Mr. Manuel Cervera, Mr. rovira ramon, post master, Simon Hendrik E Van Olmen; **Sri Lanka**: Prof. Nimal Adikaram; **Sweden**: Mr. Lars Mogren, Ms. Anita Gunnarsson, Ms. Sara Bergquist; **Switzerland**: Hans-Jakob Schaerer, Leonel Sanchez; **Tanzania**: Mr. Abe Suleman; **Thailand**: Dr. Anupan Kongbangkerd, Jureeporn Ammaralikhit, Mr. somchai pattanapitoon; **Tunisia**: Mr. Khereddine Kahia, Prof. Mohamed Elyes Kchouk; **Turkey**: Ass. Prof. Yesim Aysan, Dr. Fulya Baysal Tustas, Mr. levent 351en, Mr. Seyit Karan, Prof. Hasan Vurdu; **United Kingdom**: Dr. Anna Snowdon, Dr. David Gray, Dr. David Smith, Dr. philippa Guest, Dr. Tim Moss, Mr. Alistair Blake, Mr. Dimitrios Doukas, Mr. Jason Perrott, Mr. John Fulton, Mr. Manoj Parekh, Mr. Neil Seegobin, Mr. Philip Wilkes, Mr. William Curran, Ms. Anita Chillmaid, Ms. Claire Shaddick, Prof. David Atkinson; **United States of America**: Albert H. Markhart, Amy Bader, Amy Kafka, Arlene De Santis, Ass. Prof. Scott Michaels, Chris Hinds, Chris K. Beytes, Cindy De La Cruz, Dave Wyckoff, Dr. Bert Cregg, Dr. Daniel Leskovar, Dr. Donald Makus, Dr. Eddie L. Nixon, Dr. Edward Kostansek, Dr. Eleanor Thorne, Dr. George Matoian, Dr. Hisham Moharram, Dr. Jerome Pier, Dr. Pawan Srivastava, Dr. Robert Hartley, Dr. Yaguang Luo, Edward Walsh, Eric Pillemer, J. Dana Call, Jeanna A. Briggs, Jeff Mitchell, Joel Goldblatt, John Linton, John Postema, John Shelson, Jonathan Wilcox, Jordan Kovacev, Joseph Baca, Kathleen Leahy, Mark Hall, Michael W. Smith, Michal Bettale, morty kaplan, Mr. Adam Bresser, Mr. Alpesh Patel, Mr. Brett Perkins, Mr. Charles Uche, Mr. Chris Wiesinger, Mr. Frank McDonough, Mr. Gerald Grott, Mr. Glenn Sheldon, Mr. Greg Stach, Mr. Hedeer ElShowk, Mr. John Doyle, Mr. Kraig Klicker, Mr. Matthew Blanchard, Mr. michael kokora, Mr. Paul Santos, Mr. Philip Schwallier, Mr. richard meister, Mr. Scott Cernosek, Mr. Sebastian Nonis, Mr. Srinivas Gundeaboina, Mr. Thomas Jaszewski, Mr. Thomas O. Oyler, Jr., Mr. Warren Davenport, Mr. Zebuel Jones, Ms. Jennifer Simonetti, Ms. Juan Carlos Gonzalez U., Ms. Kate Casale, Ms. Marcelina da Silva, Ms. Susan Eagar, Norman Hilbert, Pamella Simon, Prof. Philip VanBuskirk, Richard Paterson, Robert Nichols, Robin Cross, Thomas C. Weiler, Tom Schroder, Wansang Lim, Wei Qiang Yang; **Uruguay**: Mr. Alejandro Gorostidi

# In Memoriam

## IOANNIS C. PORLINGIS

Prof. I.C. Porlingis passed away on 30 November 2003 at the age of 78. He had been a member of the ISHS since 1979.

Professor Porlingis received his B.Sc. degree in Agriculture in 1950 and his Ph.D. in Horticulture in 1956 from the Aristotle University of Thessaloniki. He continued his studies in the USA on a Fulbright scholarship, first in the University of California (Davis) and then at Cornell University (New York) where he obtained a second Ph.D. degree in the physiology of horticultural plants. He returned to Greece in 1959 and joined the staff of the Faculty of Agriculture in the University of Thessaloniki. In 1969 he was appointed full professor of Biology of Horticultural Plants and in this capacity he served with dedication until his retirement in 1992. In 1993 he was awarded the status of Professor Emeritus.

Prof. I.C. Porlingis had pioneered the research on plant hormone physiology, in Greece. The nursery industry, also, owes him much because he introduced the mist propagation system in Greece. His basic and applied research on root formation in cuttings, and on flower physiology of olive and pistachio are still to day the main source of reference for relevant subjects.

Dr. Porlingis strongly believed in the significance of postgraduate studies in Horticulture and due to his efforts the first such program was activated in the University of Thessaloniki, in 1972. He was, also, a strong proponent of the open communication among scientist and he urged his younger colleagues to participate in meetings and symposia, where the scientific knowledge can be disseminated. He was one of the founding members of the Greek Society for Horticultural Science and served as its president from 1981 to 2001.

Prof. I.C. Porlingis with his untiring interest in teaching and research contributed greatly to Greek horticulture and set an example to his former students and later colleagues by whom he will be missed. He is survived by his sister.

**D.G. Voyiatzis, Aristotle University of Thessaloniki, Greece**

## PASSED AWAY

R. Booji (The Netherlands), ISHS member, passed away on December 11th, 2003

J.D. Gordon (Australia), ISHS member, passed away on February 4th, 2004.

# 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.**

## MAJOR ISHS HORTICULTURAL MEETINGS IN BRISBANE, 2004

Between August 25th and September 10th this year, Queensland's Sunshine Coast will host important horticultural scientists from around the world. A number of meetings will be held at the Hyatt Coolum, with associated visits in south east Queensland. These include Meetings of the Board, Executive, and Council of ISHS, a regional conference on "Harnessing the Potential of Horticulture in the Asian-Pacific Region", and The Vth ISHS International Strawberry Symposium. Regional and international scientists are invited to take part. Further information can be obtained from Professor Richard Williams of the University of Queensland, Gatton Campus (Mrichard.williams@mailbox.uq.edu.au or from the Australian Society for Horticultural Science website (www.aushs.org.au).

## REGULAR CALENDAR

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

## YEAR 2004

- March 23-27, 2004, Orlando, FL (USA): **International Symposium on Protected Cultivation in Mild Winter Climates.** Info: Prof. Dr. Daniel J. Cantliffe, University of Florida, IFAS, Horticultural Sciences Dept., 1251 Fifield Hall, Box 110690, Gainesville, FL 32611-0690, USA. Phone: (1)3523921928x203, Fax: (1)3523926479, email: djc@mail.ifas.ufl.edu web: conference.ifas.ufl.edu/ishs/
- April 3-7, 2004, Melbourne (Australia): **International Symposium on Protea.** Info: Dr. Audrey I. Gerber, New and Innovative Industry Development Officer, Primary Industries Research Victoria, Department of Primary Industries, Ovens Centre, PO Box 235, Myrtleford VIC 3737, Australia. Phone: (61)357311244, Fax: (61)357311223, email: audrey.gerber@dpi.vic.gov.au
- April 19-22, 2004, Niigata (Japan): **IX International Symposium on Flowerbulbs.** Info: Prof. Dr. Hiroshi Okubo, Lab. of Horticultural Science, Faculty of Agriculture, Kyushu University, Fukuoka 812-8581, Japan. Phone: (81)926422827, Fax: (81)926422827, email: hokubo@agr.kyushu-u.ac.jp web: http://jshs.ac.affrc.go.jp/symposium/bulb2004/index.html
- April 21-26, 2004, Beijing (China): **IV International Symposium on Edible Alliaceae.** Info: Convener Prof. Zhu Dewei, Chinese Society for Horticultural Science, 12 Zhongguancun Nandajie, Beijing 100081, China. Phone: (86)1068919531, Fax: (86)1062174123, email: ivfcaas@public3.bta.net.cn or ivfcaas@mail.caas.net.cn web: www.ivfcaas.net.cn
- June 4-6, 2004, Awaji Island, Hyogo Prefecture (Japan): **VIII International People-Plant Symposium (IPPS 2004).** Info: Prof. Matsuo, email: ei_matsuo@m5.dion.ne.jp
- May 3-8, 2004, Nova Oeiras and Alalá del Rio, Sevilla (Portugal and Spain): **VIII International Symposium on Vaccinium Culture.** Info: Dr. Luis Lopes da Fonseca, Estação Agronomica Nacional, Av.da Republica s/n, 2784-505 Nova Oeiras, Portugal. Phone: (351)214403500, Fax: (351)214411797, email: llf@mail.telepac.pt or Dr. Fernando Romero Muñoz, Centro Las Torres Tomejil, 41200 Alcala del Rio, Sevilla, Spain. Phone: (34)955045500, Fax: (34)955045625
- June 6-11, 2004, Verona (Italy): **V International Postharvest Symposium.** Info: Prof. Dr. Pietro Tonutti, University of Padova, Department of Agronomy and Crop Sciences, Agripolis, Via Romea 16, 35020 Legnaro (Padova), Italy. Phone: (39)0498272845, Fax: (39)0498272850, email: pietro.tonutti@unipd.it or postharvest2004@unimi.it web: www.soihs.it/postharvest2004
- June 7-10, 2004, Perugia (Italy): **International Symposium on Nutrition and Fertilization - Toward ecologically sound fertilisation strategies in field vegetable production.** Info: Prof. Francesco Tei, Dept.Agroenvir. & Crop Science, University of Perugia, Borgo XX Giugno 74, 06121 Perugia, Italy. Phone: (39)0755856320, Fax: (39)0755856344, email: f.tei@unipg.it web: www.unipg.it/ishs2004
- June 13-18, 2004, Budapest (Hungary): **VIII International Symposium on Integrating Canopy, Rootstock and Environmental Physiology in Orchard Systems.** Info: Prof. Dr. Károly Hrotkó, St. Stephen University, Buda Campus, Department of Fruit Science, 1518 Budapest, Pf. 53, Hungary. Phone: (36)13726284, Fax: (36)13726337, email: hrotko@omega.kee.hu web: www.altagra.hu/confers/ishs2004/c_ishs2004_index.html

NEW

- June 14-16, 2004, Viterbo (Italy): **Meeting of the Physiology Section of the European Association for Potato Research.** Info: Dr. Robert Viola, Scottish Crop Research Institute, SCRI, Invergowrie, Dundee DD2 5DA, United Kingdom. Phone: (44)07799354118 or (44)1382562731, Fax: (44)1382562426 email: rviola@scri.sari.ac.uk or Dr. Raffaele Casa, Universita Della Tuscia, Dipartimento di Produzione Vegetale, Via San Camillo De Lellis snc, 01100, Viterbo, Italy. Phone: (39)0761357559, Fax: (39)0761357558, email: rcasa@unitus.it web: www.unitus.it/dipartimenti/dpv/eapr04.htm

NEW

- June 14-18, 2004, Reus-Tarragona (Spain): **VI International Congress on Hazelnut.** Info: Dr. Joan Tous and Dr. Mercè Rovira, Apartat 415, 43280 Reus (Tarragona), Spain. Phone: (34)977328424, Fax: (34)977344055, email: joan.tous@irta.es or merce.rovira@irta.es web: www.hazelnut2004.com
- June 15-17, 2004, Cameron Highlands (Malaysia): **International Symposium on Greenhouses, Environmental Controls and in-house Mechanization for Crop Productions in the Tropics and Subtropics: Controlled Environment Technology for Sustainable Agricultural Production.** Info: Dr. Rezuwan Kamaruddin, MARDI (Malasian Agricultural Research and Development Institute), Serdang, PO Box 12301, GPO 50774 Kuala Lumpu, Malaysia. Phone: (60)389437072, Fax: (60)389482961, email: rezuwan@mardi.my web: http://www.mardi.my/ver2/sem_conf/ishs/index.html
- June 20-24, 2004, Copenhagen (Denmark): **VII International Symposium on Modelling in Fruit Research and Orchard Management.** Info: Dr. Peter Braun, Royal Veterinary & Agricultural University, Department of Agricultural Sciences, Section Horticulture, Højbakegårds Alle 21, 2630 Taastrup, Denmark. Phone: (45)35283534, Fax: (45)35283478, email: pbr@kvl.dk
- June 21-24, 2004, Orlando, FL (USA): **I International Symposium on Tomato Diseases.** Info: Dr. Timur Momol, Plant Pathology Department, NFREC, IFAS, University of Florida, 155 Research Road, Quincy, FL 32351, USA. Phone: (1)8508757154, Fax: (1)8508757188, email: tmomol@ufl.edu web: http://plantdoctor.ifas.ufl.edu/istd.html
- June 21-25, 2004, Davis, CA (USA): **VII International Symposium on Grapevine Physiology.** Info: Prof. Dr. Larry Williams, 9240 South Riverbend Ave., University of California - Davis, Kearney Ag Center, Departement of Viticulture and Enology, Parlier, CA 93648, USA. Phone: (1)559-646-6500, Fax: (1)559-646-6593, email: williams@uckac.edu
- July 5-9, 2004, Bologna (Italy): **X International Workshop on Fire Blight.** Info: Prof. Carlo Bazzi, University of Bologna, Via Filoppo Re 8, 40126 Bologna, Italy. Phone: (39)0512091446, Fax: (39)0512091446, email: cbazzi@agrsci.unibo.it web: www.agrsci.unibo.it/fireblight
- August 1-8, 2004, Corvallis, OR (USA): **I International Symposium on Humulus.** Info: Dr. Kim Hummer, USDA ARS NCGR, 33447 Peoria Road, Corvallis, OR 97333-2521, USA. Phone: (1)541.738.4201, Fax: (1)541.738.4205, email: khummer@ars-grin.gov and Prof. Dr. Lyle Craker, Dept. of Plant & Soil Science, University of Massachusetts, Stockbridge Hall, Amherst, MA 01003-7245, USA. Phone: (1)413-545-2347, Fax: (1)413-545-3958, email: craker@pssci.umass.edu web: www.ars-grin.gov/cor/hop-symposium.htm

- August 2-7, 2004, Chapingo (Mexico): **V International Symposium on Cactus Pear and Cochineal.** Info: Dr. Candelario Mondragon-Jacobo, Nogal 259, Arboledas, Queretaro, Qro. 76140, Mexico. Phone: (52)442122546 and (52)461611029413, Fax: (52)461611029413, email: jacobo77@hotmail.com or rebe27_10@yahoo.com and Prof. Dr. Paolo Inglese, University of Palermo, Dipt. colture Arboree, Viale delle Scienze, 90128 Palermo, Italy. email: pinglese@unipa.it

- August 18-21, 2004, Perth (Australia): **International Symposium on Horticultural Education Extension and Training. Recent Advances in Horticultural Education.** Info: Peter J. Batt and Ass. Prof. Zora Singh, ISHS Education Symposium, Horticulture Curtin University of Technology, GPO Box U1987, Perth 6845, WA, Australia. Phone: (61)892667596 or 892663138, Fax: (61)892663063, email: ishs@curtin.edu.au web: www.muresk.curtin.edu.au/ishs/ download the first announcement here.

- August 25-26, 2004, Maroochy (Australia): **ISHS Board Meeting**

- August 27, 2004, Maroochy (Australia): **ISHS Executive Committee Meeting**

- August 28-31, 2004, Maroochy (Australia): **Joint ISHS Executive Committee and Council meeting**

- August 29-September 3, 2004, Berlin (Germany): **International Symposium on Horticultural Economics and Management. Creating Value in a Changing Society.** Info: Prof. Dr. Wolfgang Bokelmann, Humboldt University, Faculty of Agriculture and Horticulture, Inst. of Economics and Social Science in Agriculture, Luisenstrasse 56, 10099 Berlin, Germany. Phone: (49)3020936136, Fax: (49)3020936236, email: w.bokelmann@agrar.hu-berlin.de web: www.agrar.hu-berlin.de/wisola/ishs

- September 1-3, 2004, Coolum (Australia): **Regional Conference: Harnessing the Potential of Horticulture in the Asian Pacific Region.** Info: Prof. Richard Williams, University of Queensland Gatton Campus, School of Agronomy and Horticulture, Gatton Qld 4343, Australia. Phone: (61)754601305, Fax: (61)754601283, Email: richard.williams@uq.edu.au web: www.aushs.org.au

- September 6-9, 2004, Lofthus (Norway): **VIII International Symposium on Plum and Prune Genetics, Breeding and Technology.** Info: Dr. Lars Sekse, Plante Forsk - Norwegian Crops Research Institute, Ullensvang Research Centre, 5781 Lofthus, Norway. Phone: (47)53671200, Fax: (47)53671201, email: lars.sekse@planteforsk.no web: http://www.planteforsk.no/

- September 7-10, Gumushane (Turkey): **I International Rose Hip Conference.** Info: Dr. Sezai Ercisli, Ataturk University, Agricultural Faculty, Department of Horticulture, 2540 Erzurum Turkey. Phone: (90)4422312599, Fax: (90)4422360958, email:sercisli@atauni.edu.tr or sercisli@hotmail.com

- September 5-10, 2004, Brisbane (Australia): **V International Strawberry Symposium.** Info: Dr. Neil Greer, QLD Dept Primary Industries, PO Box 5083, Sunshine Coast Mail Centre, Nambour, QLD 4560, Australia. Phone: (61)754449605, Fax: (61)754412235, email: greern@dpi.qld.gov.au web: http://www.qsga.org/symposium/

- September 6-10, 2004, Bursa (Turkey): **III Balkan Symposium on Vegetables and Potatoes.** Info: Dr. H. Özkan Sivritepe, Department of Horticulture, Faculty of Agriculture, Uludag University, 16059 Bursa, Turkey. Phone: (90)2244428970, Fax: (90)2244429098, email: ozkan@uludag.edu.tr web: http://www.3bsvp.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)0679348186, Fax: (39)0679340158 , email: davanzato@mclink.it or Dr. Maria-Emilia Malvolti, CNR, Istituto per la Biologia Agroambientale e Forestale, Viale Marconi, 2 05010 Porano (Terni), Italy. Phone: (39)0763374688, fax: (39)0763374330, email: mimi@ias.tr.cnr.it web: (active March 2004) www.walnut2004sistemacongressi.com

- September 12-16, 2004, Leuven (Belgium): **International Symposium GREENSYS 2004 - Sustainable Greenhouse Systems: Co-operation of Engineering and Crop Science .** Info: Prof. G.P.A. Bot, Wageningen-UR, PO Box 43, NL-6700 AA Wageningen, Netherlands. Phone: (31)317476442, Fax: (31)317425670, email: info@greensys.nl, and Dr. Leo F. M. Marcelis, Plant Research International, Bornsesteeg 65, PO Box 16, 6700 AA Wageningen, Netherlands. Phone: (31)317475802, Fax: (31)317423110, email: l.f.m.marcelis@plant.wag-ur.nl web: www.greensys2004.nl

- September 12-17, 2004, Debrecen (Hungary): **V International Symposium on In Vitro Culture and Horticultural Breeding.** Info: Dr. Miklós Fári, Böszörményi ut 138, 4032 Debrecen, Hungary. Phone: (36)52316947, Fax: (36)524183332, email: silvercentrum@axelero.hu or fari@helios.date.hu web: www.ivchb2004.org

- September 12-17, 2004, Fortaleza (Brazil): **III International Symposium on Tropical and Subtropical Fruit.** Info: Dr. Osvaldo Kiyoshi Yamanishi, University of Brasilia, Faculty of Agriculture and Veterinary, Fruit Section, Caixa Postal 04508 - Asa Norte, 70910-970 Brasilia, DF Brazil. Phone: (55)613072858, Fax: (55)613071161, email: kiyoshi@unb.br web: http://www.3istsf.cjb.net

- September 27 - October 2, 2004, (Turkey): **V International Symposium on Olive Growing.** Info: Dr. Mucahit Taha Ozkaya, University of Ankara, Faculty of Agriculture, Department of Horticulture, 06100 Ankara, Turkey. Phone: (90)5355264860, Fax: (90)3123179119, email: ozkaya@agri.ankara.edu.tr web: www.olive2004turkiye.com

- October 4-8, 2004, Corfu (Greece): **VI International Symposium on Chemical and Non-Chemical Soil and Substrate Desinfestation.** Info: Prof. Dr. Eris Tjamos, Agricultural University of Athens, Department of Plant Pathology, Iera Odos 75, 11855 Votanikos-Athens, Greece. Phone: (30)2105294505, Fax: (30)2105294513, email: ect@aua.gr web: http://www.aua.gr/SD2004/

- October 5-9, 2004, Jinju (Korea): **III International Symposium on Persimmon.** Info: Dr. Seong-Mo Kang, Department of Horticulture, Gyeongsang National University, Jinju 660-701, Korea. Phone: (82)557515486, Fax: (82)557515483, email: smk@nongae.gsnu.ac.kr

- October 20-23, 2004, Chaves (Portugal): **III International Chestnut Symposium.** Info: Dr. Carlos Abreu, Universidade de Tras-Os-Montes e Alto Douro, Apartado 202, 5000-911 Vila Real . Phone (351)259350508 Fax: (351)259350480, email: cgabreu@utad.pt web: www.utad.pt/eventos/chestnutcongress

- 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 305-764, South Korea. Phone: (82)428215739, Fax: (82)428231382, email: yplim@cnu.ac.kr web: www.brassica2004.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)0679348186, Fax: (39)0679340158 , email: davanzato@mclink.it or Dr. Maria-Emilia Malvolti, CNR, Istituto per la Biologia Agroambientale e Forestale, Viale Marconi, 2 05010 Porano (Terni), Italy. Phone: (39)0763374688, fax: (39)0763374330, email: mimi@ias.tr.cnr.it you can download the first announcement here.

- 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)396148949, email: carolyn@airah.org.au web: www.airah.org.au/postharvest2004

- November 14-21, 2004, Almería (Spain): **IX International Symposium on Growing Media and Hydroponics.** Info: Dr. Miguel Urrestarazu Gavilán, Dpto. Producción Vegetal, Universidad de Almería, Lan Cañada de San Urbano, 04120 Almería, Spain. Phone: (34)950015929, Fax: (34)950015939, email: mgavilan@ual.es

- November 15-18, 2004, Melbourne (Australia): **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: http://www.worldtomatocongress.com.au/

- November 2004, Cancun (Mexico): **II International Symposium on Acclimatization and Establishment of Micropropagated Plants.** Info: Dr. Jorge Santamaria, Centro de Investigación Cientifica 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

## YEAR 2005

- January 10-14, 2005, Santiago (Chile): **VI International Symposium on Peach.** Info: Prof. Dr. Rodrigo Infante, Santa Rosa 11.315, Departamento de Produccion Agricola, Universidad de Chile, Santiago, Chile. Phone: (56)26785813, Fax: (56)26785626, email: rinfante@uchile.cl web: www.peach2005.cl

- January 17-22, 2005, Talca (Chile): **V International Symposium on Mineral Nutrition of Deciduous Fruit Crops.** Info: Dr. Jorge Benjamin Retamales, University of Talca, Escuela de Agronomía, Casilla 747, Talca, Chile. Phone: (56)71200214, Fax: (56)71200212, email: jretamal@utalca.cl

- March 13-17, 2005, Bonn (Germany): **X International Symposium on Timing of Field Production in Vegetable 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: lippertf@uni-bonn.de
- April 11-15, 2005, South Africa: **IV International Pineapple Symposium.** Info: Mr. Allen Graham Duncan, Managing Director, Summerpride Foods Ltd., PO Box 507, East London, 5200, South Africa. Phone: (27)2743-7311770, Fax: (27)2743-7311544, email: allen@sumpride.co.za web: www.pinesymp05.org
- April 12-14, 2005, Almeria (Spain): **International Workshop on Greenhouse Ventilation, Cooling and Control.** Info: Dr. J. Pérez Parra, Estacion Experimental Las Palmerillas de Cajamar, Autovia del Mediterráneo Km. 420, 04710 El Ejido (Almería), Spain. Phone: (34)950580569, Fax: (34)950580450. email: jpparra@cajamar.es
- NEW 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: http://www.pri.ir
- 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: atillaer@uludag.edu.tr or Co-convener Dr. Masum Burak, Ataturk Central Horticultural Research Institute, 77102 Yalova, Turkey. Phone: (90)2268142520, Fax: (90)2268141146, email: masum_burak@yalova.tagem.gov.tr
- NEW June 13-17, 2005, Murcia (Spain): **XIII International Symposium on Apricot Breeding and Culture.** Info: Dr. Felix Romojaro and Dr. Federico Dicenta, CEBAS-CSIC, PO Box 164, 30100 Espinardo (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: congresos@viajescajamurcia.com
- June 16-19, 2005, Horst/Venlo (Netherlands): **XI International Asparagus Symposium.** Info: Ir. Pierre Lavrijsen, Asparagus bv, PO Box 6219, 5960 AE Horst, Netherlands. Phone: (31)773979900, Fax: (31)773979909, email: plavrijsen@asparagus.nl or info@ias2005.com, web: www.ias2005.com
- 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
- NEW June 26-30, 2005, Saltillo Coahuila (Mexico): **X International Symposium on Plant Bioregulators in Fruit Production.** Info: Dr. Homero Ramirez, Salazar 1081, Zona Centro, Saltillo Coahuila 25000, Mexico. Phone: (52)84174167, email: homeror@terra.com.mx web: www.saltillo2005.org
- 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: http://opgc.osu.edu
- July 13-15, 2005, Columbus, Ohio (USA): **International Symposium on Greenhouse Systems and Energy Conservation.** Info: Prof. T. Short, Dept. Agric. Engineering, OARDC, Ohio State University, Wooster, OH 44691, USA. Phone: (1)330-263-3855, Fax: (1)330-263-3670, email: short.2@osu.edu
- August or September 2005, Townsville or Hamilton Island, North QLD (Australia): **III International Symposium on Cucurbits.** 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 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@inh.fr
- December 5-7, 2005, Santiago (Chile): **IX International Rubus and Ribes Symposium.** Info: Dr. Maria Pilar Banados, Universita Catolica de Chile, Departamento de Fruticultura y Enologia, Casilla 306-22, Vicuna Mackenna 4860, Santiago, Chile. Phone: (56)26864305, Fax: (56)25534130. email: pbanados@puc.cl
- 2005, Faro (Portugal): **III International Symposium on Figs.** Info: Prof. Dr. José Leitao, UCTA, Campus de Gambelas, 8000 Faro, Portugal. Phone: (351)289800939, Fax: (351)289818419, email: jleitao@ualg.pt
- 2005, Kearneysville, WV (USA): **I International Symposium on Transgenic Fruit Crops.** Info: Dr. Ralph Scorza, USDA-ARS, Appalachian Fruit Research Station, 45 Wiltshire Rd., Kearneysville, WV 25430, USA. Fax: (1)3047282340, email: rscorza@afrs.ars.usda.gov
- 2005, Kuala Lumpur (Malaysia): **II International Symposium on Sweet Potato.** Info: MARDI web: www.mardi.my
- 2005, Cuzco (?) (Peru): **International Symposium on Potatoes for Development.** Info: CIP web: www.cipotato.org
- 2005, Florida (USA): **International Symposium on Biotechnology of Tropical and Subtropical Species.** Info: Dr. R. Litz
- 2005, (USA): **IX Controlled Atmosphere Conference.** Info: Dr. Randolph Beaudry, Michigan State University, Department of Horticulture, A22 Plant& Soil Sci. Building, East Lansing, MI 48824-1325, USA. email: beaudry@pilot.msu.edu

## 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)137260113, email: elphickr@iafrica.com
- March 28-31, 2006, Lorca - Murcia (Spain): **VI International Symposium on Artichoke, Cardoon and their Wild Relatives.** Info: Ir. Regino Aragón Pallarés, Dpto. Horticultura, IMIDA, C/ Mayor, S/N, 30150 La Alberca (Murcia), Spain. Phone: (34)968366773, Fax: (34)968366792, email: regino.aragon@carm.es or Dr. Juan A. Fernández, Departamento Producción Vegetal, Universidad Politécnica de Cartagena, Paseo Alfonso XIII, 52, 30203 Cartagena, Spain. Phone: (34)968325446, Fax: (34)968325435, email: juan.fernandez@upct.es
- August 2006, Udine (Italy): **IX International Conference on Grape Genetics and Breeding.** Info: Prof. Enrico Peterlunger, Università di Udine, Dip. di Produzione Vegetale e Tecnologie Agrarie, Via delle Scienze 208, 33100 Udine, Italy. Phone: (39)0432558601, Fax: (39)0432558603, email: enrico.peterlunger@dpvta.uniud.it
- August 13-19, 2006, Seoul (Korea): **XXVII International Horticultural Congress. web: http://www.ihc2006.org**
- October 7 - 9, 2006, Mashhad (Iran): **II International Symposium on Saffron Biology and Technology.** Info: Prof. A. Koocheki, CESC, Faculty of Agriculture, Ferdowski University of Mashhad, P.O. Box 91775-1163, Mashhad, Iran. Phone: (98)5118788494, Fax: (98)5118787430, email: saffron-ir@ferdowsi.um.ac.ir web: http://saffron-ir.um.ac.ir
- **2006, Antalya (Turkey):** XX International Symposium on Virus and Virus-like Diseases of Temperate Fruit Crops and XI International Simposium of Small Fruit Virus Diseases. Info: Prof. Dr. Kadriye Çaglayan, Mustafa Kemal University, Agriculture Faculty, Plant Protection Department, 31034 Antakya-Hatay, Turkey. Phone: (90)3262455836 Ext.1347, Fax: (90)3262455832, email: caglayan@mku.edu.tr and Prof. Dr. Filiz Ertunc, Ankara University, Faculty of Agriculture, Department of Plant Protection, 06110 Ankara, Turkey. Phone: (90)3123170550 ext.1120, Fax: (90)3123187029, email: ertunc@agri.ankara.edu.tr

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- 2007, Geneva, NY (USA): **II International Symposium on Rootstocks.** Info: Dr. Terence Robinson, Dept. Horticultural Science, New York State Agricultural Experiment Station, Geneva, NY 14456-0462, USA. Phone: (1)315-787-2227, Fax: (1)315-787-2216, email: tlr1@nysaes.cornell.edu

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