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.

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# Using Genetic Resources to Augment Sunflower Production

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**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 facing sunflower production can be overcome by increasing the genetic variability of the cultivated sunflower by using wild sunflower species for interspecific hybridization.

Breeding for yield components, disease, insect and drought resistance, salt tolerance, oil quality and herbicide resistance require increased utilization of wild species of the genus *Helianthus*.

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# Indo-UK Collaboration on Oilseeds–Towards Improving the Genetic Base of Rapeseed-Mustard in India

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The key factors to increased production are the evaluation of a wide range of genotypes under appropriate testing environments. Genetic enhancement will continue to be an exciting and important dimension for the improvement of cropping systems and will certainly contribute to the sustainability of crop production in the future.

Indo-UK Collaboration (Phase II) on Oilseed Crops (Rapeseed-Mustard) is an 8-year project started in 1998, which follows on from a successful phase-I project (1991-1998). Phase I was collaboration between Rothamsted Research (UK) and GB Pant University of Agriculture and Technology–Pantnagar (GBPUAT). Rothamsted Research is implementing phase-II under the umbrella of the Indian Council of Agricultural Research in collaboration with the National Research Centre on Rapeseed-Mustard (Bharatpur), The Energy and Resources Institute (New Delhi) and GBPUAT-Pantnagar. Phase-I focused on resistance to downy mildew, whereas phase-II is focusing on; a) developing resistance to white rust and Alternaria blight diseases, b) develop rapeseed-mustard crops in 15 districts across seven states in India through farmers participatory research as well as rural livelihoods development.

A range of accessions, which included breeding lines developed at Rothamsted Research with wide differential resistant profile to *Phytophthora parasitica*, were given to GBPUAT-Pantnagar through the National Bureau of Plant Genetic Resources (New Delhi) for adaptation, evaluation and further selection. These included 54 accessions of *Brassica napus*, 52 of *B. juncea* and 23 of *B. rapa*. Two accessions of *B. napus* code named EC 338986-2 and EC 338996-1, maintained high resistance to downy mildew and white rust as well as tolerance to *Alternaria* blight and *Seclerotinia* stem rot, whereas EC 339000 stood out as relatively early maturing with high yield, particularly n the hilly regions like Kangra (Himachal Pradesh) and RS Pura (Jammu & Kashmir) and had more yield than the national check (GSL-1). Four accessions of *B. juncea*, EC 399296, EC 399299, EC 399301 and EC 399313 appeared to be almost free from downy mildew, white rust and *Seclerotinia* as well as tolerant to *Alternaria* blight diseases. Moreover, two more accessions of *B. juncea*, EC 414308 (code named NRCR-837) and EC 414319 (code named NRCR-836) were evaluated in initial variety trial (IVT) and found to be tolerant to downy mildew, white rust and *Sclerotinia* stem rot. EC 414308 was promoted to advanced variety trial -1 (AVT-1). EC 399301 has been extensively utilized in the breeding programme.

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