

i

PN-AAQ 687

AGPG: IBPGR/84/18  
June 1984

1211 35981

INTERNATIONAL BOARD FOR PLANT GENETIC RESOURCES

INSTITUTES CONSERVING CROP GERMLASM:  
THE IBPGR GLOBAL NETWORK OF GENE BANKS

by

J. Hanson, J.T. Williams and R. Freund

IBPGR Secretariat  
Rome, 1984

11

The International Board for Plant Genetic Resources (IBPGR) is an autonomous international scientific organization under the aegis of the Consultative Group on International Agricultural Research (CGIAR). The IBPGR was established by the CGIAR in 1974 and its Executive Secretariat is provided by the Food and Agricultural Organization of the United Nations. The basic function of the IBPGR is to promote and coordinate an international network of genetic resources centres to further the collection, conservation, documentation, evaluation and use of plant germplasm and thereby contribute to raising the standard of living and welfare of people throughout the world. The Consultative Group mobilizes financial support from its members to meet the budgetary requirements of the Board.

IBPGR Executive Secretariat  
Crop Genetic Resources Centre  
Plant Production and Protection Division  
Food and Agriculture Organization of the United Nations  
Via delle Terme di Caracalla, 00100 Rome, Italy

© International Board for Plant Genetic Resources, 1984

CONTENTS

|  | <u>Page</u> |
|--|-------------|
| INTRODUCTION                                 | 1           |
| BASE AND ACTIVE COLLECTIONS                  | 1           |
| THE IBPGR GLOBAL NETWORK OF BASE COLLECTIONS | 2           |
| INSTITUTES CONSERVING CROP GERMPLASM         | 3           |
| STANDARDS FOR SEED STORAGE                   | 3           |
| PRACTICAL CONSTRAINTS                        | 4           |
| REFERENCES                                   | 5           |
| APPENDIX I                                   | 6           |
| APPENDIX II                                  | 10          |
| APPENDIX III                                 | 25          |

## INTRODUCTION

The International Board for Plant Genetic Resources (IBPGR) was founded in 1974 by the Consultative Group on International Agricultural Research (CGIAR) to coordinate existing national, regional and international efforts in the conservation of crop genetic resources and to stimulate the initiation of others. The mandate of the IBPGR calls for the establishment of a network of replicated storage centres for the major crop species together with the provision of advice on the methods and standards necessary to ensure the security of valuable germplasm.

In 1976 only a handful of seed stores and genebanks were dealing with the conservation of germplasm. The establishment of seed storage facilities for the conservation of endangered crop germplasm has been considerably accelerated, especially over the past five years. In 1979 a report on seed stores for genetic conservation listed fifty-four seed stores, of which twenty-four had long-term storage conditions conforming to the IBPGR preferred standards for seed storage (Ng and Williams, 1979). Improvements in seed storage conditions within existing facilities and the establishment of new stores in recent years have led to the need for a new listing of the current situation.

In line with its policy to stimulate a rapid growth in the numbers of genebanks, the IBPGR established an International Advisory Committee on Seed Storage to provide guidance on standards for the conservation of all types of seeds. At its first meeting in 1981 this committee noted that in many cases, seeds were not being stored under the most appropriate conditions to ensure optimum longevity.

Constraints affecting the efficient collection and exchange of plant germplasm also impinge on the efficiency and management of genebanks. An IBPGR consultation met in 1983 to identify which constraints, other than quarantine, affect the movement of germplasm. The participants from the international community agreed that the duties of genebank curators need to be formally identified (in an attempt to raise standards) so that "seed stores" involved with conservation in fact function as "genebanks" (IBPGR, 1983). The report of the consultation noted that curators may well contribute more to loss of valuable material than might have occurred in the field. The less than optimal efficiency is a major reason in many cases for apparent "non-availability" from some genebanks.

## BASE AND ACTIVE COLLECTIONS

Seed samples stored in genebanks are maintained to meet the needs of plant breeders and research workers who require small sub-samples of well-documented and sometimes variable accessions.

Two types of genebank collection are distinguished for the storage of desiccation tolerant seeds:

1. BASE collections contain seed samples stored for long periods at low moisture contents and low temperatures. Materials are only removed from base collections in order to regenerate materials when the seed viability has started to decline below an acceptable regeneration standard, or when stocks of a particular sample are no longer available from other sources. Seed is not normally used for routine distribution from a base collection.

2. ACTIVE collections contain seed samples stored under less stringent conditions and from which seeds are obtained for distribution, evaluation and multiplication purposes.

These two types of collections complement each other. They may or may not be situated within the same centre or genebank.

THE IBPGR GLOBAL NETWORK OF BASE COLLECTIONS

Since 1974 the IBPGR has worked to initiate, coordinate and support where necessary efforts to develop a global network of genebanks to hold base collections of major food crops (IBPGR, 1983a). In the immediate future a similar network of active collections will also be designated by the IBPGR and will be dealt with in future publications.

The global network has been expanded over the last seven years (Fig. 1). The network had grown from only five centres in 1976 to one including five international centres and 25 national centres by the end of 1983 (Appendix I). Other additional base collections also exist (see Appendices I and II).

The IBPGR requires that centres holding base collections guarantee availability of the material to the international scientific community and that the materials be stored under appropriate conditions to preserve viability for long periods. All materials in base collections should be duplicated for safety, using appropriate monitoring and regeneration regimes to safeguard the long-term maintenance of the collection.

Present indications are that about 50 base collections will form a reasonably complete network for about 40 major crops. Currently 30 genebanks in 24 countries have been designated and have accepted to hold the base collections of 34 of the major staple seed crops. The IBPGR has set 1986 as a target to complete the designation of its network of base collections.

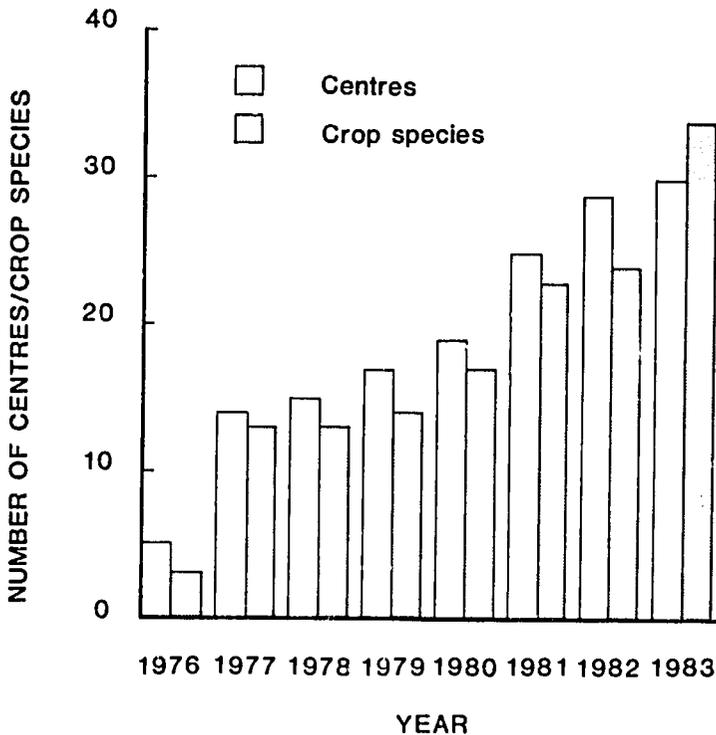


Fig.1. The growth of the IBPGR global network of base collections

## INSTITUTES CONSERVING CROP GERmplasm

Information on the storage facilities of the institutes which conserve germplasm and the species conserved has been collated by the IBPGR in a computerized data base. This data base will be updated as new information becomes available and as new genebanks are constructed.

The information in this report reveals that more than 100 centres are now involved in the maintenance of germplasm in the form of seed and that 55 of these have conditions conforming to the IBPGR standards for long-term conservation (Appendix II). Several other genebanks are under construction and are expected to be completed before 1986 (Appendix III).

## STANDARDS FOR SEED STORAGE

The IBPGR Seed Storage Committee has reviewed the standards for seed storage and will make recommendations about the acceptable conditions and also preferred conditions which should be attained to safeguard seeds in storage in genebanks. Standards will be assessed periodically in the light of new advances from research in seed physiology. Current standards have been defined on the following:

### (1) Seed quality

It is extremely important that seed samples entering genebanks should be of high quality. Only seeds of high quality retain a high viability during storage over long periods, even under ideal conditions. It is therefore important that any handling at the field level during collection and afterwards in the genebank be done in such a way that it has minimum detrimental effects on the seeds.

### (2) Sample size

Each accession in the genebank should comprise sufficient seeds to fully represent the total variation in the original sample, whether a population or a more uniform variety, and allow sufficient seeds for viability monitoring during storage and subsequent regeneration. The recommendation of the IBPGR is that the size of an accession in a base collection should not be less than 4 000 seeds for genetically uniform material and 12 000 seeds for heterogeneous material (IBPGR, 1977; IBPGR, 1982). The minimal acceptable standard advised by the IBPGR Seed Storage Committee is 3 000 seeds and 4 000 seeds respectively.

### (3) Seed drying and moisture content

Seed drying is important because drying conditions can have appreciable effects on subsequent viability. Both hot air and sun drying can be detrimental to seed quality and longevity, and therefore should be avoided. It is strongly recommended that a drying room maintained at about 15°C and 10 to 15% relative humidity is used to achieve low seed moisture contents without deleterious effects on the seeds (Cromarty, Ellis and Roberts, 1982). The IBPGR Seed Storage Committee has recommended that more emphasis be placed on seed drying.

Low seed moisture contents in desiccation tolerant seeds are essential to preserve viability during storage. The IBPGR recommends that seeds be stored at 3 to 7% moisture content (calculated on a wet weight basis) as a preferred standard of seed storage (IBPGR, 1977), except where there is strong evidence that subsequent problems during storage at low moisture contents for certain species will be encountered. However, the IBPGR Seed Storage Committee has noted that storing seeds at even lower moisture contents can improve storability and may be more suitable for seeds of species with a short storage period (Cromarty, Ellis and Roberts, 1982).

#### (4) Moisture content determination

Various methods for the determination of seed moisture content are used by seed analysts. Standard methods for determination and expression of seed moisture content are essential in order to make comparisons between individual samples and between genebanks. The standard methods adopted by the International Seed Testing Association are widely used and are suitable for genebanks. Moisture content is calculated and expressed on a wet weight basis according to ISTA rules (ISTA, 1976).

#### (5) Seed Containers

Containers that are hermetically sealed are recommended so that the low moisture content of the seed can be maintained without necessarily controlling the humidity in the store as a whole, thus saving on energy and operating costs and ensuring control of seed moisture content during unforeseen breakdowns or interruptions in the power supply. The materials used for these containers include laminated aluminium foil, glass and metals of varying kinds. Both containers and seals should be of high quality, particularly in the case of laminated aluminium foil packets and screw top jars, to avoid leakage of moist air into the container during storage.

#### (6) Storage temperature

Seed longevity during storage is increased at low temperatures. The IBPGR has recommended  $-18^{\circ}\text{C}$  or less as a preferred temperature standard for long-term storage, although in certain cases the temperature standard could be lowered to  $-10^{\circ}\text{C}$  when the responsibility of the genebank is restricted to a single species where seed viability is high and longevity characteristics are already determined (IBPGR, 1977). The lower seed moisture contents indicated above would allow storage at less stringent temperatures without undue effect on storage period and considerable saving on energy and equipment costs. The IBPGR Seed Storage Committee is currently considering this problem and will report in due course.

#### (7) Viability monitoring

All accessions require testing to monitor viability before and during storage. The high cost of collection, regeneration and storage of seed and the limited amount held in base collections necessitates that the least amount of seed that provides accurate results should be used in testing. The IBPGR strongly recommends a sequential germination test to monitor viability of accessions (Ellis, Roberts and Whitehead, 1980; Ellis and Wetzel, 1983).

#### (8) Regeneration interval

As viability declines a parallel process of deterioration and genetic change occurs within the seeds. In order to avoid excessive genetic change in seed accessions it is necessary to regenerate before viability declines to low levels. The IBPGR Seed Storage Committee has recommended that a regeneration standard should be agreed for each species, although genebanks are expected to make individual decisions based on practical knowledge and feasibility. A regeneration standard at 85% true viability has been taken as an acceptable level for the majority of species of crop plants.

### PRACTICAL CONSTRAINTS

Whilst specific practical constraints can affect the efficiency of any genebank, the IBPGR strongly recommends that the above standards be attained whenever possible to minimize change and/or loss during seed conservation.

Small sample size is the most common constraint encountered. The IBPGR encourages collectors to ensure that large samples are collected to preclude the necessity of several cycles of regeneration, which is time consuming, costly and entails risks such as unintentional selection. Monitoring procedures which are destructive and reduce seed number should be kept to a minimum. The use of a sequential germination test and the

development of new apparatus for non-destructive moisture analysis are advances which should help prevent undue depletion of valuable seed.

High temperatures and relative humidities in tropical areas make many of the processes of seed drying and storage more difficult. These problems can be overcome with adequate attention to detail and the provision of proper seals around drying rooms and sufficiently thick insulation around cold rooms. A gradual temperature gradient from ambient to low temperatures, by means of air-conditioning the rooms around seed stores or the use of dehumidifying equipment, can help to prevent the formation of condensation on the outside of cold surfaces. Seed containers should not be opened until their contents are in equilibrium with the room temperature to prevent changes in moisture content from condensation and should be open for the least possible time under low relative humidity conditions for removal of seeds.

Lack of specific information on the seed storage characteristics of many tropical species during long periods in storage at sub-zero temperatures is another constraint when dealing with diverse material. This may cause excessive work in monitoring viability, until sufficient information is collected over longer periods to permit accurate estimates of storability and suitable regeneration standards. The lack of information on seed dormancy is another problem when dealing with less common species and dormancy characteristics should be understood for efficient genebank management. The IBPGR strongly recommends that the staff of a genebank includes a seed physiologist.

The use of common seed dressings of fungicides and insecticides tend to have deleterious effects on seed viability during storage. The IBPGR Seed Storage Committee has indicated that further research is required to identify deleterious effects of seed dressings and has recommended that the use of seed dressings should be avoided during long-term storage until more specific information is available.

#### REFERENCES

- Cromarty, A.S., Ellis, R.H. and Roberts, E.H.  
1982 The Design of Seed Storage Facilities for Genetic Conservation. IBPGR, Rome. 96p.
- Ellis, R.H., Roberts, E.H. and Whitehead, J.  
1980 A new, more economic and accurate approach to monitoring the viability of accessions during storage in seed banks. *Pl. Genet. Resources Newsl.*, 41:3-18.
- Ellis, R.H. and Wetzel, M.  
1983 Recent developments in applying sequential analysis to genebank seed viability monitoring tests. *Pl. Genet. Resources Newsl.*, 55: 2-15.
- IBPGR  
1977 Report of a Working Group on Engineering, Design and Cost Aspects of Long-term Seed Storage Facilities. IBPGR, Rome. 19p.
- IBPGR  
1982 IBPGR Ad-hoc Advisory Committee on Seed Storage. Report of the First Meeting. IBPGR, Rome. 13p.
- IBPGR  
1983 Practical constraints affecting the collection and exchange of wild species and primitive cultivars. IBPGR, Rome. 11p.
- IBPGR  
1983a A Global Network of Genebanks. IBPGR, Rome. 7p.
- ISTA  
1976 International rules for seed testing. *Rules 1976. Seed Sci. & Technol.*, 4:3-49.
- Ng, N.Q. and Williams, J.T.  
1979 Seed Stores for Crop Genetic Conservation. IBPGR, Rome. 31p.

Current status of the global network of IBPGR designated base collection centres and other significant germplasm collections

| CROP                     | IBPGR DESIGNATED SECURITY BASE COLLECTIONS |                                     | OTHER SIGNIFICANT COLLECTIONS  |   |
|--------------------------|--|-------------------------------------|--|---|
|                          | GLOBAL                                     | REGIONAL                            | IN LONG-TERM STORAGE   | IN MEDIUM-TERM STORAGE 1/   |
| <u>CEREALS</u>           |  |                                     |  |   |
| BARLEY                   | CAN01, ICARDA**                            | ETH01, JPN09*, JPN03*, NGB          | AUS03, AUT01, DDR01, DEU01, ESP04, ISR02, KOR02, SYR03, USA06, ZAF01   | AFG01, BGR01, CAN05, COL02, CSK01, DDR01, GBR05, GRC05, HUN03, IRQ01, ITA04, JPN01, NLD03, PAK01, POLO3, TUR01, USA32                                     |
| MAIZE                    | CIMMYT**                                   | JPN03*, PRT01, SUN01*, THA06, USA06 | ARG05, BRA03, CAN01, DDR01, ESP04, ETH01, ISR02, JPN03, KOR02, PRT06, ZAF01  | AFG01, BGR01, CAN01, CHN01, COL02, CSK02, DDR01, ETH01, GBR05, HUN03, ITA04, KEN03, MEX01, MWI02, NLD03, PAK01, PER02, TUR01, ZMB01                       |
| MILLETS:                 |  |                                     |  |   |
| <u>Pennisetum</u> spp.   | CAN01, ICRISAT, USA06                      |                                     | SUN01, ZAF01   | FRA03, FRA13, MWI02, SUN01, USA19   |
| <u>Eleusine</u> spp.     | ETH01, ICRISAT                             |                                     | JPN03, USA06   | MWI02, UGA01, USA19, ZMB01  |
| minor Indian millets     |  | IND01                               |  |   |
| <u>Eragrostis</u> spp.   | ETH01                                      |                                     | JPN03, USA06   | USA25   |
| <u>Panicum miliaceum</u> | ICRISAT                                    |                                     | JPN03  | HUN03, MEX01, USA23   |
| <u>Setaria italica</u>   | CHN01**, ICRISAT                           |                                     | JPN03  | FRA13, HUN03, MEX01, USA23  |
| OAT                      | CAN01, NGB                                 |                                     | ARG05, AUT01, DDR01, ESP04, ETH01, ICARDA, JPN03, SYR03, TUR01, USA06, ZAF01   | BGR01, CAN05, DDR01, DEU01, ETH01, GBR05, HUN03, ITA04, KEN03, POLO3, USA32   |
| RICE:                    |  |                                     |  |   |
| Asiatic rice             | IRRI, JPN03                                | IITA, USA06                         | BRA03, CIV01, ISR02, JPN03, KOR02, KOR03, MYS05, SUN01, THA07  | AFG01, AUS01, BGR01, CHN01, CIV01, COL02, FRA03, FRA13, IDN09, IDN13, IND08, MWI02, PAK01, SUN01, TUR01, USA32, WARDA, ZMB01                              |
| African rice             |  | IITA                                |  |   |
| RYE                      | NGB, POLO3                                 |                                     | AUS03, ESP04, ISR02, PRT06, USA06, ZAF01   | BGR01, DEU01, DDR01, GBR05, USA32   |
| wild species             | TUR01*                                     |                                     |  |   |
| SORGHUM                  | ICRISAT, USA06                             |                                     | ARG05, ETH01, ISR02, JPN03, KOR02, SUN01, ZAF01  | CHN01, COL02, DEU01, ETH01, FRA03, FRA13, HUN03, MEX01, MWI02, POLO3, SUN01, UGA01, USA19   |
| WHEAT                    | ITA04, SUN01*, USA06                       |                                     | ARG05, AUS03, AUT01, BRA03, CAN01, CIMMYT, DDR01, ESP04, ETH01, GRC05, ISR02, JPN03, KOR02, NGB, PRT06, SYR03, ZAF01 | AFG01, BGR01, CAN05, CHE01, CHL05, CHN01, COL02, CSK01, DDR01, DEU01, ETH01, GBR05, GRC05, HUN03, ICARDA, IRQ01, JPN01, NLD03, PAK01, POLO3, TUR01, USA32 |
| wild species             | JPN01                                      |                                     | GRC05, SYR03   | GRC05, ICARDA, PYR01, USA32   |

FOOD LEGUMES

|                                |                                 |              |   |  |
|--------------------------------|---------------------------------|--------------|---|--|
| CHICKPEA                       | ICARDA**, ICRISAT               |              | ESP04, ETH01, GRC05, ISR02, SUN01, SYR03  | AFG01, BGR01, CHL05, ETH01, GRC05, HUN03, IRQ01, MEX01, PAK01, SUN01, TUR01, USA25   |
| FABA BEAN                      | ICARDA**                        | ITA04        | DDR01, ESP04, ETH01, GBR06, GRC05, SYR03  | AFG01, BGR01, CAN05, DDR01, DEU01, ETH01, GRC05, HUN03, IRQ01, NLD03, POL03, TUR01, USA25                                    |
| GROUNDNUT<br>perennial species | ICRISAT<br>BRA03                | ARG05        | CHN01, PHL05, SUN01, USA06, ZAF01   | BGR01, HUN03, MWI02, SUN01, USA19  |
| LENTIL                         | ICARDA**                        |              | DDR01, ESP04, ETH01, GRC05, ISR02, SUN01, SYR03   | AFG01, BGR01, CSK01, DDR01, ETH01, GRC05, HUN03, IRQ01, MEX01, SUN01, TUR01, USA25   |
| LUPIN                          | DDR01                           |              | ESP04, PRT06, SUN01   | AUS01, AUS02, COL02, DEU01, ECU03, HUN03, SUN01, USA25   |
| PEA                            | NCB                             | ITA04, POL03 | DDR01, ESP04, ETH01, GRC05, ICARDA, ISR02, JPN03, NLD01, SUN01, USA06, ZAF01                            | AUS01, BGR01, DDR01, DEU01, ETH01, GBR11, GRC05, HUN03, PAK01, SUN01, USA03  |
| PHASEOLUS<br>wild species      | CIAT, USA06<br>BEL01, CIAT      | DEU01        | ARG05, AUT01, BRA03, CATIE, DDR01, ESP04, ETH01, GRC05, ISR02, ITA06, NLD01, PHL05, PRT06, SUN01, ZAF01 | AFG01, BGR01, CATIE, CHL05, COL02, CSK01, DDR01, ETH01, GBR14, GRC05, HUN03, IDN02, JPN01, MEX01, SUN01, TUR01, USA21, USA25 |
| PIGEON PEA                     | ICRISAT, INDO1**                |              | PHL05   | IDN02, USA19   |
| SOYABEAN<br>perennial species  | CHN01**, JPN03*, USA06<br>AUS01 |              | ARG05, BRA03, CAN01, DDR01, IITA, KOR02, PHL05, SUN01, ZAF01  | AUS01, AVRDC, BGR01, CAN01, CSK01, DDR01, DEU01, HUN03, MEX01, POL03, SUN01, USA33, USA36                                    |
| VIGNA:<br>wild species         | BEL01                           |              |   | IITA   |
| <u>Vigna radiata</u>           | AVRDC, INDO1**, PHL05           |              | JPN03, KOR02  | AFG01, IDN02, IDN13, USA19   |
| <u>Vigna mungo</u>             | INDO1**                         |              | JPN03   | AVRDC  |
| <u>Vigna umbellata</u>         | INDO1**                         |              |   | IDN02  |
| <u>Vigna unguiculata</u>       | IITA, USA06                     | INDO1**      | BRA03, GHA07, IDN02, PHL05, SUN01, ZAF01  | BGR01, CIAT, IDN02, MWI02, SUN01   |
| <u>Vigna angularis</u>         | JPN03*                          |              |   |  |
| WINGED BEAN                    | PHL05, THA06                    |              | CATIE, CIAT, IDN02  | CATIE, CIAT, IDN02   |

| CROP                       | IBPGR DESIGNATED SECURITY BASE COLLECTIONS |                                     | OTHER SIGNIFICANT COLLECTIONS                             |   |
|----------------------------|--|-------------------------------------|---|---|
|                            | GLOBAL                                     | REGIONAL                            | IN LONG-TERM STORAGE                                      | IN MEDIUM-TERM STORAGE  |
| <u>VEGETABLES</u>          |  |                                     |   |   |
| ALLIUM                     | GBR06,NLD01*,USA06                         | CHN01**,JPN03*                      | BGR01,BRA03,ISR02,NGA04,NGB,<br>NLD07,SUN01               | COL02,ESP06,HUN03,ITA04,JPN11,PAK01,<br>SUN01,TUR01,USA03,USA25                                   |
| AMARANTHUS                 | USA06                                      | IND01,MEX01**,NGA04**               |   | AVRDC,ECU03,USA23   |
| CAPSICUM                   | CATIE,NLDG1                                | IND01**                             | BGR01,DDR01,ETH01,GBR03,ITA06,<br>NGA04,PHL05,SUN01,USA06 | COL02,DDR01,ESP06,ETH01,FRA11,HUN03,<br>ITA04,JPN01,PER13,SUN01,TUR01,TWN05,<br>USA19             |
| CRUCIFERS:                 |  |                                     |   |   |
| <u>Brassica carinata</u>   | DEU01,ETH01                                | JPN03                               | CAN04   | NLD03,PAK01   |
| <u>Brassica oleracea</u>   | CHN01**,GBR06,NLD01                        | JPN03                               | BGR01,CAN04,GRC05,GBR10,NGB,<br>NLD07,PHL05,SUN01         | DEU01,FRA10,GRC05,JPN05,JPN07,NLD03,<br>SUN01,TUR01,USA03   |
| <u>Brassica campestris</u> | CAN01,CHN01**,DEU01,GBR06                  | IND01**,JPN03*                      | CAN04,SUN01   | AVRDC,JPN05,JPN07,NLD03,PAK01,SUN01   |
| <u>Brassica juncea</u>     | CAN01,CHN01**,DEU01,GBR06                  | IND01**,JPN03*                      | CAN04,SUN01   | JPN05,PAK01,SUN01,USA23   |
| <u>Brassica napus</u>      | CAN01,DEU01,GBR06                          | JPN03                               | BRA03,CAN04,GBR10,SUN01                                   | CHN01,NLD03,SUN01,USA23   |
| <u>Sinapis alba</u>        | CAN01,DEU01                                | JPN03                               | SUN01   | SUN01   |
| <u>Raphanus spp.</u>       | CHN01**,GBR06,IND01**                      | JPN03                               | SUN01,NGB,USA06   | JPN05,NLD03,SUN01,TUR01,USA23   |
| <u>Wild species</u>        | ESP05,JPN07                                | JPN03*                              |   |   |
| CUCURBITS:                 |  |                                     |   |   |
| <u>Cucurbita</u> spp.      | CATIE,MEX01**,SUN01*,<br>USA06             | IND01**,NGA04**                     | BGR01,DDR01,JPN03,PHL05                                   | DER01,ETH01,HUN03,PER13,TUR01,<br>USA03,USA19   |
| <u>Cucumis</u> spp.        | ESP04,IND01**,NGA04**,<br>SUN01*,USA06     |                                     | BGR01,ISR02,JPN03,NLD01,<br>PHL05,ZAF01                   | ESP06,FRA11,HUN03,ITA04,MEX01,TUR01,<br>USA19   |
| <u>Citrullus</u> spp.      | ESP04,IND01**,NGA04**,<br>SUN01*,USA06     |                                     | BGR01,ISR02,PHL05   | HUN03,ITA04,TUR01,USA19   |
| <u>Lagenaria siceraria</u> | CATIE**,IND01**                            |                                     | PHL05   | USA03,USA19   |
| <u>Sechium edule</u>       | CATIE                                      |                                     |   |   |
| <u>Benincasa</u> spp.      | IND01**,PHL05                              |                                     |   | USA19   |
| <u>Luffa</u> spp.          | IND01**,PHL05                              |                                     |   | USA19   |
| <u>Momordica</u> spp.      | IND01**,PHL05                              |                                     |   | USA19   |
| <u>Trichosanthes</u> spp.  | IND01**,PHL05                              |                                     |   | USA03   |
| EGGPLANT                   | IND01**,NLD01                              | NGA04**,PHL05***,USA06              | ITA06,JPN03,PHL05,SUN01                                   | FRA11,SUN01,TUR01,USA19   |
| OKRA                       | USA06                                      | CIV01*,IND01**,PHL05***,<br>NGA04** | GBR03,GHA07,PHL05   | IRQ01,PAK01,TUR01,USA19   |
| TOMATO                     | CATIE,DDR01,USA06                          | PHL05                               | ARG05,BRA03,CAN01,GBR03,JPN03,<br>NGA04,NLD01,SUN01,ZAF01 | AVRDC,BGR01,CAN01,COL02,DEU01,ESP06,<br>FRA11,GBR06,HUN03,ITA04,JPN05,PER13,<br>SUN01,TUR01,USA23 |

ROOTS AND TUBERS

|              |                      |       |                           |                            |
|--------------|----------------------|-------|---------------------------|----------------------------|
| POTATO       | CIP                  |       | BGR01, CHL03, POL02, GNPG | BGR01, COLO2, JPN03, JPN11 |
| SWEET POTATO | IITA*, JPN03*, USA06 | AVRDC |                           | JPN12, SLB01               |

INDUSTRIAL CROPS

|            |                              |               |                     |                                   |
|------------|------------------------------|---------------|---------------------|-----------------------------------|
| BEET       | DEU01, NGB                   | GBR06*, GRC05 | JPN03, SUN01, USA06 | GBR03, HUN03, SUN01, TUR01, USA23 |
| SUGAR CANE | IND12*, JPN03*, USA06        |               |                     |                                   |
| COTTON     | FRA02***, SUN01***, USA06*** | GRC05         | ARG05, ISR02        |                                   |

FORAGES

|         |                       |              |   |  |
|---------|-----------------------|--------------|---|--|
| FORAGES | Global collections*** | ESP04, ITA04 | ARG05, AUS01, AUS08, BGD01, DDR01, ETH01, GBR04, GBR16, GRC05, ICARDA, YSR02, JPN03, NGB, SUN01, SYR03, USAC5 | AUS01, AUS02, AUS06, AUS08, BGD01, BGR01, CHE01, CIAT, CSK01, DDR01, ETH01, GRC05, HUN03, KEN03, MEX01, NGB, PAK01, POL03, PYR01, SUN01, TUR01, USA03, USA19, USA23, USA25 |
|---------|-----------------------|--------------|---|--|

- \* under discussion or awaiting formal agreement
- \*\* will be invited to participate when facilities are available
- \*\*\* will be invited to participate in 1984/5

1/ The division of genebanks into those with long-and medium-term storage in this table should not be regarded as an assessment, since the standards for classification of genebanks are currently under review. The codes used for the centres correspond to the full listing found in Appendix II.

List of centres conserving crop germplasm in medium- and long-term storage units

| COUNTRY/ACRONYM | CENTRE  | MAJOR CROPS   | SEED STORAGE CONDITIONS  |
|-----------------|---|---|--|
| Afghanistan     | AFC01*<br>Plant Genetic Resources<br>Unit, Darulaman                                  | Significant collections of local<br>germplasm of barley, chickpea, faba<br>bean, lentil, pea and wheat, and<br>introduced germplasm of maize, mung<br>bean, <u>Phaseolus</u> and rice | Seeds stored at 2°C and 35 to 40% relative<br>humidity   |
| Argentina       | ARG05<br>Estación Experimental<br>Regional Agropecuaria,<br>Pergamino                 | Large collection of germplasm of<br>barley, cotton, flax, forages,<br>groundnut, maize, oat, <u>Phaseolus</u> ,<br>sorghum, soyabean, tomato and<br>wheat                             | Seeds with a moisture content of 5 to 7%<br>stored in hermetically sealed cans<br>at -18°C             |
| Australia       | AUS01<br>Commonwealth Scientific<br>and Industrial Research<br>Organization, Canberra | Collection of introduced germplasm<br>of forage grasses and legumes,<br>soyabean, sunflower, rice, and<br>indigenous wild <u>Glycine</u> species                                      | Seeds with a moisture content of 7% stored in<br>laminated aluminium foil packets at 2°C               |
|                 | AUS02<br>Western Australian Depart-<br>ment of Agriculture,<br>South Perth            | Large collection of introduced<br>forage grasses and legumes  | Seeds with a moisture content of 5% stored in<br>laminated aluminium foil packets at 4°C               |
|                 | AUS03<br>Australian Wheat Collection<br>Department of Agriculture,<br>Tamworth        | Large collection of <u>Aegilops</u> and<br>wheat and smaller collections of<br>barley, rye and Triticale  | Seeds with a moisture content of 6% stored in<br>laminated aluminium foil packets at -10°C             |
|                 | AUS04<br>Queensland Department of<br>Primary Industries,<br>Brisbane                  | Collection of cluster bean and<br>safflower   | Seeds with a moisture content of 8 to 10%<br>stored in laminated aluminium foil packets<br>at 3 to 6°C |
|                 | AUS06<br>South Australian Department<br>of Agriculture, Adelaide                      | Large collection of wild species<br>of forage legumes   | Seeds stored in laminated aluminium foil<br>packets at 2°C   |
|                 | AUS08<br>CSIRO Division of Tropical<br>Crops and Pastures, St Lucia                   | Large collection of tropical<br>grasses and legumes   | Seeds stored at 5 to 10 and -20°C  |

|            |  |  |   |
|------------|--|--|---|
| Austria    | AUTO1<br>Landwirtschaftlich-<br>Chemische Bundesversuchsan-<br>stalt, Linz | Collection of local landraces and advanced cultivars of barley, oat and wheat and local landraces of <u>Phaseolus</u>  | Seeds stored in glass jars at -14°C   |
| AVRDC      | Asian Vegetable Research*<br>and Development Center,<br>Taiwan, China      | Large collection of Asiatic landraces, advanced cultivars and breeding lines of <u>Amaranthus</u> , black gram, chinese cabbage, other brassicas, mung bean, soyabean, sweet potato and tomato   | Seeds stored in laminated aluminium foil packets at 5 to 8°C  |
| Bangladesh | BGR01<br>Bangladesh Jute Research<br>Institute, Dacca                      | Collection of landraces, wild species, advanced cultivars and mutants of species of <u>Corchorus</u> and <u>Hibiscus</u>   | Seeds stored in laminated aluminium foil packets at 4 and -20°C   |
| Belgium    | BEL03<br>Faculté des Sciences<br>Agronomiques de l'Etat à<br>Gembloux      | Large number of wild species of <u>Phaseolus</u> and <u>Vigna</u> and related genera   | Seeds with a moisture content of 6 to 7% stored in laminated aluminium foil packets at -20°C  |
| Brazil     | BRA03<br>National Genetic Resources<br>Center, Brasilia                    | Local collections of brassicas, groundnut and related wild species, maize, <u>Phaseolus</u> , soyabean and tobacco and introduced germplasm of cowpea, rice, sesame and wheat. This collection is being expanded with material from active genebanks     | Seeds with a moisture content of 4 to 6% stored in sealed cans and laminated aluminium foil packets at -19°C  |
| Bulgaria   | BGR01<br>Institute of Introduction<br>and Plant Resources,<br>Sadovo       | Collection of barley, brassicas, <u>Capsicum</u> , chickpea, cowpea, cucurbits, faba bean, forage grasses and legumes, groundnut, lentil, maize, oat, onion, pea, <u>Phaseolus</u> , potato, soyabean, sunflower, rice, rye, tomato, Triticale and wheat | Seeds stored in glass jars at 5 and -18°C   |
| Canada     | CAN01<br>Plant Gene Resources of<br>Canada, Ottawa                         | Large collections of introduced germplasm of barley, brassicas, maize, millets, oat, soyabean, tomato and wheat  | Seeds with a moisture content of 4 to 8% stored at 4°C with the collection duplicated in long term storage in laminated aluminium foil packets at -20°C |

| COUNTRY/ACRONYM | CENTRE  | MAJOR CROPS   | SEED STORAGE CONDITIONS   |
|-----------------|---|---|---|
| Canada          | CAN04<br>Agriculture Canada Research<br>Station, Saskatoon  | Diverse collection of introduced<br>germplasm of landraces, breeding<br>lines, advanced cultivars and<br>related wild species of brassicas  | Seeds stored in sealed glass vials at<br>-10°C  |
|                 | CAN05<br>Université Laval, Quebec   | Collection of introduced germplasm<br>of barley, faba bean, oat and wheat   | Seeds stored in an atmosphere of 40% relative<br>humidity at 4°C                              |
| CATIE           | Centro Agronomico Tropical<br>de Investigacion y<br>Enseñanza, Turrialba.   | Large collections of indigenous<br>germplasm of landraces, wild<br>species and advanced cultivars of<br><u>Capsicum</u> , <u>cucurbits</u> , <u>Phaseolus</u> ,<br><u>Sechium edule</u> , <u>Solanum</u> and tomato | Seeds stored in medium-term storage at<br>5°C and duplicated in long-term storage<br>at -20°C |
| Chile           | CHL03<br>Banco de Genes, Instituto<br>de Producción y Sanidad<br>Vegetal, Universidad<br>Austral de Chile, Valdivia | Collection of landraces and wild<br>species of potatoes   | Seeds stored in plastic at -18°C  |
|                 | CHL05<br>La Platina Experiment<br>Station, INIA, Santiago   | Large collection of chickpea,<br>lentil, <u>Phaseolus</u> , sunflower and<br>wheat  | Seeds of low moisture content stored<br>at 4°C  |
| China           | CHN01*<br>Chinese Academy of Agric-<br>ultural Sciences, Beijing  | Collection of indigenous brassicas<br>and related wild species, maize,<br>sorghum, rice and wheat   | Seeds stored in sealed containers at<br>0 to 5°C  |
|                 |   | Large collection of groundnut and<br>related wild species   | Seeds with a moisture content of 10% stored<br>at -15°C                                       |
|                 | CHN04<br>Beijing Vegetable Research<br>Centre, Beijing  | Range of local vegetable landraces  | Seeds stored in aluminium cans with silica<br>gel at 0°C                                      |
|                 | TWN05<br>Taiwan Seed Service,<br>Taichung, Taiwan   | Collection of landraces, breeding<br>lines and advanced cultivars of<br>brassicas and advanced cultivars of<br><u>Capsicum</u>  | Seeds stored at 5 to 8°C  |

|                |   |  |   |
|----------------|---|--|---|
| CIAT           | Centro Internacional de*<br>Agricultura Tropical, Cali,<br>Colombia   | Large collection of forage grasses<br>and legumes  | Seeds stored in laminated aluminium foil<br>packets at 5 to 8°C   |
|                |   | Large collection of New World land<br>races, advanced cultivars and<br>related wild species of <u>Phaseolus</u><br><u>coccineus</u> , <u>P. lunatus</u> , <u>P. vulgaris</u><br>and smaller collections of cowpea<br>and winged bean | Seeds with a moisture content of 10 to 12%<br>stored at 5 to 8°C in plastic bags and seeds<br>with a moisture content of 5 to 8% stored in<br>laminated aluminium foil packets at<br>-2 to -6°C |
| CIMMYT         | Centro Internacional de*<br>Mejoramiento de Maiz y<br>Trigo, El Batán,<br>Mexico                            | Large collection of indigenous land<br>races of maize from Central and<br>South America  | Seeds with a moisture content of 8 to 10%<br>stored in metal cans at 0°C  |
|                |   | Large collection of cultivars and<br>breeding material of wheat  | Seeds stored at -20°C   |
| CIP            | Centro Internacional<br>de la Papa, Lima,<br>Peru   | Large collection of indigenous<br>Central and South American land<br>races and advanced cultivars of<br>potato and related wild species  | Seeds with a moisture content of 5 to 6%<br>stored in laminated aluminium foil packet<br>at 0 and -10°C   |
| Colombia       | COLO2*<br>Instituto Colombiana<br>Agropecuaria, Bogota  | Large collection of landraces of<br><u>Allium</u> , barley, <u>Capsicum</u> , cucurbits,<br>lupins, maize, <u>Phaseolus</u> , rice,<br>sorghum, tuber-bearing solanums,<br>tomato and wheat  | Seeds stored in laminated aluminium foil<br>packets at 3°C  |
| Cyprus         | CYP01*<br>Agricultural Research<br>Institute, Nicosia   | Local collections of cereals and<br>legumes  | Seeds stored in an environment of 25 to 30%<br>relative humidity at 0 to 4°C  |
| Czechoslovakia | CSK01<br>Research Institute of Plant<br>Production, Bratislava  | Collections of barley, clover,<br>lentil, lucerne, <u>Phaseolus</u> ,<br>soyabean, Triticale and wheat   | Seeds with a moisture content of 10% stored<br>at 5 to 8°C  |
|                | CSK02<br>Maize Research Institute,<br>Trstinska   | Collection of maize germplasm  | Seeds with a moisture content of 8 to 10%<br>stored in glass jars at 4 to 7°C   |
| Ecuador        | ECU03<br>Instituto Nacional de<br>Investigaciones Agropecuarias,<br>Estación Experimental<br>Santa Catalina | Collection of indigenous landraces<br>of <u>Amaranthus</u> , <u>Lupinus</u> and quinoa   | Seeds stored in laminated aluminium foil<br>packets at 0 to 2°C   |

| COUNTRY/ACRONYM                  | CENTRE   | MAJOR CROPS  | SEED STORAGE CONDITIONS   |
|----------------------------------|--|--|---|
| Ethiopia                         | ETH01<br>Plant Genetic Resources<br>Center, Addis Ababa  | Large collection of indigenous<br>germplasm of barley, brassicas,<br>castor oil, chickpea, cucurbits,<br>faba bean, flax, lentil, millets,<br>niger-seed, pea, safflower, sesame,<br>sorghum, wheat, and introduced<br><u>Capsicum</u> , maize and <u>Phaseolus</u>                                      | Seeds stored in laminated aluminium foil<br>packets and cans at 4°C and -10°C |
| France                           | FRA03<br>Office de la Recherche<br>Scientifique et Technique<br>Outre-Mer, Bondy                                 | African collections of millets,<br>sorghum and rice  | Seeds with a moisture content of 10% stored<br>at 5°C                         |
|                                  | FRA10<br>INRA Station d'Amélioration<br>des Plantes, Le Rheu   | Large collection of landraces<br>and breeding lines of cauliflower   | Seeds stored at 2 to 4°C  |
|                                  | FRA11<br>INRA Station d'Amélioration<br>des Plantes Maraichères,<br>Montfavet to Avignon                         | Large collection of introduced<br>landraces and related wild species<br>of <u>Capsicum</u> , eggplant and melon<br>and advanced cultivars and breeding<br>lines of tomato  | Seeds stored at 3°C   |
|                                  | FRA13<br>C.N.R.S. Laboratoire de<br>Génétiq ue et Physiologie du<br>Développement des Plantes,<br>Gif sur Yvette | Large collection of millets, rice<br>and sorghum   | Seeds stored at 4°C   |
| German<br>Democratic<br>Republic | DDR01<br>Zentralinstitut für Genetik<br>und Kulturpflanzenforschung,<br>Gatersleben                              | World collections of <u>Aegilops</u> ,<br>barley, <u>Capsicum</u> , cucurbits, faba<br>bean, flax, forage grasses and<br>legumes, lentil, lupin, maize,<br>medicinal plants, millets, oat,<br>pea, poppy, <u>Phaseolus</u> , rye, sorghum,<br>soyabean, spices, tobacco, tomato,<br>vegetables and wheat | Seeds stored in glass jars at both 0°C<br>and -15°C as duplicate collections  |
| German Federal<br>Republic       | DEU01<br>Institut für Pflanzenbau<br>und Pflanzenzüchtung,<br>Braunschweig                                       | Large collections of landraces<br>and advanced cultivars of barley,<br>beet, brassicas, clover, faba<br>bean, lupin, oat, pea, poppy, rye,<br>sorghum, tomato and wheat  | Seeds stored in sealed cans at 30%<br>relative humidity and 3 to 4°C          |

|         |   |   |  |
|---------|---|---|--|
| GNPC    | German-Netherlands<br>Potato Genebank, Braunschweig   | Large collection of introduced germplasm of potato and related wild species   | Seeds stored in sealed cans at -10°C   |
| Ghana   | GHA07*<br>Crops Research Institute,<br>Bunso  | Collection of local landraces of bambarra groundnut, cowpea, lima bean, okra and other local legumes and vegetables   | Seeds with low moisture contents stored at below zero temperatures in deep freeze chests   |
| Greece  | GRC05*<br>Greek Genebank, Thessaloniki  | Locally collected germplasm of <u>Aegilops</u> , barley, beet, brassicas, chickpea, clover, cotton, faba bean, lentil, pea, <u>Phaseolus</u> and wheat  | Seeds stored in metal cans and laminated aluminium foil packets at 0 to 2°C and -20°C  |
| Hungary | HUN05<br>Research Centre for<br>Agrobotany,<br>Institute for Plant<br>Production and Qualification,<br>Tapioszele | Collection of landraces and advanced cultivars of barley, beet, brassicas, <u>Capsicum</u> , chickpea, clover, cucurbits, faba bean, forage legumes, groundnut, lentil, lupin, millets, oat, pea, <u>Phaseolus</u> , poppy, sorghum, soyabean, wheat and related wild species and locally collected material of flax, lettuce, maize, onion, sunflower and tomato | Seeds with a moisture content of 5 to 8% stored in glass jars at 4 °C  |
| ICARDA  | International Center for*<br>Agricultural Research in<br>Dry Areas, Aleppo,<br>Syria                              | Large collection of germplasm of <u>Aegilops</u> , barley, chickpea, faba bean, forage grasses and legumes, lentil, oat, pea, Triticale and wheat   | Seeds stored at 10% relative humidity and 2°C and seeds with a moisture content of 8% stored at -20°C  |
| ICRISAT | International Crops<br>Research Institute for<br>the Semi-arid Tropics,<br>Hyderabad, India                       | Large collection of local and introduced germplasm of chickpea, groundnut, millets, pigeon pea and sorghum  | Seeds stored at 4 to 5°C and below 0°C   |
| IITA    | International Institute*<br>of Tropical Agriculture,<br>Ibadan, Nigeria   | Large collection of African germplasm of african yam bean, bambarra groundnut, cowpea and related wild species, kersting's groundnut, lablab bean and rice<br><br>Large collection of cowpea and related wild species, rice and soyabean  | Seeds stored in laminated aluminium foil packets at 5°C<br><br>Seeds with a moisture content of 5 to 6% stored in cans and laminated aluminium foil packets at -20°C |

| COUNTRY/ACRONYM | CENTRE   | MAJOR CROPS  | SEED STORAGE CONDITIONS   |
|-----------------|--|--|---|
| India           | IND08<br>Central Rice Research<br>Institute, Cuttack                                   | Large collection of rice and related<br>wild species   | Seeds stored at 4 to 5°C  |
| Indonesia       | IDN02*<br>National Biological<br>Institute, Bogor                                      | Seeds of indigenous tropical legumes   | Seeds with a moisture content of 7 to 10%<br>stored in laminated aluminium foil packets<br>at 4°C and seeds with a moisture content of<br>5% stored in laminated aluminium foil packets<br>at -20°C |
|                 | IDN09<br>Research Institute<br>for Food Crops, Bogor                                   | Large collection of local land-<br>races and advanced cultivars of<br>rice   | Seeds stored at 4°C   |
|                 | IDN13<br>Research Institute<br>for Food Crops, Sukamandi                               | Collection of local landraces and<br>advanced cultivars of rice and<br>introduced germplasm of mung bean   | Seeds stored at 4 °C  |
| Iraq            | IRQ01*<br>Plant Genetic Resources Unit,<br>Agricultural Research Centre,<br>Baghdad    | Significant collections of local<br>germplasm of <u>Aegilops</u> , barley,<br>chickpea, lentil, okra and wheat   | Seeds with a moisture content of 9% stored in<br>sealed cans at 5 to 10°C   |
| IRRI            | International Rice<br>Research Institute,<br>Los Banos, Philippines                    | Large collection of Asiatic and<br>African landraces, advanced<br>cultivars, breeding lines and<br>wild species of rice  | Seeds stored in glass jars and hermetically<br>sealed cans at 3°C and seeds with a<br>moisture content of 6% stored in hermetically<br>sealed cans at -10°C   |
| Israel          | ISR02<br>Agricultural Research<br>Organization, Bet Dagan                              | Collections of barley, brassicas,<br>chickpea, cotton, forage legumes,<br>lentil, maize, melon, onion, pea,<br><u>Phaseolus</u> , rice, rye, watermelon<br>and wheat | Seeds with a moisture content of 12% stored<br>in cans at -10°C   |
| Italy           | ITA04<br>Istituto del Germoplasma,<br>CNR, Bari  | Large collection of landraces<br>and cultivars of barley, faba<br>bean, forage grasses and legumes<br>maize, oat, pea, tomato and wheat                              | Seeds stored in laminated aluminium foil<br>packets at 0°C  |
|                 | ITA06<br>Istituto di Miglioramento<br>Genetico and Produzione<br>delle Sementi, Torino | Collection of landraces and<br>advanced cultivars of <u>Capsicum</u> ,<br>eggplant and <u>Phaseolus</u>  | Seeds with a moisture content of 2% stored in<br>glass bottles at -20°C   |

|             |   |  |   |
|-------------|---|--|---|
| Ivory Coast | CIV01*<br>Office de la Recherche<br>Scientifique et Technique<br>d'Outre-Mer, Abidjan               | Large collection of indigenous<br>germplasm of cultivated and<br>related wild species of okra<br>and rice  | Seeds stored in plastic bags at 5°C and<br>-18°C  |
| Japan       | JPN01<br>Plant Germplasm Institute,<br>Kyoto  | Large collection of introduced<br>material of <u>Aegilops</u> , barley,<br><u>Capsicum</u> , <u>Phaseolus</u> and wheat  | Seeds stored in sealed cans at 4 to 6°C   |
|             | JPN03<br>National Institute of<br>Agrobiological Resources,<br>Yatabe                               | Large collection of landraces,<br>advanced cultivars and breeding<br>lines of barley, beet, brassicas,<br>cucurbits, eggplant, flax, forages,<br>maize, millets, mung bean, oat,<br>onion, pea, rice, sorghum, soyabean,<br>sweet potato, tomato and wheat | Seeds stored in hermetically sealed cans<br>or laminated aluminium foil packets at<br>-10°C                     |
|             | JPN05<br>Vegetable and Ornamental<br>Crops Research Station,<br>Mie                                 | Large collection of landraces<br>of brassicas and landraces,<br>breeding lines and wild species<br>of tomato   | Seeds stored at 8°C   |
|             | JPN07<br>Tohoku University,<br>Sendai   | Large collection of brassicas<br>and related wild species  | Seeds with a moisture content of 1% stored in<br>glass vials at 2°C   |
|             | JPN08<br>Faculty of Agriculture,<br>Kobe University, Kobe   | Large collection of introduced<br>germplasm of landraces of potato<br>and related wild species   | Seeds stored in plastic containers at 5°C   |
|             | JPN09<br>Institute for Agricultural<br>and Biological Sciences,<br>Okayama University,<br>Kurashiki | Large collection of germplasm of<br>cultivated barley and related<br>wild species  | Seeds with a moisture content of 7% stored at<br>5°C and seeds with a moisture content of 6%<br>stored at -17°C |
|             | JPN11<br>Hokkaido National<br>Agricultural Experiment<br>Station, Shimamatsu,<br>Hokkaido           | Large collection of introduced<br>germplasm of landraces and<br>advanced cultivars of potato<br>and smaller holdings of onion  | Seeds stored in plastic containers at 0 -<br>5°C  |
|             | JPN12<br>Laboratory of Plant<br>Breeding, Mie University  | Collection of advanced cultivars<br>and landraces of sweet potato  | Seeds stored at 5°C   |

| COUNTRY/ACRONYM       | CENTRE   | MAJOR CROPS  | SEED STORAGE CONDITIONS   |
|-----------------------|--|--|---|
| Kenya                 | KEN03*<br>National Agricultural<br>Research Station, Kitale                        | Large collection of maize, oat<br>and tropical forage species  | Seeds stored in laminated aluminium foil<br>packets or plastic bags at 5°C                          |
| Korea, Republic<br>of | KOK02<br>Germplasm Management<br>Office, Office of<br>Rural Development,<br>Suweon | Large collection of indigenous land-<br>races of rice and wild species of<br>soyabean and locally collected<br>germplasm of barley, maize, mung<br>bean, red bean, sorghum and wheat   | Seeds stored in cans at -1 and -10°C  |
|                       | KOR03<br>Agricultural Experiment<br>Station, Suweon                                | Large collection of landraces and<br>introduced cultivars of rice  | Seeds stored in environment of 50%<br>relative humidity aluminium cans at<br>-10°C and -1°C         |
| Malawi                | MW102<br>Chitedze Agricultural<br>Research Station, Lilongwe                       | Collection of landraces and wild<br>species of cowpea, groundnut<br>and other minor legumes, maize,<br>millets, rice and sorghum   | Seeds stored in an environment of 50%<br>relative humidity and 6 to 10°C                            |
| Malaysia              | MYS05<br>Rice Research Centre,<br>Bumbong Lima                                     | Large collection of local land-<br>races of rice   | Seeds with a moisture content of 11% stored<br>at 10°C and in aluminium foil packets at<br>at -10°C |
| Mexico                | MEX01*<br>Instituto Nacional de<br>Investigaciones Agrícolas,<br>Mexico City       | Large collection of local germplasm<br>of cucurbits, maize, <u>Phaseolus</u> and<br>tropical legumes and introduced<br>germplasm of chickpea, lentil,<br>medicago, millets, safflower,<br>sesame, sorghum, soyabean and<br>temperate grasses | Seeds with a moisture content of 10% stored<br>in glass jars at 0 to 5°C                            |
| Netherlands           | NLD01<br>Institute of Horticultural<br>Plant Breeding,<br>Wageningen               | Large collection of landraces,<br>advanced cultivars and related<br>wild species of brassicas,<br><u>Capsicum</u> , eggplant, lettuce,<br>melon, pea and <u>Phaseolus</u>  | Seeds stored at -18°C   |
|                       | NLD07<br>Bejo-Zaden,<br>Noordsarwoude  | Collection of landraces and<br>advanced cultivars of brassicas<br>and onion  | Seeds stored at -25°C   |

|             |   |  |  |
|-------------|---|--|--|
|             | NLD03<br>Foundation for Agricultural Plant Breeding, Wageningen                                 | Large collections of barley, brassicas, faba bean, maize and wheat   | Seeds with a moisture content of 6 to 12% stored in an environment of 15 to 20% relative humidity at 2°C |
| NCB         | Nordic Gene Bank, Lund, Sweden  | Collection of local and introduced barley, beet, brassicas, clover, flax, forage grasses, oat, onion, pea, rye and wheat                               | Seeds with a moisture content of 3 to 6% stored in glass jars at -20°C                                   |
| Nigeria     | NGA04*<br>National Horticultural Research Institute, Ibadan                                     | Collection of landraces, advanced cultivars and breeding lines of <u>Amaranthus</u> , <u>Capsicum</u> , cucurbits, okra, onion and tomato              | Seeds stored at -20°C  |
| Pakistan    | PAK01*<br>Pakistan Agricultural Research Council, Islamabad                                     | Collection of germplasm of landraces of barley, brassicas, chickpea, forages, maize, okra, onion, pea, rice and wheat                                  | Seeds stored in cans at 0°C  |
| Paraguay    | PRY01<br>Instituto Agronomico Nacional, Cacupe  | Collections of native landraces and introduced forage grasses and legumes and wheat  | Seeds stored at 40% relative humidity and 4 to 8°C   |
| Peru        | PER02*<br>Programa de Investigaciones de Maiz, Universidad Nacional Agraria, La Molina, Lima    | Large collection of indigenous germplasm of maize  | Seeds with a moisture content of 8 to 10% stored at -18°C  |
|             | PER13<br>Programa de Investigación en Hortalizas, Universidad Nacional Agraria, La Molina, Lima | Large collection of indigenous germplasm of <u>Capsicum</u> , cucurbits and tomato   | Seeds stored at 5°C  |
| Philippines | PHL05*<br>Institute of Plant Breeding, University of the Philippines, Los Banos                 | Large collection of brassicas, <u>Capsicum</u> , cowpea, cucurbits, eggplant, groundnut, mung bean, okra, pigeon pea, soyabean, tomato and winged bean | Seeds with a moisture content of 5% stored in laminated aluminium foil packets at -15°C                  |
| Poland      | POL02<br>Institute for Potato Research, Roszalin  | Collection of wild species of potato   | Seeds stored in glass jars at -1°C   |

| COUNTRY/ACRONYM | CENTRE  | MAJOR CROPS   | SEED STORAGE CONDITIONS  |
|-----------------|---|---|--|
| Poland          | POL03<br>Plant Breeding and<br>Acclimatization<br>Institute, Radzikow                     | Large collection of barley, faba bean,<br>forages, oat, pea, rye, sorghum,<br>soyabean and wheat  | Seeds of low moisture content sealed<br>in laminated aluminium foil packets or<br>hermetically sealed cans stored at<br>approximately 10°C |
| Portugal        | PRT01*<br>Maize Breeding Centre,<br>Braga   | Collection of Mediterranean<br>maize  | Seeds stored in laminated aluminium foil<br>packets at -18°C   |
|                 | PRT06<br>Departamento de Genética,<br>Estação Agronómica<br>Nacional, Oeiras              | Collection of local germplasm of<br>lupin, maize, <u>Phaseolus</u> , rye and<br>wheat   | Seeds stored in deep freezers at -20°C   |
| Solomon Islands | SLB01<br>Dodo Creek Research<br>Station, Ministry of<br>Agriculture and Lands,<br>Honiara | Collection of landraces of sweet<br>potato  | Seed stored at 4°C   |
| South Africa    | ZAF01<br>Division of Plant and<br>Seed Control, Pretoria                                  | Large collection of introduced<br>germplasm of advanced cultivars<br>and landraces of barley, brassicas,<br>cotton, cowpea, cucurbits, forage<br>legumes and grasses, groundnut,<br>lupin, oat, onion, <u>Phaseolus</u> , rye,<br>sesame, sorghum, soyabean, sunflower,<br>tomato and wheat | Seeds stored in laminated aluminium foil<br>packets at -20°C   |
| Spain           | ESP04*<br>Banco de Germoplasma<br>INIA, Finca El Encin,<br>Madrid                         | Collection of landraces, advanced<br>cultivars and wild species of barley,<br>chickpea, faba bean, forage legumes,<br>lentil, lupin, melon and related<br>species, oat, pea, <u>Phaseolus</u> , rye<br>and wheat  | Seeds stored at -18°C  |
|                 | ESP05<br>Escuela T. S. de Ingenieros<br>Agrónomos, Universidad<br>Politécnica, Madrid     | Large collection of brassicas   | Seeds with a moisture content of 3 to 4%<br>stored in glass vials at -5°C  |

|  |  |   |   |
|--|--|---|---|
|  | ESP06<br>Centro Regional de<br>Investigacion y<br>Desarrollo Agrario<br>del Ebro, Zaragoza | Large collection of <u>Capsicum</u>   | Seeds stored in glass jars at 0 to 2°C                                    |
| Switzerland                              | CHE01<br>Station Fédérale de Recherches<br>Agronomiques de Changins, Nyon                  | Large collection of forage<br>grasses and wheat   | Seeds stored at 2°C   |
| Syria                                    | SYR03*<br>Agricultural Research<br>Centre, Douma   | Significant collection of local<br>landraces of <u>Aegilops</u> , barley,<br>chickpea, faba bean, forages,<br>lentil, oat, safflower and wheat  | Seeds stored in sealed cans at 0 to -5°C                                  |
| Thailand                                 | THA06*<br>Thailand Institute of<br>Scientific and Technological<br>Research, Bangkok       | Collection of Asiatic maize and<br>winged bean  | Seeds stored at -10 and -20°C   |
|  | THA07<br>Rice Division,<br>Department of Agriculture,<br>Bangkok                           | Large collection of local land-<br>races, wild types and advanced<br>cultivars of rice  | Seeds stored in glass jars or plastic<br>bags at 5 and -10°C              |
| Turkey                                   | TUR01<br>Aegean Regional<br>Agricultural Research<br>Institute, Izmir                      | Large collection of local land-<br>races of barley, beet, brassicas,<br><u>Capsicum</u> , chickpea, cucurbits,<br>forage legumes, lentil, maize,<br>oat, okra, onion, <u>Phaseolus</u> ,<br>poppy, rye, sesame, spinach,<br>sunflower, tobacco, wheat and<br>related wild species | Seeds with a moisture content of 6 to 8%<br>stored in sealed cans at 10°C |
| Uganda                                   | UGA01<br>Uganda Agriculture<br>and Forestry Research<br>Organisation, Soroti               | Large collection of millets and<br>sorghum  | Seeds stored in plastic bags at 5°C                                       |
| Union of Soviet<br>Socialist<br>Republic | SUN01<br>N.I. Vavilov Institute<br>of Plant Industry,<br>Leningrad                         | World collections of landraces<br>of all major crop species.<br>Includes the original collections<br>of Vavilov   | Seeds stored in sealed cans at 4 to 5°C<br>and at -10°C                   |

| COUNTRY/ACRONYM             | CENTRE  | MAJOR CROPS  | SEED STORAGE CONDITIONS  |
|-----------------------------|---|--|--|
| United Kingdom              | GBR04<br>Royal Botanic Gardens,<br>Kew  | Collection of forage grasses and legumes   | Seeds stored in glass vials at -20°C   |
|                             | GBR05<br>Plant Breeding Institute,<br>Cambridge                                     | Large collection of landraces and wild species of barley, maize, oat, rye and wheat  | Seeds stored at 1 to 2°C and 5 to 10% relative humidity                                  |
|                             | GBR06*<br>National Vegetable<br>Research Station,<br>Wellesbourne                   | Large collection of landraces and advanced cultivars of beet, brassicas, carrot, faba bean, lettuce and radish   | Seeds stored in laminated aluminium foil packets or cans at -20°C                        |
|                             | GBR10<br>Scottish Crop Research<br>Institute, Pentlandsfield                        | Collection of forage crucifers   | Seeds stored in laminated aluminium foil packets in deep freeze cabinets                 |
|                             | GBR11<br>John Innes Institute,<br>Norwich   | Large collection of landraces, advanced cultivars and wild species of pea  | Seeds stored at 5°C  |
|                             | GBR14<br>Department of Applied<br>Biology, University<br>of Cambridge               | Large collection of introduced germplasm of landraces and wild species of <u>Phaseolus</u>   | Seeds stored in laminated aluminium foil packets at 2°C                                  |
|                             | GBR16<br>Welsh Plant Breeding<br>Station, Aberystwyth                               | Large collection of forage grasses   | Seeds with 5% moisture content stored in laminated aluminium foil packets at 0 and -20°C |
| United States<br>of America | USA03<br>North Eastern Region<br>Plant Introduction<br>Station, Geneva, New<br>York | Large collection of germplasm of landraces, advanced cultivars and wild species of brassicas, celery, forage grasses and legumes, onion, pea and pumpkin | Seeds stored in laminated aluminium foil packets at 10°C and 20% relative humidity       |

|   |   |  |
|---|---|--|
| <p>USA06<br/>National Seed Storage<br/>Laboratory, Fort<br/>Collins, Colorado</p>         | <p>World collections of germplasm of<br/>barley, beet, brassicas, <u>Capsicum</u>,<br/>castor, cotton, cowpea, cucurbits,<br/>flax, forage grasses and legumes,<br/>groundnut, lentil, lettuce, maize,<br/>millets, oat, okra, onion, pea,<br/><u>Phaseolus</u>, cultivated and wild<br/>potatoes, rice, rye, safflower,<br/>sesame, sorghum, soyabean, tobacco,<br/>tomato and wheat</p> | <p>Seeds stored in laminated aluminium foil<br/>packets at -14 and -20°C</p> |
| <p>USA19<br/>Southern Region Plant<br/>Introduction Station,<br/>Experiment, Georgia</p>  | <p>Large collection of germplasm of<br/>landraces, advanced cultivars<br/>and wild species of <u>Capsicum</u>,<br/>annual clovers, cucurbits, egg-<br/>plant and other related <u>Solanum</u><br/>species, groundnut, <u>Leucaena</u><br/>millets, mung bean, okra and<br/>pigeon pea</p>   | <p>Seeds stored at 4°C and 40% relative humidity</p>                         |
| <p>USA21<br/>Department of<br/>Horticulture, Purdue<br/>University, Indiana</p>           | <p>Large collection of landraces,<br/>advanced cultivars and breeding<br/>lines of lima bean</p>  | <p>Seeds stored at 4°C</p>   |
| <p>USA24<br/>USDA Vegetable<br/>Production Research<br/>Unit, Salinas,<br/>California</p> | <p>Collection of advanced cultivars<br/>and landraces of brassicas,<br/>chicory and lettuce</p>   | <p>Seeds stored at -18°C</p>   |
| <p>USA23<br/>North Central Region<br/>Plant Introduction<br/>Station, Ames, Iowa</p>      | <p>Large collection of advanced<br/>cultivars and landraces of<br/><u>Amaranthus</u>, brassicas, beet,<br/>carrot, cucumber, <u>Cucurbita</u>,<br/><u>Lathyrus</u>, maize, <u>Medicago</u>,<br/>millets, radish, spinach,<br/>sunflower, sweet clover and<br/>tomato</p>  | <p>Seeds stored in glass jars at 35 to 40%<br/>relative humidity and 3°C</p> |
| <p>USA25<br/>Western Region Plant<br/>Introduction Station,<br/>Pullman, Washington</p>   | <p>Large collection of <u>Allium</u>,<br/>brassicas, chickpea, faba bean,<br/>forage grasses, lentils, lettuce<br/>lupin, <u>Phaseolus</u>, safflower and<br/>tef</p>   | <p>Seeds stored at 38% relative humidity<br/>and 3°C</p>                     |

| COUNTRY/ACRONYM             | CENTRE   | MAJOR CROPS  | SEED STORAGE CONDITIONS   |
|-----------------------------|--|--|---|
| United States<br>of America | USA32<br>USDA Small Grains<br>Collection, Plant<br>Genetics and Germplasm<br>Institute, Beltsville | Large collection of barley, oat,<br>rice, rye, Triticale, wild wheat<br>and related genera | Seeds stored at 45% relative humidity<br>and 13°C                             |
|                             | USA33<br>Southern Soybean Collection<br>USDA-ARS Delta Branch<br>Experiment Station, Stoneville    | Large collection of soyabean   | Seeds stored at 50% relative humidity<br>and 10°C                             |
|                             | USA36<br>USDA Soybean Laboratory,<br>University of Illinois, Urbana                                | World collection of soyabean   | Seeds stored at 35% relative humidity<br>and 10°C                             |
| WARDA                       | LBRO4<br>West African Rice<br>Development Association,<br>Monrovia, Liberia                        | Large collection of African rice<br>germplasm and introduced material<br>from Asia         | Seeds with a moisture content of 7 to 13%<br>stored in glass jars at 1 to 5°C |

\* denotes IBPGR assistance with seed storage facilities

APPENDIX III

## Institutes where genebanks are under construction or being upgraded

| <u>Country/Acronym</u> | <u>Institute</u>  |
|------------------------|---|
| Austria                | Central Agricultural Research Institute, Vienna                               |
| Bangladesh             | *Bangladesh Agricultural Research Institute, Dacca                            |
| Bolivia                | *Instituto Boliviano de Tecnologia Agropecuaria, La Paz                       |
| China                  | *Chinese Academy of Agricultural Sciences, Beijing                            |
| CIMMYT                 | *Centro Internacional de Mejoramiento de Maiz y Trigo, Mexico                 |
| Cuba                   | *Academia de Ciencias de Cuba, Habana   |
| Czechoslovakia         | Research Institute of Plant Production, Praha                                 |
| Ecuador                | *Instituto Nacional de Investigaciones Agropecuarias, Quito                   |
| Egypt                  | *Agricultural Research Centre, Giza   |
| Ghana                  | *Crops Research Institute, Bunso Agricultural Experiment Station, Bunso       |
| ICARDA                 | *International Centre for Agricultural Research for Dry Areas, Aleppo         |
| ILCA                   | International Livestock Centre for Africa, Addis Ababa, Ethiopia              |
| India                  | National Bureau of Plant Genetic Resources, New Delhi                         |
| Iran                   | *Seed and Plant Improvement Institute, Karadj                                 |
| Ivory Coast            | *Ministère de Recherche Scientifique, Abidjan                                 |
| Kenya                  | *Kenya Agricultural Research Institute, Nairobi                               |
| Malaysia               | *Malaysian Agricultural Research and Development Institute, Kuala Lumpur      |
| Mozambique             | *Universidade Eduardo Mondlane, Maputo  |
| Netherlands            | National Genebank, Wageningen   |
| Niger                  | *University of Niamey   |
| Nigeria                | *National Horticultural Research Institute, Ibadan                            |
| Peru                   | *Instituto Nacional de Investigación y Promoción Agropecuaria, Lima           |
| Poland                 | Plant Breeding and Acclimatisation Institute, Radzikow                        |
| Sudan                  | *Agricultural Research Centre, Wad Medani                                     |
| Togo                   | *Direction de la Recherche Agronomique, Lomé                                  |
| Tunisia                | *Ministère de l'Enseignement Supérieur et de la Recherche Scientifique, Tunis |
| Upper Volta            | *Institut Voltâique de Recherche Agronomique et Zootechnique, Ouagadougou     |
| Zimbabwe               | *Ministry of Agriculture Crop Breeding Institute, Harare                      |

\* Denotes IBPGR assistance with seed storage facilities