Management of seed genebank

M Elangovan
Senior Scientist, Directorate of Sorghum Research (DSR) Hyderabad 500030 (AP)

1. Introduction

The seed genebank standards was first set by then International Board on Plant Genetic Resources (IBPGR) and International Plant Genetic Resources Institute (IPGRI), now Bioversity International on the basis of a report from a FAO/IBPGR Expert Consultation Group which met in Rome, Italy from 26–29 May 1992. The most widely used technique for conserving plant genetic resources is seed banking. Seeds are dried to low moisture content and stored at subzero temperatures in cold stores or deep freezers. According to FAO, this technique accounts for 90% of the 6 million accessions conserved *ex situ* globally. However, this technique is only possible for species with seeds that can tolerate desiccation and low temperatures. Many species have seeds that cannot survive under such conditions. For species with so-called 'recalcitrant' seeds or species that are vegetatively propagated, such as roots tubers and aroids, different conservation techniques are used.

Genebanks conserve genetic resources. The most fundamental activity in a genebank is to treat a new sample in a way that will prolong its viability as long as possible while ensuring its quality. The samples (or accessions as they are called) are monitored to ensure that they are not losing viability. A cornerstone of genebank operations is the reproduction—called regeneration—of its plant material. Plant samples must periodically be grown out, regenerated, and new seed harvested because, even under the best of conservation conditions, samples will eventually die (Bioversity International 2006). There are almost 1500 genebanks in the world housing some 6.5 million samples of plant germplasm, of which some 1-2 millions are thought to be distinct (GCD Trust, 2006).

Indian subcontinent is one of the 12 mega biodiversity centres (Zeven and Zhukovsky, 1975) and represents two of the eight Vavilovian centres of origin and diversity of crop plants (Harlen, 1971).

2. National Genebank

National Bureau of Plant Genetic Resources (NBPGR) is the lead institute for national network on plant genetic resources conservation. The import and export of seeds, plants, products and planting materials in India are regulated by the rules and regulations under DIP Act of 1914. NBPGR has been authorized to issue Import Permit and import/export of agricultural, horticultural and agri-silvicultural plants in small quantities for research purpose for public and private sector research base.

It houses National Genebank, primarily responsible for conservation of seed collections on long term basis for posterity. Long term conservation is achieved by conserving the seeds in modules maintained at -20^{o}C and through cryopreservation of ex-plants, organs and/or cells at -196 ^{o}C. The viability of the seeds is maintained at -20^{o}C for 25–50 years and at -196 ^{o}C for infinite period. The base collections are not meant to be distributed, except in emergency, on loss of an accession, for regeneration of active collections and facilitate the activity of community bank.

The introduced materials from other countries are assigned Exotic Collection (EC) number while the Indigenous Collections (IC) are assigned IC numbers.

3. National Active Germplasm Sites (NAGS)

Under the National Network on Conservation of PGR, 40 crop specific NAGS holds active/working germplasm collections in cold storage modules for sustainable use. Active collections are for use in present day research and crop improvement efforts. NAGS are responsible for multiplication, evaluation and distribution of germplasm to the bonafied users. They are situated at various ICAR institutes, State Agricultural Universities and other research organizations which hold 2.0 lakh accessions. Apart from these NBPGR, Regional Stations holds 1.1 lakh active collections in its 10 stations.

4. Seed genebank

Seed genebanks are set with the objective to minimize the loss of viability and genetic integrity of seed material during storage and regeneration. Seed genebanks are for orthodox seed species which can be dried to very low seed moisture. There are three types of seed bank storage viz., short-term, medium-term and long-term storages.

4.1: Short-term storage (STS): These are generally maintained at a temperature of 15–20^{o}C and relative humidity (RH) of 30–40 per cent. The breeders materials and germplasm materials in processing for long-term can be stored in these short-term storage modules.

4.2: Medium-term storage (MTS): The temperature of 0–10^{o}C and relative humidity (RH) of 25–30% and seed moisture 6–8% are adequate for medium-term storage modules. It can maintain seed longevity for a period of 25–35 years. These storage modules are meant to maintain active collections. Medium-term conservation, regeneration, multiplication, distribution to bonafied users and evaluation are other important activities. The accession size comprises of as large a quantity as possible to avoid frequent regeneration. Relative humidity is controlled through de-humidifier. Since RH is controlled, the seeds in MTS can be kept in paper bag, cloth bag or any other moisture pervious containers. The viability of the seeds is monitored in the interval of five years.

4.3: Long-term storage (LTS): The storage condition in the long-term refers to a temperature of -10 to -20^{o}C and no control of relative humidity. Only the base collections are maintained in these conditions and it can maintain the seed anywhere from 50-100 years. The base collections with a minimum of 2000 seeds for self-pollinated crops and 4000 seeds for cross-pollinated crops are generally preferred for storage. In case of wild species, 500 seeds must be stored. The seeds are dried to a moisture content of 3-7 per cent and the seeds are stored in a hermetically sealing the container.

5. Standards for seed genebank

5.1: Seed drying: Seeds should be dried prior to place in the storage bags/containers. Sun drying/shade drying, natural air drying, hot air drying, and use of desiccants in sealed containers are generally used. Lower the seed moisture for prolonging the longevity of the seed using the dehumidifier or drying the seed at 10-25^{o}C and 10-15 per cent relative humidity.

5.2: Seed cleaning: The seed to be stored should be fee from weeds, pests and diseases. Crop specific knowledge on weeds, pests and diseases associated with the seeds are preferred.

5.3: Storage containers: The storage containers are different for the three types of storage purposes. Generally, paper bags or plastic bags are used in the short-term storage, plastic containers, and plastic pouches are used in the medium-term storage. Where as in the long-term storage modules, aluminum containers, multi-layered pouches of polyethylene are used.

5.4: Monitoring of seed viability: The minimum acceptable limit of germination is 65–85% for genebanks. It will be assessed through germination test. A minimum of 100-200 seeds are used for germination at the start of the seed storage. The period of viability monitoring is 10 years for base collections and 5 years for active collections.

5.5: Regeneration: Regeneration should be undertaken when the viability falls below 85%. Seeds of 100 plants or more seeds for regeneration to avoid large losses of allele. Seeds used for regeneration should be genetically as close as possible to the original sample

5.6: Information management: Plant Genetic Resources database is very important at national, international, regional and global level to conservation of rapidly disappearing genetic stocks for possible future use in crop improvement programmes. The following databases are important for the management of seed genebank.

5.6.1: Germplasm Passport database: The data referring to the identity and history of an accession, collected at the time of collection.

5.6.2: Germplasm Characterization database: The database of an individual accessions on recording of those characters that are highly heritable, can be seen by the naked eye, and are expressed in all environments evaluation

5.6.3: Germplasm Evaluation database: The database of individual accessions on recording those characters those are important from the point of value of an accession.
5.6.4: Genebank Conservation database: The database with the information on genebank storage (accession number, form of material, form of storage, location, storage date, seed quantity), viability monitoring and regeneration of the material.

5.7: Germplasm exchange: The seeds should be supplied in suitable containers with adequate information of the material for effective use. Seed lot should have high viability level. Plant quarantine regulations are strictly followed. The material should also accompany Material Transfer Agreement (MTA) as per national requirement

5.8: Maintenance of module: A voltage stabilizer to protect from voltage fluctuations, a built-in electric control panel with complete operation information and indicator lights to display operating conditions are important. The spares such as compressor unit, thermostat, fan motor, expansion valves, compressor contractor, overload relays, and fuses etc for immediate replacements are very much essential to run the module with out any major interruption

5.9: Safety and security of module: Uninterrupted power supply to the module especially in summer, fire precautions, alarm, security to the personals like protective cloths and material are to be taken into consideration. The refrigeration standards and construction and installation should follow as per the Design of Seed Store Facility (DSSF).

6. Sorghum Seed Genebank at DSR

Directorate of Sorghum Research (DSR) is one of the National Active Germplasm Sites (NAGS) to act as a national repository for sorghum germplasm in India. The objectives of the sorghum genebank are collection, conservation, characterization, evaluation, documentation of sorghum genetic resources and distribute to the bonafied users of the country.

6.1: Germplasm collection: A total of 1194 accessions are collected by DSR since 2002–2012 and 22,550 acc. received from national and international research institutes.

6.2: Germplasm conservation: A total of 31,944 accessions are conserved at medium-term storage. The maximum contribution was from repatriation material (19,199 acc.). Since 2002, a total of 7458 accessions are submitted to the National Genebank (NGB), NBPGR, for long-term storage.

6.3: Material Transfer Agreement: Since 2001, a total of 46,928 germplasm source materials were distributed to the sorghum researchers of the country. A total of Standard Material Transfer Agreement (MTA) for exchange of sorghum genetic resources to the bonafied users of the country for research purposes is developed and documented since 2002

7. Conclusion

History stands testimony to the fact that human beings conserved the seeds for food and later seeds for multiplication and livelihood security. The world today is fighting for the rights and ownership. Hence, we need to conserve our diversity in the seed banks to prevent bio-piracy and for our children's tomorrow.

8. Suggested readings:

Biodiversity themes, Bioversity International, 2006

GCD Trust, 2006. The role of the Global Crop Diversity Trust in helping Ensure the Long-term Conservation and Availability of PGRFA – an overview, 1-6.

Harlen JR, 1971. Agricultural origin: Centres and non-centres. Science, 174: 468-474.

Manual on Maintenance and management of seed bank facilities, Under the Jai Vigyan National Science and Technology Mission on Conservations of Agro biodiversity and the National Agricultural Technology Project on Plant Biodiversity, 2001.

Zeven AC and PM Zhukovsky, 1975. Dictionary of cultivated plants and their centres of diversity PUDOC, Wageningen, p219.