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Short communication

Maintainers and restorers for CMS lines of rice

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Abstract

Seven cytoplasmic-genic male sterile (CMS) lines of rice having wild abortive (WA) cytoplasmic male sterility source and one having *Oryza perennis* CMS source were crossed with 34 entries to assess their maintainer/restorer behaviour. Most of the genotypes expressed differential fertility reactions when crossed with CMS lines having WA cytoplasm and all test entries produced sterile hybrids when crossed with CMS line having *O. perennis* source. Among the genotypes tested, 'Annapoorna', 'Kanchana', IR 36, 'Mattatriveni' and 'Aiswarya' are recognized as effective restorers for WA cytoplasmic male sterile lines. 'Jyothy' produced completely sterile hybrids with all CMS lines. 'Aruna', 'Pavizham' and Ptb 10 were maintainers for five CMS lines.

Keywords: Heterosis, hybrid rice, pollen sterility, fertility restoration, wild abortive

In heterosis breeding programme using cytoplasmic male sterility (CMS) system, identification of maintainers and restorers is fundamental. Restorers for different cyto-sterile sources will increase the cytoplasmic diversification, which in turn can prevent genetic vulnerability due to the use of single CMS source (Pradhan et al., 1992). While a large number of restorers have been identified for the wild abortive (WA) CMS lines (Virmani and Edwards, 1983; Pradhan et al., 1992), effective restorers for *Oryza perennis* source have not been identified so far. The present investigation was undertaken to identify maintainers and restorers for these two sources of cytoplasmic male sterility from among the local and high yielding rice (*Oryza sativa* L.) varieties of Kerala.

Eight CMS lines from two cytoplasmic–genic male sterile sources *viz*., wild abortive (WA) and *O. perennis* and 34 genetically diverse test varieties were grown in a source nursery at the Agricultural Research Station, Mannuthy during *rabi* 1995. Staggered planting of the CMS lines was 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 (272) were attempted and mature seeds were collected from 232 combinations (i.e., 201 for WA and 31 for *O. perennis*) for further evaluation.

During *kharif* 1996, the F_1 seeds were grown in the field in single rows having 15 plants alternated by male parents. 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

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to 80% pollen fertility) and effective restorers (81 to 100% pollen fertility).

Results show that F_1 hybrids produced by crossing CMS lines with selected rice genotypes behaved differently with regard to pollen fertility. Out of the 201 F_1 hybrids having CMS lines with WA cytoplasm, 36 were completely fertile and 47 completely sterile. The remaining 118 hybrids expressed varying degrees of fertility. Sixty-one of them were partial maintainers and the remaining 57 were partial restorers. All hybrids (31) with *O. perennis* as source of cytoplasmic male sterility expressed complete pollen sterility. In particular, IR 66707A produced sterile hybrids when crossed with 31 rice genotypes (Table 1).

Table 1. Classification of rice genotypes into restorers (R), maintainers (M), partial restorers (PR) and partial maintainers (PM) for WA and *Oryza perennis* cytosterile lines

Genotypes	WA lines							*O. perennis* lines
	IR 58025A	IR 62829A	IR 67684A	IR 68890A	IR 68891A	PMS 3A	PMS 10A	IR 66707A
'Annapoorna'	PM	R	M	R	R	PR	R	M
'Hraswa'	PM	PR	-	-	PR	-	-	M
'Jyothi'	M	M	M	M	M	M	M	M
'Mattatriveni'	M	R	PM	R	R	PR	R	M
'Kairali'	PM	R	M	PM	PR	PM	M	M
'Kanchana'	PM	R	R	R	R	PR	R	M
'Jayathi'	PR	PR	PM	PR	PM	PM	PR	M
'Bhagya'	PM	PM	PR	M	PR	PM	M	M
'Onam'	M	M	PM	PM	PM	PR	PM	M
'Aruna'	M	M	M	M	M	PM	R	M
'Makom'	PM	PM	PM	PM	PR	M	PR	M
IR 36	PM	R	PM	R	R	M	R	M
IR 8	R	M	PR	PM	R	M	PR	M
'Jaya'	R	PM	PR	M	R	R	M	M
'Pavizham'	PR	PM	M	M	M	M	M	M
'Aathira'	PM	R	PM	PM	PR	PR	PR	M
'Aiswarya'	R	R	PM	R	R	R	R	M
'Remya'	PM	PR	PM	PM	PR	PR	PM	M
'Kanakom'	PR	PR	M	PM	PM	M	PR	M
'Ponmani'	-	-	PM	PR	-	-	PR	M
Ptb 1	-	-	PM	PR	PM	PM	PM	M
Ptb 9	PM	PM	M	PR	M	M	R	M
Ptb 10	M	M	M	R	M	M	R	M
Kau 10-1-1	PR	PR	-	-	PR	-	-	-
'Mahsuri'	-	-	PM	PR	PR	-	-	-
'Bharathi'	PM	PR	-	PM	PR	-	PM	M
'Suvarnamodan'	PR	-	PM	PR	PR	PM	M	-
'Swarnaprabha'	-	PR	PR	-	-	PR	-	M
M 42-6-3	M	M	PM	-	PM	-	-	M
M 45-20-1	PM	PR	PR	M	PM	PR	PM	M
M 38-4-2	PR	M	PM	PR	PR	PM	PR	M
M 48-11-3	-	R	-	PM	PR	M	-	M
M 38-4-1	-	-	PR	PR	PM	PR	-	M
M 42-6-2	-	R	PM	PR	-	-	PM	M

Genotypes expressed differential fertility reactions in crosses with CMS lines having WA cytoplasm. 'Annapoorna', 'Kanchana', IR 36, 'Mattatriveni' and 'Aiswarya' produced more fertile hybrids and are hence considered as effective restorers for WA cytoplasmic male sterile lines (Table 1). 'Annapoorna', 'Mattatriveni' and IR 36 were restorers for four CMS lines, while 'Kanchana' restored fertility of five CMS lines and 'Aiswarya' produced fertile hybrids when crossed with six CMS lines. IR 62829A *x* 'Kanchana', IR 68890A *x* 'Kanchana', IR 68890A *x* 'Aiswarya', IR 68891A *x* IR 36, IR 62829A *x* 'Mattatriveni' were identified as promising heterotic combinations suitable for Kerala. This is consistent with the findings of Leenakumary et al. (1998) who found 'Mattatriveni' and 'Kanchana' as effective restorers.

'Aruna', 'Pavizham' and Ptb 10 produced sterile hybrids when crossed with five CMS lines, while 'Jyothi' formed sterile hybrids for all crosses involving the CMS lines under study. 'Jyothi' being a maintainer could be utilised in back cross breeding programmes for the development of male sterile versions of this variety ('Jyothi A'). Being the most popular and well-adapted variety, conversion of 'Jyothi' into CMS line can be of great use in the development of rice hybrids for Kerala. Furthermore, in the tropics where even stable CMS lines express fertility to a certain extent, this may be advantageous. High genotype–environment interaction for sterility behaviour in CMS lines was already reported by Rosamma and Vijayakumar (2002).

'Aruna', 'Pavizham' and Ptb 10 were maintainers for five CMS lines. 'Aruna' and Ptb 10 also restored the fertility of some CMS lines. For example, 'Aruna' restored fertility of one CMS line and Ptb 10 restored fertility of two CMS lines with WA sterile cytoplasm. Present study also revealed differential reaction to fertility restoration by other varieties. Similar results were reported by other workers too. For instance, Prasad et al. (1993) found that CO 43 is a maintainer for IR 62829A and restorer for V20A. It was partial restorer for IR 58025A and TNAU 1A. 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.

Until recently, more than 95% of the CMS lines used in the commercial *indica* rice hybrids were of the WA type. In the present investigation, cytoplasmic male sterile line IR 66707A having *O. perennis* cytoplasmic source of male sterility was hybridised with 31 rice genotypes to identify restorers if any for this new source of cytoplasmic male sterility. None of the 31 genotypes, however, could restore fertility when crossed with this CMS line. All of them showed 99 to 100% sterility and were effective maintainers. More genotypes should, therefore, be tested to identify restorers for this particular source of male sterility.

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