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HYBRID SEED PRODUCTION TECHNIQUES OF RAPESEED & MUSTARD

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HYBRID SEED PRODUCTION

Hybrid seed production based on CMS-FR system requires four isolations. These are : maintenance of CMS line (A X B), multiplication of maintainer (A) line, multiplication of restorer (R) line and hybrid seed (A X B) production. The production of hybrid seed by cross pollination is the most important factor affecting the bio-economics of seed set on female lines using various production techniques. Wind and insects have been reported to be the main agents for pollination, though only the pollen grains that are initially disturbed by insects may become truly air borne. The factors that can influence the extent of seed setting on female lines include ; male-female ratio, synchronized flowering of male and female parents, nector production and bee foraging, yielding ability of CMS lines, pollen production of male parents.

A very wide variability in seed yield has been observed in different experiments. Genotype has been a major source of variation and selection of female parents suitable for cross-fertilization. Different kinds of row ratios for female vs. Male were found to be useful for commercial hybrid seed production. A study on Indian mustard **(Banga *et al.*, 1995)** has shown that the extent of hybrid seed set was maximum when the male rows were sown in higher frequency i.e., 2 : 4 > 1 : 2 > 1 : 3 > 1 : 4. There was significant reduction when the male : female ratio was changed from 1 : 3 to 1 : 4. In addition to the reduced seed set, a sharp decline occurred in the number of successful pods on the male sterile plants as was evident from an increased frequency of empty or aborted pods. While greater production of female rows is desirable to enhance the production of hybrid seed, care must be taken to ensure adequate pollen supply to facilitate hybrid seed set on female plants. Orientation of rows against the direction of wind has generally been found useful to maximize out-crossing on female plants.

The block seed production method, using ogu CMS material has been found to be suitable in *B. Napus* **(Hogarth *et al.*, 1995).** Isolation distance depends upon several factors. These include location, wind direction, viability for air-borne pollen and extent of bee population. Production of hybrid seed should be carried out in crossing fields isolated from other plants of related species with a minimum distance of 500 to 3000m depending upon the species. Crucial role of nector production for bee foraging and seed set on male sterile plants has been established in various crops. Keeping beehives in the seed production plots of rapeseed-mustard has been found to be useful. Another factor, which has profound

influence on the economics of hybrid seed production, is the synchronized flowering of male and female parents. It must be realized that nicking is the best isolation. Nicking can be improved by cultural manipulations or by selective application of growth regulators to delay or advance flowering in male/female lines. In oilseed rape, detopping of alternate plants of male parent coupled with application of N @ 25 kg/ha between pollinator rows after flowering was found to be effective to delay flowering in male parent besides ensuring pollen supply for longer duration.

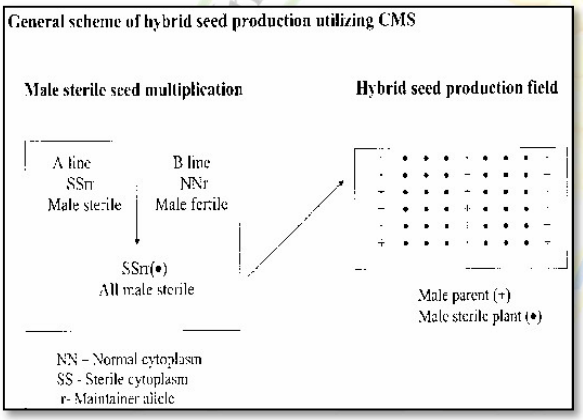

Fig.-1: A general scheme of hybrid seed production utilizing CMS in rapeseed & mustard.

PRODUCTION OF HYBRID SEED OF SYNTHETIC VARIETY IN SELF-STERILE RAPES AND MUSTARDS: The method of isolating inbred lines and then crossing the best of these for the production of hybrid seed or synthetic variety as is being practiced in corn has not been exploited in case of cross pollinated rapes and mustards. **Singh and Mehta (1954)** as a result of varietal crosses in brown sarson obtained significant increase in yield in F_1. One of the hybrids gave an increase in yield of about 250 per cent over their parents and an increase of about 47 per cent over the highest strain. Certain hybrids showed great resistance to Aphids. For employing hybrid vigour to maximize yield, the following three steps are necessary:

1. Raising of inbreds.
2. Selection of the best inbred lines for crossing.
3. Utilisation of the best lines in crosses.

1. RAISING OF INBREDS:

a. Inbreeding: Inbreeding of toria, lotni brown sarson and taramira on account of self-sterility is more tedious and labour-consuming than corn where selfing can be done simply by bagging. Selfing in the self-sterile forms of *Brassica* oilseeds is done through bud pollination where buds two to three days before their opening are pollinated by pollen from flowers of the same plant. To avoid contamination of the pollen, the buds which are likely to open the next day, are covered by a muslin bag. Next morning, the stigma is touched by the dehisced anthers and then covered by a muslin bag. The bud pollination on an inflorescence will be continued till the desired number of buds have been selfed. After this all the other buds from the inflorescence are removed.

b. Effect of inbreeding: Mohammad (1935) reported that the plants raised from selfed seed in toria and brown sarson were usually found to be short stature and much less vigorous than those raised from seeds obtained by crossing. The following observations were made:

Similar observations with regard to loss and decrease in the average percentage of pod setting as a inbreeding were recorded by **Alam (1938)** in taramira. In the studies made at Kanpur the effect of inbreeding in brown sarson was found to vary in different varieties. In some cases, the loss of vigour is so great that after 4 to 5 generations of selfing

the inbred lines eventually die. Though generally inbreeding is accompanied by a decrease in height, certain inbred lines were found to be as tall as the parent even after five generations of selfing. Such lines were, however, found to be highly sterile and were continued from generation to generation with great difficulty. Inbreeding tends to isolate lines with varying degrees of self-sterility ranging from almost complete self-sterile lines to almost 100.0 per cent self-fertile. As a result of inbreeding it has been possible to discover new inherited characters in brown sarson.

2. SELECTION OF INBRED LINES FOR CROSSING

Such inbred lines which are self-sterile but cross-fertile are selected for crossing. It is also essential to test their combining ability to select the best parents which will have the ability to transmit high yielding potentiality to their hybrids. Singh and Mehta (1954) from diallel crosses amongst six strains of brown sarson found that the extent of increase in yield in F_1 varied with different combinations. While the hybrid 4 x 3 gave an increase in yield of about 250.0 per cent over their parents, hybrid 2 x 1 showed negative heterosis. In order to test the combining ability of inbred lines, the methods used in case of corn are however not suitable. Polycross method suggested for testing the combining ability of open pollinated crops like perennial grasses may be profitably utilized in case of toria, lotni brown sarson and taramira as well.

In the polycross method the different inbred lines are grown randomized in a plot. The lines are allowed to cross by natural means. The assumption is that all the lines will have a common source of pollen, a mixture of all due to their random distribution. The seed is harvested from all lines and sown next year in a replicated trial. The lines giving the best performance with regard to yield are considered to be best combining ability.

In case of polycross method the number of inbred lines to be tested should not be very large otherwise the random distribution of pollen will not be possible. It will be quite safe to have about 25 inbred lines at a time. Besides this polycross plot should be in an isolated place so that the pollen from any other source may not be carried there.

3. UTILIZATION OF THE COMBINING LINES

The best combining lines can be put into crosses either for the production of the hybrid seed in single cross or multiple crosses or synthetic variety. For hybrid seed production the best combining lines which should be self-sterile but cross-fertile may be brown side by side in an isolated plot. The seed harvested from the inbred lines will be the hybrid seed as a result of natural cross pollination.

In India there seems to be better scope for a synthetic variety where about 4 to 6 or even more high combining lines can be crossed with each other. For effecting crosses amongst the inbred lines, the use of insect proof cages and of bags as suggested by **Mohammad and Sikka (1941)** and already described, will prove very useful. The crossed seed can be multiplied in an isolated plot on an experimental farm and distributed to the cultivations as a synthetic variety.

PRODUCTION OF SYNTHETICS FROM SHORT-TERM INBREDS

Where it may not be possible to produce hybrid seed or synthetic variety on the lines described above, the method of producing synthetic variety from short term inbreds as suggested in corn may be profitably utilized with certain modifications. The essential steps may be outlined as follows:

1. Isolate one generation of selfed lines.
2. Half of the S_1 seed may be sown in as many replication as possible for testing their combining ability by the polycross method.
3. On the basis of the results of the polycross test the most desirable lines are selected and the remnant seed of such S_1 lines will be grown for letting them intercross freely to produce a synthetic variety.

This process will be repeated to produce a new wave of seed of a new synthetic variety after the first variety had a generation or two of mixing.

PRODUCTION OF HYBRID SEED IN SELF-FERTILE *oleiferous brassicae:*

Attempt large number of crosses between several varieties of rai (*Brassica juncea*) and obtained increased yields in F_1 up to 25.0 per cent or more in certain combinations. The increase in yield, however, was not found to be due to any increase in the size of pods in F_1. The results of these experiments also clearly indicated the importance of selecting suitable parents for making crosses because increased yield in the hybrids is obtained only in certain combinations. Thus it is evident that seed yield in case of rai (*Brassica juncea*) can be considerably increased through production of hybrid seed but the difficulties involved in making crosses between parents are so great that hybrid vigour can never be commercially exploited unless some male sterile lines as found in tomato, onion, sorghum, etc. are obtained. Male sterility can either be induced through radiation or a search has to be made to discover some naturally occurring male sterile individuals. A mutant in rai which is almost 100.0 per cent cross-pollinated has been isolated at Kanpur and the possibilities of utilizing this mutant in the production of hybrid seed on a commercial scale are now being worked out.