Use of Chickpea and Pigeonpea Germplasm and their Impact on Crop Improvement in India

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The important pulse crops grown in India are chickpea (*Cicer arietinum* L.), pigeonpea (*Cajanus cajan* (L.) Millsp.), mung bean (*Vigna radiata* (L.) Wilczek), urd bean (*Vigna mungo* (L.) Hepper), lentil (*Lens culinaris* Medik.), fieldpea (*Pisum sativum* L.), cowpea (*Vigna unguiculata* (L.) Walp.), moth bean (*Vigna aconitifolia* (Jacq.) Marechal), horse gram (*Macrotyloma uniflorum* (Lam.) Verdc.), grass pea or khesari (*Lathyrus sativus* L.) and dry bean (*Phaseolus vulgaris* L.). Other pulses of minor importance grown in restricted areas in India are faba bean (*Vicia faba* L.), rice bean (*Vigna umbellata* (Thunb.) Ohwi and Ohashi), lablab bean (*Lablab purpureus* (L.) Sweet), and winged bean (*Psophocarpus tetragonolobus* L.). Among these, chickpea and pigeonpea are the most important.

Many of these pulses have been cultivated since time immemorial under diverse agroclimatic and management conditions which favored genetic diversity in these crops. Efforts have been made from time to time to collect, evaluate and utilize the germplasm of these pulses, particularly pigeonpea and chickpea. However, these efforts have been localized and scattered over different pulse-growing states. Germplasm collections were also made under the Rockefeller Foundation's Regional Pulse Improvement Project. All these collections were later transferred to ICRISAT. Since the establishment of the National Bureau of Plant Genetic Resources (NBPGR), joint missions involving scientists from NBPGR, Agricultural Universities, and ICRISAT have been collecting germplasm in the country.

Available Germplasm Resources

The gene bank at ICRISAT has 15 564 chickpea accessions of which 5863 lines are from India. In pigeonpea, there are 11 034 accessions of which 9084 are of Indian origin. Part of these collections are maintained under the All India Coordinated Pulses Improvement Project (AICPIP). Working collections are maintained at various centres. Among the various pulse crops, chickpea and pigeonpea are at the top of the list with respect to the number of germplasm lines.

ICRISAT (International Crops Research Institute for the Semi-Arid Tropics). 1989. Collaboration on Genetic Resources: summary proceedings of a Joint ICRISAT/NBPGR(ICAR) Workshop on Germplasm Exploration and Evaluation in India, 14-15 Nov 1988, ICRISAT Center, India. Patancheru, A.P. 502 324, India: ICRISAT.

Germplasm Distribution

As a world repository of chickpea and pigeonpea germplasm, the ICRISAT gene bank supplies germplasm to scientists working on these crops. From 1974 to 1988, a total of 33 020 samples of chickpea and 20 502 samples of pigeonpea have been sent to different programs and scientists in India. Under AICPIP, 11 centers have been assigned the responsibility to assemble and evaluate the existing germplasm, and make it available to workers in the country.

The germplasm accessions available at ICRISAT have been evaluated for 25 characters in chickpea and for 40 characters in pigeonpea. Some of these accessions have been evaluated at different locations in India—Akola, Gwalior, Issapur, and Hisar—in collaboration with NBPGR, to characterize them in different agroecological zones.

Uses of Germplasm Lines

Chickpea and pigeonpea germplasm has been used in the country in the following manner:

- direct use as released varieties for cultivation,
- sources of resistance to biotic stresses like diseases and insect pests,
- sources of tolerance to abiotic stresses like moisture deficit/excess, high/low temperature, soil salinity, etc.,
- parental material for hybridization for improvement of agronomic traits,
- base material for polyploidy and mutation breeding,
- sources of new plant types to study physiological and agronomic adaptation,
- material for basic studies on phylogenic and cytogenetic relationships, and
- material for genetic studies on the mode of inheritance, to study the expression of a gene or group of genes under different genetic backgrounds.

Impact on Crop Improvement

Many germplasm lines have been directly released as varieties. In India, germplasm lines account for about 63% of the varieties of pulses released so far. Of the 291 varieties released in 13 pulse crops, 175 are direct selections from the germplasm. Of the remaining, 6 are pure line selections, 96 through hybridization, and 14 through mutation breeding. Recent examples include ICP 8863 of pigeonpea, released as Maruti in Karnataka; and ICC 8933 of chickpea, released as JG 315 in Madhya Pradesh.

A large number of germplasm lines have been used as sources for transferring resistance to diseases. These include pigeonpea lines resistant to fusarium wilt, sterility mosaic, phytophthora blight, and chickpea lines resistant to fusarium wilt, ascochyta blight, and stunt. Most of the lines in the AICPIP Disease Nurseries that are tested at different locations are germplasm lines. Some of these are resistant to more than one isolate/strain, and also to more than one disease.

Compared to disease resistance, there are very few resistant sources for insect pests, and the level of resistance is also not high. Some lines have been identified with resistance to *Heliothis* pod borer in chickpea, and resistance to pod borer and podfly in pigeonpea. These are now being used in breeding programs.

Many lines with desirable agronomic characters such as earliness (in breeding extra-early pigeonpeas), seed size, and color (in breeding bold-seeded and kabuli chickpeas) have been used in hybridization programs to develop varieties with high yield and desirable plant type. Germplasm has contributed significantly in these programs.

The use of pigeonpea germplasm lines with the genetic male sterile gene has opened up possibilities for hybrid pigeonpeas in India. Many institutions are now using the original or converted germplasm lines in their hybrid pigeonpea programs.

Germplasm lines have been used to generate information on the inheritance of characters, and also to elucidate cytogenetic and phylogenic information.

Future Emphasis

1. The areas which have not been explored so far should be surveyed for collection of germplasm.
2. The existing germplasm available at different centers should be pooled and evaluated so as to discard duplicates and to identify desirable types.
3. Germplasm accessions should be evaluated under different agroclimatic situations and growing conditions in order to characterize them, and to test the stability of characters; the entire germplasm collection should be characterized and catalogued.
4. All the information related to germplasm should be computerized.
5. One set of germplasm should be kept at NBPGR in long-term storage, for future use.
6. Facilities to screen the germplasm against viral diseases should be strengthened and techniques for quick screening should be devised.