United States Department of Agriculture / Agricultural Research Service - Tropical Agricultural Research Station (USDA-ARS/TARS)

Deutsche Gesellscaft für Technische Zusammenarbeit (GTZ) GmbH

# CARIBBEAN COMMITTEE ON MANAGEMENT OF PLANT GENETIC RESOURCES (CMPGR)

*First Programming Meeting*

IICA OFFICE IN SAINT LUCIA

## WHAT IS IICA?

The Inter-American Institute for Cooperation on Agriculture (IICA) is the specialized agency for agriculture of the Inter-American system. The Institute was founded on October 7, 1942 when the Council of Directors of the Pan American Union approved the creation of the Inter-American Institute of Agricultural Sciences.

IICA was founded as an institution for agricultural research and graduate training in tropical agriculture. In response to changing needs in the hemisphere, the Institute gradually evolved into an agency for technical cooperation and institutional strengthening in the field of agriculture. These changes were officially recognized through the ratification of a new Convention on December 8, 1980. The Institute's purposes under the new Convention are to encourage, facilitate and support cooperation among its 33 Member States, so as to better promote agricultural development and rural well-being.

With its broader and more flexible mandate and a new structure to facilitate direct participation by the Member States in activities of the Inter-American Board of Agriculture (IABA) and the Executive Committee, the Institute now has a geographic reach that allows it to respond to needs for technical cooperation in all of its Member States.

The contributions provided by the Member States and the ties IICA maintains with its 13 Permanent Observer Countries and numerous international organizations provide the Institute with channels to direct its human and financial resources in support of agricultural development throughout the Americas.

The 1987-1993 Medium Term Plan, the policy document that sets IICA's priorities, stresses the reactivation of the agricultural sector as the key to economic growth. In support of this policy, the Institute is placing special emphasis on the support and promotion of actions to modernize agricultural technology and strengthen the processes of regional and sub-regional integration. In order to attain these goals, the Institute is concentrating its actions on the following five Programs: Agricultural Policy Analysis and Planning; Technology Generation and Transfer; Organization and Management for Rural Development; Trade and Integration; and Agricultural Health.

The Member States of IICA are: Antigua and Barbuda, Argentina, Barbados, Belize, Bolivia, Brazil, Canada, Chile, Colombia, Costa Rica, Dominica, the Dominican Republic, Ecuador, El Salvador, Grenada, Guatemala, Guyana, Haiti, Honduras, Jamaica, Mexico, Nicaragua, Panama, Paraguay, Peru, St.Kitts and Nevis, Saint Lucia, St. Vincent and the Grenadines, Suriname, Trinidad and Tobago, the United States of America, Uruguay and Venezuela. The Permanent Observer Countries of IICA are: Arab Republic of Egypt, Austria, Belgium, European Communities, France, Germany, Hungary, Israel, Italy, Japan, Kingdom of the Netherlands, Portugal, Republic of Korea, Romania, Russian Federation and Spain.

ISSN 0253-4746
A2/LC-94-001

# CARIBBEAN COMMITTEE ON MANAGEMENT OF PLANT GENETIC RESOURCES (CMPGR)

# PROCEEDINGS

First Programming Meeting
March 20-24, 1994
Mayaguez, Puerto Rico

**Compiled by:**

**Antonio M. Pinchinat**
**Antonio Sotomayor-Rios**
**Raul Pineda**

Castries, Saint Lucia
July, 1994

REPORTS, RESULTS AND RECOMMENDATIONS
FROM TECHNICAL EVENTS SERIES
ISSN 0253-4746
A2/LC-94-001

*Castries, Saint Lucia*
*July 1994*

**The Meeting was undertaken cooperatively by:**

**United States Department of Agriculture / Agricultural Research Service - Tropical Agricultural Research Station (USDA-ARS/TARS)**
**German Agency for Technical Cooperation (GTZ)**
**Inter-American Institute for Cooperation on Agriculture (IICA)**

The Participants expressed their immense gratitude to
the United States Department of Agriculture / Agricultural Research
Service - Tropical Agricultural Research Station,
for hosting the meeting.

## CONTENTS


| | | Page |
|---|---|---|
| | Abbreviations and Acronyms | vii |
| | Preface | ix |
| 1.0 | **RESOLUTIONS AND 1994 PLAN OF JOINT ACTION** | |
| 1.1 | Resolutions | 3 |
| 1.2 | 1994 Plan of Joint Action | 5 |
| 2.0 | **PRESENTATIONS** | |
| 2.1 | Remarks:<br>- A. M. Pinchinat, CMPGR's Executive Secretary, IICA, Saint Lucia | 13 |
| 2.2 | Message:<br>- Hon. Neftali Soto, Secretary of Agriculture, Puerto Rico | 15 |
| 2.3 | CARDI's Policy and Achievements in Plant Germplasm Management<br>- H. Adams and S. Parasram, CARDI, Trinidad and Tobago | 17 |
| 2.4 | Review of the Programmes of CIRAD/FLHOR<br>- P. Cao-Van, CIRAD/FLHOR, Martinique, FWI | 21 |
| 2.5 | Genetic Resources Management at INRA<br>- G. Anais, INRA, Guadeloupe, FWI | 25 |
| 2.6 | Research Programs and Germplasm Collections of the USDA-ARS Tropical Agriculture Research Station<br>- A. Sotomayor-Rios and F. Vasquez, USDA-ARS, Puerto Rico | 29 |
| 2.7 | Germplasm Conservation at the St. Augustine Campus<br>- E. J. Duncan, UWI, Trinidad and Tobago | 31 |

2.8 Plant Genetic Resources 35
- S. A. Eberhart and L. E. Wiesner, USDA/ARS, USA

2.9 Regulations on Status of Importation/Exportation/Domestic Movement of Plant Material for Genetic Purposes 45
- D. Rivera, USDA/APHIS, Puerto Rico

2.10 Activities of IPGRI in Latin America and the Caribbean 47
- K. A. Okada, IPGRI, Colombia

2.11 Review of GTZ Support Programme 53
- J. Carls, GTZ, Costa Rica

2.12 Potential for a Latin America and Caribbean Network Approach in Phytogenetic Resources 63
- M. N. Alvarez, CATIE, Costa Rica

2.13 FAO Activities on Plant Genetic Resources Conservation and Use in the Caribbean Region 67
- K. L. Tao, K. Ringlund and N. Anishetty, FAO, Italy

2.14 Germplasm Resource Management 75
- T. W. Zimmerman, UVI, St. Croix

3.0 ANNEXES

3.1 Constitution of CMPGR 79

3.2 Programme 83

3.3 List of Participants 87

## ABBREVIATIONS AND ACRONYMS

| | |
|---|---|
| APHIS | Animal and Plant Health Inspection Service |
| ARS | Agricultural Research Service |
| CARDI | Caribbean Agricultural Research and Development Institute |
| CARICOM | Caribbean Community |
| CATIE | Tropical Agricultural Research and Training Center |
| CBI | Caribbean Basin Initiative |
| CENARGEN | National Genetic Resource Center of Brazil |
| CFCS | Caribbean Food Crops Society |
| CIRAD | Center for International Cooperation in Agronomic Research for Development (French) |
| CCMPGR | Caribbean Committee on Management of Plant Genetic Resources |
| EARTH | Regional Agricultural School for the Humid Tropics |
| ECS | Eastern Caribbean States |
| FAO | United Nations Food and Agriculture Organization |
| FDA | Dominican Agricultural Foundation |
| FIC | Inter-Ministerial Fund for Cooperation |
| FLHOR | Food Legumes and Horticulture |
| FWI | French West Indies |
| GRIN | Germplasm Resources Information Network |
| GTZ | German Agency for Technical Cooperation |
| IICA | Inter-American Institute for Cooperation on Agriculture |
| IITF | International Institute of Tropical Forestry |
| INRA | National Institute for Agronomic Research (French) |
| IPGRI | International Plant Genetic Resources Institute |
| NARI | National Agricultural Research Institute |
| ORSTOM | French Organization for Overseas Scientific and Technical Research |
| RDC | French Regional Delegation for Cooperation |
| TARS | Tropical Agricultural Research Station |
| UPR | University of Puerto Rico |
| USAID | United States Agency for International Development |
| USDA | United States Department of Agriculture |
| UVI | University of the Virgin Islands |
| UWI | University of the West Indies |
| WISCO | West Indies Sugar Cane Breeding Company |

## PREFACE

The Caribbean Committee on Management of Plant Genetic Resources was established in 1993 by a broad group of institutions, agencies and private concerns, to support agricultural sustainability through proper and responsible management of plant genetic resources in the Caribbean.

As established in its Constitution (Annex 1), CMPGR's basic functions encompass:

- Identifying priority areas for undertaking joint regional actions to improve plant genetic resources management.
- Facilitating intra-regional and international exchange of information and materials.
- Instilling awareness about property rights and preservation needs concerning national plant genetic resources.

The specific objective of the Programming Meeting was to prepare CMPGR's 1994 Plan of Operation. This should allow CMPGR members to:

- Justify and organize a specific action agenda to address identified problems.
- Define specific objectives per area of action.
- Identify expected results.
- Select indicators and targets of success and set a timetable to achieve results.
- Draft an operating strategy, including basic activities during the period.
- Identify resource needs and budget for programmed activities.
- Identify or propose sources of funding.

Additionally, participants were offered an opportunity to get acquainted with management of plant genetic resources in the host country.

Guillermo E. Villanueva
IICA Representative in the ECS
Antonio M. Pinchinat
Executive Secretary, CMPGR

# 1.0 RESOLUTIONS AND 1994 PLAN OF JOINT ACTION

## 1.1 RESOLUTIONS

### 1.1.1 ELECTION OF CMPGR OFFICIALS

| | | |
|---|---|---|
| | Chairperson: | CARDI, represented by Mr. Herman Adams |
| | Vice-Chairperson: | USDA/TARS, represented by Dr. Antonio Sotomayor-Rios |
| - | Executive Secretariat: | IICA (Office in Saint Lucia), represented by Dr. Antonio M. Pinchinat |

### 1.1.2 TERMS OF OFFICE OF INSTITUTIONAL STEERING GROUP

| | | | |
|---|---|---|---|
| CARDI - Chair | : | Two years | (1994-1996) |
| USDA/TARS - Vice-Chair | : | Two years | (1994-1996) |
| CIRAD - member | : | One year | (1994-1995) |
| INRA - member | : | One year | (1994-1995) |
| UWI - member | : | One year | (1994-1995) |

### 1.1.3 REGULAR OPERATION YEAR

The regular Annual Operation Cycle of CMPGR's business begins on the first business day of an Annual Meeting of the Caribbean Food Crops Society (CFCS) and ends on the first business day of the following CFCS Annual Meeting. Thus the first Regular Annual Operation Cycle will start on August 1st, 1994 at the 30th Annual Meeting of CFCS in St Thomas, V.I., and will end on the first business day of the Society's 31st Annual Meeting in Barbados in 1995.

### 1.1.4 MEMBERSHIP CATEGORY

Institutional Membership in CMPGR is offered at two levels: Core and Support.

### 1.1.5 INVITATION FOR MEMBERSHIP

The Chair of the Steering Group, through the Executive Secretariat, will extend an invitation for membership to the following institutions:

1.1.5.1 Core

CATIE, Costa Rica
Regional Agricultural School for the Humid Tropics (EARTH, Costa Rica)
National Agricultural Research Institute (NARI, Guyana)
French Organization for Overseas Scientific and Technical Research (ORSTOM, Martinique)
Ministry of Agriculture of Cuba (through INRA, Guadeloupe)
West Indies Sugar Cane Breeding Company (WISCO, Barbados)

1.1.5.2 Support

Dominican Agricultural Foundation (FDA, Dominican Republic)

## 1.1.6 CMPGR'S SPECIFIC OBJECTIVE

Within the overall purpose to support agricultural sustainability, CMPGR's specific objective is:

***To assist Caribbean institutions in increasing technical capabilities for better management and use of plant genetic resources through regional joint action and support of the international community of concerned institutions or agencies.***

## 1.1.7 CROP PRIORITIES

Among the crop groups which are endangered in the region, Fruit Tree Crops will have first priority on CMPGR's 1994-1995 action agenda.

Second priority is reserved equally to Food Legumes and Root Crops.

## 1.2 1994 PLAN OF JOINT ACTION

### 1.2.1 SHORT TERM ACTIONS

#### 1.2.1.1 Seminar on Joint Action for Conservation and Use of Plant Genetic Resources in the Caribbean

**Purpose:**
To outline a common regional action agenda for improving plant genetic resource management.

**Target Clients:**
Policy-makers, planners, scientists/technologists, the media, and Non-Government Organizations and Donors.

**Outputs:**

- Exchange of information on conservation and use of plant genetic resources.
- Institutional and technical bases to outline a regional policy for the management of plant genetic resources.
- Harmonization of procedures and guidelines for acquisition, exchange and maintenance of plant germplasm.
- Identified training needs and proposals for regional and international training.
- Recommendations for research and development.

**Organizing Committee:**

UWI, IPGRI, FAO and IICA.

**Deadline:**

March 1995.

#### 1.2.1.2 Listing of Fruit Germplasm Accessions in the Caribbean

IICA will finalize, put on computer diskette, and distribute the List already available in draft form from the IICA/Government of France - funded Project on Development of Tropical Fruits in the Caribbean.

1.2.1.3 Data Base on Seed Storage

The USDA will assist interested institutions from the Caribbean in accessing its data base coded GRIN (Genetic Resource Information Network).

1.2.1.4 Recollection of Plant Germplasm

USDA, through TARS will continue expanding recollection of plant genetic resources, in tropical fruit tree crops.

Two expeditions are programmed as follows:

1. Mexico: *Annonaceae*
   *Sapotaceae*

2. Haiti: *Anacardiaceae* (Mango)

Recollection of hot pepper and eggplant germplasm will be coordinated by INRA and CATIE.

1.2.1.5 CMPGR Linkages

IICA will facilitate participation of a CMPGR representative in Meetings of Genetic Resource Management Networks coordinated by IICA in cooperation with IPGRI and CATIE.

1.2.1.6 Training in Plant Genetic Resource Management

CATIE and UWI will join efforts immediately to offer and facilitate training in areas related to plant genetic resource management. Possibility for bilingual translation (Spanish - English) will be explored by CATIE.

TARS, through the Caribbean Basin Initiative Scholarship Programme (CBI) will fund a two-year MSc training programme in plant genetic resource management for one professional from the Caribbean. The course will emphasize:

- Gene bank management.
- Curatorship.
- Cryopreservation.
- Biotechnology.

The course will be offered at Colorado State University, in cooperation with USDA, by September 1994.

In addition, UPR, assisted by IPGRI, will offer a short-course (three months or less) in plant genetic resource management centered on bio-engineering. Applicants from the Caribbean will be selected by the Caribbean Scholarship Selection Committee (IICA as chair, CARDI and UWI). The course will be offered possibly in Fall (September) 1994.

#### 1.2.1.7 Information Exchange

- IPGRI will send to CMPGR information on genetic resource management at the National Genetic Resource Center of Brazil (CENARGEN).

- Representatives of CMPGR institutions will attend the CFCS 30th Annual Meeting in St. Thomas (July 31-August 6, 1994).

- The CMPGR Chairperson will present an Annual Report on CMPGR at each Annual Meeting of CFCS, beginning with the 30th Annual Meeting and will submit a status report every six months to CMPGR membership.

- CMPGR will hold a night business session at each CFCS Meeting, beginning with the 30th Annual Meeting.

- CMPGR news will be published in the CFCS Newsletter.

### 1.2.2 LONG-TERM PROJECTS

#### 1.2.2.1 Assessment of Plant Germplasm Management in the Caribbean

The Executive Secretariat will consult IPGRI for technical and financial assistance to finalize the assessment begun by IICA (through Consultancy by Dr Lucien Degras). Possibility of hiring a Consultant and secure funding of local contacts to gather information will be explored, principally in Caribbean countries where large plant genetic resource bases can be found.

#### 1.2.2.2 Economic Valorization of Under-Utilized Fruit Tree Crops in the Caribbean

i) **Specific Objective:**

To promote production and processing of under-utilized fruit crops.

ii) **Focus and Strategy:**

Native or long-time established species suitable for fresh fruit production or agro-processing.

iii) **Outputs:**

- Potential and constraints for economic development assessed.
- Information on potential and constraints exchanged for action.
- Technology needs for production and processing identified and research/development programme undertaken.

iv) **Activities:**

- Assessment (identification and feasibility study) of potential species and types for fresh fruit production and processing.
- Characterization of species and types.
- Data base development for networking.
- ***In-situ/ex-situ*** conservation.
- Technology research/development and training.

v) **Strategy to Develop the Project:**

Small team comprising USDA, CATIE and IPGRI, coordinated by the IICA Tropical Fruit Development Project in the Caribbean will develop the Project idea into project profile.

vi) **Funding:**

CMPGR, in cooperation with RDC, CIRAD and IICA/GTZ will explore possibilities for funding by the European Community, GTZ, and other sources.

- IICA will submit profile to CARICOM Secretariat for political backing.
- CMPGR will follow up implementation and results.

### 1.2.2.3 Project Ideas for Seeking External Funding

- FAO will assist CMPGR in preparing Project ideas as basis to develop final Technical Cooperation Projects for external funding.

- Likewise by June 1994, INRA, CIRAD, RDC and GTZ will cooperate in identifying and preparing Projects to be submitted to FIC (Inter-Ministerial Fund for Cooperation).

- CATIE and GTZ will assist CMPGR in preparing in-vitro conservation and mass production projects on root crops and food legumes.

- GTZ will support training, transfer of technology and institution building through its Project **Development and Testing of New Plant Breeding Procedures**, based at GTZ Headquarters in Germany.

# 2.0 PRESENTATIONS

## 2.1 REMARKS

*A. M. Pinchinat*
*CMPGR's Executive Secretary, IICA, Saint Lucia*

| | |
|---|---|
| Chairman: | Dr. Antonio Sotomayor-Rios |
| Hon. Neftali Soto: | Secretary of Agriculture - Puerto Rico |
| Prof. Pablo Rodriquez: | Acting Chancellor, University of Puerto Rico at Mayaguez |
| Dr. L. E. Wiesner: | USDA Representative |
| Dr. Jurgen Carls: | GTZ Representative |
| Dr. Enrique Alarcon: | IICA Program II Acting Director |

Colleague Members of CMPGR

Guests:

The Executive Secretariat is pleased to address this first business meeting of the Caribbean Committee on Management of Plant Genetic Resources. This activity results from the enthusiastic and diligent efforts undertaken cooperatively by four institutions, namely:

US Department of Agriculture, through the Tropical Agricultural Research Station, Mayaguez, Puerto Rico.

University of Puerto Rico, through its Mayaguez Campus.

German Cooperation Agency, through its Representative in Costa Rica.

Inter-American Institute for Cooperation on Agriculture, through its office in Saint Lucia, where the CMPGR's Executive Secretariat is based.

The considerable importance of the Meeting can be inferred from the high level of representation of participating institutions, as manifested by the presence of the Secretary of Agriculture of Puerto Rico, the Hon. Neftali Soto; the Acting Chancellor of the University of Puerto Rico - Mayaguez, Professor Pablo Rodriquez; Dr. L. E. Wiesner, representing Dr. Henry Shands, Associate Deputy Administrator of Genetic Resources of the US Department of Agriculture; the Representative of GTZ, Dr. Jurgen Carls; and IICA Representative, Dr. Enrique Alarcon, Acting Director of Programme II, dealing with Technology Generation and Transfer.

The success of the Meeting in achieving its specific objective, as outlined by the Chairperson, can be augured by the professional calibre and institutional responsibility of CMPGR core and support members in attendance. They represent the key research/ development and training institutions concerned with plant genetic resource management

in the Caribbean, namely - CARDI, CATIE, CIRAD, FAO, INRA, IPGRI, UPR, USDA/APHIS, USAID/IITF, USDA/TARS, UVI, and UWI.

Please refer to CMPGR's Constitution and other reference documents placed by the Organizing Committee in each participant's folder. They will guide the proceedings of the business of the Meeting.

Thank you.

## 2.2 MESSAGE

*Hon. Neftali Soto Santiago*
*Secretary of Agriculture, Puerto Rico*

Good morning ladies and gentlemen! It is a great honor to be with you this morning and share with the members of the Caribbean Committee on Management of Plant Genetic Resources (CMPGR). I welcome you to our beautiful Island, a land of good people, good climate and a very promising agriculture. At a time when resources in all countries around the world are becoming scarce then the challenge to all of us is to fulfill the basic needs of our people. The need for food, housing, recreation, good living standards, requires team work. The joint effort of governmental officials, scientists and the general public will make the difference. It is the key to a promising future for agriculture and to the other branches of growth and development.

Organizations like this Committee are the keystones, to that future. Some of the basic functions or objectives of this Committee include:

- Identifying priority areas for undertaking joint regional actions to improve plant genetic resources management.

- Facilitating intra-regional and international exchange of information and materials.

- Instilling awareness about property rights and preservation needs concerning national plant genetics resources.

In these objectives or functions there are three very important and meaningful words:

**JOINT - EXCHANGE - AWARENESS**

The first word, **JOINT**, indicates the unity, the team work that should exist among our people, among our countries. **EXCHANGE**, indicates the need to share resources, to share knowledge, the need to give others what we have for the benefit of our communities. **AWARENESS**, indicates the responsibility to understand and acknowledge the rights and needs of others.

We want to have a strong agriculture, and to achieve that, a strong effort in science and technology is required. In our genetic resources there is an infinite potential to improve crop production and to obtain the maximum revenue from our natural resources. Biotechnology is the word of the decade. Recently we have heard a lot about BST, a hormone to improve milk production; we have heard about genetically improved fruits and vegetables; crops of improved quality, highly resistant to pests and diseases and high tolerance to adverse environmental conditions.

Very often we see people in favor of exploiting to a maximum our genetic resources and others opposing it. But they all have one thing in common, they are looking to a better agriculture, to improve the use of the resources available. The future for agriculture is very promising and we should set our goals to creativity, innovation and efficiency. We cannot, nor should we, go back to the past, but from time to time we should look to our past and learn from our mistakes. We should take the best of it, and use it for a better future. My colleague and friend Mr. Tommy Irvin, Commissioner of the Georgia Department of Agriculture expressed the same thoughts in a very elegant and direct way. Commissioner Irvin once said, and I quote.

> ***"We cannot go back to the past in agriculture, any more than we can go back to the past in medicine, space, transportation, or any other branch of science and culture."***

The need for food has never been greater than it is today. World population continues to grow at a rate of 1.6 to 1.7 percent, resulting in almost 90 million more consumers of agricultural products annually. It is expected that by the year 2000 world population will reach 8.2 billion. Over 90 percent of this growth is occurring in the developing world, many parts of which are already suffering from an inadequate food supply. However, for the past several years, world farmers have been able to keep up with the demand for food. What we are facing is a problem of food distribution, a problem of sharing with those less fortunate. Here again the words **JOINT, EXCHANGE** and **AWARENESS** come to mind and should always be present in our minds.

The high efficiency of our farmers has been the result of the technological advances in agricultural sciences. Development of new crop varieties, hybrids of high production and new techniques of crop and soil management have been determinant factors in the success of our farmers. The high productivity of our land resources has been achieved with the development and use of improved crop varieties, combining higher genetic yield potential and yield dependability with improved disease and insect resistance. Soil restoration and optimum management practices to improve fertility, and improved crop management including integrated pest management has also contributed significantly to this success.

The exchange of scientific knowledge and resources has been the key to this success and I foresee a great future for initiatives like this committee. At a time when marketing and trade barriers between countries are disappearing, and cultural and economic exchange between countries is being facilitated, the exchange of scientific knowledge is an essential complement for economic and cultural growth.

The Department of Agriculture of Puerto Rico is committed to the development of a strong agriculture that will contribute solidly to our economic growth. We recognize the importance of combining resources, knowledge and technology and we congratulate and gladly join with this Committee in this initiative. I wish you great success at this Meeting and in the future and I thank you all for giving me the opportunity to bring you this message.

## 2.3 CARDI'S POLICY AND ACHIEVEMENTS IN PLANT GERMPLASM MANAGEMENT

*H. Adams and S. Parasram*
*CARDI, Trinidad and Tobago*

### 2.3.1 INTRODUCTION

Biodiversity in all living matter, flora and fauna, is the essential mechanism to ensure survival of the earth. Within this framework, the regional germplasm must be considered. The regional plant germplasm is of prime importance to the quality of life and to regional agricultural production and productivity.

The germplasm, differing from somatoplasm, denotes any cell or set of cells which send the genes forward into the future to produce the progenies. The size of this genetic base, the number of potential gene recombinants, the actual number of genotypes within all the taxonomic categories of plants etc. determine the resilience of the germplasm to meet changes in the environment. Apart from the biotic and abiotic natural influences of micro-organisms (bacterial, fungal and viral diseases, etc) and pests (insects, animals etc), the plant germplasm also has to meet the additional challenges of changing consumer tastes.

The great importance of plant germplasm emphasizes the need for a well co-ordinated regional management to ensure the most efficient conservation and utilization. The former should have as its objective the safeguard of all germplasm against losses of any kind.

Destructive forces leading to genetic erosion and, in the worst case, extinction, should be recognized and halted. The wild types and land races should be characterized so that their high general and specific adaptabilities in the various ecological niches, could be safeguarded and utilized in genetic improvement programmes. This need can be met by a number of activities ranging from collecting missions, the development of descriptors, ***in situ*** conservation measures (like natural parks, botanic gardens, storage and rejuvenation of seeds/propagules) to the exchange of information and germplasm.

### 2.3.2 ACHIEVEMENTS

#### 2.3.2.1 Germplasm Evaluation and Selection

Over the past 19 years, since its establishment in the English Speaking countries of the Caribbean, CARDI has been working mainly on the introduction and evaluation of food crop germplasm, followed by the multiplication and distribution of planting material. Recently, work was started on the ***in-vitro*** propagation and storage of vegetatively propagated plant species.

A brief review of CARDI's work, on mainly food crop germplasm, is given in Table 1.

**Table 1: Some Achievements of CARDI in the Area of Crop Germplasm Management**

| Achievements | Country |
|---|---|
| Evaluation and identification of 2 types of cultivars of Tannia, Jamaique and Rabess, for commercial production and *in-vitro* propagation and storage. | Dominica, Saint Lucia, St. Vincent, Grenada |
| The tomato cultivars, Zenith, Name 316 and Napoli have been recommended for processing. | Trinidad |
| Tomato cultivar, Caribe, has been released for fresh use. | Saint Lucia |
| Pigeon pea varieties released for green peas and split peas. | Trinidad and Tobago and Barbados |
| The onion varieties, Galil or Grandstand, Special 38, Textar 80, Henry's Special, Texas Yellow Grano and some Israeli cultivars, were evaluated and recommended for production. | Barbados or Montserrat |
| The peanut cultivars, NC$^2$, Kidang, ICGS54 and CARDI Payne were recommended. | Trinidad, Belize, Guyana and Jamaica |
| A cowpea cultivar, Vita 3, was selected. Varieties of cantaloupe, broccoli and cauliflower were evaluated and recommended. | Jamaica, Windward and Leeward Islands |
| Six sweet potato varieties were evaluated and released. | St.Vincent, Saint Lucia and Grenada |
| Three cultivars of sorghum, cultivar of soybean, 3 cowpea lines and 2 lines of pigeon peas, evaluated and selected. | Guyana |
| Forage legume and grass germplasm evaluated, selections made for acid soils, alkaline soils, wet and dry conditions. | Guyana, Antigua, Barbados, Trinidad and Tobago and Jamaica |
| Aroids were characterized and evaluated and selections were recommended for production. | Windward Islands |
| A large yam germplasm collection was evaluated and selections were made for anthracnose tolerance and commercial production. | Windward Islands and Barbados |
| A soybean and rice selections were released. | Belize |
| A hot pepper cultivar was selected for export production. | Antigua |
| Passion fruit selections were made based on general adaptability and high yields. | Dominica and Saint Lucia |

Germplasm evaluation and selections were done over a wide range of food and forage crops. Theoretically, CARDI's role was to introduce, evaluate and release selections for which only breeder's seed was to be maintained. However, since there were no commercial seed growers to whom the basic or foundation seeds could have been handed over, CARDI was obliged to get into the additional business of seed multiplication and distribution to the farmers.

### 2.3.2.2 *In-Vitro* Propagation and Storage of Germplasm

Germplasm was mainly stored in the fields and seed rooms for true seeds. With the advent of tissue culture techniques, two centres for micro-propagation were established: a large one in Barbados and a smaller capacity in Dominica.

Large numbers of cultures are kept for 12 varieties of anthuriums, 3 varieties of orchids, 38 varieties of yams, 28 varieties of sweet potatoes, 30 varieties of cassava, pineapples, dwarf plantains, tannia and garlic. Rapid multiplication techniques were employed to supply planting material to farmers. Research has also produced some notable successes, viz:

- The full protocol was developed for pink anthurium.
- Efficient protocols was developed for 4 other anthuriums.
- Orchid seed culture was refined.
- A full protocol was developed for orchids in general.
- Full commercial protocols were developed for yams, sweet potato, cassava, bananas, plantains and pineapples.

### 2.3.2.3 Linkages

In order to achieve the above, CARDI fostered linkages with other workers within and outside the CARICOM region. Intra-regionally, the local germplasm was collected from the farmers, the Ministries of Agriculture and commodity organizations. Close ties were also established with regional representatives of IICA, INRA (Guadeloupe), CDB and FAO. The principal international organizations with which exchanges of information and germplasm, were made, were CIAT, IRRI, CIMMYT, ICRISAT, IITA, CIP, IBPGR, and many Universities in the U.S. (these include the Universities of Georgia, Florida, North Carolina, Illinois, etc.).

### 2.3.3 CONCLUSION

In concurrence with its mandate and mission, CARDI recognizes the critical importance of biodiversity and will continue to contribute towards its conservation, maintenance, increase and efficient utilization. This is reflected in CARDI's strategic plan, medium term plan and work programmes.

In addition, past work has yielded significant results in the provision of genetically improved crop cultivars and increased production of high quality seeds. However, efforts need to be redoubled and directed towards a greater regional co-ordination in the management of plant genetic resources.

## 2.4 REVIEW OF THE PROGRAMMES OF CIRAD/FLHOR

*P. Cao-Van*
*CIRAD/FLHOR, Martinique, FWI*

The *Centre de Cooperation Internationale en Recherche Agronomique pour le Developpement* (CIRAD) is a French centre for international cooperation in development-oriented agricultural research, with emphasis on tropical and sub-tropical areas. It contributes to the development of these regions through research, experimentation, training, and dissemination of scientific and technical information. CIRAD is composed of seven research departments:

- Forestry (CIRAD-Foret).
- Livestock Production, Veterinary Medicine (CIRAD-EMVT).
- Annual Cops (CIRAD-CA).
- Perennial Crops (CIRAD-CP).
- Fruit and Horticultural Crops (CIRAD-FLHOR).
- Food Technology, rural system (CIRAD-SAR).
- Management, common services, labs and documentation (CIRAD-GERDAT).

A staff of 1,850 persons, including 920 senior staff are employed in the research centres, laboratories and experimental stations located in France (Paris and Montpellier), in the French overseas departments and territories, and in different countries all over the tropical and sub-tropical world. In the Caribbean, CIRAD activities are conducted through a staff of 35 researchers in three of its seven departments located in the French West Indies, Martinique and Guadeloupe:

**CIRAD-CA:** its research aims at quantitative and qualitative crop improvement in both traditional and intensive farming systems such as sugar cane, maize and rice.

**CIRAD-EMVT:** contributes to the improvement of tropical livestock and to industries using animal products.

**CIRAD-FLHOR:** is now referred to as the department of fruit and horticultural crops and conducts its activities on fruits, vegetables and ornamentals in different ways such as technical and economic trials, post-harvest and agro-processing. In the French West Indies (Martinique and Guadeloupe), this department has a staff of 23 researchers working in the following programmes:

| | | |
|---|---|---|
| Banana | : | 13 researchers (Guadeloupe and Martinique) |
| Pineapple | : | 3 researchers (Martinique) |
| Citrus | : | 2 researchers (Martinique) |
| Tropical Fruits | : | 2 researchers (Guadeloupe and Martinique) |
| Vegetables | : | 2 researchers (Martinique) |
| Ornamentals | : | 1 researcher (Martinique) |

For these fruit programmes, germplasms have been established, both in Martinique and Guadeloupe, with local accessions collected during country surveys and inventories and completed with exotic introductions or genetic work accessions. The research teams involved in these programmes have also developed, along the years, several computerized tools to improve the management of these plant genetic resources. Some of these software programmes are now recognized by different organisations.

In terms of "germplasm" or "Management of Plant Genetic Resources", CIRAD-FLHOR should contribute to a regional programme by supplying materials and helping countries to manage or improve the management of their own germplasm through training and cooperation.

In terms of "Tropical Fruit Crops", which are now recognized as a priority for the Caribbean, CIRAD-FLHOR, according to its research developed in the region, should cooperate as follows:

i) **Bananas and plantains:**

A germplasm base of more than 400 cultivars is located in Guadeloupe where a team of geneticists is working to improve both resistance to disease and quality as productivity. A software programme called "MUSAID" has been developed to help people involved with this crop to differentiate and to name plants of unknown origin.

ii) **Citrus:**

A germplasm base of 143 cultivars and 29 root stocks, free of virus or virus-like diseases has been established since 1988 in Martinique. It is a partial duplication of the National Citrus Germplasm located in Corsica, and contributes to a better knowledge of the behaviour of citrus under a humid, tropical climate. A computerized management system has been developed in Martinique. It provides a complete description of the cultivars according to an extended version of the IBPGR descriptor, and allows for management of the phytosanitary surveys (i.e. Tristeza, Exocortis, ...) and the exportation of budwoods. This computerized system will soon be extended to other stations under different climates to allow a general knowledge of the cultivars.

iii) **Tropical fruits:**

This topic has been mainly developed in Guadeloupe. A germplasm base of about 80 genus has been established from which material can be delivered. Several observations are made which help determine cultivars which should be of most interest as commercial crops. A special mention should be made of mangoes for which a germplasm of about 120 accessions collected in different parts of the world has been transferred from the Ivory Coast to Guadeloupe. A new emphasis for Asian fruits of tropical and sub-tropical climates leads us to believe that our germplasm will soon receive some new species.

iv) **Pineapple:**

CIRAD-FLHOR has one of the largest germplasm bases for pineapple with over 600 accessions. This germplasm is used for a programme of hybridation.

## 2.5 GENETIC RESOURCES MANAGEMENT AT INRA

*G. Anais*
*INRA, Guadeloupe, FWI*

### 2.5.1 INTRODUCTION

The INRA Research Centre for Antilles and Guyana is one of 22 Regional Centres of the French National Agronomic Research Institute (INRA). Its operations are, therefore, tied to the French, National regulations and the policy of INRA with special concern for those crops on which research is carried out in Guadeloupe.

In France, Genetic Resources Management is the responsibility of the Ministry of Higher Education and Research, which manages a Board of Genetic Resources. However, this Board only has the power to act as coordinator in research training and information. The actual conservation and management of genetic resources is the responsibility of the various institutions involved in this task in the field of research extension or production.

### 2.5.2 RESEARCH ACTIVITIES

INRA is deeply involved in spreading genetic progress.

#### 2.5.2.1 Nature and Origin of INRA Genetic Resources

i) **Local Populations and Old Varieties**

This material is collected, evaluated, conserved and used in breeding programmes. It can be considered as live collections (e.g. Early Maize, cold-resistant peppers).

ii) **Related Species of Cultivated Plants**

Related species are used mainly to introduce resistance to disease and pests (e.g. tomato vs ***Lycopersicon*** and ***Solanum*** from Peru).

Most of the advanced bedding material is released to private seed companies. In the case of forest trees, ***in-situ*** conservation is practiced.

#### 2.5.2.2 Research on Characterization and Management of Genetic Diversity

- Genome characterization and mapping are practiced on many species: maize, sunflower, wheat, rapeseed, tomato etc.

- Appreciation of genetic value and use in new breeding strategies.

- Conservation methodology, with special attention to gametes conservation of vegetatively propagated germplasm.

2.5.2.3 Specific Programmes on Germplasm Conservation

Methodology of germplasm conservation:

This is done by the description and understanding of workable genetic diversity (PRODIGE). This programme, launched in 1990, has three objectives:

- Characterization of the genome and introgressions.
- Methodology of research studies.
- Modelisation.

2.5.3 RESEARCH PROJECTS (% of species)

2.5.3.1 Description and Comparison of Various Types of Diversity (38,6%)

- Classification, grouping, core collections.
- Identification of allogamous populations.
- Comparisons of various forms of diversity

2.5.3.2 Populations Genetics and Dynamics (13,1%)

- Genetic flux intra- and inter-populations, specifically phylogeny.
- Mode of populations evolution under natural or artificial selection pressure.
- Evaluation of selection pressure.
- Interspecific phylogeny.
- Genetic systems evolution.
- Co-evolution.

2.5.3.3 Enrichment of Genetic Variability (33,1%)

- Intogression (intra- and inter-specific).
- Introgression by genetic engineering (mutation, transformation).

2.5.3.4 Atomization and Conservation: Economic Aspects (15,2%)

- Atomization of genetic marking.
- *In-situ* and *ex-situ* conservation (including *in-vitro*).
- Economic aspects (cost).

## 2.5.4 THE SITUATION IN GUADELOUPE

### 2.5.4.1 Working Collections:

| | |
|---|---|
| Yams: | Stable |
| Vegetables: | Increasing (disease and pest resistance) including *Solanacearum* |
| Maize: | Increasing (insect resistance) |
| Ornamentals: | Increasing (crop diversification) |
| Forest Trees: | (*in-situ* preservation) |

### 2.5.4.2 Management (also in French Guyana)

Team of Plant Breeders: Total 9

| | |
|---|---|
| Vegetables and Root Crops | 5 |
| Maize | 2 |
| Ornamentals | 2 |

### 2.5.4.3 Genetic Resources

Varieties 69.8%, populations 12.9%, related species 9.7%, particular material 7.6%.

### 2.5.4.4 Mode of Conservation

| | *ex-situ* 56.4% | *in-situ* 43.3% | *in-vitro* 0.2% |
|---|---|---|---|
| Protein Plants | 1.3 | 15.5 | |
| Vine grape | 40.1 | -- | |
| Ornamentals | 8.3 | -- | |
| Beetroot | 4.0 | 3.2 | |
| Vegetables | 14.2 | 10.2 | |
| Maize | -- | 15.2 | |
| Forage | -- | 7.2 | |
| Cereals | -- | 36.3 | |
| Oil Plants | -- | 12.3 | |

## 2.5.5 COLLECTIONS WITH INRA IN COLLABORATION WITH IRFA AND ENSA

**Table 1. Collections**

| Species | Location | Cultivars and Related Species | Local Population and Old Varieties |
|---|---|---|---|
| Fruit Trees | Bordeaux, San Guiliano Manduel, Angers | 20 cultivated species, 60 related species (*Citrus, Malus, Prunus, Pyrus*) | 5,000 varieties, clones, stocks |
| Grapevine | Montpellier, Colmar, Montreuil, Belley | Very numerous of genus *Vitis* and neighbouring | 7,000 origins of which 2,500 clones of Vitis vinifera |
| Small Fruits | Angers | *Ribes, Rubus* - botanical and related species | 350 varieties, ecotypes, clones |
| Ornamental Flowering Shrubs | Angers, Frejus | Cultivated species and new prospecting of wild species | 500 clones, varieties, various genotypes |
| Ornamental Plants | Frejus, Ploudaniel, Dijon, Versailles (ENSH) | 8 cultivates of species | 2,000 varieties, eco-types, various origins |
| Vegetables | Montpellier, Ploudaniel, Versailles (INRA/ENSH) Montfavel, Rennes (ENSA) | Large collection of *Allium Brassica, Capsicum*, flax, bean, tomato, melon and 50 related species | 7,000 farm varieties, cultivars, lines, clones |
| | Petit-bourg (Guadeloupe) | Roots and tubers (yam, sweet potato),7 cultivated species, 7 wild species | 200 varieties |
| Straw Cereal | Rennes, Clermont Ferrand, Versailles, le Moulon, Montpellier | 6 cultivated species 25 related species | 10,000 population, cultivars, parents, ecotypes |
| Maize | Mons-en-Chaussee, le Moulon, Lusignan, Clermont-Ferrand, St. Martin de Hinx Petit-bourg (Guadeloupe) | | 265 French populations, 500 French lines, large base pools, plentiful foreign material |
| Protein Plants | Dijon, Rennes, Lusignan, Montpellier | 4 cultivated species, some related species | 2,200 populations |
| Sunflower | Montpellier | 50 related species | 450 wild ecotypes |
| Forage and Turf | Clermont-Ferrand, Dijon, Lusignan, Montpellier | 15 cultivated species 10 related species 15 *Medicago* species spontaneous | 2,100 ecotypes populations |

## 2.6 RESEARCH PROGRAMS AND GERMPLASM COLLECTIONS OF THE USDA-ARS TROPICAL AGRICULTURE RESEARCH STATION

*A. Sotomayor-Rios and F. Vazquez*
*USDA-ARS, Puerto Rico*

### 2.6.1 ABSTRACT

The Tropical Agriculture Research Station (TARS) of the United Sates Department of Agriculture, Agriculture Research Service (USDA-ARS), in Mayaguez, Puerto Rico, conducts programmes of importance and benefit to the United States, Puerto Rico, the Caribbean Basin countries, and the tropics in general. TARS maintains collections of diverse germplasm that complement its research efforts and are of value to scientists studying tropical crops and to the public.

### 2.6.2 RESEARCH PROGRAMMES

TARS has a diverse research programme covering cereals, beans, root crops, tropical fruits, forage grasses and legumes. Two of the cereals that have been intensively studied at TARS are sorghum (*Sorghum spp.*) and corn (*Zea mays*). Its research programmes have produced disease-resistant sweet corn and four field corn populations for the tropics and, in a joint venture with Texas A & M, has made over 400 lines of grain sorghum available to breeders worldwide that can be used in temperate and tropic zones.

At its Germplasm Introduction and Research Unit (GIRU) on St. Croix in the U.S. Virgin Islands, TARS has a programme to grow out quarantined corn and sorghum germplasm received from various countries by the National Plant Germplasm System (NPGS). This growout allows the germplasm to be utilized (if disease-free) by plant breeders in the U.S. and has an impact on sorghum breeding throughout the world.

In its bean research, TARS has a long-standing commitment to improve this crop for the tropics, selecting disease-resistant varieties having good yield, higher protein content, and lower condensed tannin content.

TARS' research also concentrates on developing technical packages and systems for use with certain crops such as yam (*Dioscorea spp.*), banana and plantain (*Musa spp.*), and tannia (*Xanthosoma spp.*), which can result in increased production and can be utilized throughout the tropics.

Root crop research at TARS has also developed new varieties for the marketplace such as Viola, a sweet potato that has many desirable characteristics and is tolerant to the acid soils of the tropics.

Two projects at TARS involve tannia. One of them aims to produce tannia that are resistant to the devastating disease dry-root rot syndrome. In addition, a TARS scientist has

been working with scientists in Alabama and Hawaii on a growth simulation model for tannia and taro (*Colocasia esculenta*) that will centralize information on various aspects of crop production and help to optimize the productivity of these crops.

Our farm at Isabela gives an extra growing season to ARS, state and private industry scientists in the U.S. to accelerate plant breeding and evaluation for their crop research programmes.

TARS has a programme for promoting the application and utilization of agricultural technology in the developing countries of the Caribbean Basin. In its two-year Technology Transfer Programme, recent college graduates from Puerto Rico and other Caribbean islands receive training at TARS or another research institution, or can get practical, hands-on experience in any field of agriculture in which they are interested. The programme also allows trainees to obtain an MS degree from the University of Puerto Rico.

Grass and legume research at TARS is contributing to the lowering of livestock production costs in the tropics. Recent research has involved such plants as napier grass (*Pennisetum purpureum*) and perennial peanut (*Arachis pintol*).

### 2.6.3 GERMPLASM COLLECTIONS

Germplasm collections of selected plants offer sources of genetic diversity for the development of plant varieties with disease resistance and greater yield. Germplasm is living tissue from which new plants can be grown. This can be seed, pollen, a part of the plant such as a leaf or stem, or only a few cells that can be developed microbiologically into a growing plant.

TARS plays an important role in the NPGS by acting as a repository for the introduction, maintenance, enhancement, evaluation and distribution of various types of tropical and subtropical plant germplasm.

TARS is the official repository for banana and plantain (*Musa spp.*), 73 accessions; bamboo, 86; Brazil nuts (*Lecythis spp.* and *Bertholletia excelsa*) 3; and root crops such as yam (*Diascorea spp.*), 24: tannia (*Xanthosoma spp.*), 78; cassava (*Manihot esculenta*), 54; and sweet potato (*Ipomoea batatas*), 93. It also maintains a collection of more than 500 entires of many tropical and subtropical fruits, ornamentals, and spice and medicinal plants.

Since 1902, TARS has been conducting research programmes that have benefitted the U.S. and tropical agriculture. In the years ahead, TARS will continue to make important contributions toward improving tropical crops and expanding our knowledge of them and to have a keen interest in collecting and preserving valuable germplasm as insurance against disastrous crop failures and as a legacy for the future.

## 2.7 GERMPLASM CONSERVATION AT THE ST. AUGUSTINE CAMPUS

*E. J. Duncan*
*UWI, Trinidad and Tobago*

### 2.7.1 INTRODUCTION

I should like to focus, in my presentation, on one aspect of the management of plant genetic resources as far as the St. Augustine Campus of The University of the West Indies is concerned - conservation. I will deal briefly with what is currently conserved, the methods of conservation used, the capabilities on the campus for conservation and plans for the future.

There has been a history of germplasm conservation at the St. Augustine Campus dating back to the Imperial College of Tropical Agriculture (ICTA) the forerunner of the present-day Faculty of Agriculture of the University. Notable among the collections were those of ***Theobroma cacao*** (cocoa) and ***Musa spp.*** much of the latter of which has unfortunately been lost. At present the Departments of Crop Science and Plant Science and the Cocoa Research Unit are involved in some measure of germplasm conservation. The species conserved are directly related to the research interests of the departments/unit concerned, which in turn are in large measure influenced by the perceived needs of the territories the University serves. The species conserved are thus mainly of agricultural importance.

### 2.7.2 THE COLLECTIONS

***Theobroma cacao*** L. - this crop is said to have been introduced to Trinidad in 1525. The type introduced was Criollo, which was grown until the 18th century, when the crop was all but destroyed by 'blast' in 1727. Forastero material was introduced from Venezuela later in the century and was hybridized with such Criollo type as remained, resulting in the Trinitario population. Research on the crop was initiated in 1930 at ICTA, established some nine years earlier. Work in the early years resulted in the selection of 100 clones - the ICS clones - from among the Trinidad population. Explorations to Ecuador in 1938 and the Amazon Valley in 1943 resulted in collections of wild cocoa types.

In the early 1940's a selection programme was carried out in Grenada, which resulted in the establishment of the GS clones.

In the mid 1950's, emphasis on plant improvement shifted from collection and selection to breeding, using Amazon and ICS material as parents. All the types collected, selected and bred now form a part of the International Cocoa Genebank, Trinidad.

The current work of the Unit includes *inter alia*:

- Conservation on one site a field genebank of all primary germplasm existing in Trinidad.

- Enlarging existing collections of primary germplasm.

- Characterising all accessions held.

There are now 2,500 accessions held at ICGT, 1,700 of which are established in the field, the others are in various stages of preparation for field planting, including some held in quarantine. The Unit runs an off-island quarantine station on neighbouring Barbados. This station, with one at Reading in the United Kingdom and one at Montpellier in France, are the world's three (3) recognised cocoa quarantine stations.

There is an active exchange of material through the quarantine station (s), with cocoa growing regions of the world.

*Artocarpus altilis* (Breadfruit) - The awareness of the potential of breadfruit as a staple has led to the initiation of a programme of research on the crop which includes collection and selection of material. The Department of Crop Science holds a 21-month old collection consisting of 25 accessions, two of which are from the Caribbean, the remainder from the South Pacific.

## 2.7.3 FOOD LEGUMES

The Department of Plant Science holds collections of *Cajanus cajan* Mills (Pigeon Pea), *Vigna unguiculata* (L) Walp. (Cowpea) and *Lablab purpureous* (Seim Bean).

The corn collection is the largest and consists of:

- 206 germplasm lines
- 4 local varieties
- 15 breeding lines

The pigeon pea collection consists of:

- 28 germplasm lines
- 6 local varieties
- 52 breeding lines

The seim collection, the smallest and most recently started comprises:

- 3 introductions, and
- 17 local varieties

In addition to the collections mentioned above, crop museum plots hold small teaching collections of grasses, cover crops, fibre crops, condiments, maintained by the Department of Crop Science.

## 2.7.4 METHODS OF CONSERVATION

At present methods of conservation are confined to field collections and seed collections.

The ***Theobroma*** collection is maintained in the field of 4 blocks covering an area of approximately 20 hectares. Each block is divided into plots holding 16 plants, established in a square planting design of 1.83 m x 1.83 m. Permanent shade is provided by ***Erythrina sp.*** and temporary shade by original 'old' cocoa trees and non-commercial banana plants.

The ***Artocarpus*** collection is maintained at the Field Station of the University. The food legume collections are held as seed.

## 2.7.5 CAPABILITIES ON THE CAMPUS

Financial constraints prevent the development of other collections beyond small holdings for teaching purposes. There are no proper facilities by way of seed storage rooms on the campus. The seed collection is thus maintained in cooled incubators, which limits the size of the collection.

There is a well run tissue culture laboratory on campus with capability for ***in-vitro*** germplasm storage.

## 2.7.6 FUTURE PLANS

The tissue culture laboratory possesses the capability to conserve germplasm in-vitro. A protocol for the propagation of Artocarpus has been developed in the laboratory and currently two varieties are held in culture.

With the development of protocols for ***in-vitro*** conservation more collections will be held in that form. The Cocoa Research Unit is making plans to have one of its members trained in the techniques of cryopreservation, with a view to establishing the method as a means of cocoa germplasm.

## 2.8 PLANT GENETIC RESOURCES

*S. A. Eberhart and L. E. Wiesner*
*USDA-ARS, USA*

### 2.8.1 INTRODUCTION

Many diverse plant species are available from the centuries of natural evolutionary processes, but relatively few have been domesticated to provide food, fibre, animal feed and industrial products for humankind. Very few of these domesticated crops are native to the United States: sunflower, pecan, strawberry, blueberry, cranberry, certain grasses and a few others. Due to this limited source of plant resources, farming systems in the U.S.A. were founded on plant genetic resources from other countries. Native North Americans had introduced maize, beans, squash and other crops from Central and South America. Early immigrants from Europe and Asia also brought the seeds for many crops with them. In 1819, American consuls overseas were asked to collect the seeds of useful plants. The U.S. Patent Commissioner administered the introduction of plants from 1836 to 1862.

The continuing need to acquire and introduce plant germplasm into the U.S. was one of the reasons for establishing the U.S. Department of Agriculture (USDA). The Organic Act of 1862, establishing the Department of Agriculture, directed the first Commissioner of Agriculture, Isaac Newton,

> *"to collect, as he may be able, new and valuable seeds and plants; to test, by cultivation, the value of such of them as may require such tests; to propagate such as may be worthy of propagation, and to distribute them among agriculturalists."*

In 1898, the Seed and Plant Introduction Section, which later became the Plant Introduction Office, was established to manage plant explorations and introductions.

The local landraces and weedy relatives of crops that have evolved by human and natural selection over the millennia have been rich sources of genetic resistance to new pathogens, insect pests, soil related stresses, and food quality. Before the late 1940's, introductions were sent directly to interested scientists without any requirements that they be maintained. Adequate preservation methodologies and facilities were not available then and, as a result, many accessions were lost.

### 2.8.2 THE NATIONAL PLANT GERMPLASM SYSTEM

The Research and Marketing Act of 1946 (Public Law 733) authorized the creation of four Regional Plant Introduction Stations (Ames, Iowa; Geneva, New York; Griffin, Georgia; Pullman, Washington) with the mission to acquire, maintain, evaluate and distribute germplasm to scientists to be used for crop improvement. The Inter-Regional Potato Introduction Station, Sturgeon Bay, Wisconsin, was established in 1947. Cold storage vaults were constructed at all locations to store seed at low temperatures and low humidity

(5°C and below 40% RH). The National Seed Storage Laboratory (NSSL), Fort Collins, Colorado was established in 1958 for long-term preservation of duplicate samples of this valuable germplasm. National Germplasm Clonal repositories were established in the mid-1980's to provide more systematic maintenance of local germplasm. The National Small Grains Collection, now in Aberdeen, Idaho, began in 1894 as a breeder's collection in Beltsville, Maryland.

These units have been integrated into a National Plant Germplasm System (NPGS). The NPGS is a network of cooperating institutions, agencies, and research units in the Federal, State, and private sectors (Seeds of Our Future, 1990). "The National Plant Germplasm System of the United States," in ***Plant Breeding Reviews*** (Janick, ed., 1989), gives a detailed description of NPGS. The mission of the NPGS is:

> ***"To effectively collect, document, preserve, evaluate, enhance, and distribute plant genetic resources for continued improvement in the quality and production of economic crops important to the U.S. and world agriculture. This is achieved through coordinated effort by the U.S. Department of Agriculture in cooperation with other public and private U.S. and international organisations. The NPGS's plant genetic resources are made freely available to all bona fide users for the benefit of humankind."***

The activities of the NPGS help to provide high-yielding cultivars to farmers; to improve the quality of agricultural and horticultural products; to minimize production costs; to reduce dependence on pesticides (thus enhancing the quality of the environment); and to minimize the vulnerability of agriculturally important germplasm to pests and environmental stresses.

Plant germplasm collections include old and current crop cultivars, elite breeding lines, landraces of crops that have emerged over millennia of selection by farmers, wild or weedy plants related to cultivated crops, and mutant genetic stocks maintained for research.

As new stress-tolerant and higher yielding varieties are developed and then grown by farmers in the centres of diversity for the various crops, the local landraces and weedy relatives with their rich sources of useful genes, may be lost forever unless they have been collected and preserved in gene banks.

This germplasm can be preserved ***ex-situ*** as:

- dried seeds stored at sub-zero temperatures in moisture-resistant containers;
- plants growing in a greenhouse, screenhouse or field plantings;
- ***in-vitro*** cultures of tissues;
- buds, pollen or other plant parts preserved at ultra-low temperatures.

In the National Plant Germplasm System the four regional Plant Introduction Stations, the National Clonal Germplasm Repositories, the Inter-Regional Potato Introduction Station, the National Small Grain Collection, specific crop collections, and the Woody Landscape Collection of their National Arboretum each functions, and is accepted, as a national plant germplasm repository even though some are partially supported by regional and inter-regional funds. The more than 415,000 accessions maintained in the NPGS active collections have been divided among these 19 repositories. Numbers of accessions for the larger collections are presented in Table 1.

**Table 1. National Plant Germplasm System Genetic Resources**

| Genus | Species | Crop | No. of Accessions |
|---|---|---|---|
| *Arachis* | *hypogaea* | PEANUT | 7,943 |
| *Avena* | *sativa* | OAT | 6,580 |
| *Avena* | *sterilis, etc.* | OAT RELATIVES | 13,419 |
| *Cajanus* | *cajan* | PIGEON-PEA | 4,156 |
| *Capsicum* | *annuum* | PEPPER | 2,313 |
| *Carthamus* | *tinctorius* | SAFFLOWER | 2,218 |
| *Cicer* | *arietinum* | CHICKPEA | 3,962 |
| *Cucumis* | *melo* | MELON | 3,374 |
| *Glycine* | *max* | SOYBEAN | 14,316 |
| *Gossypium* | *hirsutum* | COTTON | 4,746 |
| *Helianthus* | *annuus* | SUNFLOWER | 2,607 |
| *Hordeum* | *vulgare* | BARLEY | 28,612 |
| *Lens* | *culinaris* | LENTIL | 2,618 |
| *Linum* | *usitatissimum* | FLAX | 2,722 |
| *Lycopersicon* | *esculentum* | TOMATO | 8,601 |
| *Malus* | *domestica* | APPLE BUDS | 163 |
| *Medicago* | *sativa* | ALFALFA | 3,454 |
| *Oryza* | *sativa* | RICE | 18,213 |
| *Phaseolus* | *vulgaris* | BEAN | 10,448 |
| *Pisum* | *sativum* | PEAS | 3,590 |
| *Secale* | *cereale* | RYE | 2,618 |
| *Solanum* | *tuberosum* | POTATO | 5,486 |
| *Sorghum* | *bicolor* | SORGHUM | 34,480 |
| *Triticum* | *aestivum* | WHEAT | 34,391 |
| *Triticum* | *durum* | DURUM WHEAT | 6,831 |
| *Vigna* | *unguiculata* | COWPEA | 3,958 |
| *Zea* | *mays* | CORN | 28,376 |
| Others | | | 155,710 |
| TOTAL | | | 415,905 |

These repositories cooperate and participate in a coordinated national programme of acquiring and exchanging foreign and domestic plant germplasm potentially valuable for agricultural, horticultural, medicinal, industrial and environmental uses. The new acquisitions must be increased, characterized and preserved as part of the active collection. Each repository conducts a systematic evaluation program to obtain specific information on disease and insect resistance, nutritional quality, agronomic and physiological attributes and other traits of interest. Information on the collection and characterization (passport data) and evaluation data are entered in the Germplasm Resources Information Network (GRIN). Samples are distributed, on request, at no cost to scientists worldwide for use in crop improvement and basic research. Research relating to improved methods of collection, regeneration, propagation, preservation, evaluation and distribution is conducted, and the results are published.

The principal mission of NSSL is to preserve the base collection of the NPGS and conduct research to develop new and improved technologies for the preservation of seed and other plant propagules. The goal of NSSL is the long-term preservation of duplicate samples of all accessions maintained in active collections at national plant germplasm repositories.

As accessions propagated by seed are regenerated or increased at the repositories, seed samples are divided with one part staying in the local active collection and the other part deposited in the NSSL base collection. When seed samples are received at NSSL, they are dried, counted, tested for viability and placed in moisture-resistant containers in sub-zero cold vaults (-18°C) or stored above liquid nitrogen (-160°C) in cryotanks. Research by NSSL scientists and others has shown that the viability of seeds is greatly extended, perhaps for several decades or even centuries, when dry seeds are stored at sub-zero temperatures. However, samples are monitored periodically for viability, and sub-standard samples are regenerated at the appropriate repository.

Plant germplasm preservation research at NSSL focuses on the development of new and improved technologies for the long-term preservation of all forms of plant germplasm. This research is expected to increase:

- the number of species that can be stored at NSSL;
- the longevity of the various accession; and
- the efficiency of viability testing of accessions.

The longer storage periods and reduced number of field and/or greenhouse regeneration cycles will result in lower costs and greater genetic integrity of the germplasm. In addition, the basic research will add to our understanding of cryobiology and seed/cell aging through greater insights into the basic biological/biochemical processes in cells and their response to desiccation and low temperature stresses. Research scientists at NSSL work closely with all components of the NPGS.

The National Germplasm Resources Laboratory (NGRL), located at the Beltsville Agricultural Research Center (BARC), Beltsville, MD, is responsible for a number of activities that support the entire NPGS.

The Plant Introduction Office (PIO) coordinates the acquisition and exchange of plant germplasm; documents passport data and descriptive information for newly acquired material and assigns unique Plant Introduction (PI) numbers; publishes an annual USDA Plant Inventory of newly received accessions; and serves as a liaison on quarantine matters. Plant germplasm for the NPGS is acquired through exchanges, exploration (domestic and foreign), special projects and agreements, gifts, and travelers. In addition to introduced germplasm, all released plant materials (cultivars, germplasm releases, parental lines, and genetic stocks) that are registered by the Crop Science Society of America are assigned PI numbers and the seed is deposited in the appropriate active collection and with the NSSL by the originator.

The Plant Exploration Office (PEO) works with germplasm curators, Crop Advisory Committees (CAC), state universities and others to assess the genetic diversity of germplasm collections currently held by the NPGS and others as compared to total genetic diversity that may exist in nature. This assessment is used to develop long-range strategies for increasing the genetic diversity of U.S. collections. Based on these strategies, gaps in current germplasm collections are identified and communicated to the appropriate CAC or other crop specialists for their concurrence. Priorities for exploration are influenced by several factors such as the completeness of the U.S. collection, the need for specific traits of agricultural significance, the threat of immediate loss of old landraces and wild relatives in centers of diversity because of agricultural changes or urban development, and political factors affecting future availability of germplasm.

The Germplasm Resources Information Network (GRIN) is the official database for the NPGS and is currently maintained on a minicomputer in the National Agricultural Library at Beltsville, Maryland. The functions of the GRIN are to:

- act as a repository of all information for NPGS plant germplasm;
- unify the NPGS with regard to data standards and movement of germplasm;
- allow fast access to the most current data available to all users of the germplasm and its accompanying information;
- facilitate and track the distribution of germplasm; and
- provide to germplasm maintenance sites a system of inventory management that automatically signals the need for germplasm increases and/or replenishment.

Data in GRIN are available to any plant scientist or researcher worldwide, either through direct connection to the database or through contact with the curator for the active collection of interest. GRIN contains data on taxonomy, origin, evaluation and characterization for plant germplasm preserved in the NPGS. All movements and distributions of germplasm within the NPGS and foreign countries are recorded in GRIN.

All plant germplasm entering the NPGS from outside the U.S. must comply with federal quarantine regulations designed to facilitate the exchange of plant germplasm while limiting/preventing the movement of pathogens. Regulations are written, interpreted, and enforced by APHIS. Scientists cooperate to import plant germplasm free of pests. Accession of certain crops must be grown under quarantine at designated sites, including the ARS St. Croix research station and greenhouses at specified locations under APHIS inspection, before they can enter the NPGS active and base collections.

The NGRL facilitates the activities of the Crop Advisory Committees. The public and private scientists on these committees represent the germplasm user community for a particular crop or group of crops. These committees provide crop-specific expert guidance on germplasm needs, collection gaps, descriptors, documentation, regeneration, evaluation, and research goals to various components of the NPGS. Although the ARS components of the NPGS are administered by the Area Director for the geographic location of that component, the National Program Leader for Plant Germplasm on the National Program Staff provides leadership for the NPGS and coordinates activities. The National Program Leader for Plant Germplasm also provides administrative support to the various advisory boards and committees for plant genetic resources.

The NPGS has been described as a "user-driven system." Between 1986 and 1992, the NPGS distributed an average of 175,400 samples each year:

- U.S. public scientists (67%);
- U.S. private industry scientists (12%);
- foreign public scientists (9%);
- foreign private industry scientists (10%); and
- international centers and USAID (2%).

## 2.8.3 USE OF PLANT INTRODUCTIONS

Plant genetic resource conservation and utilization have been the foundation for improvement of agronomic, ornamental, and horticultural crops. During the Twentieth Century, U.S. research scientists have been using introduced plant genetic resources to develop new cultivars that are responsive to improved cultural practices, that have more desirable nutritional or fiber qualities and that have resistance to disease and insect pests and to environmental stresses. ***Use of Plant Introductions in Cultivar Development, Part 1 and Part 2*** (Shands and Wiesner, eds., 1991, 1992) documents some uses of this plant germplasm

for research. Plant introductions from the centers of diversity have been very important sources of disease and insect resistance. For example, 82% of wheat varieties released in the U.S. since 1975 were either developed in the U.S. with parents introduced after 1920, or were grown as direct introductions. Similarly, 75% of the 300 released sorghum inbred lines registered in *Crop Science* between 1960 and 1986, had some introduced germplasm in their pedigrees. Duncan et al. (1991) list ten sorghum accessions as sources of post-flowering drought tolerance and twenty-four accessions as sources of acid soil tolerance (Al toxicity).

When breeding populations are developed and improved by recurrent selection or when $F_2$ or backcross populations are used in the pedigree system, Eberhart, et al. (1991) emphasize that multi-stage selection has been very effective for the simultaneous improvement of multiple traits. In multi-stage selection, a large number of $S_0$ or $F_2$ plants are gown and selfed with mass selection from one or two highly heritable traits. Several hundred $S_1$ or $F_2$ lines can be screened for two or three traits involving stress tolerance (drought, Al toxicity, insects etc.), with replication at two or more locations if necessary. One plant in each selected family can be selfed and advanced to the next generation. The $S_2$ or $F_3$ families can be evaluated per se in replicated field trials or crossed to testers for the yield evaluations.

Increasingly the NPGS collections are being used for biotechnological research and development. Biotechnologists must have a reservoir of genes available to manipulate if they are to improve economically important crops. As biotechnology programs develop, plant genetic resource conservation becomes even more critical.

Not only have public and private plant breeders used introduced germplasm from the NPGS and other sources effectively to produce stress tolerant and high yielding varieties and hybrids, but farmers have also used these improved products to increase their yields and lower production costs so that the average U.S. family now spends less than 12% of its income for food.

### 2.8.4 CORE SUBSETS

The NPGS is developing a core subset of each major crop which would represent "with a minimum of repetitiveness, the genetic diversity of a crop species and its relatives" (Frankel, 1984). This core subset will provide scientists with a more representative and smaller sample for identifying sources of desired traits and will reduce operating costs of NPGS. Brown (1989) recommended stratified sampling methods in which germplasm accessions are grouped using data on geographical origins and genetic characteristics. CIMMYT is currently developing a core subset within each maize race with these procedures. Taba et al. (1992) have reported on the Tuxpeno race complex.

The core subset will be used for more extensive evaluation and characterization for each crop. The development of the core subset will be a dynamic process whereby new

accessions will be added and one of a pair of accessions that have been shown to be very similar can be dropped as more detailed information becomes available.

### 2.8.5 INTERNATIONAL COOPERATION AND COORDINATION

The need to preserve, exchange, and utilize plant genetic resources is now recognized worldwide. Even countries with great genetic diversity in certain crops are heavily dependent on many crops introduced from other areas. Because the U.S. has had to import almost all of its crop germplasm, the NPGS maintains a very comprehensive germplasm collection from around the world. The NPGS has been able to assist several countries recover germplasm of their key crops which had been lost for various reasons.

Many countries now have genetic resource preservation programs with an associated genebank. The NSGS maintains a close working relationship with many of these programs with a free exchange of germplasm with most countries.

The ten International Agricultural Research Centers (IARC) involved with crops (Table 2) are key institutions for the collection, preservation and distribution of many agronomically important crops. These centers are supported through the Consultative Group on International Agricultural Research (CGIAR) which includes foundations, development agencies of several countries, the World Bank, the United Nations Development Program, and the United Nations Food and Agriculture Organization (FAO). The International Plant Genetic Resource Institute (formerly the International Board for Plant Genetic Resources) assists in the coordination of plant genetic resource programs of the IARC's and more than 100 countries for the benefit of all humankind. The NPGS cooperates with these IARC's in the acquisition and preservation of plant genetic resources including the free exchange of information and plant materials.

**Table 2. Genetic Resources of IARC**

| Center (Host Country) | Species | Number of Accessions |
|---|---|---|
| **CIAT** (Colombia) | Common bean (*Phaseolus vulgaris*) | 35,950 |
| | Other beans (*Phaseolus spp.*) | 5,111 |
| | Cassava (*Manihot esculenta*) | 4,600 |
| | Cassava wild relatives (*Manihot spp.*) | 48 |
| | Forage legumes | 17,982 |
| | Forage grasses | 2,514 |
| **CIMMYT** (Mexico) | Maize (*Zea mays, Tripscum*) | 10,500 |
| | Cereals (*Triticum aestivum, T. durum, Triticale, Hordeum*) | 62,000 |
| **CIP** (Peru) | Potato (*Solanum tuberosum*) | 5,000 |
| | Potato wild relatives (*Solanum spp.*) | 1,500 |
| | Sweet potato (*Ipomea batatas*) | 5,200 |
| **ICARDA** (Syria) | Cereals (*Hordeum spp., Triticum spp., Triticale*) | 49,749 |
| | Food legumes (*Vicia, Lens, Cicer*) | 16,890 |
| | Forages | 19,952 |
| **ICRISAT** (India) | Sorghum (*Sorghum bicolor*) | 31,030 |
| | Pear millet (*Pennisetum glaucum*) | 6,610 |
| | Minor millets (*Pennisetum spp.*) | 19,796 |
| | Groundnut (*Arachis spp.*) | 12,160 |
| | Pigeon-pea (*Cajanus cajan*) | 11,040 |
| | Chickpea (*Cicer arietinum*) | 15,564 |
| **IITA** (Nigeria) | Cassava (*Manihot esculenta*) | 2,000 |
| | Plantain and banana (*Musa spp.*) | 250 |
| | Cowpea (*Vigna unguiculata*) | 15,100 |
| | Cowpea relatives (*Vigna spp.*) | 810 |
| | Rice (*Oryza spp.*) | 12,000 |
| | Soybean (*Glycine max*) | 1,500 |
| | Yam (*Dioscorea spp.*) | 1,000 |
| | Maize (*Zea mays*) | 500 |
| | Bombara groundnut (*Voandezia spp.*) | 2,000 |
| **ILCA** (Ethiopia) | Forage grasses | 1,524 |
| | Forage legumes | 6,443 |
| | Browse species | 1,429 |
| **IRRI** (Philippines) | Rice (*Oryza sativa*) | 78,420 |
| | African rice (*O. glaberrima*) | 2,408 |
| | Wild relatives (*Oryza spp.*) | 2,214 |
| | Other rices | 21 |
| **WARDA** (Ivory Coast) | Rice (African & Asian) | 5,600 |
| **AVRDC** (Taiwan) | Vegetables (tomato, mungbean, pepper, cabbage, amaranth, soybean, etc.) | 32,200 |

Source: Various CGIAR and IARC Reports

## 2.9 REGULATIONS ON STATUS OF IMPORTATION/EXPORTATION/DOMESTIC MOVEMENT OF PLANT MATERIAL FOR GENETIC PURPOSES

*D. Rivera*
*USDA/APHIS, Puerto Rico*

The regulations of the United States Department of Agriculture, the Animal and Plant Health Protection and Inspection Service, and the Plant Protection and Quarantine (USDA-APHIS-PPQ) concerning the status of importation, exportation, or the domestic movement of plant material intended for genetic purposes, apply in a similar way to the Continental U.S., the outside states of Hawaii and Alaska, Puerto Rico, the U.S. Virgin Islands, and other U.S. territories.

In addition to its own regulations, USDA enforces the regulations of other departments such as the U.S. Department of Interior Fish and Wildlife. Before elaborating on the particular regulations of the USDA, let me give you an overall vision of USDA's mission with regard to plant material intended for further growth or propagation.

It is very easy nowadays to move plant material for propagation from almost any part of the world to almost any other part. The use of tissue culture, spores propagation, etc. greatly facilitates this movement. Besides the risk of introducing undesirable plants, such as noxious weeds, many pests of great commercial significance could also be unwittingly introduced.

The mission of the USDA and, similarly, that of the agricultural departments or ministries of most countries, is not to interfere with international commerce or scientific or experimental work, but to regulate the movement of plant material in such a way that it prevents the introduction of undesirable plant species or significant pests or diseases.

The principal regulation of the USDA governing the introduction of plant material into the U.S. is Quarantine 319.37. This section of the regulations is currently being revised to evaluate the possibility of permitting the entry of some 50 additional plant species which are now prohibited. This quarantine applies to all plant material, including tissue cultures, spore growth, seeds, bulbs, corms, etc. It takes into consideration all other USDA and other department regulations in determining the entry status of plant material for propagation, such as:

**CITES** (Convention for International Trade in Endangered Species);

**ESA** (Endangered Species Act);

**T** = Threatened;

**E** = Endangered.

**I - 7CFR Part 340:** regulates the movement of genetic material. Recent changes have been introduced to allow inter-state movement of certain micro-organisms, such as certain strains of ***Escherichia coli, Bacillus subtilis***, and others.

There is a need to request a permit, through PPQ Form 1001, for all movement, both foreign and inter-state.

**II - CITES:** USDA is responsible, through its inspection stations, for regulating commerce in and movement of plants subjected to these regulations:

| | | |
|---|---|---|
| **CITES I** | - | in danger of extinction; |
| **CITES II** | - | threatened species; |
| **CITES III** | - | post-entry. |

A major distinction is whether the plant, or plant part, proceeds from the wild or from cultivated premises.

A recent change allows the importation of CITES II plant material, without foreign documents, in personal baggage or as part of a household shipment. However, since it is the bearer who has the burden of proving that such material proceeds from cultivated origin and not from the wild, it is more practical to have some form of documentation.

All plant material entering into the United States for propagation purposes , or any material that has propagative capacity and may be so used, must be referred to an inspection station operated by USDA-APHIS-PPQ. The station in San Juan, Puerto Rico, serves both Puerto Rico and the U.S. Virgin Islands for material intended for these destinations or entering the U.S. through them. Their contact address is:

USDA-APHIS-PPQ,
Inspection Station,
P.O.Box 37521,
Airport Station,
San Juan, PR 00937-0521.

**III - Post-Entry:** Applies to certain plant material that needs an observation period in the field before being given final release for establishment.

**IV - Departmental Permits:** Issued by the Permit Section in Washington.

**V - Export Certification:** PPQ 577, 579.

## 2.10 ACTIVITIES OF IPGRI IN LATIN AMERICA AND THE CARIBBEAN

*K. A. Okada*
*IPGRI, Colombia*

IBPGR was formally established in June 1974 and has operated with the support of and under the legal and administrative umbrella of the Food and Agriculture Organization of the United Nations (FAO).

The International Plant Genetic Resources Institute (IPGRI), the legal successor of IBPGR, was formally established in October 1991; it became operational in January 1994, after the Italian Government ratified both, the IPGRI Establishment Agreement and the Headquarters Agreement.

The Establishment Agreement was also signed by the following countries: Belgium, Bolivia, Cameroon, Chile, China, Cyprus, Costa Rica, Denmark, Ecuador, Egypt, Greece, Hungry, India, Iran, Italy, Jordan, Kenya, Pakistan, Panama, Peru, Poland, Portugal, Rumania, Russia, Senegal, Syria, Switzerland, Turkey, Ukraine, and Uganda, for a total of 30 countries.

IPGRI was created in response to the evolving needs of our partners, mainly national programmes, and IBPGR's own new demands as a complex institution of global responsibilities in the conservation of plant genetic resources (PGR).

The emphasis in the 1970's and 1980's in the conservation of plant genetic resources was reflected in IBPGR's programme which stressed collecting and conservation activities.

At the end of the Twentieth Century and into the beginning of the next, IPGRI will emphasize the links between conservation and the use of PGR for development, the increasing importance of biotechnology and the key role of international cooperation in addressing biodiversity and PGR issues.

The new IPGRI's strategy, "Diversity for Development" is set forth in four basic objectives:

1. To assist countries, particularly developing nations, to assess and meet their needs for conservation of PGR, and to strengthen links to users. IPGRI will pay particular attention to those countries that lack the capacity to develop a fully effective system themselves, to assist them to assess their own needs for PGR conservation, exchange and use.

2. To build international collaboration in the conservation and use of PGR. IPGRI will encourage and support the formation of networks, both on a crop and on an eco-geographical basis. Networking efforts will concentrate on those plants of key importance to regional agriculture or forestry. IPGRI will cooperate closely with national programmes, CG's centres, NGO's private organisations and FAO's Commission on Plant Genetic Resources.

3. To develop and promote improved strategies and technologies for PGR, and integrated methods of conservation. Retention of diversity in collections, conservation technology and plant health are major topics. Work on wild relatives of crops and of forest genetic resources will involve research into *in-situ* conservation. Taking into account the human dimension of PGR, conservation and use, IPGRI will initiate research for conserving traditional knowledge on plant uses and local practices for conserving PGR and generating new variability.

4. To provide an information service to inform the world's genetic resources community of both practical and scientific developments in the field. An active public awareness programme will target donors, policy makers both in donor and partner countries, and hose that influence them.

Partnership is the keynote of IPGRI's strategy, and the changes in organisation are specifically made to enable IPGRI to work more closely and effectively with its partners.

To achieve its goals, IPGRI will consolidate its structure in five Regional Groups and three Thematic Groups (Fig. 1). The Thematic Groups are all based at IPGRI HQs in Rome. They comprise the following groups:

i) The Genetic Diversity (GD) Group

ii) The Germplasm Management and Use (GMU) Group

iii) The Documentation, Information and Training (DIT) Group.

The Regional Groups include:

i) The regional office for Asia, the Pacific and Oceania (APO) based at Singapore

ii) The regional office for Sub-Saharan Africa (SSA) based at Nairobi, Kenya

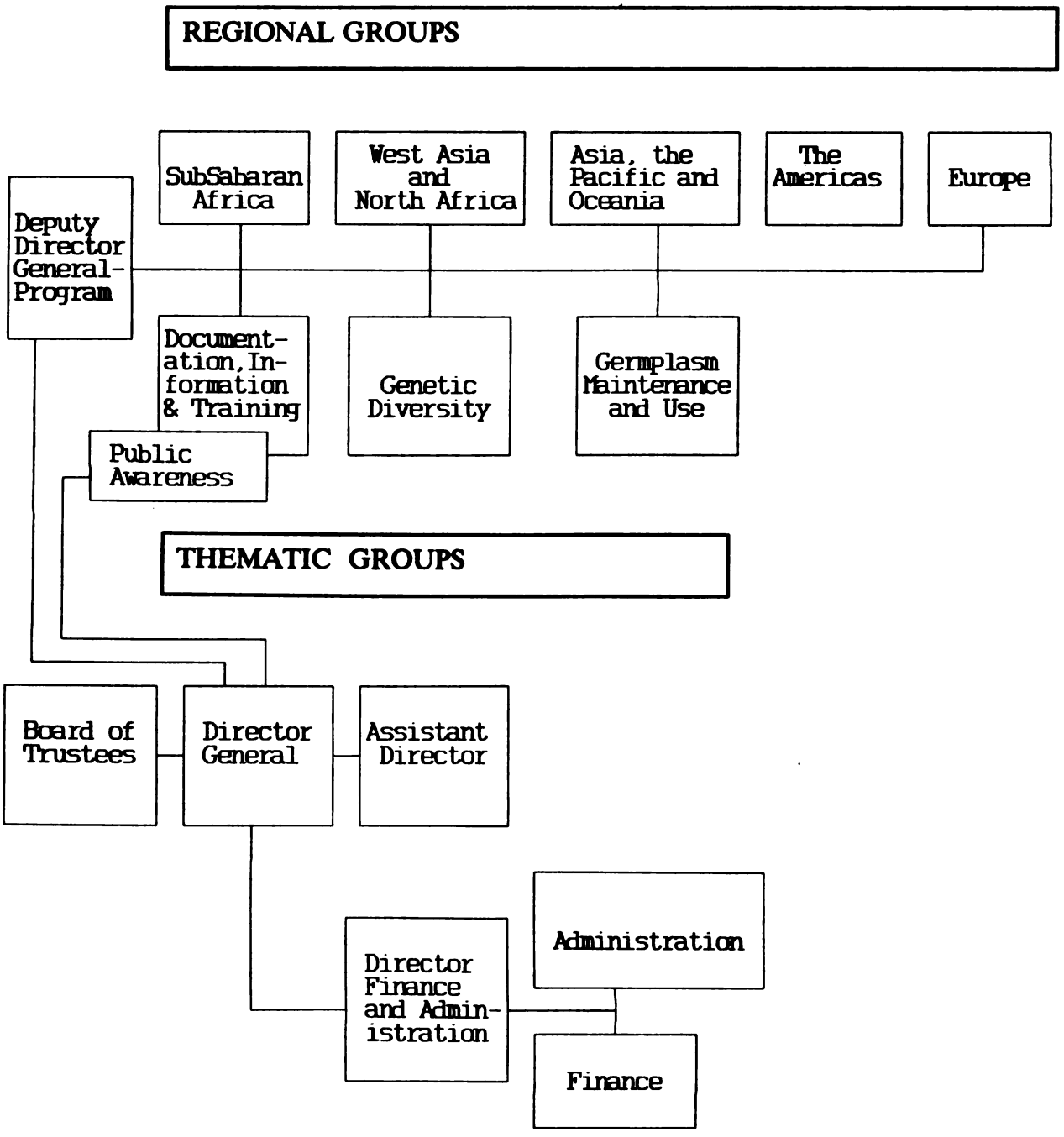
iii) The regional office for West Asia, North Africa (WANA) based at Aleppo, Syria

iv) The regional office for Europe based in Rome, Italy

v) The regional office for the Americas based at Cali, Colombia.

The regional office for the Americas is located in one of the richest regions in terms of biodiversity. Out of the planet's 265,000 plant species, 90,000 (34%) occur in Latin America. Of these, at least 45,000 species are found in three Andean countries - Colombia, Ecuador and Peru - which makes the northern Andean region a cornucopia of plant diversity.

**Figure 1. Organization of IPGRI**



The region contains two major centres of origin and diversity of crop plants. Firstly, the Central American and the Caribbean region, and secondly the Andean region. In addition to these two major centres, the region contains three minor ones, namely, the North American Centre for ***Helianthus*** (sunflower), the Southern Chilean Centre and the Brazilian-Paraguay Centre.

This trove of biodiversity has produced several crops of world importance such as maize, potato, and tomato to name just a few.

The Americas office has responsibilities in PGR activities in Latin America (12 countries in South America; 8 countries in Central America), the Caribbean region (14 countries) as well as the development of linkages between these two regions with North American institutions.

Fortunately, most Latin American countries are now aware of the importance of PGR to attain a sustainable agricultural development.

Nine countries have already established national programmes on PGR, namely, Argentina, Brazil, Chile, Colombia, Ecuador, Mexico, Peru, Uruguay, and Venezuela, and four Central American countries (Costa Rica, Honduras, Panama, and Nicaragua) have created national commissions on PGR.

To develop its strategy, the Americas office takes into account the following factors:

- IPGRI's objectives.
- The needs of national programmes.
- The possibility of interacting with other regional/international public institutions.
- The possibility of interacting with NGO's and private companies.
- The current socio-economic environment in the region.
- What IPGRI can realistically offer.

The Americas strategy is driven by two key problems facing most national programmes of the region. The first refers to the fact that most gene pools of native crops and their wild relatives are seriously affected by accelerated rates of genetic erosion which place them on the brink of extinction. How to conserve these dwindling resources for the benefit of worldwide agriculture before they are irretrievably lost for future generations?

The second problem concerns the more complex issue of developing native germplasm into new production options. Good conservation of germplasm is only the first step of the process of using PGR to increase and diversify agricultural outputs and to improve farmers' income, especially in developing countries. How can PGR be used for the development of a sustainable agriculture in Latin America and the Caribbean?

To address these problems, the Americas group has put forward a network approach entailing some specific advantages as an instrument for:

- Including all genetic diversity relevant to agriculture and forestry of a region sharing similar biological, ecological and socio-economic features.
- Encouraging national programmes to team up to achieve common goals.
- Helping national programmes to achieve consensus on crop priorities.
- Using more effective and efficient human, physical and financial resources available in the region for PGR activities and for achieving an economy of scale with negotiating clout.
- Coordinating activities with other regional PGR or utilization networks.
- Drawing political/institutional support for PGR activities in the region.

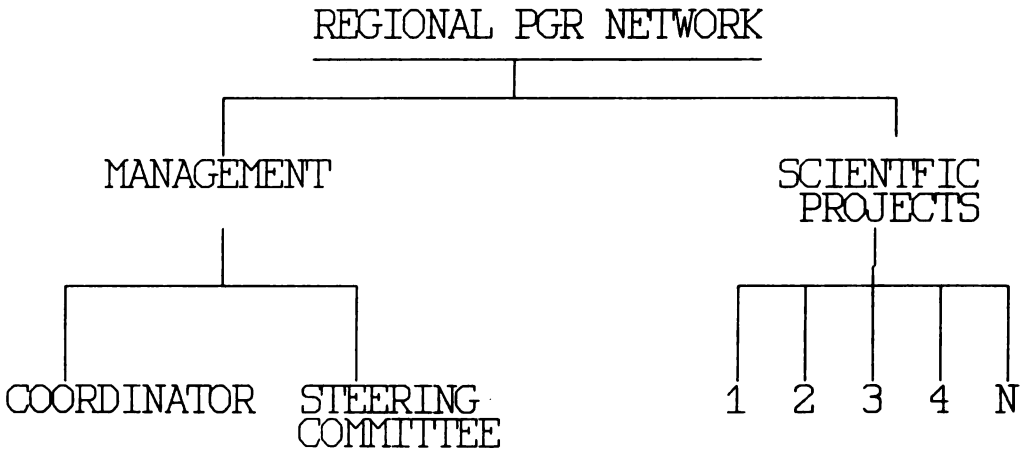
An IPGRI's regional network usually includes two components; the management of the network and its technical/scientific projects (Fig. 2). In the framework of a regional network approach, the regional office of the Americas provides services for:

- Technical and scientific support to NARS in:
  - Formulating and implementing PGR programmes.
  - Integrating their PGR programmes into regional networks.
- Assistance to PGR networks in:
  - Formulating project proposals according to agreed priorities and submitting them to international donors.
  - Monitoring the state of PGR in the region and assessing the threat of genetic erosion of important native gene pools.
- Organisation of scientific, training and public awareness activities with regional and international institutions.
- Development of a regional PGR documentation centre.

In a joint action with IICA and with the participation of sister international centres, CATIE and FAO, the regional office has helped set up three regional networks, namely, the Mesoamerican Network on PGR (REMERFI) covering Central America (Belize, Costa Rica, El Salvador, Guatemala, Honduras, Mexico and Nicaragua); the Andean Network on PGR (REDARFIT) including Bolivia, Colombia, Ecuador, Peru and Venezuela and the Amazonian Network on PGR (TROPIGEN) to cover Bolivia, Brazil, Colombia, Ecuador, Guyana, Peru, Surinam and Venezuela.

In the Southern Cone, IICA's PROCISUR has set up a regional PGR programme including Argentina, Bolivia, Brazil, Chile, Paraguay and Uruguay in which IPGRI has been invited to participate.

**Figure 2. Structure of Regional PGR Network**




In the Caribbean region a group of participants (including IPGRI) who attended the workshop on Germplasm Resource Management and Biotechnology, convened at the 29th Annual Meeting of the Caribbean Food Crops Society, 4-10 July, 1993. Fort-de-France, Martinique, agreed on the establishment of the Caribbean Committee on Management of Plant Genetic Resources (CMPGR) which might be considered the embryo of a future Caribbean network on PGR.

As to specific projects for the networks, we have so far considered the following:

**1. Conservation and Use of Native Genetic Resources in Tropical America**

A. Fruit species

- ***Sapotaceae*** of Central America (REMERFI) (funded by IDB)
- ***Passifloras*** of the Andean region (REDARFIT) (funded by IDB)
- "Characterization and Evaluation of the Amazonian Germplasm Collection of ***Bactris gasipaes***." Prepared by Dr.C.Clements, to be submitted to the ECC on behalf of TROPIGEN.

B. Vegetable species

- ***Cucurbitaceae***
- ***Capsicum***

C. Forest and Agro-Forestry species

**2. Conservation and Use of Plant Genetic Resources in Mesoamerica.**

## 2.11 REVIEW OF GTZ SUPPORT PROGRAMME

*J. Carls*
*GTZ, Costa Rica*

### 2.11.1 INTRODUCTION

Against a background of worldwide changing conditions and requirements, GTZ has also realized that technologies cannot simply be transferred to other countries. In the pioneer years the focus was on setting up model farms, industrial plants and training institutes - measured and carried out with German standards. The projects were very often "foreign bodies" in their environment, and today only ruins remain. These projects were not "sustainable", neither economically, socially nor ecologically!

A new understanding of projects and programmes emerged at GTZ and elsewhere. It was realized that a project can only be successful in the long-run, if the people it is intended to assist, feel responsible for it. That means a sustained impact can only be expected from development cooperation from something which fits into the particular scenario and thus has a chance of survival.

Today GTZ is undertaking more than 2,000 projects in more than 120 countries. During 1992, GTZ has assured the planning and execution of projects with a total expenditure of 1,460 million Deutsch Marks.

Today, safe water, fertile soil and fresh air to breath are becoming increasingly rare. Problems of climatic change, deforestation, and erosion of genetic resources are becoming more pronounced. Poor countries are worst hit, and the exploitation of natural resources is accelerated by the steadily increasing poverty.

UNCED once again demonstrated, both to those affected by environmental degradation and those responsible for it, the close inter-relationship between development and ecology. The Rio Conference endorsed the concept of supporting development processes by measures to reduce poverty and conserve natural resources.

Therefore, GTZ increasingly supports projects in the field of environmental protection and natural resources. In the Dominican Republic, for example, the following projects are supported (see Table 1).

**Table 1. Natural Resource Projects Supported by GTZ in the Dominican Republic**

| Project | Name | Duration | Source of Funding |
|---|---|---|---|
| INDESUR | Rational Management of Dry Forests | 1986-1985 | 2,850,000 DM |
| OCOA | Regional Development in Rural Areas in OCOA | 1989-1994 | 7,500,000 DM |
| PROPESCAR SUR | Promotion of Artesinal Coastal Fisheries in Barahona and Pedernales | 1987-1995 | 10,200,000 DM |
| ISA | Strengthening of the Department of Forest Resources Through the Superior Institute of Agriculture, ISA | 1993-1996 | 1,790,380 DM |

Over the next three years one billion DM will be made available for development - policy measures in connection with Agenda 21.

### 2.11.2 CONVENIO IICA - GTZ

The idea of the "IICA - GTZ Project on Sustainable Development" was born in 1990. The project was initiated with a mutual cooperation agreement between IICA and GTZ. IICA with its international reputation and hemispherical mandate has, among others, the big advantage that cooperation can take place directly with his member states. The main objective of the project is:

> ***The strengthening of IICA's institutional and operational cooperation capacity with respect to the management of natural resources and sustainable agricultural development.***

During the first phase the project was working in five large areas:

i) Development of a conceptual framework.

ii) Institution building.

iii) Training of counterparts.

iv) Development of information and communication systems.

v) Identification and formulation of projects.

## 2.11.3 BMZ/GTZ SUPPORTED PROGRAMMES IN RESEARCH AND APPLICATION OF BIOTECHNOLOGY AND MANAGEMENT OF PLANT GENETIC RESOURCES

### 2.11.3.1 General Criteria for Technical Cooperation

The often emotional discussion on the contribution biotechnology can make toward solving problems in partner countries, in most cases, supposes that the so-called "new" or "future" technologies are not adaptable and cannot be integrated into the production systems. This argument ignores the fact that modern biotechnologies below the level of genetic engineering offer very good opportunities for solutions to two of the most pressing problems, we are faced with:

i) To increase food production.

ii) To conserve natural resources.

The techniques to be introduced must be capable of smooth integration with the existing methods being used as well as with the existing structure in breeding and plant production. First preference must be given to the introduction of uncomplicated rather than advanced techniques like "Genetic Engineering, Gene Transfer and DNA-Technology".

Upon the introduction of plant biotechnological methods within Technical Cooperation Programmes, the advantage to the end-user is crucial. Institutional and organizational structures are needed to assure equitable, as well as economically and socially desirable procedures particularly for small farmers.

A realistic socio-economic assessment which takes the private sector into account is imperative in this regard. Possible repercussions on the regional bio-diversity and the suitable conditions for its safeguarding should be examined within the framework of an environmental impact study.

For immediate use in Technical Cooperation there is a broad spectrum of appropriate techniques available below the level of gene transfer, such as:

- Microbial inoculation of plants, which involves the selection and multiplication of the most effective plant-beneficial microorganisms, such as ***Rhizobium*** inoculants, ***Mycorrhizae*** inoculants, and biological control agents based on microbial inoculants.

- ***In-vitro*** culture for the purpose of:
  - clonal multiplication from plant tissue;
  - production of virus-free planting material through micropropagation;
  - ***in-vitro*** conservation of germplasm, etc.

- Pathogen diagnostic technology for the development and production of monoclonal antibody and polyclonal antisera probes for reliable testing of plant bacteria, fungi and viruses.

## 2.11.4 PROGRAMMES/PROJECTS SUPPORTED BY BMZ/GTZ

The main programmes which are being supported in the framework of cooperation between BMZ/GTZ and partner countries as well as international institutions, are the following:

### 2.11.4.1 Bilateral Programmes (Table 2)

**Table 2. Bilateral Projects Supported by BMZ/GTZ - Working Areas**

| Country | Gene Bank | Seed Multiplication | Reforest-ation | Fruit Trees | Food Legumes | Coconut Product | Potato Propagation |
|---|---|---|---|---|---|---|---|
| TANZANIA | | | | | | X | |
| ETHIOPIA | X | | | | | | |
| KENYA | X | | | | | | |
| ALGERIA | | | | X | | | |
| MOROCCO | | | | | | | X |
| BHUTAN | | X | | | | | |
| PAKISTAN | | | | | | | X |
| PHILIPPINES | | | | X | | | |
| CHINA | | | X | | | | |
| PARAGUAY | | | | | X | | |
| COSTA RICA | X | | | | | | |

i) **Gene banks, Ethiopia, Kenya and Costa Rica**

Working areas:

- Conservation of genetic resources with the help of *in-vitro* techniques for plant species without seeds, or whose seeds are not preservable.
- Diagnosis of diseases and their elimination.
- Identification of agronomically valuable genes and their localization through genome markers.
- Improvement of methods for long-term conservation.
- Development of strategies for a safe and efficient distribution and utilization of germplasm for breeding.

Crops:

The gene banks work with a broad range of plant species, of both annual and permanent food and industrial crops.

ii) **Support of the seed sector Bhutan:**

Working areas:

- ELISA tests for selection of virus and pathogen free crops and forestry species.
- ***In-vitro*** cultivation of apical meristems for the elimination of viruses.
- Rapid propagation techniques, including tissue culture procedures.

Crops:

Sweet potatoes, ginger, bananas, asparagus, strawberry and fruit trees (Citrus, apples, cherries, and pears).

iii) **Reforestation with fast growing trees, China:**

Working areas:

- ***In-vitro*** tissue culture.
- Development of methods for the propagation of trees, which currently lack regeneration procedures from cells of tissues.

Crops:

A broad selection of fast growing local and imported trees.

iv) **Propagation of potatoes, Morocco and Pakistan:**

Working areas:

- ELISA tests for elimination of viruses and pathogens.
- Fast propagation.
- Production of microtubers.

v) **Breeding of fruit trees and wine grapes, Algeria:**

Working areas:

- ELISA tests for elimination of viruses and pathogens.
- ***In-vitro*** culture of apical meristems for elimination of viruses.
- Thermotherapy for elimination of viruses.
- Optimization of methods for ***in-vitro*** culture of local and imported fruit trees.

Crops:

Citrus, apples, pears, peaches, table wine grapes.

vi) **Central Chaco Agronomic Research Station, Paraguay:**

Working areas:

- Selection of efficient ***Rhizobia*** strains for inoculation of legumes.
- Production of selected ***Rhizobia*** strains.

Crops:

Food legumes

vii) **Promotion of fruit production in the Philippines:**

Working areas:

- Development of ***in-vitro*** culture methods.
- Micropropagation.

Crops:

Fruit trees, nuts.

viii) **Support of coconut production, Tanzania:**

Working areas:

- Embryo cultivation with the help of *in-vitro* techniques.
- *In-vitro* conservation.

Crops:

Coconuts

In conclusion, the BMZ/GTZ bilateral support policy has, as a priority, the application of technologies already known in partner countries. The activities range from traditional biotechnologies to the application of modern cellular and molecular biology procedures for diagnostics and *in-vitro* techniques. Preferential support is given to:

- Diagnostics for the identification of virus and disease-free seeds, and fruit tree propagation materials.
- *In-vitro* clonal micropropagation of selected disease-free material.
- *In-vitro* conservation of species propagating vegetatively, with the goal of better using available germplasm and satisfying quarantine requirements in the international exchange of material.
- Development of methods for the *in-vitro* tissue culture of plant varieties, which still cannot be regenerated from cells or tissues.

## 2.12.5 SUPPORT OF INTERNATIONAL AGRICULTURAL RESEARCH CENTRES

**Table 3. Support of International Agricultural Research Centres (Crops)**

| Institutes | Phaseolus Beans | Chick Peas | Rye | Sweet Potato | Andean Root Crops | Vegetables | Rice |
|---|---|---|---|---|---|---|---|
| CIAT | X | | | | | | |
| ICARDA | | X | X | | | | |
| CIP | | | | X | X | | |
| AVRDC | | | | | | X | |
| IRRI | | | | | | | X |

i) ***In-vitro* regeneration of *Phaseolus* beans at CIAT (concluded)**

The goal was to develop an efficient and reproducible system for the regeneration of plants from cells or tissues to speed breeding programs.

ii) **Improvement of cold tolerance of *Phaseolus* beans, CIAT**

The research goal is the development ot transgenic cold tolerant ***Phaseolus*** beans.

iii) **Finger printing of "kichererbsen", ICARDA**

The research goal is the identification of resistance against ***Ascochyta*** with the use of molecular biology methods.

iv) **DNA markers for rye breeding, ICARDA**

The research goals are the identification of resistance genes against rye diseases and their marking in the genome for plant breeding.

v) **Somatic cell fusion in sweet potatoes, CIP**

The goal is the development of a method for the fusion of protoplasts, with the purpose of combining genetic properties of two unrelated species that cannot normally be crossed.

vi) **Collection, conservation and use of agriculturally non-exploited root plants of the Andean Highlands, CIP**

The goal is to collect agronomically valuable seeds from wild species for breeding of potatoes, sweet potatoes, yams and other root crops. To do this, wild materials are collected and preserved and then genetically analyzed. Molecular biology procedures are also used to introduce these genes into crops.

vii) **Identification and characterization of viral diseases of vegetables (AVRDC)**

The exact definition of viral disease in vegetable crops is a requirement for the development of diagnostic techniques and the preparation of the necessary areas.

viii) **Asian Rice Biotechnology Network, IRRI**

The goal of this initiative is the development of know-how and methods at the national research centers in IRRI's area of mandate.

The emphasis of the support policy of BMZ in relationship to the international agricultural research centres is in the development of biotechnological procedures for the improvement of food crops. There is an emphasis on species which are of little international economic importance and which therefore are of little interest for the private sector. Typical representatives of this group are root crops and food legumes.

## 2.11.6 SUPPORT MEASURES OF SUPRA-REGIONAL CHARACTER

### 2.11.6.1 Support to the International Service for the Acquisition of Agri-biotech Applications (ISAAA)

The central purpose of ISAAA is the transfer of patent protected biotechnological procedures and products, specially from the private sector of industrial countries to partner countries. The intermediary function also includes support to the build-up of national research infrastructures for the development and use of biotechnological procedures and products.

### 2.11.6.2 Supra-regional Project "Development and testing of new plant breeding procedures"

The central purpose of this initiative is the conception of infrastructural, organizational and legal conditions for the testing and use of biotechnological procedures within technical cooperation projects and in relevant institutions in partner countries.

## 2.12.7 CONCLUSION AND PERSPECTIVES

There are various possibilities to support agricultural sustainability through management of plant genetic resources in the Caribbean:

- Bilateral Projects.
- International Agricultural Centres.
- Measures of Supra-Regional Character.

### 2.11.7.1 Bilateral or Regional Projects

The process starts with an idea developed by the partner country, either a government or regional institution working in the area. The German Embassy will be contacted and the request forwarded to the Ministry for Economic Cooperation (BMZ). The BMZ then commissions the GTZ to examine and finally carry out the project. Location specific proposals below genetic transformation have high priorities to be supported.

The success of such requests depends decisively on whether a realistic cost/benefit analysis can be made, the necessary infrastructure (specialist personnel, electricity supply, the supply of spare parts, etc.) can be guaranteed and whether co-operation with the private sector can be ascertained at the planning stage of the project.

### 2.11.7.2 Regional Support via an International Agricultural Centre

This type of cooperation in the area of ***in-vitro*** conservation and mass production of vegetatively propagated root crops have high priority to be supported on a regional basis.

### 2.11.7.3 Measures of Supra-Regional Character

GTZ supports regional or supra-regional concepts which offer the possibility of strengthening the existing national research and development structures, so that they can adapt and utilize the new techniques efficiently and purposefully in the developmental process. This way appears to be cost efficient and more appropriate as compared with interventions in rural development projects.

## 2.12 POTENTIAL FOR A LATIN AMERICA AND CARIBBEAN NETWORK APPROACH IN PHYTOGENETIC RESOURCES

*M. N. Alvarez*
*CATIE, Costa Rica*

The nature of the mission of the Caribbean Committee for Management of Plant Genetic Resources, requires it to maintain an inter-institutional, inter-disciplinary approach to deal with the diversity of germplasm collection, maintenance and exchange of information. A viable scientific and technical network will enable it to respond to emergency problems and new demands and challenges with appropriate action. At a time when there is increased competition for funding, the multi-disciplinary/institutional approach on a bi-regional level will be helpful in attracting support. The committee could be catalytic in bringing the plight and needs of phytogenetic resources to the attention of policy makers and donors.

### 2.12.1 INTRODUCTION

Over the last decade, fruit crops have slowly been gaining attention as viable crops for export. However, this is based on a narrow germplasm base. The lack of adequate data and the limited capacity of many national programmes to collect and preserve their tropical fruits germplasm have been catalytical in emphasizing the need to review the state of the plant genetic resource in the Caribbean.

Despite the visible decline of the germplasm base and the potential role of fruit crops in foreign exchange earning and nutrition, the resource allocation for their long-term conservation and improvement is minimal. It is in dealing with this limitation that CMPGR was formed.

CATIE has expressed an interest in participating with CMPGR in its initiative to collect, preserve and increase the utilization of tropical fruit production as a factor for improving farmers' income earnings. The centre has a collection of so-called "minor tropical fruits" such as sapota, sapodilla, and others (see Table 1) on which a regional research network has been initiated. Since a regional mandate has been given to CATIE for the conservation of these tropical species some immediate benefits could be realized by the committee.

### 2.12.2 GENETIC RESOURCES

Tropical fruit crop development in the Caribbean could be limited by its narrow genetic base in available species and cultivars. CATIE could, therefore, be instrumental in introducing germplasm for a programme of evaluation, selection and multiplication. The

unique climatic niche in the several Caribbean islands will make it necessary for each major area of agro-ecology to undertake its own evaluation.

Based on the limited ability of many countries to handle plant genetic resources, their introduction and testing would need to be dealt with by the Ministries of Agriculture. Special precautions will have to be taken to ensure that pests and diseases are not introduced.

Duplication of the germplasm resource and sharing of long-term storage space for regional interest, would also be an option for ensuring the security of valuable germplasm.

### 2.12.3 RESEARCH

With the increasing demand for tropical fruits, an opportunity exists for increasing the level of production. However, the necessary research to backstop the envisaged expansion is still in its infancy or non-existent in some countries. It will, therefore, be necessary for CMPGR to play a catalyzing role to encourage governments to promote fruit crops in their development policies.

Development or selection of new fruit varieties to meet competitive market standards will need trained staff if the production of the expected fruit industry is to be met. The diversity of tropical fruit species in the region has great potential which could be realized if more investment were made in that sector. Small-scale farmers will need to be provided with selected material, knowledge about inputs and production practices.

### 2.12.4 OPERATIONAL STRATEGY

The research operational strategy should use a network/team work approach. the committee could coordinate national collaborating scientists, regional scientists/projects and institutions with a common interest. Several steps have already been taken toward this strategy:

- This meeting has identified and grouped some fruit crops development constraints.
- A team approach is being used to group, prioritize and formulate solutions.
- Clear cut, specific objectives will need to be formulated and shared among the collaborators based on their relative capacities.

In the area of germplasm improvement, evaluation, preservation and manpower development, CATIE could play a lead role in the execution of the network's strategy, in close collaboration with IPGRI.

Some suggested areas that could be addressed within a network's framework that would be of interest to CATIE are:

- Characterizing and defining varieties of priority fruits in the Caribbean and Latin America.

- Optimizing use of existing long-term storage space in collaboration with UWI and other institutions.

- Standardization of propagation techniques using biotechnology.

- In-service and post-graduate degree training in plant phytogenetic resource and production systems.

- Exchange of research information and improved planting materials.

CATIE believes that this committee will be an important body to keep in action a regional mechanism for cooperation between interested Caribbean countries and institutions with equivalent interest groups in Latin America. However, it will be important that the full cooperation of the national scientists of the collaborating countries be guaranteed. This interest will be necessary in order to maintain and reinforce more personal attention to genetic diversity from people who will play an active role in the network in maintaining this treasure.

**Table 1. Tropical Fruits at CATIE with Potential for the Caribbean**

| Common Name | Botanical Name | Family |
|---|---|---|
| Soursop (guanabana) | *Annona muricata* | *Anonaceae* |
| Mangosteen | *Garcinia mangostana* | *Gutiferae* |
| Pejibaye | *Bactris gasipaes* | *Palmae* |
| Jackfruit | *Artocarpus heteropyllus* | *Moracea* |
| Carambola | *Averrhoa carambola* | *Oxalidacea* |
| Uvilla | *Pouroma cecropiaefolia* | *Moracea* |
| Caimo | *Pouteria caimito* | *Sapotacea* |
| Araza | *Eugenia stipitata* | *Myrtacea* |
| Chicozapote | *Manilkara sapota* | *Sapotacea* |
| Zapote | *Pouteria sapota* | *Sapotacea* |
| Caimito | *Chrysophyllum cainito* | *Sapotacea* |
| Guayaba | *Psidium guayaba* | *Myrtacea* |
| Canistel | *Pouteria campechiana* | *Sapotacea* |
| Jaboticaba | *Myrciaria cauliflora* | *Myrtacea* |
| Zunza | *Lycania platyphus* | *Rosacea* |
| Nance | *Byrsonima crassifolia* | *Malpigiacea* |
| Biriba | *Rollinia mucosa* | *Anonacea* |
| Cas | *Psidium friedrischtalianum* | *Myrtacea* |
| Pitanga | *Eugenia uniflora* | *Myrtacea* |
| Zapote negro | *Diospyros digyna* | *Ebenacea* |
| Ciruela del gobernador | *Flacourtia indica* | *Flacurtiacea* |
| Quetembille | *Dovyalis hebecarpa* | *Flacurtiacea* |

## 2.13 FAO ACTIVITIES ON PLANT GENETIC RESOURCES, CONSERVATION AND USE IN THE CARIBBEAN REGION

*K. L. Tao, K. Ringlund and N. Anishetty*
*FAO, Italy*

### 2.13.1 INTRODUCTION

Plant genetic resources are the basis for all agricultural plant production. Improvement in production potential, quality characteristics, resistance to diseases and pests, and adaptation to climatic and edaphic stresses are all based on existing genetic variability. Through crop improvement programs new genotypes are produced, and, hence, the genetic variability is increased for further developments.

In the Caribbean Region, the plant genetic resources (PGR) are rich in diversity, due to the isolation of the island ecosystems. However, there is little or no genebank storage facility in this region to conserve plant genetic resources. There is also little or no germplasm information or exchange of species and variety performance among the Caribbean countries, except for sugarcane, banana and a few other crops. Consequently, efforts are duplicated in the same crop varieties and species.

A linkage between good quality seed production and the access to germplasm is important for the utilization of plant genetic resources. The production of good quality seed is limited in the Caribbean Region. Properly trained personnel at all levels is a major constraint in seed and germplasm activities.

As background for further discussion on the subject of plant genetic resources (PGR), I would like to describe some of the international activities on PGR conservation and use. The major activities on plant genetic resources for food and agriculture (PGRFA) are the responsibilities of the FAO. In addition the Convention on Biodiversity, developed at UNCED in Rio in 1992 and entering into force on 29th December this year, gives important guidelines for activities in this area.

### 2.13.2 THE COMMISSION ON PLANT GENETIC RESOURCES

The Commission on Plant Genetic Resources was established by the FAO Conference in 1983, and a total of 120 countries are now members of this subsidiary of the FAO. The Commission meets every two years to discuss matters related to Plant Genetic Resources, and makes recommendations to the FAO Director General on actions to be taken in this area. The Commission has established a Working Group which meets at more frequent intervals, and prepares documentation for the Commission through the Secretariat.

## 2.13.3 THE INTERNATIONAL UNDERTAKING ON PLANT GENETIC RESOURCES

One of the major documents for the conservation of PGRFA, is the "International Undertaking on Plant Genetic Resources" adopted by the FAO Conference in 1983. The Undertaking is now being revised to include three amendments added by the FAO Conference since 1983, and to harmonize the text with the Biodiversity Convention. In Article One of the original Undertaking it was stated that:

> ***"The objective of the Undertaking is to ensure that plant genetic resources of economic or social interest, particularly for agriculture, will be explored, preserved, evaluated and made available for plant breeding and scientific purposes. This Undertaking is based on the universally accepted principle that plant genetic resources are the common heritage of mankind and consequently should be available without restrictions."***

The Undertaking covers both cultivated, obsolete and primitive cultivars as well as wild and weedy relatives to cultivated plants and special genetic stocks from plant breeding and research programmes. The governments adhering to the Undertaking, which today represent a total of 109 countries, agree to collect, conserve and to support evaluation and documentation of genetic resources. The Undertaking makes specific mention of international cooperation in order to strengthen the capabilities, particularly of the developing countries, in plant survey and identification, plant breeding, and seed multiplication and distribution with the aim of enabling all countries to make full use of plant genetic resources for the benefit of their agricultural development.

The Undertaking also describes a range of international arrangements to facilitate the flow of germplasm for increased utilization for food and agriculture, arrangements for firm financial security for PGR activities, provisions for the FAO to monitor the international situation concerning PGR and arrangements for appropriate phytosanitary measures to prevent the introduction and spread of plant pests.

### 2.13.3.1 Amendments to the Undertaking

In resolution 4/89 the FAO Conference added an "Agreed Interpretation of the International Undertaking". Still recognizing that PGR are the "common heritage of mankind", the Conference agreed that Plant Breeders Rights, as provided for under UPOV, are not incompatible with the International Undertaking. States adhering to the Undertaking also recognized the enormous contribution that farmers of all regions have made to the conservation and development of PGR, and that this constitutes the basis for plant production throughout the world, and also the basis for the concept of Farmer's Rights. It was further understood that "free access" does not mean free of charge

In resolution 5/89 on Farmers' Rights the FAO Conference endorsed the concept of Farmers' Rights in order to:

- ensure that the need for conservation is globally recognized and that sufficient funds for these purposes will be available;

- assist farmers and farming communities, in all regions of the world, but especially in the areas of origin/diversity of plant genetic resources, in the protection and conservation of their plant genetic resources, and of the natural biosphere;

- allow farmers, their communities, and countries in all regions, to participate fully in the benefits derived, at present and in the future, from the improved use of plant genetic resources, through plant breeding and other scientific methods.

Finally, in resolution 3/91 the FAO Conference recognizes that the concept of common heritage of mankind, as applied in the International Undertaking is subject to the sovereignty of nations over their plant genetic germplasm, and endorses that:

1. Nations have sovereign rights over their plant genetic resources.

2. Breeders lines and farmers' breeding material should only be available at the discretion of their developers during the period of development.

3. Farmers' Rights will be implemented through an international fund on plant genetic resources which will support plant genetic conservation and utilization programs, particularly, but not exclusively, in developing countries.

4. The effective conservation and sustainable utilization of plant genetic resources is a pressing and permanent need, and therefore the resources for the international fund as well as for other funding mechanisms should be substantial, sustainable and based on the principle of equity and transparency.

5. Through the Commission on Plant Genetic Resources, the donors of genetic resources, funds and technology will determine and oversee the policies, programmes and priorities of the international fund and other funding mechanisms, with the advice of the appropriate bodies.

The revision of the Undertaking is going to be a step by step process implemented by the Commission on PGR and its Working Group. The first meeting of the Working Group for this purpose will be held in April 1994.

## 2.13.4 NETWORK OF *EX-SITU* BASE COLLECTIONS

The International Undertaking refers to an international network of base collections under the auspices or jurisdiction of the FAO. Agreements between national governments and the FAO concerning such a network have been prepared by the FAO's legal office in cooperation with the Plant Production and Protection Division. At present more than 30 countries have responded positively to joining the network. The aim is to facilitate access to germplasm for scientific and technological use. IBPGR's register of base collections will be merged with the FAO's network, and the International Agricultural Research Centres have offered to place their germplasm collections under the auspices of the FAO. Basic agreements of different types have been prepared and sent to the interested countries and institutions.

### 2.13.4.1 Duplicate Storage

Duplicate safety storage has been developed for orthodox seed. The long term storage of vegetative material is more costly, but it is important for safety reasons to store the same germplasm in different collections.

## 2.13.5 NETWORK FOR *IN-SITU* AND ON-FARM AREAS

The International undertaking stresses the complementarity of *ex-situ* and *in-situ* conservation. The Third Session of the Commission on PGR agreed that *in-situ* conservation must be based on the efforts of local communities, non-governmental organizations and national institutions working within an international framework. *In-situ* conservation is particularly interesting for forest species, fruit trees and wild relatives of crop species.

## 2.13.6 CODE OF CONDUCT FOR COLLECTION AND TRANSFER

A Code of Conduct for Collection and Transfer of plant germplasm was adopted by the FAO Conference in 1993. The code is voluntary and the purpose of the code is to provide broad guidelines for plant germplasm collection and transfer to facilitate rational conservation and use of plant genetic resources.

## 2.13.7 WORLD INFORMATION AND EARLY WARNING SYSTEM

The establishment of a World Information and Early Warning System for PGR is provided for in Article 7.1 of the International Undertaking on PGR. An Early Warning System is being developed to draw rapid attention to hazards threatening the operation of genebanks holding base collections, and to the danger of extinction of plant species and the

loss of genetic diversity throughout the world. The Seed Information System, which forms the base for information on crops, has been integrated into the World Information and Early Warning System to form the new Plant Genetic Information and Exchange Unit.

A major objective of this system is to provide detailed information on which to base the "State of the World's Plant Genetic Resources" report. The primary function will be to provide facts and figures on conservation and utilization of PGR. Information is being solicited from different countries through a questionnaire developed by FAO/IBPGR. More than 80 countries have provided information on their national programs on collections and on utilization of genetic resources as well as analyses of national needs and priorities. The Information System is intended to be a dynamic, constantly updated database of databases.

The Warning System's main function will be to continuously monitor key elements of genetic resource conservation in order to alert of any threats. Warnings will be directed to the decision-making bodies when needed.

### 2.13.8 GENEBANK STANDARDS

Based on the conclusion of an Expert Consultation Group, the FAO and IBPGR jointly recommended a set of technical standards for genebank operations within the international network. These standards were endorsed by the Commission on PGR in 1993. Again, these standards are most important for orthodox seed collections. The standards define different types of collections, set standards for seed storage including environment, seed moisture and seed cleaning and health. They further discuss requirements for seed containers, storage conditions for base- and active collections, accession size, viability monitoring, regeneration and required information on samples in base collections. The Standards also have a chapter on exchange and distribution of seeds from active collections.

### 2.13.9 THE FOURTH INTERNATIONAL TECHNICAL CONFERENCE AND PROGRAMME FOR PGR

The Fourth Session of the Commission on PGR in 1991 asked the FAO to prepare the first report on the "State of the World on PGR" and the first "Global Plan of Action" through the preparatory process of the Fourth International Technical Conference on PGR (ICPGR). At the present time a Phase I of this project is funded and will cover a country driven process to assess the situation of plant genetic resources for food and agriculture and to formulate national and sub-regional action plans for *ex-situ* and *in-situ* conservation and utilization of these resources. The assessment reports and action plans should identify problems, set priorities and provide programmes to develop and strengthen institutional capacity building including human resource development. These reports and plans will be the major inputs to a State of the World Report and the first Global Plan of Action.

## 2.13.10 ISSUES UNDER DISCUSSION

Over the ten year period that the Commission on Plant Genetic Resources has existed, there has been an important shift in some of the major ideas governing PGR conservation and use. There has been a shift in priorities from collection and conservation to sustainable utilization. From strong emphasis on the idea of plant genetic resources being the common heritage of man, there has been a development through the acceptance of Plant Breeders' Rights and Farmers' Rights to emphasis on national sovereignty over these resources. The questions of monetary value of plant genetic resources and the sharing of benefits from these resources have received much attention during the later meetings of the Commission.

There is an ongoing discussion on many of these issues, and there are still many concepts that need further clarification. Many germplasm collections are international in the sense that they have been collected under the concept of global access. Since all countries depend on genetic resources from many areas of the world for their food and agricultural production, it is important that these international collections remain available to the global community. The benefits for the producers, are to have access to the best material for their own production, but the conservation of genetic diversity is also essential for further development of improved plant material.

## 2.13.11 FAO ACTIVITIES IN THE CARIBBEAN REGION

FAO provides supports to the Caribbean Region through different mechanisms, including:

- Regular Programme
- Technical Cooperation Programme (TCP)
- Trust Fund Projects
- UNDP Projects

The funds available from the Regular Programme for PGR are rather limited. Projects with a budget higher than US$15,000 are usually supported through the TCP, UNDP and Trust Fund. Some example projects are:

### 2.13.11.1 TCP Projects

i) **Conservation of Tropical PGR - Saint Vincent Botanical Garden:**

This project provided assistance in developing a botanical garden collection

and accession policy, germplasm data base, expansion of nursery facilities and staff development and training.

ii) **In-vitro Conservation of Sugarcane Germplasms in Cuba:**

This project is very successful. Following the National Training Workshop, visits of an FAO consultant and the overseas training, the Cuban scientists have developed, second only to France, the cryopreservation technology for long-term conservation of sugarcane germplasms in Cuba.

iii) **In-vitro Conservation of Vegetable, Root and Tuber Germplasms in Tuber:**

This project is similar to the sugarcane project and it was initiated at the beginning of 1994.

2.13.11.2 Trust Fund Project

i) **Improved Seed Production: CARICOM Countries and Suriname:**

This project is financially supported by Italy and will be completed in 1994, it involved 14 member countries and its objectives are to:

- Develop a regional training programme.
- Establish an information network on available germplasms and variety trials.
- Propose uniform seed standards.
- Support specific programme in selected countries.

## 2.14 GERMPLASM RESOURCE MANAGEMENT

*T. W. Zimmerman*
*UVI, St. Croix*

### 2.14.1 INTRODUCTION

Both the UVI Agricultural Experiment Station on St. Croix and the UVI Science Division on St. Thomas are active in Germplasm resource Management and Biotechnology. The UVI Agricultural Experiment Station on St. Croix has working collections of *Musaceae* (9), Papaya (21), Forage legumes (33) and Forage Grasses (43). The calcereous soils and semi-arid climate has put strong selection pressures on the germplasm that can be grown and maintained on St. Croix.

### 2.14.2 THE BIOTECHNOLOGY PROGRAMME

In late 1993, the biotechnology laboratory of the University of the Virgin Islands Agricultural Experiment Station on St. Croix was established and became functional under the guidance of Dr. Thomas W. Zimmerman. The goal of the biotechnology programme is to use genetic engineering to improve plant production in the Caribbean by inserting specific genes for characteristics to impart disease resistance or increase drought tolerance. The biotechnology laboratory has been certified by the United States Department of Agriculture, Animal and Plant Health Inspection Service to conduct plant-related recombinant DNA research.

The biotechnology lab is equipped for plant transformation work via *Agrobacterium tumefaciens* or electroporation. The lab maintains three wild type strains and four disarmed strains of *Agrobacterium tumefaciens* which are used for gene transfer into plants. Pollen electrotransformation is being evaluated for its use in genetic transformation of tropical fruit trees and ornamental plants.

The biotechnology lab also has the ability to carry out recombinant DNA research, grow and transform bacteria, isolate and purify vector plasmids, develop transgenic plants and assay for gene insertion. For plant cell culture research, the laboratory facilities contain all the equipment necessary for media preparation and includes a temperature controlled tissue culture growth room with 100 square feet of lighted shelves.

Papaya, breadfruit, hibiscus, bougainvillea and petunia are the subjects of current projects in progress. Papaya, *Carica papaya*, regeneration and genetic transformation systems are being developed for the locally grown papaya varieties. Papaya ringspot virus (PRV) is a scourge to papaya production in the Caribbean. There is ongoing research to isolate the gene for the coat protein from the Caribbean strain of PRV and genetically engineer papaya varieties with this gene to "immunize" them against the virus.

A project with breadfruit, ***Artocarpus altilis***, involves using plant cell culture techniques to regenerate plants from immature floral organs and plant tissues. Hibiscus and bougainvillea micro-propagation and regeneration systems are being developed to facilitate bio-engineering cultivars with a dwarfing gene to increase water use efficiency. Petunia is use as a model system to test plasmid constructs for their expression in a plant.

### 2.14.3 THE TROPICAL FRUITS PROGRAMME

The major aim of the fruits programme is to evaluate varieties of ***Musacea***, avocado and papaya for disease resistance and tolerance to the local conditions. Limited numbers of non-traditional tropical fruits are also being evaluated.

### 2.14.4 THE AGRONOMY PROGRAMME

Agronomic research involves screening forage legume and grass germplasms for production and nutritional quality. The development of management techniques for this germplasm that promote dry matter production, enhance forage quality and improve local pastures by integrating nitrogen-fixing legumes with high yielding grasses is in progress. In addition, grazing trials determine the animal carrying capacity of native and well maintained pasture lands.

### 2.14.5 THE BIOLOGY PROGRAMME

Dr. Robert Wyatt, of the UVI Science Division on St. Thomas, is involved with isolating lectin genes from tropical legume species. The goal is to isolate novel lectin genes that can be used as tools in the diagnosis and treatment of cancer.

# ANNEXES

# ANNEX I

## CONSTITUTION OF THE CARIBBEAN COMMITTEE FOR MANAGEMENT OF PLANT GENETIC RESOURCES (CMPGR)

### 1.0 BACKGROUND

On July 6th, 1993, during the 29th Annual Meeting of the Caribbean Food Crops Society (CFCS) in Fort-de-France, Martinique, a group of eighteen participants in a **Workshop on Germplasm Resource Management and Biotechnology** (as listed below), agreed to establish the Caribbean Committee for Management of Plant Genetic Resources (CMPGR). They represented seven major centers or institutes operating in the Caribbean, with responsibilities for agricultural research, technology development, technology transfer, and graduate and post-graduate education. The group also included representatives from two international organizations involved in technical cooperation and one private concern.

The nine founding member institutions comprised:

- The Caribbean Agricultural Research and Development Institute (CARDI)
- The Center of International Cooperation in Agronomic Research for Development (CIRAD)
- The International Board for Plant Genetic Resources (IBPGR)
- The Inter-American Institute for Cooperation on Agriculture (IICA)
- The National Institute for Agronomic Research (INRA)
- The University of Puerto Rico at Mayaguez (UPR)
- The Tropical Agricultural Research Station - Mayaguez (TARS) of the United States Department of Agriculture (USDA)
- The University of the Virgin Islands (UVI)
- The University of the West Indies (UWI)

The retired professional who represented the private concern was included as founding individual member.

### 2.0.2 ORGANIZATION

2.1 Institutional membership is offered at two levels: Core and Support. Core membership is reserved to resident institutions directly engaged in research and training in the management of plant genetic resources.

2.2 Initially, CMPGR's Steering Team comprised one institutional representative from each of the following five institutions:

| | |
|---|---|
| CARDI | USDA |
| CIRAD | UWI |
| INRA | |

2.3 Representatives on the Committee will elect among themselves a Chairperson and Vice-Chairperson, whose term of office is one year. The Chairperson and Vice-Chairperson may be re-elected for subsequent one-year periods.

2.4 IICA will provide Executive Secretariat support to CMPGR.

2.5 The Chairperson may invite to CMPGR's meetings resource professionals from relevant institutions, organizations, agencies or other concerns in both the public and private sectors.

## 3.0 MISSION, SPECIFIC OBJECTIVE, AND FUNCTIONS

3.1 CMPGR's mission is to support agricultural sustainability through proper and responsible management of plant genetic resources in the Caribbean.

3.2 CMPGR's specific objective is to assist Caribbean Institutions in increasing technical capabilities for better use and preservation of plant genetic resources through regional joint action and support of the international community of concerned institutions or agencies.

3.3 CMPGR's basic functions encompass:

- Identifying priority areas for undertaking joint regional actions to improve plant genetic resources management.
- Facilitating intra-regional and international exchange of information and materials.
- Instilling awareness about property rights and preservation needs concerning national plant genetic resources.

## 4.0 OPERATIONS

4.1 The Committee will hold an annual meeting preferably within the framework of the Annual Meeting of the CFCS. It may hold ad-hoc meetings if deemed warranted.

4.2 The Chairperson of the Steering Team will present an Annual Report, during a session of the corresponding Annual Meeting of CFCS.

4.3 The Committee will limit its scope of action to the Caribbean countries covered by the mandate of the institutions comprising its membership.

4.4 The Committee must take into consideration relevant programmes, projects or activities being undertaken or proposed by other parties.

4.5 It will use CFCS as a channel to disseminate information of interest on plant genetic resource management in the Caribbean.

4.6 The Committee will prepare and implement an Annual Plan of Operation (APO).

## 5.0 FUNDING

5.1 Core financial resources in cash or kind needed to implement CMPGR's APO will come from:

- Resources already available at the participating institutions, and
- resources that can be accessed from regional, bilateral or international organizations.

5.2 Additional resources may be obtained through specific projects prepared by the Committee and funded through grants or other means.

## ANNEX 1 - continued

## PARTICIPANTS IN THE WORKSHOP ON GENETIC RESOURCES AND BIOTECHNOLOGY (9TH JULY 1993)

XXIXth Annual Meeting of the Caribbean Food Crops Society
Fort-de-France, Martinique (4-10th July 1993).

1. A. M. Pinchinat (IICA, Saint Lucia), Chairman
2. L. Degras (INRA, Guadeloupe) Rapporteur
3. S. L. Sharrock (CARDI, Barbados)
4. C. Langlais (CIRAD Martinique)
5. J. Servant (CIRAD, Martinique)
6. D. Debouck (IBPGR, CIAT)
7. K. Okada (IBPGR, CIAT)
8. G. Anais (INRA, Guadeloupe)
9. R. Arnolin (INRA, Guadeloupe
10. E. Ambrose (IICA, Saint Lucia)
11. G. Barbeau (IICA, Trinidad & Tobago)
12. G. E. Villanueva (IICA, Saint Lucia)
13. R. Montalvo-Zapata (UPR, Rio Piedras)
14. A. Sotomayor-Rios (USDA/TARS, Mayaguez)
15. T. Zimmerman (UVI, St Croix)
16. L. E. Chinnery (UWI, Barbados)
17. G. Sirju-Charran (UWI, Trinidad & Tobago)
18. F. W. Martin (Retired)

# ANNEX II

## CARIBBEAN COMMITTEE FOR MANAGEMENT OF PLANT GENETIC RESOURCES

## FIRST PROGRAMMING MEETING
## March 20-24, 1994, MAYAGUEZ, PUERTO RICO

### *PROGRAMME*

**Sunday, March 20th**

| | |
|---|---|
| 1800-2000 | **Welcome of Guests** |
| | A. Sotomayor-Rios<br>F. Vazques |

**Monday, March 21st**

| | |
|---|---|
| 0830-0845 | **Opening Session** |
| | A. Sotomayor-Rios (Chair) |
| | **Remarks** |
| | Prof. Pablo Rodriquez, Acting Chancellor, UPR, Mayaguez Campus |
| | L. E. Wiesner, Research Leader, National Seed Storage Laboratory, Fort Collins, Colorado |
| | A. M. Pinchinat, CMPGR, Executive Secretary (CES) |
| | Hon Neftali Soto, Secretary of Agriculture, Puerto Rico |
| | **Review of CMPGR Institution's Programmes** |
| 0845-0900 | CARDI, H. Adams |
| 0900-0915 | CIRAD/FLHOR, P. Cao-Van |
| 0915-0930 | INRA, G. Anais |
| 0930-0945 | TARS, A. Sotomayor-Rios |
| 0945-1000 | UWI, E. J. Duncan |

**Monday, March 21st**

| | |
|---|---|
| 1000-1015 | **Coffee Break** |
| | **Review of Institutional Support Programmes, R. Ayala** |
| 1015-1035 | USDA-ARS, L. E. Wiesner |
| 1035-1055 | USDA-APHIS, D. Rivera |
| 1055-1115 | IPGRI, K. Okada |
| 1115-1135 | GTZ, J. Carls |
| 1135-1205 | CATIE, Team - E. Alarcon/M. Alvarez |
| 1205-1220 | FAO, Kar-ling Tao |
| 1220-1235 | Discussions and Synthesis, A. M. Pinchinat |
| 1235-1400 | **Lunch** |
| 1400-1445 | **Election of CMPGR Chairperson and Vice Chairperson, CES (Chair/Rapporteur)** |
| 1400-1415 | Chairperson<br>Short-listing of two candidates<br>Secret balloting |
| 1415-1430 | Vice-Chairperson<br>- CARDI<br>- USDA/TARS<br>Short-listing of two candidates (one of which is runner-up in previous balloting)<br>Secret balloting |
| 1430-1445 | Short Acceptance Speeches |
| | Chairperson, Elected CMPGR Chairperson (CCP) |
| | Vice-Chairperson, Elected Vice-Chairperson (VCP) |
| 1445-1530 | **CMPGR 1994 Action Programming, CCP (Chair)** |
| | Action Agenda<br>Programming |

**ANNEX II (continued)**

**Monday, March 21st**

| | |
|---|---|
| 1530-1700 | **Visit to University of Puerto Rico, Mayaguez Campus, R. Ayala** |
| | Authorities<br>Facilities |
| **Tuesday, March 22nd** | |
| 0830-1230 | **1994 Plan of Operation, CCP (Chair)** |
| | Short-term Actions |
| 1000-1015 | **Coffee Break** |
| | Projects |
| 1230-1400 | **Lunch** |
| 1400-1545 | **1994 Plan of Operation, CCP (Chair)**<br>Projects (continue) |
| | UVI - T. W. Zimmerman |
| | Agenda of CMPGR's First Annual Meeting (within the 30th Annual Meeting of CFCS, St Thomas, USVI) |
| | UPR - R. Ayala |
| | **Closing, A. Sotomayor-Rios, (Chair)** |
| 1545-1555 | Remarks by IICA, E. Alarcon |
| 1555-1610 | Address by CMPGR Chairperson, CCP |
| 1610-1615 | Closing words, L. E. Wiesner<br>Conclusion - CCP (Chairman) |

**ANNEX II (continued)**

**Wednesday, March 23rd**

| | |
|---|---|
| 0730-1400 | **Field Trip, A. Sotomayor-Rios** |
| 0730 | Departure from Mayaguez |
| 0800-1200 | Site Visits |
| 1200-1400 | **Courtesy Lunch** |
| 1400-1600 | Return to Mayaguez |

**Thursday, March 24th**

| | |
|---|---|
| 0700-2000 | **Departure of Participants A. Sotomayor-Rios** |

# ANNEX III

## LIST OF PARTICIPANTS


Mr. Herman Adams
CARDI
44, Brickdam
Stawbroek
Georgetown
Guyana
Tel: 592 2 67826/51492
Fax: 592 2 63175

Dr. Enrique Alarcon
Specialist
Technology Generation & Transfer
IICA Headquarters
Carretera a Coronado
2200, Coronado
San Jose
Costa Rica
Tel: 506 229 2728
Fax: 506 229 4741/292659

Dr. Marikis N. Alvarez
Head, Tropical Crops Area
CATIE
7170, Turrialba
Costa Rica
Tel: 506 56 02 32
Fax: 506 56 15 23

Dr. Guy Anais
President INRA Antilles Guyane
Institut National de la Recherche Agronomique (INRA)
B.P.1232, 97185 Pointe a Pitre Cedex
Guadeloupe
Tel: 590 25 59 45
Fax: 590 94 11 72

Dr. Alejandro Ayala
Assoc. Dean of Faculty
College of Agricultural Sciences
University of Puerto Rico
Mayaguez Campus
P.O.Box 5000, Mayaguez
Puerto Rico 00681
Tel: (809) 834 3045
Fax: (809) 265 0220

Dr. Jurgen Carls
Project Coordinator IICA-GTZ
Inter-American Institute for Cooperation on Agriculture (IICA)
Carretera a Coronado
2200 Coronado
San Jose, Costa Rica
Tel: 506 229 3691
Fax: 506 229 1620

Dr. Phillipe Cao-Van
CIRAD
P.O.Box 427, 97202
Fort de France
Martinique
Tel: 596 51 17 05
Fax: 506 51 45 67

Mr. Phillippe J. Cujo
Regional Delegate for Cooperation
to the Caribbean
c/o French Embassy
Santo Domingo
Dominican Republic
Tel: (809) 685 0840/8432
(809) 682 3019
Fax: (809) 221 8408

Dr. E. Julian Duncan
Professor of Plant Science
The University of the West Indies
St. Augustine
Trinidad & Tobago
Tel: (809) 662 4996
Fax: (809) 645 7132

Mr. Rafael Perez Duverge
Investigations Supervisor
Agricultural Development Foundation (FDA)
c/o IICA Office in the Dominican Republic
Apartado 711
Santo Domingo
Dominican Republic
Tel: 1 (809) 533 7522/2797
Fax: 1 (809) 532 5312

## ANNEX III (continued)

Dr. Katsuo A. Okada
Regional Director
International Plant Genetic Resources
Institute (IPGRI)
Apdo Aereo 6713
Cali
Colombia
Tel: 57 23 675050
Fax: 57 23 647243

Dr. R. Pietri-Oms
University of Puerto Rico
P.O.Box 5000
Mayaguez
Puerto Rico 00681 5000
Tel: 1 809 833 2865
Fax: 1 809 265 0220

Dr. Antonio M. Pinchinat
Regional Specialist
Technology Generation & Transfer
IICA Office in Saint Lucia
P.O.Box 1223
Castries
Saint Lucia
Tel: (809) 451 6760/1
Fax: (809) 451 6774

Dr. D. Rivera
USDA/APHIS
P.O.Box 70, Mayaguez
Puerto Rico 00681-0070
Tel: (809) 831 3435
Fax: (809) 832 1025

Prof. Pablo Rodriguez
Acting Chancellor
University of Puerto Rico
Mayaguez Campus
Mayaguez
Puerto Rico 00681-5000
Tel: (809) 833 2865
Fax: (809) 265 0220

Hon Neftali Soto
Secretary
Department of Agriculture
P.O.Box 10163
Santurce
Puerto Rico 00908
Tel: (809) 721 2120

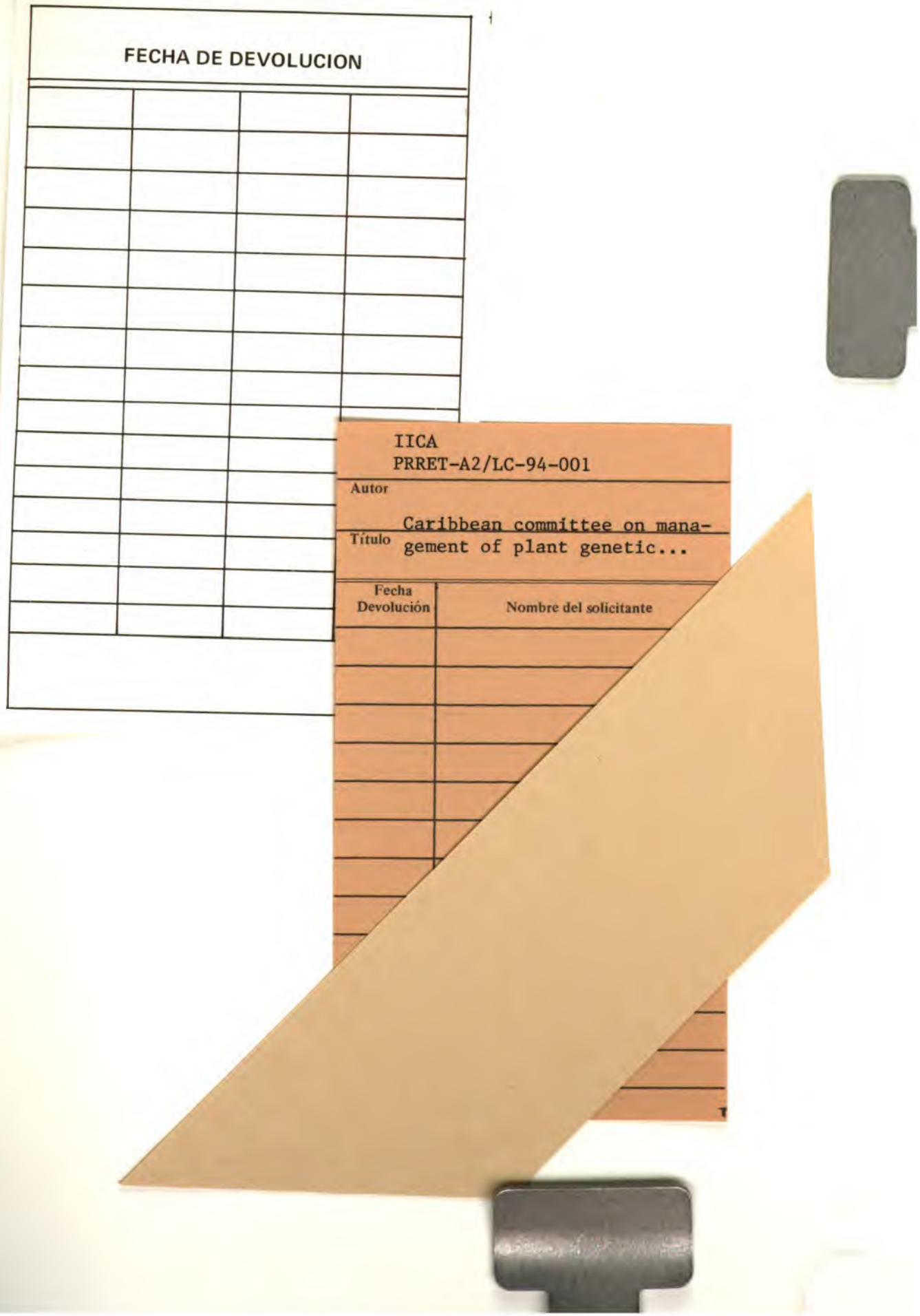
Dr. Antonio Sotomayor-Rios
Research Leader
Tropical Agricultural Research Station
P.O.Box 70
Mayaguez
Puerto Rico 00681-0070
Tel: (809) 831 3435
Fax: (809) 832 1025

Dr. Kar-ling Tao
Agricultural Officer
Food and Agriculture Organization
of the United States (FAO)
Viale delle Terme di Caracalla
00100 Rome
Italy
Tel: (39 6) 52255347
Fax: (39 6) 52256347

Dr. Francisco Vasquez
Tropical Agricultural Research Station
P.O.Box 70
Mayaguez
Puerto Rico 00681-0070
Tel: (809) 831 3435
Fax: (809) 832 1025

Dr. Loren E. Wiesner
Research Leader
National Seed Storage Laboratory
USDA/ARS/NPA
Fort Collins
Colorado
USA
Fax: 1 303 221 1427

Dr. Thomas W. Zimmerman
Biotechnologist
University of the Virgin Islands
Agricultural Experiment Station
RR2 Box 10000
Kingshill
St. Croix, USVI - 00850
Tel: (809) 778 1043
Fax: (809) 778 5636


FECHA DE DEVOLUCION
IICA
PRRET-A2/LC-94-001
Autor
Título
Caribbean committee on mana-
gement of plant genetic...
Fecha Devolución
Nombre del solicitante

INTER-AMERICAN INSTITUTE FOR COOPERATION ON AGRICULTURE
IICA Office in Saint Lucia, P.O. Box 1223, Castries, Saint Lucia
Tel: (809) 451-6760/61/63 Fax: (809) 451-6774