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 inbreds 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

<table>
<thead>
<tr>
<th>No. Inbred</th>
<th>DRSF-114A (PEF)</th>
<th>DRSF-115A (PEF)</th>
<th>DRSF-116A (PEF)</th>
<th>DRSF-117A (PEF)</th>
<th>DRSF-124A (CMS I)</th>
<th>DRSF-125A (CMS I)</th>
<th>DRSF-127A (CMS I)</th>
<th>DRSF-131A (PET-2)</th>
<th>DRSF-132A (PET-2)</th>
<th>DRSF-105A (PET-1)</th>
<th>DRSF-107A (PET-1)</th>
<th>DRSF-109A (PET-1)</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>DRM 34-2R</td>
<td>R</td>
<td>R</td>
<td>R</td>
<td>M</td>
<td>M</td>
<td>M</td>
<td>M</td>
<td>M</td>
<td>M</td>
<td>M</td>
<td>R</td>
</tr>
<tr>
<td>2</td>
<td>DRSF-110R</td>
<td>R</td>
<td>M</td>
<td>M</td>
<td>R</td>
<td>R</td>
<td>R</td>
<td>R</td>
<td>R</td>
<td>R</td>
<td>R</td>
<td>R</td>
</tr>
<tr>
<td>3</td>
<td>DRSF-113R</td>
<td>R</td>
<td>R</td>
<td>M</td>
<td>M</td>
<td>R</td>
<td>R</td>
<td>R</td>
<td>R</td>
<td>R</td>
<td>R</td>
<td>M</td>
</tr>
<tr>
<td>4</td>
<td>DRSF-116R</td>
<td>R</td>
<td>M</td>
<td>M</td>
<td>R</td>
<td>R</td>
<td>R</td>
<td>R</td>
<td>R</td>
<td>R</td>
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<td>R</td>
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<tr>
<td>5</td>
<td>DRSI-32</td>
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<td>R</td>
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<td>M</td>
<td>M</td>
<td>M</td>
<td>R</td>
<td>M</td>
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<tr>
<td>6</td>
<td>DRSI-165</td>
<td>R</td>
<td>R</td>
<td>R</td>
<td>M</td>
<td>R</td>
<td>R</td>
<td>R</td>
<td>R</td>
<td>M</td>
<td>M</td>
<td>R</td>
</tr>
<tr>
<td>7</td>
<td>P-356R</td>
<td>R</td>
<td>M</td>
<td>M</td>
<td>M</td>
<td>R</td>
<td>M</td>
<td>R</td>
<td>R</td>
<td>R</td>
<td>R</td>
<td>R</td>
</tr>
<tr>
<td>8</td>
<td>RHA-6D1</td>
<td>R</td>
<td>M</td>
<td>R</td>
<td>M</td>
<td>M</td>
<td>R</td>
<td>R</td>
<td>R</td>
<td>R</td>
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<tr>
<td>9</td>
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<td>R</td>
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<td>R</td>
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<td>R</td>
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<tr>
<td>10</td>
<td>R272-I</td>
<td>M</td>
<td>R</td>
<td>R</td>
<td>M</td>
<td>R</td>
<td>M</td>
<td>M</td>
<td>M</td>
<td>M</td>
<td>M</td>
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</tr>
<tr>
<td>11</td>
<td>R-298</td>
<td>M</td>
<td>M</td>
<td>R</td>
<td>M</td>
<td>M</td>
<td>R</td>
<td>M</td>
<td>M</td>
<td>M</td>
<td>M</td>
<td>M</td>
</tr>
<tr>
<td>12</td>
<td>R-856</td>
<td>R</td>
<td>M</td>
<td>R</td>
<td>M</td>
<td>R</td>
<td>R</td>
<td>R</td>
<td>R</td>
<td>M</td>
<td>M</td>
<td>R</td>
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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-R 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-116A (PEF), DRSF-124A (CMSI), DRSF-127A (CMSI), DRSF-105A (PET-1), DRSF-107A (PET-1) and DRSF-109A (PET-1). Two inbreds, R-298 and DRSI-32, acted as maintainers for many cms lines except for DRSF-116A (PEF), DRSF-124A (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 acted 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 uti-
lization in hybrid breeding programs for developing diverse hybrids with better heterosis and resistance to diseases and insect pests.

REFERENCES


UTILISATION DE NOUVELLES LIGNES AUTOGAMES DE TOURNESOL DANS L'IDENTIFICATION DES RESTAUREURS 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 restaurateur 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.