

## *Lecture: - 10*

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### **Bulk method**

**10.1 The bulk method:** It was first proposed by Nilsson Ehle in 1908 at Svalof. This method is also known as mass method 'or' Population method of breeding. It is used for isolation of homozygous lines. It involves opportunity for natural selection. F<sub>2</sub> and subsequent generations are harvested in mass as bulk to raise the next generation. At the end of the bulking period (after attaining homozygosity) individual plants are selected and evaluated similar manner as pedigree method of breeding.

**10.2 The procedure for bulk method:-**The following procedure is described for the isolation of homozygous lines. The breeder may introduce various modifications in the scheme to suit his needs.

**Hybridization :** Parents are selected according to the objective of the breeding programme. A simple or a complex cross is then made depending upon the number of parents involved.

- **F1 Generation:** F<sub>1</sub> is space-planted and harvested in bulk. The number of F<sub>1</sub> plants should be as large as possible; usually more than 20 plants should be grown.
- **F<sub>2</sub>-F<sub>6</sub> Generations** F<sub>2</sub> to F<sub>6</sub> generations are planted at commercial seed rates and spacings. These generations are harvested in bulk. During this period, environmental factors, disease and pest outbreaks would change, the frequencies of different genotypes in the population. Artificial selection is generally not done. The population size should be as large as possible, preferably 30,000-50,000 plants in each generation.
- **F<sub>7</sub> Generations:** About 30-50 thousand plants are space-planted. 1000 to 5000 plants with superior phenotypes are selected and their seeds harvested separately. Selection is based on the phenotype of plants, grain characteristics, disease reaction, etc.
- **F<sub>8</sub> Generation:** Individual plant progenies are grown in single or multi-row plots. Most of the progenies would be reasonably homozygous and are harvested in bulk. Weak and inferior progenies are rejected on the basis of visual evaluation. Only 100-300 plant progenies with desirable characteristics are saved. Some progenies which show segregation are generally

rejected unless they are of great promise. In promising progenies, individual plants may be selected; preliminary yield trial will be delayed for one year in such cases.

- **F9 Generation:** Preliminary yield trial is conducted by using standard commercial varieties as checks. The progenies which are superior than the check are advanced. Quality test may be conducted to further reject undesirable progenies. The progenies are evaluated for height, lodging resistance, maturity date, disease resistance and other important characteristics of the crop species.
- **F10-F13 Generations:** Replicated yield trials are conducted over several locations using standard commercial varieties as checks. The lines are evaluated for important characteristics in addition to yield, disease resistance and quality. If a line is superior to the standard varieties in yield trials, it would be released as a new variety.
- **F14 Generation:** Seed of the released variety is increased for distribution to the cultivators.

### **10.3 Merits of bulk method:**

- The bulk method is simple, convenient and less expensive.
- Since, each F2 plant is equally represented till F6, no chance of elimination of good genotypes in early generations.
- Artificial or natural disease epiphytics, winter killing high temperature etc. eliminates undesirable types and increases the frequency of desirable type. Thus isolation of desirable types becomes easier.
- Progenies select from long term bulks are superior than the selection from F2 or short term bulk.
- As little work and attention is needed in F2 and subsequent generation more no. of crosses can be handled.
- No pedigree records which saves time
- Since large population are grown, transgressive segregants are more likely to appear and increase due to natural selection. Hence, there is a greater chance to isolate good segregants than pedigree method.

## **10.4 Demerits of bulk method:**

- The major disadvantage of bulk method is that it takes a much longer time to develop a new variety. Natural selection becomes important only after F8 or F10, and bulking may have to be done upto F20 or more. Thus the time required is considerably longer, and most breeders do not use the bulk method simply for this reason.
- In short-term bulks, natural selection has little effect on the genetic composition of populations. But short -term bulks are useful for the isolation of homozygous lines and for specific objectives as in Harlan's mass -pedigree method.
- It provides little opportunity for the breeder to exercise his skill or judgement in selection. But in the modified bulk method, the breeder has ample opportunity for practicing selection in the early segregating generations.
- A large number of progenies have to be selected at the end of the bulking period.
- Information on the inheritance of characters cannot be obtained which is often available from the pedigree method.
- In some cases, at least, natural selection may act against the agronomically desirable types.

## **10.5 Single-seed-descent method:-**

- Another modification of the bulk method is the single-seed-descent method, which is becoming increasingly popular. In this method, a single seed from each of the one to two thousand F2 plants is bulked to raise the F3 generation. Similarly, in F3 and the subsequent generations one random seed is selected from every plant present in the population and planted in bulk to raise the next generation.
- This procedure is followed till F5 or F6 when the plants would have become nearly homozygous. In F5 or F6, a large number (1 to 5 hundred) of individual plants are selected and individual plant progenies are grown in the next generation.
- Selection is done mainly among the progenies, and the number of progenies is sufficiently reduced to permit replicated trial in the next generation. Individual plants may be selected only from outstanding families not showing segregation.
- Thus preliminary yield trials and quality tests begin in F7 or F8 and coordinated yield trials in F8 or F9.

**10.6 Objective of single-seed-descent method:** is to rapidly advance the generations of crosses; at the end of the scheme, a random sample of homozygous or near homozygous genotypes/lines is obtained. F<sub>2</sub> and the subsequent generations are grown at very high plant densities as vigour of individual plants is not important. In each year, 2-3 generations may be raised using off-season nurseries and greenhouse facilities.

### **10.7 Important features of this scheme:**

- lack of selection, natural or artificial, till F<sub>5</sub> or F<sub>6</sub> till the Population reasonably homozygous
- Raising of F<sub>3</sub> and later generations from a bulk of one seed from each F<sub>2</sub> and the subsequent generation plant in order to ensure that each F<sub>2</sub> plant is represented in the population.
- As a result of the speed and economy, the single-seed- descent scheme is becoming increasingly popular with the breeders.

### **10.8 Merits of single-seed-descent scheme:**

- Advances the generation with maximum possible speed in a conventional breeding method
- Requires very little space, effort and labour
- Makes the best use of greenhouse and off -season nursery facilities
- Ensures that the plants retained in the end population are random sample from the F<sub>2</sub> population.

### **10.9 Demerits:-**

- It does not permit any form of selection (which is implied in the scheme) during the segregating generations.
- In each successive generation, the population size becomes progressively smaller due to poor germination and death of plants due to diseases, insect pests and accidents. In some crops, e.g., pulses, plant loss may be one of the most serious problems of the scheme.