Chronica Horticulturae

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ISHS

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The Journal of Horticultural Science & Biotechnology (JHSB)

The JHSB, a "partner" refereed research Journal of the ISHS, is a leading peer-reviewed, citation-rated Journal of international stature, reputation and eminence. It publishes high-quality original research findings in horticultural science and biotechnology to a world-wide audience. JHSB is an English Charity owned by its Trustees for the benefit of horticultural science and society-at-large, on a not-for-profit basis. Available online at **www.pubhort.org**

The ISHS has a number of collaboration agreements with other Journals. Additional information can be seen from the PubHort website.

Cover photograph: A bowl of pomegranate cultivars representing the diversity of pomegranate fruits grown in Israel, see article p. 12.

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

ISHS

Contents

ISHS Board, Executive Committee and Council Meeting, 2008

Robert J. Bogers

Robert J. Bogers, ISHS Treasurer

In April of this year the ISHS Board, Executive Committee and Council met in Agadir, Morocco. Important issues to be discussed, in addition to the reports of the President and other Board members and those of the Section and Commission Chairs, were the Society's involvement in "horticulture for development", our role in advocacy and relations with other stakeholders in the horticultural science community and the horticultural industry, the International Horticultural Congress in Lisbon, 2010, and the Society's finances.

The scientific activities of the Society continue to be successful, thanks to a very active group of Section and Commission Chairs and symposium conveners. In relation to this, the years 2007 and early 2008 have been very exciting with respect to the publications of the Society. In 2007, 36 volumes of *Acta Horticulturae* were published with 41 volumes anticipated for 2008 and we expect continued growth. *Scripta Horticulturae* is getting off the ground and new volumes have been scheduled. The ISHS has initiated talks with many societies active in scientific fields closely related to horticultural science, and to this end several contracts have been signed that will link their publications more closely to ISHS. Our full scientific programme can be accessed on the ISHS web site.

Our connections with the "research for development" community, through GlobalHort and other outreach activities, are proving helpful, generating international symposia on topics of special interest to that community and gaining individual, institutional and country members in Asia, Africa and Latin America. Recent efforts to raise the Society's profile in South America have been very successful, with Argentina returning as country member and agreements for co-operation with EMBRAPA (Brazil) and horticultural societies in Argentina and Colombia. Our relations with CTA contribute to promoting horticulture and horticultural research in African, Caribbean and Pacific countries.

In developing countries horticulture can act as engine for the economy: high-value crops like fruits and vegetables, medicinal and aromatic plants and flowers can become valuable export products that bring in the necessary foreign currency. At the same time it is of the utmost importance to maintain the existing scientific capacity in the developed world as the science basis on which future developments will also depend. To that end our members in developed countries have a role to play to promote the interest of governments and young scientists in horticulture, and to stimulate their involvement in horticultural research. The relations of our members with politicians and the general public should be strengthened and used to inform them about, e.g., the impact of climate change on horticulture and public health, and the importance of scientific research to tackle these issues. Horticulture as a career must become an attractive option to students, and position papers could be a useful tool to achieve this by helping to promote a positive image of the sector.

The preparation of the XXVIII IHC is on schedule. The first announcement was printed earlier this year and has been distributed in both printed and electronic form. The Congress will consist of colloquia (plenary sessions on cutting-edge topics presented by world-renowned invited speakers), symposia on specific topics, one-day seminars, workshops and thematic oral and poster sessions. The theme of the Congress will be "Science and Horticulture for People."

Ample time was devoted to a discussion on the dues structure of the Society. In particular the level of the Country dues has for many years been a matter of concern. From 1994 to 2005 the Country dues had been € 4,085 (Category-1 countries), € 2,610 (Category 2), € 1,310 (Category 3) and € 590 (Category 4), respectively, according to the World Bank list of country incomes. As many countries, in particular those for which national societies have to pay the dues, were experiencing difficulties in finding those amounts of money, in 2005 the dues were lowered to € 2,400, € 1,200, € 600 and (in some cases) a first-year introductory rate of € 0, respectively. In 2006 the ISHS Council accepted a Board proposal to simplify the dues structure and to lower the dues further to € 1200 for all high-income countries, € 600 for all upper- and lower-middle-income countries and € 0 for low-income countries that were not yet ready to pay the country dues. As this still did not solve the problems of some countries it was also decided that a special committee, chaired by the Society's treasurer, would reconsider the dues structure.

During its meeting in Brazil, October 2007, the Board discussed the various proposals and suggestions made by this Committee. The Board also took into account the wish of Committee members to increase the democratic character of Country representation and decided to submit to the Council a proposal that could be implemented without a change in the present Statutes and which does not alter the "United Nations" model of representation. After ample deliberations the Council accepted the following:

1. The Council will consist of representatives of the country/state members, of representatives of the individual members citizens of non-member countries/states, and of representatives of officially recognised geographical regions (Statutes, article 8.1). Per country/state/region up to three Council members will be elected/appointed according to the procedures of the country/state/region concerned. Each Council member is expected to represent all members in his/her country/state/region.
2. Where there is a national society for horticultural science the country/state/region will be encouraged to consider the possibility of appointing the national society as the organisation that is entitled to elect/appoint one or more of the country/state/region's Council members.
3. Country dues will be lowered to the same level as the dues for Institutional membership, which will be increased from the present € 160 to € 240. To compensate for the loss of income from Country dues and to encourage members also to become members of their national societies the individual dues will be raised to € 60 per year (developed countries) or two years (developing countries), or € 50 per year/two years for members of affiliated national societies.

The new dues structure will be implemented in 2009. The present (2008) individual dues are € 50 per year/two years, or € 45 per year/two years for members of affiliated national socie-

Figure 1. Net income (revenues minus expenses) from membership-/Society-related activities and publications.

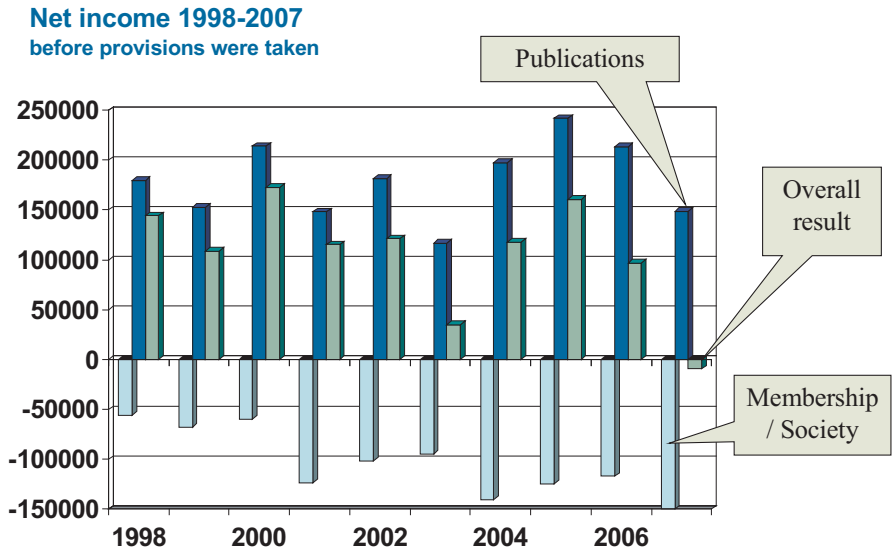

Figure 2. Value of cash and deposits, including reserves in investment account.

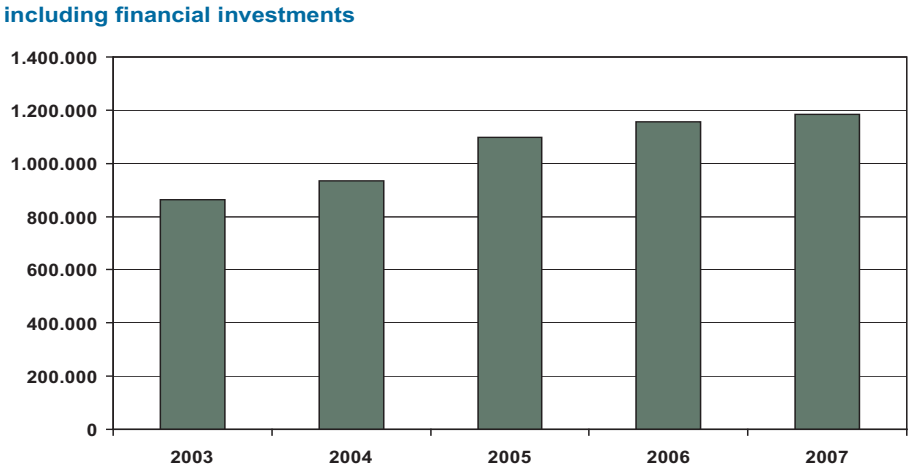

Figure 3. Profit-and-loss account (revenues and expenses) for the years 2004-2007.

Profit-and-loss account 2004-2007

	2004	2005	2006	2007
REVENUES				
Membership dues	263.651	275.918	312.061	346.212
Sales	670.942	792.349	732.136	776.332
Other Income	25.962	47.088	26.691	4.694
Total	**960.555**	**1.115.355**	**1.070.887**	**1.127.237**
EXPENSES				
Costs of books	207.844	268.089	243.289	259.254
Personnel	363.400	397.517	400.922	521.863
Office costs	126.136	147.659	139.788	138.598
Depreciation	6.406	7.143	8.080	10.588
General management	139.013	134.128	182.178	206.386
Changes in provisions	37.121	26.647	29.405	-9947,92
Total	**879.920**	**981.183**	**1.003.662**	**1.126.740**
Result: Revenues over Expenses	**80.635**	**134.172**	**67.226**	**497**

ties. Thus, the increase in individual dues will be € 10 for non-members of affiliated national societies but only € 5 for members of affiliated national societies. Also after this change in dues structure the Society's income from membership dues will still be considerably less than its expenses for membership-related issues. A breakdown of the financial results of the past ten years into membership-/Society-related results and publications-related results, taking into account the staff time involved, shows that the negative results caused by membership-/Society-related activities are more than compensated for by the positive results from publications-related activities (Fig. 1). In other words, the services offered to our members are to a large extent financed by the revenues from our publications. This allows us to keep our membership dues at a relatively low level.

It should be noted that the positive overall result in the years 1998-2006 was used to achieve the Society's goal of having one year's turnover in reserves in order to meet Belgian legal requirements and have a sound basis for future developments. This is reflected in the Balance sheet for last year and previous years, which shows a healthy organisation. The value of cash and deposits (current account plus investment account) has grown from € 862,510 at the end of 2003 to € 1,183,051 at the end of 2007 (Fig. 2). The value of the reserves in our (conservative) investment account has increased from € 210,260 at the end of 2003 to € 805,770 at the end of 2007, including two transfers of € 250,000 each from the current account to the investment account in 2004 and 2006.

During the period 2004-2007 both revenues and expenses have grown (Fig. 3). The increase in revenues stems both from increasing income from membership dues and from higher sales of the Society's publications. In direct relation to this, an increased production of publications meant additional production costs and additional engagement of personnel. The years 2006 and 2007 closed with a positive result of revenues over expenses of € 67,226 and € 497, respectively, after provisions were taken. The results of 2007 allowed us to finance a considerable number of the recommendations of the Strategic Plan (approved by Council in 2006) from this year's revenues. Thus, the higher expenses for General management and Personnel in 2007 were used to implement an important number of elements of this Plan in order to ensure the viability of the Society in the coming years. As a result a range of new products and publications will gradually be introduced.

By the end of 2007, individual membership had increased to 7,273 (2005: 6,151), and the number of organisational members had increased to 157. Thus, those years confirmed the positive trend in membership recruiting of the last years. With 42 Country members in 2007, a small increase in the number of Country members was achieved.

Alphabet Soup: Acronyms Associated with Horticulture

Acronyms make comprehension difficult in many articles in the agricultural and horticultural development community, especially when they are unexplained. Authors assume they are understood in context to the initiated, but this is not always the case. Also many different organizations use the same acronyms. For example if you google ISHS you come up with the International Society for Horticultural Science and the International Society for Humor Studies! The following list is our first attempt to make some order out of chaos. Web links are provided for further information. We invite readers to help us complete this list.

AARINENA	Association of Agricultural Research Institutions in the Near East and North Africa [www.aarinena.org]
ABH	Associação Brasileira de Horticultura (Brazilian Horticultural Association) [www.abhorticultura.com.br]
ABS	Access and Benefit Sharing [brought upon by CBD and IT-PGRFA]
ACDI (CIDA)	Agence Canadienne de Développement International (Canadian International Development Agency) [www.acdi-cida.gc.ca]
ACIAR	Australian Centre for International Agricultural Research [www.aciar.gov.au]
ACSS	African Crop Science Society
ADB	Asian Development Bank [www.adb.org]
AfDB	African Development Bank [www.afdb.org]
AFSTA	African Seed Trade Association [www.afsta.org]
AGRA	Alliance for a Green Revolution in Africa [www.agra-alliance.org]
AGRICORD	Agri-Agencies for Cooperation in Development [www.agricord.org]
AHS	American Horticultural Society [www.ahs.org]
AIPH	International Association of Horticultural Producers [www.aiph.org]
ALAP	Asociación Latinoamericana de la Papa (Latin American Potato Association) [www.papalatina.org]
ALVA	Arbeitsgemeinschaft für Lebensmittel-, Veterinär- und Agrarwesen (Association of Food, Veterinary Science and Agriculture) – Austria [www.alva.at]
AMITOM	Association Méditerranéenne Internationale de la Tomate (Mediterranean International Association of the Processing Tomato) [www.amitom.com]
APA	African Potato Association
	Asian Potato Association
APAARI	Asia-Pacific Association of Agricultural Research Institutions [www.apaari.org]
APH	Associação Portuguesa de Horticultura (Portuguese Horticultural Association) [www.aphorticultura.pt]
APS	American Phytopathological Society [www.apsnet.org]
	American Pomological Society [www.americanpomological.org]
APSA	Asia Pacific Seed Association [www.apsaseed.org]
ARC	Agricultural Research Council – South Africa [www.arc.agric.za]
	Agricultural Research Center – Egypt [www.arc.sci.eg]
ARS	Agricultural Research Service (USDA) [www.ars.usda.gov]
ASA	American Society of Agronomy [www.agronomy.org]
ASAHO	Asociación Argentina de Horticultura (Horticultural Association of Argentina) [www.asaho.com.ar]
ASARECA	Association for Strengthening Agricultural Research in Eastern and Central Africa [www.asareca.org]
ASHS	American Society for Horticultural Science [www.ashs.org]
ASP	American Society for Plasticulture [www.plasticulture.org]
ASTA	American Seed Trade Association [www.amseed.com]
AU	African Union [www.africa-union.org]
AuSHS	Australian Society of Horticultural Science [www.aushs.org.au]
AVRDC	The World Vegetable Center (previously Asian Vegetable Research and Development Centre) [www.avrdc.org]
AVRDC-RCA	The World Vegetable Center - Regional Center for Africa [www.avrdc.org/rca.html]
BARC	Bangladesh Agricultural Research Council [www.barc.gov.bd]
BeneluxSHS	Benelux Society for Horticultural Science [www.beneluxshs.eu]
BMGF	Bill and Melinda Gates Foundation [www.gatesfoundation.org]
BMZ	Bundesministerium für wirtschaftliche Zusammenarbeit und Entwicklung (Federal Ministry for Economic Cooperation and Development) – Germany [www.bmz.de]
CAAS	Chinese Academy of Agricultural Sciences [www.caas.net.cn/engforcaas/index.htm]
CATIE	Centro Agronómico Tropical de Investigación y Enseñanza [www.catie.ac.cr]
CBD	Convention on Biological Diversity [www.cbd.int]
CBO	Community-Based Organization
CCCP	CGIAR Climate Change Challenge Program [in the making]
CFAR	Center for Applied Research – USA [www.cfar.com]
CGIAR	Consultative Group on International Agricultural Research [www.cgiar.org]
CIAT	Centro Internacional de Agricultura Tropical (International Center for Tropical Agriculture) [www.ciat.cgiar.org]
CIDA	Canadian International Development Agency [www.acdi-cida.gc.ca]
CIFOR	Center for International Forestry Research [www.cifor.cgiar.org]
CIHEAM	Centre International de Hautes Etudes Agronomiques Méditerranéennes (International Centre for Advanced Mediterranean Agronomic Studies) [www.ciheam.org]
CIMMYT	Centro Internacional de Mejoramiento de Maiz y Trigo (International Maize and Wheat Improvement Center) [www.cimmyt.org]

CIP	Centro Internacional de la Papa (International Potato Center) [www.cipotato.org]
CIRAD	Centre de Coopération Internationale en Recherche Agronomique pour le Développement (French Agricultural Research Centre for International Development) [www.cirad.fr]
COA	Council of Agriculture – Taiwan [eng.coa.gov.tw]
COL	Commonwealth of Learning [www.col.org]
COP	Conferences of the Parties (ensuing from any United Nations agreement or treaty)
CORAF (WECARD)	Conseil Ouest et Centre Africain pour la Recherche et le Développement Agricole (West and Central African Council for Agricultural Research and Development) [www.coraf.org]
CORPOICA	Corporación Colombiana de Investigación Agropecuaria (Colombian Corporation for Agricultural Research) [www.corpoica.org.co]
CP	Challenge Program of the CGIAR
CPWF	CGIAR Challenge Program on Water & Food [www.waterandfood.org]
CRI	Crops Research Institute – Ghana [www.cropsresearch.org]
CSHS	Canadian Society for Horticultural Science [www.cshs.ca]
	Chinese Society for Horticultural Science
CSIRO	Commonwealth Scientific and Industrial Research Organization – Australia [www.csiro.au]
CSO	Civil Society Organization
CSSA	Crop Science Society of America [www.crops.org]
CTA	Centre Technique de Coopération Agricole et Rurale (Technical Centre for Agricultural and Rural Cooperation) [www.cta.int]
Danida	Danish International Development Assistance [www.um.dk/en]
DfID	Department for International Development – UK [www.dfid.gov.uk]
DGDC	Directorate-General for Development Cooperation – Belgium [www.dgic.be/en/index.html]
DGG	Deutsche Gartenbauwissenschaftliche Gesellschaft (German Society for Horticultural Science) [www.gartenbauwissenschaft.org]
DGIS	Directorate-General for International Cooperation – The Netherlands [www.minbuza.nl/en/home]
EAPR	European Association for Potato Research [www.eapr.net]
EARI	Ethiopian Agricultural Research Institute [www.eiar.gov.et]
EFARD	European Forum on Agricultural Research for Development [www.efard.org]
EIARD	European Initiative for Agricultural Research for Development [www.eiard.org]
EMBRAPA	Empresa Brasileira de Pesquisa Agropecuária (Brazilian Agricultural Research Corporation) [www.embrapa.br]
EU	European Union
EUCARPIA	European Association for Research on Plant Breeding [www.eucarpia.org]
FAO	Food and Agriculture Organization of the United Nations [www.fao.org]
FARA	Forum for Agricultural Research in Africa [www.fara-africa.org]
FORAGRO	Foro de las Américas para la Investigación y Desarrollo Tecnológico Agropecuario (Forum for the Americas on Agricultural Research and Technology Development) [www.iica.int/foragro]
FONTAGRO	Fondo Regional de Tecnología Agropecuaria (Regional Fund for Agricultural Technology) – Latin America and the Caribbean [www.fontagro.org]
GCDT	Global Crop Diversity Trust [www.croptrust.org]
GCP	CGIAR Generation Challenge Program [www.generationcp.org]
GESET	Genetically-Enhanced Seed-Embedded Technology
GFAR	Global Forum on Agricultural Research [www.egfar.org]
GHA	Global Horticulture Assessment
GHI	Global Horticulture Initiative [www.globalhort.org]
GTZ	Gemeinsamschat für Tropische Zusammenarbeit (German Tropical Cooperation Agency)
HarvestPlus	CGIAR Challenge Program for Breeding Crops for Better Nutrition [www.harvestplus.org]
HAK	Horticultural Association of Kenya [www.geocities.com/hak.2006]
HSHS	Hellenic Society for Horticultural Science
HORTAX	Horticultural Taxonomy Group [www.hortax.org.uk]
Horticulture CRSP	Horticulture Collaborative Research Support Program [in the making]
HORTIVAR	Horticulture Cultivars Performance Database [www.fao.org/hortivar/index.jsp]
IAASTD	International Assessment of Agricultural Knowledge, Science and Technology for Development [www.agassessment.org]
IABMS	International Association of Botanical and Mycological Societies [http://lsb380.plbio.lsu.edu/IABMS/IABMS.home.html]
IAPB	International Association of Plant Biotechnology [www.danforthcenter.org/iapb-stl]
IAPPS	International Association for the Plant Protection Sciences [www.plantprotection.org]
IAR4D	International Agricultural Research-For-Development
IBRD	International Bank for Reconstruction and Development [better known by its most popular name as The World Bank; www.worldbank.org]
IAR	Institute for Agricultural Research – Samaru, Nigeria
IAR&T	Institute of Agricultural Research and Training – Moor-Plantation, Ibadan, Nigeria
ICAR	Indian Council of Agricultural Research [www.icar.org.in]
ICARDA	International Center for Agricultural Research in the Dry Areas [www.icarda.org]
ICBA	International Center for Biosaline Agriculture [www.biosaline.org]
ICDF	International Cooperation and Development Fund [www.icdf.org.tw/english]
ICIPE	International Centre of Insect Physiology and Ecology [www.icipe.org]
ICMAP	International Council for Medicinal and Aromatic Plants [www.icmap.org]
ICRA	International Cultivar Registration Authority
ICRAF	World Agroforestry Centre [www.worldagroforestrycentre.org]

ICRISAT	International Crops Research Institute for the Semi-Arid Tropics [www.icrisat.org]
ICUC	International Centre for Underutilised Crops [www.icuc-iwmi.org]
IDB [BID]	Inter-American Development Bank [www.iadb.org]
IFAD	International Fund for Agricultural Development [www.ifad.org]
IFAP	International Federation of Agricultural Producers [www.ifap.org]
IFDC	International Center for Soil Fertility and Agricultural Development [www.ifdc.org]
IFPRI	International Food Policy Research Institute [www.ifpri.org]
IIAM	Instituto de Investigação Agrária de Moçambique [www.iiam.minag.org.mz]
IICA	Inter-American Institute for Cooperation on Agriculture [www.iica.int]
IITA	International Institute of Tropical Agriculture [www.iita.org]
INERA	Institut National pour l'Etude et la Recherche Agronomique (National Institute for Agricultural Study and Research) – D.R. Congo
INH	Institut National d'Horticulture (National Institute of Horticulture) – France [www.inh.fr/pages/accueil.htm]
INIA	Instituto de Investigaciones Agropecuarias (Institute of Agricultural Research) – Chile [www.inia.cl]
	Instituto Nacional de Innovación Agraria (National Institute of Agricultural Research) – Peru [www.inia.gob.pe]
	Instituto Nacional de Investigación Agropecuaria (National Institute of Agricultural Research) – Uruguay [www.inia.org.uy]
	Instituto Nacional de Investigaciones Agrícolas (National Institute of Agricultural Research) – Venezuela [www.inia.gob.ve]
	Instituto Nacional de Investigación y Tecnología Agraria y Alimentaria (National Institute of Agricultural and Food Research and Technology) – Spain [www.inia.es]
INIAP	Instituto Nacional de Investigação Agrária e das Pescas (National Institute for Agricultural and Fisheries Research) – Portugal [www.iniap.min-agricultura.pt]
INIBAP	International Network for the Improvement of Banana and Plantain – today included under Bioversity International [bananas.bioversityinternational.org]
INIFAP	Instituto Nacional de Investigaciones Forestales, Agrícolas y Pecuarias – Mexico (National Institute of Forestry, Agricultural and Animal Research) [www.inifap.gob.mx]
INRA	Institut National de la Recherche Agronomique (National Institute of Agronomic Research) – France [www.inra.fr]
INTA	Instituto Nacional de Tecnología Agropecuaria (National Institute of Agricultural Technology) – Argentina [www.inta.gov.ar]
IoH	Institute of Horticulture – UK [www.horticulture.org.uk]
IPGRI	Former acronym of today's Bioversity International [www.bioversityinternational.org] – also known before by its old acronym IBPGR when at FAO
IPPS	International Plant Propagators Society [www.ipps.org]
IPR	Intellectual Property Rights
IPS	International Peat Society [www.peatsociety.fi]
IRAD	Institute of Agricultural Research for Development – Cameroon [www.irad-cameroon.org]
IRAZ	Institut de Recherches Agronomique et Zootechnique (Institute of Agronomic and Zootechnic Research of the Economic Community of the Countries of the Great Lakes (CEPGL), which includes Burundi, Democratic Republic of Congo and Rwanda)
IRD	Institut de Recherche pour le Développement (Research Institute for Development) – France [www.ird.fr]
IRRI	International Rice Research Institute [www.irri.org]
ISABU	Institute of Agronomic Sciences of Burundi
ISAR	Institut des Sciences Agronomiques du Rwanda (Institute of Agricultural Sciences of Rwanda)
	Institut Sénégalais de Recherche Agricole (Institute of Agricultural Research of Senegal)
ISC	International Society of Citriculture [www.lal.ufl.edu/societies/ISC/index.htm]
ISHS	International Society for Horticultural Science [www.ishs.org]
ISMS	International Society for Mushroom Science [www.isms.biz]
ISOFAR	International Society of Organic Agriculture Research [www.isofar.org]
ISSS	International Society for Seed Science [www.usd.edu/isss]
IT-PGRFA	International Treaty on Plant Genetic Resources for Food and Agriculture [www.planttreaty.org]
IUBS	International Union for Biological Science [www.iubs.org]
JIC	John Innes Centre [www.jic.ac.uk]
JICA	Japan International Cooperation Agency [www.jica.go.jp]
JIRCAS	Japan International Research Center for Agricultural Sciences [ss.jircas.affrc.go.jp]
JSHS	Japanese Society for Horticultural Science [www.jshs.jp]
KARI	Kenya Agricultural Research Institute [www.kari.org]
KSHS	Korean Society for Horticultural Science [www.horticulture.or.kr]
KULeuven	Katholieke Universiteit Leuven (Catholic University of Leuven) – Belgium [www.kuleuven.ac.be]
KVL	Danish acronym of the former Royal Veterinary and Agricultural University; today's Faculty of Life Science at the University of Copenhagen [www.life.ku.dk]
MARDI	Malaysian Agricultural Research and Development Institute [www.mardi.my]
MoU	Memorandum of Understanding
MTA	Material Transfer Agreement
MTP	Medium-Term Plans (CGIAR monitoring and evaluation tool that includes project logframes)
NARC	Nepal Agricultural Research Council [www.narc.org.np]
NARES	National Agricultural Research and Extension Systems
NARI	National Agricultural Research Institute – Spanish acronym: INIA
	National Agricultural Research Institute – Papua New Guinea [www.nari.org.pg]
NARO	National Agricultural Research Organization – Uganda [www.naro.go.ug]
NARS	National Agricultural Research System – Spanish acronym: SNIA

NASGA	North American Strawberry Growers Association [www.nasga.org]
NEPAD	New Partnership for Africa's Development [www.nepad.org]
NGO	Non Governmental Organization
NIAB	National Institute of Agricultural Botany [www.niab.com]
NIHORT	National Horticultural Research Institute – Ibadan, Nigeria [nihort.org]
NJF	Nordic Association of Agricultural Scientists [www.njf.nu]
NORAD	Norwegian Agency for Development Cooperation [www.norad.no]
NRI	Natural Resources Institute – UK [www.nri.org]
NR International	Natural Resources International Ltd. [www.nrinternational.co.uk]
NRM	Natural Resources Management
NZIAHS	New Zealand Institute of Agricultural and Horticultural Science [www.agscience.org.nz]
Oasis	A New Global Agricultural R4D Parnership against Dryland Degradation and Desertification [www.oasisglobal.net]
PAA	Potato Association of America [www.umaine.edu/paa]
PARC	Pakistan Agricultural Research Council [www.parc.gov.pk]
PRI	Plant Resource International, Wageningen UR – The Netherlands [www.pri.wur.nl]
PROSEA	Plant Resources of South-East Asia [proseanet.org/pro-sea]
PROTA	Plant Resources of Tropical Africa [www.prota.org]
PSHS	Pakistan Society of Horticultural Sciences [www.pshs.org.pk]
	Polish Society for Horticultural Science [ptno.ogr.ar.krakow.pl]
R4D	Research-For-Development
RHS	Royal Horticultural Society – UK [www.rhs.org.uk]
SAA	Sasakawa Africa Association [www.saa-tokyo.org]
SADC	Southern African Development Community [www.sadc.int]
SADC-FANR	Southern African Development Community – Food, Agriculture and Natural Resources Directorate [www.sadc.int/english/fanr/fanr_about/index.php]
SASHS	Southern African Society for Horticultural Sciences [www.sashs.co.za]
SBFPO	Sociedade Brasileira de Floricultura e Plantas Ornamentais (Brazilian Society for Floriculture and Ornamental Plants) [www.sbfpo.com.br]
SCCH	Sociedad Colombiana de Ciencias Hortícolas (Colombian Society for Horticultural Science) [www.soccolhort.com]
SCI	Society of Chemical Industry [beta.soci.org]
SDC	Swiss Agency for Development and Cooperation [www.sdc.admin.ch]
SECH	Sociedad Española de Ciencias Hortícolas (Spanish Society for Horticultural Science) [www.sech.info]
SIDA	Swedish International Development Cooperation Agency [www.sida.se]
SIST	Système d'Information Scientifique et Technique (Scientific and Technical Information System)
SIUPA	Strategic Initiative on Urban and Peri-urban Agriculture – known today as Urban Harvest [www.cipotato.org/urbanharvest]
SLU	Sveriges lantbruksuniversitet (Swedish University of Agricultural Sciences) [www.slu.se]
SNHF	Société Nationale d'Horticulture de France (National Society for Horticulture in France) [www.snhf.asso.fr]
SOI	Società di Ortoflorofrutticoltura Italiana (Italian Horticultural Society) [www.soihs.it]
SMTA	Standard Material Transfer Agreement of the multilateral system of the IT-PGRFA
SSA-CP	FARA-led CGIAR Sub-Saharan Africa Challenge Program
SSAS	Saudi Society of Agricultural Science
SSHS	Singapore Society for Horticultural Science
SSSA	Soil Science Society of America [www.soils.org]
TARO	Tanzania Agricultural Research Organization
TFNet	International Tropical Fruits Network [www.itfnet.org]
TRIPS	Trade-Related aspects of Intellectual Property Rights [www.wto.org/english/tratop_e/TRIPS_e/TRIPS_e.htm]
UMB	Universitetet for Miljø- og Biovitenskap (Norwegian University of Life Sciences) [www.umb.no]
UNDP	United Nations Development Programme [www.undp.org]
UNEP	United Nations Environment Programme [www.unep.org]
UNESCO	United Nations Educational, Scientific and Cultural Organization [www.unesco.org]
USAID	United States Agency for International Development [www.usaid.gov]
USDA	United States Department of Agriculture [www.usda.gov]
VEGINET	Vegetable Science International Network [www.pnasf.org/veginetN.htm]
VITAA	Vitamin A for Africa – A Food-Based Approach to Vitamin A Deficiency in Sub-Saharan Africa [www.cipotato.org/vitaa]
WARDA	Africa Rice Center (West Africa Rice Development Association) [www.warda/org]
WFP	United Nations World Food Programme [www.wfp.org]
WHO	World Health Organization of the United Nations [www.who.int]
WOCMAP	World Congress on Medicinal and Aromatic Plants
WTO	World Trade Organization [www.wto.org]
WUR	Wageningen University and Research Centre – The Netherlands [www.wur.nl]

The Future of Irrigation in Horticulture

Elias Fereres

Agriculture is the main user of water worldwide, with about 70% of total water withdrawals, including the water used in livestock and aquaculture production. Water diverted for irrigation is the lion's share of agricultural water use and, in spite of increased demands from other sectors, notably the environment, it is still the primary user of water on the planet. Because of the increasing demands for food production caused by population growth and by the diet changes of emerging countries such as China, it is anticipated that irrigation water demand will continue to increase in the foreseeable future, albeit at a slower rate than that experienced in past decades. Such prediction is cause of concern in many urban circles, where irrigation is perceived as inefficient and unsustainable. The recent increase in basic food prices and the (transitory) use of biofuels, are two new developments that will contribute to further irrigation expansion, adding more pressure to the fixed and scarce water supplies in many world areas.

It is not easy to quantify the total world irrigated area; the estimates of 250-280 million ha that are often quoted from international organizations such as FAO or the International Commission of Irrigation and Drainage (ICID), contrast with the figures obtained in a recent remote sensing study by the International Water Management Institute (IWMI; Thenkabail et al., 2006). The total area equipped for irrigation exceeded 400 million ha, while more than 485 million ha were detected in 2000 as irrigated lands, including the double cropping areas. Although the methodologies used may have errors and the area compiled included informal irrigation, this discrepancy suggests that there are more irrigated lands than those officially reported by the water authorities of many countries. That is a symptom of uncontrolled irrigation expansion that creates even more pressure on the scarce water resources, and that may be an important source of conflicts in the future. China and India represent more than half of the world total irrigated area, and more than 60% is irrigated only from surface sources, while less than 20% depends exclusively on groundwater.

It should be stated at the outset that irrigation in many semi-arid and in the arid areas is not sustainable in the long run. All irrigation waters contain salts and the evaporation process from the plants and the soil concentrate the salts in the profile. Salt leaching through appropriate drainage networks is therefore needed to avoid soil salinization, and it has been provided in most but not all of the irrigation networks. The new threat to the sustainability of irrigation is that the disposal of the drainage waters, once considered matter of fact, has now become a very serious environmental problem. Return flows from irrigated lands contain not only salts, but sediments, nutrients and pesticides, all having a negative impact on aquatic ecosystems. In a few cases, the water authorities have forbidden the discharge of drainage from irrigated areas, threatening their sustainability. Reducing or minimizing the pollution from irrigation return flows is a challenge that must be addressed by the irrigation community worldwide, which has to internalize the costs of pollution and no longer can ignore the negative impact of irrigation on the environment.

Drip irrigation in an apple orchard.

The high water demand from irrigation and its environmental impact must be weighed against the large increases in crop productivity obtained when the water constraint to crop production is removed by irrigation. Crop yields increase two to three times relative to those obtained under rain fed conditions; thus, the contribution of irrigated lands to world food security is essential and would be more so in the future. We must therefore find ways to make irrigation more efficient and more sustainable than it has been in the past, in situations where the rate of irrigation expansion must slow down, and when the investments in irrigation and drainage are also on the decline. Many are the challenges faced by irrigated agriculture, including the modernization of irrigation networks and management, the improvement of water institutions, and the responses to periodic droughts. If the focus is on irrigation of the horticultural sector, two major changes have occurred in recent years that have contributed significantly to industry expansion and to the improvement of productivity. One is the development of groundwater for irrigation, and the other is the introduction of new water saving technologies in horticulture.

In addition to the large expansion of groundwater use for irrigation of the main cereal crops in many Asian countries after the launching of the green revolution, groundwater development at many scales has been the primary source for irrigation supply of horticultural

crops in both developed and developing countries. The low development and energy costs (until now), and the flexibility in use that groundwater offers relative to the rigid supply in the collective irrigation networks, are key factors that favor the use of groundwater in horticultural irrigation. The two major limitations of many collective networks are the seasonality of supply that limits duration of the irrigation season and thus raising off-season crops, and the rotational delivery that sometimes allows for the development of water deficits between two irrigations, a negative factor given the high sensitivity to water stress of many horticultural crops. Groundwater supply for irrigation has thus been an important source for horticultural crops and has been used rather efficiently, as energy costs are an incentive for water conservation. At the same time, the degree of control that farmers have over irrigation has been important to achieve the recent increases in production and in quality. Nevertheless, the expansion of groundwater use has led to overexploitation in many world areas, and this represents a threat to the sustainability of irrigation. In coastal areas where the climate is favorable for horticultural production and where groundwater development has reached its limits, the risks of sea water intrusion represent a major threat to the industry. The water table decline due to overexploitation has increased the pumping costs at a time when the energy costs are soaring. Water quality degradation is often associated to groundwater overdraft. All of these problems indicate that sustainable groundwater use has reached its limits or even has been exceeded in many areas, and that wise use of the resource is needed to match the demand to the supply available.

Microirrigation.

Irrigation has been carried out by surface water application for thousands of years. The development of innovative irrigation methods took place early in the second half of the 20th Century, but their expansion and widespread adoption is much more recent. First, sprinkler irrigation followed by microirrigation have caused a revolution in the water application techniques in horticulture. In particular, drip irrigation is now the most common method in the irrigation of fruit trees and vines worldwide. While reliable statistics are lacking, it is estimated that microirrigation is used today in more than 7 million ha worldwide, while thirty five years ago it was used in less than 0.1 million ha. One important, recent development is the production of low-cost, low pressure drip systems for use by small farmers in the developing countries, where microirrigation, now more affordable, is expanding rapidly for horticultural production. The adoption of fertigation, and the more recent introduction of subsurface drip systems offer additional options for more efficient nutrient and water use. The expansion of microirrigation has been so rapid that in some countries, such as Israel or Spain, it is now the most widespread irrigation method. The high frequency of application in these permanent irrigation systems offers the additional advantage of avoiding plant water deficits even in marginal soils of very low water holding capacity. The advances in automation allow the application of water even in pulses every few hours if needed, at no additional cost.

The engineering advances described above increase the precision of irrigation to levels that have not been sufficiently exploited in horticulture. The knowledge of the crop water needs and of its responses to water is not as complete yet, and the lack of sufficient research in this area generates significant uncertainties in the water management of many horticultural crops. Farmers then tend to be conservative and to be on the safe side in terms of amounts of applied water. Recent and future advances in crop water status monitoring should permit future improvements in precision irrigation, by

Greenhouse landscape in Southeast Spain.

Soilless vegetable production with recycled water.

combining very uniform water application with the accurate determination of water needs. In situations where water scarcity is becoming the norm rather than the exception, improving irrigation efficiency would not be sufficient though, simply because water supply would not be enough. In such cases, the use of deficit irrigation strategies is the only viable alternative to sustain irrigated production, particularly in drought years. In particular, regulated deficit irrigation (RDI) offers promise in fruit trees and vines as a practice that can maintain farmers' income while using less water. Research has developed RDI strategies for some of the main fruit tree crops but there is still a need to extend the results, and to evaluate the long term effects of RDI. Another development in terms of water use is the greenhouse production of vegetables in semi-arid regions, using soilless culture. If drainage waters are regenerated and recycled, the water requirements of those production systems are very low as compared to outdoor vegetable production systems in the same climate (less than 30%). The limits of low water consumption in agriculture may be explored with those systems, where ventilation and thus evaporative loss may be reduced to a minimum (depending on plant protection needs) and even the collection of transpirational water may not be ruled out in the future.

In the future, water conservation and efficient water use in irrigation will be critical in face of competing demands from other users. The trend already observed of shifting scarce water resources towards irrigation of high-value crops will increase, providing horticulture with much needed water supplies. The consumption of large amounts of water by crops is unavoidable because it is dictated by the evaporative demand of the environment, and is tightly associated with biomass production and yield. Increases in biomass production per unit water transpired during the next 10-20 years will be small, despite promises from biotechnology. Where water supplies are adequate, the main opportunity to increase water-use efficiency resides in closing the gap between actual and potential yields. In cases of insufficient water supply, deficit irrigation will be a viable alternative. For both situations, vigorous research and extension programs are prerequisites for achieving the goals of making horticultural irrigation more productive and sustainable.

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The Pomegranate: New Interest in an Ancient Fruit

Doron Holland and Irit Bar-Ya'akov

Pomegranate (*Punica granatum* L., Punicaceae) is an ancient, highly praised plant and fruit. Pomegranate culture and its usages are deeply embedded in human history and utilization is found in many ancient human cultures as food and as a medical remedy. Despite this fact, pomegranate culture has always been restricted and generally considered as a minor crop. In recent years pomegranates are increasingly recognized as attractive fruit trees that provide a good combination of tasty and appealing fruit appearance, highly valued health beneficial ingredients and a wide range of usages for the fruit and its products. Pomegranate fruit can be consumed as a fresh whole fruit, juice, juice concentrates, ready to use extracted fresh arils, dried arils, wine, cosmetical and pharmaceutical products and oils. Recent medical research indicates that pomegranate fruit has a wide range of important medical activities such as protection against cardiovascular diseases, anticancer and antimicrobial activities. These recent findings combined with public demand for healthy fruit resulted in a pronounced increase of pomegranate fruit consumption in the western world including countries that traditionally did not consume pomegranate fruit.

POMEGRANATE DISTRIBUTION AND WORLD PRODUCTION

Wild pomegranates are growing today in central Asia from Iran and Turkmenistan to Northern India. Pomegranate is considered as native to these regions. The ability of pomegranate trees to adjust to variable climatic conditions is reflected in the wide distribution. Culture of pomegranate began in prehistoric times. It is estimated that pomegranate domestication initiated somewhere in the Neolithic Era. The optimal climatic growth conditions for pomegranate exist in Mediterranean like climates. These include high exposure to sunlight, mild winters with minimal temperatures not lower than -12°C and dry hot summers without rain during the last stages of the fruit development (Levin, 2006). Under such conditions the fruit will develop to its best size and optimal color and sugar accumulation without the danger of splitting. Commercial orchards of pomegranate trees are now grown in the Mediterranean basin (North Africa, Egypt, Israel, Syria, Lebanon, Turkey, Greece, Cyprus, Italy, France, Spain, Portugal), and in Asia (Iran, Iraq, India, China, Afghanistan, Bangladesh, Myanmar, Vietnam, Thailand, in the former USSR republics: Kazakhstan, Turkmenistan, Tajikistan, Kirgizstan, Armenia and Georgia). In the New World, pomegranates are grown in the U.S.A., Mexico, Argentina and Chile. Although there is no updated, accurate and direct data on pomegranate growth in the world due to the rapid increase in its production and growth, the current total annual world production of pomegranates is estimated to be around 1.5 million tonnes and the four larger producers of pomegranates are Iran, India, China and the U.S.A. (Table 1).

NEW DEVELOPMENTS IN POMEGRANATE CULTURE

The developing market and the consequent increase in world production are associated with development of new technologies in fruit processing, fruit storage, agricultural management and horticultural aspects. Some of the new technologies include the development of industrial methods to mechanically extract intact arils in an efficient way and in large quantities, extension of the pomegranate fruit storage period for up to four months, development of new growing methods that produce high yield crop of more than 40 t/ha in successive years, development of new cultivars with high fruit quality and longer production season and development of irrigation methods that enable the usage of recycled water. The new achievements enable growers to produce high quality fruit throughout a longer period of time for growth in regions that previously were not suitable for pomegranate culture. Development of optimal dripping irrigation methods together with usage of recycled water make it now possible to grow high yielding pomegranate water loving trees in arid regions that except for water shortage, are otherwise highly suitable for pomegranate cultivation (Fig. 1 and 2A). Most of the large commercial orchards in Israel, India, and the U.S.A. utilize drip irrigation methods. In certain experiments done in India and in Iran, drip irrigation saves up to 66% of water compared to surface irrigation (Chopade et al., 2001). Some growers prefer to use sprinklers but those cause difficulties in weed control. In view of the global warming phenomenon and the increasing water shortage experienced in many arid and semi-arid regions that are the

Table 1. Estimated world pomegranate production and export based on research done by Yael Kachel, Department of Market Research, Israeli Ministry of Agriculture.

Country	Planted area (ha)	Production (t)	Export (t)
Iran	65,000	600,000	60,000
India	54,750	500,000	22,000
China	Unknown	260,000	Unknown
U.S.A.	6,070	110,000	17,000
Turkey	7,600	90,000	Unknown
Spain	2,400	37,000	14,000
Tunisia	2,600	25,000	2,000
Israel	1,500	17,000	4,000
Other[1]	Unknown	Unknown	Unknown

[1] Egypt, Morocco, Chile, Argentina, Australia

Figure 1. Pomegranate orchard in the hot arid Arava region of Israel: A. Spring flower. B. Dormant trees during winter.

Figure 2. Pomegranate culture: A. Six months old pomegranate orchard in the Arava region in Israel irrigated with salted water and planted on plastic mulch. B. High density breeding pomegranate orchard. Seedlings are planted 1 m x 4.5 m and drip fertigated by a buried irrigation system. C. Pomegranate in high tunnels.

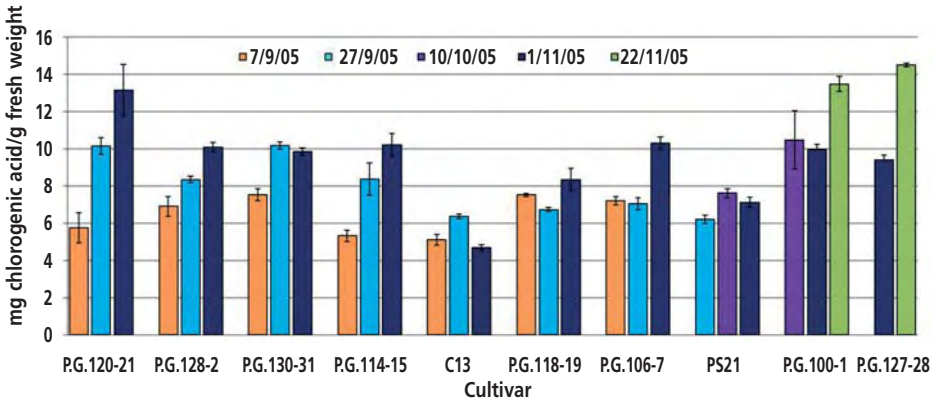
Figure 3. Mechanical extraction of arils.

most suitable regions for pomegranate growth, water availability and irrigation are of major consideration in pomegranate culture. Therefore much more effort will be required to develop optimal and computer-aided effective irrigation methods that will be suitable for pomegranate growth. The increased knowledge on how to control pomegranate pests and diseases enables growers to plant orchards in regions that suffer from high infestation of pests and diseases such as the Mediterranean fruit fly *Ceratitis capitata* (Tephritidae: Dacinae) and the pomegranate butterfly *Virachola livia* (Lepidoptera: Lycaenidae). The development of mechanical disruption techniques allows for the production of more than a tonne of arils per day and enables the development of new products such as ready to use extracted arils that were not marketed as such before (Fig. 3). The longer period of pomegranate storage and the development of new technologies offer a much higher marketing flexibility for pomegranate producers and extend the range of markets through all over the world. New storage technology (modified atmosphere packaging) that involves the usage of special bags (Xtend®) that have small pores (microperforation) (Porat et al., 2006; Sachs et al., 2006) was developed. These bags result in the development of 5% CO_2 and 12% to 14% O_2 within the bag surrounding the fruit. The Xtend® packaging reduces weight loss from 7% to 3.5%, reduces scald from 38% to 21% and reduces crown decay when pomegranate fruit were stored at 6°C for 16 weeks. Using either the Xtend® packaging technique described above, or CA conditions of 2% O_2 + 3% CO_2 at 6°C permitted storage of pomegranate fruit for 4 to 5 months with acceptable commercial quality.

HEALTH BENEFITS AND MEDICAL IMPORTANCE

Perhaps the aspect that contributed the most to the increased demand of pomegranates all over the world is the renewed interest in its health promoting effects. Traditional usage of pomegranate was already practiced in many human cultures. Recent modern scientific work strengthens the status of pomegranate fruit as an important medicinal fruit that contains valuable medically active compounds. Modern chemical analysis of bioactive phytochemicals produced by the pomegranate tree is just in its beginning. Potentially active phytochemicals found in pomegranates include sterols and terpenoids in the seeds, bark and leaves, alkaloids in the bark and leaves, fatty acids and triglycerides in seed oil, simple gallyol derivatives in the leaves, organic acids in the juice, flavonols in the rind, fruit, bark and leaves, anthocyanins

Figure 4. Differences in antioxidant activity among pomegranate cultivars and picking dates grown in Newe Ya'ar Research Center, 2005. Antioxidant activity was measured by DPPH (2,2-diphenylpicrydrazyl) scavenging activity defined as mg chlorogenic acid per gram fresh weight. Different picking dates are shown in different colors.



and anthocyanidins in the juice and rind and catechin and procyanidins in rind and juice. The level of these compounds in the pomegranate tree may change during the development of the tree, during fruit maturation, under different environmental and cultivation conditions and between pomegranate cultivars (Fig. 4). A large variation among pomegranate cultivars with respect to the level of polyphenols, antioxidative activity, and the corresponding content of phytochemicals such as elagic acid, galagic acid, punicalin and punicalagin have been demonstrated. Potential disease targets of pomegranate compounds include coronary heart diseases, cancer (skin, breast, prostate and colon), inflammation, hyperlipidemia, diabetes, cardiac disorders, hypoxia, ischemia, aging, brain disorders and AIDS (Seeram et al., 2006). The recent encouraging experimental medical data suggesting that consumption of pomegranate juice may have a potential effect on reduction of the progression of prostate cancer and on reduction of risks associated with cardiovascular diseases sparked a dramatic increase of scientific and public interest in pomegranates. This in turn resulted in large increase of consumption of the pomegranate fruit.

POMEGRANATE CULTIVARS

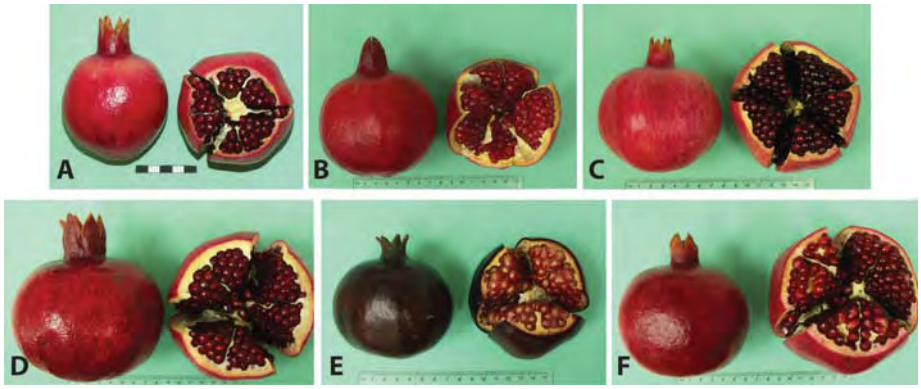
Pomegranate cultivars are grown in very divergent regions around the globe and their features are widely divergent. Most probably some of the different names of pomegranate cultivars correspond to the same or similar cultivar or a landrace of a particular cultivar. Some of the commonly used cultivars include: 'Wonderful' (U.S.A., Israel), 'Rosh Hapered' and 'Acco' (Israel), 'Mollar de Elche' (Spain), 'Bagua' (India), 'Hicanzar' (Turkey), 'Manafaluty' (Egypt) and Iranian late cultivars. 'Wonderful' is a late cultivar with sweet sour taste, large size fruit and an appealing appearance. The 'Wonderful' cultivar is stored very well for long periods and is highly prized in many countries. In Israel several 'Wonderful' types have been characterized and

Figure 5. Differences of skin color accumulation among 'Wonderful' pomegranate types. P.G.100-1 (upper box) and 'Kamel' (lower box) a month before ripening. The outer skin color of 'Kamel' is full red while P.G.100-1 is mostly green with a slight red blush.

Table 2. Fruit characteristics of different pomegranate accessions grown in Newe Ya'ar.

Accession number	Common name	Ripening time	Fruit size	Taste	Peel color	Aril color	Aril size	Peel thickness	Seed hardness
P.G.100-1	Wonderful	Late	Large	Sour sweet	Red	Dark red	Mid.-large	Thin	Medium
P.G.101-2	Wonderful	Late	Large	Sour sweet	Red	Dark red	Mid.-large	Thin	Medium
P.G.105-6	No common name	Middle	Large	Sweet	Strong red	Dark red	Very large	Medium	Hard
P.G.106-7	Malisi	Middle	Medium	Sweet	Pink yellow	Light pink	Very large	Medium	Very soft
P.G.107-8	Shami	Middle	Medium	Sweet	Dark pink	Pink	Medium	Medium	Soft
P.G.116-17	No common name	Late	Large	Sour	Dark red	Dark red	Mid.-large	Medium	Soft
P.G.118-19	Hershkovich	Middle	Large	Sour sweet	Dark red	Dark red	Large	Medium	Soft
P.G.119-20	Rosh Hapered	Early	Large	Sweet	Dark pink	Pink	Large	Thick	Medium
P.G.124-25	Rosh Hapered	Early	Medium	Sweet	Dark pink	Light pink	Mid.-large	Very thin	Very soft
P.G.127-28	Black	Very late	Small	Sweet	Black	Pink red	Medium	Thin	Soft
P.G.128-29	Acco	Early	Medium	Sweet	Red	Dark red	Medium	Medium	Soft
P.G.130-31	Shani-Yonay	Early	Medium	Sweet	Red	Dark red	Medium	Thin	Soft
P.G.131-32	No common name	Early	Medium	Sour sweet	Bordeaux	White red	Medium	Medium	Soft
P.G.134-35	Kamel	Late	Large	Sour sweet	Bordeaux	Red	Mid.-large	Medium	Hard
P.G.135-36	No common name	Late	Large	Sour sweet	Red	Red	Mid.-large	Thick	Medium
P.G.136-37	Za'ati	Very late	Large	Sour	Pink	Pink	Large	Medium	Very hard

Figure 6. Pomegranate cultivars: A 'Acco', early; B. 'Emek', early; C. 'Shani Yonay', early; D. 'Kamel', dark red, late; E. 'Black', dark, late; F. (no common name), dark, late.



shown to be differing from each other with respect to skin and aril color (Fig. 5 and 6D), time of ripening and some other minor fruit characteristics. 'Wonderful' is the mainly produced cultivar today in countries such as the U.S.A. and Israel and is among the main important pomegranate cultivars in the European and American markets. The Indian evergreen cultivar 'Bagua' is produced in India throughout the entire year but its fruit qualities particularly with respect to skin color are changed in the different seasons. This is a sweet and relatively small cultivar with a strong red skin and aril color. 'Mollar' and 'Rosh Hapered' are general names for a series of cultivars with similar features that slightly diverge from each other and are characterized by sweet sour less taste, pink color and large fruit. Recently several cultivars were introduced to commercial growth in Israel that have an appealing taste and color and precede the time of ripening of 'Wonderful' by about a month (Table 2, Fig. 6). These cultivars together with cultivars such as 'Bagua' are very important for extending the production season and enable much higher flexibility with respect to fruit picking and supply to the markets. Examples for such cultivars are 'Emek', 'Shani-Yonay' and 'Acco'. They are characterized by red skin and aril color, early ripening time and soft seeds. The latest cultivar in Israel today is 'Black', the black cultivar P.G.127-28 characterized by dark skin color, dark pink arils, sweet taste and soft seeds (Fig. 6).

FUTURE PROSPECTS

Despite of the advance in pomegranate production and processing technologies much is still needed to be studied in order to exploit pomegranates and develop this field to its full potential. Perhaps the most challenging of all will be the production of high quality fruit with attractive appearance that will contain relatively high content of healthy ingredients, free of fungicides and pesticides. Such purposes could be achieved more efficiently, by application of modern research technologies to pomegranate research. One of the most challenging aspects of such research is the development of new pomegranate cultivars. There are many cultivars today that are attractive to the consumer and grower. However, cultivars that combine most of the desired features including good taste and color, high content of anti cancer and antioxidant compounds and resistance to major pests and diseases are rare. Modern methods in molecular genetics such as molecular mapping, marker assisted selection (MAS) and biological mutagenesis were not yet applied to pomegranate research. Only few genes from pomegranates were isolated and identified and no Expressed Sequence Tags (ESTs) or other genetic databases were established. *Agrobacterium* mediated genetic transformation of pomegranate was recently reported by Terakami et al. (2007). Pomegranate cultivars developed through genetic engineering are not expected in the near future. This is due to severe restrictions on commercial usage of genetically modified plants and because transformation systems have not been developed for commercially important cultivars. However, the development of transformation system in 'Nana' is expected to be useful as a model system to study genetic manipulation of pomegranate, in identifying important pomegranate genes for future exploitation and for deciphering the function of genes in pomegranates. The full potential of natural variation in pomegranates is not yet fully exploited and the list of available cultivars that could serve as potential parental lines in breeding programs is not yet available and perhaps not yet identified and selected from their natural environments.

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Giant Pumpkins: Genetic and Cultural Breakthroughs

Jules Janick

The increasing record size of pumpkin has become an intriguing phenomenon over the past 150 years. The recent listing of winners in the *Guinness World Records* has provided incentive for hundreds of passionate growers worldwide to compete for financial rewards in prizes, returns on the sale of seed, and fame in the world of horticulture. A number of grower organizations are involved and the rules are wide open; nothing is prohibited except adding external weights, although there are careful regulations that require precision for the weighing procedure while rotting pumpkins are disqualified. Competition has become intense and in many ways the phenomenon is similar to sporting events involving racing animals (horses, dogs, camels, and humans) in which industries have been created and sums are wagered (Hill and Bünger, 2004). There are a number of other contests involving plants, e.g. fruit size (tomato, apple, lemon), plant size (sunflower, rose, amaranth), or crop performance (yield of maize and wheat), but none have caught the attention of the public as pumpkin fruit size. Competitors in the strange world of pumpkin size have been growers and plant fanciers with little interest shown up to now by the scientific community. The spectacular results being achieved have all been by empirical means suggesting that advanced degrees and science often take a backdoor to ingenuity achieved by ordinary folk.

HISTORY OF THE CONTEST

Interest in large pumpkins derives from exhibits from state agricultural fairs that became an important part of North American rural life in the 19th century. In 1900, William Warnock, a grower in Ontario, Canada received a special bronze medal from the French government for a 400 pound pumpkin exhibited at the Paris World's Fair (Fig. 1) and in 1904 provided tips for growers. Since then, a number of contests have been held regularly in the United States and at present pumpkin organizations include the Great Pumpkin Commonwealth (GPC), The New England Pumpkin Growers Association (NEPGA), and The World Pumpkin Confederation (WPC), whose pumpkin weigh off was established in 1983, along with the Riesenkürbis Forum in Germany, and Giant Vegetable Growers of Ontario, Canada. Although the contests are international, most of the records have been achieved in New England located in the northeastern United States, where competition is fierce. The 2007 record (Fig. 2) is an astounding 1689 pounds (766.3 kg). The giant pumpkins have led to bizarre spinoffs including pumpkin cannons and pumpkin boat races (Fig. 3).

Figure 1. William Warnock with his 403 pound Mammoth Giant Pumpkin and his medal from the French Exposition Universelle of 1900 (Connolly, 2006).

GENETIC MATERIAL

A number of cucurbit species have large fruit size including *Cucurbita pepo* and *Cucurbita maxima*. The contest now is centered on round orange or grey fruits of *C. maxima,* which has long been known to produce the largest fruit in the plant kingdom. The giant round orange phenotypes of *C. maxima* appear to be in a narrow gene pool out of 'Atlantic Giant' (oblong phenotypes are called 'Dill's Atlantic Giant' developed by William Dill, a Canadian from Nova Scotia, Canada). It is likely that the 'Atlantic Giant' and related huge show pumpkins trace their origin to the cultivar 'Mammoth,' recorded in the seed trade as far back as 1834 (Tapley et al., 1937). There has been continuous selection for size over a century with no evidence that the gains in record fruit weight, in absolute terms, are slowing down (Fig. 4). In fact, the 2007 record pumpkin exceeded the previous winner by 187 pounds. This large positive trend is suggestive of significant genetic change along with advances in cultivation techniques although definitive tests of trials with older germplasm have not been made. As the competition has increased, breeding and selection efforts have taken place with increasingly large sums paid for seeds of record winners (the record appears to be US$850 for a single seed). Breeding systems have been empirical but recently pedigrees have been established for contest winners, similar to those found in horse racing.

CULTURAL PRACTICES

The cultural practices used to achieve fruit size include a number of standard practices in horticulture including improving soil tilth, good nutrition, pruning and fruit thinning, pest control, and season extension by using plastic covers in the spring (Langevin, 2003). Appropriate light and temperature is usually achieved by selection of locations favoring long days, cool nights, and warm sunny days without temperature extremes. Thus, there is clearly a latitude effect in record pumpkin size. There have been attempts to use misting to control day temperature, application of growth regulators, grafting to increase the number of root systems, and there are references to feeding of milk in the popular literature (my favorite is the chapter entitled Summer-Time in the classic 1933 book *Farmer Boy* by Laura Ingalls Wilder).

Figure 2. World record giant pumpkin, 2007 grown by Joe Jutras of North Scituate, Rhode Island, USA.

Figure 3. Race of the pumpkin boats. Courtesy of Wayne Hackney.

Recent record results suggest that a combination of improved culture and genetic change is responsible for the enormous increases in fruit size in giant pumpkin.

As the contest progressed there were a number of goals that seemed unachievable but each has been surpassed with ease. The first goal was the 500 pound (187 kg) pumpkin, quickly followed by 1000 pound (373 kg) and 1500 pound (560 kg). The 2007 record yield of 1689 pounds points to a new goal of 2000 pounds (746 kg) and clearly the international scale of the conference will make 1000 kilos (2204 pounds) the goal in the near future.

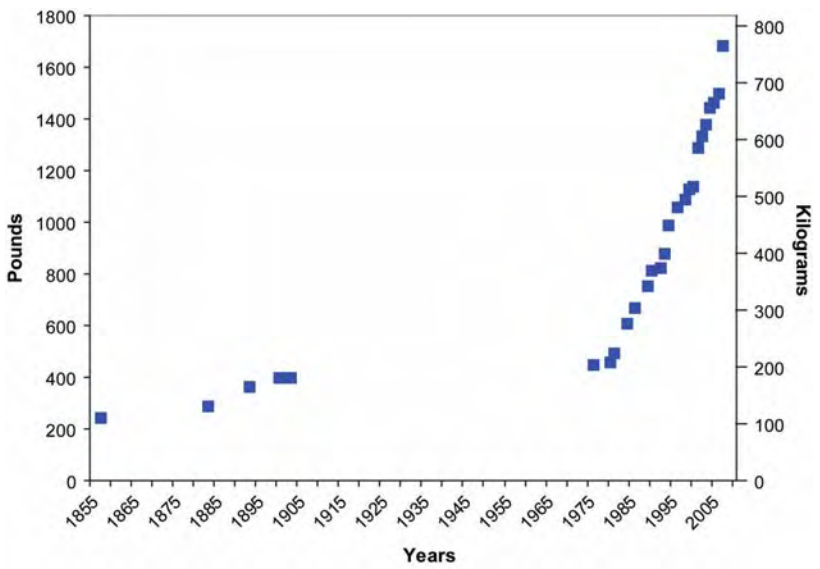
THE PHYSIOLOGY AND GENETICS OF FRUIT SIZE

The accumulation of fruit size is a combination of physiology, environment, and genetics. The water content of pumpkin is about 88% and may be as high as 91 to 94% in giant pumpkins (Culpepper and Moon, 1945). The fruit acts as a physiological sink and the combination of cell size and cell number determines final fruit size. In large-fruited pumpkin as compared to fruits of smaller cucurbits there is a more extended period of cell division and greater cells expansion after cell division ceases (Sinnott, 1939). In the larger show pumpkins the period from seeding to harvest is about 130 to 140 days while the period from pollination to harvest is about 60 to 80 days but the major growth phase is considerably shorter and must be under genetic control. As a practical matter, since pumpkin is grown outdoors there is a seasonal limit in temperate climates. The growth of fruit is under negative genetic control, thus in small fruited species a gene that stops fruit growth was first identified as *fw 2-2* in tomato and cloned (Liu et al., 2003). Mutations in this gene result in continuous fruit growth. Interesting enough, the physiology of fruit growth in pumpkin has not been extensively studied in relation to cell number and cell expansion. It is unclear when cell division ceases in *C. maxima* fruits or how large each cell can be. Weight estimates made in intervals throughout the season indicate that maximum daily gains can reach 50 pounds (18.7 kg) per day, as compared to about 3.5 pounds (1.3 kg) per day fresh weight with cattle.

SCIENTIFIC QUESTIONS

The success achieved in increasing the growth of pumpkin fruit is a challenge to horticultural science that has been ignored. An obvious question would be to determine the upper limit of fruit size; another would be to apportion the genetic, environmental, and physiological limits. Perhaps, there is no obvious limit and it might very well be possible to continually expand fruit growth if fruit senescence could be deferred or eliminated and increased cell number could be continued indefinitely. Clearly, answers to these questions are being approached empirically by nonacademic horticulturists, and it is time for the academic community to get involved. Someone has accused academics in the agricultural arena of merely proving that the practices achieved by the best growers are correct. I suggest the academic and scientific community cooperate on this engaging problem for the delight of the public everywhere.

Figure 4. World records of pumpkin fruit weight, 1857 to 2007.



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Opium Poppy: Societal Blessing and Curse

Giuliano Finetto

Opium poppy (*Papaver somniferum*, Papaveraceae) is one of the earliest and most famous of cultivated plants (Fig. 1). The products of the plant are widely used for a number of useful products including pharmaceuticals such as morphine and codeine, seed for glazing and fillings of bakery products, oil for cooking, paints, varnishes, and soaps, and as an ornamental (Tétényi, 1997). The alkaloids are of special importance for a broad spectrum of medicinal uses including the alleviation of acute pain and cough suppression. The plant was known to the ancient Greeks for its sleep inducing effect, hence the name "somniferum"; the narcotic effects were attributed to the god Hypnos who personified sleep and dreams. Despite the many valued uses for poppy, the widespread illegal use of opium in the drug culture has long been a societal scourge and the illegal cultivation of opium must be considered as a part of the dark side of horticulture.

Figure 1. Poppy plant (*Papaver somniferum*). Source: Natural History Museum of London.

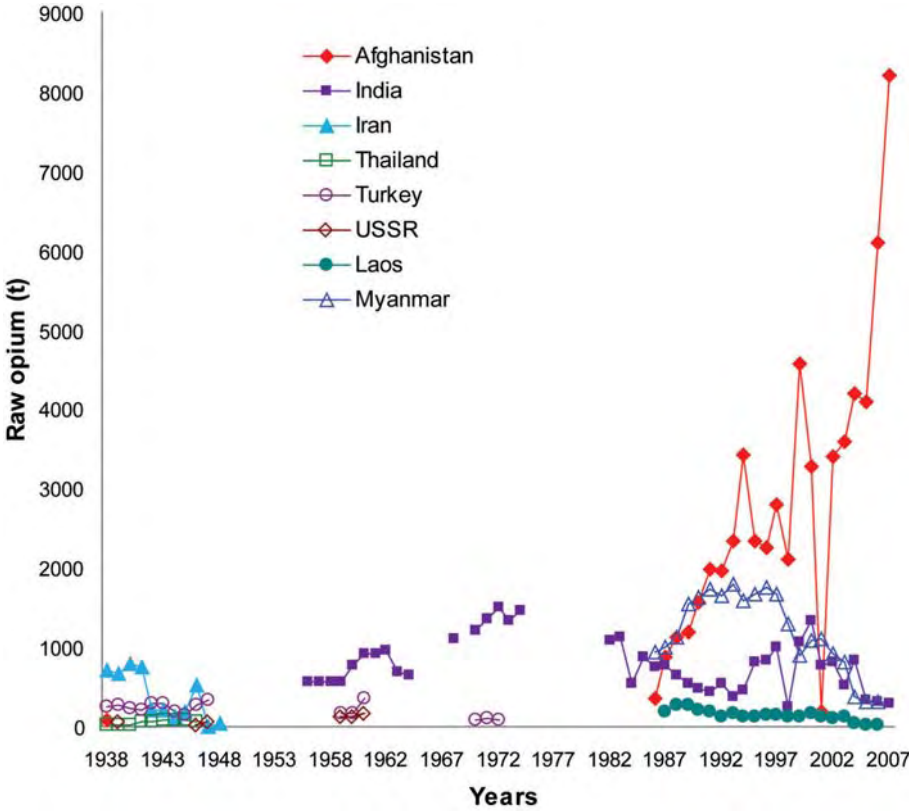
OPIUM PRODUCTION

Afghanistan, presently producing about 93% of the world's poppy crop, is the major source of illegal opium paste used in the manufacture of heroin (Fig. 2) (Finetto, 2005). Fifty years ago, India, Turkey and Iran were the main opium producers and their farmers developed sophisticated agricultural strategy for growing the plants and extracting the latex produced by injuring the capsule and collecting the exudate. Since 1970, as a result of the application of international law on the control of drugs and narcotics, farmers in these countries have been induced to eliminate illegal cultivation based upon government programs to obtain sustainable alternative programs. However, poppy production moved to Southeast Asia (Myanmar, Laos, Thailand) and Afghanistan. From the 1980s, opium production markedly increased, especially in Myanmar and Afghanistan, and from 1990 onward, Afghanistan has become the leading source of opium paste. While production declined during the Taliban hegemony, there is now a sharp increase and this war-ravaged country appears to be rapidly developing into a narco-state. At present Myanmar and India produce only 300 tonnes (t) as compared to over 8000 t for Afghanistan. India and Turkey, traditional producers, still produce licit opium either in traditional ways or from whole plant extraction (poppy straw) defined as *"all parts of the poppy after mowing except the seed, from which narcotics can be extracted"* (United Nations Opium Conference, 1953).

In the late 1930s, India and Iran production averaged about 25-30 kg/ha of crude opium (adjusted to 30% moisture). However at present, the official average yield in Iran is now said to be around 6 kg/ha suggesting that substantial amounts are not reaching the government. In Turkey, the yield of opium supposedly varies anywhere from 1-16 kg/ha, and the average is about 10, but 20 to 50 kg of opium is the figure given in Turkish agricultural research papers. In Afghanistan, yields are high (42.5 kg/ha as the national average). The potential opium production in Afghanistan for 2007 was 8,200 t, representing an increase of around 34% as compared to 2006.

The 1953 United Nations Opium Conference Protocol (which is still in effect) for limiting and regulating the cultivation of the opium poppy plants, asserts that Bulgaria, Greece, India, Iran, Turkey, the U.S.S.R. and Yugoslavia are the only countries that may legally produce opium for export. However, countries other than these might grow poppy for purposes other than the production of opium, exclusively for seed or oil; Bulgaria, Romania, Japan, Pakistan cultivate

Figure 2. Raw opium production, 1938-1974 and raw opium (licit and illicit) and straw poppy production around the world from 1983-2007 (Data from International Narcotics Control Board-INCB and UNODC).



mainly for seed but also produce amounts of opium for experimentation and for part of their domestic medical needs as well. The only country where substantial amounts of licit opium is now produced for export is India (Table 1), which for all practical purposes has a monopoly on the licit opium destined for international trade.

The demand for natural alkaloids that are obtained from the opium poppy plant (morphine, codeine and thebaine) continues to increase. Global consumption of morphine for the treatment of severe pain also continues to increase. Approximately 80% of the morphine and 93% of the thebaine manufactured worldwide were obtained from poppy straw, while the rest was obtained from opium. Australia, France, Hungary, Spain and Turkey have been the main producer countries, together accounting for over 90% of the world production of poppy straw and of concentrate of poppy straw (a product obtained in the process of extracting alkaloids from poppy straw). In 2005, manufacture of both morphine (401 t) and thebaine (118 t) reached record levels. Manufacture of codeine, which is mainly obtained from morphine through a semi-synthetic process, also reached an all time high of 309 t. Codeine (an opiate used to treat mild to moderate pain, as a cough suppressant and to treat diarrhoea) continues to be the most commonly consumed narcotic drug in the world, in terms of doses and the number of countries where it is consumed. Its use follows a slight upward trend. Both morphine and codeine are used in therapy as well as for conversion into other opioids. Thebaine is not itself used in therapy, but is an important starting material for the manufacture of a number of opioids.

Table 1. The production of licit opium and opiates from poppy straw during 2004-2007 (Narcotic Drugs Report 2007).

Country	Production (t)			
	2004	2005	2006	2007 (estimated)
Opium				
China	15	13	12	12
India	832	332	318	289
North Korea	0.29	0.34	0.34	0.34
Japan	0.003	0.003	0.002	0.003
Poppy straw concentrate				
Australia	124	116	93	Not available
France	56	53	59	Not available
Spain	36	32	54	Not available
Turkey	57	71	85	Not available

ORIGIN AND ECOLOGY

Opium poppy, unknown as a wild plant, is now generally regarded as having originated through cultivation from a Mediterranean species. The truly wild plant (var. *setigerum*) is found on the northern coast of the Mediterranean. It has toothed leaves, the lobes sharp-pointed, each ending in a bristle. The flower stalks and sepals are covered with scattered bristled hairs with 7 or 8 stigmas. *Papaver somniferum* has three varieties: *P. somniferum* var. *nigrum*, a wild form of the opium poppy with purple-red flowers, roundish oblong capsules; *P. somniferum* var. *album*, a wild form with white flowers, roundish ovate capsules; and *P. somniferum* var. *abnormale*, with small red flowers, streaked with dull green and roundish to oblong capsules.

Opium poppy lends itself to cultivation in a broad range of agroclimates but morphine content of opium can vary by a factor of 5 depending on environmental factors. Maximum yields of opium require the right amount of moisture at the appropriate point in its growing cycle, and high temperatures after the plant has flowered. Frost can completely destroy the young plant if the fields are not covered with snow. During harvest, highest yields are obtained on clear, sunny days. Heavy spring rain can result in the development of fungi that constrain production and rain at the flowering stage can reduce the morphine content of the latex. Too much water, or too little, during sowing, germination, rapid vegetative growth, flowering and harvest causes fluctuations in productivity. Although opium poppy is relatively more drought resistant than wheat and other grain crops, drought is detrimental. Irrigation is critical during the period of rapid vegetative growth from the appearance of the stem through capsule development, but excess water in this state leads to disease. Excessive rains during harvest wash away the latex and reduce opium quality. Strong winds can uproot the plant and topple plants when capsules are mature. Although opium poppy lends itself to cultivation in a broad range of soil types poppy does best in

sandy or loamy black soils with pH 6 or more; heavy clay or waterlogged soils are unsuitable.

CULTIVATION

In all countries poppy is grown in small plots. In India the size of a poppy field varies from 0.01 to 10 ha. These same fields are often utilized for food crops during that part of the year when poppy is not cultivated. On rare occasion, a field might be allowed to lie fallow before the sowing of poppy seed. The land is elaborately prepared so as to render it smooth, otherwise the seeds are lost during sowing. In India and Afghanistan field preparation begins in late September; in Iran land preparation extends up to November.

In Turkey, poppy is produced with "heavy" use of manure and/or chemical fertilizers. Many Turkish farmers grow tobacco on the same land after the poppy harvest. In Southeast Asia, poppy is cultivated on inter-mountain plateaus and steep mountain slopes where it is difficult to grow rice, the main staple. Opium poppy is sown in different fields in late August at the earliest to November, usually an alternation with maize.

Sowing

In India the seeds are mixed with soil or sand before broadcasting, to enable a better distribution of the small seeds. About 8 kg of seeds are planted per hectare. The field is then re-plowed or harrowed so as to bury the seed and is then usually divided into squares of 2 to 3 m, leaving an interval that is raised about 15 cm and a channel is excavated on these ridges to convey water to every square from a well near the field.

In Western Turkey, fields are hand-seeded by the broadcast method in October. About 1 kg of seed is used per hectare; sometimes the seeds are mixed with sand or ashes in a ratio of about 1 part seed to 4-5 parts dry earth or sand. As much as 25-30 kg of seed per hectare are used if the land is not properly prepared. An improved practice is to plant seed in rows some 60 cm apart, and to thin them to about 25 cm between plants. Another light plowing covers the seeds with a few centimeters of soil, and then an additional final harrowing is carried out.

In Iran, Afghanistan, and China, seeds are broadcast from September to November. In Turkey, seeds are broadcast from October to January. The first sowing is usually done from September to mid-November; the second from December to January and the third sometime between late February and March to mid-April. These staggered sowings help to avoid crop failure but only provide about two weeks difference in capsule maturation time or harvest. Early sowing is generally thought to yield the best crop; autumn planting is carried out in some 60-70% of the opium poppy growing districts; and in late sowing, seeds start to germinate and emerge by mid-November. Irrigation is necessary if there is no rain at the time of sowing.

In Thailand, the opium poppy is generally sown mixed with seeds such as lettuce, parsley, bean, and mustard, and covered up lightly by gentle raking with the fingers. The cultivation and care of these plants is meticulous. In India, Iran and Turkey, young poppy plants that are thinned are eaten in salads and used as potherbs.

Germination

Temperature and moisture are the main factors influencing germination. In India, germination takes place some 5 to 20 days after sowing, depending on soil moisture. Since the poppy does not readily tolerate transplanting, the young plantlets are thinned to about 25-30 cm apart when they are approximately 7 to 14 days old. In Iran, about six weeks after sowing, plants are thinned to about 15 to 22 cm apart. Plants are irrigated in March every 7-10 days and then irrigation is reduced to prevent overgrowth.

In Turkey germination lasts from 2-3 weeks, and plants have about four leaves by December. Stalks begin to form 2 weeks later. Snow before the first frost protects the young plants from the cold and results in an excellent crop. Freezes before a snowfall risk crop losses and farmers will have to plant again in March or April. Morphine content of spring sown crops is much lower than that of fall-sown crops. Plants are thinned to about 15 plants/m^2.

Flowering

In India, plants are waist high and begin to flower 90 to 100 days after sowing (or 75 to 80 days after germination). Flowering is at its peak in Uttar Pradesh the first weeks of March. Capsules are ready for lancing 10-14 days after petal fall. In Iran and Turkey, capsules are generally ready for incision at the beginning of June. Some Turkish farmers thin out smaller capsules. A field of flowering poppy in Afghanistan is shown in Fig. 3.

Lancing

Lancing is the incision of opium capsules during harvest using a sharp instrument, causing the opium latex to ooze out of the capsule (Fig. 4), which is later scraped and collected. The lancing operation requires efforts of the entire family. In some districts, very young children are generally not allowed into the fields during incision time because the fumes are so heavy and intense that a sort of "narcosis" can be induced if there is insufficient wind to dissipate the vapors. Precautions are also taken to keep homes closed during this period.

After years of experience, farmers can identify the optimum time of lancing with cues based on yellowing of the older leaves, capsule elasticity (it has to be firm and the color "just right"), and the appearance of the stigmatic rays. The appearance of a black line at the torus (the former point of attachment of the floral leaves to the stem) due to the oxidation of exuded latex is another clue that the capsules are ready for incision.

The time of incision is critical, for if the capsule is lanced too soon, the latex will drip onto the soil; if too late, the latex will have decreased levels of morphine. It is critical that no rainfall occurs for a week before incision of the capsules, otherwise latex flow will be minimal. Lancing is usually done either in the morning or evening. If capsules are incised in the morning, latex collection is done late in the evening of the same day. If the cutting is done around sunset, the latex is collected early the next morning. In

Figure 3. Poppy field in Afghanistan.

Figure 4. Lanced poppy pods showing the oozing of raw opium resin.

elevated locations where the climate is mild, incisions are often made after sunset.

The depth of the incision is important; if the incisions are too deep, the latex is exuded to the interior of the capsule and lost and the maturation of the seeds ceases. This means that appropriate yields of oil cannot be obtained. If the cut is too shallow, latex yield will be low. The latex, which exudes immediately upon cutting, is initially milky in appearance and accumulates on the outer wall of the capsule. Although the latex is initially white or slightly pinkish in appearance, it quickly darkens. Ordinarily 1 or 2 days lapse before a second lancing.

In India the farmers begin at the edge of the field and work backwards in order to avoid contact with the exuding latex. The hand is quickly passed over a capsule and a subjective decision is made as to whether it is ready for incision. The lancing instrument, called a *nashtar*, is a homemade gadget comprised of four tines about the dimension of ordinary needles spaced a few millimeters apart or so and affixed to a holder some 18 cm long. About 150 to 200 capsules can be lanced per hour by an experienced worker. The lancing process is ordinarily repeated twice, making a total of three series of vertical incisions.

In Iran, incision is either vertical from top to bottom or diagonal with an instrument having three or four blades, called *agasch*. It is carried out in the late afternoon towards sunset, and the latex is collected the next morning.

In Turkey, masks are used to prevent inhalation of excessive vapors. The scalpel-like knife called a *lizgi bicag* has a small prong protruding about 1.5 mm from the edge of the curved blade. In eastern Anatolia, a knife having three parallel blades is used with diagonal gashes but a circumferential cut is the most common method. In some areas the circumferential cut is prolonged spirally to beyond the starting point. Turkish farmers incise the capsule a single time and thus handle a head once. The Turkish method yields an opium with a higher morphine content, but latex yield per hectare is lower as compared to India.

In Afghanistan capsules were traditionally lanced diagonally with a three-pronged blade and the number of lancings varied from 3 to 6 depending on location. At present, three vertical lancings are performed with an instrument similar to that used in Iran.

In Thailand the Yao tribe carries out up to three vertical lancing operations that yield about 25 kg/ha. The Miao usually perform only one or two lancing operations.

In China, capsule lancing was either horizontal, perpendicular, or transverse. Ordinarily, the incisions were made with a tool comprised of three or four small parallel blades in a short wooden handle, so arranged as to leave the tips exposed only far enough to effect a cut of the proper depth.

Scraping and Collection

Scraping (Fig. 3) is arduous because the capsules have to be handled individually. The latex thus collected is transferred to a pot. The scraping is carried out by grasping the capsule between the thumb and forefinger of the left hand and inclining it gently; the scraper is then drawn upwards. The crude latex generally is collected directly into a small copper or earthen bowl by means of a blunt bladed instrument or trowel (called a *seetoah* in India, an *algi biqa'g* in Turkey) usually carried on the collector's belt. Those instruments scrape the capsule exudate without injuring the wall. In Iran the crude latex is then manipulated with a special spatula-like instrument called a *hassur* and air dried on wooden boards to the desired consistency. In China the exuded latex is collected with flat bamboo strips and placed in containers fashioned out of bamboo cross-sections.

Cultivars

In India (Uttar Pradesh), as well as in Iran, all of the opium poppy currently cultivated is of the white flowered type called 'Teyleah' or 'Telia', 'Haraina', 'Sufaid-danthi' or 'Katha Bhabutia', 'Kutila', 'Katila' or 'Kotila', 'Choura Kutila', 'Kaladanthi', 'Kalidanthi Baunia', 'Monoria', and 'Dheri-Danthi'. These have the advantage of producing only a few capsules per plant and high content of morphine, which narrows the harvest period and thus minimizes the need to "back track" in the lancing operation. In the Iranian high-plateau area around Isfahan a crimson-flowered form is cultivated.

Afghan types have white flowers with purple or deep red lunulae, and speckles instead of a spot. These types have a short vegetative period. In 2007, cultivars preferred by most farmers were 'Watani Soorgula' (27%), 'Sebi' (15%) and 'Bahrami Soorgulai' (12%). A morphological description of cultivars is shown in Table 2.

In Southwest Asia, the Yao plant three kinds of poppy. Flowers are white or purple-red.

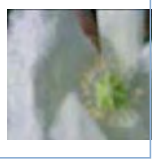
Diseases and Pests

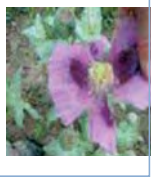
Opium poppy is affected by a number of diseases and pests. John Scott's *Manual of Opium Husbandry* (1877) is still the basic source of information on diseases. Fungal diseases include opium blight or so-called "downy" mildew caused by *Peronospora arborescens*; mildew is caused by the ascomycete *Erysiphe polygon*; fruit and leaf spots are caused by *Entyloma fuscum* (Ustilaginales); while *Verticillium* and *Fusarium* species, *Dendryphion penicillatum*, and *Pleospora calvescens*, the perfect stage of *Helminthosporium papaveris*, cause serious disease problems.

Weevils and cutworms (*Agrotis suffusa*), which attack young seedlings, are another problem. *Heliothis armigera* feeds on the young leaves of poppy plantlets. As the poppy grows and matures, the insect eats its way up the stem and ultimately bores its way into the poppy head and proceeds to destroy the capsule. The cricket *Gryllotalpa vulgaris*, a root feeder, causes damage. Parasitic angiosperms, such as *Orobanche aegyptiaca* "broom rape", attack roots and are a problem in India and Afghanistan.

Even after the latex is successfully collected and processed, there is the problem of further contamination with fungi such as *Scopulartopsis brevicaulis* var. *glabra, Aspergillus niger, A. repens, A. flavus, A. wentii, A. ostianus, Fusarium solani, Penicilium* species, *Oospora* species. Although the morphine content of the opium is not greatly affected by these fungi, the general quality and attractiveness deteriorates.

Table 2. Morphological description of opium poppy varieties in Afghanistan from UNODC (2007).

Cultivar	Occurrence (% area covered)	Flower colour	No. sepals	No. petals	Plant height (cm)	Capsule description (height x diam., cm)	No. of stigmatic rays	Ripening	No. incisions, opium quality	
Papaver somniferum cv. Persian White	Nangarhar (10)	White	2	4	125-130	5.5x19.5, no/small longitudinal waves	10-13, standing	Early	3-4, high opium, high water content	
Papaver somniferum cv. Album	Nangarhar (20)	White	2	4	110-115	6x17, no/small longitudinal waves	10-14, creeping	Late	3-4, high opium, high water content	
Papaver somniferum cv. Danish Flag (early variety)	Nangarhar (60)	Red, white blotches on the base	2	4	110-115	6.5x16, longitudinal waves	11-13, standing	Early	6-9, high opium, low water content	
Papaver somniferum cv. Danish Flag (late variety)	Nangarhar (10)	Whitish-red, white blotches on the base	2	4	120-130	6x17.5, more longitudinal waves	10-15, smooth	Late	6-9, high fresh opium	
Papaver somniferum cv. Persian Blue	Nangarhar (negligible)	Purple, black black blotches on the base	2	4	100-110	4x9, more longitudinal waves	9-10, standing	Early	1-3, low latex and low opium	
Papaver somniferum cv. Danish Flag	Hilmand, Kandahar (60)	Pink, blotches on the base	2	4	120-122	6x17.5, more longitudinal waves	12-13, standing	Late	7-8, high opium, high water content	
Papaver somniferum cv. Laciniatum (single-flowered)	Hilmand, Kandahar (20)	Deep red margins, pink bases	2	4	118-122	6x5.5, no/small longitudinal waves	11-14, creeping	Late	5-6, high opium, high water content	
Papaver somniferum cv. Laciniatum (late-maturing, single-flowered)	Hilmand, Kandahar (20)	Pink margins, white bases	2	4	118-122	6x6.5, no/small longitudinal waves	11-14, creeping	Late	5-6, high opium, high water content	
Papaver somniferum cv. Gigantean (Shawano or Baronial)	Hilmand, Kandahar (20)	Deep pink or rose margins, white bases	2	4	125-128	6.5x7, smooth	11-14, creeping	Early	6-8, high opium, high water content	
Papaver somniferum cv. Danish Flag (early ripening)	Balkh (30)	Red, white blotches on the base	2	4	130-135	5.5x19.5, no/small longitudinal waves	10-14, standing	Early	6-8, high opium, low water content	
Papaver somniferum cv. Danish Flag	Balkh (20)	Pink, white blotches on	2	4	120-125	6x17.5, no/small longitudinal waves	10-13, standing	Late	7-10, high water content	
Papaver somniferum cv. Album (classified)	Balkh (30)	White	2	4	125-130	5.5x19.5, no/small longitudinal waves	2-12, standing	Early	3-4, high opium, high water content	

Papaver somniferum cv. Danish Flag (early ripening)	Badakhshan (25)	Red, white blotches on the base	2	4	115-120	6x19, no/small longitudinal waves	10-14, standing or smooth	Early	7-10, high opium, low water content	
Papaver somniferum cv. Danish Flag	Badakhshan (30)	Pink, white blotches on the base	2	4	125-130	6x17.5, no/small longitudinal waves	11-14, standing	Late	8-13, high opium, high water content	
Papaver somniferum cv. Persian White	Badakhshan (30)	White	2	4	125-130	5x16.5, no/small longitudinal waves	12-16, standing or smooth	Late	4-5, high opium, high water content	
Papaver somniferum cv. Hungarian Blue	Badakhshan (25)	Purple	2	4	110-115	7x15.5, longer and smoother than the other varieties	12-16, standing first purplish, later becoming green	Late	2-3, low opium, low water content	
Papaver somniferum cv. Danish Flag (early ripening)	Badakhshan (30)	Red, white blotches on the base	2	4	80-100	5x15.5, no/small longitudinal waves	10-14, standing or smooth	Early	4-5, high opium, low water content	
Papaver somniferum cv. Danish Flag (Jalalabady with pink flowers)	Badakhshan (25)	Pink, white blotches on the base	2	4	100-105	6x17.5, no/small longitudinal waves	11-14, standing	Late	7-8, high opium, high water content	
Papaver somniferum cv. Persian White	Badakhshan (20)	White	2	4	100-108	5x16.5, no/small longitudinal waves	12-16, standing or smooth	Late	4-5, high opium, high water content	
Papaver somniferum cv. Hungarian Blue	Badakhshan (25)	Purple	2	4	110-115	7x15.5, longer and smoother than the other varieties	12-16, standing, first purplish, later becoming green	Late	2-3, low opium, low water content	
Papaver somniferum cv. Persian Blue	Badakhshan (30)	Purple, dark blotches on the base	2	4	110-115	4x9.5, longer and smoother than the other varieties	9-12, standing, first purplish, later becoming green	Late	1-2, low opium, low water content	

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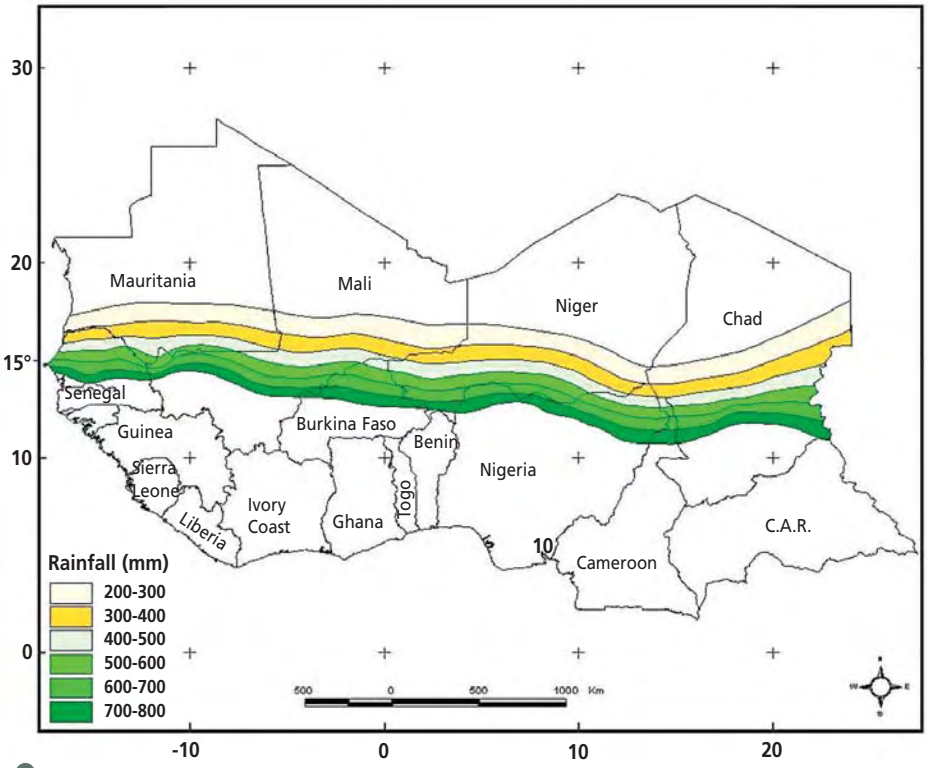
Fruit Trees for the Sudano-Sahel Region of West Africa

A. Nikiema, D. Pasternak, D. Fatondji, D. Senbeto, J. Ndjeunga, L. Woltering and S. Abdoussalam

Along with urbanization, fruit consumption is likely to increase in many developing countries. Agricultural programs in semi-arid Africa as in other developing countries should adapt to this trend of consumer demand. Research institutes should also follow by developing quality material and facilitating its multiplication and sharing.

Fruit trees can be incorporated into rain-fed or irrigated production systems and therefore contribute to income generation for poor farmers. Fruits have an important role in balancing human nutrition. Domesticated indigenous trees can play very important ecological and economic roles. Processed fruit in the form of dry fruit or fruit juices can become a major source of export revenue to the countries of Africa's Semi-Arid Tropics (SAT). The comprehensive research for development activities carried out by The International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) is revealing the potential of fruit trees to transform the current cereal based low-value agricultural system of Africa's SAT into a sustainable, income generating activity.

ICRISAT regional nursery at Sadore.



Rainfall map of the Sudano Sahel region.

BACKGROUND

The Consultative Group on International Agricultural Research (CGIAR) Science Council recently recommended the use of fruit trees as a means for reducing poverty in Africa through agricultural diversification and emerging opportunities for high value commodities and products. In semi-arid West Africa, countries such as Burkina Faso, Mali and Senegal are paying increasing attention to fruit production because of its important contribution to food security and income generation for rural farmers. Annual production of fruits in each of these countries ranges from 20,000 to 80,000 tons (FAOSTAT, 2006). In some countries export earning from fruits has been multiplied by a factor of 3 in the last 5 years (World Bank, 2007).

Despite the lack of reliable data on fruit consumption in the region, it is expected that along with urbanization, the development of fruit production will increase as it happened in other regions of the world such as India (ISHS, 2005; Dar, 2007). Rural farmers should be the first to benefit from this opportunity.

Mango grafting at ICRISAT nursery.

ICRISAT activities on fruit trees that focus on facilitating sharing of germplasm and building capacity on propagation and nursery management are a unique contribution to the improvement of food security and income generation in the rural areas of semi-arid regions of West Africa. Most fruit trees and other high value plants can be combined with the annual staple crop production thus allowing farmers to increase overall field production and productivity.

In the past many semi-arid countries in West Africa have attempted to develop fruit production (mostly mango and citrus) without great success because of many constraints linked with this sector including the availability of quality and adapted germplasm, insufficient propagation capacity and facilities, inadequate pest and disease management capacities, poor irrigation management, poor postharvest handling capacity (packaging, storage and transport), and poor market access. ICRISAT Sahelian Center (ISC) in Niamey (Niger) is currently contributing to solving the first two constraints by establishing mother plantations for a range of species and cultivars and operating a regional plant nursery.

Since 2001, ISC adopted a program on systems and crop diversification. This program aims at increasing income generation of poor farmers from both dryland and irrigated agriculture, increasing export opportunities, supporting fruit based agro-industries, and improving the nutritional status of the local population. This program promotes planting of fruit trees and other high value trees in the farmlands. ICRISAT work in the Sudano-Sahel region resulted so far in: (1) collection of cultivars and provenances and maintenance of mother plantation on station; (2) establishment and operation of plant propagation facilities; (3) well trained nursery staff; and (4) the implementation of projects to overcome the arising problems that come along with the promotion of fruit trees in semi-arid West Africa.

COLLECTION, PROPAGATION AND SHARING OF FRUIT PLANTS

Sadore Fruit Trees Mother Plantation

The availability of a reliable source of quality material for propagation remains a bottleneck for promoting fruit trees in semi-arid West Africa. Many of the collections established in Guinea, Mali, Senegal and Cameroon between 1947 and 1962 were made of mango cultivars (Rey et al., 2004) but other fruit plants such as *Tamarindus indica* and *Ziziphus mauritiana* were neglected.

These early collections have been lost or were poorly maintained. Within the framework of its crop diversification program and as a means to give a base for the development of fruit production for the semi-arid regions, ISC has established a collection of fruit plants at the Sadore Experimental Station located 45 km south of

Table 1. Fruit plant accessions in ICRISAT Sadore collection located 45 km south of Niamey.

Family	Species	Common name	Cultivars	Processing	Market
Anacardiaceae	*Mangifera indica*	Mango	28	Fresh fruit, dried, juice	Good local, regional and international markets
	Sclerocarya birrea	Marula	3 from the sub-species Caffra	Fresh fruit, liqueur, juice, oil, bio-ethanol	To be explored in West Africa
Annonaceae	*Annona atemoya*	Atemoya	1	Fresh fruit, juice	Potential good regional and international markets
	Annona reticulata		1	Fresh fruit, juice	Potential good regional and international markets
	Lannea microcarpa		1 wild accession	Fresh fruit, juice	Market to be explored
Apocynaceae	*Saba senegalensis*	Saba	7 wild accessions	Fresh fruit, juice	Good local, regional and international markets
Arecaceae	*Phoenix dactlifera*	Date	13	Fresh fruit, dried	Good local, regional and international markets
Caesalpiniaceae	*Tamarindus indica*	Tamarind	5 of sweet tamarind	Dried, juice, sauces	Good local, regional and international markets
Ebenaceae	*Diospyros kaki*	Persimmon	1	Fresh fruit	Potential good regional and international markets
Euphorbiaceae	*Emblica officinalis*	Amla	1	Fresh fruit	To be explored in West Africa
Moraceae	*Ficus carica*	Fig	31	Fresh fruit, dried	Good local, regional and international markets
Punicaceae	*Punica granatum*	Pomegranate	9	Juice, fresh	Potential good regional and international markets
Rhamnaceae	*Ziziphus mauritiana*	Jujube, Ber, Sahel apple	10	Fresh and dried fruit, juice	Potential good local and regional markets
Rutaceae	*Citrus grandis*	Pummelo	2	Fresh fruit, juice	Good local and regional markets
	Citrus tangelo	Tangelo	4	Fresh fruit, juice	Good local and regional markets
	Citrus reticulata	Tangerine	1	Fresh fruit, juice	Good local and regional markets
	Citrus limon	Lemon	3	Fresh fruit, juice	Good local and regional markets
	Citrus chinensis	Orange	3	Fresh fruit, juice	Good local and regional markets
Sapotaceae	*Manilkara zapota*	Sapodilla	4	Fresh fruit	Potential good local and regional markets
Vitaceae	*Vitis vinifera*	Grape	8	Fresh fruit, raisins	Good local, regional and international markets

Niamey. This collection includes not only the well known mango and citrus cultivars but also fruit plants of proven or recognized potential importance for the region e.g. *Ziziphus mauritiana* (jujube), *Ficus carica* (fig), *Vitis vinifera* (grape), *Punica granatum* (pomegranate), *Diospyros kaki* (persimmon), *Tamarindus indica* (tamarind), *Emblica officinalis* (amla), *Sclerocarya birrea* (marula), *Annona atemoya* (atemoya), and others (Table 1).

Regional Nursery and Propagation Facilities

The promotion of fruit tree plantations in many Sub-Saharan African countries is undermined by an inefficient propagation system as well as by lack of good supply of quality plant material for multiplication. Nurseries should have appropriate facilities such as net houses, glasshouses and/or shade and cool areas depending upon the climatic zone.

At ICRISAT Sadore, a nursery complex for plant propagation was established to enable multiplication of the cultivars assembled in the collection and to facilitate sharing of germplasm with nongovernmental organizations (NGOs), National Agricultural Research Institutes and development partners within the region. It also provides an excellent platform for experimenting and for training on fruit tree nursery techniques.

Pomme du Sahel: A. Fruit before ripening. B. Dryland plantation intercropped with watermelons. Note earth bunds for water harvesting. C. Juices and nectars from fruit.

Sweet tamarind from USDA-Florida grafted on local rootstock.

Propagation by cuttings is done in net and glasshouses where humidity and temperature conditions can be improved. In the Sudano-Sahel region rooting rate of cuttings is significantly improved under such conditions. Fruit tree cultivars are usually propagated by grafting, which requires well-trained and skilled nursery workers. A very limited number of nurseries in the region has fulfilled these conditions. ICRISAT training activities on fruit tree propagation techniques that started in 2001 in collaboration with International Program for Arid Land Crops (IPALAC) and other partners such as the US Agency for International Development (USAID), Islamic Development Bank (IDB), The John Paul II Foundation and numerous NGOs are now filling the gap through regional training courses. Around 30 technicians coming from all over West and Central Africa are trained every year. In addition scores of nursery people receive on-the-job training based on requests by various organizations.

FIELD EVALUATION OF FRUIT CULTIVARS AT ISC

Indian Jujube / Pomme du Sahel *(Ziziphus mauritiana)*

Ziziphus mauritiana, Rhamnaceae, is a shrubby plant indigenous to the tropical semi-arid zones of southeast Asia. Its edible fruits are widely consumed in the Sahel where it is known as jujube. Improved cultivars introduced from India to Israel were distributed over West Africa by IPALAC. Five cultivars, 'Gola', 'Umran', 'Kaithely', 'Seb' and 'Ben-Gurion', were included starting in 1997. Five additional cultivars were introduced in 2006. The improved fruits are about 10 times larger than the local fruit and are tastier and juicier. Fruit production of mature trees can be as high as 15 t/ha and could provide a good source of income for farmers (Azam-Ali et al., 2006). Yield data in Sadore (Niger) are encouraging (see Table 2).

Table 2. Fruit production of 5 different cultivars of Ziziphus under irrigated and non-irrigated conditions.

Cultivar	Average tree yield (kg)	
	Drip irrigation 3 years after planting	Rainfed conditions 5 years after planting
Umran	23.6	6.9
BG	24.4	10.4
Gola	23.1	8.3
Kaithely	20.9	10.4
Seb	17.4	8.4
Mean	21.9	8.9
LSD 0.05	7.0	6.4

Tamarind *(Tamarindus indica)*

Tamarind is an indigenous fruit plant of semi-arid Africa, commonly used as food additive in Asia and Africa. The export market is continuously growing because of the huge demand from the juice industries all over the world (El-Siddig et al., 2006). There is an increasing interest in the Sudano-Sahelian countries of West Africa in promoting tamarind plantations for juice production, which is unfortunately undermined by the poor quality of the wild cultivars. The selection and use of improved cultivars is of great priority to support the initiatives in tamarind plantations. ISC in collaboration with the Sahelian Fruits consortium (SAFRUIT), a regional project funded by the

Three-years-old 'Brown Turkey' fig in the mother plantation.

Five-years-old 'Barchi' date loaded with fruits at ICRISAT Sadore.

European Union (EU), has been given the task to collect germplasm, particularly of the sweet cultivars for performance test within semi-arid West Africa. Recently four cultivars of sweet tamarind have been introduced from USDA-Florida.

Fig *(Ficus carica)*

The first fig introduction by ISC was carried out in 2002. 'Brown Turkey', one of 31 introduced cultivars, performed best. In the Sahel figs give the highest yield during the December-March period of the year. This is a good period for exportation of fresh fruit for Europe since Turkey – the main fig exporter – cannot supply these at that time. However the highest potential for figs is for the dried fruit industry. Selection of high yielding quality fig cultivars for drying is being carried out from germplasm provided by USDA-California.

Date *(Phoenix dactylifera)*

Dates are an important fruit for the population of the Sudano-Sahel region. But currently most of the dates consumed in this region are imported from North Africa and from the Emirates. Ecologically date palm is very suitable for production in the hot climate of the Sahel.

The first date palm plantation was established at Sadore in 2002. So far only two leading cultivars ('Barchi' and 'Medjoul') were planted. Performance of 6-years-old date plantation that fruited for the first time is quite impressive under drip irrigation with 72% of the date palms bearing fruits and fruit yield varying from 20-30 kg per plant. A comparative trial of 13 selected cultivars will be established in 2008 under drip irrigation.

Pummelo *(Citrus grandis / C. maxima)*

Pummelo is one of the well performing citrus in the poor sandy soil of Sadore (Niger). It can be easily propagated by grafting and starts bearing fruits 2 years after transplanting under drip irrigation. It is very attractive to farmers because of its sweet taste and the huge fruit load during production period.

DOMESTICATION

Potential and Challenges for Indigenous Fruit Trees

Many indigenous fruit trees are highly valued by farmers who developed local management practices to stimulate production. The efforts made by local farmers to domesticate indigenous fruit trees is usually limited to natural assisted regeneration, and selection based on common desired traits such as fruit taste and size (Boffa, 2000; Maranz and Wiesman, 2003; Ouédraogo, 1995).

The so-called agroforestry parklands are the results of traditional management practices of useful trees in farmlands by local farmers (Nikiema, 2005). Fruit trees commonly found in the parklands of the Sudano-Sahel zone include *Vitellaria paradoxa, Parkia biglobosa, Tamarindus indica, Adansonia digitata, Ziziphus mauritiana,* and *Hyphaenea thebaica*. Most of them have a high socio-economic value either at local and/or regional level, with demonstrated important contribution to income generation for rural farmers, especially for women. Tree crops of the parklands including fruits contribute 20 to 30% of household income in the rural areas (Boffa, 2000).

Traditional tree management systems cover only those indigenous trees considered to be compatible with the local farming system. Trees whose products are harvested but are removed from farmlands are likely to join the list of the threatened species. Semi-domesticated parkland trees as well as important wild fruit plants should therefore undergo domestication process in order to improve the quality of the fruits and develop appropriate agronomic as well as propagation techniques (Nikiema, 2005).

Saba *(Saba senegalensis)*

Saba senegalensis, Apocinaceae, is a liana that occurs in the Sudan savanna of Africa. It is usually found along seasonal rivers and in open woodland. Because of its climbing habit, it grows very often next to other trees such as *Vitellaria paradoxa, Tamarindus indica, Diospyros mespiliformis*, and *Acacia* sp.

Saba fruits are appreciated for its tasty sweet-sour and yellow pulp. It is widely consumed as a fruit, used as a food additive, and more recently to make juice that is very much popular in Burkina Faso, Mali and Senegal. Because of the growing success of its juice, Saba fruits are intensively harvested in the wild and sold in urban markets. Saba is ranked by many authors (Bonkoungou et al., 2002; Ouédraogo et al., 2003; Nikiema, 2005) to be among the highest valued indigenous food plants of semi-arid West Africa. Saba fruit is a good source of income for the rural farmers and especially for women who undertake the harvesting and selling activities at local level. The supply of Saba fruit is very limited in time and quantities. Fruits are available only from June till August. Natural populations of Saba are declining and subject to

Five-years-old pummelo tree loaded with large fruits.

A. Hypogeal germination of *Saba senegalensis* seed. B. Saba fruit market in Ouagadougou. C. Saba fruit from a three-years-old plantation at ICRISAT-Niger.

Student working on propagation experiment.

severe threat because of lack of regeneration in the agricultural lands (Nikiema, 2005).

In order to improve the supply of fruit while ensuring the regeneration of the resource, ICRISAT has started a domestication program on *Saba senegalensis* in 2004 with short-term objectives to: (1) evaluate variability in fruiting and fruit quality between and within provenances; (2) select high yielding Saba plants; and (3) develop propagation techniques.

RESEARCH ON PROPAGATION AND MANAGEMENT OF FRUIT TREES

ICRISAT Sadore research on fruit trees is focusing so far on: (1) adaptation of fruit plant cultivars to drought and poor soil conditions; (2) identification of well adapted rootstocks; and (3) development of suitable agronomical techniques to improve fruit production in a sustainable manner. Evaluation of rootstocks and grafting methods resulted in good propagation techniques for various fruit plants and adapted to local conditions as shown in Table 3.

Table 3. Highlights in fruit trees grafting at ICRISAT Sadore.

Fruit species	Rootstock	Grafting method	Remarks
Annona	*Annona senegalensis* (local)	Top cleft	Incompatibility
Citrus sp.	*C. volcameriana*	Budding	
Grapes	*Vitis carribea* var. tropical	Chip budding, top cleft	
Kaki	*Diospyros mespiliformis* (local)	Top cleft	Incompatibility
Mango	*Mango nunkourouni* *Mango bouche longue*	Side cleft Top cleft, side veneer	
Marula	*Sclerocarya birrea* (local)	Top cleft	
Tamarind	*Tamarindus indica* (local)	Chip budding, top cleft	
Ziziphus	*Ziziphus spina christi* (local) *Ziziphus mauritiana* (local) *Ziziphus mucronata* (local) *Ziziphus rotondifolia* (India)	Top cleft	Incompatibility with *Z. mucronata*

FUTURE PROSPECTS

Agro-horticulture / Agro-forestry

Fruit trees have always been part of the traditional agricultural systems in the Sudano-Sahel zone where species such as *Vitellaria paradoxa* (shea tree), *Parkia biglobosa* (néré) and *Tamarindus indica* (tamarind) are managed by farmers because of their irreplaceable contribution to the daily diet, food security, and income generation for the rural populations. In the integrated fruits-crops-livestock system developed by ICRISAT and named the Sahelian Eco-Farm (Pasternak et al., 2005), contribution of fruit trees to farmers' annual profit can be as high as 48%.

Dry Land Fruit Tree Plantations

ICRISAT dryland fruit trees system under experiment is testing the performance of fruit production in low rainfall conditions with water harvesting techniques and by using well adapted rootstock.

Fruit Trees for Reclamation of Degraded Lands

Degraded crusted soils dominate the landscape of the Sudano-Sahel. ICRISAT Sahelian Center in Niger is now experimenting with an integrated production system to reclaim these degraded lands. A series of water harvesting structures including micro-catchments (half-moons), trenches and planting pits (zai holes) are produced. Hardy fruit trees such as pomme du Sahel, tamarind and marula are planted in the half-moons, whereas hardy leafy vegetables such as roselle, *Senna obtusifolia* and okra are planted in the zai holes. So far development of the various fruit trees is satisfactory.

Integrated Fruit Trees–Cereals–Vegetables System (FCV)

The FCV system is a farmers' innovation of the Gaya region of Niger. This is a means for intensification of horticulture production for farmers with limited land resources. Cereals are used for both field sanitation and food security whereas vegetables and fruit are for income generation

Six-months-old grafted *Sclerocarya birrea* performs well in half-moon water catchment.

Integrated fruit trees-cereals-vegetables system for intensification of small-scale horticulture: A. Fruit trees with onions in dry season. B. Fruit trees with rice in rainy season.

and year round cash flow. The fruit trees enjoy the water, fertilizers and manure provided to the vegetables and cereals. ICRISAT is paying special attention to such farmers' innovation in order to develop technologies that are suitable to the local environment and can easily be adopted by local farmers.

Dissemination through Nursery Network

The main mechanism for dissemination of the new fruit trees germplasm is through the construction of nurseries in the region. So far ICRISAT/IPALAC supported the construction of 13 fruit trees nurseries in 8 Sahelian countries. The operators of these nurseries were trained at ICRISAT that supplied them with a range of species and cultivars for planting in their mother plantations. Nursery manuals are being developed as field guides for the trainees and for other nursery operators in the region.

Supporting Research on Fruit Processing through Partnership

In partnership with the food technology laboratory of the University of Niamey, Pomme du Sahel, marula and saba fruit are processed into juice.

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New Books, Websites

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

BOOK REVIEWS

The Encyclopedia of Fruit & Nuts. Jules Janick and Robert E. Paull (eds.). 2008. CABI Publishing, Wallingford, Oxfordshire, UK. 954p. ISBN 978 0 85199 638 7. €240 / £195 / $390. www.cabi.org

Most will know about apple and grape and peach, some will know about persimmon, avocado and mango, but do you know about mombin, pitahaya or stinking toe? If not then this comprehensive encyclopedia of fruits and nuts will most likely provide the information that you require.

This very comprehensive text, edited by Jules Janick and Robert E. Paull and published by CABI, has 129 contributing authors most of whom are well known in the international horticultural science community. The text is a little unusual in that it is organised alphabetically by family and then by species. However, a very complete index allows entries to also be found by species binomial and by common names. The other unusual feature is that some entries are for what would normally be regarded as vegetable species in some countries and other entries, for example on palm species, challenge the horticulturist to think comprehensively about what should and should not be included in the discipline. These entries are justified in an informative preface.

Each entry follows a fairly standard content: background on the species; statistics in world production and yield; information on uses and composition; details on botanical characteristics (taxonomy and nomenclature, description, ecology and climatic requirements, reproductive biology, and fruit growth and development); and horticultural requirements (propagation, cultivation, training and pruning, nutrition, irrigation, harvesting and postharvest handling, pests and diseases, and cultivars and breeding). Hence all aspects relevant to a commercially significant fruit or nut species are covered and each entry is completed with a list of selected, key references.

The contributing authors have done a fine job of reducing the wealth of information that exists on many of these species to a concise and helpful text that summarises the information of most relevance to a reader who is likely to be seeking information for the first time on a particular species, or is hoping to find details on some aspect of a particular fruit or nut. Where the species is of minor significance, the length of the text is carefully contained in most instances. The editors note that the text is intended for libraries, researchers, students and serious amateurs and, consequently, the use of scientific terms is appropriate and appeared to be accurate and complete. A very helpful glossary of terms is provided at the front of the text for those who may lack familiarity with some botanical, scientific or horticultural terms.

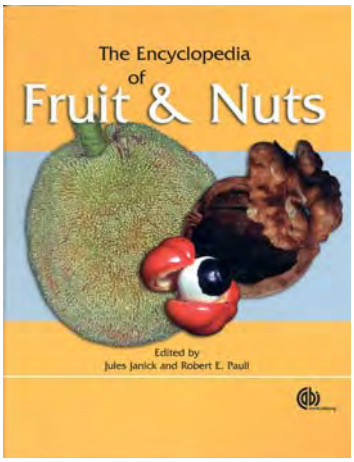
It was encouraging to note that the entries often included information on the claimed health and nutritional benefits of that particular species. In all cases it seemed that the claims were suitably qualified and were often backed up with appropriate references. It was also pleasing to see that reference was made to the use of genetic modification and the application of molecular techniques where these were relevant.

While the editors have clearly worked hard to ensure that the texts followed a standardized content, in some instances excessive detail was provided of specific factors such as individual pests and diseases (for example, the entries for hazelnut and walnut), notwithstanding the fact that the information (in these examples) was accurate and of value to those with interests in plant pathology and entomology.

One minor omission within the sections on horticultural practices, that might be considered in preparing future texts of this type, was any commentary on sustainable or organic production practices. Given the current interest from consumers for produce that is free from pesticides and about production practices that demonstrate careful stewardship of the environment, these are topics that deserve some attention.

Many of the texts on each species were supported with illustrations either in the form of line drawings, black and white photographs or colour photographs, but many were not. This was a major disappointment given the visual beauty of either the trees or the vines, their flowers and/or their fruits. Furthermore, such visual information assists greatly in both teaching and in plant identification. Aside from the omissions of visual material to support some entries, the quality of the material that was used was sometimes very variable – some line drawings are outstanding and others had a wonderful historical context, but others lacked depth of focus and detail or were simply not of a standard that might be expected in a text of this overall quality. As editors, authors and indeed publishers we too often fail in texts such as this to get the balance, quality and quantity of the illustrations to a high professional standard.

Overall this is an essential text for any serious horticultural science or indeed botanical library. It is certainly a text that all fruit and nut scientists will wish to have access to.



It is very well edited with excellent content on many different fruit and nut species. These species greatly enrich our lives through providing essential vitamins, minerals and nutrients, through providing essential daily food intake and, in many cases, through enriching our lives by providing diversity to our diets, visual beauty in the form of diverse vegetation, flower and fruit types, and a myriad of fresh and processed products to simply enjoy.

Reviewed by Ian Warrington, Massey University, New Zealand

***Nuove Frontiere dell'Arboricoltura Italiana* (New Frontiers of Italian Tree Crops). Edited by Silviero Sansavini. Preface by Franco Scaramuzzi. 2007. Oasi Alberto Perdisa, Grupo Perdisa Editore / Airplane srl., Bologna, Italy. 562p. ISBN 978-88-8372-418-3. In Italian. € 50. Sponsored by "Accademia dei Georgofili", Firenze; "Fundazione Cassa Risparmio", Bologna; Ministero della Politiche Agricole, Alimentari e Forestali, Roma and Università di Bologna.**

Italy is one of the world reference countries for tree crops, both for the economical relevance of its fruit production and for its extended forest areas. The diversity of cultivated species and climates (from temperate to subtropical), the large historical tradition and the many different products and uses of these agricultural systems define Italy as one of the leading Mediterranean countries in fruits and derived products (from olive oil to wine).

This book focuses on the technological transformation experienced by tree crops and their products in Italy since the end of World War II. The book has been published to pay homage to Enrico Baldini, Emeritus Professor of the University of Bologna on his 80th birthday. His outstanding role in this profound change is honored by the 66 authors, many of them disciples of Baldini. The text presents a panoramic and updated view of the current state of tree crops in Italy. The content is organized in six topics and 29 articles [Economics, Policies, History and Legends (4); Environment and Landscape (5); Major Fruit Crops and Products (6); Cultivars, Propagation, Genetic Resources, and Biotechnology (6); Agronomic Resources

and their Management (5); Forestry, Biomass and Wood Tree Crops (3)]. A biographical profile of Enrico Baldini, including his publications and stressing his fundamental contribution to Fruit Science, completes the book.

Two aspects of merit should be underscored. First of all is the role of scientific research in the transformation of tree crops in Italy in the last 50 years. The conversion of traditional and empiric fruit systems to a modern and competitive fruit production industry is closely associated to the R&D efforts in this country. This emphasis for the change of empirical agricultural practices into the scientifically sound technological approaches of current fruit production and fruit transformation systems is a leitmotiv in all of the articles compiled in this book. This theme also represents the best homage that can be rendered to Baldini and his generation of scientists. They have succeeded in a Mediterranean country in developing a sound scientific system helpful to horticulture. This merit of the Italian scientific community is recognized worldwide, particularly since the celebration in Florence of the XXIII IHC in 1990.

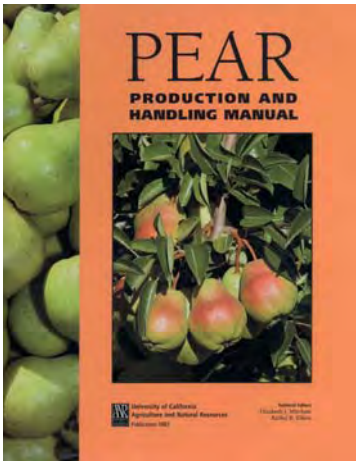
The latest changes and the current challenges for world agriculture and their impact on Italian tree crops are also an object of consideration by the authors. Thus one finds discussions on present-day and controversial topics such as the conflict between many agricultural practices and sustainability, with particular emphasis on soil erosion in Mediterranean soils, the contradiction between the need for renewal of old groves (particularly in olive) and the concern for conservation of this traditional landscape in the Italian laws, the adaptation of fruit crops to climatic change, the concern about quality and healthy guarantees in the consumption of fruits and their derived products, the need for new cultivars and rootstocks and the prospects of breeding, biotechnology and GMO in fruit and forest production, the need for and the advances in mechanical harvesting in fruit tree crops, the global market for inputs and outputs in fruit and forest productions, the new prospective for pest, weed and disease control and the integrated and organic systems in fruit production, the immediate shortage of water resources for agriculture and the need for efficient irrigation systems and practices, and biomass production.

In summary, this book is a detailed and valuable approach to Italian tree crops and their current challenges and opportunities, which can also apply to other Mediterranean countries. It also recounts a worthy example of the transformation of traditional fruit groves into new competitive systems based on scientific research and development in one of the most important fruit producing countries of the World.

Reviewed by Luis Rallo, University of Cordoba, Spain

Pear Production and Handling Manual. Elizabeth J. Mitcham and Rachel B. Elkins (Technical Editors). 2007. Publication 3483, University of California, Agricultural and Natural Resources, Davis, California, USA. 215p. ISBN: 978-1-879906-65-1. $25 plus postage. http://anrcatalog.ucdavis.edu

A new manual designed to provide a basic understanding of growth and fruit development, as well as practical considerations on pear culture. Publication is addressed mainly to 'Bartlett' ('Williams') pear growers but growers of all cultivars will find the information useful. Other fruit manuals in the series include: Tree Fruit Pest Identfication and Monitoring Cards; Organic Apple Production Manual; Integrated Pest Management for Stone Fruits; Peaches, Plums and Nectarines: Growing and Handling for Fresh Market; Training and Pruning Almond Trees; IMP for Almonds; Almond Production Manual; IPM for Walnuts; Walnut Production Manual; Disease of Temperate Zone Tee Fruit and Nut Crops; Kiwifruit Growing and Handling; Olive Production Manual.



Global Conservation Strategy for *Fragaria* (Strawberry). Kim E. Hummer (ed.). 2008. *Scripta Horticulturae* 6. International Society for Horticultural Science. 87p. ISBN 978 90 6605 129 4. € 60. Available from the ISHS Secretariat.

Strawberry was listed in the International Treaty on Plant Genetic Resources for Food and Agriculture, Annex 1, as a crop of global horticultural significance. The Global Crop Diversity Trust and Bioversity International requested that a global conservation strategy be developed for strawberry. In 2005, the Trust signed a memorandum of understanding with the International Society for Horticultural Science to provide advice on the development of global conservation strategies for horticultural crops. Dr. Hummer, curator for the US strawberry genebank, was appointed by the Trust as coordinator for the development of the Global Strawberry Strategy. An international expert committee meeting was held 5 to 8 July 2006, at the US Department of Agriculture, Agricultural Research Service, National Clonal Germplasm Repository, Corvallis, Oregon. The Global Conservation Strategy for *Fragaria* (Strawberry) is now published as *Scripta Horticulturae* Number 6, which is available from ISHS. Additional information about the Global Crop Diversity Trust and their strategies for conservation of economically important food and fiber crops can be obtained from the Global Crop Diversity Trust website at http://www.croptrust.org/main/strategies.php? itemid=82.

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Eyzaguirre, Pablo B. and Linares, Olga F. (eds.). 2004. Home Gardens and Agrobiodiversity. Smithsonian Books, Washington, USA. 296p. ISBN 978-1-58834-112-9 (hardback). $40. www.ipgri.cgiar.org/publications

Gallegly, Mannon E. and Hong, Chuanxue. 2008. Phytophthora: Identifying Species by Morphology and DNA Fingerprints. APS Press, St. Paul, MN, USA. 168p. ISBN 978-0-89054-364-1. $79.00. www.shopapspress.org

Mediterra 2008. The Future of Agriculture and Food in Mediterranean Countries. / Les Futurs Agricoles et Alimentaires en Méditerranée. Published by the International Centre for Advanced Mediterranean Agronomic Studies / Centre International de Hautes Etudes Agronomiques Méditerranéennes (CIHEAM) and Presses de Sciences Po, France. 368p. ISBN 978-2-7246-1064-2 (paperback). €35 (in English) / €32 (in French). www.ciheam.org and www.pressesdesciencespo.fr

WEBSITES

A new internet website, www.fruitpedia.com, has been launched on 15 May, 2008. The objective of this website is to provide basic information on edible fruits, particularly those which are not known much outside the area of their habitat.

The website has been initiated by the Indian horticulturist, Dr. Chiranjit Parmar. At present, the site contains chapters on 200 fruits. Each chapter comprises of 2-6 pages and also contains 2-4 pictures of the fruit. Information in 165 chapters has been compiled personally by Dr. Parmar. Information in the other chapters has been obtained from experts from all over the world.

Dr. Chiranjit Parmar intends to make this website as an online encyclopedia of the edible fruits. His dream is to put information on ALL EDIBLE FRUITS OF THE WORLD at this website. There is no precise estimate about the total number of fruits that are eaten by people all over the world. However, the general view is that this number is around 4000. So it is a gigantic task and may take a few years to complete.

Dr. Parmar has plans to get chapters on various fruits from horticulturists from all parts of the world. He shall be updating the site every week. He is getting quite helpful response from his contacts all over the world. So he is very optimistic that in a couple of years, this website will have information on ALL the edible fruits of the world.

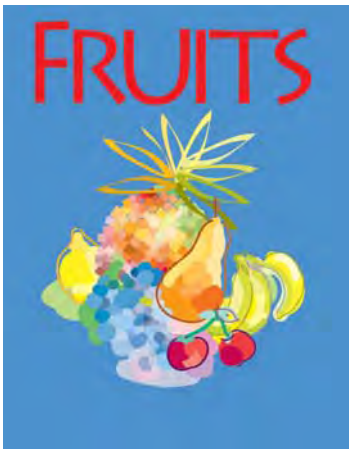
The currently available literature on fruits only carries information on fruits of commercial importance. There are very few books on minor or wild growing fruits. Thousands of wild growing fruits fondly eaten by local people have been ignored. Fruitipedia is going to cover all such fruits.

A translator has also been provided at the website for the help of those who do not have enough knowledge of English. With this translator the information can be read in eleven languages of the world including Chinese and Hindi.

All the ISHS members are requested to contribute articles for Fruitipedia.

FRUITS: INTERNATIONAL FRUIT JOURNAL

FRUITS is a scientific journal for original articles and reviews on fruit crops in temperate, Mediterranean, subtropical and tropical regions that is associated with CIRAD, the French Agricultural Research Centre for International Development, published by EDP Sciences in France, and recognized by the International Society for Horticultural Sciences. More than ever the journal is engaged in key challenges dealing with a knowledge-based horticulture, where fruit production, postharvest technology, marketing, and consumption are considered as promising ways for contributing to income generation, nutrition, and well-being and health of population in rural and urban areas of developed and developing countries. Unfortunately, fruits had not been on the forefront of the agricultural research agenda for the scientific community worldwide, where, until now, priority was given to staple foods and industrial crops.



This is changing and fruits are now considered by the international community as "high value crops" with a strong part to play in development. As a consequence, there is a huge knowledge gap to fill.

FRUITS has been indexed and abstracted in a number of abstracting and databases. Since January 2008 the journal is being indexed in two major databases of ISI (Institute for Scientifc Information): Science Citation Index Expanded and Journal Citation Reports/Science Edition. Through this recognition the journal hopes to attract the best science in order to be part of the active innovation process, which is required for fostering fruit production and consumption as part of the prosperity in the world. More information about this journal can be found at *www.fruits-journal.org*

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

ISAFRUIT FORUM: INCREASING FRUIT CONSUMPTION TO IMPROVE HEALTH

ISAFRUIT is a European Integrated Research Project that focuses on all aspects of fruit from its start as a seed till a consumer bites into a juicy end product. It has been awarded under Thematic Priority 5 - Food Quality and Safety of the 6th Framework Programme of RTD (Contract no. FP6-FOOD 016279-2). Approximately 200 researchers from 60 Research and Development Institutions and SMEs in 16 Countries co-operate in this project, which runs from January 2006 until the summer of 2010.

The strategic objective of ISAFRUIT is to increase fruit consumption, searching the improvement of health and well-being of Europeans and their environment, by taking a total chain approach, identifying the bottlenecks and addressing them by consumer-driven preferences.

On 28 October 2008, a joint initiative of ISAFRUIT, the International Society for Horticultural Science and the European Economic and Social Committee will be held in Brussels, Belgium. This Forum will focus on issues related to fruit consumption arising from the ISAFRUIT Project.

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Section Nuts and Mediterranean Climate Fruits

Sixth Int'l Congress on Cactus Pear and Cochineal

Participants of the Congress.

The VI International Congress on Cactus Pear and Cochineal and the VI General Meeting of FAO-CACTUSNET was held from October 22 to October 26, 2007 in João Pessoa, Paraíba State, Northeast region of Brazil. Brazil ranks among the top largest cactus producers in the world, with approximately 500,000 ha of cultivated cactus, and most of this crop is used in the region as fodder. Considering the importance of this crop to Brazil, a group of Brazilian institutions led by the Federation of Agriculture of Paraíba State organized the event.

The Congress was very successful with 533 participants from 14 countries, representing 74 different institutions. The following countries were represented in the meeting: Argentina, Australia, Bolivia, Brazil, Chile, Israel, Italy, India, Morocco, Mexico, Peru, South Africa, United States, and Tunisia. Among the participants, professionals and farmers were the largest group with 351 attendees, followed by a group of 149 students, and 33 invited speakers. The scientific program was carefully prepared by the Organizing Committee and FAO-CACTUSNET group, including 10 sessions covering different areas of knowledge such as genetics and breeding, fruit and vegetable production, post-harvest and agro-industry, medicinal, cosmetics, biofuel, pests and diseases, carmine cochineal production and utilization, biology and biotechnology, forage, desertification, and ecophysiology. In order to cover all these areas, 33 speakers were invited and 233 posters presented. Recent advances in science for different cacti uses were presented by the scientists, bringing the attention of the attendees. At the end of the meeting, there was a field tour to visit local cactus fields with 205 attendees.

Opening ceremony of the VI International Congress on Cactus Pear and Cochineal.

The general meeting of FAO-CACTUSNET occurred at the end of the Congress. The memories of previous conferences were presented by Dr. Judith Ochoa from Argentina, including several pictures of CACTUSNET members. Other important resolutions also occurred during this session, including the decision regarding the next venue for the Congress, which will be held in India and Dr. Gurbachan Singh, Director of the Central Soils Salinity Research Institute, will be the president.

The Scientific Committee of the Congress is finalizing the editing of the papers, which will be published in a special issue of *Acta Horticulturae*. Each paper was peer-reviewed by experts from different countries after initial evaluation by the Scientific Committee.

Field visit to cactus plantation in Taperoá, PB.

Important outcomes of the meeting include the presentation for the cactus scientific community of the recent advances of the cacti science in the world, giving the opportunity for sharing information and discussion about this important crop around the world, particularly for arid and semi-arid regions. In addition to that, it is expected that multiple uses of cacti will be further strengthened in Brazil after all important information presented during the meeting.

José Carlos B. Dubeux, Jr.

Contact

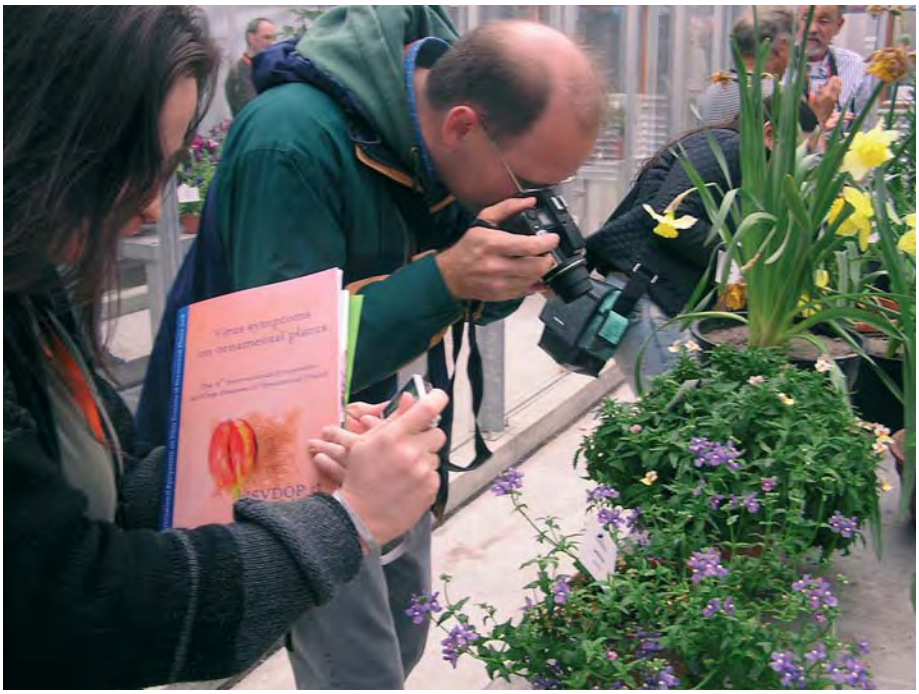
Dr. José Carlos B. Dubeux, Jr., CNPq fellow, Professor at the Universidade Federal Rural de Pernambuco and member of the Scientific Committee. Email: dubeux@dz.ufrpe.br

Twelfth Int'l Symposium on Virus Diseases of Ornamental Plants

Viruses are a continuous threat for the ornamental industry. Unexpected virus infections may result from cultivation in new areas and/or by changed cultural practices, intensified international trade and reduced use of pesticides. These changes urge to improve certification schemes, detection methods, resistance breeding and integrated vector and virus management. In this context the 12th International Symposium on Virus Diseases of Ornamental Plants was held from 20 to 24 April 2008 in Haarlem, The Netherlands. With 117 participants from 25 countries a new record was set since the 7th meeting in 1988. Both the Scientific Board of the ISHS Working Group on Virus Diseases of Ornamentals and local Organizing Committee were eager to make attendance possible for representatives of countries that recently started virus research in ornamentals. Therefore, two participants were supported financially.

Many participants used the welcome reception on Sunday evening to renew and make new contacts in an informal and friendly sphere, which was typical for this symposium as a whole.

In an introductory lecture, the importance of the ornamental industry for the Dutch economy was set forth by Ir. Sjaak Langeslag, President of the Royal General Bulbgrowers' Association. The audience was very interested in his estimation of direct and indirect losses caused by virus diseases, which was illustrated with figures from tulip cultivation. He challenged the researchers to look for more practical solutions for and with growers.



Exhibition of virus diseases in a wide range of ornamentals at WUR Applied Plant Research was a big success.

Participants enjoyed the congress dinner during the cruise on the lakes near Leiden.

The scientific program included 33 oral presentations and 30 posters and was divided into five sessions. In the session "Viroids and Phytoplasmas" Dr. Ricardo Flores presented recent research on viroids, which was a very welcome update for most of the participants. The session "Detection Techniques" started with an overview of new techniques presented by Dr. John Hammond and included also practical applications and validation of detection methods. Both sessions were a good basis for and introduction to the plenary discussion on "Validation of detection methods, Quarantine and Trade" with Dr. Nico van Opstal, Director-general of the European and Mediterranean Plant Protection Organization, as Chairman. Five participants made and defended a statement which resulted in animated and exciting discussions in which Dr. Abed Gera acted as pace-maker.

In the session "Resistance" Prof. Rob Goldbach presented an informative overview on novel

insights in the working mechanisms of natural host resistance to viruses. Dr. Katja Richert-Pöggeler and Prof. Hanu Pappu attracted special attention as they demonstrated the integration of viral DNA of 2 Caulimoviridae in host DNA and discussed the implications of these findings for plant breeding, diagnostics and disease management. In the extensive session "New Viruses/Host plants", new viruses or known viruses in a new host were identified and characterized in a broad spectrum of ornamental crops. Most of the new viruses belonged to the Potyvirus genus. This provoked discussion about the criteria that are used to make difference between a strain and a new virus in this genus. But, in this symposium it was also shown with molecular techniques that various potyviruses described in literature were identical or strains of the same virus. In the session "Epidemiology/Transmission and Control", Dr. Yeheskel Antignus gave an overview about the control strategies of plant viruses. Many examples were given of the effect of optical barriers interfering with the landing behavior of flying insects acting as virus vector and the use of UV-absorbing plastics and screens reducing the virus spread within greenhouses.

The technical excursion started with a guided tour at the world's largest flower auction in Aalsmeer and was followed by a visit to the breeding and propagation enterprise Fides in De Lier. The tour was completed by a visit to WUR Applied Plant Research in Lisse, the center of the oldest Dutch bulb growing area. The timing of the visit could not have been better since tulips, narcissi and hyacinths were in full bloom. The exhibition of virus diseases in a wide range of ornamental crops was a big success.

Animated discussions during the poster sessions.

Visit to the glasshouses of Fides with explanation about the new breeding material and disease control measures.

At the business meeting no decision was made yet for the location of the next symposium; there are 3 candidates for the organization, viz. Norway, Singapore and China. After the business meeting, the congress ended with a visit to the famous bulb flower exhibition "Keukenhof" in Lisse and a congress dinner during a boat trip on canals and lakes near Leiden.

Toon Derks

Contact

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Sixth Int'l Symposium on Mineral Nutrition of Fruit Crops

Participants at the University of Algarve (Campus of Gambelas).

The VI International Symposium on Mineral Nutrition of Fruit Crops was held at the University of Algarve (Faro, Portugal) from 19 to 23 May 2008. This symposium was organised by the CDCTPV (Research Center on Plant Production and Technologies), and by the Faculty of Engineering of Natural Resources, under the auspices of the ISHS Working Group on Mineral Nutrition of Fruit Crops.

The fundamental purpose of this symposium was to provide novel insight into nutritional aspects of all fruit crops, having in mind the new concerns of agriculture in this century: the quality of plant commodities, food safety, conservation of soil and water, and the sustainability of the agroecosystems. The scope of this symposium was more expansive than the prece-

The conveners: Maribela Pestana (left) and Pedro José Correia (right).

ding symposia, formally encompassing mineral nutrition of tropical and subtropical fruit trees as well as deciduous fruit trees.

Around 150 participants from all continents and from 27 different countries attended the symposium and a total of 40 oral and 80 poster presentations were given at 7 thematic sessions: water saving and mineral nutrition, fertilisation practices and their environmental impacts; nutritional implications of organic management; cycling and traceability of nutrients in Mediterranean-type ecosystems; low input and precision agricultural systems; mineral nutrition and human health and effects of mineral nutrition on fruit quality and nutritional disorders. One opening session was given by Dr. Gerry Neilsen (Canada), who spoke on tomorrows challenges in fruit nutrition research. In the last day of the symposium, Dr. Luc Maene (France) presented several aspects concerning fertilizer's industry and fertilization management.

Each working session was introduced by a keynote lecture. In the session Water saving and mineral nutrition, Prof. Manuela Chaves (Portugal) spoke on the different approaches to increase the efficiency in water use without losing yield or fruit quality. The majority of the presentations of this session focused on irrigation management and its effects on plant and fruit quality. In session 2, Cycling and traceability of nutrients in Mediterranean-type ecosystems, Prof. Hans Lambers (Australia) reviewed the efficient phosphorus-use strategies and adaptations of plants in the Mediterranean environment of Western Australia. Most of the works in this session dealt with plant nutrients demand and nutritional status of fruit tree species. The following session, Low input and precision agricultural systems, was introduced by Prof. Patrick Brown (USA) who addressed important questions about yield variability and its impacts on nutrient use efficiency in fruit tree orchards. Nutrient partition, nitrogen uptake, nitrogen fertilization, and iron deficiency studies were the main topics in this session, but some works on plant nutritional diagnosis were also presented. Prof. Moreno Toselli (Italy) was the invited speaker for the session Nutritional implications of organic management. His lecture was about nutrient management in organic farming, including the effects of organic fertilization on fruit quality. Most of the presentations focused on the effects of organic fertilization on yield and plant nutritional status. In the session Fertilization practices and their environmental impacts, Dr. Victoria Fernandez (Spain) reviewed some of the factors relating to the penetration, distribution and bioactivity of foliar sprays. Most of the presentations were on foliar fertilization effects. In the session Mineral nutrition and human health, Dr. Michael Grusak (USA) gave an overview of the contribution of fruit tree crops to human mineral requirements. Only a few works were presented in this session, which reported some data on antioxidant activities and vitamin C in fruits. In the last session, Effects of mineral nutrition on fruit quality and nutritional disorders, Prof. Esmaeil Fallahi reviewed these aspects in apples, with emphasis to calcium and boron. A large number of presentations were on the effects of mineral nutrition on fruit quality and nutritional disorders.

The opening ceremony.

Visit to a citrus orchard at "Quinta Nova", Algoz (Silves).

Two technical tours allowed the participants to visit strawberry and raspberry plants in soilless culture, persimmon trees, avocado trees and citrus tree orchards, and vineyards for wine and table grapes production.

This symposium was an opportunity to launch new ideas and collaborative projects on all aspects of mineral nutrition and the conveners would like to thank the sponsors and all the people involved in this organization.

Maribela Pestana and Pedro José Correia

Contact

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Third Int'l Late Blight Conference

Section Root and Tuber Crops – Section Vegetables – Commission Plant Protection

Participants of the Conference.

The Third International Late Blight Conference was held in Beijing from 3-5 April, 2008, and was sponsored by the Chinese Academy of Agricultural Sciences, the International Potato Center, Global Initiative on Late Blight and ISHS. The conference was a great success, with 154 attendees representing 34 countries. Participation in sharing of scientific knowledge was high as there were 14 keynote presentations, 28 oral presentations and 39 posters.

Enthusiasm at the conference reflects the global importance of this disease. Globally, late blight is primary disease of potato and a major constraint of tomato. Present estimates put annual losses due to potato late blight (caused by *Phytophthora infestans)* and fungicide costs at several billion dollars globally. This is set to increase as the spread of new, more aggressive strains of the pathogen is causing increasing damage worldwide. Furthermore, the consensus of most climate change models is that the highland tropics will get wetter and warmer and these conditions will make it even more difficult for farmers to manage the disease.

This was the third in a series of conferences; the earlier ones in Hamburg, Germany in 2002 and Quito, Ecuador in 1999. The Beijing conference was organized around several major themes, including: epidemiology, pathogen biology and dynamics, resistance breeding, disease manage-

Dr. Wei Liu handing over the ISHS medal and certificate to Dr. Forbes.

ment, molecular biology & host pathogen interactions and chemical control. Keynote speakers presented advances in reseach since the previous conferences. Advances in genomics have facilitated the study of the host pathogen interaction. Sequencing of the *P. infestans* genome and that of other *Phytophthora* species has permitted the identification of a large group of effectors, substances secreted into to the host to enhance pathogenicity. These are recognized by host resistance genes and there is evidence of co-evolution in the respective arsenals of this host/pathogen arms race.

On the other extreme of the food chain, we also saw how knowledge theory and pedegogical principles have been used to develop improved guides to facilitate building capacity among resource-poor farmers. These guides are particularly appropriate for farmer field schools or other highly participatory methodologies.

There was a strong focus in the meeting on pathogen populations studies, including information on analysis of DNA extracted from herbarium samples, which has changed previous assumptions about historical migrations of the pathogen. Researchers from Europe demonstrated procedures and software for managing pathogen passport and marker data (see http://www.eucablight.org/EucaBlight.asp). This aroused much interest among the international participants and there are currently efforts to extend and even globalize this technology.

Some presentations and much discussion focused on the use of potatoes genetically modified for resistance to late blight. The use of marker gene free transformation and R genes from crossable species was presented as a cisgenic breeding approach, which could engender less resistance among the public. In addition to public concern, there is also an issue related to the durability of resistance once deployed, and evaluation of deployment strategies (host mixtures or pyramiding) is also an area of intense study. This is an area of clear linkage with the last conference in Hamburg, where cloning of a resistance (R) gene from *Solanum bulbocastanum* was announced. R genes from this species are currently the primary technology for genetic modification currently underway in the public and private sector.

Visit to experimental fields of the Institute of Crop Science of the Sichuan Academy of Agricultural Sciences.

Several papers were also presented on late blight epidemiology. The benefits of simulation modeling were evaluated, as the practical implications of this type of research are frequently questioned. In the case of potato late blight, simulation has played a role as a research tool. Improved computing power and availability of weather data (historical and predicted) will be used to test the potential for using simulation in a Web-based application for practical disease management. Another paper on epidemiology demonstrated how the disease behaves differently in the tropics where crops and disease are present year round.

The meeting ended with a session on future directions, and it was in this forum that we discussed the possibility of a research framework for the global initiative. Several participants are now developing drafts of this framework.

After the conference, about 35 participants travelled to Sichuan province to visit potato fields and research facilities.

Finally, it is important to note that the unique Chinese tradition, culture and hospitality, and the fantastic food, provided an unforgettable context.

All abstracts are available at the GILB Web page http://gilb.cip.cgiar.org/.

Greg Forbes

Attendees enjoy one of many excellent meals on field trip to Sichuan.

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Sixth Int'l Strawberry Symposium

Attendants to the VI ISS 2008.

The VI International Strawberry Symposium (VI ISS 2008) that took place from the 3rd to the 7th of March 2008 at Huelva, Spain, was the summit of a long and hard process that started five years ago. Gaining the ISHS members' confidence during the Australian meeting to hold this event in 2008, gave to us a feeling of a job well done but also an idea of the tremendous effort that this would mean for the next years. Now, we realise that this feeling was only a part of what really meant organising such an event like the ISHS International Strawberry Symposium. Finally, thanks to the effort of many people and institutions, we achieved all our objectives, and it was a complete success.

In a meeting like that, more important than the amount of scientific work presented is to meet colleagues, technicians, researchers, growers and so on, which gives one the opportunity of sharing experiences and ideas related to research programs or crop problems, and easily finding solutions or new perspectives. Although the new communication technologies make it easy to get in contact with people from all around the world, the personal touch is still important. In this aspect, the Symposium has been an unique opportunity.

Attendance to the meeting has overwhelmed all our expectations, with more than six hundred authors and companions, from more than sixty different countries all over the world, presenting their works. During the scientific sessions, five invited speakers presented talks, sixty six oral communications were attended and two hundred seventy two posters were presented in the seven different scientific topics: Genetics and breeding, Physiology, Nurseries, Soil disinfestation, Crop production, Crop protection and Post-harvest and quality. A one day technical tour took place during the symposium, with four different itineraries allowing to the symposium participants the opportunity of deeply knowing the strawberry crop in Huelva and Spain. Finally an Open Day for growers and public in general took place, in which the book entitled "The Strawberry Crop in Huelva" was presented, with English and Spanish versions.

The symposium motto "Quality, Health and Environment" underlined the importance of working together to achieve strawberries of excellence, with a higher influence on the well-

Dr. José López Medina, VI ISS Convener.

being of consumers all inside the reference of a sustainable and environmentally friendly agriculture, and this motto also followed the symposium conclusions, like the influence of global weather change on the strawberry crop, more efficient and better adapted to new social challenges production systems (like new cultivars, no more use of banned pesticides, null residues on fruits, biological control of pests and diseases, etc.) and the nutraceutical importance of strawberries as a healthy fruit.

I would also like to mention the incorporation of new countries, especially developing countries that were not often present in scientific events like the VI ISS, and that are interested in the more technical aspects of the crop, like new cultivars and new production systems. It has been a great effort for many of these attendees to be present in Huelva, but maybe this is a call of attention for other countries for what the future will be in a more and more "global world".

I would like to thank all people who put their confidence in us, as well as all people, institutions and sponsors for their interest, time and the effort they made. Without them, this event could not have taken place. I want to mention the International Society for Horticultural Science, the Spanish Society of Horticultural Science, the Consejería de Agricultura y Pesca, the University of Huelva, the Consejería de Innovación, Ciencia y Empresa (IFAPA), the Diputación de Huelva, Freshuelva, the Ministerio de Agricultura, Pesca y Alimentación, Cajasol, Fundación Caja Rural del Sur, Grupo Medina, Cora, Inotalis and Eurosemillas.

Book presentation "The strawberry crop in Huelva".

I do not want to forget our dearest friend Dr. Jean Claude Navatel who unfortunately passed away during the celebration of the symposium. I want to give the best and deepest wishes from the entire strawberry world to his widow and sons.

Finally, a call to remind all the ISHS members that the VII International Strawberry Symposium will take place in Beijing, China, in 2012. I am sure we will all meet again in four years.

José López Medina

Technical tour.

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Commission Plant Substrates and Soilless Culture – Commission Protected Cultivation

Int'l Symposium on Strategies towards Sustainability of Protected Cultivation in Mild Winter Climate

Participants of the Symposium.

Protected cultivation has rapidly expanded in suitable regions all over the world. Formerly the major objective was crop improvement through enhanced growth and efficient pest and disease management. On the other hand, climate control was and still is today a heavy issue. Nowadays, environmental concerns play an important role in the trade since it is also reflected on consumers' demands besides product quality and safety. The future developments seem to be under the pressure of increased international competition where production cost possesses a significant share and particularly high in some countries, remarkable attention of the consumers to the produce quality and safety and the sustainability of production processes as well as the supply chain. In this scenario, the priority is focused on possible strategies that suit improved efficiency of production systems.

The International Symposium on "Strategies towards Sustainability of Protected Cultivation in Mild Winter Climate" was organized by the Faculty of Agriculture, Ege University and ISHS in Antalya, Turkey on 7-10 April, 2008 collaborating with FAO (Food and Agriculture Organization of the United Nations), TUBITAK (The Scientific and Technological Research Council of Turkey), Turkish Society for Horticultural Sciences and BASF The Chemical Company. IPM Russel, Delta T Devices and Koppert also supported the Symposium.

The symposium was opened with an address by Prof. Dr. Y. Tüzel, Convener, who welcomed all participants on behalf of the Organizing Committee; the speech on behalf of the Protected Cultivation Commission was given by Dr. N. Castilla, Chair of the Commission. As the Chair of the Working Group on Protected Cultivation in Mild Winter Climates, Assoc. Prof. C. Leonardi welcomed the participants. Subsequently Prof. W. Schnitzler (Chair of the ISHS Commission Plant Substrates and Soilless Culture) gave an overview of ISHS activities. Mr. W. Baudoin represented FAO in welcoming to the Symposium.

There were more than 135 participants from 5 continents and 35 countries as Albania, Algeria, Bahrain, Bosnia Herzegovina, Bulgaria, Canada, Croatia, Czech Republic, Egypt, Germany, Greece, Hungary, India, Iran, Ireland, Israel, Italy, Jordan, Korea, Libya, Macedonia, Moldova, Netherlands, New Zealand, Oman, Romania, Saudi Arabia, Serbia, Slovenia, Spain, Sweden, Tunisia, Turkey, UK and USA.

Sessions were devoted to structures, covering materials & screens, environmental control, stress factors, irrigation and nutrition management, soilless culture, seedling & grafting, produce and process diversification, pest & disease management and marketing. Each day, the Scientific Program started with invited papers as "Greenhouse Technology for Sustainable Production in Mild Winter Climate Areas: Trends and Needs" by J.I. Montero, "Crop Management in Greenhouses: Adapting the Growth Conditions to the Plant Needs or Adapting the Plant to the Growth Conditions?" by L. Marcelis and "Management of Nutrition and Irrigation in Soil-Grown and Soilless Cultivations in Mild-Winter Climates: Problems, Constraints and Trends in the Mediterranean Region" by D. Savvas.

A round table discussion chaired by Prof. W. Schnitzler on "Opportunities & constraints of good agricultural practices (GAP) for quality and safety of vegetables and fruits" received high attention.

In the Business meeting of the two ISHS Commissions (Protected Cultivation and Plant Substrates and Soilless Culture), Chairpersons gave information regarding their future activities.

On the second day, a two hours city tour was organized in order to introduce the beauties of the city to the participants.

Posters were displayed during the first two days of the Symposium. During the last day of the scientific session, the posters were briefly summarized by the related chairs of the sessions. A competition was held among the posters displayed and a present (Turkish ceramics) was given to the best three posters selected by a Committee. These posters were orally presented for three minutes each.

After regional dance performance of Organizing Committee.

Invited speakers and Conveners. From left to right: Drs. I. Hakkı Tüzel, Ayşe Gül, Dimitrios Savvas, Juan Ignacio Montero, Leo Marcelis and Yüksel Tüzel.

Greenhouse visits of participants.

All the participants agreed on the following as the concluding remarks of the Symposium:

- Both crop management and greenhouse structure in mild winter climate can be improved. Simple models could contribute to fulfill this task.
- Semi and closed greenhouse systems could also be proposed for mild winter climates to economize production.
- Soilless culture currently seems one of the safest and most effective alternatives to MeBr. Nutrient solution recycling systems are more and more considered by the scientific community as ready for practical use.
- Different 'tools' (i.e. sensors) can be used to increase water and nutrient use efficiencies.
- Grafting could also be a tool against stress.
- Good Agricultural Practices will receive considerable attention to meet retailer and consumer demands for quality and healthy produce.
- Protected cultivation needs to diversify the process and produce to meet the changing demands of the consumers.

A Turkish night with folkloric dances and henna ceremony for the bride accompanied the farewell dinner, which was organized in a historical building at the port. The surprise of the night was the regional dance performance of the Organizing Committee. ISHS medals and certificates were also presented to the Symposium Conveners during the Farewell dinner.

After the scientific sessions, a daily technical tour allowed the attendants to see the expansion of protected cultivation along the southwest coast of Turkey. The visits were focused on soilless culture (RS Tarim), young plants nursery, grafting (Antalya Tarim) and production of cut roses and anthuriums (Ayer Tarim). The participants enjoyed visits to Zenon's theater (Aspendos), one of the well-conserved antique theaters in Turkey, where even today sound acoustic is still perfect. It was nice to have a drink at Manavgat Waterfall with white foaming water rushing powerfully over the rocks.

Participants coming from various countries expressed their appreciation to the organizers both in respect to the scientific quality of the presentations and social activities. The organizers, on the other hand, would like to extend their thanks to all participants and contributors for a very fruitful and enjoyable meeting and look forward for the next meeting.

Yüksel Tüzel, Ayşe Gül and I. Hakkı Tüzel

Commission and Working Group Chairs handing out the ISHS medals and certificates to the Symposium Conveners. From left to right: Drs. Nicolas Castilla (Chair Protected Cultivation Commission), Ayşe Gül (Co-Convener), Yüksel Tüzel (Convener and Vice Chair Protected Cultivation Commission), I. Hakkı Tüzel (Co-Convener), Wilfried Schnitzler (Chair Commission Plant Substrates and Soilless Culture), and Cherubino Leonardi (Chair Protected Cultivation in Mild Winter Climates Working Group).

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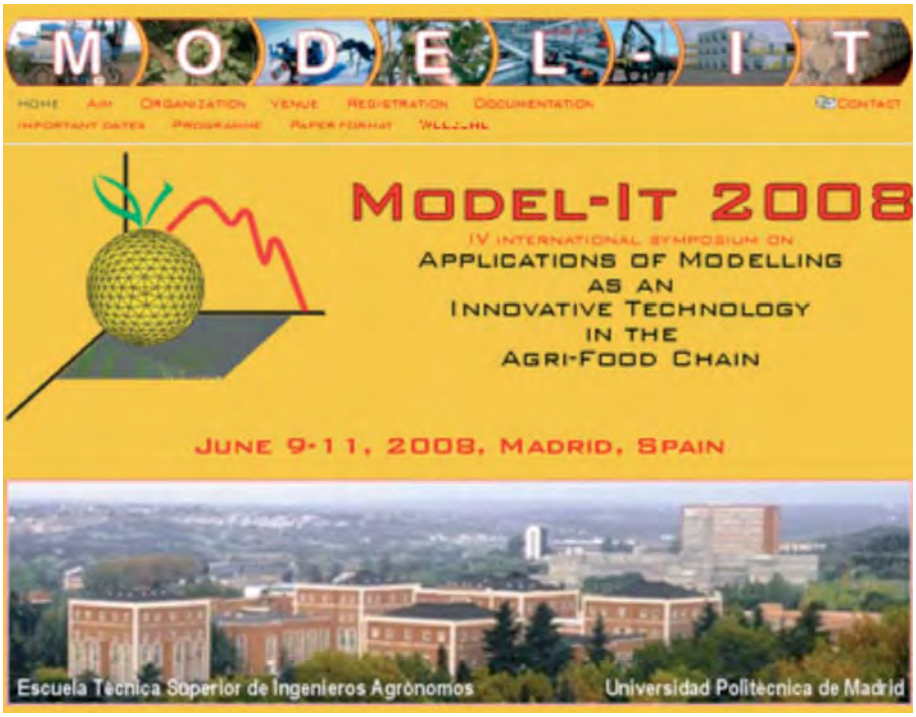
Model-IT 2008, Better Equipped for Life...



Web page where details on the symposium can be found.

The 4th International Symposium on Applications of Modelling as an Innovative Technology in the Agri-Food-Chain (Madrid, Spain) was hosted by the Universidad Politécnica de Madrid as an initiative of Working Group 5 of COST action 924. The earlier Model-IT symposia were organized in The Netherlands (1998), New Zealand (2001) and Leuven (2005), and their results and publications by ISHS have shown that the tradition that started ten years ago is still attractive. Model-IT 2008 was organised under the aegis of a number of international and Spanish professional institutions (ISHS, IIR, EurAgEng, ESCH, and SEA), which emphasizes the broad goal of Model-IT to cater the wider agri-food chain with new modelling concepts. For proper chain management, good and reliable predictive models covering all aspects of the food chain are necessary to control and optimise the food chain, going from farm to fork, with respect to quality and safety. This wide range was mirrored by the expertises displayed in the various conference contributions.

Dr. Maarten Hertog, responsible for the workshop Kinetic Models.

In total, 41 oral and 20 poster presentations were presented during the three day symposium attracting 100 participants coming from 23 countries from all over the globe. Although the number of participants was limited, the quality of interaction was inversely proportional to this. The symposium offered three invited speakers highlighting the application and potential of modelling within their own domain.

Theo Geisel, Director from the Max-Planck-Institute for Dynamics and Self-Organization and Professor of Theoretical Physics, University of Göttingen, gave an interesting talk on complexity observed in modern epidemics. By combining simple kinetic models for the transfer of diseases with the more complex approach of super diffusion to account for modern human travel, it comes within reach to forecast the geographic spreading of modern epidemics. This concept was illustrated using historical data on the spreading of US dollar bills.

José Miguel Aguilera, Professor of civil industrial engineering at the Catholic University of Chile, talked about microstructures in food. After a more general introduction into microstructures and food processing showing the increasing opportunities of designing functional microstructures to satisfy the growing demands in the food industry, he took us along into his recent area of interest of gastronomic engineering. In this area he works together with famous chefs to apply scientific principles to achieve provocative sensations in food tasting and with that made everyone's mouth water.

Finally Francisco José Vico, leader of the Research Group in Biomimetics and Associate Professor at the School of Computer Science both of the University of Málaga, Spain, gave an intriguing overview of biomimetics. Biomimetics is a relatively new science that studies biological systems to imitate them and to take creative inspiration from them to solve human engineering problems. In this way man can learn from the refined systems developed by nature over millions of years. What better model could there be?

Furthermore, the symposium offered the participants four workshops specially prepared for this occasion. The workshop on *Data Mining* gave a practical introduction to a number of techniques for multivariate analysis, both supervised and unsupervised, to explore large amounts of data and to extract relevant information from non random behaviors. These techniques have enabled the transfer of scientific methodologies from the laboratory to the industry by revealing the latent information hidden within large data sets. The workshop on *Calibration Transfer in Spectrometric Devices*

Dr. Francisco Vico, invited speaker talking on biomimetics.

focused on fundamental causes for the spectral variations between two spectrometers and how these differences can be overcome by calibration transfer. This is of the utmost importance to allow comparison of results obtained with different devices, ensuring reproducibility and robustness of the results in different campaigns. A third workshop on *Image Processing of Multi- and Hyperspectral Vision* provided a general overview on the multi- and hyperspectral vision techniques applied in the agri-food sector. Participants were to work with several relevant image processing techniques including the extraction of parameters for the characterization of both internal and external quality in agricultural products. Finally, a workshop was presented on *Kinetic Model Development and Calibration Based on Ordinary Differential Equations.* The use of these equations is widely spread for the development of kinetic models. A general introduction was given on the power and pitfalls of ordinary differential equation (ODE) based models using hands-on exercises after which the participants were to implement their own model.

After three days of an intensive and successful symposium the participants were sent away with a take home message from Goethe to *venture ourselves into knowledge and science to return better equipped for life* and to meet again at the next Model-IT symposium to be held in Paris, France in 2011!

Detail of the computer rooms where the workshops took place.

On behalf of the Organizing Committee of Model-IT 2008, Pilar Barreiro Elorza and Maarten Hertog

Contact

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The Patriarch Still Wants to Live!

During the 27th International Horticultural Congress held in Seoul in 2006, and in my capacity as Chair of the ISHS Section Nuts and Mediterranean Climate Fruits, I suggested to organize a Symposium with the topic "Current and Potential Uses of Nut Trees Wild Relatives". Two countries offered to host the event: Iran and Georgia. Both countries dispose of an extraordinary richness in plant germplasm, an important aspect to attract the scientific community to participate in a transversal Symposium like this. The Board and Council of the ISHS voted in favour of Georgia because, up to now, there had been no opportunity to organize an ISHS conference in this country.

The Symposium, which has the scope to focus the attention of the scientific world on the high potential (for breeding, landscape, uses and traditions, etc.) hidden in Crop Wild Relatives, has been set in the calendar for October 2008.

The two Conveners appointed, Dr. Zviad Bobokashvili, researcher at the Georgian Research Institute of Horticulture, Department of Fruit and Vine Crop Germplasm; and Dr. Maya Marghania of the Georgian Ministry of Agriculture, worked hard to get this conference on track for the last two years and were indeed very close to harvest the fruits of their efforts to unite participants to discuss a highly pressing topic: some issues in the vast area of plant genetic resources. The arguments used in the preliminary documents of this meeting were adopted by a number of scientists and later also politicians of the region showed their full interest, resulting in already a number of political initiatives targeted at the safeguard of genetic resources. In line of what is happening in the international area, the International Treaty, signed in the realm of the FAO, calls on all countries to safeguard and sustainably utilize plant genetic resources in order to be able to hand them over to future generations. Often, however, man loses the light of reason, and in a second, destroys the patient work of years.

The war between Georgia and Russia is a terrible event that the scientific world cannot accept. Raising arms to solve controversial issues between countries is not the way to go. The course of history, however, interferes today with the Symposium of Tbilisi, Georgia and forces us to put things on hold.

When I was a boy, my father taught me to accept people for what they are and what they do. As an adult, I have applied his lessons and can proudly say that I shared my table with many friends, Muslims or Christians, atheists or preachers. I always approached ethnic, religious or national diversity with an inner sentiment of friendship. This approach to different people is the reason why I was anxious about the fate of my friends during the earthquake in China and the hurricane in Louisiana; just as I am anxious these days for my Georgian and Russian friends. This is what I suggest the spirit of a researcher must be.

After the hurricane comes the calm… and, waiting for the calm, we suspend today the Symposium in Georgia but determined to reactivate it, where it should be held in the same place, when the quietness of peace will allow us to listen to the Russian speaker who speaks to us about Vavilov, or a Georgian fellow who tells us about a Patriarch living in the Vashlovani forest in Georgia, about this 900-years-old tree of *Pistacia mutica* that doesn't want to die under the bombs but wants to keep on living.

Damiano Avanzato, Chair ISHS Section Nuts and Mediterranean Climate Fruits

New ISHS Members

ISHS is pleased to welcome the following new members:

NEW INDIVIDUAL MEMBERS:

Argentina: Ms. Silvia Hongn, Dr. Maria Cecilia Rousseaux; **Australia:** Mr. Andrew Douglas, Dr. James Scott Hanan, Mr. Matthew Hannaford, Dr. Brian Joseph Jones, Mr. John Kennedy, Mr. Shane McCulloch, Karthika Rajendran, Ms. Siti Zaharah Sakimin, Mr. Andrew Thompson, James Lisle Thompson; **Austria:** Alessandro Holler; **Barbados:** Mr. John Leach; **Botswana:** Mr. Alistair Tite; **Brazil:** Marcos José Fonseca, Ms. Itamar Gislon, Dr. Roberto Leite; **Bulgaria:** Dr. Vania Kamenova, Mr. Rosen Radev; **Canada:** Mr. Ali Alamoudi, Sharon Anderson, Mr. Yves Dubé, Mr. Pete Hendriksen, Arianus M. Koeman, Ms. Jennifer Lawetz, Stephen Lebans, Greg Marles; **Chile:** Karl Conrads, Mr. Joseph Vella; **China:** Prof. Dr. Conglin Huang; **Colombia:** Mr. Javier Mauricio Aguirre; **Croatia:** Dr. Vjera Bilusic Vundac, Mr. Damir Lucic; **Cyprus:** Mr. Koullis Phylactou; **Egypt:** Prof. Dr. Ismail Abdel-Galil, Prof. Dr. Samir Z. 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Prof. Eric Schranz, Stefan Tekelenburg, Mr. Gerard van 't Klooster; **New Zealand:** Mr. Harvey Hall; **Nigeria:** Ms. Pamela Akin-idowu; **Norway:** Dr. Ishita Ahuja, Egil Ingvar Aune, Dr. Ole Petter Thangstad; **Oman:** Mr. Shauwn Basson; **Peru:** Assist. Prof. Carlos Chuquillanqui, Mr. Luis Razetto; **Philippines:** Mr. Eduardo Fajardo; **Portugal:** Ms. Ana Beirão, Mr. Ivo Pimentel, Rui Santos, Maria Vila-Chã; **Romania:** Mr. Adrian Bondor, Dr. Frasin Loredana Beatrice, Prof. Dr. Doru Pamfil, Dr. Silvia Preda; **Russian Federation:** Mr. Parviz Hajiyev; **Saudi Arabia:** Mr. Jean de Saxce; **Serbia:** Mr. Nenad Manojlovic; **Slovenia:** Mr. Tine Grebenc; **South Africa:** Mr. Nel Buks, Mr. Deon Coetzee, Jack de Mooij, Richard Devine, Mr. Calla Du Toit; **Spain:** Prof. Dr. Montaña Cámara, Dr. Victoria Fernandez, Dr. Victor Frias, Maria Jesus, Inmaculada Moreno Alías; **Sweden:** Dr. Hkan Asp, Dr. Sylvain Dubé, Mia Kristiansson, Prof. Dr. Johan Meijer, Vicente Pizarro; **Switzerland:** Michael Calhoun, Behcet Ciragan, Ms. Emilia De Angelis, Simon Egger, Prof. Dr. Donita Frazier, Prof. Dr. Urs Hilber; **Thailand:** Prof. Dr. Wandee Gritsanapan, Dr. Somsak Maneepong; **Trinidad and Tobago:** Mr. Steave Warner; **Tunisia:** Dr. Mohamed Neffati; **Turkey:** Semih Basay, Kubilay Bastas, Mr. Bartu Bugatur, Mr. Attila Kadikoy, Ms. Cigdem Kildir, Mr. Hayim Kohen, Mr. Mustafa Ozsoy; **United Arab Emirates:** Mr. Husein Karimjee; **United Kingdom:** Ms. Kate Boothman Meier, Mr. Mike Brown, Ms. Tina Ebimami, Ms. Rachel English, Dr. Sharon Hall, Mr. Peter Hill, Mr. Steve Homer, Mr. Graham Moore, Ms. Ruth Smith, Mr. Jason Stockdale, Dr. Neal Wright, Dr. Kevin Wyse; **United States of America:** George Allen, Ruthie S. 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Roland Leatherwood, Robert Lee, Helena Mahias, Denise Massa, Hannah Mathers, Carmen Medina Mora, Mr. Gerald Miller, Mark Morrison, Mr. John Moussouris, Mr. George Nelson, Joe Nelson, Mr. Tri Nguyen, Anne Novitsky, Lawton Pearson, Connie Peters, Dr. Anil Ranwala, Tobias Ron Reid, Michael Ricks, Richard Rosecrance, Bryan Sakuma, David Sanford, Robin Shimabuku, Prof. Alan Taylor, Sven Verlinden, Mr. James Vickery, Jose Villarreal, Nicole Waterland, Christine Welge, Mr. David Whitwood, Dr. H. Dayton Wilde

Calendar of ISHS Events

For updates and more logon to www.ishs.org/calendar. To claim the reduced registration for ISHS members make sure your ISHS membership is current and mention your membership number when registering. See www.ishs.org/directory/ if in doubt regarding your ISHS membership status.

YEAR 2008

- September 1-5, 2008, Dresden, Pillnitz (Germany): **I International Symposium on Biotechnology of Fruit Species.** Info: Dr. Viola Hanke, Baz, Institute for Fruit Breeding, Pillnitzer Platz 3a, 01326 Dresden, Germany. Phone: (49)3512.616.214, Fax: (49)3512.616.213, E-mail: v.hanke@bafz.de Web: http://www.biotechfruit2008.bafz.de

- September 1-5, 2008, Gent (Belgium): **II International Humulus Symposium.** Info: Dr. Denis De Keukeleire, Ghent University, Laboratory of Pharmacognosy and Phytochemistry, Harelbekestraat 72, 9000 Gent, Belgium. Phone: (32)478369850 or 92648055, Fax: (32)92648192, E-mail: denis.dekeukeleire@ugent.be or Dr. Kim Hummer, USDA ARS NCGR, 33447 Peoria Road, Corvallis, OR 97333-2521, United States of America. Phone: (1)541.738.4201, Fax: (1)541.738.4205, E-mail: kim.hummer@ars.usda.gov E-mail symposium: arne.heyerick@ugent.be Web: http://www.ishshumulus2008.ugent.be/

- September 3-6, 2008, Stellenbosch (South Africa): **IX International Protea Research Symposium and XIII International Protea Association Conference.** Info: Mr. Hans Hettasch, Arnelia Farms, P.O. Box 192, 7355 Hopefield, South Africa. Phone: (27)227231022, Fax: (27)227231022, E-mail: arnelia@intekom.co.za or Dr. Retha Venter, International Protea Association, PO Box 5600, Helderberg, Somerset West 7135, South Africa. Phone: (27)218554472, Fax: (27)218552722, E-mail: reventer@netactive.co.za Web: http://www.ipa2008.co.za

- September 8-12, 2008, Lillehammer (Norway): **V International Symposium on Brassicas and XVI Crucifer Genetics Workshop.** Info: Dr Magnor Hansen, Agricultural University of Norway, Dept. of Hort & Crop Science, PO Box 5022, N 1432 Aas, Norway. E-mail: magnor.hansen@umb.no E-mail symposium: brassica2008@umb.no Web: http://www.brassica2008.no/

- September 9-12, 2008, Plovdiv (Bulgaria): **IV Balkan Symposium on Vegetables and Potatoes.** Info: Prof. Dr. Liliya Krasteva, Institute of Plant Genetic Resources, 2 Drujba Str., 4122 Sadovo, Bulgaria. Phone: (359)32629026, Fax: (359)32629026, E-mail: krasteva.liliya@gmail.com Web: http://www.4bsvp.org/

- September 9-13, 2008, Evora (Portugal): **VI International Symposium on Olive Growing.** Info: Prof. Dr. Anacleto Pinheiro, Universidade de Évora, Departamento de Engenharia Rural, Apartado 94, 7002-554 Évora, Portugal. Phone: (351) 266 760 837, Fax: (351)266 760 911, E-mail: pinheiro@uevora.pt or Dr. Manuel Pedro Fevereiro, ITQB, Quinta do Marques, Apt° 127, 2780 Oeiras, Portugal. Phone: (351)214469447, Fax: (351)214411277, E-mail: psalema@itqb.unl.pt Web: http://olivegrowing.uevora.pt

- September 9-13, 2008, Villa de Leyva (Colombia): **International Symposium on Tomato in the Tropics.** Info: Prof. Dr. Gerhard Fischer, Universidad Nacional Colombia, Facultad de Agronomia, Apartado Aéreo 14490, Bogota, Colombia. Phone: (57)13165498 or 3165000ext19041, Fax: (57)13165498, E-mail: gerfischer@gmail.com or Dr. Alonso Gonzales-Mejia, CIAT, Dept. Tropical Fruits, recta Cali-Palmira Km. 17, Cali, A.A. 6713, Colombia. Phone: (57)24450000, Fax: (57)24450073 E-mail symposium: soccolhort@gmail.com Web: http://www.soccolhort.com/tomato/

- September 21-25, 2008, Baoding (China): **I International Jujube Symposium.** Info: Prof. Dr. Mengjun Liu, Research Center of Chinese Jujube, Agricultural Univesity of Hebei, Baoding, Hebei, 71001, China. Phone: (86)312754342, Fax: (86)3127521251, E-mail: kjliu@hebau.edu.cn E-mail symposium: ijs2008@hebau.edu.cn Web: http://www.ziziphus.net/2008/

- September 22-29, 2008, Alnarp (Sweden): **IV International Symposium Toward Ecologically Sound Fertilization Strategies for Field Vegetable Production.** Info: Prof. Rolf Larsen, Department of Crop Science, P.O. Box 44, S-230 53 Alnarp, Sweden. Phone: (46)40-415369, Fax: (46)40460441, E-mail: rolf.larsen@vv.slu.se Web: http://ishs2008.slu.se/

- NEW September 25-28, 2008, Beijing (China): **IV International Chestnut Symposium.** Info: Prof. Dr. Ling Qin, Beijing Agricultural College, No 7 Beinong Road, Changpin District, Beijing 102206, China. Phone: (86)1080799136 or 1080799126, Fax: (86)1080799004, E-mail: qinlingbac@126.com E-mail symposium: chestnut2008@126.com Web: http://www.chestnut.org.cn

- NEW October 5-8, 2008, Tbilisi (Georgia): **International Symposium on Current and Potential Uses of Nut Trees Vine Perennials.** Info: Dr. Zviad Bobokashvili, Georgian Res. Inst. of Horticulture, Dept. Fruit and Vine Crop Germplasm, D. Gulua Street #6, Tbilisi 0115, Georgia. Phone: (995)93 357 13, E-mail: bobokashvili@hotmail.com or Dr. Maya Mamharghania, Kostava 41, Tbilisi, Georgia. Phone: (995 999 15076, E-mail: mmarghania@hotmail.com Web: http://www.nutssymposium2008.ge/ **Postponed until October 2009**

POSTPONED

- October 5-9, 2008, Mombasa (Kenya): **International Conference Banana and Plantain in Africa. Harnessing International Partnerships to Increase Research Impact.** Info: Thomas Dubois, IITA c/o Lambourn Ltd, Carolyn House, 26 Dingwall Road, Croydon CR9 3EE, United Kingdom. Phone: (256)75 2787808, Fax: (256)41 285079, E-mail: t.dubois@cgiar.org Web: http://www.banana2008.com

- October 14-17, 2008, Beijing (China): **II International Symposium on Vegetable Production and Quality and Process Standardization in Chain: a Worldwide Perspective.** Info: Dr. Wei Liu, Beijing Vegetable Research Center, Quality Control, PO Box 2443, Beijing 100097, China. Phone: (86)1051503003, Fax: (86)1088446286, E-mail: liuwei@nercv.com or Prof. Dr. Silvana Nicola, Dipartimento di Agronomia, Selvicoltura e Gestione del Territorio, Via Leonardo Da Vinci 44, 10095 Grugliasco (TO), Italy. Fax: (39)0112368773, E-mail: silvana.nicola@unito.it Web: http://www.bvrc.com.cn/Vege2008Beijing/

- October 20-24, 2008, Tucson, AZ (United States of America): **International Workshop on Greenhouse Environmental Control and Crop Production in Semi-Arid Regions.** Info: Prof. Dr. Gene A. Giacomelli, University of Arizona, Controlled Environment Agric. Ctr., CEA Building, 1951 E. Roger Road, Tucson, AZ 85719, United States of America. Phone: (1)5206269566, Fax: (1)5206261700, E-mail: giacomel@ag.arizona.edu Web: http://www.ghworkshoparidregions2008.org/

- October 22-24, 2008, Sevilla (Spain): **VII International Workshop on Sap Flow.** Info: Dr. José Enrique Fernandez, Inst. de Rec. Nat.y Agrobiol., Campus de Reina Mercedes, Apartado 1052, 41080 Sevilla, Spain. Phone: (34)954624711, Fax: (34)954624002, E-mail: jefer@irnase.csic.es Web: http://www.7iwsapflow.com/

- NEW October 28, 2008, Brussels (Belgium): **ISAFRUIT Forum: Increasing Fruit Consumption to Improve Health.** Info: Dr. Sharon Hall, Warwick HRI, University of Warwick, Wellesbourne, CV35 9EF Warwick, United Kingdom. Phone: (44)2476575254, Fax: (44)2476574500, E-mail: sharon.hall@warwick.ac.uk Web: http://www.isafruit.org

- NEW October 29-31, 2008, Geisenheim (Germany): **Workshop on Berry Production in Changing Climate Conditions and Cultivation Systems.** Info: Dr. Erika Krüger, Forschungsanstalt Geisenheim, Fachgebiet Obstbau, Von-Lade-Strasse 1, 65366 Geisenheim, Germany. Phone: (49)6722502561, Fax: (49)6722502560, E-mail: krueger@fa-gm.de or Dr. Christoph Carlen, Res.Stat.Agroscope Changins, Wädenswil ACW, Centre des Fougères, 1964 Conthey, Switzerland. Phone: (41) 27 345 35 11, Fax: (41) 27 346 30 17, E-mail: christoph.carlen@acw.admin.ch or Prof. Dr. Bruno Mezzetti, Dip.di Scienze Amb. e delle Prod.Veg., Università Politecnica delle Marche, Via Brecce Bianche, Ancona 60100, Italy. Phone: (39)0712204933, Fax: (39)0712204858, E-mail: b.mezzetti@univpm.it E-mail symposium: krueger@fa-gm.de Web: http://www.cost863climatechange.de/

- November 3-7, 2008, Bogor (Indonesia): **IV International Symposium on Tropical and Subtropical Fruits.** Info: Dr. Roedhy Poerwanto, Jl. Abiyasa Raya No. 1, Bantarjati, 16143 Bogor, Indonesia. Phone: (62)251328942, Fax: (62)251326881, E-mail: roedhy@indo.net.id Web: http://www.ifs2008.info/

- November 4-7, 2008, Berlin (Germany): **Postharvest Unlimited 2008.** Info: Dr. Martin Geyer, Inst. für Agrartechnik Bornim, Abteilung Technik im Gartenbau, Max-Eyth-Allee 100, 14469 Potsdam-Bornim, Germany. Phone: (49)3315699610, Fax: (49)3315699849, E-mail: geyer@atb-potsdam.de Web: http://www.atb-potsdam.de/postharvest08

- November 8-13, 2008, Firenze, Faenza and Caserta (Italy): **IV International Symposium on Persimmon.** Info: Prof. Dr. Elvio Bellini, University of Firenze, Horticultural Department, Viale delle idee 30, 50019 Sesto Fiorentino, Italy. Phone: (39)0554574053, Fax: (39)0554574017, E-mail: elvio.bellini@unifi.it or Dr. Edgardo Giordani, Department of Horticulture, University of Florence, Viale delle Idee 30, 50019 Sesto Fiorentino)FI), Italy. Phone: (39)0 55 4574050, Fax: (39)0 55 4574017, E-mail: edgardo.giordani@unifi.it Web: http://www.4persimmon2008.it

- November 9-14, 2008, Cape Town (South Africa): **WOCMAP IV: World Congress on Medicinal and Aromatic Plants.** Info: Prof. Dr. Kobus J.N. Eloff, Phytomedicine Programme, University of Pretoria, Private Bag X04, Onderstepoort 0110, South Africa. Phone: (27)12-5298244, Fax: (27)12 5298525, E-mail: kobus.eloff@up.ac.za E-mail symposium: wocmap@up.ac.za Web: http://www.wocmap2008.com/

- November 10-13, 2008, Mérida (Mexico): **II International Symposium on Guava and other Myrtaceae.** Info: Dr. Wolfgang Rohde, MPIZ, Calf-von-Linné-Weg 10, 50829 Koeln, Germany. Phone: (49)2215062101, Fax: (49)2215062113, E-mail: rohde@mpiz-koeln.mpg.de or Dr. Jose Saul Padilla Ramirez, INIFAP-Campo Experimental Pabellon, Km. 32,5 Carr. Aguascalientes-Zacatecas, Apdo Postal No. 20 CP 20660, Pabellon de Arteaga, Aguascalientes, Mexico. Phone: (52)4659580167, Fax: (52)4659580167 Web: http://www.cicy.mx/eventos/guavasymposium2008/

- December 7-11, 2008, Chiang Mai (Thailand): **XVI International Symposium on Horticultural Economics and Management.** Info: Peter J. Batt, Horticulture, Curtin University of Technology, GPO box U1987, Perth, WA 6845, Australia. Phone: (61)8 9266 7596, Fax: (61)8 9266 3063, E-mail: p.batt@curtin.edu.au or Prof. Dr. Peter P. Oppenheim, Deakin Business School, Deakin University, 336 Glenferrie Road, Malvern, VIC 3144, Australia. Phone: (61)3 9244 5549, Fax: (61)3 9244 5040 Web: http://www.muresk.curtin.edu.au/conference/ishsem

- December 7-11, 2008, Chiang Mai (Thailand): **V International Symposium on Horticultural Research, Training and Extension.** Info: Peter J. Batt, Horticulture, Curtin University of Technology, GPO box U1987, Perth, WA 6845, Australia. Phone: (61)8 9266 7596, Fax: (61)8 9266 3063, E-mail: p.batt@curtin.edu.au or Associate Professor Dr. David Aldous, University of Melbourne, Burnley College, Swan Street, Richmond VIC 3121, Australia. Phone: (61)0392506800, Fax: (61)0392506885 Web: http://www.muresk.curtin.edu.au/conference/ishset

- December 8-12, 2008, Bangalore (India): **IV International Symposium on Acclimatization and Establishment of Micropropagated Plants.** Info: Dr. Jitendra Prakash, In Vitro International Pvt. Ltd., #12/44, Rajiv Gandhi Nagar, Bommanahalli, Bangalore 560 068, India. Phone: (91)80 41109273, Fax: (91)80 25727030, E-mail: invitro@bgl.vsnl.net.in Web: http://www.int-tissueculturecconf.org/

- December 9-12, 2008, Madurai, Tamil Nadu (India): **II International Symposium on Papaya.** Info: Dr. N. Kumar, Department of Fruit Crops, Horticultural College & Research Institute, Priyakulam, 625 604, India. Phone: (91)4546231726, Fax: (91)4546231726, E-mail: kumarhort@yahoo.com Web: http://www.ishs-papaya2008.com/

YEAR 2009

- NEW January 28 - February 1, 2009, Dharwad (Karnataka State) (India): **II International Symposium on Pomegranate and Minor, including Mediterranean, Fruits.** Info: Dr. Jagadish Hanamant Kulkarni, University of Agricultural Sciences, UAS, Dharwad 580 005, Karnataka, India. Phone: (91)8362447783, Fax: (91)8362448349, E-mail: jhkulkarni@yahoo.co.in or Dr. Mohammed Kaiser Sheikh, College of Agriculture, Department of Horticulture, Bijapur 586 104, Karnataka, India. Phone: (91)08352267378, Fax: (91)08352267378, E-mail: dr_mksheikh@yahoo.co.in Web: http://www.uasd.edu/pomegranatesymposium

- February 25-27, 2009, Melbourne (Australia): **VI International Walnut Symposium.** Info: Mr. Bryan Goble, Walnut Producer, 222 Kerang-Koondrook Rd, Koondrook, VIC 3580, Australia. E-mail: btgoble@westnet.com.au or Dr. Leigh Titmus, PO Box 417, Devonport, TAS 7310, Australia. Phone: (61)364283539, E-mail: leigh.titmus@websterltd.com.au Web: http://www.walnut.net.au/symposium_2009.htm

- NEW March 26-28, 2009, Jerba (Tunisia): **International Symposium on Medicinal and Aromatic Plants SIPAM2009.** Info: Dr. Mohamed Neffati, Institut des Regions Arides (IRA), 4119 Medenine, Tunisia. Phone: (216)75633839, Fax: (216)75633006, E-mail: neffati.mohamed@ira.rnrt.tn

- April 4-7, 2009, Antalya (Turkey): **X International Controlled and Modified Atmosphere Research Conference.** Info: Dr. Mustafa Erkan, Dep. of Horticulture, Fac. of Agric. Akdeniz Univ., 07058 Antalya, Turkey. Phone: (90) 242 3102428, Fax: (90) 242 2274564, E-mail: erkan@akdeniz.edu.tr Web: http://www.cama2009.com/

- NEW April 5-8, 2009, Leuven (Belgium): **I International Symposium on Cryopreservation in Horticultural Species.** Info: Dr. Bart Panis, Kasteelpark Arenberg 13, 3001 Leuven, Belgium. Phone: (32)16-321690, Fax: (32)16-321993, E-mail: bart.panis@biw.kuleuven.be or Prof. Rony Swennen, Lab. Tropische Plantenteelt, Kasteelpark Arenberg 13, 3001 Leuven, Belgium. Phone: (32)16321421, Fax: (32)16321993 E-mail symposium: ISHSPlantCryo@biw.kuleuven.be Web: http://www.agr.kuleuven.ac.be/dtp/tro/ISHSplantcryo/index.htm

- April 8-12, 2009, Antalya (Turkey): **VI International Postharvest Symposium.** Info: Dr. Mustafa Erkan, Dep. of Horticulture, Fac. of Agric. Akdeniz Univ., 07058 Antalya, Turkey. Phone: (90) 242

3102428, Fax: (90) 242 2274564, E-mail: erkan@akdeniz.edu.tr Web: http://www.postharvest2009.com/

- May 20-24, 2009, Krokos, Kozani (Greece): **III International Symposium on Saffron Biology and Technology: Forthcoming Challenges in Cultivation, Research and Economics.** Info: Dr. Maria Tsimidou, Aristotle University Thessaloniki, Chemistry Department, Lab. FD Chemical Technology, 54124 Thessaloniki, Greece. Phone: (30)2310997796, Fax: (30)2310997779, E-mail: tsimidou@chem.auth.gr

- May 24-29, 2009, Gifu (Japan): **V International Symposium on Rose Research and Cultivation.** Info: Prof. Yoshihiro Ueda, Gifu International Academy of Horticulture, 1094-8 Shio, Kani-shi, Gifu Pref., Japan. Phone: (81)574605547, Fax: (81)574605547, E-mail: ueda-yoshihiro@horticulture.ac.jp E-mail symposium: rose2009@jecs.org Web: http://www1.gifu-u.ac.jp/~rose/index.html

- June 1-5, 2009, Charlotte, NC (United States of America): **II International Symposium on Growing Media and Composting.** Info: William C Fonteno III, North Carolina State University, Dept. of Horticultural Science, Box 7609 - 152 Kilgore Hall, Raleigh, NC 27695-7609, United States of America. E-mail: bill_fonteno@ncsu.edu

- June 8-11, 2009, Lleida (Spain): **VII International Peach Symposium.** Info: Dr. Joan Girona, Centre UdL-IRTA, Rovira Roure, 177, 25198 Lleida, Spain. Phone: (34)973 702587, Fax: (34)973 238301, E-mail: joan.girona@irta.es

- June 9-13, 2009, Bologna (Italy): **II Conference on Landscape and Urban Horticulture.** Info: Prof. Dr. Giorgio Prosdocimi Gianquinto, Dip. Scienze e Tecnologie Agroambientali , DISTA, Università degli Studi di Bologna, Viale Fanin, 44 - 40127 Bologna , Italy. Phone: (39) 0512096641, Fax: (39) 0512096245 , E-mail: giorgio.gianquinto@unibo.it or Prof. Dr. Alessandro Chiusoli, Dept. DCA, via Fanin 46, 40127 Bologna, Italy. Phone: (39)051 2096446, Fax: (39)051 2096450, E-mail: alessandro.chiusoli@unibo.it E-mail symposium: dista.luh2009@unibo.it Web: http://www.luh2009.org

- June 14-19, 2009, Quebec City (Canada): **International Conference on Sustainable Greenhouse Systems - Greensys2009.** Info: Prof. André Gosselin, Université Laval, Pavillon ENVIROTRON, Ste-Foy (Quebec), G1K 7P4, Canada. Phone: (1)4186562131ext2068, Fax: (1)4186567871, E-mail: andre.gosselin@crh.ulaval.ca or Ms. Martine Dorais, Horticultural Research Center , Laval University, Envirotron Bldg, Room 2120, Quebec G1K 7P4, Canada. Phone: (1)418-6562131, Fax: (1)418-6567871, E-mail: doraisma@agr.gc.ca E-mail symposium: info@greensys2009.com Web: http://www.greensys2009.com/

- June 15-17, 2009, (Turkey): **I International Mulberry Symposium.** Info: Prof. Dr. Sezai Ercisli, Ataturk University Agricultural Faculty, Department of Horticulture, 25240 Erzurum, Turkey. Phone: (90) 442-2312599, Fax: (90) 442 2360958, E-mail: sercisli@atauni.edu.tr E-mail symposium: sercisli@hotmail.com

- June 16-19, 2009, Saint-Pol de Léon (France): **VII International Symposium on Artichoke, Cardoon and their Wild Relatives.** Info: Christophe Bazinet, Bretagne Biotechnologie Végétale (BBV), Pen Ar Prat., 29250 Saint-Pol de Leon, Brittany, France. Phone: (33)298290644, Fax: (33)298692426, E-mail: bazinet@bbv.fr E-mail symposium: contact@bbv.fr Web: http://www.vegenov.com/artichoke_symposium/

- July 29 - August 1, 2009, Corvallis, Oregon (United States of America): **International Symposium on Molecular Markers in Horticultural Species.** Info: Dr. Nahla V. Bassil, Plant Geneticist, Nat'l Clone Germplasm Repository, 33447 Peoria Road, Corvallis, OR 97331-23521, United States of America. Phone: (1)5417384214, Fax: (1)5417384205, E-mail: nahla.bassil@ars.usda.gov E-mail symposium: conferences@oregonstate.edu Web: http://oregonstate.edu/conferences/molecularmarkers2009/

- August 31 - September 4, 2009, Wageningen (Netherlands): **XXIII Eucarpia Symposium on Ornamentals - Colorful Breeding and Genetics.** Info: Dr. J.M. Van Tuyl, Plantbreeding, Wageningen University & Research Center, Droevendaalse steeg 1, 6708 PB Wageningen, Netherlands. Phone: (31)317477329, Fax: (31)317418094, E-mail: jaap.vantuyl@wur.nl Web: http://www.ornamentalbreeding.nl/

- September 8-11, 2009, Balsgard (Sweden): **II International Rose Hip Conference.** Info: Prof. Hilde Nybom, Balsgard-Dept. Crop Science, Swedish Univ. Of Agric. Sci., Balsgard Fjalkestadsvagen 459, S-291 94 Kristianstad, Sweden. Phone: (46)44265802, Fax: (46)44265830, E-mail: hilde.nybom@ltj.slu.se

- September 14-18, 2009, Guangzhou, Guangdong (China): **International ISHS-ProMusa Symposium: Global Perspectives on Asian Challenges.** Info: Prof. Dr. Ganjun Yi, Fruit Tree Research Institute, Guangdong Academy of Agricultural Sciences, Wushan, Guangzhou Guangdong 510640, China. Phone: (86)2038765869 or 13302200898, Fax: (86)2038765626, E-mail: yiganjun@vip.163.com or Dr. Augustin B. Molina, Bioversity Asia & The Pacific, 3rd Floor, Collaborator Centre, c/o IRRI Khush Hall, Los Baños, Laguna 4031, Philippines. Phone: (63)495360532, Fax: (63)495360532, E-mail: a.molina@cgiar.org or Dr. Inge Van den Bergh, Bioversity International, 1990 Boulevard de la Lironde, Parc Scientifique Agropolis II, 34397 Montpellier, France. Phone: (33)4-67611302, Fax: (33)4-67610334, E-mail: i.vandenbergh@cgiar.org

- September 20-24, 2009, Bologna (Italy): **XI International Symposium on Plant Bioregulators in Fruit Production.** Info: Prof. Guglielmo Costa, Ordinario di Arboricoltura Generale, Dipartimento di Colture Arboree, Via G. Fanin 46, 40127 Bologna, Italy. Phone: (39)051 20 9 6443, Fax: (39)051 20 9 6401, E-mail: guglielmo.costa@unibo.it E-mail symposium: scientific@bologna2009.it Web: http://www.ishs.pbr.bologna2009.it/

- September 21-26, 2009, Changsha, Hunan (China): **IV International Cucurbit Symposium.** Info: Prof. Xiaowu Sun, No.587, Dongda Road, Shaoyang City, Hunan, 422001, China. Phone: (86)739-5050618, Fax: (86)739-5050652 E-mail symposium: cucurbit2009@188.com Web: http://www.cucurbit2009.org

- September 29 - October 3, 2009, Meknes (Morocco): **IV International Symposium on Fig.** Info: Prof. Dr. Messaoudi Zerhoune, Dept. Arboriculture-Viticulture, Ecole Nationale d'Agriculture de Meknes, B.P. S/40, 50000 Meknes, Morocco. Phone: (212)61353653, Fax: (212)35300238, E-mail: messaoudiz@yahoo.fr

- October 4-7, 2009, London (United Kingdom): **International Symposium on Plants for People and Places – Valuing Plants and Human Welfare.** Info: Erin Taylor, Group Development Manager, SCI – International Headquarters, 14-15 Belgrave Square, London, SW1X 8PS, United Kingdom. Phone: (44)2075981594, Fax: (44)2075981545, E-mail: erin.taylor@soci.org Web: www.soci.org/events

- October 13-17, 2009, Sanliurfa (Turkey): **V International Symposium on Pistachios and Almonds.** Info: Prof. Dr. Bekir Erol Ak, University of Harran, Faculty of Agriculture, 63200 Sanliurfa, Turkey. Phone: (90)4142470384 2319, Fax: (90)4142470384, E-mail: beak@harran.edu.tr

- October 14-16, 2009, Cuneo (Italy): **I European Congress on Chestnut - Castanea 2009.** Info: Prof. Dr. Giancarlo Bounous, Dipartimento di Colture Arboree, Università degli studi di Torino, Via Leonardo da Vinci 44, 10095 Grugliasco, TO, Italy. Phone: (39)0116708653, Fax: (39)0116708658, E-mail: giancarlo.bounous@unito.it E-mail symposium: castanea2009.dca@unito.it Web: http://www.arboree.unito.it/castanea2009

- October 18-21, 2009, Murcia (Spain): **V International Symposium on Seed , Transplant and Stand Establishment.** Info: Dr. Francisco Perez-Alfocea, Dept. Of Irrigation and Salinity, CEBAS - CSIC, PO Box 4195, 30080 Murcia, Spain. Phone: (34)968396200, Fax: (34)968396213, E-mail: alfocea@cebas.csic.es or Dr. Jose A. Pascual Valero, CEBAS-CSIS, Campus Univ. De Espinardo s/n, 30100 Murcia, Spain. Phone: (34)968396200, Fax: (39)968396213

- NEW October 27-29, 2009, Nasser City, Cairo (Egypt): **XIII International Conference and Exhibition: Medicinal and Aromatic Plants - Challenges and Opportunities.** Info: Prof. Dr. Ismail Abdel-Galil, Desert Research Center, 1, Mothaf El-Matariya, Cairo, Egypt. Phone: (20)226374800 or 26332846, Fax: (20)226357858, E-mail: ismaill@brainy1.ie-eg.com or Dr. Farouk El-Shobaki, ESMAP, 6, Dr. Farouk El-Shobaki Street, El-Koum El-Akhdar, Pyramids, Giza, Egypt. Phone: (20)233869898, Fax: (20)233841120, E-mail: drfarouk@elshobaki.com

- NEW October 29 - November 1, 2009, Lima (Peru): **XII International Asparagus Symposium.** Info: Prof. Andres V. Casas Diaz, Dept. Of Horticulture, Univ. Nac. Agraria - La Molina, Apdo. 12-056, Lima 12, Peru. Phone: (51)13485796, Fax: (51)13481660, E-mail: cda@lamolina.edu.pe

- November 2-6, 2009, Viña del Mar (Chile): **VI International Symposium on Irrigation of Horticultural Crops.** Info: Dr. Samuel Ortega-Farias, Casilla 747, Talca, Chile. Phone: (56)71200214, Fax: (56)71200214, E-mail: sortega@utalca.cl or Gabriel Selles, Inst. De Invest. Agro., Santa Rosa 11610, Santiago, Chile. Phone: (56)27575105, E-mail: gselles@inia.cl or Nelson Pereira Muñoz, National Irrigation Commission, Alameda B. O'Higgins 1449, Piso 4°, Santiago, Chile. Phone: (56)024257914, Fax: (56)024257901, E-mail: nelson.pereira@cnr.gob.cl

- November 15-19, 2009, Tsukuba (Japan): **VI International Symposium on Light in Horticulture.** Info: Eiji Goto, Chiba University, 648 Matsudo, Chiba 271-8510, Japan. Phone: (81)47-308-8841, Fax: (81)47-308-8842, E-mail: goto@faculty.chiba-u.jp E-mail symposium: info@lightsym2009.jp Web: http://www.lightsym2009.jp

- NEW November 15-20, 2009, Santiago (Chile): **VI International Cherry Symposium.** Info: Dr. Marlene Ayala, Departamento de Fruticultura y Enología, Facultad de Agronomía e Ingeniería Forestal, Casilla 306 Correo 22, Santiago, Chile. Phone: (56)6864159 , Fax: (56)5534130, E-mail: mayalaz@uc.cl or Prof. Juan Pablo Zoffoli, Av Vicuna Mackenna 4860, Dept. Fruticultura y Enologia, Santiago 30622, Chile. Phone: (56)2 686 4159, Fax: (56)2 5534130, E-mail: zoffolij@uc.cl

- NEW November 25-27, 2009, New Delhi (India): **II International Symposium on Medicinal and Nutraceutical Plants** Info: Dr. Sushil Chandra Mahapatra, All India Institute for Medical Sciences, Nutrition&Phytomed. Lab, - Dept. Physiology, Ansari Nagar, New Delhi 110 608, India. Phone: (91)1126594812, Fax: (91)1126588641, E-mail: scmahapatra@gmail.com

- November 30 - December 4, 2009, Campinas (Brazil): **International Symposium on Genetic Research of Bamboos and Palms.** Info: Dr. Antonio Fernando Tombolato, Instituto Agronomico, Avenida Barão de Itapura 1481, Caixa Postal 28, 13012-970 Campinas SP, Brazil. Phone: (55)1932415188, Fax: (55)1932417570, E-mail: tombolat@iac.sp.gov.br or Prof. Kathia Pivetta, Rodovia Carlos Tonanni, Km 5, Departamento de Horticultura, 14870-000 Jaboticabal, Brazil. Phone: (55)163232500, Fax: (55)163224275, E-mail: kathia@fcav.unesp.br

YEAR 2010

- NEW January 12-15, 2010, Taichung (Taiwan): **I International Orchid Symposium.** Info: Dr. Yung-I Lee, Botany Department, National Museum of Natural Science, N0 1, Kuan-Chien Rd., Taichung 404, Taiwan. Phone: (886)-4-23226940-153, Fax: (886)-4-23285320, E-mail: leeyungi@hotmail.com or Assist. Prof. Erik Runkle, A240-C Plant & Soil Sci. Bldg., Michigan State University, East Lansing, MI 48824, United States of America. Phone: (1)517.355.5191 x350, Fax: (1)517.353.0890, E-mail: runkleer@msu.edu

- May 3-6, 2010, Antakya-Hatay (Turkey): **III International Symposium on Loquat.** Info: Prof.Dr. A. Aytekin Polat, Mustafa Kemal University, Faculty of Agriculture, Dept. of Horticulture, Antakya Hatay, 31034, Turkey. Phone: (90)6232455605, Fax: (90)3262455832, E-mail: apolat@mku.edu.tr

- July 25-30, 2010, Ischia (NA) (Italy): **III International Symposium on Tomato Diseases.** Info: Prof.Dr. Aniello Crescenzi, Dip.di Biol, Difesa e Biotech Agro-Forestale, Fac. di Agraria, University of Basilicata, Via dell'At. Lucano 10, Lotto 3a, Stanza 310, 85100 Potenza (Potenza), Italy. Phone: (39)0971205700, Fax: (39)0971205703, E-mail: aniello.crescenzi@unibas.it

- August 1-5, 2010, Geneva, NY (United States of America): **X International Conference on Grapevine Breeding and Genetics.** Info: Bruce Reisch, NY State Agric. Exp. Station, 630 W. North Street, Geneva, NY 14456, United States of America. Phone: (1)3157872239, Fax: (1)3157872216, E-mail: birl@cornell.edu

- NEW August 15-19, 2010, Warsaw (Poland): **XII International Workshop on Fire Blight.** Info: Dr. Piotr Sobiczewski, Res. Inst. of Pomology, Ul. Pomologiczna 18, 96-100 Skierniewice, Poland. Phone: (48)46 8332021, Fax: (48)46 8333228, E-mail: psobicz@insad.pl

- August 19, 2010, Lisbon (Portugal): **Meeting of the ISHS Executive Committee**

- August 20-21 and 26, 2010, Lisbon (Portugal): **Joint meeting of the ISHS Executive Committee and Council**

- August 22-27, 2010, Lisbon (Portugal): **XXVIII International Horticultural Congress - IHC2010.** Info: Prof. Dr. António A. Monteiro, Instituto Superior de Agronomia, Technical University of Lisbon, Tapada da Ajuda, 1349-017 Lisboa, Portugal. Phone: (351)213653451, Fax: (351)213623262, E-mail: amonteiro@isa.utl.pt or Dr. Víctor Galán Saúco, Inst. Canario de Inv. Agrar., I.C.I.A., Apartado 60, 38200 La Laguna, Tenerife, Spain. Phone: (34)922476321, Fax: (34)922476303, E-mail: vgalan@icia.es E-mail symposium: info@ihc2010.org Web: http://www.ihc2010.org

- NEW August 30 - September 3, 2010, Pescia (PT) - Tuscany (Italy): **II International Symposium on the Genus Lilium.** Info: Dr. Antonio Grassotti, CRA-VIV, Via dei Fiori 8, 51012 Pescia (PT), Italy. Phone: (39)0572451033, Fax: (39)0572453309, E-mail: antonio.grassotti@entecra.it

- NEW September 15-30, 2010, Faenza (Italy): **VII International Symposium on Kiwifruit.** Info: Prof. Guglielmo Costa, Ordinario di Arboricoltura Generale, Dipartimento di Colture Arboree, Via G. Fanin 46, 40127 Bologna, Italy. Phone: (39)051 20 9 6443, Fax: (39)051 20 9 6401, E-mail: guglielmo.costa@unibo.it

- NEW September 20-21, 2010, Vienna (Austria): **V International Phylloxera Symposium.** Info: Prof. Dr. Astrid Forneck and Dr. Michaela Griesser, University of Natural Resources and Applied Life Sciences, Department of Applied Plant Sciences and Plant Biotechnology, Institute of Horticulture and Viticulture, Peter Jordan Str. 82, A-1190 Vienna, Austria. Phone: (43)1476543441, Fax: (43)1476543359, E-mail: astrid.forneck@boku.ac.at and michaela.griesser@boku.ac.at

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- Medical scientists and practitioners
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Draft Programme

The aim of this conference is to provide a mixture of paper reading sessions, plenary sessions with invited speakers and poster sessions. As well as both free ranging seminars and structured seminars highlighting the contents of the posters.

Sunday 4 October 2009
Registration and reception

Monday 5 October 2009
Conference
Evening drinks reception and poster session

Tuesday 6 October 2009
Conference followed by evening event

Wednesday 7 October 2009
Morning conference
Afteroon visit
Farewell dinner

Thursday 8 October 2009
Optional post symposium excursion

Call for Abstracts

To submit abstracts for oral and poster presentations , please send a 300 word abstract to erin.taylor@soci.org by the end of November 2008. Templates for abstracts can be found on the website below.

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