

# PLANT BREEDING

"Better suited for cultivation"

given better yields and are disease resistant"

\* Recorded evidence of plant breeding date back to 9000-11,000Y ago.

classical plant breeding

crossing

Hybridisation

- 1) increased crop yield and improved quality
  - 2) incr. tolerance to environmental stresses
  - 3) resistance to pathogens (virus, fungi and Bacteria)
  - 4) incr. tolerance to insect pests.
- Salinity, extreme temperatures, drought

Fisheries has an important place in Indian economy. It provides income and employment to millions of fishermen and farmers, particularly in the coastal states. For many, it is the only source of their livelihood. In order to meet the increasing demands on fisheries, different techniques have been employed to increase production. For example, through aquaculture and pisciculture we have been able to increase the production of aquatic plants and animals, both fresh-water and marine. *Find out the difference between pisciculture and aquaculture.* This has led to the development and flourishing of the fishery industry, and it has brought a lot of income to the farmers in particular and the country in general. We now talk about 'Blue Revolution' as being implemented along the same lines as 'Green Revolution'.

## 9.2 PLANT BREEDING

Traditional farming can only yield a limited biomass, as food for humans and animals. Better management practices and increase in acreage can increase yield, but only to a limited extent. Plant breeding as a technology has helped increase yields to a very large extent. Who in India has not heard of **Green Revolution** which was responsible for our country to not merely meet the national requirements in food production but also helped us even to export it? Green revolution was dependent to a large extent on plant breeding techniques for development of high-yielding and disease resistant varieties in wheat, rice, maize, etc.

### 9.2.1 What is Plant Breeding?

Plant breeding is the purposeful manipulation of plant species in order to create desired plant types that are better suited for cultivation, give better yields and are disease resistant. Conventional plant breeding has been practiced for thousands of years, since the beginning of human civilisation; recorded evidence of plant breeding dates back to 9,000-11,000 years ago. Many present-day crops are the result of domestication in ancient times. Today, all our major food crops are derived from domesticated varieties. Classical plant breeding involves crossing or hybridisation of pure lines, followed by artificial selection to produce plants with desirable traits of higher yield, nutrition and resistance to diseases. With advancements in genetics, molecular biology and tissue culture, plant breeding is now increasingly being carried out by using molecular genetic tools.

If we were to list the traits or characters that the breeders have tried to incorporate into crop plants, the first we would list would be increased crop yield and improved quality. Increased tolerance to environmental stresses (salinity, extreme temperatures, drought), resistance to pathogens (viruses, fungi and bacteria) and increased tolerance to insect pests would be on our list too.



Plant breeding programmes are carried out in a systematic way worldwide—in government institutions and commercial companies. The main steps in breeding a new genetic variety of a crop are –

- (i) **Collection of variability:** Genetic variability is the root of any breeding programme. In many crops pre-existing genetic variability is available from wild relatives of the crop. Collection and preservation of all the different wild varieties, species and relatives of the cultivated species (followed by their evaluation for their characteristics) is a pre-requisite for effective exploitation of natural genes available in the populations. The entire collection (of plants/seeds) having all the diverse alleles for all genes in a given crop is called **germplasm collection**.
- (ii) **Evaluation and selection of parents:** The germplasm is evaluated so as to identify plants with desirable combination of characters. The selected plants are multiplied and used in the process of hybridisation. Purelines are created wherever desirable and possible.
- (iii) **Cross hybridisation among the selected parents:** The desired characters have very often to be combined from two different plants (parents), for example high protein quality of one parent may need to be combined with disease resistance from another parent. This is possible by cross hybridising the two parents to produce hybrids that genetically combine the desired characters in one plant. This is a very time-consuming and tedious process since the pollen grains from the desirable plant chosen as male parent have to be collected and placed on the stigma of the flowers selected as female parent (In chapter 2 details on how to make crosses have been described). Also, it is not necessary that the hybrids do combine the desirable characters; usually only one in few hundred to a thousand crosses shows the desirable combination.
- (iv) **Selection and testing of superior recombinants:** This step consists of selecting, among the progeny of the hybrids, those plants that have the desired character combination. The selection process is crucial to the success of the breeding objective and requires careful scientific evaluation of the progeny. This step yields plants that are superior to both of the parents (very often more than one superior progeny plant may become available). These are self-pollinated for several generations till they reach a state of uniformity (homozygosity), so that the characters will not segregate in the progeny.
- (v) **Testing, release and commercialisation of new cultivars:** The newly selected lines are evaluated for their yield and other agronomic traits of quality, disease resistance, etc. This evaluation is done by growing these in the research fields and recording their performance under ideal fertiliser application, irrigation, and other crop management practices. The evaluation in research fields is followed

by testing the materials in farmers' fields, for at least three growing seasons at several locations in the country, representing all the agroclimatic zones where the crop is usually grown. The material is evaluated in comparison to the best available local crop cultivar – a check or reference cultivar.

India is mainly an agricultural country. Agriculture accounts for approximately 33 per cent of India's GDP and employs nearly 62 per cent of the population. After India's independence, one of the main challenges facing the country was that of producing enough food for the increasing population. As only limited land is fit for cultivation, India has to strive to increase yields per unit area from existing farm land. The development of several high yielding varieties of wheat and rice in the mid-1960s, as a result of various plant breeding techniques led to dramatic increase in food production in our country. This phase is often referred to as the Green Revolution. Figure 9.3 represents some Indian hybrid crops of high yielding varieties.



(a)



(b)



(c)

**Figure 9.3** Some Indian hybrid crops: (a) Maize; (b) Wheat; (c) Garden peas