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Pre-Breeding Approaches in Crop Improvements

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Introduction

Pre-breeding includes basic research attempt to make wide crosses, and activities that facilitate the use of exotic materials or wild relatives for crop improvement. Pre-breeding consists of identifying a useful character, capturing its genetic diversity and putting such genes into usable form. Pre-breeding activities confined to transferring resistance gene(s) to major diseases and insects, and tolerance to abiotic stresses, from wild relatives into cultivated through using introgression and incorporation techniques. Pre-breeding aims to keep breeders ready to use materials with specific traits of interest as well as a means to broaden the diversity of improved germplasm. It does not differ significantly from general framework of plant breeding and is considered as vital step of sustainable plant breeding. The Global Crop Diversity Trust defined pre-breeding as 'the art of identifying desired traits, and incorporation of these into modern breeding materials'. As pre-breeding is being carried out, the resulting materials are expected to have merit to be included in ordinary breeding programs. Pre-breeding aims to reduce genetic uniformity in crops through the use of a wider pool of genetic material to increase yield, resistance to pests and diseases, and other quality traits.

Genetic enhancement / Pre-breeding approaches:

1. Backcross

Backcross refers to crossing either of its parents. Backcross is widely used for introgression and incorporation of desirable gene from exotic germplasm and wild species into well adapted cultivars.

(a) Introgression

Introgression is the transfer of one or more genes from exotic/un-adapted / wild stock to adapted breeding populations. This can be achieved by making crosses between the donor and the recurrent parent. The concept of introgression through crop breeding techniques like backcrossing was evolved by Dr. Edgar Anderson.

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(b) Incorporation

Incorporation aims to develop locally adapted population using exotic / un-adapted germplasm. This was first suggested by Simmonds. In contanary to introgression, incorporation aims at indexing the crop genetic base.

2. Convergent Improvement

- In this method two genotype say A and B are selected for crossing. The crossing is done between these genotypes and the F1 is backcrossed to both A and B parents.
- The main objective of this scheme is to improve both the lines simultaneously.
- The desirable character of A is transferred to B and vice-versa.
- This method is used when each of the two parent is deficient in one character which is present in the other parent.

3. Bridge cross

- Bridge cross is used when the hybrid between cultivated species and wild species is sterile in a backcross programme and this does not permit the transfer of character from the donor to the recipient species.
- An example of pre breeding through bridge cross is the use of synthetic N. digluta for the transfer of resistance to tobacco mosaic virus from N. sylvestris to N. tobacum (2n = 4x = 48).

4. Biotechnological Approaches

- The transfer of genes for various aspects viz. insect resistance, virus resistance, herbicide resistance, quality traits etc. From unrelated species or even from unrelated organism into easily crossable genetic background also comes under pre-breeding.
- example- glyphosate resistant soyabean etc.

Introgression lines with good agronomic performance derived from three-way interspecific crosses for use in chickpea improvement.

Traits	Number of promising introgression lines	
	ICC 4958 ´ (ICC 17264 ´ IG 69978)	ICCV 95311 ´ (IG 72933 ´ ICC 20192

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Early flowering (<40 d)	33	---
Number of pods per plant (>200 pods)	63	114
Pod weight per plant (>100 g)	7	3
Number of seeds per plant (>200 seeds)	47	104
Seed weight per plant (>100 g)	3	2

Advanced backcross populations derived from wild species for use in chickpea, and pigeonpea improvement programs available at ICRISAT, Patancheru, India.

Cross	Generation	Number of lines
Chickpea		
ICC 4958 ´ (ICC 17264 ´ IG 69978)	BC2F4	~1500
ICCV 95311 ´ (IG 72933 ´ ICC 20192)	BC2F3	~2000
Pigeonpea		
ICPW 68 ´ ICPL 85010	BC4F12	138
ICPL 85010 ´ ICPW 004	BC1F13	68
ICPL 87119 ´ ICPW 12	BC2F7	149
ICPL 87119 ´ ICPW 29	BC2F7	183

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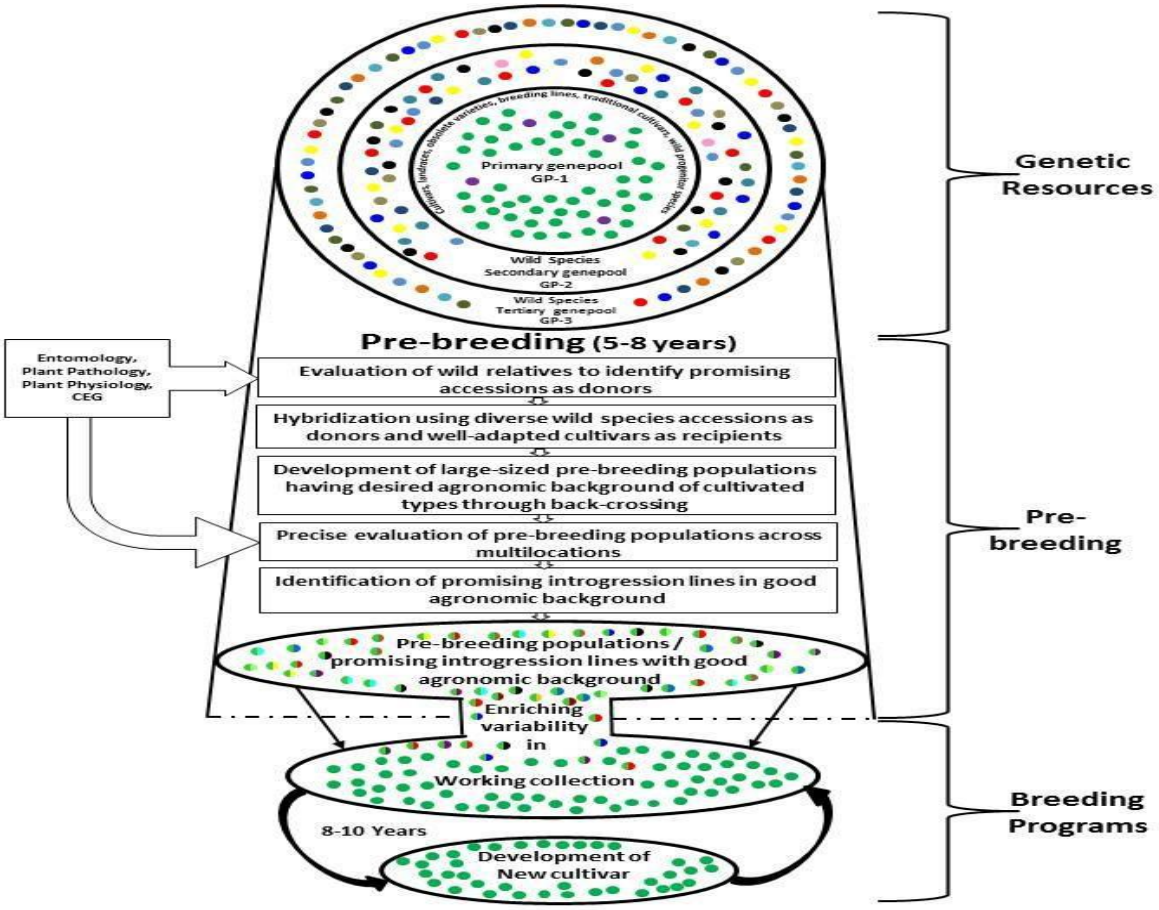
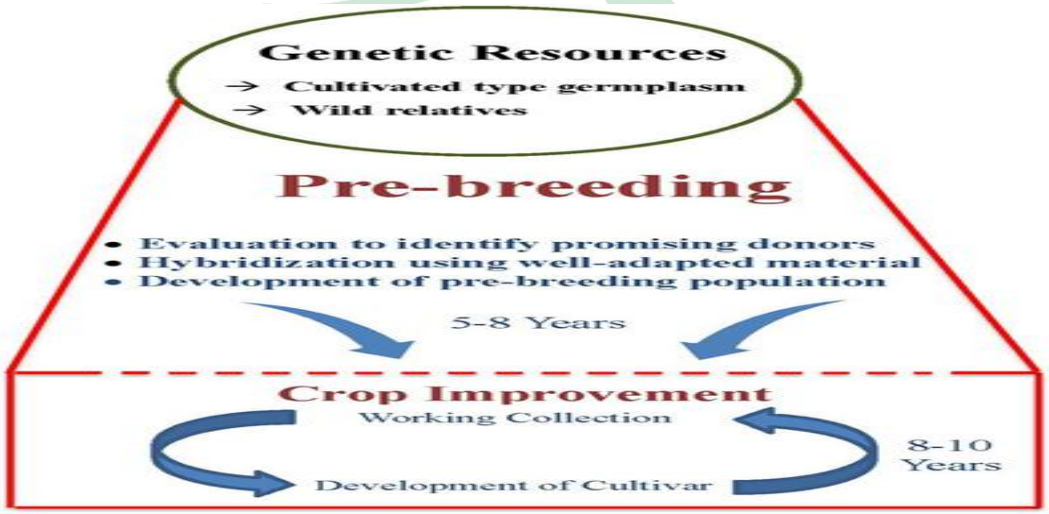
Procedure of pre breeding and Breeding Programs



Pre-breeding as a bridge between genetic resources and crop improvement



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Conclusion:

The process of pre-breeding identifies a useful character in unadapted materials, 'captures' it's genetic diversity, and incorporates those genes into a usable form employing different techniques: For field crops improvement, sufficient genetic diversity exists in the form of landraces and wild relatives, which carry several useful genes for cultivar improvement. However, utilization of these resources in breeding programs is time-consuming and resource demanding. To overcome this, pre-breeding activities should be initiated to generate new genetic variability using promising landraces and wild relatives for use by the breeders in crop improvement programs. Pre-breeding should focus on the continuous supply of useful variability into the breeding pipeline to develop new high-yielding cultivars with a broad genetic base, pre-breeding should not focus on increasing yield. Though pre-breeding is useful to enrich the primary gene pool for cultivar improvement, it is a time-consuming and difficult affair as well.