SHORT COMMUNICATION

Identification of Restorers and Maintainers for CMS lines of Rice (*Oryza sativa* L.)

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Three cytoplasmic-genic male sterile (CMS) lines of rice having wild abortive (WA) cytoplasmic male sterility source were crossed with 60 genotypes to identify their restorer/maintainer nature. Most of the genotypes expressed differential fertility reactions when crossed with CMS lines. Among the genotypes tested, 16 were found to be common as effective restorers for all the three CMS lines. These genotypes may be tested for heterosis for development of rice hybrids. Three genotypes viz; Narendra Usar-3, CR2340-5 and Maleshiya produced completely sterile hybrids with all the three CMS lines which may be used in developing new male sterile lines.

Key Words: CMS lines, Fertility restoration, Maintainers, Rice, Wild abortive

Heterosis breeding in rice is effective only when promising restorers are identified for different sources of cytoplasmic-genic male sterile (CMS) lines. The CMS source of Wild Abortive (WA) is being used most extensively in China and India for development of hybrids (Lin and Yuan, 1980).

Restorers for different cytosterile lines will increase the cytoplasmic diversification, which in turn can prevent genetic vulnerability due to the use of single CMS source (Pradhan *et al*., 1992). The restorers and maintainers for WA cytoplasm were reported earlier by Rangaswamy *et al*. (1987), Yogesha and Mahadevappa (1994), Rosamma and Vijayakumar (2005), Ingale *et al*. (2005), Raju Ram *et al*. (2006), Sabar *et al*. (2007) and Akhter *et al*. (2008). Considering the importance of heterosis breeding the present investigation was undertaken with the objective to identify different restorers and maintainers for 3 CMS lines from among the local and high yielding rice (*Oryza sativa* L.) genotypes.

Three CMS lines; IR58025A, IR68897A and Pusa 6A from wild abortive (WA) sources and 60 different test genotypes were grown in a source nursery at the Agricultural Research Farm, Banaras Hindu University, Varanasi during rainy season of 2007. Staggered planting of the CMS lines were done to ensure synchronous flowering. Each CMS line was planted in twin rows, with 10 plants alternating pollen parents (in single rows at 20 x 15 cm spacing). All CMS lines were tested for pollen sterility using 2% iodine-potassium iodide stain and the pollen shedders were removed. Panicles of CMS lines were bagged prior to anthesis. Pollen from male parents were collected at the time of anthesis and dusted separately on the bagged panicles. All possible cross combinations (180) were attempted and mature seeds were collected from 180 F_1 hybrids for further evaluation. The F_1 hybrids were grown at Banaras Hindu University, Varanasi, during rainy season 2008 in single rows having 15 plants. Before anthesis three panicles of each F_1 plant were bagged so as to avoid contamination. Pollen fertility and spikelet fertility were recorded from bagged panicles and the test entries were classified into effective maintainers (<1% pollen fertility), partial/weak maintainers (1 to 20% pollen fertility), partial restorers (21 to 80% pollen fertility) and effective restorers (81 to 100% pollen fertility).

The present observations revealed that F_1 hybrids produced by crossing different rice genotypes with CMS lines behaved differently with regard to pollen fertility Table 1. Out of the 180 F_1 hybrids, 28 were completely sterile and 77 completely fertile. The remaining 75 hybrids expressed varying degrees of fertility, eighteen of them were partial maintainers and the remaining 57 were partial restorers.

Genotypes; CR 2340-1, Type-3, Basmati-370, Pant Dhan-11, Pusa Sugandh-3, Krishna Hansa, HUBR 2-1, Narendra-359, HUR 3022, Taraori Basmati, MTU-7029, BPT 5204, Sarju-52, Malviya-36, Badshabhog and Pusa Sugandh-4 produced higher fertile hybrids and are hence considered as effective restorers for all the three CMS lines (Table 1). Genotypes; IDR-763, Pant-12, CR-2340-7, Pusa Basmati-1, IR-64, GR-32, Kalanamak, Sona Choor, Tulsiparsad and Super Basmati were found to be effective

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Table 1. Classification of rice genotypes into restorers (R), maintainers (M), partial maintainers(PM) and partial restorers for different cytosterile lines

S.No	Genotypes	IR 58025A	IR 68897A	Pusa 6A
1.	Vishnuprag	PR	M	PM
2.	CR 2340-1	R	R	R
3.	Rupali	PR	R	M
4.	Pant Dhan-10	PR	PR	PR
5.	Pant Dhan-4	M	R	PR
6.	Type-3	R	R	R
7.	Basmati-370	R	R	R
8.	Manhar	PR	M	PR
9.	Pant Sugandh Dhan-17	PR	PR	PR
10.	Pant Dhan-11	R	R	R
11.	Annada	PM	R	PR
12.	Pusa Sugandh-3	R	R	R
13.	Pant Dhan-6	PR	PR	M
14.	Gautam	PR	R	PR
15.	Krishuna Hansa	R	R	R
16.	HUBR 2-1	R	R	R
17.	NDR-118	PR	R	PR
18.	IDR-763	R	PR	R
19.	Pant-12	R	PR	PR
20	Narendra-359	R	R	R
21	Narendra-80	PR	R	R
22	Narendra2026	PR	PR	PM
23	Narendra Usar-3	M	M	M
24	Narendra-97	PR	R	PM
25	Kanak Jeer	M	PR	PR
26	Anjali	PM	M	PM
27	Naveen	M	PR	PR
28	HUR 3022	R	R	R
29	Narendra Usar-2	PR	PM	PR
30	GR-2340-7	R	PM	R
31.	CR2340-5	M	M	M
32.	BAU-170-90	PR	PR	PM
33.	Pusa Basmati-1	R	PR	PR
34.	IR-64	R	R	PR
35.	Taraori Basmati	R	R	R
36.	G R-32	R	R	PR
37.	Kalanamak	R	R	PR
38.	Jaya	PR	M	R
39.	M T U-7029	R	R	R
40.	BPT 5204	R	R	R
41.	Sarju-52	R	R	R
42.	Malviya-36	R	R	R
43.	Maleshiya	M	M	M
44.	Lalmati	M	PM	PR
45.	Heera	M	PM	M
46.	Vandana	PR	R	PM
47.	Sona Choor	R	R	M
48.	Badshahbhog	R	R	R
49.	Tulsiparsad	R	PM	PR
50.	Pusa Sugandh-2	PR	PR	R
51.	Super Basmati	R	R	PR
52.	Pusa-44	PR	PR	R
53.	Pusa Sugandh-4	R	R	R
54.	CR 2340-3	PR	M	PM
55.	Kalinga 1	PM	M	M
56.	Barni Deep	PR	PR	PR
57.	Khilish	M	PM	M
58.	Sulk Smarat	PR	M	PR
59.	Birsa Dhan 101	PR	PR	PM
60.	BVD 109	PM	PR	PR

restorers for IR58025A while Rupali, Pant Dhan-4, Annada, Gautam, NDR-118, Narendra-80, Narendra-97, IR-64, GR-32, Kalanamak, vandana, Sona Choor, Super Basmati showed effective restoration for IR68897A and IDR-763, Narendra-80, CR-2340-7, Jaya, Pusa Sugandh-2 and Pusa-44 were effective restorers for Pusa 6A.

Narendra Usar-3, CR2340-5 and Maleshiya produced sterile hybrids when crossed with all the three CMS lines while Pant Dhan-4, Kanak Jeer, Naveen, Lalmati, Heera and Khilish produced sterile hybrids when crossed with IR58025A. Vishnuprag, Manhar, Anjali, Jaya, CR2340-3, Kallinga-I and Sulk Smarat produced sterile hybrids when crossed with IR688897A and Rupali, Pant Dhan-6, Heera, Sona Choor, Kallinga-I and Khilish produced sterile hybrids when crossed with Pusa 6A, these genotypes could be utilized in back cross breeding programmes for the development of new male sterile lines. Conversion of genotypes which are well adapted in a particular agroclimatic region into CMS lines can be of great use in the development of rice hybrids for Uttar Pradesh. As observed in the present study, the differential raction to fertility restoration by different genotypes, earlier worker have also reported the similar results. For instance, Rosamma and Vijay kumar (2005) found that 'Aruna' and 'Ptb10' were maintainers for five CMS lines where as these were found effective restorers for some others CMS lines, Oka (1974) suggested that the genetic background of a female parent could influence pollen and spikelet fertility of F_1 hybrids in inter-varietal rice hybrids.

The genotypes, Narendra Usar-3, CR2340-5 and Maleshiya could be said to be perfect maintainers as these genotypes produced sterile hybrids in all the three CMS lines. These genotypes may be converted into new CMS lines through back cross breeding programmes. Genotypes showed effective restoration with promising heterosis in this area could be exploited for development of hybrids, rice varieties.

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