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A Review

Studies on fertility restoration and maintenance of male sterility in sunflower (*Helianthus annuus* L.)

C.V.C.M. Reddy[1]*, B. Sinha[1] and A. V. V. Reddy[2]

Department of Genetics & Plant Breeding, Institute of Agricultural Sciences, Banaras Hindu University, VARANASI (U.P.) INDIA

ABSTRACT

Three diverse CMS lines (PET-1, ARG and GIG-1) were crossed to fifty inbred testers by collecting pollen from the inbreds in a petridish by using small brush and applying on the corresponding CMS lines in morning hours. There were twenty eight restorers for PET-1 and ARG. All the fifty inbreds expressed for maintenance of GIG-1. Twenty two inbreds maintained for PET-1 and ARG.

Key words : *Helianthus annuus*, Maintainer, Restorer, Male sterility.

INTRODUCTION

Sunflower hybrid breeding has developed successfully since the discovery and application of cytoplasmic male sterility and pollen fertility restoration, i.e., within a period of time not longer than 25 years. The hybrid breeding of sunflower was greatly assisted by the discovery of cytoplasmic male sterility among progenies of the interspecific cross *Helianthus petiolaris* x *Helianthus annuus* (Leclercq, 1969). The source of cytoplasmic male sterility has proved to be able to be very stable and is used almost exclusively in breeding programmes around the world. Most important, restorers and maintainers of sterility are easily available in cultivated sunflower species.

MATERIALS AND METHODS

Three diverse sources of cytoplasmic male sterile sources of sunflower viz., CMS PET1 (*Helianthus petiolaris*), CMS ARG (*Helianthus argophyllus*), CMS GIG1 (*Helianthus giganteus*) and fifty male parental inbred lines of diverse genetic background were obtained from Directorate of Oilseeds Research, Hyderabad. The trials held at College Farm, Institute of Agricultural Sciences, Banaras Hindu University during *Rabi*, 2003. Three male sterility lines and fifty male inbreds planted with a spacing of 60 x 30 cm. Staggered sowings of male parents twice at weekly interval were taken up in order to synchronize the flowering. The recommended agronomic practices like application of fertilizers, weeding, inter-cultivation, irrigation and plant protection measures against pests and diseases were taken up to maintain good crop.

Each male sterile line was sown in 20 rows of 5 meters length and the inbreds were sown in 2 rows in separate plots. The heads of male sterile lines and the inbred lines were covered with cloth bag at ray floret stage i.e. just before the commencement of flower opening and crossing was effected. All the fifty inbred lines were crossed to three different CMS sources in a line x tester fashion analysis by collecting pollen from the inbreds in a petridish by using small brush and applying on the corresponding CMS lines in morning hours between 8 a.m. to 11 a.m. For each cross, the crossing was repeated till all the disc florets had completed their opening. All precautionary measures were taken up to avoid any possible contamination.

RESULTS AND DISCUSSION

The fertility restoration and maintenance behaviour of inbred lines on diverse cytoplasm appeared to be same in all the three different environments. In order to identify maintainers and restorers for the new sources of cytoplasmic male sterility i.e., CMS PET-1, CMS ARG and CMS GIG-1 were crossed to fifty inbreds and the resultant one hundred and fifty hybrids were examined for presence or absence of pollen after flower opening. Further pollen fertility was confirmed using 1 percent Acetocarmine stain and the crosses were grouped as either sterile or fertile, based on which the inbreds were classified as maintainers or restorers as presented in Table 1.

Out of one hundred and fifty crosses made of three diverse CMS systems, ninety four crosses found to be male sterile with no pollen production and remaining fifty six were fertile hybrids. Twenty eight out of fifty inbreds produced fertile hybrids with CMS PET-1 and CMS ARG. The inbreds namely RHA 271, RHA 273, RHA 274, RHA 297, RHA 298, RHA 341, RHA 344, RHA 345, RHA 346, RHA 356R, RHA 587, RHA 859, RHA 6D-1, HAM 161, RHA 174, RHA 175, RHA 180, SF 206, SF 207, SF 208, SF 211, SF 216, BLC P6, PARRUN 1329, RES 834-1, RCR 8297, R 83 R6 and NDLR-1 found to restore the fertility, while the rest twenty two inbreds namely RHA 348, 7-1 B, 234 B, 302 B, 378 B, 851 B, 852 B, HA 341 (tall), HA 380, GP 290, GP 2008, GP 2111, GP 761, GP 898, M 307-2, M 1008, M 1015, M 1026, DRM 34-2, DRM 70-1, NDOL 87 and LTRR 1 produced sterile F_1s on CMS PET-1 and CMS ARG sources. Further all the inbreds showed maintainers and none expressed restorers for CMS GIG-1. The inbreds, which produced fertile hybrids, are classified as restorers and the ones that gave sterile F_1s as maintainers to the respective CMS source.

Maintainer and restorer behaviour of fifty inbreds on the three CMS sources CMS PET-1, CMS ARG and CMS GIG-1 is presented in table 1. The results revealed that no male inbred line restored fertility on all three sources of CMS commonly. All of the maintainers and restorers of classical CMS PET-1 cytoplasm were identified as maintainers and restorers of CMS ARG cytoplasm. It was interesting to note that the maintainer lines of CMS GIG-1 found to be restore fertility on CMS PET-1 and CMS ARG. RHA 348, 7-1B, 234B, 302B, 378B, 851B, 852B, HA 341 (tall), HA 380, GP 290, GP 2008, GP 2111, GP 761, GP 898, M 307-2, M 1008, M 1015, M 1026, DRM 34-2, DRM 70-1, NDOL 87 and LTRR 1 behaved as maintainers on CMS PET-1, CMS ARG, CMS GIG-1. These studies indicate that the restorer genes for CMS sources CMS PET-1 and CMS GIG-1. But there are similar restorers for CMS PET-1 and CMS ARG. The inbreds which restored fertility on one source of CMS, behaved as maintainers on other sources of CMS and vice versa. These studies indicate that the restorer genes for different CMS sources are different. The inbreds which restored fertility on one source of CMS, behaved as maintainers on other sources of CMS and vice versa.

These results suggest that the two new CMS sources are different from classical French cytoplasm. Similar observations were also made using other CMS lines by Whelan (1981), Serieys and

[1]Department of Genetics and Plant Breeding, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi (U.P.) India
[2]Directorate of Oilseeds Research, Hyderabad (A.P.) India
***Author for correspondence**