Seed quality of genetic resources at ICRISAT

Introduction
- Plant Genetic Resources (PGR) are the most important components of biodiversity.
- The Rajendran Sadasivam Genebank at ICRISAT conserves over 114,600 accessions of sorghum, pearl millet, chickpea, pigeonpea, groundnut and six small millets (finger millet, foxtail millet, little millet, kodo millet, proso millet, and barnyard millet).
- Maintaining seed quality of such a large collection requires careful planning and standard protocols for seed production and storage.
- Majority of the accessions are orthodox seed producing lines. Only a few wild species are vegetatively propagated. Seed quality plays a major role in seedling establishment, crop growth and production, and genetic conservation.
- Several pre- and post-harvest factors such as crop management, seed production environment, maturity, harvesting, cleaning and drying practices influence initial seed quality and its subsequent longevity.

Materials and methods
International Genebank Standards (FAO/PGS 1994) are followed to maintain seed quality of the conserved germplasm.

Conservation of germplasm
- Active collections are stored in standard aluminium cans (medium-term storage up to 25 years at 4°C and 50% RH) and supplied to scientists for research and training (Figure 1).
- Rare collections are stored at -20°C in vacuum packaged standard aluminium foil packets at -3 to -7°C seed moisture (long-term storage up to 77 years) for safety and priority.

Regeneration of germplasm
- Deposition of seed in storage necessitates regular regeneration of collections, which is simple and involves no risk to genetic integrity.
- Germplasm regeneration at ICRISAT is mainly carried out in the avocado season.
- Genetic diversity in sorghum and pearl millet accessions is maintained by selfing during storage (Figure 2) and in pigeonpea, by growing plants in field nurseries (Figure 3).
- Chickpeas need special treatment: seeds are separated by polystyrene sheets during heat (6 weeks) to control soil borne diseases, particularly the bacteria wilt.

Harvesting and drying
- Harvesting, threshing and handling are done manually to avoid abrasion and mechanical injuries to seeds. Clean seed transfer immediately to cool rooms avoids loss of seed viability.
- Sorghum and millet seeds are cleaned using a winnow. Chickpeas, pigeonpeas, and groundnut seeds are cleaned manually through winnowing.
- Standard sieves are used to separate seeds of good quality.

Seed moisture testing
- A low-temperature near-drying method (100°C for 16 hours for groundnut and a high-temperature drying method (150°C for 1 hour) for sorghum, millets, chickpea and pigeonpeas follow the International Seed Testing Association (ISTA) procedures.

Seed drying
- Seed longevity depends upon crop species, the initial quality of the seed, the moisture content to which seeds have been dried and the temperature at which they are stored.
- A balance seed drying room with 15°C and 35% RH (Figure 4) is used for drying germplasm seed and the seeds of different crops with initial moisture contents of up to 25% to 30% are dried to 5.4% to 5.9% within four weeks for long-term conservation (Saty et al., 2003).
- Desiccation injury is rare in orthodox seeds and reducing seed moisture content to lower than 8% has proved to be a promising technique for reducing risk of deterioration.

Seed health testing
- Germination seed health testing is carried out on all accessions meant for storage, and accessions with significant infection levels are identified for further regeneration.
- A selection test for all samples and an agar test for a specific pest control by incubation at 22°C near ultra-violet (UV) light for 7 days, and microscopic examination of individual seed for detecting seed-associated microorganisms (Figure 5).

Seed viability testing
- The standard germination test is used to measure the seed quality.
- Germination tests are evaluated and classified as (1) normal, which are capable of growing into plants given favorable conditions, (2) abnormal, which are incapable of further development, (3) deficiency, (4) death or decay (Figure 6).
- General guidelines and specific advice on the conduct of germination and appropriate dormancy-breaking procedures are followed (Sha et al., 1998).
- Mean viability in the two viability tests on active collections conservative for 3 to 7 years in the CRII genebank ranged between 87.0% and 87.7% and mean of all accessions (19,840) is 94.4%, which is well above the minimum standards (95%) for active collections (Table 1).
- The viability of grain stored in a genetic resource genebank decreases significantly. Genebank accessions (active and base collections) are stored regularly. The period varies (5-20 years) depending on storage conditions, the crop and the initial seed viability.

Conclusions
- The ex situ collection of ICRISAT has been maintained at preferred genebank standards for present and future use of humankind.
- Core collection (10% of entire collection) and mini core collection (10% of core and 1% of entire collection) are conserved and supplied to researchers.
- Germplasm conserved at ICRISAT genebank has become an important source of diversity available to breeders in both public and private sectors throughout the world.
- Stashed germplasm accessions of other crops have been released directly as cultivars in 44 countries contributing to food security. Viable numbers of germplasm accessions have been used as building blocks for numerous varieties and hybrids cultivated in many parts of the world.

References

International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), Patancheru 502 324, Andhra Pradesh, India