Pre-Breeding

&

Green Revolution

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Pre-breeding

Video

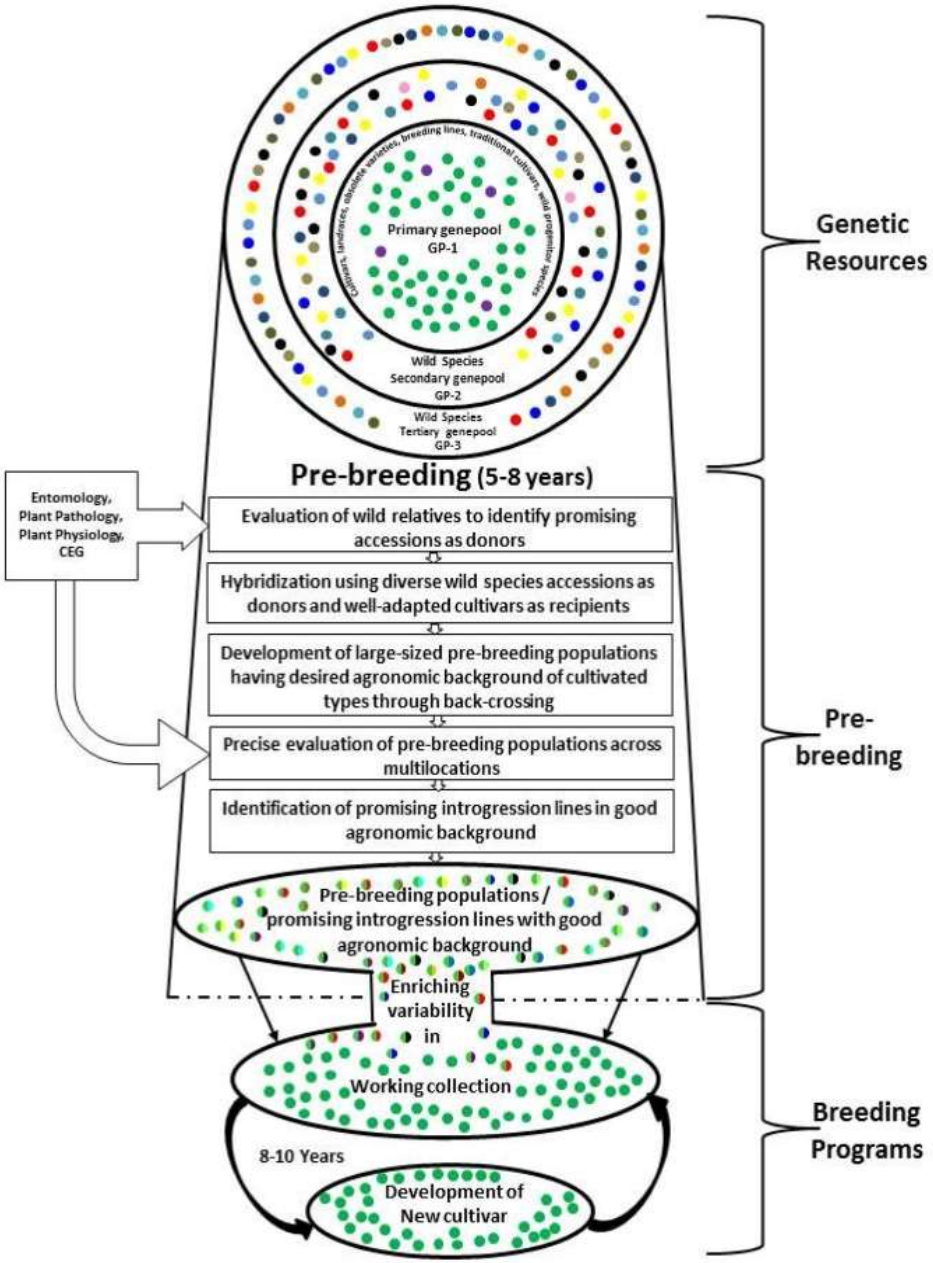
Pre-Breeding: Crop Wild Relatives (For online video: cwrdiversity.org)

Pre-breeding

- Using crop wild relatives (CWR) in crop improvement is much more difficult than breeding with domesticated varieties. Pre-breeding aims to isolate desired genetic traits (e.g. disease resistance) from unadapted material like CWR and introduce them into breeding lines that are more readily crossable with modern, elite varieties.
- Pre-breeding broadens the elite genepool by re-capturing lost beneficial genetic diversity.

Definition

- Pre-breeding (PB) refers to all activities designed to identify desirable characteristics and/or genes from unadapted materials that cannot be used directly in breeding populations and to transfer these traits to an intermediate set of materials that breeders can use further in producing new varieties for farmers. It is a necessary first step in the use of diversity arising from wild relatives and other unimproved materials.



Procedure of Pre-breeding and Breeding

The Gene Pool Concept: "The gene pool is the total genetic variation in the breeding population of a species and closely related species capable of crossing with it". The gene pool of a crop is made up of botanical varieties, landraces, inbred lines, ancient landraces, obsolete and modern cultivars, related wild species, subspecies, and weedy companion species.

Primary gene pool: same species cultivated and wild

Secondary gene pool : different species than the cultivated

Tertiary gene pool: more distantly related

Quaternary gene pool: unrelated plant species and/or other organism

Applications of Pre-breeding in crop improvement

Pre-breeding mainly applied in four major aspects:

- Narrow genetic base results into the crop vulnerability to different biotic and abiotic stress. Pre-breeding is adopted for broadening the genetic base, to reduce vulnerability.
- Identifying desirable traits in exotic materials and moving those genes into material more readily accessed by breeders.
- Wild species and crop wild relatives are the reservoir of the gene for cope with the changing climate, identification of this important gene and moving them from wild species into breeding populations when this appears to be the most effective strategy.
- Identification of novel genes in the unrelated species and transfer them using genetic transformation techniques.

GREEN REVOLUTION

What is Green Revolution??

- The Green Revolution or Third Agricultural Revolution was a period when the productivity of global agriculture increased drastically as a result of new advances.
- During this time period (between 1950 and the late 1960s), new chemical fertilizers and pesticides were created. The chemical fertilizers made it possible to supply crops with extra nutrients and, therefore, increase yield. The newly developed pesticides controlled weeds, kill insects, and prevented diseases, which also resulted in higher productivity.

History and Development of Green Revolution

- The beginnings of the Green Revolution are often attributed to **Norman Borlaug (**March 25, 1914 – September 12, 2009**)**, an American scientist interested in agriculture. Dr. Norman E. Borlaug receives the Congressional Gold Medal in 2007. Burlaug, a **1970 Nobel Laureate**, was honored for his work in the 'Green Revolution,' saving millions of lives from famine in India, Mexico, and the Middle East.
- Borlaug was often called "*the father of the Green Revolution*".

Green Revolution in India

Roots of India's Food Problem

- While under British rule, India switched from being a net food exporter to being a net food importer in 1919. India's food problems were perhaps most severely exemplified by the **Great Bengal Famine of 1943**, in which an estimated 1.5 to 3 million people died in the modern state of West Bengal in India and modern-day Bangladesh.
- Famine in India was rare prior to British rule, but common during the British occupation of India.
- At the time of independence, 1947, British India was partitioned into modern day **India** and **Pakistan**, with great consequences to India's food supply. Punjab, India's wheat growing center, was split between the two nations, with most of the irrigated cropland going to Pakistan. Pakistan also received the majority of India's agricultural research and education facilities, including the Agricultural College and Research Institute at Lyallpur. Whereas western Punjab previously supplied the rest of India with wheat, now India would need foreign exchange in order to purchase it from Pakistan.
- Problems grew when, in 1949, Britain devalued its currency against the dollar and India followed suit. Pakistan did not devalue its currency, making it more expensive for India to purchase food from Pakistan than before.
- However, Indian economist Amartya Sen (recipient of the Nobel Prize for Economics, 1998) has established that while food shortage was a contributor to the problem, a more potent factor was the result of hysteria related to World War II, which made food supply a low priority for the British rulers.

Green Revolution in India

- In 1965 the government of Mrs. Indira Gandhi decided to major steps on agriculture conditions.
- Thus Green Revolution was applied to the period from 1967 to 1978 basically in the parts or Haryana and Punjab.
- At this stage concern was on Wheat and Rice.
- Dr. M S Swaminathan from India led the Green Revolution as the Project Director & Dr. Norman Borlaug from Mexico supported the Green Revolution through the introduction of high yielding variety of wheat seeds.

Methods used in Green Revolution

- Double/ Multiple Cropping system
- Seeds with superior genetics
- Proper irrigation system
- High Yielding Variety (HYV) of seeds
- Use of pesticides and fertilizers
- Use of modern machinery (Tractor, Harvester, Thrasher)
- Expansion of farming areas

Basic elements used methods of Green Revolution

- *Continued expansion of farming areas:* Green Revolution continued with quantitative expansion of farmlands.
- *Double-cropping existing farmland:* Instead of one crop season per year, the decision was made to have two crop seasons per year. There had to be two monsoons" per year. One would be the "*natural monsoon*" and the other an "*artificial monsoon*".
- *Using seeds with superior genetics:* This was the scientific aspect of the Green Revolution to use High Yielding Variety (HVY) of seeds.

Causes of Green Revolution

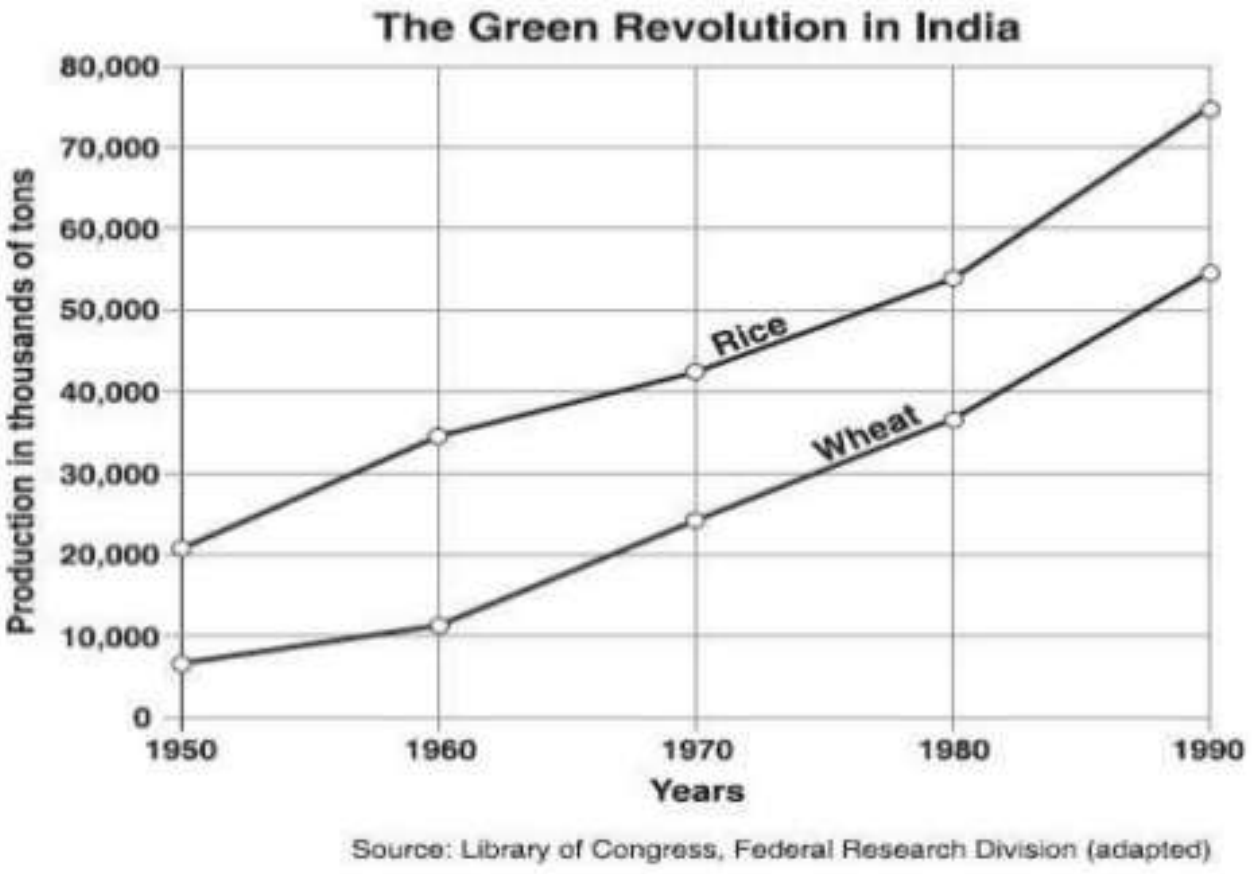
- High Yielding Varieties of Seed.
- Chemical Fertilizers.
- Irrigation.
- Multiple Cropping.
- Modern Agricultural Machinery.
- Credit Facilities.
- Agricultural Research.
- Plant Protection.
- Rural Electrification.
- Soil Testing and Soil Conservation.

Effects of Green Revolution

- Increase in Production
- Capitalistic Farming
- Effect on Rural Employment
- Reduction in Imports of food grains
- Development of Industries
- Effect on Prices
- Base for Economic Growth
- Effect on consumers
- Effect on Planning
- Increase in Trade
- Change in Thinking of Farmers

Result/Evaluation of Green Revolution:

1. Statistical Result:



Advantages of Green Revolution

- Yields increased three times.
- Multiple cropping.
- Other crops grown which varied the diet. Surplus to sell in cities creating a profit improving the standard of living.
- Allows purchase of fertilizers, machinery etc.
- India becomes self sufficient in food grains.

Limitation of Green Revolution

- The Green Revolution, howsoever impressive, but NOT a 100% success.
- Only Punjab and Haryana states showed best results of Green Revolution.
- The new farming techniques, has given birth to the serious pollution of drinking water causing cancer and other diseases.
- A recent Punjabi University study found a high rate of genetic diseases among farmers, which was attributed to pesticide use.
- The new organic fertilizer, pesticides and chemicals are ruining the soil.
- Lead to unemployment and Rural-Urban Immigration.

Conclusion

Green Revolution has done a lot of positive things, saving the lives of millions peoples and exponentially increasing the yield of food crops. But environmental degradation makes the Green Revolution an overall inefficient, short-term solution to the problem of food insecurity. So, more sustainable and environmental friendly system of cultivation needs to be practiced. The world needs green Revolution 2, which promises to feed a growing world population sustainably –without compromising the needs of future generations

DNA based molecular markers and their applications in plant breeding

Molecular markers reveals the genetic differences in the primary structure of DNA between individuals. Compared to protein markers, DNA based polymorphisms are more stable, and can reveal subtle changes in the genomic DNA (Powell et al., 1996; Horacek et al., 2009). Different DNA based marker techniques have been successfully used such as restriction fragment length polymorphism (RFLP), random amplified polymorphic DNA (RAPD), amplified fragment length polymorphism (AFLP), simple sequence repeats (SSR) and single nucleotide polymorphisms (SNP) (Powell et al., 1996; Lusser et al., 2012). Molecular markers are 'landmarks' on chromosomes that serve as reference points to the location of other genes when a genetic map becomes available. If genetic maps are constructed, then the plant breeder establishes association between markers and desirable phenotypic traits. The trait of interest is then selected by indirectly selecting for the marker which is readily accessed or observed (Podlich *et al*., 2004; Goodman, 2004). In plant breeding, markers are used to locate the chromosomal positions of candidate genes, to determine genomic organization among different gene pools and to conduct marker-assisted breeding. Identification of DNA markers associated with traits of interest may be facilitated by comparative mapping, i.e., by cross-referencing to the maps of model crop species, owing to gene synetny. These markers may facilitate inter-generic gene transfers and help to minimize linkage drag (Podlich *et al*., 2004).

Thank You