Experiment: Field techniques for Hybrid seed production

Aim: To study about the field techniques for production of Hybrid seed production.

The following points highlight the four main steps of hybrid seed production.

The steps are:

1. Choice and Development of Seed Parent (A-Line)
2. Choice and Development of Restorer or Male Parent (R-Line)
3. Maintenance and Multiplication of Parental Seeds
4. Production and Improvement of F_1 Hybrids.

Step 1 Choice and development of seed parent (A-Line):

The seed parent or the female parent of a commercial hybrid should be a male sterile line. But in case of non-availability of suitable male sterile line, the fertile line or a self-incompatible line can be used where manual labour will be needed.

In case of food grain crops where the number of seeds produced ineach pollination is restricted, there the cytoplasmic-genetic male sterile line should be used as seed parent.

But in case of vegetable crops where seed is not the economic product and also only a single pollination will produce many seeds, there fertile pure line can be used as seed parent. In case of monoclinous plants like maize, the male flowers can be removed easily as these are borne on apices of the plants.

After identification of a male sterile line (A-line), it should be maintained by an isogenic B-line. Strains can be identified to have the B-line reaction by crossing them to the A-line. Then a potential B-line is converted to A-line by a process of repeated back- crossing till the A and B lines become similar (isogenic).

Transfer of male sterility is required when disease susceptibility or unwanted agronomic traits are associated with male sterile character.

This can be done in two ways:

1. Single phase repeated back-crossing:

This method follows the repeated back- crossing of existing male sterile line (non-recurrent parent) possessing the desirable characteristics. In case of transferring cytoplasmic male sterility, it is convenient through six generations of back-crossing. But in case of developing cytoplasmic-genetic male sterility, it should possess required agronomic characters and maintenance of male sterility is needed through B-line or maintainer line.

2. Two phase limited back-crossing:

In this method instead of using A-line as non-recurrent parent, the B-line is back-crossed with a parent of desirable donors and the new line formed is termed as IBC. Then these developed lines are again crossed with A-line to seek out the male sterile line. These lines are then back-crossed repeatedly with IBC lines which will help to develop the male sterile line with desirable attributes.

The desirable attributes which should be considered for a male sterile line or A-line development are:

1. Plant Height:

Male sterile line should not be too tall or too dwarf. Since plant height of the hybrid is the function of both the parents, so plant height of A- line should be lower than that of R-line (male fertile parent).

2. Duration and Span of Flowering:

This is an important attribute for commer¬cial hybrid seed production. Successful hybrid seed production depends on the synchrony between the flowering of seed parent (A-line) and male fertile parent (R-Line).

3. Tillering Ability:

Profuse and synchronous tillering on a male sterile line is advantageous both for harvesting male sterile seeds and also hybrid seeds.

4. Productivity Potential:

As the main objective is more hybrid seed production, thus male sterile lines should possess a high productivity potential.

5. Stable Male Sterility:

An ideal male sterile line should maintain its sterility under all environmental conditions.

6. Free from Diseases:

The male sterile line and also the R-line should be resis¬tant to probable diseases particularly seed borne diseases.

7. Combining Ability:

The male sterile line under use must have a high general combining ability, so that it can combine well with R-lines to produce a large number of hybrids.

Step 2: Choice and development of restorer or male parent (R-Line):

The second component which is required for hybrid production is the male parent or restorer lines which are essentially inbred lines, like A-lines. Their development is done through pure line selection method where forced selfing is practiced.

The procedure is as follows:

a) From a heterozygous gene pool, the S0 is selected on the basis of desirable attributes such as vigour, productivity, disease resistance, etc.

b) After self-pollination, the S1 plants are obtained and growing them row-wise, after repeated selfing S2 seeds are obtained.

c) This process is continued up to S5 or S6 generation.

A number of inbred lines are developed for a successful hybrid programme as to improvise the genetic potential of the source material which can impart hybrid vigour. The inbreds are evaluated for their agronomic traits and on the basis of general combining ability.

The unwanted inbred lines are discarded in the beginning of inbreeding process and also the prospective R lines should be chosen for the development of F1 hybrids on the basis of combining ability in S5 or S6 generation.

The choice of parents for restorer line specifically depends on the presence of few attributes like:

a) Ability to produce abundant pollen grains (profuse pollen production),
b) Maximum genetic diversity from the A-line chosen,
c) High specific combining ability of the cross between A-line and the R-line.

Step 3: Maintenance and Multiplication of Parental Seeds:

In case of cross pollinated crops, the hybrid programme is based on 3 lines: A-line (ms), B-line (Maintainer) and R-line (Restorer) -all homozygous inbreds are maintained by the breeder. Any kind of change in the population should be discarded by the breeder which may occur due to random pollination and mutation.

For proper maintenance, the A-lines and B-lines are grown in field in ideal agronomic condition and in rows in 4: 2 ratios. In the border rows also, the B-lines are grown which supply sufficient pollen for pollinating A-line. On maturity the seeds of B-line are harvested first and kept separately. Then the seeds of A-line are harvested. Thus in the same field both A-lines and B-lines are maintained and multiplied in the same block.

For maintenance of R-line, the plot should be completely isolated from others. The natural open pollination characteristic of cross-pollinated crop will be helpful for its main¬tenance. There is no need to maintain the R-line separately except for the first use, as R-line is automatically maintained in the hybrid production block.

Step 4: Production and Improvement of F1 Hybrids:

For F1 hybrid seed production, A-line and R-line are grown together in 4: 2 ratio in hybrid production block (Fig. 7.1). The arrangement is same except the B-lines have been substituted by R-lines. At maturity the seeds of A-rows are harvested separately and carefully as these hybrids and also the R-line seeds are harvested for next use.

For improvement of F1 hybrids, the parental lines should be improved. If the incidence of diseases (for which the inbred lines are not resistant) occurs, breakdown of male sterility in A-line and genetic weakness (like combining ability, nutritional quality) appear, then these drawbacks can be removed by changing the parental lines.

In many crops like pearl millet, sorghum and maize, hybrid seed production programme has been pursued and many of the hybrid varieties have been released

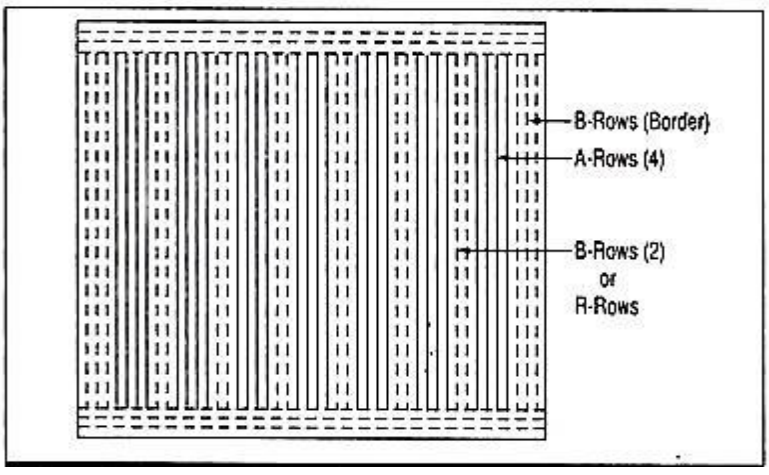

Fig : Maintenance block of A, B & R-line