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INHERITANCE OF GENIC MALE STERILITY OBTAINED BY IMMATURE EMBRYO CULTURE IN SUNFLOWER CV MORDEN

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SUMMARY

A male sterile plant was observed in a sunflower (*Helianthus annus L.*) population raised from a 12-day old immature embryo culture of cultivar Morden. This plant was crossed with parental line. The F_1 was fertile and the F_2 segregated in the ratio of 3 fertile: 1 sterile indicating that male sterility was governed by a single recessive nuclear gene. The monogenic recessive nature was confirmed by test cross, where it segregated in the ratio of 1 fertile: 1 sterile. With the Cultivar Morden, being early and dwarf, male sterility could be effectively exploited for developing early, dwarf and semidwarf lines/hybrids.

Key words: Sunflower, immature embryo, inheritance, genic male sterility.

INTRODUCTION

Hand emasculation in sunflower (*H. annuus* L.) is a tedious job and therefore male sterility could provide a means of genetic emasculation which can be applied for massive hybridization. It also helps avoid the problem of selfing. Genic male sterility has wide applications (Krishnarao et al., 1990). Genic male sterile lines have been developed through mutation breeding and analysed for inheritance (Vranceanu, 1970; Jan, 1992). A male sterile plant from the population developed through immature embryo culture in sunflower cultivar Morden was recovered. This study deals with identification of the nature of inheritance of male sterility.

MATERIALS AND METHODS

Immature embryo culture was initiated with the objective of advancing the number of generations in a year (unpublished). Twelve-day old immature embryos of the variety Morden were dissected asceptically and grown on Murashige and Skoog (1962) medium devoid of growth hormones. They were cultured for 3 days on media under continuous light for plantlet development. Small plantlets were hardened for 5 days in thermocole cups containing a mixture of soil: sand:vermiculite (1:1:1 v/v) under continuous illumination and 25°C and then transferred to earthen pots. Out of 47 well developed plants, one plant was found to be male sterile. It was morphologically similar to the fertile parent. This plant was crossed with the parent Morden. Of the hybrid seeds, 25% were retained to grow alongwith the F_2 population. The F_1 generation was grown in the 1992 rainy season. The capitulum was bagged before flowering with muslin cloth bag and hand pollination was carried out without opening the bag to ensure self pollination. The F_2 generation was grown in summer 1993 along with F_1. Observation on pigmentation was taken at the seedling stage. Male sterile (MS) and male fertile (MF) plants were scored

at flowering stage on the basis of anther development, extrusion and pollen production. Few male sterile plants were bagged and pollinated by the pollen of the F_1 plant. The $BC_1.F_1$ generation was grown in *Rabi* 1993 and scored for male sterile and male fertile plants. X^2 test was applied to test the goodness of fit.

RESULTS AND DISCUSSION

Unlike fertile flowers, male sterile flowers had anthers which were free, shrivelled, epipetalous and introse with short filaments. Few sterile pollen grains were observed in the anther lobe and tapetal cell walls remained intact. Vilichku (1989) and Jan (1992) found that male sterile plant lacks anther extrusion and pollen production while intact tapetal cell walls in male sterile anthers were observed by Nakashima and Hosokawa (1974).

Table 1. Segregation for male sterile (MS) and male fertile (MF) phenotypes in the F_2 and $BC_1.F_1$ generations

Generation of Morden (MS) X Morden (MF)	MF	MS	Ratio	X^2
F_1	13	–	–	–
F_2	306	91	(3:1)	0.913
$BC_1.F_1$	59	44	(1:1)	2.180

When the male sterile plant was crossed with the fertile parent, F_1 was fertile indicating that fertility was dominant. In F_2, plants segregated in the ratio of 3 fertile : 1 sterile (Table 1). In $Bc_1.F_1$, the segregation ratio was found to fit the ratio 1 fertile : 1 sterile. This indicated that male sterility is controlled by single recessive nuclear gene. Male sterile plant obtained through mutation breeding was found to be controlled by single recessive nuclear gene (Vranceanu, 1970; Vilichku, 1989; Jan, 1992). Vranceanu and Stoenescu (1972) observed that male sterility gene was linked to purple pigmentation. But Spirova (1978) reported that male sterility was independent of anthocyanin colour of seedling. However, no linked character was observed in present studies. Probable reason for male sterility could be spontaneous mutation or exposure of embryo to continuous light and low temperature on basal media which leads to somoclonal variation. Schuster (1979) found that combined action of short photoperiod and low temperature in field condition was necessary for the development of male sterility in sunflower. Expression of male sterility in some mutants of barley and tomato is temperature - controlled (Sharma and Reinbergs, 1976; Sawhney, 1983).

Dwarfs and semidwarfs are easy to harvest and also they overcome the problems of lodging and stalk breakage caused by excessive growh, high winds and severe storms (Schneiter, 1992). Morden is short statured, early maturing, suitable for multiple and mixed cropping. It is widely cultivated in India. Male sterility in Morden could be of great importance for developing early dwarf and semidwarf lines/hybrids by involving it in hybridization programme.

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HERENCIA DE UNA ANDROESTERILIDAD GENICA OBTENIDA POR CULTIVO DE EMBRIONES INMADUROS EN EL CULTIVAR DE GIRASOL MORDEN

RESUMEN:

Una planta androesteril fue observada en una población de girasol (*Helianthus annuus* L.) obtenida a partir de cultivo de embriones inmaduros del cultivar Morden. Esta planta se cruzó con la línea parental. La F1 fue fértil y la F2 segregó en la proporción de 3 fértiles: 1 estéril indicando que la androesterilidad génica estuvo controlada por un gen nuclear simple. La naturaleza monogénica recesiva fue confirmada en un cruce con el recesivo (test cross).

HÉRÉTABILITÉ DE LA STÉRILITÉ MLE GÉNIQUE OBTENUE PAR CULTURE D'EMBRYON IMMATURE CHEZ LE TOURNESOL CV MORDEN

RÉSUMÉ:

Une plante mle stérile a été observée chez des populations de tournesol issues du cultivar "Morden" (*Helianthus annuus* L.) et obtenues par culture d'embryons immatures de 12 jours. Cette plante a été croisée avec une lignée parentale. La F1 était fertile et la F2 a ségrégé suivant le ratio 3 individus fertiles: 1 individu stérile indiquant une stérilité mle gouvernée par un géne nucléaire unique et recessif. La nature monogènique recessive a été confirmée par test cross qui a permis d'obtenir un ratio 1 fertile : 1 stérile. Le cultivar "Morden" étant précoce et nain, la stérilité mle issue de ce cultivar pourrait tre effectivement exploitée pour développer des lignées et hybrides précoces, demi-nains.