Biodiversity and Crop Improvement: An Integrated Approach to Enhance use of Plant Genetic Resources for Sustainable Food Production

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Plant genetic resources are the basic materials for future genetic progress and an insurance against unforeseen threats to agricultural production. Use of germplasm in crop improvement is one of the ways to conserve valuable genetic resources, protect the natural ecosystems, and simultaneously enhance agricultural production and food security.

Plant Genetic Resources at ICRISAT Genebank, Patancheru, India

- 118,882 accessions of its five mandate crops and six small millets from 144 countries
- 80% landraces, 16% advanced breeding lines/cultivars, 2% wild relatives
- 87% accessions preserved under long-term storage (-20°C)
- Continue to acquire new germplasm not represented in collection
- Developing marker-aided introgression lines as a resource for the discovery and exploitation of unused genetic variability
- Identifying novel alleles from wild relatives associated with agronomic traits.

- Identifying new sources of variation for crop breeding is essential to make crops adapted to these extremes
- Climate change is threatening biodiversity that must be preserved for humankind.

<table>
<thead>
<tr>
<th>Cargo</th>
<th>Entire Collection</th>
<th>Mini Core Collection</th>
<th>Composite Collection</th>
<th>Reference Set</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sorghum</td>
<td>37,904</td>
<td>22,474</td>
<td>2,247</td>
<td>242</td>
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<tr>
<td>Pearl millet</td>
<td>21,594</td>
<td>20,844</td>
<td>2,094</td>
<td>238</td>
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<tr>
<td>Chickpea</td>
<td>20,140</td>
<td>16,991</td>
<td>1,956</td>
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<td>Pigeonpea</td>
<td>13,632</td>
<td>12,153</td>
<td>1,290</td>
<td>146</td>
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<tr>
<td>Groundnut</td>
<td>15,419</td>
<td>14,310</td>
<td>1,704</td>
<td>184</td>
</tr>
<tr>
<td>Finger millet</td>
<td>5,949</td>
<td>5,940</td>
<td>622</td>
<td>65</td>
</tr>
<tr>
<td>Foxtail millet</td>
<td>1,535</td>
<td>1,474</td>
<td>155</td>
<td>-</td>
</tr>
</tbody>
</table>

Core and mini core to enhance utilization of germplasm in crop improvement

- Distributed 0.694 million seed samples to researchers in 144 countries and 0.651 million seed samples to farmers at ICRISAT
- Sixty-six germplasm lines released directly as cultivars in 44 countries contributing to food security
- Using ICRISAT-bred breeding lines, 77 countries have released 545 varieties and hybrids for cultivation by farming communities.

Crop improvement programs globally benefited from the genebank accessions

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Table 1. Entire, core, mini core, composite collections and reference sets established at ICRISAT

- Studying population structure and diversity in composite collection and reference set

- Composite collections developed for chickpea, groundnut, pigeonpea, pearl millet, sorghum, finger millet and foxtail millet
- Reference sets developed for chickpea, groundnut, pigeonpea, sorghum, finger millet and foxtail millet representing over 76% allelic variation from composite collections
- Reference sets as a resource for whole genome scanning and marker-trait association.

Global warming impacting biodiversity and world food production

- Significant decline in yields predicted for most crops, although cooler regions might benefit
- Expected are more frequent drought, flood, temperature extremes, and rise in salinity
- Identifying new sources of variation for crop breeding is essential to make crops adapted to these extremes
- Climate change is threatening biodiversity that must be preserved for humankind.

New sources identified for drought, salinity and high temperature tolerance

- 18 drought, 12 salinity and 5 high temperature tolerant chickpea lines
- 18 drought, 12 salinity and 158 low temperature tolerant groundnut lines
- 16 salinity tolerant pigeonpea lines
- 7 sorghum and 22 pearl millet salinity tolerant lines.

Conclusions

- Core and mini core collection and genotype-based reference sets are in demand by NARS for evaluation
- Tolerance to drought and salinity identified for use in crop improvement
- Genetically diverse and agronomically superior germplasm with beneficial agronomic traits identified
- Trait-specific germplasm identified by NARS
- Mini core collections and reference sets available for genomics studies.

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