

Introduction

Plant genetic resources are the basic materials for progress in crop improvement and an insurance against unforeseen threats to agricultural production. Greater use of germplasm in crop improvement is needed for sustainable conservation of genetic resources, to protect the natural ecosystems and simultaneously enhance agricultural production for food security.

Crop improvement programs globally benefited from the genebank collections

- ICRISAT genebank distributed 0.70 million seed samples to researchers in 144 countries and 0.65 million samples to researchers at ICRISAT
- Seventy-five germplasm accessions directly released as cultivars in 39 countries contributing to food security
- Six hundred and fifty seven cultivars developed from ICRISAT-bred materials were released for cultivation by the farming community in 77 countries
- Several germplasm accessions were used in academic studies and as donor parents in hybridization program.

Research approaches to enhance use of germplasm and its utilization

- A very small proportion (<1%) of the available germplasm has been used in crop improvement
- Main reason for low use of germplasm is lack of information on traits of economic importance, large size of collections, and breeders' interest in their own working collection
- Core collections (10% of entire collection) developed in chickpea, pigeonpea, groundnut, sorghum, pearl millet, finger millet, foxtail millet, Proso millet and barnyard millet to enhance germplasm use, but the number of accessions was still large
- ICRISAT scientists postulated the mini core (10% of core collection or 1% of entire collection) concept, where core collections were large (see flow diagram below)
- Mini core collections of chickpea, groundnut, pigeonpea, sorghum, pearl millet, finger millet and foxtail millet were developed (Table 1).

Table 1. Entire, core and mini core collections established in various crops.

Crop	Number of accessions			
	Entire collection	Used in core development	Core collection	Mini core collection
Sorghum	37,943	22,473	2,247	242
Pearl millet	21,594	20,766	2,094	238
Chickpea	20,140	16,991	1,956	211
Pigeonpea	13,632	12,153	1,290	146
Groundnut	15,419	14,310	1,704	184
Finger millet	5,949	5,940	622	80
Foxtail millet	1,535	1,474	155	35

Identifying new germplasm sources using core/mini core approaches

Extensive multi-disciplinary screening/evaluation of core/mini core collections at ICRISAT resulted in identifying new germplasm sources for use in crop improvement.

Resistance to biotic stresses

Chickpea: Wilt-67 accessions; dry root rot-6; ascochyta blight-3; botrytis grey mold-55; multiple diseases-31; tolerant to Helicoverpa-5

Pigeonpea: Sterility mosaic-8 accessions, wilt-5, wilt+sterility mosaic-3

Groundnut: Aflatoxin-5 accessions, ELS-3, LLS and Rust-4

Sorghum: Grain mold-50 accessions; Anthracnose-10; downy mildew-6

Finger millet: Neck blast-23 accessions

Resistance to abiotic stresses

Chickpea: Drought-18 accessions; salinity-31; high temperature-16

Pigeonpea: Salinity-16 accessions, water logging-24

Groundnut: Drought-18 accessions; salinity-12; low temperature-158

Sorghum: Salinity-7 accessions

Finger millet: Drought-10 accessions; salinity-10

Foxtail millet: Drought-10 accessions; salinity-10

Germplasm with specific agronomic traits

- Early maturing accessions in chickpea (28), groundnut (21) and pigeonpea (19)
- 39 chickpea accessions with early maturity, high yield and large seed size

- 54 accessions in pigeonpea with high yield
- 20 accessions in both finger millet and foxtail millet with high seed yield and early maturity.
- 60 groundnut accessions with large seed size, high yield and shelling percentage

Germplasm with specific nutritional traits

- Chickpea: Protein-5; anthocyanin-5
- Pigeonpea: Zinc-14
- Sorghum: Protein-10; Iron-10; Zinc-10; stalk sugar-28
- Pearl millet: Iron-1; Zinc-2
- Finger millet: Iron-15; Zinc-15; Protein-15; Calcium-15; all four nutrients-24
- Foxtail millet: Iron-10; Zinc-10; Protein-10; Calcium-10



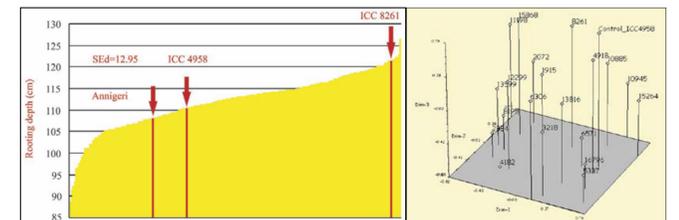
NARS using mini core/core collections

Provided on request 133 sets of mini core collections to NARS partners in 20 countries (Canada, China, France, Germany, India, Japan, Kenya, Malawi, Mali, Mexico, Niger, Nigeria, Senegal, Syria, Tanzania, Thailand, UAE, Uganda, USA and Vietnam)

NARS identified trait-specific germplasm from mini core collection

Groundnut

- Oil quality and content – China (11), Vietnam (10), India (13)
- Agronomic traits – China, Vietnam and Thailand (5 each), India (10 each in four locations)
- Disease resistance – China (bacterial wilt-14), Thailand (LLS and rust-10) and India (LLS, rust and aflatoxin-39)
- Lectin content – India (11)
- Multiple traits – India (23)
- Large seed size – India (27)
- Confectionary type – India (15)



Variation for drought tolerance (root length density) in chickpea mini core.



Variation for low temperature tolerance (at germination) (left) and salinity tolerance in groundnut (right).

Chickpea - India

- Large seeded Kabuli-13
- High yield-28
- Early maturity-23
- Ascochyta blight-6
- Botrytis grey mold-2

Pigeonpea - India

- Early maturity-8
- High seed yield-2

Sorghum - USA

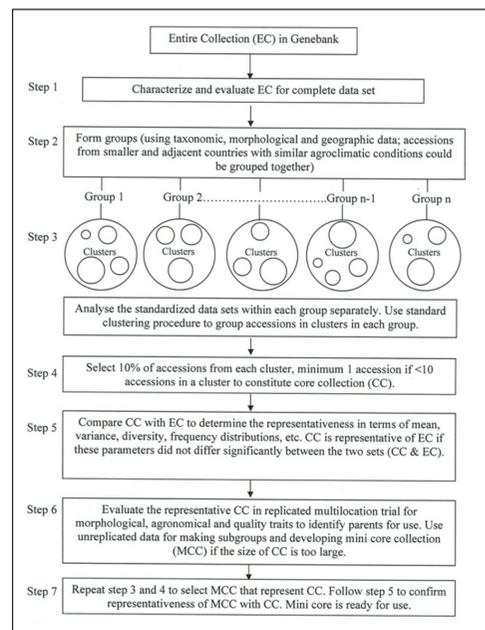
- Anthracnose-123
- Head Smut-58
- Downy mildew-31

Pearl millet - India

- Early maturity-4
- Large seed size-5
- Green fodder-19
- Grain yield-9

Conclusions

- Our strategic research on core and mini core collections and identification of trait specific diverse sources have met the long felt need of breeders and enriched their working collection
- Molecular characterization of mini core and trait specific germplasm has enhanced usefulness of germplasm to breeders in enhancing traits more efficiently and in allele mining
- Mini core collection is an International Public Good (IPG) and serves as a gateway to the utilization of plant genetic resources in crop improvement programs
- Use of trait-specific genetically diverse lines will result in development of high yielding cultivars with a broad genetic base
- NARS benefited greatly by use of mini core in identifying trait-specific genetically diverse sources for their use in crop improvement.



Flow diagram to establish core and mini core collections in a crop species.



Genotypic variation for root mass (left) and salinity tolerance (right) in chickpea.

Small millets - India

- Finger millet – Seed yield and early maturity (15 accessions in 4 locations)
- Foxtail millet - Seed yield and early maturity (15 accessions in 4 locations)