

5. Plant material i.e. germ plasm
6. Objectives : Well set objectives and planning

### **Hybridization procedure or steps involved in hybridization**

Details of the following steps have to be covered in

Practical classes

1. Choice or selection of parents
2. Evaluation of parents i.e. by selfing and studying the progeny
3. Emasculation
4. Crossing or pollination
5. Bagging & Labelling
6. Harvesting of  $F_1$  seed
7. Raising  $F_1$  generation

From  $F_2$  onwards the generations are known as segregating generations and they may be handled either by pedigree method or Bulk method or backcross method for evolving new varieties.

## **Lecture No 13**

### **HANDLING OF SEGREGATING GENERATIONS Pedigree Method**

In the pedigree method, individual plants are selected from  $F_2$  and subsequent generations, and their progenies are tested. During the entire operation a record of all parent off spring relationships is kept. This is known as pedigree record. Individual plant selection is continued till the progenies show no segregation. At this stage the selection is done among the progenies, multilocation tests are conducted and released as varieties.

The pedigree may be defined as a description of the ancestors of an individual and it generally goes back to some distant ancestors. It is useful to know the relationship of two individuals and useful for selection of parents and prediction of outcome of the cross.

Procedure of pedigree method

**1<sup>st</sup> year** : cross is made between the parents possessing desirable characters.

**2<sup>nd</sup> year** : Sow the  $F_1$  seed giving wide spacing so that each  $F_1$  plant produces more seeds. Raise as many  $F_1$  plants as possible to produce large number of  $F_2$  seeds. Harvest in bulk.

**3<sup>rd</sup> year** : Grow 2000-10000 plants of  $F_2$  giving wide spacing for full expression of the characters in  $F_2$  generation plants. Grow parents for comparison. Depending upon the facilities and objectives of the programme about 100-500 superior plants are selected. The

value of selection depend on the skill of the breeder. He has to judge which  $F_2$  plant will produce superior progeny for characters under consideration. The breeder develops this skill through close study of the crop for many generations. The selection in  $F_2$  is done for simply inherited characters like head type disease resistance etc. and selection for characters governed by many genes like yield will be reserved for later generations. The selected plants are harvested separately and given serial numbers and description entered in pedigree registers.

**4<sup>th</sup> year** : Progeny rows of  $F_3$  i.e. seeds of one selection plant in one row are space planted along with parents and checks. From superior progeny rows, individual plants with desirable characters are selected (about 50-100 families and about 5 plants in each family and harvested separately). Diseased, lodging and undersirable progenies are discarded.

**5<sup>th</sup> year** :  $F_4$  plants raised again as head to row. Desirable plants are selected from desirable rows and harvested separately.

**6<sup>th</sup> year** :  $F_5$  plants raised in 3 row plots i.e. seeds of each selected plant sown in 3 rows. By this time many families might have become reasonably homozygous. For comparison check variety is grown for every 3 or 5 block. Progenies are evaluated for yield and the inferior ones are rejected. The number should be reduced to 25-50. superior plants from superior progenies are selected. Plants from each progeny are bulked.

**7<sup>th</sup> year** :  $F_6$  individual plant progenies are grown in multi-row plots and evaluated. Inferior progenies are rejected and superior progenies are selected. Plants of each progeny are harvested in bulk. Diseased and inferior plants from the progenies are removed.

**8<sup>th</sup> year** :  $F_7$  preliminary yield trial with 3 or more replications are conducted to identify superior lines. The progenies are evaluated for many characters including yield. Standard commercial varieties must be included as checks. Two to five outstanding lines are selected and advanced to coordinated yield trials.

**9<sup>th</sup>, 10<sup>th</sup> & 11<sup>th</sup> year** : selected lines are tested in several localities for 2 or 3 years for adaptation tests. Lines are evaluated for all characters mainly yield and disease resistance. A line that is superior to commercial variety in yield and other characters is selected. **11<sup>th</sup> and 12<sup>th</sup> year** : Selected superior lines is named, multiplied and released as a new variety. Number of year can be reduced if generations are advanced during off seasons either in green house or under irrigated conditions.

Several modifications for the above described pedigree method are followed by breeders depending upon the crop, time and availability of funds and facilities like labour, land etc.

**Early generation tests :**

The objective of these test is to find out superior crosses and superior progenies in early generations i.e. in  $F_2$  and  $F_3$ . we need not advance all the crossed and all selected progenies in each cross upto  $F_8$ . much labour, time and cost would be saved by this early generation testing. A more reliable information about the potential crosses and progenies may be obtained by conducting replicated tests (preferably in more location) and evaluating them for yield and other characters in  $F_2$  or  $F_3$  itself. A desirable cross or progeny should have high mean yield, high genetic variance and high expected genetic advance under selection. Other crosses and progenies are rejected in the beginning i.e.  $F_2$  and  $F_3$  generations itself.

**$F_2$  progeny testing :** Another modification for pedigree method. In  $F_2$  make as many single plants selections as possible. From  $F_3$  to  $F_6$  advance the progenies in bulk making selections of the progenies as a whole and discarding the inferior progenies. Thus each of the progeny is derived from the single plant selected in  $F_2$  generation. In  $F_6$  make single plant selections in each of the progeny. Compare the yields of the single plants with progenies from which they are selected. Select superior single plant progenies and advance to preliminary yield trials, multilocation tests etc. There are two advantages 1. No. of crosses can be handled simultaneously 2. Natural selection operates from  $F_3$  to  $F_6$  since they are advanced in bulk.

**Mass pedigree method :** This is another modified pedigree method. Crosses are made and further generations grown in bulk or as mass until suitable season occurs for making desirable selections against drought, insect and diseases etc. The population will be exposed to the natural conditions of vagaries. From the remaining population individual plants are selected and harvested progenies are evaluated for yield and other characters in preliminary yield trials and further generations are proceeded as in pedigree method till release of variety. The advantages of both bulk and pedigree methods can be obtained and large number of crosses can be handled at a time. The disadvantage is that it takes a bit longer time.

**Merits of pedigree method :**

1. It gives maximum opportunity for the breeder to use his skill and judgement in selection of plants
2. It is well suited for the improvement of characters which can be easily identified and are simply inherited.
3. Transgressive segregation for yield and other quantitative characters may be recovered.
4. Information about the inheritance of characters and pedigree of lines can be obtained.

5. Inferior plants and progenies are eliminated in early generations.
6. It takes less time than bulk method to develop new variety.

**Demerits of pedigree method :**

1. Valuable genotypes may be lost in early generations, if sufficient skill and knowledge are lacking in the breeder, at the time of selection.
2. No opportunity for natural selection
3. Difficult to handle many crosses
4. Maintenance of records, selections, growing progeny rows etc are time consuming and laborious.

**Achievements :** Large number of varieties have been developed by pedigree method in many crops.

A few examples are

Wheat – NP-52, 120,125, 700 and 800 series

Rice – ADT– 25, Jaya, Padma

Cotton – Lakshmi, Digvijay, Sorghum – Co 18, RS 610 etc., Tobacco – NP 222

Sorghum – Co 18, Rs 610, Tobacco – NP 222

Lecture No. 14

## **BULK METHOD**

The bulk method was first proposed by Nilsson Ehle in 1908 at Svalof. This method is also known as **mass method** 'or' Population method of breeding

- ❖ Isolation of Homozygus lines
- ❖ Waiting for the opportunity for selection
- ❖ 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.

## ***THE PROCEDURE FOR BULK METHOD***

The exact procedure for the bulk method would vary depending upon the objective of breeder. 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.