Utilization of Germplasm Introductions in Sunflower Improvement in India

A Seetharam and DM Hegde[1]
Emeritus Scientist, AICRP on Small Millets, UAS, GKVK Campus, Bangalore-560 065, Karnataka
[1]Project Director, Directorate of Oilseeds Research, Rajendranagar, Hyderabad-500 030, Andhra Pradesh

Plant introduction in broader perspective is a crop species or a variety or a genetic stock introduced from one country to another. In olden days the moving farmers and communities carried with them the crops and the varieties used by them to newer areas of their migration. After the advent of new world, the movement of crops between the new and old world increased enriching the crop diversity enormously in both the regions. Sunflower is one of the recent examples of successful introduction of a new world crop to India from erstwhile USSR, helping in crop diversification and improving edible oil supply in the country.

Large-scale commercial production of sunflower began in India with the introduction of four varieties from USSR – Armavarts (EC 69874), VNIIMK 8931 (EC 68413), Peredovic (EC 68414) and Armaviriskij 3497 (EC 68415). However, the new open pollinated varieties introduced were poorly adapted to climate in India. The genetic heterogeneity of the populations along with intensive selection work led to elimination of non-adopted types, resulting in new populations showing better fitness and yield. Thus the introduced sunflower varieties gradually became adopted and the two varieties viz., Peredovic and Armaviriskij 3497 covered large areas in the country. Cernianka 66 or Morden (EC 101145) is another variety introduced in 1978 after the initial process of 3-4 years of acclimatization. Owing to its superior plant stature, earliness and good seed filling found ready acceptance of the farmers. Another variety Rumsun Record (EC 132351), a cultivar introduced from Rumania was released for cultivation in Punjab.

Soon after the introduction of sunflower in early 1970's, crop improvement work was initiated using the introduced materials. The hybridization among introduced varieties resulted in generating the required genetic variation for selection (adaptation) and contributed a great deal towards the development of newer varieties with superior performance. About a dozen open pollinated varieties have been released from the above efforts.

Heterosis breeding which began in 1975 in the country was initially based on introduced CMS, Restorer and Inbreed lines from USA. Majority of the hybrids released in the country till now have one or both parental lines that are introductions. The New Seed Policy which came into being during 1988 became an important instrument for introducing superior planting materials especially hybrids from the other countries to India. As many as 116 hybrids have been tested under this scheme for their performance and adaptation and several of them have found their way to commercial cultivation.

As the sunflower breeding in the recent years is getting advanced, the introductions are largely being used as donors of gene or gene combinations required for improving the varieties/parental lines lacking in one or more characteristics such as susceptibility to important diseases like downy mildew, rust, *Alternaria* leaf spot and viral necrosis; pests such as capitulum borer and several foliage feeding caterpillars; and for improving oil content and quality.

More than 7000 accessions of sunflower germplasm have been introduced from over 33 countries during the past five decades through NBPGR. This includes wild species, open pollinated varieties, improved populations, land races, CMS/GMS lines, maintainer lines, restorer lines, large number of inbreeds, hybrids and other genetic stocks. As many as 43 wild and weedy species representing secondary and tertiary gene pool have been introduced.

The introduced germplasm have been evaluated for their usefulness in national crop improvement activities. Germplasm accessions promising for yield components, agronomic attributes, oil content, oil quality, high autogamy, various biotic and abiotic stresses have been identified. The utility of wild species as sources of useful genes especially for major diseases prevailing in the country has been assessed.

Genetic enhancement work has been going on at several locations in the country using the introduced germplasm. One area of concern related to introduced germplasm is inadequate attention shown towards its conservation. Only one-fourth of the introduced genetic stocks may have been conserved in the country and even these stocks might have undergone significant

genetic changes due to inadequate population size during maintenance and regeneration.

Sunflower being a recent introduction to India, the availability of local germplasm is negligible therefore, the dependence on introduced germplasm is inevitable.

Off late access to new materials present outside the country is getting difficult and restricted. It is important to find ways and means of augmenting superior germplasm and channalizing them to the national breeding programmes. This includes primary, secondary and tertiary gene pools especially from the centres of crop diversity.

The Central and North America possess the largest diversity especially in wild and weedy relatives which could be used as donors of useful genes for managing several important biotic and abiotic stress factors.

Sunflower was domesticated first in Europe in later part of 18 century and contributed a great deal for the creation of large diversity in cultivated sunflower (primary gene pool). Carefully planned introductions from these countries could help considerably the genetic enhancement of the already acclimatized local elite material. Introductions from Australia, Argentina and Brazil having similar ecology as that of India might be equally useful. Introduction of germplasm having special attributes like non oil types and with unique oil quality (high oleic, high linoleic) is important for enlarging the industrial base of the crop in India.

Using Genetic Resources to Augment Sunflower Production

Dragan Škoric
Institute of Field and Vegetable Crops, 21000 Novi Sad, Serbia and Montenegro

Key Words: Sunflower, Genetic resources, Breeding, Diseases, Insects, Drought, Oil Quality

The limiting factor in sunflower production is the narrow genetic variability within cultivated sunflower genotypes, insufficient resistance to diseases and insects, insufficient tolerance to stress conditions (soil and atmospheric drought), poor adaptability to changed growing conditions, low self-fertility, insufficient attractiveness to pollinators (bees), and inefficient use of soil nutrients. All this highlights the importance of utilizing wild species of the genus *Helianthus* in increasing the genetic variability of the cultivated sunflower.

In countries of southeast Asia, sunflower is a new oil crop. Its production in the region is hampered by a number of limiting factors. This paper reviews the possibility of increasing the genetic variability of the cultivated sunflower through an increased use of wild species of the genus *Helianthus* by means of interspecific hybridization.

Sunflower breeding for direct and indirect components is key to obtaining productive hybrids of this crop. The breeders' primary task is to find genes for resistance to downy mildew, rust, *Alternaria*, *Sclerotinia*, *Macrophomina* and other pathogens in wild sunflower species and then incorporate them into cultivated sunflower genotypes. Sunflower breeding for resistance to drought is also very important. Another high-priority task is the development of increased salt tolerance. No less important is selection for increased tolerance to certain insects causing economic damage to sunflower crops. Wild sunflower species can be successfully used in breeding for resistance to certain herbicide groups.

In breeding programs, it is very important that the breeder realizes limitation of working on a large number of traits simultaneously. Therefore, priorities need to be in advance set and hybrid development to be carried out gradually. Also, it is essential for the breeder to involve experts from various fields. Recently, use of the new biotechnology methods assumed great importance to achieve the goals faster and with greater success rate. The quality of sunflower oil can also be changed using induced mutations.

Conclusions of our analysis of sunflower production in southeast Asia with special focus on India as the region's main sunflower grower, reveals that sunflower production is limited by a number of factors. The main factor is deficiency of genes found in sunflower genotypes used commercially. Inadequate implementation of cultural practices also leads to low and unstable yields. Problems