



FACULTY OF AGRICULTURAL SCIENCES AND ALLIED INDUSTRIES

Pedigree method, bulk method, back cross method and various modified methods

Pedigree method

In this method, individual plants are selected from F₂ and subsequent generations and their progenies are tested. During this process details about the plants selected in each generation is recorded in Pedigree Record. By looking into Pedigree record we can know about the ancestry of the selected plants.

There are several ways to maintain the pedigree Record. The selection of plants starts from F₂ onwards.

The details about selected plants can be recorded as follows. E.g. F₂ X S 9801 - 7. Here the 7 denotes seventh plant selected. In F₃ if selection is made from the 7th plant of cross X S 9801 it can be recorded as F₃ X S 9801 - 7 - 4. The number four indicates that fourth plant of 7th plant of F₂ is selected. This can be followed till F₄ or F₅ generations. After F₄ or F₅ the selected plants are bulked to form a family.

In the pedigree record all the biometrical data like plant height, number of branches, No. of pods / plant, pod length, seeds / pod, pod weight, seed weight are recorded.

Merits of Pedigree Method

1. Gives maximum opportunity to the breeder to use his skill and judgement for the selection of plants.
2. Well-suited for characters which are simply inherited
3. Transgressive segregants can be easily identified through records.
4. Information about inheritance is precisely obtained.

Demerits

1. Maintenance of pedigree record is time consuming and limits handling of larger population.
2. The success in this method is largely dependent on skill of the breeder. There is no opportunity for natural selection.
3. Selection for yield in F₂ and F₃ is ineffective. If care is not taken to maintain larger population, valuable materials may be lost.

Pedigree Method

Procedure

F₁ Generation: The F₁ seeds are space planted so that full expression of F₁ can be had. It is advisable to raise the parents involved in the cross to raise as border rows so that dominance and other characters can be studied. The F₁s are harvested as single plants.

F2 generation: In F2, 2000 to 10,000 plants per cross are planted. About 100 - 500 plants are selected and harvested on single plant basis. The selection in F2 depends upon the skill of the breeder. The selection intensity may be 5 to 10%.

F3 generation: Individual plant progenies are space planted. Again desirable plants are selected. From F3 onwards the term family is introduced. The line selected from each cross is termed as family.

F4 generation: Similar to F3.

F5 generation: Many families would have attained homozygosity and may be harvested as row bulk.

F6 generation: The row bulk may be assessed in multi row trial. The families exhibiting segregation may be isolated and studied separately.

F7 generation: RRYT

F8 generation: PYT

CYT 3 seasons.

Basis of selection: Depending upon the objective, selection is to be made in segregating generation. For insect and disease resistance part of the seeds may be reserved in segregating generation and the rest may be subjected to epiphytotic conditions. The families exhibiting resistance may be identified and the reserve seeds may be used for further selection and testing.

Early generation testing: If superior families are identified in F3 or F4, they can be tested for desirable characters and this is known as early generation testing.

Shuttle breeding: This is followed especially in disease or insect resistance breeding. For e.g. at Coimbatore YMV in blackgram is in epidemic form during summer season only. Whereas at Vamban (Pudukkottai) the YMV is epidemic during kharif season. So instead of waiting for next summer at Coimbatore the materials can be tested at Vamban during kharif and thus one season is saved.

Off season nursery: Some crops may be season bound. But it may be non - season bound in certain agro - climatic zone. For e.g. Thalai virichan cholam. (Sroxburghii) is season bound at Coimbatore. It has to be sown during July - August and harvested during December January. But this Sroxburghii is non - season bound in Yercaud. So to save one season, the segregating material can be raised during Rabi summer at Yercaud. This method is otherwise known as rapid generation advancement (RGA).

Bulk Method: In this method F2 and subsequent generations are harvested as bulk to grow the next generation. The duration of bulking may be 6 - 7 generations. Selection can be made in each generation but harvest is done as bulk. This is similar to mass selection. At the end of bulking period single plant selection is made and tested for yielding ability. If bulking period is long say 20 - 30 seasons, then natural selection acts on the homozygous lines. In

this method the breeder uses his skill for selecting the plants and at the same time there is no pedigree record. This saves much time and labour.

Merits of bulk method

1. Simple, convenient and inexpensive
2. By inducing artificial epiphytotic conditions undesirable or weaker genotypes can be eliminated.
3. If bulking period is longer natural selection operates and desirable genotypes are selected.
4. No pedigree record is maintained.
5. Since large population is grown there is chance for appearance of transgressive segregants which will be superior than parents or F₂.

Demerits

1. Takes much longer time to develop a new variety.
2. In short term bulk there is no chance for natural selection.
3. A large number of progenies are to be selected in each generation which requires much labour, time and space.
4. We cannot get information on inheritance.

Single Seed - Descent Method

It is the modification of the bulk method. In this method a single seed from each of the F₂ plants is collected and bulked to raise F₃ generation. Similarly single seed from each F₃ plant is collected and carried forward to F₄. This procedure is followed till F₆ or F₇. After wards single plant selection is made and studied in progeny rows.

In this Scheme the main features are:

1. Lack of selection till F₆ or F₇ when the population becomes homozygous.
2. Each F₂ plant is represented till F₆ or F₇ generation.
3. In this method there are chances for reduction in population size due to pest, disease or poor germination.
4. Rapid generation advancement (RGA) can be made with the use of glass house or off season nursery.

Modified bulk method

Here selection can be practiced in F₂ and F₃ and subsequent generations. There will not be any pedigree record but superior plants are selected bulked and carried forward. In F₄ superior plants are selected and harvested on single plant basis. In F₅ these single plants are studied in progeny rows and best progenies are selected and harvested. In F₆ PYT can be conducted to select best families. In subsequent generations regular trials can be conducted.

This modification of the bulk method provides an opportunity for the breeder to exercise his skill and judgement in selection. Further there is no maintenance of pedigree record which is another advantage.

Mass pedigree method

This was proposed by Harrington. It is a solution to one of the deficiencies in the pedigree method of breeding. For e.g. if the population is to be subjected to disease resistance screening like YMV and if there is no method to create artificial epiphytotic conditions, it is wasteful to study the population in pedigree method. Instead we can carry the population as a mass and test them when there is occurrence of the disease. When conditions are favourable for the disease, we can terminate the bulking and resort to single plant selection.

Comparison between Pedigree and Bulk Methods

Pedigree method

1. Individual plants are selected in F₂ and the subsequent generations and individual plant progenies are grown.
2. Artificial selection, artificial disease epidemics etc., are an integral part of the method
3. Natural selection does not play any role in the method.
4. Pedigree records have to be maintained which is often time consuming and laborious
5. It generally takes 14-15 years to develop a new variety and to release it for cultivation.
6. Most widely used breeding method.
7. It demands close attention from the breeder from F₂ onwards as individual plant selections have to be made and pedigree records have to be maintained.
8. The segregating generations are space planted to permit individual plant selection.
9. The size of population is usually smaller than that in the case of bulk method.

Bulk method

1. F₂ and the subsequent generations are maintained as bulks.
2. Artificial selection, artificial disease epiphytotics etc., may be used to assist natural selection. In certain cases, artificial selection may be essential.]
3. Natural selection determines the composition of the populations at the end of the bulking period.
4. No pedigree record is maintained.
5. It takes much longer for the development and release of a variety. The bulk population has to be maintained for more than 10 years for natural selection to act.
6. Used only to a limited extent.
7. It is simple, convenient and inexpensive and does not require much attention from the breeder during the period of bulking.
8. The bulk populations are generally planted at commercial planting rates.
9. Large populations are grown. This and natural selection are expected to increase the chances of the recovery of transgressive segregants.