https://scienceinkrishi.com
KS-2026-3; *Geeta*, 2026
Popular article ISSN:2583-4150

PRE-BREEDING: UNLOCKING NATURE'S HIDDEN POTENTIAL FOR BETTER CROPS

Geetha Devi G.

College of Agriculture, Acharya N G Ranga Agricultural University, Bapatla, AP-522101

*Corresponding author: geethakrishna940@gmail.com

Accepted on July 12, 2026

Introduction

The term Pre-breeding or enhancement was first used by Jones (1983); later, Rick (1984) used the term pre-breeding. Pre-breeding, also called as genetic enhancement, is the process of identifying and transferring useful genes from unadapted or wild germplasm into breeding materials that plant breeders can use to develop improved crop varieties (Bessey, C.E., 1906). It offers a unique opportunity by introgression of desirable genes from wild germplasm into cultivated varieties. It is an early phase of any breeding program to utilize wild genetic resources for the development of new varieties. Conventional plant breeding relies on selecting only the best-performing plants, which narrows the genetic base of many crops, making them more vulnerable to environmental stresses and reducing opportunities for further improvement to avoid this, pre-breeding becomes indispensable. It identifies and transfers valuable genes from wild species, wild relatives, landraces and other genetic resources into breeding materials that can be readily used by the plant breeders. Though the process may not receive widespread attention, it lays the foundation for the development of superior crop varieties capable of feeding the world in the face of changing environmental conditions (Jain, S.K., Omprakash., 2019).

Objectives

- To broaden the genetic base.
- Transfer of abiotic and biotic stress resistance genes.
- Improvement of parental stocks.
- Enhancement of quality and nutritional traits.

Why is it important?

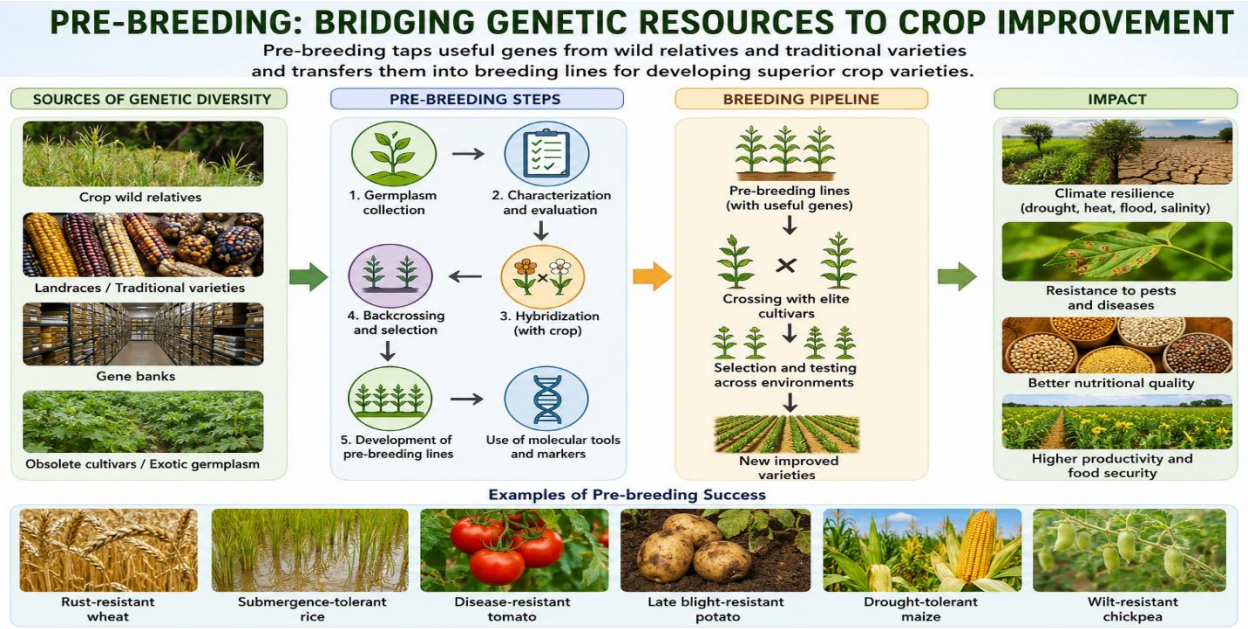
- Broadening the genetic base: Many modern crop varieties share a narrow genetic background because they originate from a limited number of parental lines (Nass, L.L. and Paterniani, E., 2000). While this has increased productivity, it has also reduced genetic diversity, making crops more susceptible to diseases and environmental stresses. Pre-breeding introduces new genes into breeding populations, thereby expanding the genetic base and enhancing breeding potential.
- Combating climate change: Changing climatic conditions expose crops to drought, heat waves, floods, salinity, and erratic rainfall. Many wild relatives (Valkoun, J.J., 2001) possess natural adaptations to these harsh environments.
- Improving resistance to pests and diseases: New races of pathogens and insect pests continue to evolve, often overcoming existing resistance genes. Wild species and traditional varieties by nature possess novel resistance genes that are absent in cultivated crops.
- Enhancing nutritional quality: Nowadays, there is a demand for nutritious foods rich in vitamins, minerals, and protein. It facilitates the transfer of genes responsible for improved nutritional quality, contributing to biofortified crops that address hidden hunger and malnutrition.
- Conservation of genetic resources: These plant genetic resources are conserved in gene banks worldwide (Ortiz, R., 1999). Without active utilization, these collections remain underexploited. It transforms stored germplasm into useful breeding materials, ensuring that valuable genetic diversity contributes to crop improvement.
- Developing improved cultivars to meet the market requirement.

Pre-breeding:how it is done

The following steps are required to do pre-breeding:

- Germplasm collection or tapping: Research scientists collect plant materials from farmers' fields, forests, research institutions and gene banks.
- Characterization and evaluation: All the available germplasm lines are studied for important traits, and those traits invisible to the naked eye are evaluated by using modern molecular tools that identify useful genes with greater precision.
- Selection of donor parents: Promising accessions were selected as donor parents for crossing with cultivated varieties.

- Hybridization: The donor parent is crossed with an adapted cultivar to transfer the target trait into an agronomically acceptable background.
- Backcrossing and selection: 4 to 5 generations of backcrossing and selection are carried out to eliminate undesirable traits while retaining the desired gene. This step minimises linkage drag.
- Development of pre-breeding lines: This is the final step after the selection process; pre-bred lines were utilized as valuable parental materials for plant breeders.



Problems associated with pre-breeding are:

- Cross incompatibility barriers
- Linkage drags
- Hybrid inviability and sterility
- Lack of availability of donors for specific traits
- Longer duration, temperature and photoperiod sensitivity of wild species
- Unstability of introgressed genes
- Intellectual property and legal bottlenecks

Methods involved in pre-breeding

- Back cross, wide cross and bridge cross through conventional breeding.
- Marker-assisted selection enables breeders to identify plants carrying desired genes irrespective of stage of plant development.

- Genomic selection predicts breeding values using genome-wide markers, which accelerates the selection process.
- Genome sequencing helps in discovering novel genes associated with important agronomic traits.
- Gene editing technologies allow precise modification of target genes.
- Speed breeding shortens generation time, enabling several breeding cycles within a single year.
- Artificial intelligence and data analysis assist researchers in analyzing large datasets to identify promising germplasm.

Conclusion

Pre-breeding is a vital bridge between genetic resource conservation and crop improvement. It enables breeders to identify and transfer desirable genes from wild germplasm to the adapted breeding lines. This broadens the genetic base of crops by introgression of resistance genes to both abiotic and biotic stress and it improves yield, quality, and development of climate-resilient varieties. Pre-breeding may not produce commercial crop varieties directly, but it acts as a raw material in the breeding of cultivated varieties. Pre-breeding enriches the genetic diversity available to plant breeders to ensure sustainable agriculture for future generations.

References

Bessey, C.E., 1906. Crop improvement by utilizing wild species. *Journal of Heredity*, (1):112-118.

Ortiz, R., 1999. Genetic diversity of cultivated crops and in situ conservation of genetic resources. *Bot. Lithuanica Suppl*, 2:15-30.

Nass, L.L. and Paterniani, E., 2000. Pre-breeding: a link between genetic resources and maize breeding. *Scientia Agricola*, 57:581-587.

Valkoun, J.J., 2001. Wheat pre-breeding using wild progenitors. *Euphytica*, *119*(1):17-23.

Jain, S.K., Omprakash., 2019. Pre-breeding: a bridge between genetic resources and crop improvement. *Int J Curr Microbiol Appl Sci*, 8(2):1998-2007.