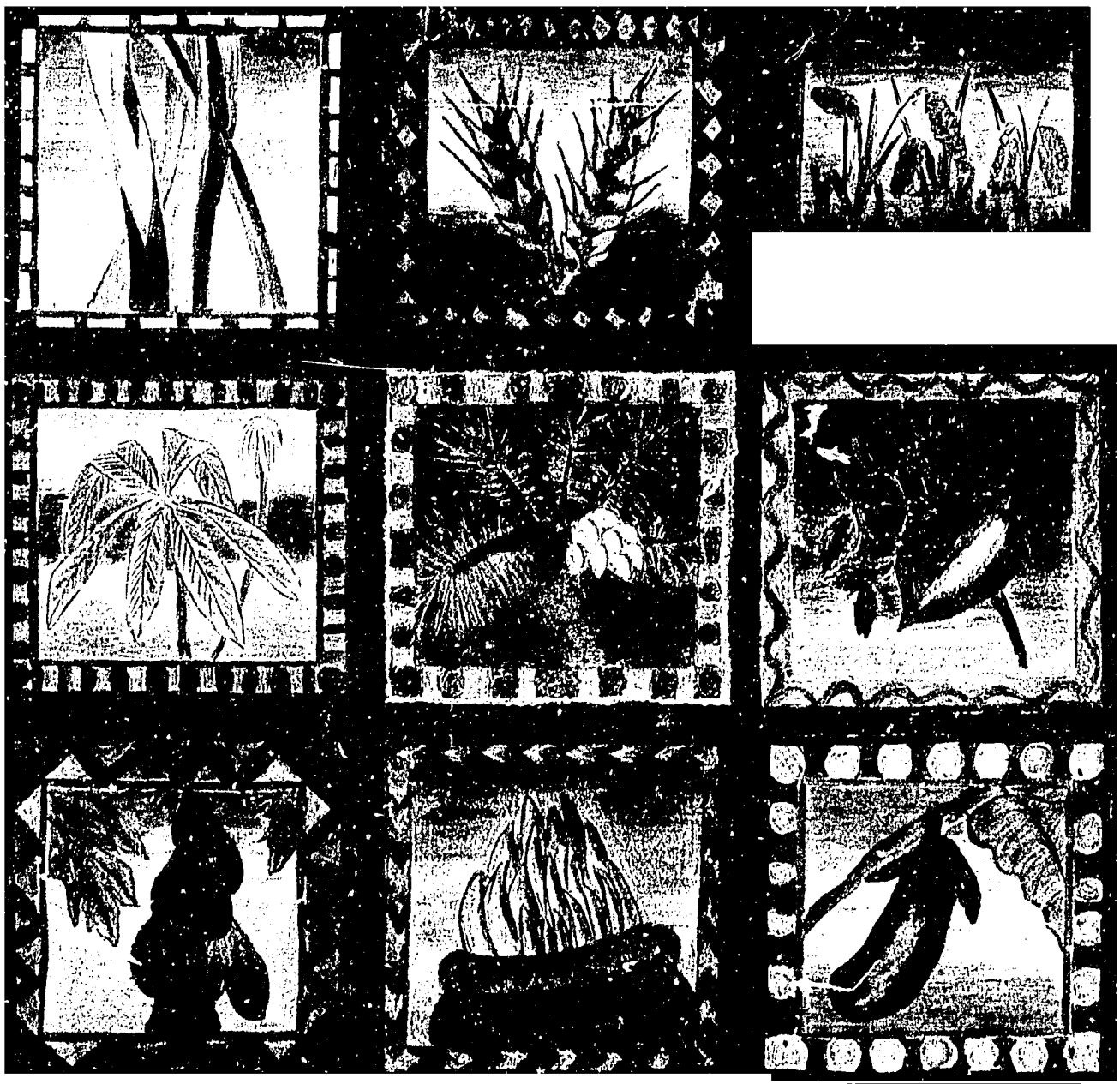
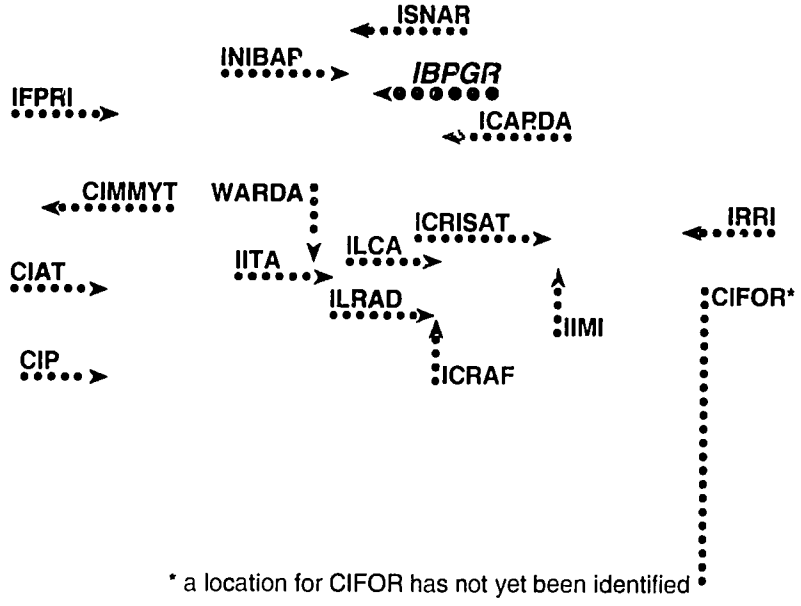
Annual Report *1991* IBPGR



INTERNATIONAL BOARD FOR PLANT GENETIC RESOURCES

International Agricultural Research Centres of the CGIAR



* a location for CIFOR has not yet been identified

CIAT - Centro Internacional de Agricultura Tropical, Cali, Colombia
***CIFOR** - Centre for International Forest Research, location not determined
CIMMYT - Centro Internacional de Mejoramiento de Maiz y Trigo, Mexico D.F., Mexico
CIP - Centro Internacional de la Papa, Lima, Peru
IBPGR - International Board for Plant Genetic Resources, Rome, Italy
ICARDA - International Center for Agricultural Research in the Dry Areas, Aleppo Syria
ICRAF - International Council for Research in Agroforestry, Nairobi, Kenya
ICRISAT - International Crops Research Institute for the Semi-Arid Tropics, Andhra Pradesh, India
IFPRI - International Food Policy Research Institute, Washington, USA
IIMI - International Irrigation Management Institute, Colombo, Sri Lanka
IITA - International Institute of Tropical Agriculture, Ibadan, Nigeria
ILCA - International Livestock Center for Africa, Addis Ababa, Ethiopia
ILRAD - International Laboratory for Research on Animal Diseases, Nairobi, Kenya
INIBAP - International Network for the Improvement of Banana and Plantain, Montferrier-sur-Lez, France
IRRI - International Rice Research Institute, Manila, Philippines
ISNAR - International Service for National Agricultural Research, The Hague, Netherlands
WARDA - West Africa Rice Development Association, Bouake, Côte d'Ivoire

IBPGR is a centre of the **Consultative Group on International Agricultural Research**. CGIAR is an informal association of 40 public and private sector donors that supports a network of 17 international agricultural research centers. The Group was established in 1971. **Mission**: "Through international research and related activities, and in partnership with national research systems, to contribute to sustainable improvements in the productivity of agriculture, forestry, and fisheries in developing countries in ways that enhance nutrition and well-being, especially among low-income people."

International Board for
Plant Genetic Resources

Annual Report
1991

Contents

3 IBPGR Trustees
4 Introduction
6 Highlights of 1991
10 FIELD PROGRAMME
10 Germplasm Conservation
11 Regional Office Activities
16 Global Genetic Resources
19 Germplasm Collecting
21 Germplasm Distribution
22 Germplasm Documentation and Characterization
27 Training
30 RESEARCH
30 Genetic Diversity Research
39 Seed Conservation Research
42 *In Vitro* Research
47 Plant Pathology and Quarantine
52 COMMUNICATIONS AND LIBRARY SERVICES
52 Library
52 Public Affairs
54 Publications
56 OTHER PROGRAMME ACTIVITIES
56 Task Force on Intellectual Property Rights
57 OFFICE OF THE DIRECTOR
57 IPGRI
60 IBPGR Staff in 1991
62 Financial Report
63 Financial Statement of Account 1991
64 Abbreviations

Citation
IBPGR. 1992. Annual Report 1991. International Board for Plant Genetic Resources, Rome
ISBN 92-9043-207-1
IBPGR Headquarters, Via delle Sette Chiese 142, 00145 Rome, Italy
Printed by Stamford Press, Singapore
Line illustrations by Pina Di Pilla, Rome
Cover illustrations by Paul Stapleton
Graphics by Paul Stapleton and Rachel Denning
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The IBPGR mandate

The International Board for Plant Genetic Resources (IBPGR) is an autonomous international scientific organization under the aegis of the Consultative Group on International Agricultural Research (CGIAR). IBPGR was established by the CGIAR in 1974 and is administered by the Food and Agriculture Organization of the United Nations. The basic function of IBPGR is to promote and coordinate an international network of genetic resources centres to foster the collecting, conservation, documentation, evaluation and use of plant germplasm and thereby contribute to raising the standard of living and welfare of people throughout the world. Financial support for the core programme is provided by the governments of Australia, Austria, Belgium, Canada, China, Denmark, France, Germany, India, Italy, Japan, the Netherlands, Norway, Spain, Sweden, Switzerland, the UK and the USA, the United Nations Development Programme and the World Bank

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[a] Joined during 1991
[b] Left during 1991
[c] Up to August 1991
[d] From August 1991

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Introduction

Twenty years ago, the United Nations Stockholm Conference put plant genetic resources on the global agenda when it adopted a resolution calling for an international programme to preserve the germplasm of tropical and subtropical crops. Responding to this resolution, the CGIAR established IBPGR in 1974. It is therefore fitting that the sequel to Stockholm, the UN Conference on Environment and Development (UNCED) met in Brazil in June just as IBPGR is winding down operations - to be replaced by a new institute with a new mandate, a new name and a radical change in its structure and mode of operation.

This is more than just a coincidence of timing. Environmental efforts over the last two decades have shown the essential link between the environment and economic and social development. For any nation, food security is the first step towards a sustainable improvement in living standards. Plant genetic resources are the basis of a dynamic, diverse and adaptable agriculture. They are fundamental to national food security and so their conservation must be a part of any development strategy. This is the conviction that will guide the activities of the new International Plant Genetic Resources Institute which will replace IBPGR.

The discipline of plant genetic resources has evolved rapidly over the past 20 years. In 1974, there were fewer than 10 fully functional plant genetic resources programmes. Now, at least in part due to IBPGR's efforts, there are well over 100, with more emerging every year. The number of regional and international programmes is also increasing.

Significant advances have been made in conserving the germplasm of the major crop plants of the world, but a large part of the total diversity of most crop genepools is still not safely conserved. This is particularly true for minor crops and trees. Some collections have not been adequately duplicated for safety, and others are not held under ideal conditions. Not all accessions are well documented and evaluation data are not readily available. Valuable collections are not always adequately regenerated and not enough seed may be available for exchange or use.

Where conservation technologies are already established, they may need to be improved and adapted to meet the constraints and needs of developing countries. For many species, adequate storage and regeneration technologies already exist, but the resources to do the work are lacking. For other species, however, further research is required, either on conservation techniques or evaluation methods. In the meantime, a trend is emerging towards restrictions on germplasm accessibility. Another challenge is to ensure cooperation at the national, regional and international

levels, as well as to secure the increased funding required to develop and maintain an adequate system of conservation. A global strategy for the sustainable conservation and use of plant genetic resources will require the commitment of the world community to safeguard the total diversity of plants, both *in situ* and *ex situ*.

IBPGR's original mandate, to promote a world network of plant genetic resources activities, has been overtaken by these challenges and by the active involvement of so many dedicated partners in the field of plant genetic resources.

In October 1991, representatives of the governments of China, Denmark, Italy, Kenya and Switzerland signed an agreement to establish an autonomous institute (IBPGR has been administered for many years as a field project of FAO). Another agreement, signed by the Italian Government, confirmed Rome as the new institute's headquarters location. Once these agreements come into effect, IPGRI will come into being and IBPGR will cease to exist.

'Diversity for Development', IPGRI's strategic plan, spells out the new institute's four primary objectives. First, IPGRI will assist countries, particularly in the developing world, to assess and meet their needs for the conservation of plant genetic resources, and to strengthen links to users. Second, it will build international collaboration in the conservation and use of plant genetic resources, mainly by encouraging networks on both a crop and a geographical basis. Third, it will work to develop and promote improved strategies and technologies for the conservation of plant genetic resources; and finally, the institute will develop an information service to inform the world's genetic resources community of both practical and scientific developments in the field.

The new institute will have a strengthened and decentralized organizational structure and will work closely with its partners - international, national, governmental and non-governmental organizations, as well as scientific and developmental institutions. Of these, national programmes are fundamental to global efforts to conserve plant genetic resources. The way these programmes develop in the 1990s will determine the successful conservation and use of plant genetic resources worldwide.

G.C. Hawtin
Director

W.E. Tossell
Chairman
Board of Trustees

Highlights - 1991

In October 1991 the Agreement establishing the International Plant Genetic Resources Institute (IPGRI) was signed by representatives of five governments. Four of the countries also ratified the agreement, providing IPGRI with international status. The institute will begin operations when its Headquarters Agreement is ratified by the Italian Parliament. IBPGR/IPGRI will continue to develop its programme in close consultation with FAO, under the 1990 Memorandum of Understanding on Programme Cooperation.

Dr Geoffrey Hawtin took up his post as the Director of IBPGR on 1 August 1991. He had been Director, Agriculture, Food and Nutrition Sciences Division, International Development Research Centre, Canada. IPGRI's strategic plan was under development throughout 1991. Due to be approved by the CGIAR in late 1992, the plan benefited from the input of regional consultations with National Programme leaders, CGIAR centres, NGOs and others concerned with plant genetic resources conservation and use.

The main phase of the Third External Review of IBPGR took place in January. Its report and IBPGR's response were discussed by TAC in March and approved by the CGIAR in May.

FIELD PROGRAMME

Germplasm conservation

A start was made in implementing the decision to merge, as far as possible, the IBPGR register of genebanks and the FAO global network of base collections. During 1991 the two organizations worked closely to develop further FAO's network.

Regional activities

IBPGR's seven regional offices developed and maintained contact with national and regional genetic resources programmes. Activities included providing scientific and technical advice, collaborating on collecting and training, and support for crop genetic resources networks.

Crop networks

Two new networks, for barley and coconut, were created. The *Beta* Crop Network met for a second time to assess its past activities and plan future developments. Network meetings were also held for potato and rice.

Germplasm collecting and distribution

IBPGR worked with other groups to collect wild potatoes in Ecuador, okra and eggplant in India, Nepal and Sri Lanka, and maize and sesame in India. IBPGR Collectors worked in Egypt, Lesotho, Morocco, Namibia, Oman and Zimbabwe, both collecting material and training personnel. The IBPGR Seed Handling Unit in Costa Rica became operational.

Characterization and documentation

The characterization of okra and sesame collections held in NBPGR, India was supported in 1991. Descriptors were published for maize, sweet potato, *Beta*, annual *Medicago* and pineapple. The project with IDRC to produce a self-teaching guidebook to genebank documentation with related software made substantial progress in 1991 in collaboration with national genebanks in Kenya, Guatemala and Egypt. Work continued on revised editions of directories of germplasm collections of forages and tropical fruits.

Training

IBPGR supported the training of scientists and technicians from 28 developing countries. Fellowships were provided to researchers from national programmes in developing countries to attend an MSc course in plant genetic resources at the University of Birmingham, UK. IBPGR organized training courses in Russia; Turkey; and in India with FAO.

RESEARCH PROGRAMME

Direct scientific collaboration was strengthened with France, Italy, Belgium and the Netherlands. IBPGR signed agreements with Germany for three projects involving German, IBPGR and developing country scientists to study effective pollination control methods in the regeneration of germplasm; refinement of cryopreservation techniques for potato; and spatial and temporal distribution of genetic diversity in wild forage species under stress conditions. IBPGR has also collaborated with British and Indian scientists under the ODA 'Holdback Facility' on projects concerning genetic stability in *Musa* and the conservation of recalcitrant seeds.

Genetic diversity

A project found that cowpea has low diversity and identified several wild relatives as promising sources for improvement. Another project revealed the wide diversity and corresponding value to breeding programmes of wild ancestral forms of *Phaseolus*. A survey of the world collections of wild *Triticum* and *Aegilops* species showed that 75% of accessions are unique and that the amount of information held on each accession varies widely.

Highlights 1991, *continued*

Seed conservation

Research on ultradry seed storage showed no harmful effects on seed of 12 species. Storability was improved, some enzyme systems were better maintained and deterioration products reduced. Work on recalcitrant seeds yielded promising results for cryopreservation of excised rubber and oil palm embryos.

In vitro research

In vitro methods were successfully adapted for field inoculation of citrus germplasm in Indonesia. Research continued on models for the development of cryopreservation methods. Work started on cryopreserving potato. A simple, rapid procedure was developed for cryopreserving zygotic embryos of *Musa*. Immature and mature zygotic embryos of coconut have been successfully cryopreserved.

Plant pathology and quarantine

The FAO/IBPGR Joint Programme on the Safe Movement of Germplasm published cassava, grapevine and vanilla technical guidelines. A project on therapy and virus indexing on plants held *in vitro* developed two model systems for peach and strawberry diseases.

COMMUNICATIONS AND LIBRARY SERVICES

Library

The IBPGR Library, in its second full year of operation, continued to develop its collection. The decision was taken to co-publish an abstracts journal on plant genetic resources with CAB International from mid-1992.

Public Awareness

The CGIAR/IPS Latin American Public Awareness Project on Plant Genetic Resources concluded in 1991. In April, a briefing for Italian media was held in Rome. IBPGR was given responsibility for public awareness activities for the United Nations Conference on Environment and Development in 1992.

Publications

Over 70 000 copies of 20 new titles were produced in 1991 and distributed worldwide to addresses selected from the 8000-entry mailing list. Demand continued to increase for existing titles.

OTHER ACTIVITIES

Forestry

In 1991, the CGIAR broadened its mandate to encompass forestry and agroforestry. Attention was given to adapting IBPGR's experience with agricultural species to problems in forestry and agroforestry genetic conservation. A Workshop on Forest Genetic Resources was organized by IBPGR in October on global needs for collaborative action.

IBPGR Task Forces

A Task Force coordinated CGIAR activities for UNCED in the area of biodiversity. A series of fact sheets were developed as lobbying tools for donors and policymakers. The Task Force provided input to the Convention on Biodiversity and Agenda 21. A second Task Force reviewed the status of safety duplication of the international agricultural research centres and advised where duplicates might best be lodged. A third Task Force developed IBPGR policy on intellectual property protection and contributed to a draft CGIAR discussion paper on intellectual property, biosafety and plant genetic resources.

ECP/GR

Phase IV became self-sustaining. Meetings were held of the *Brassica*, Sunflower, *Allium* and Forages Working Groups.

FIELD PROGRAMME

IBPGR has always considered national programmes of plant genetic resources as the basic elements of a global effort to conserve plant genetic resources. Hence IBPGR emphasizes placing staff in different regions of the world to facilitate interaction with these programmes.

This section briefly describes the activities of the different regional offices in 1991, as well as summarizing work on germplasm collecting and distribution, germplasm characterization and documentation, crop genetic resources networks and training.

GERMPLASM CONSERVATION

One of the most important developments in 1991 was the start of implementing the decision to merge, as far as possible, the IBPGR register of genebanks and the FAO global network of base collections. IBPGR has reached agreements with a number of national genebanks, IARCs, regional and other institutions for the long-term conservation of plant genetic resources on a species by species basis. Tables 4 and 5 in the 1989 Annual Report listed the 'register of genebanks', i.e. genebanks that have concluded an agreement with IBPGR. These tables are not reprinted here. Two genebanks entered into an agreement with IBPGR during 1990 (p. 18, 1990 Annual Report). No further agreements were concluded during 1991.

In the middle of the 1970s, IBPGR started the 'designation' of genebanks for the long-term conservation of genetic resources of specific crops, in the absence of any other international mechanism (the FAO Commission was only established in 1983 and work only started in 1991 to implement the FAO global network of base collections). Overseeing a global network of base collections is much more in line with the responsibilities of an intergovernmental organization such as FAO, rather than IBPGR. Consequently, FAO and IBPGR collaborated closely in 1991 to develop further FAO's global network of base collections, which accords

> *"Both Parties recognize the necessity of achieving maximum complementarity between the FAO network of base collections and the IBPGR register of base collections. They undertake to cooperate with a view to merging these, to the extent possible, in accordance with the principle that IBPGR would provide scientific and technical advice on the establishment, maintenance and management of base collections and FAO, while keeping an overview of scientific and technical aspects, would be mainly concerned with providing a policy and legal framework through which countries would make the necessary efforts for safe conservation and unrestricted exchange and monitoring the implementation of the provisions of the International Undertaking".*
>
> (extracted from the Memorandum of Understanding on Programme Cooperation between FAO and IBPGR)

with the Memorandum of Understanding on Programme Cooperation between the two Organizations (see box opposite).

REGIONAL OFFICE ACTIVITIES

Regional Office for North Africa, Southwest Asia and Europe

The Regional Coordinator visited Cyprus, Egypt, Iran, Malta and Turkey to provide technical and scientific advice to the national programmes of those countries. He attended the IBPGR/IDRC project initiation meeting on documentation of plant genetic resources held in Nairobi, Kenya. In addition, he went to the first meeting of the Biodiversity Network organized by the Genetic Resources Network of the African Ministerial Conference on the Environment, and the first meeting of the management and planning group of the network. Both were held in Addis Ababa, Ethiopia.

The Regional Coordinator assisted in organizing a short training course on conservation of plant genetic resources in seedbanks at PGRRI, Izmir, Turkey during October 1991 in collaboration with ICARDA. Further details of this course are given in the Training section.

Regional Office for East and Southern Africa

During 1991, plant genetic resources activities in the region steadily increased, reflecting the growing perception of their importance by national governments.

IBPGR and ILCA are making a scientific contribution to a pasture and forage project that is being funded by SIDA and implemented by the Genebank of Kenya. It was initiated in July 1990 and by the end of 1991, 6124 forage accessions had been multiplied out of a total of over 28 000. Equipment has been acquired and re-collecting and training activities started.

With IBPGR collaboration, 2518 accessions were collected during 1991 in Angola, Kenya, Namibia and Tanzania. Apart from the national programmes, other collaborators included ICRISAT, and the University of Nairobi on the Kenya missions. In all cases duplicate samples were left with the relevant national programme.

Regeneration/multiplication/characterization activities are progressing steadily in the Kenyan programme with 762 accessions handled. Zambia has also started this work and dealt with 26 accessions during the year.

Repatriation of germplasm from IARCs and other international organizations, and internal transfers at national level from commodity centres to the national genebank, continued during the year in several countries. 1573 accessions have been repatriated or transferred within the region.

The Zambian national programme is developing its facilities. IBPGR assisted in improving the seed-handling room. The Namibian genebank

complex is nearing completion. It is being constructed by the Government and will be equipped by the SRGB. IBPGR is providing scientific advice.

The IBPGR Programme and Nomination Committees of the IBPGR Board of Trustees met in ILRAD, Nairobi in September. Members visited the National Genebank, ICRAF, KEFRI, UNEP and the Crop Science Department of the University of Nairobi to learn about genetic resources activities in the region.

Regional Office for West Africa

The Regional Office assisted FAO to survey crop genetic resources in 11 countries of West Africa and to prepare a regional project for the conservation and use of the resources. Project assistance and funds at regional and national level are needed to strengthen and expand the management and conservation activities now under way in a number of countries of the region. In many cases, this work has yet to achieve sufficient organizational and financial status within the national research system.

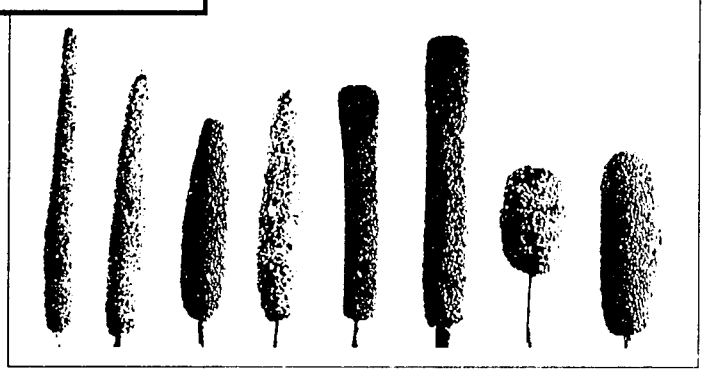
Regional office for West Africa - Niger

Conventional-style cold stores for seed storage are poorly suited to the conservation of small-sized germplasm samples under the difficult climatic working conditions prevailing in West Africa. IBPGR encourages more practical and robust techniques such as drying seed over silica gel followed by packing in moisture-proof laminated foil packets for storage at low temperature in domestic deep freezers. In 1991, IBPGR helped, with supplies of this type, crop conservation efforts at the agricultural research institutes of Côte d'Ivoire, Ghana, Guinea-Bissau, Mali and Senegal.

The Department of Botany of the University of Legon, Ghana, was provided with some specialized glassware to help set up an *in vitro* laboratory for research and teaching. The Department of Agricultural Research of Guinea-Bissau received some funds for its programme of

Harvesting millet in Zimbabwe (IBPGR archive photo)

Variation in local varieties of millet



collecting local crop varieties of millet, sorghum and maize. Assistance was also given to an onion-collecting expedition in Niger carried out by scientists from Burkina Faso and Niger.

In a region as environmentally and culturally diverse as West Africa, the food and socio-economic systems involve a wide variety of locally used plants. The UN University Programme on Natural Resources gives high priority to the study and conservation of these important plants. Regional staff participated in a consultation in Ghana to discuss activities in West Africa.

Regional Office for South and Southeast Asia

The regional office prepared a comprehensive assessment of plant genetic resources activities in Myanmar for the National Seed Bank, Agricultural Research Institute, Yezin and assisted ICAR-NBPGR, New Delhi in following up germplasm collecting of okra and eggplant in Nepal and Sri Lanka. Technical guidelines were provided and assistance given on selecting areas to be explored.

The national programmes in Nepal, Indonesia, Vietnam and Cambodia were provided with advice on technical matters, and a brief status report was prepared on the plant genetic resources of the Maldives, to assess follow up action required for future collaboration. The national programme in Malaysia was given assistance in improving their drying facilities and the Philippines supported in establishing cryopreservation facilities.

The office provided technical support to NBPGR in conducting the FAO/IBPGR/NBPGR regional training course for 18 participants on 'the Conservation and Utilization of Plant Genetic Resources of South Asia and Indo-China' held in New Delhi in October/November 1991.

The office staff gave a series of lectures to the staff of the Seed Bank, ARI, Yezin, Myanmar during June 1991, including field exercises for collecting germplasm. The Coordinator loaned his expertise to GTZ for the Project Progress Control Mission of the Genebank of Kenya during March 1991. Technical support was provided to the IBPGR-funded collaborative research project on the biological mechanism determining the recalcitrance in seeds of cocoa, jackfruit and tea with NBPGR, New Delhi.

A meeting of the ICAR-IBPGR Steering Committee in July 1991 discussed progress under the Memorandum of Understanding between ICAR and IBPGR. Collaboration is proceeding well.

Four IBPGR-supported projects on collecting, characterization and documentation of okra, eggplant (collecting only), sesame and maize are in operation.

The office helped a number of scientists take part in IBPGR-supported meetings, and assisted in preparing a first draft of a descriptor list for buckwheat.

Regional Office for East Asia

During 1991, office staff worked in a number of ways to further IBPGR objectives in the region. These were: assisting in IBPGR-supported projects in the region, organizing workshops, making country visits and participating in training activities.

Regional office for East Asia - China

Five projects were running in China and one in Japan during 1990, and the regional staff maintained contact with the institutes doing the work. One project in China working to conserve potato *in vitro* won a prize from the Ministry of Agriculture for developing such beneficial technology for crop conservation.

The office was involved with three meetings. A sweet potato genetic resources network meeting for Asia and the Pacific marked the start of the development of a genetic resources network for the crop in the region. An IBPGR workshop on less-utilized crop genetic resources brought together national coordinators to discuss present and future work. Another IBPGR-sponsored meeting, a workshop on buckwheat resources, promoted international collaboration among buckwheat scientists and institutions.

Regional staff travelled continuously during the year. In DPR Korea, assistance was given to the national programme to write a project proposal for the development of crop genetic resources in the country, and to locate potential donors. In Mongolia, staff in the national programme took advantage of IBPGR expertise to improve genebank methodology. In Japan, further collaborative opportunities were explored, for example in ethnobotany. In China itself, office staff visited many institutes and universities to strengthen linkage between them and IBPGR, as well as speaking at meetings and assisting IBPGR training work.

Regional Office for South America

The office worked vigorously to have the importance of plant genetic resources recognized in the region. The office is collaborating with the National Centre for Plant Genetic Resources, Maracay, Venezuela, which the President inaugurated in June. The Regional Coordinator attended the inauguration of the La Vicuna Base Bank, National Programme of Plant Genetic Resources, INIA, Chile in June 1991, and sponsored the participation of the Research Director of the Instituto Colombiano Agropecuario, Bogota, Colombia. The Coordinator also attended a workshop in Bogota to discuss setting up a national programme on plant genetic resources in 1992. The regional office sponsored the meeting that launched the National System on Plant Genetic Resources at INIAA, La Molina, Peru in November. The office also sponsored the Second Latin American Symposium on Genetic Resources of

Regional office for South America - Colombia

Horticultural Plants in Mar del Plata, Argentina, and the First International Symposium on Passifloras, in Palmira, Colombia.

In another approach to assisting national programmes, the office sponsored the first training course on plant genetic resources to be held at the Departamento Nacional de Recursos Fitogenéticos, Estación Experimental de Santa Catalina, INIAP, Quito, Ecuador in April 1991. Trainees from Argentina, Bolivia, Colombia and Peru attended.

Regional Office for North and Central America and the Caribbean

Based in Mexico, this office devoted a considerable amont of time to assisting national programmes. The office supported a representative from each of six countries to attend a meeting of the 'Programa Cooperativo Centroamericano para el Mejoramiento de Cultivos y Animales', a collaborative programme that is the most important forum in the region for discussing plant genetic resources. IBPGR projects are being carried out in Belize, Costa Rica, Cuba, Guatemala, Honduras and Mexico, so office staff acted as coordinators for this work.

Within the region, the office maintained close contact with staff at the host institute, CIMMYT, as well as at CATIE, which is playing an important role in plant genetic resources in central America. The office also kept close contact with IICA in Mexico, which has been promoting several networks in Latin America and the Caribbean. This institute joined together with IBPGR and the Centro Agronómico Tropical in promoting the 'Red Mesoamericana de Recursos Fitogenéticos', a regional network on plant genetic resources.

The accession editor and query system software and manuals developed by an independent group, CGNET in the USA, for a CIMMYT/IBPGR project were sent to national programmes for installation and to compile passport information on maize germplasm.

COORDINATED ANALYSIS OF REGIONAL NEEDS

During September-October 1991, regional staff from both offices in the Americas, assisted by two consultants, analyzed the status of plant genetic resources in Latin America. It was obvious from the results that central America and the Andean region of south America were the two areas most in need of immediate support. Discussions with Instituto Interamericano de Cooperación para la Agricultura in San José, Costa Rica concluded that an Andean network of plant genetic resources should be established. A consultant was appointed by the Costa Rican institute to prepare for the establishment of this network. IBPGR will almost certainly be involved in aspects of the network's operations.

GLOBAL GENETIC RESOURCES

Crop networks

Several new networks were created during the year. The network for *Beta* had a second meeting to assess activities and plan future expansion (see box below). As well as considering the very successful activities of the International Data Base for *Beta*, sponsored by CGN, the meeting heard reports on progress made on safety duplication in base collections, the regeneration of accessions, the taxonomy of the genus, (which remains problematic), characterization and evaluation, and on strategies for selecting subsets within collections, prospects for beet breeding and use of genetic resources, and the need for further collecting.

New networks

Barley

40 participants from 28 countries attended the International Barley Genetic Resources Workshop in Helsingborg, Sweden in July 1991, just before the sixth International Barley Genetics Symposium. The group agreed on an action plan, the main elements of which are:

i) creating an international barley genetic resources database through the activities of four regional databases;
ii) establishing more structured links between active and base collections;
iii) internationalizing the barley core collection that had been initiated at a European level by ECP/GR;
iv) developing an international database for genetic stocks.

A nine-member coordinating committee with Professor Jaradat from Jordan in the chair was elected to monitor activities until the next plenary meeting of the network. IBPGR agreed to act as Secretariat for the committee.

CROP NETWORKS - DO THEY REALLY WORK?

IBPGR started developing the concept of crop networks several years ago. One of the pilot networks, established in 1989 dealt with *Beta*. A network meeting in 1991 reviewed in detail for the first time the concept and operation of networks. Participants strongly supported the network concept. They agreed that collaboration was the most effective and economical way of collecting, documenting, conserving, regenerating and evaluating germplasm. Two essential elements of any viable network are a central database to collect, analyze and disseminate information, and a committee to coordinate the activities of the network. Members of a network usually have access to funds of their own national programmes, so network operation does not mean additional financial commitment, rather it is a means of gaining maximum return from resources already committed. The meeting did agree though, that the coordinating committee would be best placed to solicit extra funds for further development activities.

Coconut

The International Coconut Genetic Resources Workshop held in Cipanas, Indonesia, October 1991 under the sponsorship of ACIAR, CIDA, CTA, IBPGR and IDRC established an international network for coconut. A ten-member steering committee will plan activities on an annual basis. IBPGR will be the executing agency for the five-year Phase I and will appoint a full-time coordinator, who will serve as Secretary of the Steering Committee, as soon as additional financial resources are identified.

CIRAD in Montpellier, France will establish a comprehensive international database. Individual national collections will form the basic components of a worldwide collection. High priority will be given to research on new *in vitro* techniques of conservation. Further knowledge was required of coconut genetic diversity and distribution; collecting will be done to fill gaps in existing collections. Regular regional working sessions with breeders will develop standardized procedures and a common strategy.

Splitting coconut to produce copra in Suriname (FAO file photo)

Sweet potato

The Asian Sweet Potato Germplasm Network Meeting was organized by the regional offices of CIP and IBPGR in Beijing, with the Guangdong Academy of Agricultural Sciences of Guangzhou, from 26 February to 2 March 1991. The meeting developed objectives that included establishing a regional database, starting a project on slow growth storage of germplasm, and evolving agreed procedures for evaluation, training and pathogen testing. CIP and IBPGR were requested by the meeting to seek special project funding to support the network.

Buckwheat

A Workshop on Buckwheat Genetic Resources in East Asia, held in September 1991 in Tokyo, Japan decided not to form a network but defined individual activities for each of the participating countries, as well as a range of collaborative activities with a strong coordinating role for the IBPGR East Asian Regional Office.

Established crop networks

Crop networks have already been created with IBPGR's support for *Musa*, okra and rice. IBPGR was also involved in creating the Dryland Pasture and Forage Legume Network, coordinated by ICARDA, which was origi-

nally limited to medics. These four networks are now autonomous, but activities that IBPGR took part in are reported here.

Beta

IBPGR sponsored four participants from China, Egypt, India and Iran to attend the second meeting of the *Beta* network in June at FAL, Germany. The meeting was organized by FAL and CGN. The meeting decided that the network would be able to continue on a self-sustaining basis. Members will send seed-stock data to the International Database for Beta (IDBB) so that a joint seed-increasing programme can be started. Dr L. Frese, who is responsible for the IDBB, has moved from CGN to FAL, so the database will be now be managed by FAL.

The meeting elected a new *Beta* Coordinating Committee, which will seek funds from the sugar industry for a global project divided into two parts:

i) large-scale screening for new sources of resistance to pests and diseases;

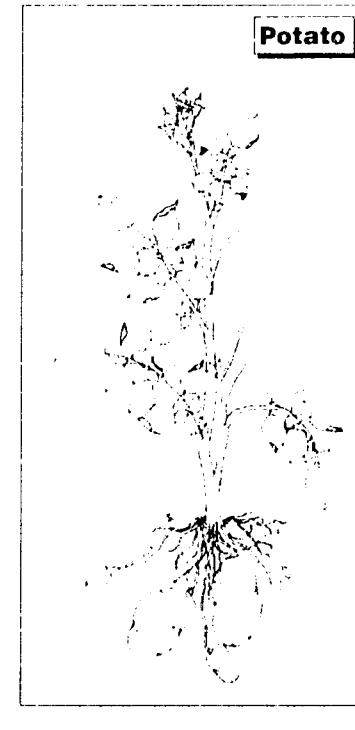
ii) creating base populations with useful characters and reasonable yields.

Rice

The first meeting of the Rice Genetic Resources Working Group, which will monitor the implementation of the rice genetic resources network, was convened in IRRI in August. Representatives of eight national programmes agreed priorities for future collaboration, i.e. solving problems related to seed-drying, and training of genebank staff in characterization, documentation and detection of duplicates; project proposals will be developed to cover these priority areas.

Potato

FAL, Braunschweig initiated in 1990 a programme of 'intergenebank collaboration' with CIP and the Inter-Regional Potato Introduction Station, USDA. IBPGR took part in the second meeting in August, 1991 and widened the network by supporting specialists from Ecudaor, Peru and Russia to attend the meeting. Participants agreed on a global strategy for documentation, including the structuring and expansion of the world database for passport data maintained by CIP, and on the preparation and later publication of a technical manual for regeneration procedure. A Steering Committee (composed of representatives from Argentina, Peru, the Dutch-German collaborative programme and CIP) was nominated to follow up on the activities that were agreed upon by the participants.



GERMPLASM COLLECTING

IBPGR reduced its own collecting activities during 1991 in line with its revised priorities, but collaboration with other groups resulted in a substantial number of samples being collected, especially of wild relatives of crop plants. IBPGR worked with USDA and INIAP to collect wild potatoes in Ecuador, and with NBPGR, India (which in turn sought cooperation with organizations in Nepal and Sri Lanka) to collect okra and eggplant (Table 1). Maize and sesame germplasm was also collected in India.

Collecting from Cyprus

The two IBPGR collectors based in Cyprus worked in Egypt, Morocco, Namibia and Oman (see Table 1 and box below). Exploration in the High Atlas Mountains in Morocco resulted in collecting for the first time *Cicer atlanticum* Maire, a perennial endemic to the High Atlas. The germplasm of *Hedysarum membranaceum* Cosson and Bal. was also collected for the first time. The mission in Egypt gathered two samples of *Lupinus digitatus* from the southeastern part of the country, the first time this species has been acquired from the region.

One of the collectors updated the collecting database at headquarters. The other, along with HQ staff, continued his efforts in editing the chapters of the IBPGR/FAO/IUCN manual on germplasm collecting. This manual is expected to be published in 1992/3.

COLLECTING ENDEMIC SPECIES IN WEST ASIA AND NORTH AFRICA

In the last few years, an important strand of IBPGR collecting in west Asia and north Africa has been concerned with filling 'taxonomic gaps' in germplasm collections. These gaps result from the absence of wild species that are either rare or grow in very restricted locations. Such species can be extremely difficult to collect. Gathering them may need a large investment in time and money, but the material often represents genetic diversity that is unique within the crop genepool. In many cases the species are also in danger of disappearing.

IBPGR has targeted regions such as southern Oman and the island of Socotra in Yemen that have high concentrations of such material. The collecting in past years of the perennial oat species *Avena macrostachya* in Algeria, of the palm *Livistona carinensis* in Yemen and of the wild relative of the pomegranate *Punica protopunica* in Socotra has been of this kind. The last two species feature in the IUCN Plant Red Data Book.

Morocco: perennial chickpea and wild pear

Oman: *Ceratoa oreothauma*

In 1991, the programme collected in Morocco *Cicer atlanticum*, a perennial chickpea species endemic to some peaks in the Atlas Mountains, and the wild pear *Pyrus mamorensis*. In addition, the recently described leguminous shrub *Ceratoa oreothauma*, the only other species in the carob genus, was collected in the mountains of northern Oman.

Table 1. Collecting activities in 1991

Partner	Country of collection	Target taxa	Number of accessions
INIAP, Ecuador	Ecuador	Wild *Solanum* spp.	27
USDA, USA INIAP, Ecuador	Ecuador	Wild *Solanum* spp.	128
ARC, Egypt	Egypt	*Lupinus digitatus*	2
NPGRC, Lesotho	Lesotho	High altitude forages and wild crop relatives	*ca.* 100
IAV Hassan II, CPSP, Morocco	Morocco	*Cicer atlanticum* and other endemic legumes; *Pyrus mamorensis*	17
National Herbarium, Namibia	Namibia	Cultivated pearl millet and sorghum	24
National Herbarium Namibia	Namibia	Arid zone forages and wild crop relatives	*ca.* 220
Min. Agric. Fish., Oman	Oman	*Ceratonia oreothauma* and other arid zone browse species	6
NPGRC, Tanzania	Tanzania	High-altitude forages and wild crop relatives	*ca.* 210
Univ. Southampton, UK Univ. Dar es Salaam, NPGRC, Tanzania	Tanzania	Wild legumes of the arid and semi-arid zone	118
USDA, USA IFVC, Yugoslavia	USA	Wild *Helianthus* spp.	140
NBPGR, India	India	Cultivated and wild sesame /maize	1112/234
NBPGR, India NARC, Nepal PGRC, Sri Lanka	India Nepal Sri Lanka	Wild and cultivated okra Wild and cultivated eggplant	923 1725
Univ. Southampton, UK VIR, Russia	CIS	Wild legumes of central Asia	156
CENARGEN/ EMBRAPA, Brazil	Brazil	Cultivated and wild *Arachis*	62

Abbreviations used in this table:

CPSP Centre de Production des Semences Pastorals
IFVC Institute for Field and Vegetable Crops
NARC National Agricultural Research Committee
PGRC Plant Genetic Resources Committee

Collecting in southern Africa

The IBPGR collector based in Harare, Zimbabwe collected in Lesotho (Fig. 1.), Namibia and Tanzania (see Table 1). Desert ecotypes of forage and wild relatives of crops were sampled in what was a war zone in north-western Namibia. While collecting in Namibia, she continued training Namibian genetic resources workers. To familiarize Namibian agricultural workers with the concepts and techniques of genetic resources work, the National Plant Genetic Resources Committee of Namibia and IBPGR organized an on-site training course for potential plant genetic resources collectors at Rundu, Kavanago. This was followed by germplasm collecting in the north of the country resulting in samples of pearl millet and sorghum.

Collecting in Lesotho, mostly trekking on horses and mules, yielded a number of samples of high-altitude forage legumes and grasses. Forage grasses growing at altitudes of up to 4800 m were obtained in the mountainous regions of Tanzania.

Fig. 1. Collecting sorghum on horseback in Lesotho (photo Helen Moss)

GERMPLASM DISTRIBUTION

Seed-Handling Units

UK

The Seed Handling Unit at The Royal Botanic Gardens, Kew continued to receive bulk samples from IBPGR collecting missions from the Central African Republic, Lesotho, Madagascar, Mali, Namibia and Niger. However, since IBPGR could not fund a staff position to administer the unit in 1991, all germplasm received was rerouted to the units in Costa Rica and Singapore for further processing and distribution.

Costa Rica

The IBPGR Seed Handling Unit at CATIE, Turrialba became operational in 1991. 1335 samples were received from the unit in the UK, processed and despatched to different centres. The unit also worked towards forming the Meso-American Genetic Resources Network and participated in its first, very productive meeting in July in Costa Rica. The unit staff member also took part in genetic resources workshops in the region and helped in preparing a report for the Latin American Plant Genetic Resources Inventory.

Singapore

As well as material from the UK, the unit received and processed 1494 accessions of safflower collected in southeast China, distributing them to

NBPGR, India to serve as a global duplicate collection. 427 accessions from a wild forage collecting mission were processed and sent on to CIAT for regeneration, duplication and further despatch.

The unit also assisted several countries to exchange germplasm. Peanut seed used in ultradrying research was forwarded from CAAS, China to AVRDC, Taiwan for analysis. Sesame germplasm was forwarded from Israel and sent to Sri Lanka.

Preliminary work to study the effects on germination of different seed-drying procedures used by the different genebanks in the region was carried out.

GERMPLASM DOCUMENTATION AND CHARACTERIZATION

Modern information technology is a key factor in the conservation and use of plant genetic resources as well as in improving efficiency in the management of genebanks and related activities.

Task Force for Safety Duplication

In 1990, IARC Directors General became concerned about the security of germplasm collections held in trust by the international centres. All accessions should be held in more than one place in case of accidental loss of the original sample. In response, IBPGR produced two reports which synthesized information supplied by the nine commodity centres. During the third meeting of the Inter-Centre Working Group on Plant Genetic Resources, it was thought that additional work should be done in this area. A Task Force made up of seven members of IBPGR staff was established in 1991. Its remit is to review the status of duplication of IARC collections and to provide advice to the IARCs on where duplicates of their collections might best be lodged. Additionally, the Task Force was asked to examine the legal status of IARC collections and recommend appropriate action if legal coverage was found to be insufficient.

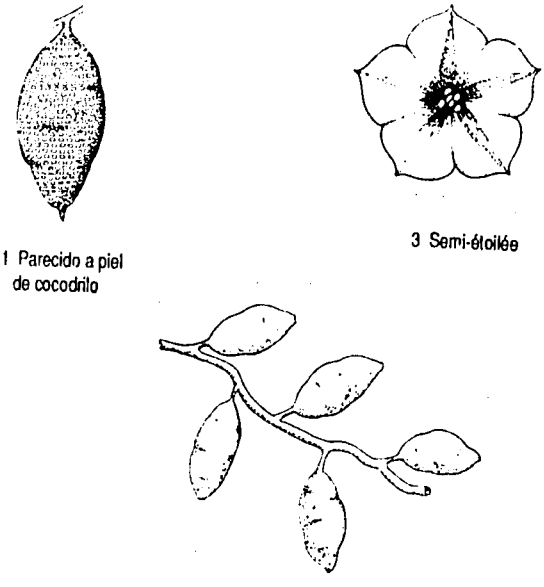
The Task Force developed a questionnaire that was sent to the nine original commodity centres and two of the recently admitted centres (INIBAP and ICRAF). After International Centres Week in Washington, USA in 1991, IBPGR commissioned a status report on the legal status of these germplasm collections. Information collected through the IBPGR survey was provided to the legal adviser who carried out the study. An analysis of the safety duplication status of the collections is currently under way. Specific conclusions and recommendations will be produced in 1992.

CGIAR Centres involved in Plant Genetic Resources

- CIAT
- CIFOR
- CIMMYT
- CIP
- IBPGR
- ICARDA
- ICRAF
- ICRISAT
- IITA
- ILCA
- INIBAP
- IRRI
- WARDA

Germplasm characterization

IBPGR has supported characterization trials to assist curators of collections to identify accessions and to help germplasm users select material with relevant characteristics. Over the years, IBPGR has supported many hundreds of these trials on different crops. During 1990 and 1991, emphasis shifted towards analyzing the success of the trials and using the data that have been generated. This will provide criteria that can be used to direct future support and provide guidelines for reporting and utilization of the data. Currently, past projects are being analyzed. Direct support for characterization has been substantially reduced, but characterization of okra and sesame collections held in NBPGR, India was supported in 1991.



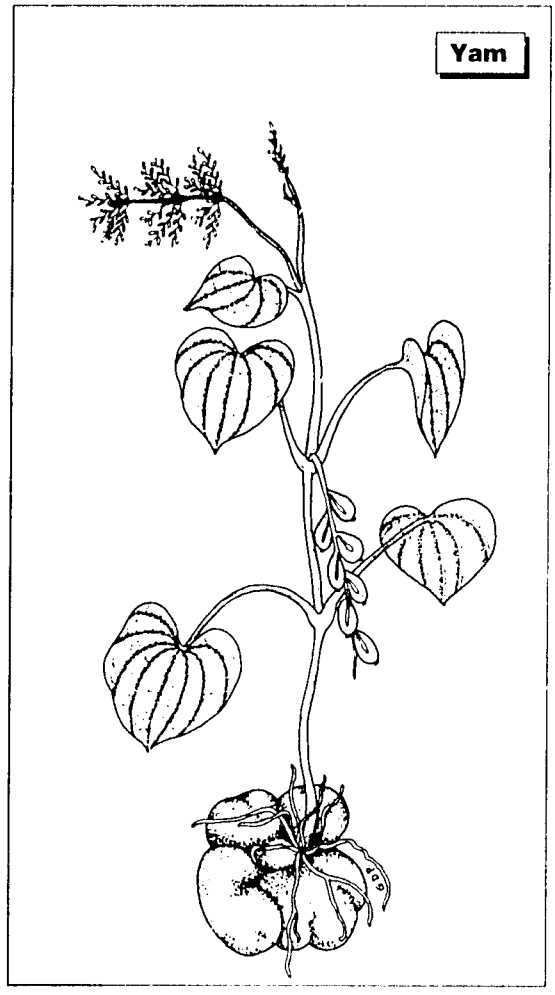
Selected illustrations for the trilingual 'Descriptors for Sweet Potato' published in 1991

The Documentation Programme has supported multiplication and/or regeneration of germplasm, usually in conjunction with characterization trials. However, there is increasing evidence that, except for a very few crop species, these activities should not be carried out simultaneously. IBPGR's Genetic Diversity programme is analyzing regeneration needs for a number of crops.

Standards for germplasm documentation

Support in the development of standards for the documentation of germplasm takes many different forms.

Primarily this subprogramme focuses on the development of crop descriptor lists that provide clear descriptor definitions and descriptor state coding schemes as a basis for exchanging and using data to describe genetic resources. In 1991, descriptors were published for maize (trilingual, i.e. English, French and Spanish), jointly with CIMMYT; sweet potato (trilingual), jointly with CIP and AVRDC; *Beta*, jointly with CGN; annual *Medicago* (bilingual, i.e. English and French); and pineapple. Work progressed on *Sorghum*, pearl millet, pigeonpea (all bilingual) and groundnut (trilingual), which will be published jointly with ICRISAT. In addition, chickpea (bilingual) will be published jointly with ICRISAT and ICARDA. Significant progress has been made on descriptors for coconut, hops, walnut, yam (to be published jointly with IITA), buckwheat and white clover.



A second aspect of standardization involves data management systems. In this area, IBPGR has supplied computer hardware and software to many genetic resources programmes in the past. Because of the increasingly wide availability of equipment, this aspect of the IBPGR Programme is being reduced. In 1991, a microcomputer was supplied to PROINPA, IBTA, Bolivia. Software was also supplied to INIFAT, Cuba.

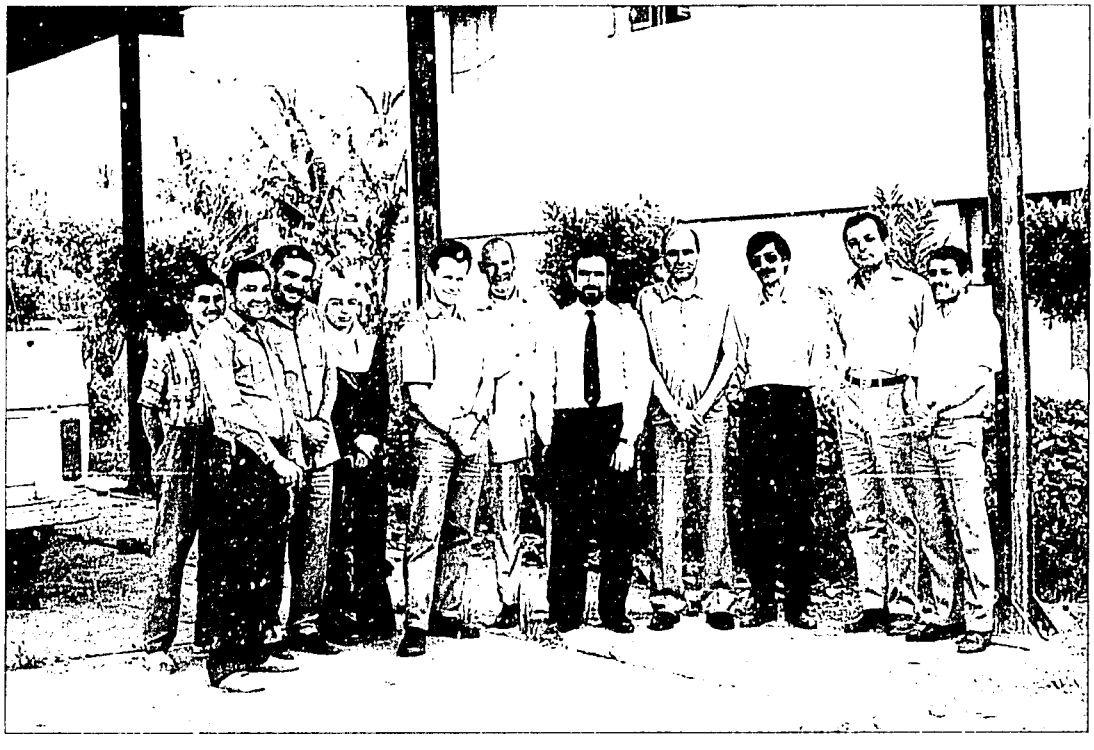
Work began on developing ideas and a firm outline of contents for a 'Reference Guide for Data Exchange' in 1991. This short reference publication should benefit programmes that do have limited expertise in this area and aims to assist in preparing genetic resources and other data types for exchange as well as in using data received from other institutions. It is expected to be published in late 1992.

Directories of germplasm collections

The Directories of Germplasm Collections that IBPGR started publishing in 1980, giving details of genebanks and their accessions, continue to be in large demand. Preparing the data is time consuming but work progressed in 1991 on compiling material for new editions of the directories for forages and tropical fruits. Additional work has been done producing software that can act as an interface to allow the data itself to be distributed and used.

Providing information

A significant amount of time is spent providing data in response to specific enquiries from organizations and individuals. For instance, IBPGR attended a meeting in March with staff from WCMC and WRI about preparing the 'Biodiversity Status Report' (to be published in early 1992 by IUCN). Subsequently, the Documentation section compiled a great deal of information on the status of various aspects of genetic resources work for the report. A similar exercise was done for WRI to enable them to prepare the 'Biodiversity Strategy and Action Plan' (published by WRI in 1992). Additional information was provided to individuals involved with the Oslo Keystone Dialogue meeting. These valuable interactions have helped IBPGR redefine the types of information it should maintain in the future and led to plans to expand current databases as well as add new ones.

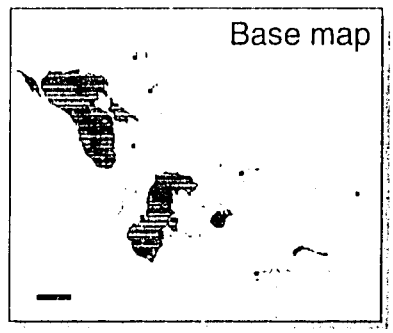


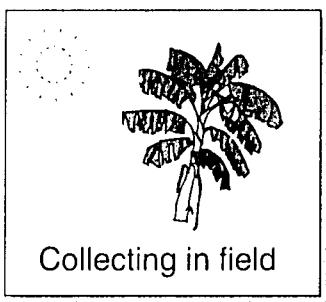
Project staff and staff of the Genebank Section of the Field Crops Research Institute, Egypt (photo Kevin Painting)

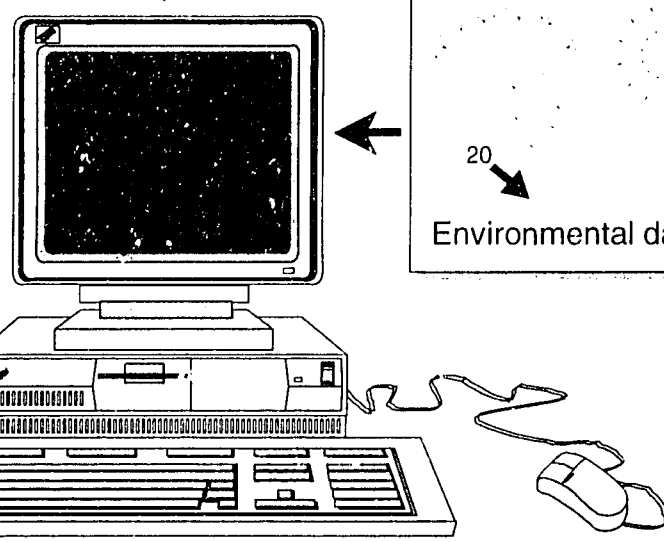
DO-IT-YOURSELF DOCUMENTATION - A JOINT PROJECT

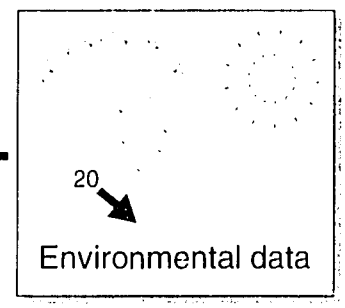
In 1990, IBPGR entered into an agreement with IDRC tc produce a self-teaching guidebook on documentation and data management in genebanks. A consultant was employed and in 1991 he gathered information and analyzed procedures during extended visits to three collaborating genebanks (the National Genebank of Kenya, Universidad de San Carlos and Instituto de Ciencia y Tecnología Agrícolas, Guatemala and the Field Crops Research Institute, Genebank Section, Egypt) and short visits to many other programmes. The Genebank of Kenya on behalf of the Kenyan Agricultural Reseach Institute hosted a project-initiation meeting. Participants included the IBPGR Regional Coordinators for East and Southern Africa, for West Asia and North Africa, and for Latin America; HQ staff; and participants from IDRC, Egypt, Guatemala and Kenya. CGNet, a US communications company, is developing documentation software that will be tailorable to local genebank conditions. This will be included with the guidebook, a first draft of which was sent out for review in 1991. Three regional workshops will test and improve the guidebook and software. The package will be completed by the end of 1992 and is expected to make a major contribution to the efficiency of long-term data handling and record keeping in genebanks of developing countries.

Geographic Information Systems
- how they contribute to IBPGR's work

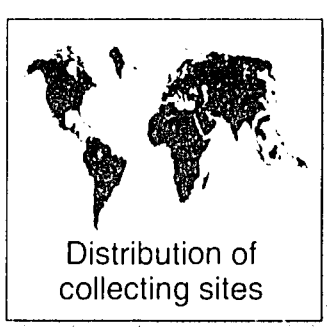


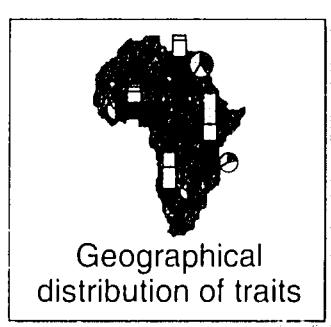


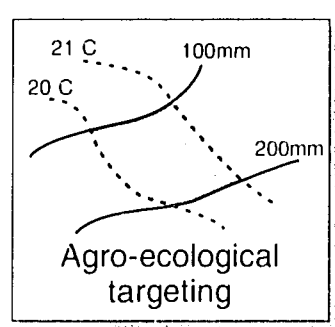




ANALYSIS







Geographical information systems

After acquiring several powerful microcomputers, the Documentation section was able to expand its use of geographical information systems (GIS). These systems can be used to map the locations of collected germplasm samples, analyze information in relation to environmental factors and provide our collaborators with the results. Joint development of databases to use with GIS systems is being discussed with several other CGIAR centres.

International crop databases

These databases are essential to developing regional or global strategies for the genetic resources of a crop. Each is compiled by a volunteer institute but their success depends on collaboration between the many institutes that maintain the specific genetic resources collections. Compiling the data reveals duplication, assists in the planning of collecting missions and facilitates collaborative trials to optimize resource use. In 1991, IBPGR supported the development of a *Musa* database in cooperation with INIBAP. A third year of support was also provided to CIMMYT to compile and distribute a global maize database. Progress was also made in the organization of several regional databases for barley. Progress on other databases is described in the section on Crop Networks.

In-house data processing capabilities

During 1991 IBPGR decided to install a Novell-based local area network (LAN) in its HQ, as well as additional personal computers, which will allow an internal electronic mail to provide up-to-date information to all HQ staff. In addition, planning has begun to install an X-25 protocol communications line that will allow the institute to communicate 'desk-to-desk' with personnel at its regional offices, as well as other CGIAR and non-CGIAR centres.

TRAINING

Despite extensive budget cuts in 1991, IBPGR worked to meet some of the needs of national programmes of developing countries in the area of human resources development through various training programmes (Figs. 2 and 3).

Group training programmes

MSc degree course

The international 12-month MSc degree training course on exploration, collection, conservation and utilization of plant genetic resources offered annually by the University of Birmingham, UK, evolved into a fully independently-supported course in 1991, in accordance with the Memorandum of Understanding signed with the University of Birmingham in 1989. IBPGR focused its support exclusively on providing fellowships to researchers from national programmes in developing countries. Out of ten participants in the 1990-91 course, five were recipients of IBPGR/UNEP

fellowships (see Fig. 1, page 18, IBPGR Annual Report 1990). In the 1991/92 academic season, two researchers from the national programmes of Argentina and Kenya received IBPGR grants (Fig. 2).

Short-Specialized Technical Courses

Three short courses were organized during 1991 (Fig. 2).

With UNEP's support, IBPGR organized a training course on documentation of genebank data at VIR, Leningrad, Russia. National programmes represented by researchers at this course were Colombia (2), Costa Rica (1), Kenya (1), Brazil (1) and Argentina (1).

In partnership with ICARDA and the Plant Genetic Resources Research Institute (PGRRI) - Izmir, Turkey, IBPGR has organized a training course on conservation of plant genetic resources in seed genebanks at PGRRI/AARI, Izmir, Turkey. Twelve researchers attended from Afghanistan (1), Libya (1), Yemen (1), Morocco (1), Tunisia (1), Iran (1), Egypt (1), Syria (1) and Turkey (4).

NBPGR, India, with assistance from FAO and IBPGR, conducted a regional training course on conservation, evaluation and utilization of crops of local importance in the South/Southeast Asia region. National programmes that participated in this course were Bangladesh (2), Bhutan (2), Thailand (1), Laos (2), Myanmar (1), Nepal (2), Sri Lanka (2), Vietnam (2) and India (5).

Individual training programmes

As a part of a Memorandum of Understanding for collaboration in training between IBPGR and ICARDA, IBPGR continued to organize practical hands-on training on management of genebanks at ICARDA in 1991. A researcher from the national programme of Egypt was trained at ICARDA's genebank in 1991.

Fig. 2. Summary of IBPGR training activities, 1991

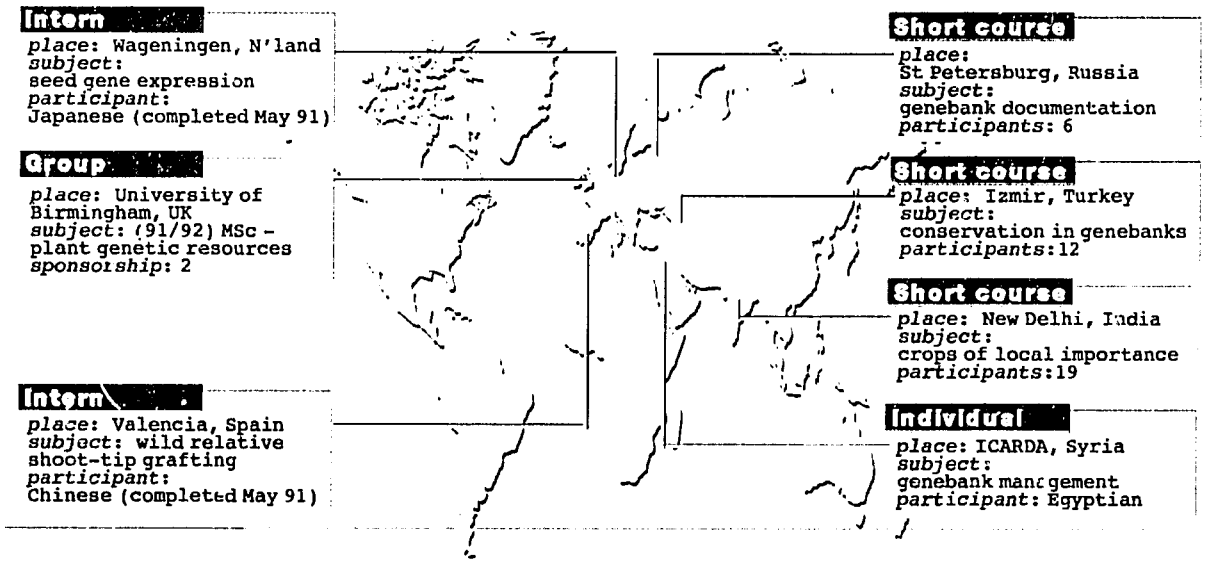


Fig. 3. Countries supported by IBPGR training activities 1991

Country	Courses: Postgrad.	Short	Individ.
Afghanistan		+	
Argentina	+	+	
Bangladesh		+	
Bhutan		+	
Brazil		+	
China	+		+
Colombia		+	
Costa Rica		+	
Egypt		+	
India		+	
Iran		+	
Japan			+
Kenya	+	+	
Laos		+	
Libya		+	
Morocco		+	
Myanmar		+	
Nepal		+	
PNG	+		
Sri Lanka		+	
Syria		+	
Thailand		+	
Tunisia		+	
Turkey		+	
Uganda	+		
Vietnam		+	
Yemen			
Zaire	+		

Intern fellowship programmes

During 1991, two interns completed their research (Fig. 2). Li Xiancai of China worked in IVIA, Valencia, in Spain on developing shoot-tip grafting techniques for wild relatives of *Citrus* and *Prunus* species to produce disease-free stocks. Y. Fujikura of Japan studied gene expression during seed storage in Wageningen Agricultural University, the Netherlands.

RESEARCH

1991 was a significant year in the development of the Research Programme despite the relatively small amount of core funding available for new research. As described below, some of the results obtained in 1991 from IBPGR-sponsored projects have important and far-reaching applications in plant genetic resources work. We can expect to see them making a wide impact on genebank practices in the next few years.

Direct scientific collaboration with donor countries began with Germany in 1990. During 1991, IBPGR signed agreements with the German government for three substantial projects involving German, IBPGR and developing country inputs. Work will commence in 1992. Similar contacts were pursued with Italy, France and Belgium in 1991 and initiated with the Netherlands. IBPGR has also benefited very significantly from collaboration with British scientists under the ODA 'Holdback Funding' scheme.

Two members of the Research staff received special honours during the year. Kar-Ling Tao, Seed Conservation Research Officer, was appointed Honorary Professor at Zhongshan University, China and Daniel Debouck, Research Officer for Wild Species received an award under the Distinguished Achievement Programme at the Biennial Meeting of the Bean Improvement Cooperative, Lincoln, Nebraska, USA.

Four important genera of Cucurbitaceae are being used as models in ecogeographic and evolutionary studies of wild relatives

A very significant development within IBPGR in 1991 was the move towards a multidisciplinary approach to research, involving greater interaction among research scientists in various disciplines and with practitioners and staff in the field.

GENETIC DIVERSITY RESEARCH

During 1991 it was possible to maintain existing projects and continue to improve the knowledge of the extent, distribution and conservation of genetic diversity in crop genepools and their wild relatives but opportunities to develop new projects were extremely limited. Current activities are aimed at a better definition of the different fractions of genetic diversity within wild species and wild relatives of crops to be conserved, establishing first the structure of genetic diversity within such crop genepools. Work to develop improved regeneration protocols and improve use of genetic resources also continues to receive high priority.

Discussions at Montpellier, France with scientists from CIRAD, INRA and ORSTOM identified a number of areas of joint interest. Of direct relevance was the interest shown in methods to develop core collections and the use of molecular genetic techniques to study genetic diversity. The latter topic was also addressed at an EEC Workshop on biotechnology and genetic resources where Toby Hodgkin acted as co-chairman of the working group developing rapid molecular genetic screening methods for genetic diversity, chosen as one of the four major directions of this EEC programme.

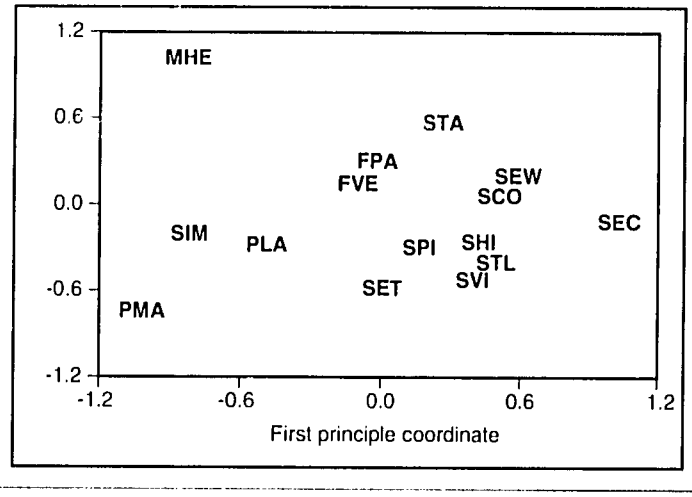
Ecogeographic and evolutionary studies in Cucurbitaceae

A first step in the study of crop genepools is to identify the different wild relative(s) and their exact geographical position in relation to the crop, the next being to measure which fraction of genetic diversity present in the biological species has been included in the crop and which fraction has been left out during the domestication process. In parallel, these studies also reveal which fractions of genetic diversity are unique to the wild relative(s) or to the crop, and where these fractions are geographically located; it is then possible to give indications for more efficient conservation actions, either through *ex situ* or *in situ* methods. One model currently being investigated is that of the Cucurbitaceae where the focus is on *Cucurbita* and *Sechium*. This study, initiated in 1990 at the Instituto de Biología, University of Mexico, focuses on four important genera of Cucurbitaceae (*Cucurbita*, *Cyclanthera*, *Sechium* and *Sicana*). During 1991, work progressed in checking herbarium specimens, and laboratory studies and field work were conducted.

Herbarium studies revealed two undescribed species of the subtribe Sicyinae from Oaxaca: *Parasycios dieterleae*, an endemic species from the region of Mixteca Alta, and *Sechium chinantlense*, a wild relative of chayote from the region of Chinantla. The ancestry of *Cyclanthera pedata*, traditionally grown for its edible fruits and stems, was checked and *C. tenuisepala* proposed as its possible ancestor. Scarce information on the crossing ability

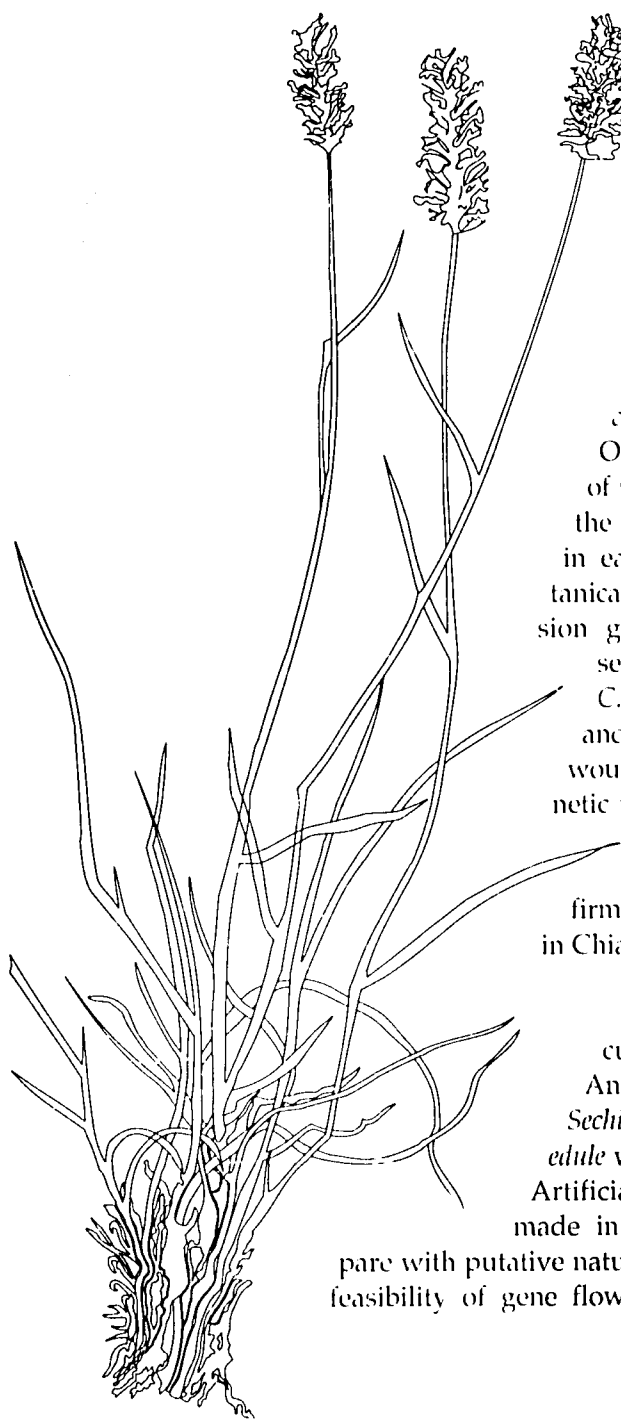
Fig. 4. Representation of the taxa of *Sechium* s.l. and its allies in a bidimensional space of characters resulting from a principal coordinate analysis.

Taxa acronyms = SCO (*Sechium compositum*); SEC (cultivated *S. edule*); SEW (wild *S. edule*); SHI (*S. hintonii*); SPI (*S. pittieri*); STA (*S. tacaco*); STL (*S. talamancensis*); SVI (*S. villosum*); FPA (*Frantzia panamensis*); FVE (*F. venosa*); MHE (*Microsechium hellerii*); PMA (*Parasicyos maculatus*); PLA (*Pterosicyos laciniatus*); SET (*Sechiopsis triquetra*); SIM (*Sicyos motozintlensis*).



of the 25 or so wild species of this genus indicated that *C. brachystachya* and *C. brachybotrys* may be conspecific.

Pollen analysis showed that the species of *Sechium* and two species of *Frantzia* are separate (see Fig. 4) so the genus *Sechium* would include ten species, two of which are cultivated. Chromosome numbers were studied for the species for which no data were found in the literature. For *Sechium compositum*, *S. hintonii* and *S. venosum* have the same number (2n = 24) as *S. edule* and other species within the subtribe of Sicyinae. *Sicana odorifera* (2n = 40) is the same as *Cucurbita* species.



The project made specific searches in Mexico for poorly known wild species and collected 131 samples. Field studies of gene flow in crop-weed complexes were made on the complex *Cucurbita fraterna-C. pepo* in Tamaulipas, and the complex *Sechium chinantlense-S. edule* in Oaxaca. The distribution of the wild relatives *versus* the crops was documented in each case, and ethnobotanical data about introgression gathered. Genetic flow seems to occur between *C. fraterna* and *C. moschata* and *C. argyrosperma*. This would indicate a closer genetic relationship between *C. moschata* and *C. argyrosperma*, confirming observations made in Chiapas in 1990, and would imply *C. fraterna* in the ancestry of three major cultigens of cucurbits. Any gene flow between *Sechium chinantlense* and *S. edule* would be rather limited. Artificial crosses have been made in both models to compare with putative natural hybrids and test the feasibility of gene flows.

Triticeae in China

Between 1986 and 1990 IBPGR supported a project to carry out an ecogeographical survey and collect wild Triticeae genetic resources from northern and western China. The major participants in the work were the Institute of Crop Germplasm Resources, Beijing and the Triticeae Research Institute, Sichuan. Each institute carried out an exploration and collecting mission in each year of the project in collaboration with colleagues from France, Sweden, Japan, Canada and the USA. More than 3500 accessions were collected during the project of a wide range of Triticeae species including *Elymus*, *Roegneria*, *Agropyron*, *Leymus* and *Hordeum* and are now maintained by the two Chinese institutes.

The internationally collaborative nature of the project was further strengthened in that two Chinese students, one in France (as an IBPGR intern) and one in Sweden worked on the material being collected. A particular feature of the project has been the close links that have been made between the collecting and exploration missions and research and utilization of the material. A new species found by the Sichuan team has been described in the scientific literature and a further 40 papers published so far on the collected material. Much of the material has already been evaluated and valuable disease resistance and hardiness characteristics have been found. Crosses have been made between collected accessions of *Agropyron* and *Triticum aestivum* in both France and Beijing in order to explore the possibility of introducing useful new genes into wheat.

At an IBPGR-sponsored workshop of the participants held at Svalof, Sweden in August, 1991 it was agreed that an IBPGR publication, provisionally entitled 'Genetic Resources of China: The Wild Triticeae' should be produced which would collate and document the achievements of the project and provide an up-to-date compilation on the status and conservation of wild Triticeae in China.

Triticum and *Aegilops* database

An important question to be addressed by all those concerned with germplasm conservation is the extent to which existing collections adequately represent the genetic diversity of a crop genepool or its wild relatives. A compilation of world germplasm holdings in the form of a unified database is a prerequisite for answering this question and is a necessary part of the work of crop networks. Where no such network exists a different approach may be required and, as noted in previous Annual Reports, IBPGR, together with ICARDA, has undertaken the development of such a database for wild *Triticum* and *Aegilops* species. Genebanks holding accessions of these two genera have supplied the data on their holdings. These were then analyzed to determine the extent to which such databases can be used to identify unnecessary duplication and undesirable gaps in collections, to guide future collection and conservation activities and to identify accessions from particular types of environment that might be of interest for plant breeding programmes.

Analysis of the database, which contains accessions from 33 countries currently held in over 50 germplasm collections, showed that 75% of the accessions were unique and unduplicated and that the amount of infor-

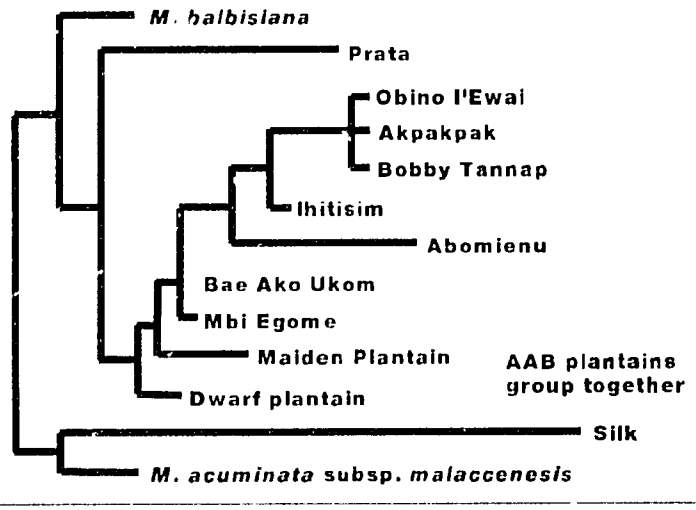
mation held on each accession varied widely. From the passport data supplied by the genebanks it was possible to map the collection location of 85% of the accessions and obtain precise data on collection altitude for 59%. Much less information was available on other aspects of the collection site and for characteristics such as soil type, site topography and associated vegetation, data were available for less than 20% of the accessions.

The analysis showed that it was possible to map the origin of existing collections of a species and obtain reasonable estimates of the distribution of collected accessions, the completeness of geographic coverage and the amount of duplication which, in this case, was very low. Direct information on the nature of the collection site which might be used to identify accessions with particular characteristics was limited but could be inferred from comparison of geographical data with other sources such as existing soil maps. This model study could be extended to a wide range of species and crops and provides a sound basis for the selection of accessions for studies on the amount of diversity in existing collections and for other work where a sample of accessions is required such as in the development of core collections. The wild *Triticum* and *Aegilops* species database is maintained by ICARDA and is available to interested users.

Molecular analysis of diversity in *Musa*

In addition to the two chloroplast (cp) DNA-based analyses described in the 1990 Annual Report, two more analyses of *Musa* were made at the University of Georgia/USDA, Griffin, Georgia, USA in 1991. One analysis was based on mitochondrial DNA (mtDNA) and the other on nuclear DNA (nuDNA). mtDNA probes detected a greater degree of polymorphism than cpDNA. Ribosomal mtDNA probes were more effective in detecting RFLPs than other mtDNA. A cladogram (Fig. 5) with a consistency index of 0.81 was constructed. Plantains (AAB) grouped together in this analysis, but two AAB dessert bananas (Prata and Silk) did not group with the plantains. 66 genomic DNA probes were used to detect RFLPs in *Musa* spp. A cladogram with a consistency index of 0.784 (Fig. 6) showed two clear groupings: one with the *Eumusa* and *Rhodochlamys* sections and the other with *Australimusa* and *Callimusa*. The only exception was *M. beccarii* (sect. *Callimusa*) which appeared to be very similar to *M. acuminata*. During the last year of the project RAPDs will be used to complement the RFLP data obtained so far.

Fig. 5. Cladogram of *Musa* based on analysis of mitochondrial DNA showing relationships among cultivated *acuminata* types



Clade, a group of organisms that is descended from a common group. Hence *cladogram*, a diagram that illustrates evolutionary relationships, in this case by assessing the degree of polymorphism in the DNA of the ribosomes.

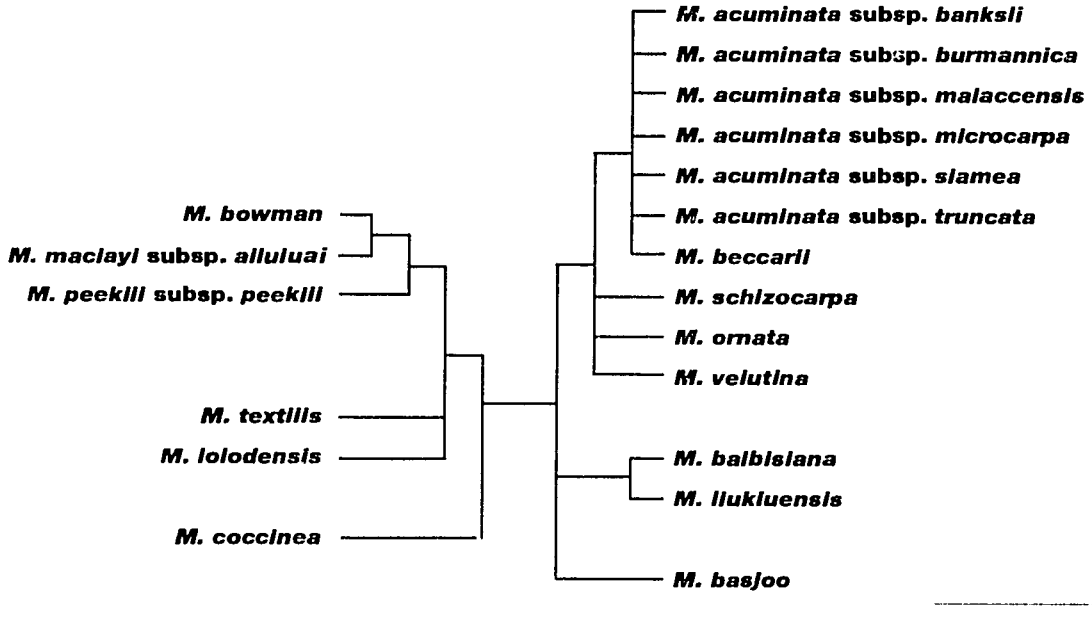


Fig. 6. Cladogram of *Musa* based on analysis of nuclear DNA showing relationships among species

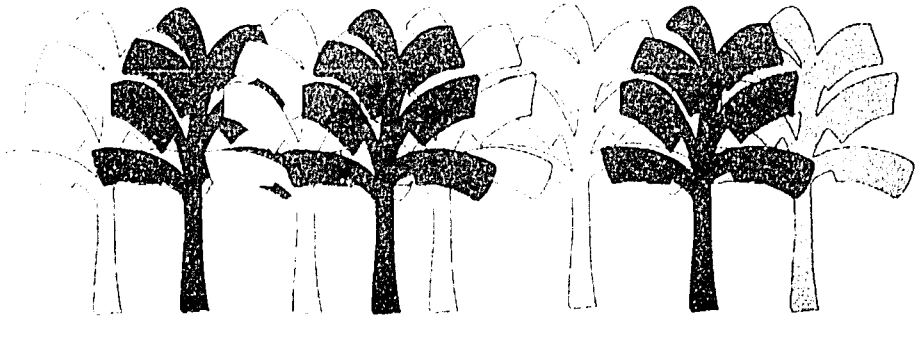
Diversity and systematics of *Vigna*

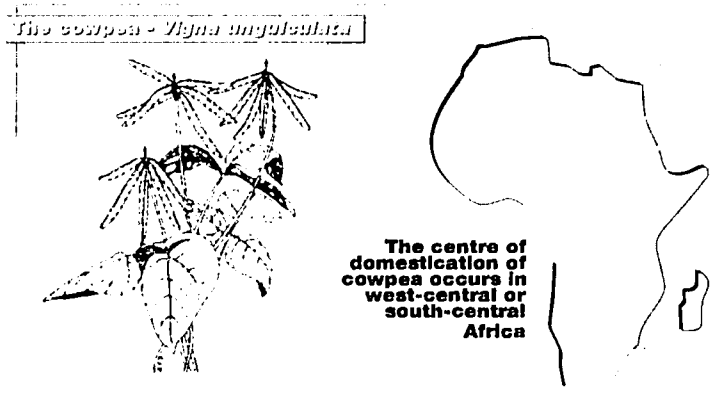
A project on the genetic diversity and systematics of *Vigna* in collaboration with Cornell University, USA concluded in 1991.

The first objective, evaluating genetic diversity, showed that the cowpea (*Vigna unguiculata* subsp. *unguiculata* cv.-gr. *unguiculata*) has a low level of diversity; the yard long bean (cv.-gr. *sesquipedalis*) and the catjang (cv.-gr. *biflora*) even lower levels.

The second objective was to determine relationships of the different species within *Vigna* to the genera *Phaseolus* and *Macroptilium*. The allozyme variants found in cv.-gr. *biflora* were a subset of those in the cowpea (cv.-gr. *unguiculata*), which strengthens further the hypothesis that these evolved from cultivated cowpeas.

The third objective was to investigate systematic relationships within the genus and with closely related genera such as *Phaseolus*, *Dipogon* and *Macroptilium* using chloroplast DNA (cpDNA) variation. Wild cowpea (subsp. *dekindtiana*) showed a high level of genetic diversity using allozyme and cpDNA data. It was difficult to distinguish the different varieties of wild cowpea (*V. unguiculata* subsp. *dekindtiana*) using isozymes. A survey of 26 wild populations and 32 cultivated accessions of cowpea from Africa provided further evidence that the centre of domestication of the cowpea





is in west-central or south-central Africa (Nigeria to Zaire).

V. unguiculata does not appear to have any close relatives. Subsp. *dekindtiana* has a high level of genetic diversity, which makes it a promising source of genes for cowpea improvement. cpDNA analysis is a good tool to identify wild germplasm conserved in genebanks and to monitor the quality of the germplasm.

Methods to characterize *Phaseolus* and *Vigna*

A second project addressing *Phaseolus* diversity continued in collaboration with the University of California, Davis, USA where work continued during 1991 in identifying DNA markers to characterize *Phaseolus* and *Vigna* genetic resources. DNA markers indicate genetic diversity. The project has identified several of them and confirmed that they give reliable results. Plants from the same group of *Phaseolus vulgaris* seeds were grown in four different locations. The markers showed that they could reveal differences in the genotypes of the plants. Using the marker method on a sample of 55 wild and cultivated *P. vulgaris* confirmed the existence of the two major genepools in beans: Meso-American and Andean.

The project has also shown the amount of diversity that has been lost in developing elite cultivars. A survey of 25 wild and 60 cultivated *P. vulgaris* accessions confirmed a reduction in genetic diversity during domestication and other work illustrated the split between Middle American and Andean materials.

Markers for *P. vulgaris* were also used to analyze genetic diversity in *V. unguiculata* and to map its genome. The work confirmed the restricted genetic lineage of single domesticated cowpea, with all the associated risks and vulnerabilities.

Conserving *Phaseolus ex situ*

The project managing *Phaseolus* genetic diversity in collaboration with CIAT concluded in 1991. Its general objective was to develop optimal management strategies for maintaining genetic diversity in a genebank by better understanding the genetic structure of *P. vulgaris* in nature and in the genebank.

When a new accession arrives at a genebank, the seed may be planted in a quarantine greenhouse, and the seed resulting from this growth planted in the field. Large differences in seed number produced per plant were observed in three wild *P. vulgaris* accessions from different origins that were tested over two years. Hence, initial seed increase presents a risk of genetic drift because of differing fecundity in a small population.

To reduce this risk, it is necessary to understand the genetic structure of the original accession and the effects on it of different methods of seed multiplication.

The study chose six out of 18 isozyme systems in the plant as indicators of genetic variation. The three test populations had different allele frequencies in the six loci, indicating significant intrapopulation diversity and providing a way to measure subsequent changes in diversity. A simulation of the effects that different seed increase methods (different population sizes and different harvesting methods) have on allele frequencies confirmed that significant changes could occur. In the actual study, when all of the harvested seeds were used, the original gene frequencies did not change very much. The size of the original population was the most important factor that affected the change in allele frequencies. So the project shows how important it is to have a large initial population and to harvest all the seeds to keep changes in the diversity of the material to a minimum.

Variation within common accessions

Accessions that are common to two or more genebanks should logically have the same genetic content. However, studies indicated that there were different seed types in the same *Phaseolus* accessions maintained in CIAT and USDA, Pullman. Different management practices could have changed the gene frequencies, so seeds of eight accessions common to the two genebanks were planted at Tenerife, and seven morphological traits checked for each plant. Plants and seeds from Pullman demonstrated more variability in many traits than those from CIAT, so some genetic change had occurred since the seeds were transferred from one genebank to the other. This illustrates that it cannot be assumed that accessions common to two genebanks are genetically identical.

Contamination through cross-pollination

Earlier studies had indicated the possibility of a significant level of cross-pollination (allogamy) in common bean, which is mostly a self-pollinated species. If this happened between accessions during seed increase in the field, then some of the seeds harvested would be genetically contaminated. Such contamination presents a serious problem in genebank management. The CIAT study used a morphological marker to estimate cross-fertilization in 11 accessions of *Phaseolus* in two Colombian locations (Popayan and Tenerife). Allogamy frequencies were low in both locations (less than 1%). Five had no cross-fertilization at either site. There may not be need for any special pollination control for regeneration of common bean at these two sites. However, this study highlights the fact that the allogamy frequency can vary with site, so outcrossing rates should be established before regenerating any germplasm.

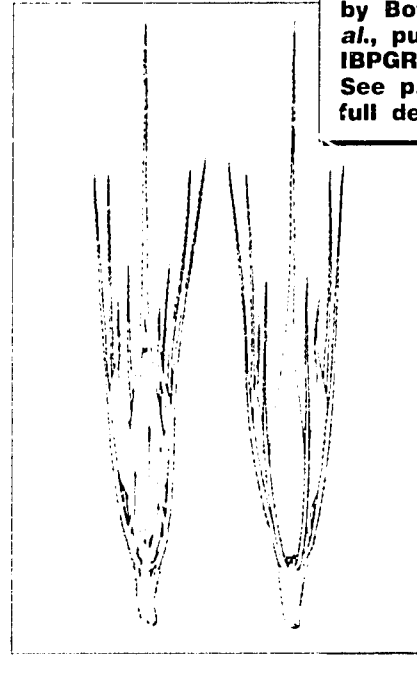


Illustration of *Hordeum roshevitzii*, taken from 'An Ecogeographic Study of the Genus *Hordeum*', by Bothmer *et al.*, published by IBPGR in 1991. See p. 55 for full details

Crop-specific guidelines for seed regeneration

Work on crop-specific guidelines for regeneration of seed continued. Drafts on barley and okra germplasm were circulated to relevant curators and researchers. The aim is to prepare guidelines that are pragmatic, but the process is complicated by the different management and regeneration methods of different genebanks. Nevertheless the demand for such guidelines is very high. IBPGR will finalize the two under preparation and extend work to other genepools.

Characterization and evaluation of quantitative characters

A large number of the characters of interest to users of plant genetic resources show significant genotype x environment interaction. Flowering response in annual crops, traditionally recorded in terms of time (i.e. days from sowing to flowering), is one such character which is subject to strong environmental interactions and information on which may be reliable only over limited geographical regions.

A collaborative project, involving the Plant Environment Laboratory, University of Reading, UK, the Cunningham Laboratory, CSIRO, Australia and AVRDC, Taiwan, China continued to investigate flowering response in soyabean and to determine whether predictive flowering equations can be used to characterize soyabean genotypes. The equations, developed in preliminary studies, have been applied to data obtained from many soyabean genotypes grown in a large number of environments. So far data from 12 genotypes have shown that: (i) data from independent investigations that include widely separated sites and different seasons are indistinguishable and fit the theoretical expectations very well; and (ii) flowering in soyabean genotypes can be predicted reliably in any location on the basis of five genotypic coefficients that characterize flowering response to photoperiod and temperature. (see Figs. 7 and 8). The analyses still to be conducted will provide data on additional genotypes and determine what minimum number of sites and sowings would give acceptable accuracy for this purpose.

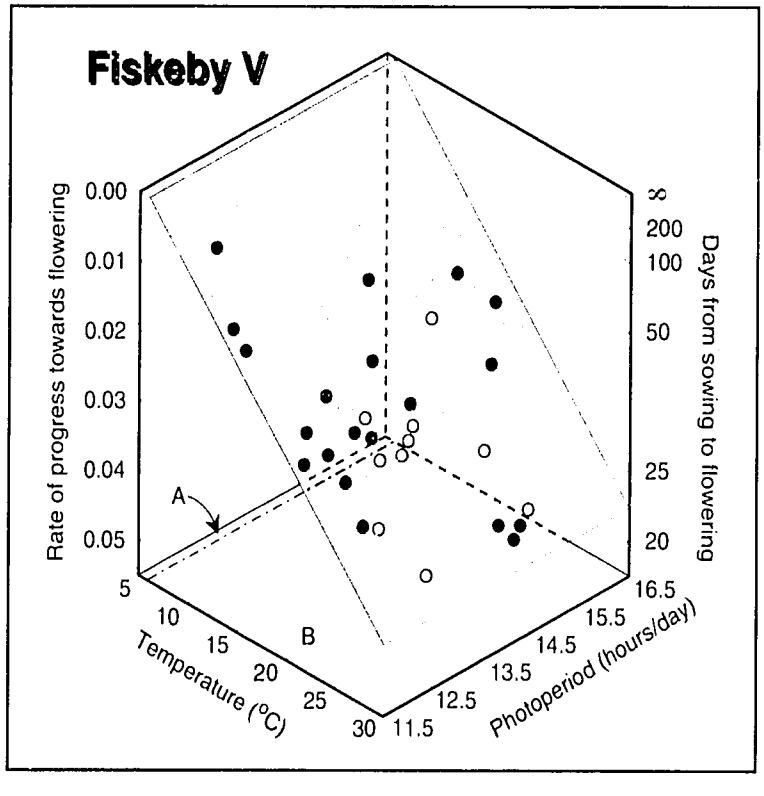


Fig. 7.

Predictive flowering equations can be used to characterize soyabean genotypes - see text for further details

New initiatives

A project on effective pollination control methods in the regeneration of germplasm, to be carried out in two German institutions, with special project funding from the Government of Germany, was finalized and approved for funding in 1991. This project aims to gather information that will allow the development of better regeneration technology for allogamous crop species, to identify efficient insect pollinators and to establish methods for breeding and rearing of such efficient pollinators.

It is well known that genetic drift can occur during each regeneration of germplasm seed conserved in the genebanks, leading to the loss of genetic diversity conserved. However, there are few hard facts of use in formulating optimum strategies for regeneration. A study is being planned in three or four genebanks on three or four crop species at each genebank to quantify the loss of diversity during a cycle of regenerations of the material. The genebanks where such a study could be carried out are being identified.

SEED CONSERVATION RESEARCH

IBPGR has continued to support research on seed conservation with the objective of improving technology for long-term conservation of plant genetic resources. Research funded by IBPGR in 1991 produced excellent results which are expected to have a great impact on the conservation of plant genetic resources.

Non-destructive methods for seed viability determination

Seed viability has to be monitored during seed storage by germinating samples of seeds. However, the germination tests currently used deplete valuable germplasm supplies and necessitate too frequent regeneration. Furthermore, some accessions with small numbers of seeds cannot be monitored adequately. IBPGR recognized this problem and has supported a research project to develop a non-destructive viability test at the National Seed Storage Laboratory and Colorado State University, USA.

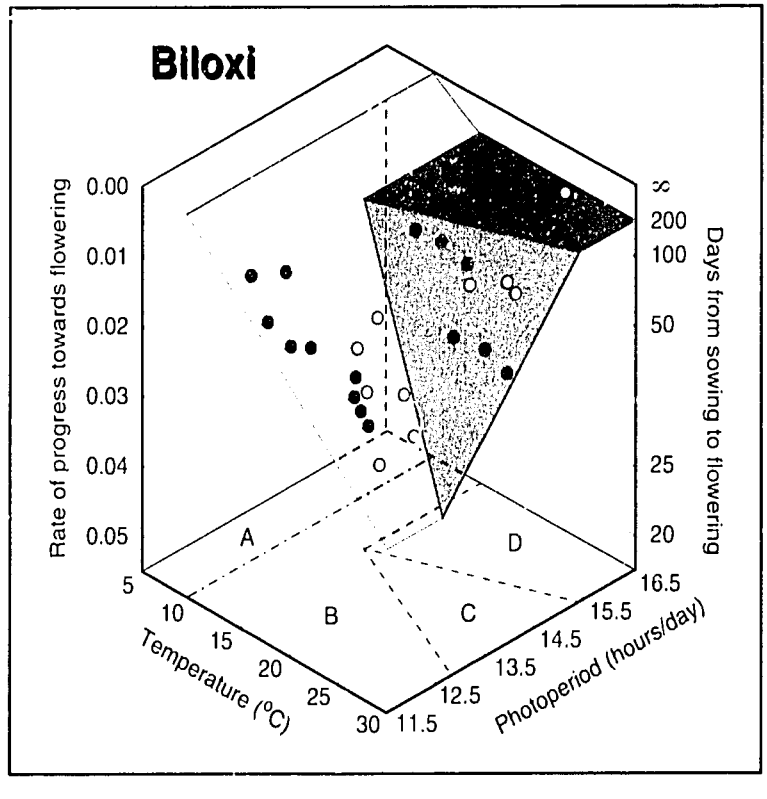


Fig. 8.

Data from independent investigations which include soyabeans grown at widely separated sites and different seasons are indistinguishable

Among four different methods studied, the seed leachate conductivity test has shown very promising results. Individual maize (*Zea mays*) seeds were soaked for four hours and the conductivity of the leachate measured. Seed leachate data on 27 naturally aged seed lots of red clover (*Trifolium pratens*) correlated very well with viability. The seed can be dried back to its original moisture level and the cycle repeated four times withou significant loss in seed viability (Fig. 9).

Ultradry seed storage

During 1991, IBPGR continued to support a research project at the University of Reading, UK on ultradry (less than 5% moisture content) seed storage. Ultradry storage is potentially very cost effective, particularly in the tropics. Seed would be dried, hermetically sealed and stored at ambient temperatures, or at least with considerably lighter refrigeration loads than currently used. Although this technology is new, some seeds have been stored unintentionally under ultradry conditions by storing seeds over dry silica gel in sealed glass tubes. Such seeds were located in one genebank and used in the Reading experiments. After 25 years' storage under ultradry conditions, there was no decrease in seed germination (Fig. 10).

Another project on ultradry seeds, this time at the Botanical Gardens, Beijing, China also yielded promising results in 1991. Ultradrying did no harm to seeds of 12 widely different species. In fact, storability can be improved by ultradrying. Some enzyme systems are better maintained in ultradry seeds and seed deterioration products, e.g. malondialdehyde and volatile aldehydes, were at lower levels in the aged ultradry seed.

A research project on the genetic stability of seeds in ultradry storage has been running at the University of Reading, UK since 1989. Field work in the summer of 1991 designed to determine the rate of hereditary mutation was completed according to plan and the second generation of seed stocks (16 300 lots) was ready for sowing. This work will continue in 1992.

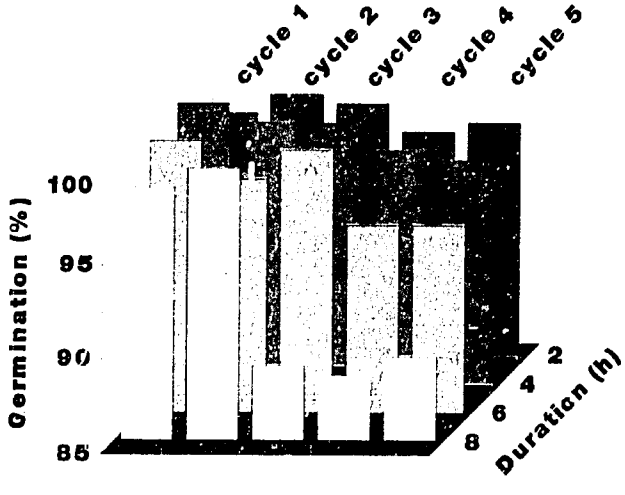


Fig. 9. Germination of maize seeds as affected by the number and duration of successive soaking/drying cycles

(Data from the National Seed Storage Laboratory and Colorado State University, USA)

Preservation of recalcitrant seeds

Many of the major plantation crops, fruit trees and timber species produce recalcitrant seeds, which cannot be stored at a low moisture content and low temperature. Appropriate technology for long-term conservation of recalcitrant seeds has not yet been developed.

An IBPGR project at the Universiti Pertanian Malaysia has, however, produced exciting results. Excised embryos of rubber (*Hevea* sp.) seeds of two cultivars have been

successfully cryopreserved in liquid nitrogen. One cultivar had survival rates of 30% after embryos had been dried to a moisture content of 11-16% and another had rates of 82% at 16-20% moisture content. No cryoprotectant was needed. Excised oil palm embryos were successfully stored in liquid nitrogen after three hours of desiccation (reaching about 10% moisture content). The high survival rate of 80% was obtained.

A new project initiated in 1991 with financial support from the Overseas Development Administration, UK at NBPGR, India will investigate biological mechanisms determining the recalcitrance in seeds of cocoa, jackfruit and tea.

Genetic stability in seeds during storage

A project carried out cooperatively by the Boyce Thompson Institute, Cornell University, USA , the National University of Mexico and CIMMYT, Mexico studied the genetic control of storage characteristics, the biochemical basis of good and poor storage, and genetic stability during seed storage. Experimental data suggest that single strands of the DNA in seeds start to break during the later stages of deterioration and further DNA breakage occurs after seed death. When the viability of maize (*Zea mays*) seeds fell below about 40% germination, no DNA could be detected with a 5S-RNA clone, which would reveal low-molecular-weight fragments. The lowest molecular weight DNA was found in a non-viable 105-year-old sample.

This project also found that maturing soyabean seeds cannot survive drying until they have accumulated substantial amounts of stacchyose, an oligosaccharide. A new hypothesis has been proposed that to survive drying, seeds depend on a combination of soluble sugars (including abundant sucrose and stacchyose) plus several stress proteins.

A Visiting Scientist from the National University of Mexico, Mexico again worked in the Boyce Thompson Institute with financial support from IBPGR. She studied soluble carbohydrates in maize seeds in relation to seed vigour. The interesting result was that during the weakening of vigour during slow artificial ageing (30°C, 75% relative humidity) the raffinose content of the embryos declined drastically. This could lead to galactose formation that could ultimately reduce the enzymic effectiveness of the seed.

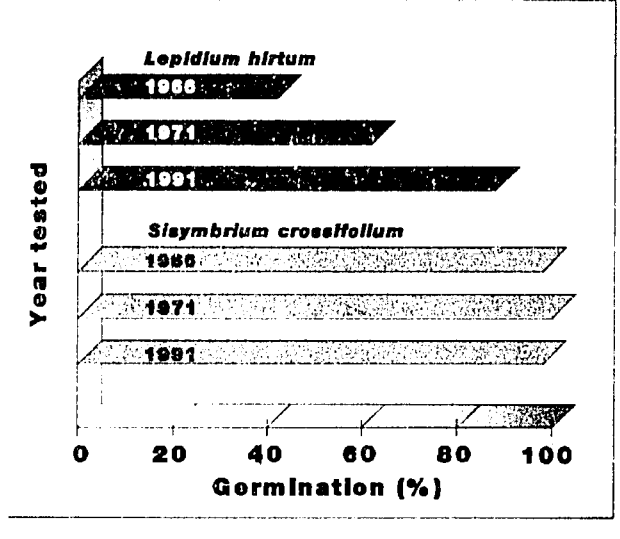


Fig. 10. Germination of ultradry crucifer seeds stored for long term (25 years)

Seed of *Lepidium hirtum* and *Sisymbrium crossifolium* were stored at 2.2-3.2% moisture content at -10°C. The increase in germination rate was a result of losing seed dormancy. Normally seeds lose their dormancy before they lose their viability (data from the University of Reading, UK).

A two-year project was completed in 1991 at the Agricultural University, the Netherlands. This project studied changes in gene expression of seeds during storage. The project found altered protein expression in cauliflower seeds (*Brassica oleracea*). Expression of certain proteins (V proteins) correlated with the rate of germination and appeared to be specific to processes preparing for visible germination. This means that the content of V-1 protein in the root tip is a potential indicator of seed vigour and a clue to understanding the biochemistry of seed ageing.

IN VITRO RESEARCH

In vitro techniques have an important role to play in conserving clonally propagated and recalcitrant seed-producing species. During 1991, IBPGR continued to take a broad approach to research on *in vitro* conservation methods.

In vitro collecting methods in *Citrus*

A project continued at the Research and Development Centre for Biotechnology, Bogor, Indonesia, to adapt *in vitro* collecting methods to citrus germplasm. Material was collected from 17 sites in Sumatra, Lampung and Bengkulu, including shoots and seeds from immature and mature fruits. Of 53 varieties collected, 27 have been cultured successfully and 14 were transferred successfully to *in vivo* growth. Failures at the culture stage were generally due to fungal and bacterial contamination, despite the inclusion of fungicides and antibiotics in the initial culture medium.

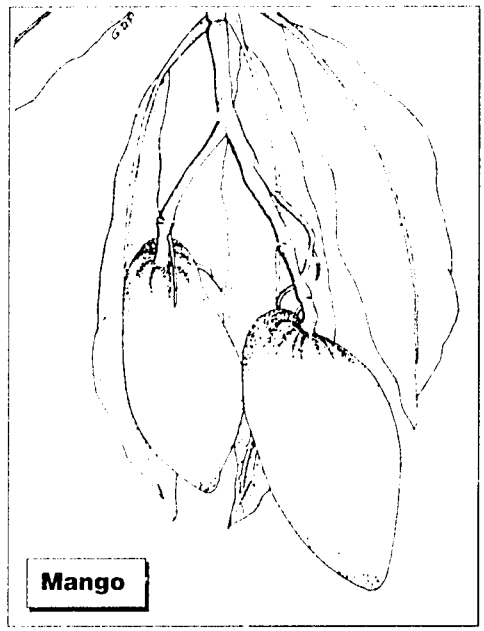
Somatic embryos as culture systems

Somatic embryos are derived from a non-sexual propagation method that clones tissues through the formation of structures that resemble the seed embryo. They are an extremely promising *in vitro* culture system for mass propagation and, with the advent of artificial seed technology, for genetic conservation. Three IBPGR projects have explored somatic embryo-based conservation systems.

Cryopreservation of somatic embryos

Scientists at the Wageningen Agricultural University, the Netherlands have been attempting to cryopreserve somatic embryos of *Xanthosoma brasiliense*. Granular callus from tubers was treated with the growth regulators benzylamino purine (BAP) and indolebutyric acid (IBA) to induce embryogenesis. Lowering the concentrations of the growth regulators then encouraged embryo growth. Abscisic acid (ABA) increased the embryos' tolerance to freezing, but combining ABA with sucrose or sorbitol, two common additives in cryopreservation pregrowth formulations, reduced the benefit of ABA. The best survival was achieved after slow cooling at a rate of 0.5°C per minute to -20°C after ABA treatment. However, the embryos did not survive beyond an initial period because of freezing injury. Parallel research on somatic embryos of *Daucus carota* has implicated membrane phase changes in such injury.

Somatic embryos as storage systems



Research has continued in two projects at the University of Florida, USA. The first involves induction and short- to medium-term storage in culture of somatic embryos of mango. The second is investigating the potential for desiccation and longer-term storage of the embryos. Considerable progress has been made in stimulating somatic embryos to germinate, but cultures do not retain embryogenic potential for extended periods of time and there is evidence of isozyme instability. This points to the unsuitability of the culture system for anything other than an initial propagation phase or as a short-term conservation method for this species. Despite these problems, the somatic embryo culture system remains very attractive in mango since it permits ready propagation from tissues of maternal genotype and provides propagules that are more likely to resist desiccation and freezing stresses than shoot-tips.

Somatic embryos of mango have been exposed to varying levels of abscisic acid (ABA) and different drying regimes to develop a conservation system based on the synthetic seed model. This approach may be valid because the embryos respond in a classic way to ABA by, for example, accumulating storage materials. Such treatment allows the embryos to tolerate desiccation for up to three weeks.

Cryopreservation

Research has continued on the three species identified by IBPGR as models for the wider development of cryopreservation methods, namely *Musa* (banana and plantain), coconut and cassava. During 1991, research was also initiated on a fourth crop, potato.

Musa

CATIE in Costa Rica has been working on the cryopreservation of both zygotic embryos and somatic tissues of *Musa*. A simple procedure has been developed for embryos. This involves drying dissected embryos in a sterile air flow for two hours, by which time their water content is reduced to 11% in the case of *M. acuminata* and 14% in the case of *M. balbisiana*. Embryos are then frozen rapidly by direct immersion in liquid nitrogen. After rapid thawing, 80% of the *M. acuminata* and 92% of the *M. balbisiana* embryos germinated. Comparison with unfrozen controls shows the majority of the viability loss under these conditions to be due to desiccation rather than freezing and thawing.

As with many other species, cultured somatic tissues of *Musa* have proven much more difficult to handle. For shoot meristems, a range of pregrowth, desiccation, cryoprotection and freezing treatments have been compared, including two promising new approaches: encapsulation in alginate and vitrification. As yet, no meristems have survived. Experiments

with callus have provided more encouraging results. Callus of the triploid variety Grand Naine survived rapid freezing in liquid nitrogen after pretreatment with high concentrations (0.5-0.75 M) of sucrose. Survival levels of up to 75% were recorded. No material survived sucrose pretreatment/rapid freezing after treatment with the cryoprotectant dimethylsulphoxide. In contrast, slow freezing after sucrose pretreatment/dimethylsulphoxide application gave survival levels of up to 83%. Such an interaction between pretreatments and freezing conditions is common in cryopreservation.

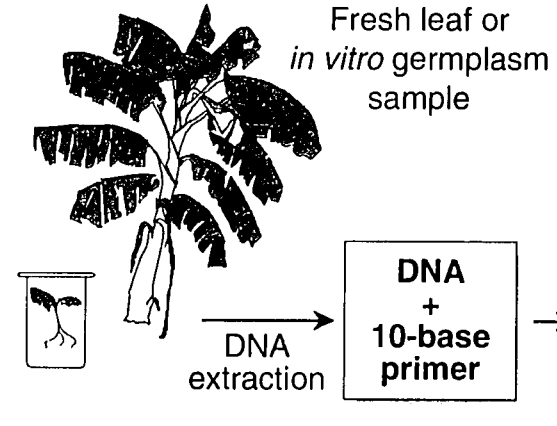
Coconut

During 1991, IBPGR and IRHO/ORSTOM successfully completed a collaborative project in France and Côte d'Ivoire on the cryopreservation of coconut embryos. During the final phase, efforts concentrated on *in vitro* culture and cryopreservation of immature embryos, medium-term storage of mature embryos and cryopreservation for long-term storage of mature embryos. The weight of immature embryos was an important factor in determining their response to culture conditions. Embryos weighing 10-20 mg grew very well on medium containing a mineral solution supplemented with glucose and sucrose. Below 10 mg, the embryos were erratic in their response or totally unresponsive.

Immature embryos have successfully been cryopreserved after pretreatment with glucose and glycerol or sorbitol, and rapid freezing. Up to 93% of mature embryos survived the same treatment, after four hours of desiccation in a sterile air flow before treatment with glucose and glycerol.

Random Amplified Polymorphic DNA (RAPD) for the detection of genetic instability/ polymorphism in germplasm samples

Advantages of RAPD
- Rapid results
- Low technical difficulty
- Non radioactive
- No need for species specific probes
- Relatively low cost
- High level of polymorphism
- Surveys the whole genome
- Small amount of plant sample



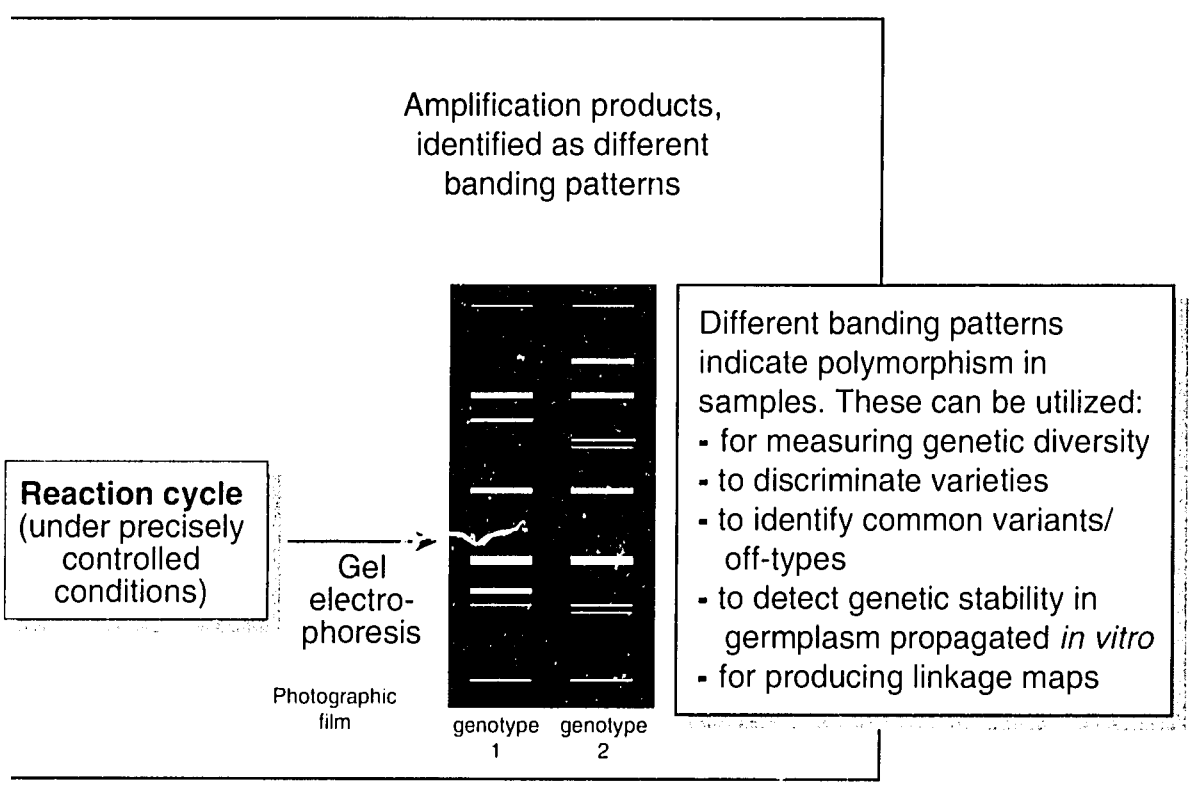
For medium-term storage, mature embryos were successfully maintained for six months on medium supplemented with activated charcoal

Cassava

A collaborative project with CIAT in Colombia on the cryopreservation of cassava finished in 1991. At the beginning of the year, the main successes had been in cryopreserving seeds and zygotic embryos. Shoot-tips, again, had been proving very difficult to handle. During the year, however, the project found that air drying shoot-tips after cryoprotection with dimethylsulfoxide dramatically improved survival potential. Rapid cooling was more effective than slow cooling, opening up the possibility of cryopreserving material without costly controlled-freezing apparatus. Genotypic factors played a very large part in the response. In a screening of 15 different genotypes, survival levels ranged from 4 to 93%, with shoots regenerating in up to 52% of the explants. The method is excellent for long-term, *in vitro* base conservation for the crop, but genotype influences must be examined further to render the technique sufficiently reliable for use in the genebank.

Potato

Towards the end of 1991, a project was started to refine cryopreservation methods for potato. This research was made possible by complementary funding from Germany and involves collaboration between two German institutes, the Institut für Pflanzenbau und Pflanzenzuchtung, and the



Deutsche Sammlung von Mikroorganismen und Zellkulturen GmbH, both in Braunschweig.

A considerable amount of research had been done over the previous 15 years but the results lacked consistency and had not been taken up by any major potato collections. The objective of this project is to analyze the research conducted to date, apply recent developments in cryopreservation technology to potato, and establish a reliable, widely applicable method.

Assessing stability and diversity in collections

Two studies have been carried out on new techniques for assessing genetic stability and diversity within collections. They are particularly pertinent to *in vitro* work since they permit characterization of *in vitro* cultures themselves, without the necessity to regenerate *in vivo* plants.

Stability and diversity

Slow growth storage based on a reliable micropropagation system and growth-retarding conditions is satisfactory for medium-term ('active') conservation. It is used for many clonally propagated crops. However, in a few cases, notably bananas and plantains, even the most reliable *in vitro* propagation process holds the risk of producing off-types ('somaclonal variants') that are probably genetic in origin. These variants have to be detected early otherwise they could pass unnoticed until the crop is in the field, with the risk of serious economic losses. The risk to the farmer is paralleled by a risk to the genetic integrity of accessions in the *in vitro* genebank.

In 1991, IBPGR secured complementary funding from ODA, UK for a collaborative project involving the University of Birmingham and the INIBAP Transit Centre in Leuven, Belgium to develop a detection method based on random amplified polymorphic DNA (RAPD or 'rapids'). In this technique, arbitrarily designed primers comprising a small number (e.g. 10) of nucleotide bases are used to detect differences in DNA sequences. A preliminary screening of 14 primers showed how powerful this technique could be in identifying cultivars. A larger-scale trial is under way to screen about 100 primers against cultivars and off-types.

In 1991, an IBPGR Visiting Scientist based at CIAT, Colombia, completed a study of DNA polymorphism and DNA fingerprinting in cassava. The work had been initiated in collaboration with the IBPGR-CIAT Pilot *In Vitro* Genebank. The study identified the most effective combinations of probes and restriction enzymes for discriminating cassava genotypes. The RAPD technique was applied successfully to two cassava cultivars and one wild species, *Manihot aesculifolia*. Successful discrimination of the three genotypes has paved the way for the first comprehensive work on molecular mapping and gene tagging of *Manihot* spp. and indicates the potential of this new technique in genetic diversity studies.

Workshop on *in vitro* conservation

The community of scientists working on *in vitro* conservation is small but growing. IBPGR projects remain a significant proportion of efforts world-

wide to develop alternative conservation techniques for problem crops. The IBPGR *In Vitro* Conservation Officer organized a workshop on germplasm conservation at the 1991 Annual International Meeting of the Society for Cryobiology. This provided an opportunity to interact with IBPGR collaborators and review the current state of development of cryopreservation technology.

PLANT PATHOLOGY AND QUARANTINE

Safe movement of germplasm

During 1991, the Joint FAO/IBPGR programme to develop technical guidelines for the safe movement of germplasm published three new titles, cassava, grapevine and vanilla, bringing the total number so far produced to ten. A meeting to develop guidelines for sugarcane, hosted by the Mauritius Sugar Industry Research Institute, was held in Reduit, Mauritius in collaboration with the International Society of Sugar Cane Technologists. Another meeting held in Puncak, Indonesia and hosted by the Central Research Institute for Industrial Crops, Bogor, developed guidelines for coconut.

In vitro virus therapy and indexing

A project to develop an *in vitro* system for virus therapy and detection at the Volcani Centre, Bet Dagan, Israel finished during 1991. Two model systems involving rosaceous fruit crops were studied: peach infected with *Prunus* necrotic ringspot virus (PNRSV) and strawberry infected with strawberry mild yellow edge virus (SMYEV).

Fig. 11. Leaflets of a test tube-grown strawberry plantlet grafted on to a greenhouse-grown indicator *Fragaria vesca* (Figure courtesy Dr S. Spiegel, Volcani Institute, Bet Dagan, Israel)

Peach

Thermotherapy is effective on peach shoot cultures in a carbon dioxide-enriched (1200 ppm) environment. Shoot-tips cultured for three weeks at 38 C/16 h light alternated with 28 C/8 h darkness completely eliminated the virus with 59% of the shoot-tips surviving. The speed the virus was eliminated varied between cultivars. *In vitro*-grown plantlets could be reliably indexed for PNRSV by testing leaflets with enzyme-linked immunosorbent assays.

Strawberry

Strawberry plantlets grown *in vitro* are very sensitive to high temperatures. The temperature and light regime most effective in peach gave survival rates of only 10 to 45% in different cultivars of rooted strawberry plantlets after 18 days.

In addition, shoot-tip (4-5 mm) culture from the surviving plantlets did not show a significant increase in the percentage of virus-free plantlets.

Two methods of virus indexing were assessed using *in vitro* grown strawberry plantlets. The first method consists of grafting leaflets from test-tube plantlets on to a greenhouse-grown indicator, *Fragaria vesca*. This method was about 75% reliable, which is similar to the 73% reliability of the conventional method of detecting SMYEV in greenhouse-grown plants. The second method used immunosorbent electron microscopy and proved to be far more accurate. This test used an antiserum specific to the potexvirus associated with SMYEV (Fig. 11), to leaf tissues of plantlets grown *in vitro*. Virus particles were detected in all infected samples tested, including samples from Australia, Belgium, Canada, Israel and USA.

This project has demonstrated the feasibility of carrying out therapy and virus indexing while plantlets remain *in vitro*. This considerably reduces the risk involved with movement of germplasm since the material remains in a totally contained environment throughout the process. A range of host-virus systems needs to be studied before a totally contained *in vitro* quarantine procedure can be recommended for routine use.

Therapy for wild relatives of citrus

Collecting and exchange of citrus relatives is becoming very important in plant genetic resources. However, the exchange of germplasm involves the risk of introducing pest and diseases. In many cases, collected germplasm is difficult to establish because of incompatibility problems with known citrus rootstocks.

To overcome these problems a research project involving an IBPGR intern, recruited from China, was carried out from 1989 to 1991 at the Instituto Valenciano di Investigaciones Agrarias, Valencia, Spain. The *in vitro* shoot-tip grafting method previously developed for *Citrus* species was studied for citrus relatives. The method is based on culturing budwood *in vitro* to produce shoot-tips that are grafted *in vitro* on to seedling rootstocks to regenerate whole plants. 21 species belonging to 13 genera were used in the experiments. *In vitro* culture of budwood was successful with all species studied, 30 to 100% growing further. Shoot-tips isolated from this growth were successfully grafted *in vitro* on to the following citrus rootstocks: *Citrus sinensis*, *C. aurantium*, *C. jambhiri*, *C. reshni*, *C. macrophylla* and *C. sinensis* x *P. trifoliata* (Fig. 12).

Atalanta ceylandica, *Clausena*, *Fortunella*, *Microcitrus*, *Poncirus*, *Severinia* and *Swinglea* were successfully grafted on to all rootstocks used. *Afraegle* and *Gycosmis* could be grafted only on *C. macryophylla*, although with only 10% success. *Atalanta citroides* failed on all rootstocks. Successful grafts

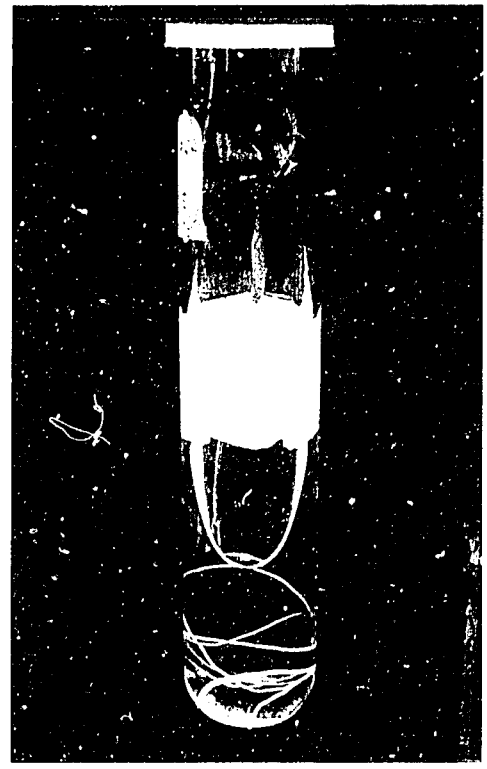


Fig. 12. Shoot-tip of *Citrus* 4 weeks after grafting on to an *in vitro*-germinated seedling
(Figure coutesy Dr L. Navarro, IVIA, Valencia, Spain)

of *Triphasia trifolia* were recovered using seedlings of the same species as rootstock. *Aegleopsis*, *Murraya* and *Pamburus* could not be regenerated on any of the rootstocks studied.

The work has established tissue culture methods for the safe movement of germplasm of most of the citrus relatives studied and with some additional research work opens possibilities for a general application to all citrus relatives.

Rapid indexing for sweet potato viruses

Significant progress was made in the project to develop a rapid indexing method for the sweet potato virus disease (SPVD) from Nigeria. The project based at Agriculture Canada Research Station, Vancouver, Canada confirmed that SPVD is caused by a combination of sweet potato feathery mottle virus and a whitefly-transmitted virus.

Virus-like particles were consistently observed in *Ipomoea setosa* infected with the whitefly-transmitted component of SPVD. Membrane-enclosed vesicles were found in SPVD-infected *I. setosa* tissue. Disease-specific double-stranded (ds) RNA was found in plants carrying the whitefly-transmitted component. Virus-specific DNA clones were made and used to measure the viral RNA. Further experiments will be required to develop an adequate detection system to diagnose infected sweet potato for incidence of this virus.

Broad spectrum tests for virus detection

This project, also based at Agriculture Canada Research Station, Vancouver investigates different approaches to developing broad spectrum tests for viruses. In 1991, the research concentrated on carmoviruses and tombusviruses. Two oligopeptides corresponding to a sequence in the coat protein gene that is well conserved among members of these two virus groups had been synthesized earlier. They did not induce any immune response in mice or rabbits. A segment of the gene of cucumber necrosis virus (CNV) containing the conserved sequence was incorporated into an expression vector. The resulting fusion protein was injected into mice. Monoclonal antibodies (MABs) specific to the fusion protein were screened. Two were selected, but they did not react with purified CNV nor with CNV-infected plant sap. This approach, although theoretically attractive, did not produce the broad spectrum test that was expected.

Mango fruits sample (photo A. B. Damania

A different approach to the development of broad spectrum tests will be investigated with the carlavirus group. Pea streak virus has been purified and a polyclonal antiserum has been produced that will be used for the screening of hybridomas.

Viruses in mango

Mangos are the world's fifth largest fruit crop but very little is known of the viruses or virus-like agents that infect them. A research project involving an MSc student from Thailand and based at the Queensland University of Technology, Brisbane, Australia was completed in 1991. The purpose of this preliminary study was to investigate if viruses or virus-like agents were present in mango germplasm from Thailand and Australia. The study produced compelling evidence that viruses and virus-like agents are present in this crop. Symptoms were induced in indicator plants inoculated with sap extracts from two mango samples. In addition a viroid-like RNA was associated with low molecular weight nucleic acid extracts from a number of different mango samples. This RNA hybridized with a specific DNA probe for chrysanthemum stunt viroid.

FOREST GENETIC RESOURCES

In 1991, the CGIAR broadened its mandate to encompass forestry and agroforestry issues. This involved the expansion of the CGIAR to include ICRAF and the new institute CIFOR, and the modification of the remits of a number of other CGIAR centres, including IBPGR. Over recent years, IBPGR has carried out a certain amount of work on woody species. In 1991, attention was given to developing a foundation from these elements, and adapting IBPGR's wide experience with agricultural crops to problems in forestry and agroforestry genetic conservation. Consultations were held in 1991 with FAO Forest Resources Division on a number of aspects of forestry and *in situ* conservation with a view to developing collaborative activities in 1992.

To widen the consultation, IBPGR organized a Workshop on Forest Genetic Resources in Rome in October 1991, providing the opportunity for discussions between IBPGR, ICRAF, CIFOR, representatives of national programmes in Africa, Latin America and Asia, forestry research institutes and organizations in Europe and FAO Forest Resources Division. There is a need for global collaborative action to conserve forest genetic resources. IBPGR could coordinate two important activities. One is developing an information management system for forestry and agroforestry genetic resources, drawing together and harmonizing data from the many available sources. The second activity is developing a list of research problems in the conservation and use of forestry/agroforestry genetic resources. This was compiled and formed the basis of a special project funding proposal by IBPGR for a project to be implemented in 1992.

COMMUNICATIONS AND LIBRARY SERVICES

LIBRARY

The objective of the Library is to provide an information service to support the institute's programme activities in Headquarters and the regions and to the wider plant genetic resources community. It supports IBPGR activities by providing literature-based information, primary documents and bibliographic data and has now built up a small collection of books, journals and CD ROMs to address the immediate needs of IBPGR staff. Current awareness tools, a bibliographic research service using CD ROMs of the major agricultural databases, and document supply and reference services are offered by the Library.

Many new acquisitions were made in 1991 and the number of journal subscriptions, though still small, was increased; a microfiche reader-printer was purchased. In late 1991, the post of Library Assistant was filled and with his appointment the task of cataloguing the backlog of books and internal reports was started.

The 1991 External Review of IBPGR suggested that the services of the Library be made more widely available and the question of the publication of a Plant Genetic Resources Abstracts Journal was raised once more. In late 1991 IBPGR had discussions with CAB International and took the decision to go ahead with the joint publication in 1992 of an abstracts journal from core funding.

PUBLIC AFFAIRS

Key targets for the IBPGR public awareness programme are policymakers in both developed and developing countries. Two groups that influence policymakers, non-governmental organizations (NGOs) and the media, are essential elements of IBPGR's public awareness strategy.

In April, Burness Communications - a US-based public relations firm - conducted a media training seminar at HQ for the CGIAR Public Awareness Association. The seminar was repeated in September for all IBPGR professional staff. Four well-known journalists and a representative from a donor agency also took part in the training. The seminar was geared towards the 'non-converted', scientists who tend to be suspicious of the media and have little understanding of the important role it can play in generating support for an institution's activities. Discussions centred around such questions as, 'Who needs the press anyway?', 'What is IBPGR?', 'Who are reporters and what do they want?' and 'What stories are hiding at IBPGR?'. The seminar proved useful in sensitizing staff to the importance of cultivating a good relationship with the media as well as providing a number of practical tools for working with journalists.

In April, a media briefing, co-sponsored by IBPGR, ENEA, CNR and Intagres, was held in Rome. The purpose of the event was to acquaint the Italian press with plant genetic resources issues and with some of the activities being undertaken by IBPGR and other organizations. Later in the year, IBPGR participa'ed in a series of European press conferences on the subject of biodiversity. The press conferences were held in Bonn, Bern and Rome and were organized by the CGIAR Secretariat as part of a media effort in connection with the United Nations Conference on Environment and Development (UNCED), to take place in Rio de Janeiro in June 1992. IBPGR was asked by the Public Awareness Association to take on general responsibility for public awareness at UNCED (see below).

Task Force UNCED

In preparation for the United Nations Conference on Environment and Development (UNCED) or 'Earth Summit', June 1992 in Rio de Janeiro, Brazil, the Acting Director appointed a Task Force in early 1991 to co-ordinate CGIAR activities on biodiversity.

The Task Force provided expert input and background information to the development of the Convention on Biodiversity and for the development of Agenda 21, a broad programme of action to be considered by the conference.

To contribute to the debate before the conference, the Task Force developed ten information sheets which targeted donors, policymakers, governmental officials and in-country UNCED preparation committees. The information sheets covered a range of topics relevant to the UNCED agenda on biodiversity: the diversity of life forms as a key to survival, environment, sustainable development, complementary conservation strategies, training, information, the role of the international centres in plant genetic resources, the future role and activities of IPGRI and the global strategy for plant genetic resources. They showed how plant genetic resources, as a component of biodiversity, provide direct and indirect opportunities for protecting the environment and enhancing sustainable development. In addition, the Task Force began preparing other materials to be used at the conference itself, aimed at the broader audience that would be expected to attend such an event.

The CGIAR/IPS Latin American Awareness Project on Plant Genetic Resources concluded in 1991, having been extended by a year. The project, which was a pilot effort by the Public Awareness Association, yielded some important lessons in how to work with Latin American journalists. As a result of project activities, there was extensive media coverage of genetic resources throughout the region, both by IPS journalists and by a number of reporters who participated in a 1989 IPS/CGIAR training seminar on plant genetic resources. In May, Colombia's *'Caja Agraria'* magazine devoted its front cover and lead article to plant genetic resources. In Brazil, *'Global Rural'*, a television programme with an average of 14 million viewers, aired a segment on plant genetic resources. A highly successful press conference held in Washington DC in connection with the project resulted in a large number of stories which appeared in such media as the *New York Times*, *Time* and *Science*.

Distribution pattern of IBPGR mailing list

1 North America 24.8%
2 Central America 18.6%
3 Africa 17.9%
4 Europe 14.4%
5 Far East & Japan 10.7%
6 South America 8.7%
7 Middle East 3.4%
8 Aust. & NZ 1.5%

TABLE 2. DEMAND FOR IBPGR PUBLICATIONS

	Books despatched* 1989	1991
Angola		6
Algeria		14
Antigua & Barbuda		4
Argentina	71	128
Australia	25	165
Bangladesh		21
Belgium	9	64
Benin		2
Bhutan		4
Bolivia		30
Botswana		4
Brazil	69	124
Cameroon		26
Canada	32	67
Chad		8
Chile		31
China	217	277
Colombia	138	198
Congo	6	
Costa Rica	189	72
Cote d'Ivoire	12	12
Cuba		20
Cyprus	45	81
Czechoslovakia	24	43
Denmark		60
Dominican Republic		12
Ecuador		18
Egypt		31
Ethiopia	3	25
El Salvador		24
Fiji	8	14
Finland	6	10
France	54	197
Gambia	30	8
Germany	22	240
Ghana	18	12
Guatemala	58	54
Guyana	5	
Haiti		12
Honduras		16
Hong Kong		35
Hungary	4	7
India	217	391
Indonesia	38	98
Iran	46	33
Iraq	10	
Ireland		12
Italy	7	256
Jamaica		11
Japan		214
Kenya	227	309
Korea (Rep.)		7
Laos		8
Madagascar	9	16
Malaysia	38	23

continued opposite

Another Public Awareness Association initiative in which IBPGR was actively involved was the preparation of 'World's Food Supply at Risk', a story for *National Geographic*, one of the highest circulating publications in the world. Nearly three years in the making, the article, by ex-CIP anthropologist Robert Rhodes (who won a National Science Writers' Association award for the story) ran in the April issue of the magazine.

The NGOs are important partners for IBPGR, as active collaborators in the conservation effort and as a source of political support and information. In many countries they are deeply involved in genetic resources conservation - both *in situ* and *ex situ*. For this reason, they are an important target for, and partners in, public awareness and in 1991, IBPGR paid increased attention to this audience group by attending as an observer the Second European Network Meeting on Genetic Resources and Biotechnology, sponsored by GRAIN. Since that time, a number of new NGO contacts have been initiated and plans are under way to undertake projects in collaboration with NGOs in 1992.

Geneflow, IBPGR's annual magazine on plant genetic resources, was released at Centers' Week. The central focus of the issue was 'Women and Plant Genetic Resources'. Demand was so high that a reprint had to be ordered almost immediately.

PUBLICATIONS

A considerable number of new titles were published in 1991 (see Table 2), representing a significant investment in time and money.

Efforts were made throughout the year to minimize print runs yet maximize exposure of the material. A very specific selection is made from IBPGR's 8000-entry mailing list to indicate to whom the title should be sent. Nevertheless, almost 70 000 copies of 1991 publications were printed.

Libraries are actively solicited for inclusion in the mailing list as a volume arriving in a library has greater potential exposure than a volume sent to an individual. Confirming the trend of past years, demand continued to increase for existing titles. Most notable have been the number of requests from libraries of institutions not previously on the mailing list asking for complete collections of the IBPGR backlist. This is a considerable task, but extremely worthwhile as such bulk donations reach very large audiences. During 1991, a much greater number of requests for publications were received compared to 1989 and many more publications despatched, indicating increased worldwide interest in genetic resources.

The *FAO/IBPGR Plant Genetic Resources Newsletter*, published on a cost-sharing basis with FAO, continued to appear. IBPGR's Editorial Office received 64 papers, of which 37 were accepted for publication. Interestingly, the rate of rejection fell during the second half of the year reflecting a rise in the standard of the papers received.

Elsevier Science Publishers, Amsterdam published an IBPGR-supplied manuscript under the title *'Elsevier's Dictionary of Plant Genetic Resources'*. This glossary defines 1800 terms in English. Preparations began in 1991 on translating the text into a number of other languages.

The Editorial and Publications unit continued to support IBPGR's public affairs work in the production of *Geneflow* and other public affairs material.

IBPGR TITLES PUBLISHED IN 1991

General
Annual Report 1990

Newsletters
FAO/IBPGR Plant Genetic Resources Newsletter Nos. 81/82, 83/84 and 85
IBPGR Newsletter for Asia and the Pacific No. 5

Research
FAO/IBPGR Technical Guidelines for the Safe Movement of:
- Cocoa Germplasm
- Citrus Germplasm
- Cassava Germplasm
- Grapevine Germplasm
- Vanilla Germplasm

Systematic and Ecogeographic Studies on Crop Genepools:
6. The distribution of *Hibiscus* L. Section *Furcaria* in Tropical East Africa (jointly with the International Jute Organization)
7. An Ecogeographical Study of the Genus *Hordeum*

Handbooks for Genebanks: No. 1. 1985, with revisions and additions 1991.
The Design of Seed Storage Facilities for Genetic Conservation
Proceedings of the Inter-Centre Meeting on Germplasm Health and Movement
INIBAP/IBPGR *Musa* Conservation and Documentation

Characterization and documentation
Descriptors for Maize/Descriptores para Maiz/Descripteurs pour le Mais
Descriptors for Annual *Medicago*/Descripteurs pour *Medicago* Annuelles
Descriptors for *Beta*
Descriptors for Pineapple
Descriptors for Sweet Potato/Descriptores de la Batata/Descripteurs pour la Patate Douce

Crop Networks
International Crop Network Series
4. Crop Networks

ECP/GR
A Guide to the European Forage Databases

Public Affairs
Geneflow III

Books
Crop Genetic Resources of Africa. Volumes I and II - Proceedings of an International Conference on Crop Genetic Resources of Africa, 17-20 October 1988, Ibadan, Nigeria, IITA/IBPGR/UNEP/CNR
Elsevier's Dictionary of Plant Genetic Resources, Elsevier/IBPGR

TABLE 2. CONTINUED

	Books despatched* 1989	1991
Malawi		4
Mali		6
Malta	3	
Mauritius		6
Mexico	194	102
Morocco		11
Mozambique		6
Myanmar		41
Nepal	7	12
Netherlands	6	179
New Zealand	5	9
Nicaragua		16
Niger	75	80
Nigeria	47	140
Norway		46
Pakistan		24
Panama		2
PNG	7	13
Paraguay		2
Peru	39	70
Philippines	244	239
Poland	8	15
Portugal	42	15
Romania		14
St. Vincent & Grenadines		2
Samoa		6
Saudi Arabia		8
Senegal		8
Sierra Leone		2
Singapore		94
Somalia	13	23
Spain	7	79
Sri Lanka		35
Suriname		2
Sweden	7	119
Switzerland	3	67
Syria	25	45
Taiwan, China	5	9
Tanzania	15	27
Tonga		3
Trin. & Tobago	7	12
Tunisia	8	14
Turkey	94	48
UK	140	252
USA	523	942
Uruguay	8	14
USSR	3	
Venezuela		22
Vietnam		8
Yemen		3
Yemen PDR	2	
Yugoslavia	11	20
Zaire		16
Zambia	6	11
Zimbabwe	58	105

*Number of publications sent from Rome HQ.

OTHER PROGRAMME ACTIVITIES

TASK FORCE ON INTELLECTUAL PROPERTY RIGHTS

Since its inception in 1974 IBPGR has based its policies on the principle of unrestricted availability of germplasm for research purposes. This was also reflected in a policy statement of the Board of Trustees in 1988, stating: 'IBPGR's policy is that all naturally occurring genetic resources, including naturally occurring genes isolated from such resources, shall be freely available'.

Rapid advances in biotechnology and an increased involvement of the private sector in agricultural research have prompted a debate on intellectual property protection of biological research products and life forms. Within this changing environment IBPGR felt the need to analyze the consequences for the free availability of both genetic resources and the results of research. In mid-1990, a Task Force on Intellectual Property Protection was formed to assist IBPGR's management in the development of a more comprehensive policy on this matter. At the same time, the CGIAR began developing a draft policy on intellectual property. The IBPGR Task Force actively contributed to this draft including wide consultation with national programmes and non-governmental organizations.

SPECIAL PROJECT: ECP/GR

As outlined in the 1990 Annual Report, Phase IV of ECP/GR became self-sustaining, with European crop-specific databases ensuring the coordination of the Working Group in collaboration with the respective Chairmen and with the support of the National Coordinators. IBPGR ensured overall coordination. A detailed report of activities will be provided at the end of Phase IV, when the Technical Consultative Committee will assess the achievements of the Programme.

Meetings

The first meeting of the *Brassica* Working Group was held in the Research Institute of Plant Production, Prague and the Vegetable Research Institute, Olomouc, Czechoslovakia, 21-23 May 1991.

The fourth meeting of the Sunflower Working Group was convened in the Faculty of Agriculture, University of Pisa, Italy, 11-12 May 1991. This meeting was held in conjunction with the Seventh Consultation of the European Cooperative Research Network on Sunflower (13-15 May 1991), which is under the aegis of FAO.

The fourth meeting of the *Allium* Working Group was convened on 10 and 14 June 1991 in the Institute for Genetics and Plant Research, Gatersleben, Germany, together with a 'Symposium on the genus *Allium* - taxonomic problems and genetic resources' which was organized by the same institute.

The fourth meeting of the Forages Working Group was convened by the Research Institute for Agrobotany, Tapioszele and was held in Budapest, Hungary, 28-30 October 1991.

OFFICE OF THE DIRECTOR

INTERNATIONAL PLANT GENETIC RESOURCES INSTITUTE

The 1990 Annual Report described the process which had been initiated to lead to a fully independent institute for plant genetic resources with very strong programmatic collaboration with FAO.

Representatives of the governments of China, Denmark, Italy, Kenya and Switzerland all signed an agreement establishing the International Plant Genetic Resources Institute (IPGRI) as an international institution in Rome on 9 October 1991, after IPGRI's Constitution had been approved by the CGIAR. The governments of China, Denmark, Kenya and Switzerland also ratified the Agreement. With the signing and ratification by four countries, IPGRI legally came into being, although the International Board for Plant Genetic Resources (IBPGR) will continue to operate until IPGRI is able to operate independently.

Simultaneously with the development of IPGRI's Establishment Agreement, intensive discussions were held on developing an agreement between the Italian Republic and IPGRI regarding the operation of IPGRI's Headquarters in Rome. On 10 October 1991, Dr W.E. Tossell, IPGRI's and IBPGR's Board Chair and Dott. G.L. Valenza, representing the Government of the Italian Republic, initialled IPGRI's Headquarters Agreement. Both IPGRI's Establishment Agreement and IPGRI's Headquarters Agreement must be ratified by the Italian Parliament. Parliamentary approval should be received sometime in 1992 or early in 1993, allowing IPGRI to start operating as an independent CGIAR Institute.

Memorandum of Understanding on Programme Cooperation between FAO and IBPGR

On 21 September 1990 FAO and IBPGR formalized their cooperation on the programme level when they signed a Memorandum of Understanding on programme cooperation (see Box on p. 58).

Third External Programme and Management Review

The main phase of the review took place from 7 to 25 January 1991 at IBPGR Headquarters. The report of the Review together with the response by IBPGR was discussed in the TAC meeting of March 1991 and subsequently approved by the CGIAR during its mid-term meeting in May 1991 in Paris.

PROGRAMME COLLABORATION BETWEEN IBPGR/IPGRI AND FAO

On 21 September 1990 IBPGR and FAO signed a Memorandum of Understanding on Programme Cooperation which is to continue in force indefinitely between IPGRI and FAO. The main elements of the Memorandum are:

- IBPGR/IPGRI subscribes to the principles of the International Undertaking on Plant Genetic Resources and will collaborate with FAO in implementing the Undertaking.
- FAO and IBPGR/IPGRI recognize the intergovernmental authority of the Commission on Plant Genetic Resources.
- FAO and IBPGR/IPGRI agree to cooperate to ensure complementarity of effort and optimal use of resources.
- FAO will focus mainly on the political, legal and technical issues contained in the Undertaking, supporting the work of the Commission on Plant Genetic Resources and assisting Member Countries.
- IBPGR/IPGRI will act within and outside the CGIAR system to sustain a viable international plant genetic resources programme, especially through enhancing national and international capabilities.
- IBPGR/IPGRI will provide scientific and technical advice to FAO and, through FAO, to the Commission.
- FAO will assist IBPGR/IPGRI in its work and will facilitate its access to FAO Member Nations.
- The two organizations will freely exchange data on subjects of common interest, will cooperate in some major databasing projects, and will produce joint technical communications where appropriate.
- FAO and IBPGR/IPGRI agree to cooperate in the preparation of a periodical report on the State of the World's Plant Genetic Resources which FAO will submit to the Commission on Plant Genetic Resources.
- The FAO Network of Base Collections and IBPGR/IPGRI's register of base collections will be merged as far as possible.
- FAO and IBPGR/IPGRI will prepare crop-specific protocols and guidelines for use by quarantine officials and scientists involved in the exchange of plant germplasm.
- The two organizations will develop, in consultation, various programme activities that are of common interest and will keep each other informed of relevant programme initiatives.
- A representative of FAO will be a Trustee of IBPGR/IPGRI and a representative of IBPGR/IPGRI will be invited to meetings of the Commission.
- IBPGR/IPGRI will provide reports of its activities through FAO to the Commission.

New Director

The Board of Trustees appointed Dr Geoffrey Hawtin as Director. He took up office in August 1991.

Strategic Plan

On his arrival, the Director took the opportunity to review with all staff the then current draft of the Strategic Plan 'Diversity for Development'. A rewritten draft was developed with four clear objectives as a basis for future programme development (see box opposite).

IBPGR Trustees

The full Board of Trustees met once in 1991 in the Hague, Netherlands (11-13 March). The Executive Committee met twice: in the Hague on 11 March and in Washington DC, USA from 2 to 5 November. The 13th meeting of the Programme Committee also took place in the Hague (12 March) while the 14th meeting took place in Nairobi, Kenya (2-6 September). Two meetings of the Nominations Committee were held; one in the Hague (12 March) and the other in Nairobi (5-6 September).

The most important items on the agenda of the 1991 meetings were the report of the External Review (the main phase of which had taken place 7-25 January in IBPGR Headquarters), the Strategic Plan, and administrative arrangements for the new independent institution that the Board decided would be called the International Plant Genetic Resources Institute (IPGRI).

Four trustees left the Board in 1991: Prof J.A. Spence (Trinidad), Dr Touré (Senegal), Prof F. Kikuchi (Japan) and Dr Holden (United Kingdom). They were replaced by Dr N. Demir (Turkey), Dr W. Collins (USA), Prof L. Holm-Nielsen (Denmark) and Dr N. Murata (Japan).

Administration

The trend for IBPGR's administration to become more self-supporting in preparation for independence continued in 1991. IBPGR staff handled most of the administrative support previously provided by the Plant Production and Protection Division of FAO. The institute still uses services provided by FAO such as personnel, travel, visa, etc. IBPGR still operates within the rules and regulations of an FAO Field Project.

OBJECTIVES OF THE INTERNATIONAL PLANT GENETIC RESOURCES INSTITUTE

IPGRI's new strategy has four major objectives:

- to assist countries, particularly developing nations, to assess and meet their needs for plant genetic resources conservation, and to strengthen links to users,
- to strengthen and contribute to international collaboration in the conservation and use of plant genetic resources,
- to develop and promote improved strategies and technologies for plant genetic resources conservation,
- to provide an international information service on plant genetic resources.

IBPGR STAFF IN 1991

OFFICE OF THE DIRECTOR

Dr G.C. Hawtin
Director [2]
Ms S. Ebel
Secretary to the Director

Administration

Mr R.H. Dery [1]
Head of Administration and Financial Controller
Ms J. Nunan
Clerk
Mrs C. Gorelli
Programme Officer
Mr G. Benzakein [1]
Registry Clerk
Mrs M. Bonomi [1]
Clerk
Ms M. Cerreto-Esposito [2]
Clerk
Ms M. Donegan [2]
Clerk
Ms M. Fabri
Receptionist
Mr M. Beltramme
Clerk
Mr S. Scategni [1]
Driver
Mr F. Di Paolo [2]
Driver

RESEARCH PROGRAMME

Dr A. McCusker
Head
Ms C. Zanettin
Secretary
Ir E. Frison
Plant Pathology and Quarantine
Prof Kar-Ling Tao
Seed Conservation
Ms H. Shelton
Secretary
Ms J. Brown-Moriani [1]
Secretary
Dr R. Rao
Genetic Diversity
Dr T. Hodgkin
Molecular Biology
Ms E. Clancy [2]
Secretary
Dr D. Debouck
Taxonomy
Ms O. Youdovich [1]
Clerk
Ms A. Mulchan-Onofri [2]
Secretary

Mr R.L. Saade
Research Associate
Herbario Nacional de Mexico
Mexico

FIELD PROGRAMME

Ir D.H. van Sloten
Head
Ms M. McArthur-Giannini
Secretary

Headquarters
Mr R. Reid [1]
Acting Head
Dr W.G. Ayad
Training
Ms D. Piergentili
Secretary
Dr M. Perry
Information

REGIONAL OFFICES

(see back cover for full contact details)

East and Southern Africa

Mr A.F.Y. Attere
Coordinator
Mr H. Kamau
Assistant Coordinator
Mrs R. Wanjiru Hassane [1]
Secretary

[1] left during the year
[2] joined during the year

Mrs Dorcas Shako [2]
Secretary
Mr J. Gaithuma
Driver

West Africa
Ms J.A. Toll
Coordinator
Mr Idiwel Moussa
Secretary
Mr Abel Soubeiga
Driver

North and Central America and the Caribbean
Mr L.G. Gonzalez [1]
Coordinator
Mr F. Rincon
Assistant Coordinator
Ms Maria Delgadillo [1]
Secretary
Ms S. Bojorges-Cornejo [2]
Secretary

South America
Dr K.A. Okada
Coordinator
Dr L. Lopez
Associate Coordinator
Ms Maria de Jesus Orozco Gonzalez
Secretary

North Africa, Southwest Asia and Europe
Dr Y.J. Adham
Coordinator

South and Southeast Asia
Dr J.M.M. Engels
Coordinator
Dr R.K. Arora
Associate Coordinator for South Asia
Mr A.R. Madas
Administrative secretary
Mr B.R. Sharma
Driver

Southeast Asia
Dr L.M. Engle [1]
Associate Coordinator for Southeast Asia

East Asia
Ms Zhou Ming-De
Coordinator
Mr Zhang Zongwen
Assistant Coordinator
Ms Dong Ying
Secretary
Mr Xu Chongping
Driver

Plant Collectors
Mr L. Guarino
(ARI, Cyprus)
Mr A. Bari
(ARI, Cyprus)
Ms H. Moss [1]
(Harare, Zimbabwe)

Coordinator of Crop Networks and ECP/GR
Dipl Ing P.M. Perret
Ms R. Andarias de Prado [1]
Secretary
Ms M. Colas
Secretary [2]

Seed Handling Units
Position vacant
Royal Botanic Gardens
Kew, UK

Ms R. Chng
National University of Singapore
Singapore

Mr C. Astorga
CATIE
Costa Rica

COMMUNICATIONS AND LIBRARY SERVICES
Mr P. Stapleton
Publications
Ms R.D. Raymond
Public Affairs
Ms J.A. Dearing
Librarian
Mr M. Nocca [2]
Clerk
Ms P. Blake
Publications Clerk
Mr R. Bonsignore
Clerk

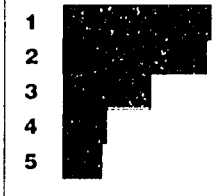
FINANCIAL REPORT

FINAL STATEMENT OF CONTRIBUTIONS IN 1991

(US$ equivalent)

Donor	Core Budget	Special Projects
ACIAR		22 861 [1]
Australia	176 245	
Austria	50 000	
Belgium [2]		9 985 [3]
Canada	525 647	
China	50 000	
CIDA		26 201 [1]
CIP		20 000 [4]
Cyprus		1 250 [3]
Denmark	258 065	
France	236 244	
Germany	212 756	
Greece		7 500 [3]
GTZ		63 629 [5]
IDRC		80 615 [6]
IDRC		10 106 [1]
India [2]		
Ireland		2 961 [3]
Italy	641 591	100 000 [7+3]
ISNAR		6 300 [8]
Japan	1 248 492	97 750 [9]
Republic of Korea	50 000	
Mexico	10 000	
Netherlands	637 443	
Norway	274 927	
ODA		9 389 [10]
Poland		5 461 [3]
Spain	39 897	
Sweden	535 646	15 000 [3]
Switzerland	519 545	15 000 [3]
UK	927 855	
USA [2]	975 000	
1990 contributions received in 1991	330 238 [11]	
Total	7 699 591	494 008

Expenditure by IBPGR Programme
(US$ equivalent as at 31 December 1991)



1 **Administration** 2 529 139
2 **Field** 2 463 877
3 **Research** 1 492 978
4 **Commun. & Lib. Services** 718 143
5 **Special Projects** 664 600

Coconut Workshop [1] 1991 contributions received in 1992: Belgium ($96 229), India ($33 268) and balance of USA contributions ($175 000) [2] FCP/GR Phase IV [3] Public Awareness [4] Cryopreservation and Kenya Genebank [5] National Genetic Resources Documentation [6] 1992 projects and FCP/GR ($12 500) [7] European Information Service [8] Collecting in Pakistan [9] NBPGR Recalcitrant seeds. France ($236 225) Germany ($41 666) India ($2 347) USA ($50 000)

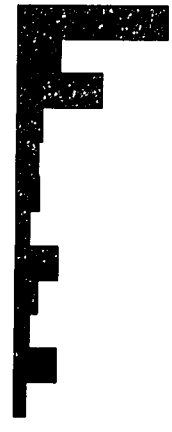
FINAL STATEMENT OF ACCOUNT 1991

(US$)

Receipts		
Balance at 1 January 1991 [1]		686 465
Governments' contributions [2]		7 699 591
Special Projects [2]		494 008
Interest accrued in 1991		249 832
World Bank [3]		700 000
Overheads on Special Projects		64 682
		9 894 578
Transfers		
WCF (interest + expenses)	227 096	
World Bank	700 000	
		(927 096)
		8 967 482
Obligations		
Core Programme		
Personnel services	2 977 395	
Duty travel	903 547	
Contractual services	1 619 308	
General operating Expenses	352 042	
Supplies and materials	122 101	
Equipment	333 155	
Fellowships	138 314	
Premises (rent)	356 166	
Support costs	402 106	
Subtotal	7 204 134 [4]	
Complementary Programme		
ECP/GR/IV	116 755	
European Information Services	75 866	
National Genet. Res. Document. Proj.	86 242	
Collecting in Albania	11 593	
Kenya Genebank	7 464	
Collecting in Pakistan	98 310	
Recalcitrant seeds	18 873	
Genetic Resources Workshops	68 154	
Coconut Workshop	62 281	
Potato cryopreservation	107 964	
Forestry Workshop	11 098	
Subtotal	664 600	
Total obligations		7 868 734
Balance at 31 December 1991		**1 098 748**

[1] Adjustments in 1990 commitments recorded after closure resulted in a higher balance than previously reported (+ $39 471)
[2] See attached statement
[3] EPR/EMR and 1st tranche 1991
[4] Includes 1991 cost of EPR/EMR ($160 821)

Expenditure by function
(US$ equivalent as at 31 December 1991)



1 **Administration** 2 368 315
2 **Communications & Library** 718 143
3 **Global Network** 1 320 621
4 **Germplasm Acquisition** 407 971
5 **Documentation & Characterization** 366 689
6 **Training** 368 596
7 ***In vitro* Culture Research** 215 051
8 **Genetic Diversity Research** 699 909
9 **Seed Conservn. Research** 363 307
10 **Pathology & Quarantine Research** 214 711
11 **Special Projects** 664 600
12 **EPR/EMR** 160 821

Abbreviations used in this report

AARI	Aegean Agricultural Research Institute, Turkey
ABA	Abscisic acid
ACIAR	Australian Centre for International Agricultural Research, Australia
ARC	Agriculture Research Centre, Egypt
ARI	Agricultural Research Institute, Myanmar - also ARI, Cyprus
AVRDC	Asian Vegetable Research and Development Center, Taiwan, China
BAP	Benzylamino purine
CAAS	Chinese Academy of Agricultural Sciences, Beijing, China
CABI	CAB International, UK
CATIE	Centro Agronómico Tropical de Investigación y Enseñanza, Costa Rica
CEAO	Communauté Economique de l'Afrique de l'Ouest
CENARGEN	Centro Nacional de Pesquisa de Recursos Genéticos e Biotecnologia
CGIAR	Consultative Group on International Agricultural Research
CGN	Centre for Genetic Resources, The Netherlands
CIAT	Centro Internacional de Agricultura Tropical - CGIAR
CIDA	Canadian International Development Agency, Canada
CIFOR	Centre for International Forestry Research - CGIAR
CILSS	Comité Permanent Inter-Etats de Lutte contre la Sécheresse dans le Sahel, Burkina Faso
CIMMYT	Centro Internacional de Mejoramiento de Maiz y Trigo - CGIAR
CIP	Centro Internacional de la Papa - CGIAR
CIRAD	Centre de Coopération Internationale en Recherche Agronomique pour le Développement, France
CNR	Consiglio Nazionale delle Ricerche, Italy
CNV	Cucumber necrosis virus
cpDNA	Chloroplast DNA
CSIRO	Commonwealth Scientific and Industrial Research Organization, Australia
CTA	Centre Technique de Coopération Agricole et Rurale, The Netherlands
ECP/GR	European Cooperative Programme for Crop Genetic Resources Networks
EEC	European Economic Community
EMBRAPA	Empresa Brasileira de Pesquisa Agropecuária, Brazil
ENEA	Ente Nazionale de Energia Atomica, Italy
FAL	Institut für Pflanzenbau und Pflanzenzüchtung der Bundesforschungsanstalt für Landwirtschaft, Germany
FAO	Food and Agriculture Organization of the United Nations
GIS	Geographic Information System
GRAIN	Genetic Resources Action International, Spain
GTZ	Deutsche Gesellschaft für Technische Zusammenarbeit, Germany
IARC	International Agricultural Research Centre
IBA	Indolebutyric acid
IBTA	Instituto Boliviano de Tecnología Agropecuaria, Bolivia
ICAR	Indian Council of Agricultural Research, India
ICARDA	International Center for Agricultural Research in the Dry Areas - CGIAR

ICRAF	International Council for Research in Agroforestry - CGIAR
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics - CGIAR
IDBB	International Data Base for *Beta*, ECP/GR Project in CGN
IDRC	International Development Research Centre, Canada
IICA	Instituto Interamericano de Cooperación para la Agricultura, Costa Rica
IITA	International Institute of Tropical Agriculture - CGIAR
ILCA	International Livestock Centre for Africa - CGIAR
ILRAD	International Laboratory for Research on Animal Diseases - CGIAR
INIA	Instituto Nacional de Investigaciones Agropecuarias, Chile
INIAA	Instituto Nacional de Investigacion Agraria y Agroindustrial, Peru
INIAP	Instituto Nacional de Investigaciones Agropecuarias, Ecuador
INIBAP	International Network for the Improvement of Banana and Plantain - CGIAR
INIFAT	Instituto Nacional de Investigaciones Fundamentales en Agricultura Tropical 'Alejandro de Humboldt', Cuba
INRA	Institut National de la Recherche Agronomique, France
INTAGRES	International Agricultural Research European Service, Italy
IPS	Inter Press Services, Italy
IRHO	Institut de Recherche pour les Huiles et Oléagineux, France
IRRI	International Rice Research Institute - CGIAR
ISNAR	International Service for National Agricultural Research - CGIAR
IUCN	World Conservation Union, Switzerland
IVIA	Instituto Valenciano de Investigaciones Agrarias, Spain
KEFRI	Kenya Forestry Research Institute, Kenya
MAB	Monoclonal antibody
mtDNA	Mitochondrial DNA
NBPGR	National Bureau of Plant Genetic Resources, India
NPGRC	National Plant Genetic Resources Committee
NGO	Non-governmental Organization
nuDNA	Nuclear DNA
ODA	Overseas Development Administration, UK
ORSTOM	Institut Français de Recherche Scientifique pour le Développement en Coopération, France
PGRRI	Plant Genetic Resources Research Institute, Turkey
PNRSV	*Prunus* necrotic ringspot virus
PROINPA	Proyecto de Investigación de la Papa, Bolivia
RAPD	Random amplified polymorphic DNA
RFLP	Restriction fragment length polymorphism
SADCC	Southern African Development Coordination Conference
SPVD	Sweet potato virus disease
SRGB	SADCC Regional Gene Bank
SIDA	Swedish International Development Authority, Sweden
SINARGEV	National System on Plant Genetic Resources, Peru
SMYEV	Strawberry mild yellow edge virus
TAC	Technical Advisory Committee - CGIAR
UNCED	United Nations Conference on Environment and Development
UNEP	United Nations Environment Programme
USDA	United States Department of Agriculture, USA
VIR	N.I. Vavilov Institute of Plant Industry, Russia
WCMC	World Conservation Monitoring Committee, USA
WRI	World Resources International, USA