Indian J. Genet., **65**(2): 141-142 (2005)

Short Communication

Stabilization and maintenance of male sterility percent in recessive genetic male sterile lines of safflower (*Carthamus tinctorius* L.)

K. Anjani

Directorate of Oilseeds Research, Rajendranagar, Hyderabad 500 030

(Received: February 2004; Revised: May 2005; Accepted: May 2005)

The development of a stable recessive genetic male sterile line MS 9(O) [1] has led to release of the first safflower (*Carthamus tinctorius* L.) hybrid - DSH 129 for commercial cultivation in India [2]. Several genetic male sterile lines were developed later on in safflower by transferring the recessive male sterility gene in agronomically superior lines. It is well known that in a genetic male sterility system, male sterility and fertility segregate in 50 : 50 ratio. The degree of male sterility in a sterile plant is 100% in a genetic male sterile line of safflower. Therefore, the male sterility percent of a genetic male sterile line is directly proportional to number of male sterile plants. The frequent problem faced by many safflower breeders in maintenance of a recessive genetic male sterile line is reduction in proportion of male sterile plants. Considering this problem, the method of stabilization and maintenance of recessive genetic male sterile parent MS 9(O) of the hybrid DSH 129 is discussed in this paper, which could also be applicable for other recessive genetic male sterile lines in safflower to maintain high proportion of male sterile plants in their maintenance blocks.

A recessive nuclear gene (*msms*) controls male sterility in MS 9(O). Pollen is absolutely absent in flower heads of a male sterile plant. Male sterility does not revert to fertility in these male sterile plants. Fig. 1 gives schematic presentation of maintenance of MS 9(O).

Initially MS 9(O) was maintained by random sib mating between fertile and sterile sister plants, this led to great reduction in proportion of sterile plants in the subsequent generations. Test-crosses showed that male sterile plant has *msms* genetic constitution for male sterility whereas male fertile plants have homozygous dominant (*MsMs*) and heterozygous (*Msms*) genetic constitution for male fertility in the initial population. The proportion of male sterile plants in sib-progeny generation was 25% when a dominant homozygous fertile plant pollinated the sterile plant whereas it was 50% whenever a sterile plant was pollinated by heterozygous fertile plant. Since the presence of homozygous fertile plants was the factor for reduction in proportion of sterile plants in MS 9(O) maintenance block, fertile plant-wise sib mating was affected between sterile and fertile plants to remove the homozygous fertile plants. All fertile plants involved in sib crossing were self-pollinated. Male to female ratio was recorded in each sib-progeny and fertile self-progeny rows. Sib crossings were effected manually by rubbing fully opened fertile flower on styles of sterile flower head. Both fertile and sterile flower heads used in sib mating were covered with butter paper bags before and after sib crossing to avoid pollen contamination through honeybee. The sib-progeny rows having only fertile plants were discarded, as these fertile plants were

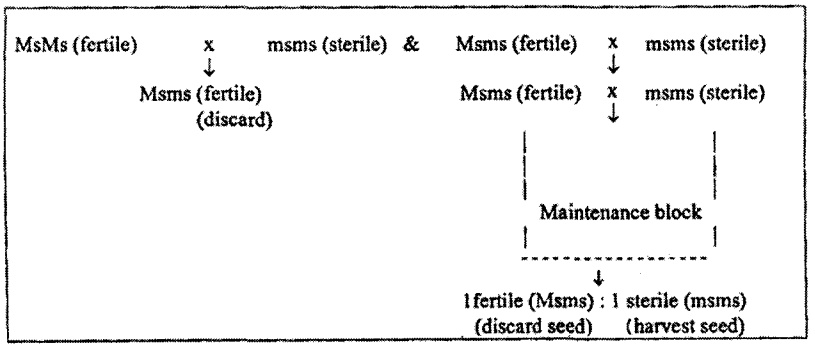

Fig. 1. Schematic presentation of maintenance of MS 9(O)

heterozygous due to dominant homozygous genetic constitution of their fertile male parents. The dominant homozygous nature of these male fertile parents was confirmed by production of only fertile progenies in their self-generations. The other sib-progeny rows having high proportion of sterile plants were selected for further sib mating as their male parental plants were heterozygous fertile. The heterozygous nature of these fertile parents was confirmed by 3 fertile : 1 sterile segregation in their self-generations. All male sterile plants in sib-progeny rows were tagged and seed was collected only from sterile plants. Seed from fertile plants was discarded to avoid any accumulation of dominant homozygous fertile gametes. Thus once male sterility percent was stabilized in MS 9(O), it was multiplied later on by random mating between male sterile (*msms*) and heterozygous fertile (*Msms*) plants through honeybee under isolation. The isolation distance followed was 600-800m.

To understand the effect of temperature on occurrence of male sterile plants, four sowings of MS 9(O) was taken up in 2000 and 2001 at one-month interval from 16th September to 15th December. The plot size for each sowing was 1000 sq.m. Recommended spacing and cultural practices were followed. Temperature and relative humidity were recorded daily from the automatic weather station located in the farm.

The mean maximum temperature during flowering in September and October sown crop was 27.2-30°C and the relative humidity was 83-89% whereas these were 32-37.2°C and 59-67%, respectively in November and December sown crop. The male sterility percent decreased from 44.2% to 25% from September sown crop to December sown crop (Fig. 2). This indicates that temperature higher than 30°C during flowering period reduced proportion of male sterile plants in MS 9(O). In *Vicia faba* also high temperatures led to high expression of male fertility and low temperatures permitted expression of sterility [3]. Zimmerman [4] showed that higher temperatures (>40°C) during anthesis did not affect fertility in safflower. However, exposure to high temperature and humidity stress during anthesis for only 24 hours in controlled environment chambers reduced seed yield by as much as 86% due to increase in aborted ovaries. The seed yield of MS 9(O) was greatly reduced in November and December sown experiments. The results indicate that appropriate choice of environmental conditions is essential to regulate male sterility percent and to realize high yields in safflower genetic male sterile lines.

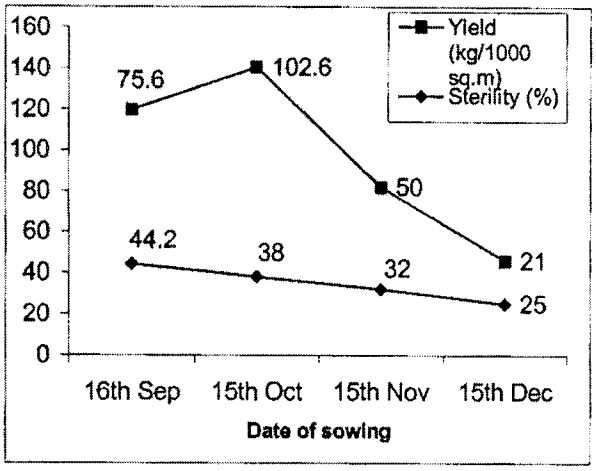

Fig. 2. Male sterility percent and yield of MS 9(O) at different dates of sowing

For maintenance and multiplication of genetic male sterile line separate maintainer line is not required. The fertile progenies in the MS 9(O) population would serve as maintainer plants. While multiplying a recessive genetic male sterile line, collection of seed from fertile plants should be avoided to stabilize male sterility percent in subsequent generations. In order to maintain high percent of male sterility as well as to achieve high yields in multiplication blocks of GMS lines, an appropriate date of sowing should be chosen in such a way that the temperature will not be more than 30°C at the time of flowering and flowers should not face humidity stress at the time of anthesis.

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