

CYTOPLASMIC MALE STERILITY IN SUNFLOWER

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Abstract

Genetic male sterile plants of H. petiolaris, H. annuus (wild) and H. annuus (ornamental) have been used to secure cytoplasmic male sterility in sunflower. Attempts with a genetic male sterile of H. debilis have been unsuccessful. Some preliminary results of seedling grafts to determine if CMS is graft transmitted are presented, but no conclusions are yet possible.

Resumen

Plantas con androesterilidad genética de H. petiolaris, H. annuus (silvestre) y H. annuus (ornamental) se han usado para asegurar la esterilidad citoplasmática del macho (CMS) en el girasol. Los intentos con un macho con esterilidad genética de H. debilis no han tenido éxito. Se presentan algunos intentos preliminares de injertos de plántulas de semillero para determinar si la esterilidad citoplasmática del macho se transmite por injerto, pero todavía no es posible extraer conclusiones definitivas.

A little more than a decade ago, Leclercq (1969) discovered cytoplasmic male sterility (CMS) in sunflowers. The CMS was found in a backcross of the hybrid of Helianthus petiolaris Nutt. x H. annuus L. to H. annuus. His seeds of H. petiolaris came from the author who had originally collected the achenes from a wild population in St. Louis, Missouri. Later, the author found genetic male sterility in H. petiolaris from this same source. By crossing one of these male steriles with H. annuus he was able to secure CMS in the F₁ hybrids (Heiser, 1978). The genetic male sterility in H. petiolaris is controlled by a single gene, and it could be that this gene is the same as the restorer gene in sunflower so that when a genetic male sterile plant (ms ms) is crossed with sunflower lacking restorer genes, the CMS becomes expressed in the F₁. Thus it appeared that possibly a rapid way of developing CMS in sunflower would be to use other genetic male steriles in crosses with H. annuus.

Therefore, when the author found a male sterile individual in a greenhouse population of wild sunflower (H. annuus var. lenticularis Ck11.) he made crosses of it as the female with cultivars of sunflower. First generation hybrids with 'Commander' gave some male sterile plants, and after backcrosses to 'Commander' a majority of the plants showed male sterility. With 'RHA265' as the male parent, stable male sterile lines were secured, and these have been released under the name "Indiana-1" (Heiser, 1982).

More recently using an old ornamental red rayed form of H. annuus showing genetic male sterility (Putt and Heiser, 1966), crosses of a genetic male sterile were made with various cultivars of sunflower. The first generation hybrids with both 'RHA265' and 'PI 117403' were all male sterile. The male steriles derived from these crosses appear to be identical to 'Indiana-1,' for both 'RHA265' and 'PI 117403' serve as maintainers of 'Indiana-1.' Both the new line and 'Indiana-1' also show pollen restoration in crosses with 'Rudorf.' In 1984 both produced plants with very little pollen production in hybrids with 'HA89.' The last result with 'Indiana-1' was somewhat surprising, for 'HA89' served as a pollen restorer for 'Indiana-1' in earlier crosses (Heiser, 1982).

Apparently not all genetic male steriles will function to produce CMS in sunflower. Several years ago a genetic male sterile was found in an ornamental form of H. debilis subsp. cucumerifolius (T. & G.) Heiser. Crosses of this genetic male sterile have now been made with over 40 accessions of cultivars or wild races of H. annuus. All of the F₁ hybrids produced pollen except for a few individuals in crosses with 'Hopi.' Backcrosses of the latter were made to sunflower but no male sterile plants were recovered.

Little is known concerning the nature of CMS in sunflower. In an attempt to learn if this trait is transmitted by grafts as in Petunia (Frankel, 1971), reciprocal grafts of seedlings were made between 'Indiana-1' and 'RHA265' (the maintainer), using the technique of S. Pawlowski (letter to author, 1965). With 'RHA265' as the stock, four plants survived the graft and all proved to be male sterile. The two plants secured of the reciprocal were also male sterile which would suggest graft-transmission of the CMS. However, the only plant secured of the latter combination in repeating the experiment proved to be male fertile. Obviously these results do not allow one to draw any conclusions. The need for more experiments using a larger number of plants, followed by the appropriate crosses as was done by Frankel (1971), is obvious.

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