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IDENTIFICATION OF MAINTAINER AND RESTORER FOR SOME NEW SOURCES OF CYTOPLASMIC STERILITY

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SUMMARY

Four new sources of cytoplasmic male sterility - CMS PF, CMS I, CMG 2 and CMG 3 were evaluated for their maintainer and restorer behaviour under local conditions. Only one out of four showed complete sterility and two showed segregation for sterility while one was complete fertile. Seventy lines were crossed to two new sources- CMS PF and CMS I and tested for their maintainer and restorer behaviour. The presence or absence of the pollen in FI's was recorded in the field whereas the pollen fertility was confirmed in the laboratory by Acetocarmine staining test. The study revealed that the new sources not only differ from the classical source - CMS F - but also differ each other. It was interesting to note that most of the lines tested including restorers of CMS F were maintainers for these new sources. Very few lines showed complete restoration for CMS PF while segregation was observed in some hybrid progenies. In case of CMS -PF some of the potential lines were selected for back crossing and they are in BC2 and BC3 generation and they will be ready for supply after 1-2 additional back crosses. Since CMS I was showing segregation both in the F1 and in subsequent generations only the sterile plants observed were crossed to its maintainers. A list of maintainer and restorers for the two new sources is reported.

INTRODUCTION

The discovery of a stable cytoplasmic male sterility source by Leclercq (1969) and several sources of fertility restoration for the cytoplasm(Kinman, 1970, Enns, et.al.1970, Leclercq, 1971,; Vranceanu and Stoenescu, 1971) have resulted in the commercial exploitation of heterosis in sunflower since 1972. However, from 1972 to date, only a single source of cytoplasmic male sterility has been utilized in commercial production of hybrid sunflower seed. The use of a single cytoplasm may limit the genetic basis of parental lines and lead to a potential risk if it becoming susceptible to a new strain of disease. Therefore, diversification of cytoplasmic sources is inevitable in any heterosis breeding programme and sunflower breeders have attempted to find new diverse sources of cytoplasmic male sterility. Recently, several new sources of cytoplasmic male sterility have been reported(Anaschenko et al., 1974,; Leclercq, 1983; Whelan and Dedio, 1980, Heiser, 1982; Serieys and Vin court, 1987).

Four new sources of cytoplasmic male sterility -CMS PF, CMS I, CMG 2 and CMS 3 were used for this study. The main objective of the study was to evaluate the new sources of cytoplasmic male sterility to identifiy maintainers and restorers for conversion and commercial exploitation.

MATERIALS AND METHODS

Four new sources of cytoplasmic male sterility (Table-1) were grown along with their maintainers under glass house as well as field conditions during summer. The number of seeds obtained were less, hence, only 5 to 10 plants of each were grown and were examined for presence or absence of pollen. Further pollen fertility was confirmed using one percent Acetocarmine(Chaudhary et al. 1981). The male sterile plants observed were crossed to their respective maintainers and the progeny was evaluated for fertility in the next season.

In order to identify maintainers and restorers, about seventy lines comprising of maintainers and restorers of classical cytoplasm - CMS F - were crossed to two new sources CMS PF and CMS I during kharif 1989. Since CMS I continued to show segregation, the fertile plants were removed and only plants showing complete sterility were used in the crossing programme. Fiftynine lines with CMS PF and 57 with CMS I gave required number of hybrid seeds.

In 1990 summer, F1 seeds from the crosses were planted. Each hybrid was grown in a single row of 3.6 m. length with plants spaced at 30 cms apart. Each row consisted of about 12 plants. Plants were classified as male fertile or male sterile at growth stage R 5.3 (Schneiter and Miller, 1981) based on anther exersion and pollen shedding at anthesis. Pollen fertility was confirmed using 1 per cent Acetocarmine. If no pollen was visible or sterile pollen (very rarely) at this stage, plants were classified as sterile. If segregation for fertility was noted, the number of plants in fertile or sterile classes were counted and recorded.

Further, 23 promising lines were selected to study the stability of cytoplasm and conversion in case of CMS PF, and six lines in case of CMS I. In each generation of back crossing, progenies were scored for fertility before crossing and only sterile plants were involved in back crossing.

RESULTS AND DISCUSSION

The results on the behaviour of new cytoplasmic sources under Indian conditions(Bangalore) are presented in Table-1. Of the four new cytoplasmic male sterility sources tested, only CMS PF showed total sterility and it was considered as stable while the other source CMG 2 showed complete fertility hence rejected. The remaining two - CMS I and CMG 3 showed partial fertility in their crosses with their maintainers suggesting instability of the cytoplasm in our condition. The instability of new cytoplasmic sources when grown under different envirnomental conditions has been reported (Havekes et al 1991). However in case of CMS I the number of fertile plants decreased after each back crossing with its maintainer suggesting it could be purified.

The behaviour of selected maintainers, restorers of CMS F and some inbred lines in the back ground of new cytoplasm - CMS PF and CMS I- are presented in Table -2. Based on these results the lines can be divided into maintainers and restorers of new cytoplasmic sources. Fortyone out of fiftynine lines tested produced sterile hybrids and behaved as maintainers on CMS PF while only 3 lines carried restorer genes for this cytoplasm and fully restored the fertility. The data further indicated that two maintainer lines of CMS F, HA 207 and HA 851 were maintainers of CMS PF. Remaining 15 lines showed segregation suggesting partial restoration.

For CMS I majority of the lines showed segregation. This may be due to in stability of the cytoplasm . Havekes et al (1991) and Wolf and Miller (1985) also observed partial restoration of new cytoplasmic male sterile lines. Twelve lines showed complete fertility which can be used as restorers.

The behaviour of some of the important maintainers and restorers of CMS F on new CMS sources were given in Table-3 & 4. The table 3 indicates that some of the restorer genes efficient on cytoplasm F were ineffective in the new cytoplasmic back ground . For example the restorers 84SR1, 3376R and 83R1 in case of CMS PF and RHA 265 in case of CMS I behaved as maintainners. Similarly some of the maintainers of CMS F for example HA 207 and HA 851 in case of CMS PF and HA 851 and HA 822 in case of CMS I restored the fertility. From these results it may be concluded that the two cytoplasms are different from classical French source-CMS F. Similar observations were also made by Serieys and Vincourt (1987) and Whelan (1981). However, additional maintainers and restorers have been identified for CMS PF and CMS I sources .

The new cytoplasmic sources also differ from each other . Some of the maintainers of CMS PF either partially or fully restored CMS I and vice versa. For example HA 822 maintainer of CMS PF restored the fertility of CMS I. However, the restorer line HA 851 will be of special interest as it restored the fertility in both the new cytoplasm.

Among 23 maintainers studied, all the crosses except three produced total sterile plants in BC1 generation and the selected 15 lines in BC2 generation with CMS PF. The occurrence of complete male sterility in two back cross progenies of the same maternal filiation suggests that the CMS PF is stable and can be utilized for heterosis breeding under Indian conditions. Some selected lines are in BC3 generation.

A few crosses showed segregation with a few fertile plants in the back cross progeny with CMS PF . This was atributed mainly due to heterozygosity of the lines for the restorer genes. Hence plant to plant crosses are being made to study the segregation pattern.

The CMS I cytoplasm found to be unstable. Most of the lines continued to show segregation even in BC1 generation. However two lines RHA 265 and HA 852 appeared to give complete sterile progeny in BC1 and BC2 generation respectively suggesting these lines can be used as maintainers of CMS I under Bangalore conditions.

The above results indicate among new two sources CMS PF is highly stable and offer immmense potential in hybrid sunflower breeding through cyto sterile diversification. However among sunflower lines restorer lines are found to be in lower frequency for CMS PF. Additional restorer genotypes must

Table 1: Sources of cytoplasmic male sterility, their maintainer and their behaviour under Indian (Bangalore) conditions.

Sl. No.	Source of cytoplasmic male sterility	Researcher	Notation	Maintainer	Behaviour under Bangalore condition
1.	*Helianthus petiolaries*	Leclereq, 1969	CMS F	HA 300, HA 301 etc	Complete Sterile
2.	*Helianthus petiolaries* ssp. petiolaries	Serieys 1986	CMS PF	RHA 274	Complete Sterile
3.	*Helianthus giganteus*	Whelan & Dedio, 1980	CMG 1	HA 300, HA 89B	Complete fertile
4.	*Helianthus maximiliani*	Whelan & Dedio, 1980	CMG 2	HA 300 HA 89B	Segregation
5.	*Helianthus annuus* ssp lenticularis	Heiser, 1982	CMS 1	RHA 265	Segregation

Table 2: Behaviour of maintainer and restorers of CMS F and some inbred lines in the crosses of CMS PF and CMS I cytoplasm.

CMS F	Tested	CMS PF		
		Sterile	Fertile	Segregation
Maintainer	31	18	2	11
Restorer	24	21	1	2
Inbred lines	4	2	--	2
Total	59	41	3	15

CMS F	Tested	CMS		
		Sterile	Fertile	Segregation
Maintainer	28	5	2	21
Restorer	25	4	9	12
Inbred lines	4	1	1	2
Total	57	10	12	35

Table 3: Behaviour of selected B and R lines of CMS F in the back ground of CMS PF.

Sl.no.	Genotype	CMS F	CMS PF Back ground		
			F1	BC 1	BC2
1.	86 B3	M	S	S	S
2.	HA 302	M	S	S	S
3.	HA 338	M	S	S	S
4.	HA 822	M	S	S	S
5.	HA 850	M	S	S	S
6.	HA 852	M	S	S	S
7.	HA 853	M	S	S	S
8.	HA 300	M	S*	S*	S*
9.	HA 301	M	S*	S*	S*
10.	HA 587	M	S	S	S
11.	HA 821	M	S	S	S
12.	WGB	M	S*	S*	S*
13.	RHA 274	R	S	S	S
14.	RR-1	R	S	S	S
15.	MR-1	R	S	S	S
16.	84SR-1	R	S	S	S
17.	3376 R	R	S	S	S
18.	83 R1	R	S	S	S
19.	RHA 278	R	S	S	-
20.	RHA 296	R	S	S	-
21.	RHA 297	R	S	S	-
22.	RHA 801	R	S	S	-
23.	RHA 857	R	S	S	-
24.	HA 207	M	R	-	-
25.	HA 60	M	R	-	-
26.	HA 851	M	R	-	-

Table 4: Bhaviour of selected B and R lines of CMS F in the background of CMS I

Sl.No.		CMS F	CMS I		
			F1	BC1	BC2
1.	RHA 265	R	S*	S*	S
2.	HA 852	M	S	S	S
3.	WGB	M	S*	S*	-
4.	HA 302	M	S	S*	-
5	HA 850	M	S	S*	-
6.	HA 853	M	S	S*	-
7.	HA 89	M	S	-	
8.	HA 851	M	R		
9.	HA 822	M	R		

S=Sterile, S*= Segregation, M= maintainer, R=Restorer, be identified and isolated in cultivated sunflower population or searched in the male progenies of the initial crosses or wild species before utilizing the source for heterosis breeding.

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