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IDENTIFICATION OF RESTORERS AND MAINTAINERS FOR DIFFERENT *cms* SOURCES IN SUNFLOWER USING NEW INBREDS

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SUMMARY

Twelve cytoplasmic male sterile lines belonging to four cytoplasmic male sterility (*cms*) sources were crossed with twelve inbreds to identify fertility restorer lines for each *cms* source. For the same source differing in line, the inbred behaved as either maintainer/restorer. Out of the twelve new inbred lines tested, fertility was restored in 9 inbreds for DRSF-114A (PEF), DRSF-132A (PET-2) and DRSF-105A (PET-1), 11 inbreds for DRSF-116A (PEF) and DRSF-127A (CMSI), 4 inbreds for DRSF-115A (PEF), 5 inbreds for DRSF-125A (CMSI) and DRSF-107A (PET-1), 6 inbreds for DRSF-124A (CMSI), DRSF-131A (PET-2) and 10 inbreds for DRSF-109A (PET-1). However, DRSF-117A (PEF) was not restored by any of the inbreds tested. The study identified several effective restorers for newly developed *cms* sources for the first time in India, which can be exploited in developing highly heterotic hybrids possessing alternate cytoplasms.

Key words: *cms* sources, maintainer, restorer, sunflower

INTRODUCTION

In sunflower, hybrids are superior over open-pollinated cultivars in terms of yield, self fertility and resistance to diseases (Miller, 1987). The first cytoplasmic male sterile source was *Helianthus petiolaris* (PET-1), discovered by Leclercq (1969), for which fertility restoration genes were subsequently identified by Kinman (1970). This led to the exploitation of hybrid vigor and commercial use of hybrid sunflower. From 1972 onwards, many hybrids were developed and released for commercial cultivation but all of them invariably possessed the PET-1 cytoplasm (Friedt, 1992; Vishnuvardhan Reddy, 1999). Large-scale cultivation of hybrids having single *cms* source might pose a threat of it becoming susceptible to pests and diseases as was recorded in other crops like corn and pearl millet. In

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order to diversify the cytoplasmic base, attempts have been made and several new cytoplasmic sources have been identified. But these diverse *cms* sources could not be used for hybrid developed because of non-availability of effective restorers for these new *cms* sources. In view of this limitation, an attempt was made at the College of Agriculture, ANGRAU, Rajendranagar, Hyderabad, to identify effective restorers for the newly developed *cms* sources.

MATERIALS AND METHODS

Twelve diverse *cms* lines with four resistance sources, PEF from *H. petiolaris* sub. sp. *fallax*, CMSI from *H. lenticularis*, PET-2 from *H. petiolaris* and the traditional cytoplasmic source PET-1 and twelve newly developed inbreds were crossed in line x tester design during *kharif* 2003. The 144 crosses obtained were evaluated to identify restorer lines for different sources during early *rabi* 2003 at College Farm, College of Agriculture, Rajendranagar, Hyderabad.

Each F_1 hybrid was grown in a single row of 4.50 m length with a spacing of 60 cm between rows and 30 cm between plants in the row. Plants were classified as male fertile/male sterile based on anther dehiscence and pollen shedding at anthesis stage. Pollen fertility was also confirmed in laboratory using 1% acetocarmine staining method.

Table 1: Maintainer/restorer reaction of different inbred lines in the background of twelve *cms* lines of four different cytoplasmic sources

No.	Inbred	*cms* line											
		DRSF-114A (PEF)	DRSF-115A (PEF)	DRSF-116A (PEF)	DRSF-117A (PEF)	DRSF-124A (CMS I)	DRSF-125A (CMS I)	DRSF-127A (CMS I)	DRSF-131A (PET-2)	DRSF-132A (PET-2)	DRSF-105A (PET-1)	DRSF-107A (PET-1)	DRSF-109A (PET-1)
1	DRM 34-2R	R	M	R	M	M	R	R	R	R	M	M	R
2	DRSF-110R	R	M	R	M	R	R	R	R	R	R	R	R
3	DRSF-113R	R	M	R	M	M	R	R	R	R	R	M	R
4	DRSF-116R	R	M	R	M	M	R	R	R	R	R	M	R
5	DRSI-32	M	R	M	M	R	M	M	M	M	R	M	M
6	DRSI-165	R	R	R	M	R	R	R	R	R	M	M	R
7	P-356R	R	M	R	M	R	M	R	R	R	R	R	R
8	RHA-6D1	R	M	R	M	M	M	R	R	R	R	R	R
9	3376R	R	R	R	M	M	M	R	R	R	R	R	R
10	R272-I	M	R	R	M	R	M	R	R	M	M	M	R
11	R-298	M	M	R	M	M	M	R	M	M	R	M	M
12	R-856	R	M	R	M	R	M	R	R	R	R	R	R

M: Maintainer; R: Restorer

RESULTS AND DISCUSSION

The maintainer/restorer behavior of the inbreds in respect to different *cms* sources is presented in Table 1. Of the 12 inbreds studied, the inbred DRM 34-2R restored fertility in seven *cms* lines, DRSF 114A (PEF), DRSF-116A (PEF), DRSF-125A (CMSI), DRSF-127A (CMSI), DRSF-131A (PET-2), DRSF-132A (PET-2) and DRSF-109A (PET-1), and behaved as maintainer for the remaining *cms* lines. Two inbreds, DRSF-113R and DRSF-116R, restored fertility in DRSF-114A (PEF), DRSF-116A (PEF), DRSF-125A (CMSI), DRSF-127A (CMSI), DRSF-131A (PET-2), DRSF-132A (PET-2), DRSF-105A (PET-1) and DRSF-109A (PET-1). The inbred DRSI-165 acted as restorer for DRSF-114A (PEF), DRSF-115A (PEF), DRSF-116A (PEF), DRSF-124A (CMSI), DRSF-125A (CMSI), DRSF-127A (CMSI), DRSF-131A (PET-2), DRSF-132A (PET-2) and DRSF-109A (PET-1).

Two inbreds, P-356R and R-856, restored fertility in nine *cms* lines, DRSF-114A (PEF), DRSF-116A (PEF), DRSF-124A (CMSI), DRSF-127A (CMSI), DRSF-131A (PET-2), DRSF-132A (PET-2), DRSF-105A (PET-1), DRSF-107A (PET-1) and DRSF-109A (PET-1).

The inbred RHA-6D1 exhibited restorer reaction in DRSF-114A (PEF), DRSF-116A (PEF), DRSF-127A (CMSI), DRSF-131A (PET-2), DRSF-132A (PET-2), DRSF-105A (PET-1), DRSF-107A (PET-1) and DRSF-109A (PET-1). The inbred 3376R restored fertility in lines DRSF-114A (PEF), DRSF-115A (PEF), DRSF-116A (PEF), DRSF-127A (CMSI), DRSF- 131A (PET-2), DRSF-132A (PET-2), DRSF-105A (PET-1), DRSF-107A (PET-1) and DRSF-109A (PET-1). The inbred R272-I maintained sterility in six *cms* lines, DRSF-114A (PEF), DRSF-117A (PEF), DRSF-125A (CMSI), DRSF-132A (PET-2), DRSF-105A (PET-1) and DRSF-107A (PET-1) and restored fertility in the remaining lines.

Two inbreds, R-298 and DRSI-32, acted as maintainers for many *cms* lines except for DRSF-116A (PEF), DRSF-127A (CMSI) and DRSF-105A (PET-1) by R-298 and DRSF-115A (PEF), DRSF-124A (CMSI) and DRSF-105A (PET-1) by DRSI-32 while DRSF-110R acted as fertility restorer for all *cms* lines evaluated except DRSF-115A (PEF) and DRSF-117A (PEF). Regarding the *cms* line DRSF-117A, all the inbreds tested acter as its maintainers only.

The data clearly indicate that majority of the tested inbreds behaved as restorers for the new *cms* sources. Similar differences in fertility restoration in different *cms* backgrounds have been reported by Whelan (1980), Virupakshappa *et al.* (1991) and Vishnuvardhan Reddy *et al.* (2002). The restorer for one *cms* line behaved as maintainer for another line of the same *cms* source, reconciling the diversity among *cms* lines of the same source and between the different sources. The new restorers identified in the present investigation will help in exploiting new *cms* sources in hybrid development by ensuring better heterosis and diversity of cytoplasm in sunflower. The newly identified maintainers, after testing for combining ability and agronomic performance, will be converted into new *cms* lines for utilization in hybrid breeding programs for developing diverse hybrids with better heterosis and resistance to diseases and insect pests.

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IDENTIFICACIÓN DE RESTAURADORES Y MANTENEDORES PARA DIFERENTES FUENTES DE *cms* EN GIRASOL USANDO NUEVAS LÍNEAS ENDOCRIADAS

RESUMEN

Se cruzaron doce líneas androestériles citoplasmáticas pertenecientes a cuatro fuentes de androesterilidad citoplasmática (*cms*) con doce líneas para identificar líneas restauradoras de la fertilidad para cada fuente de *cms*. Para cada fuente de *cms* las líneas se comportaron como mantenedoras o restauradoras. Dentro del conjunto de doce líneas endocriadas, nueve de ellas restauraron la fertilidad en DRSF-11A (PEF), DRSF-132A (PET-2) y DRSF-105A (PET-1), once líneas restauraron en DRSF-116A (PEF), cuatro líneas en DRSF-115A (PEF), cinco líneas en DRSF-125A (CMSI) y DRSF-107A (PET-1), seis líneas en DRSF-124A (CMSI) y diez líneas en DRSF-131A (PET-2) y DRSF-109A (PET-1). Sin embargo, ninguna línea restauró la fertilidad en DRSF-117A (PEF). A partir de este estudio, algunos restauradores efectivos pudieron identificarse para fuentes de *cms* recientemente desarrolladas por primera vez en India, que pueden explotarse en el desarrollo de híbridos altamente heteróticos que poseen citoplasmas alternativos.

UTILISATION DE NOUVELLES LIGNES AUTOGAMES DE TOURNESOL DANS L'IDENTIFICATION DES RESTAURATEURS ET DES CONSERVATEURS DE FERTILITÉ DANS DIFFÉRENTES SOURCES DE *cms* DE TOURNESOL

RÉSUMÉ

Douze lignées males stériles développées sur quatre sources cytoplasmiques (*cms*) différentes ont été croisées à douze lignées en vue d'identifier les sources de restauration de la fertilité mâle pour chacune des sources *cms*. Ces lignées se sont révélées avoir un statut de mainteneur de stérilité ou de restaureur de fertilité variable selon la source de stérilité ou selon la lignée mâle stérile pour une même source. 9 lignées males ont restauré la fertilité de DRSF-114A (PEF), DRSF-132A (PET-2) et DRSF-105A (PET-1); 11 lignées males ont restauré la fertilité de DRSF-116A (PEF) et DRSF-127A (CMSI); 4 lignées males ont restauré la fertilité de DRSF-115A (PEF); 5 lignées males ont restauré la fertilité de DRSF-125A (CMSI) et DRSF-107A (PET-1); 6 lignées males ont restauré la fertilité de DRSF-124A (CMSI); 10 lignées males ont restauré la fertilité de DRSF-131A (PET-2) et DRSF-109A (PET-1).Cependant, aucune lignée testée n'a restauré la fertilité de DRSF-117A (PEF). A partir de cette étude, quelques lignées restauratrices de fertilité ont été identifiées pour les nouvelles sources de stérilité mâle cytoplasmique développées récemment en Inde. Ces résultats peuvent être exploités pour développer des hybrides à fort hétérosis sur des cytoplasmes représentant des alternatives par rapport au cytoplasme couramment utilisé.