Identification of basmati maintainers and restorers of WA cytoplasmic male sterile lines in rice

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The role of hybrids in enhancing the productivity of different crops is widely acknowledged. Hybrid rice is a feasible and readily adaptable genetic option to increase rice production. India is the premier basmati-exporting country and the first basmati hybrid, Pusa RH-10, was released in 2001. Developing basmati hybrid rice in India is gaining impetus. It requires the identification of maintainers and restorers from the lines developed through conventional basmati breeding programs. Maintainers with higher adaptability and restorers having higher combining ability and ideal grain quality traits need to be developed. Four CMS lines (with wild abortive cytoplasmic background), IR68890A, UPRI 95-17A, DRR2A, and PMS 2A, and 12 testers (traditional basmati, evolved basmati, and other aromatic varieties) Taraori Basmati, Pusa Basmati, Type 3, Mahisugandha, Mugad Sugandha, HUR-PB-1S-97, Basmati 370, Pusa 25-17-251, Super Basmati, Pusa 44, Pusa Sugandh 5, and Kasturi, were used in line × tester (4 × 12) analysis with 48 hybrids. The experiment was laid out in a randomized block design with two replications. Observations of pollen fertility and spikelet fertility were carried out for the identification of maintainers and restorers. A very low magnitude of pollen and spikelet fertility of <5% was observed for hybrids (Table 1).

Table 1. Maintainers for the four CMS lines studied.

CMS line	Effective maintainers	Pollen fertility (%)	Spikelet fertility (%)
IR68890A	HUR-PB-1S-97	0.2	5.0
	Pusa 44	0.2	2.8
	Pusa Sugandha 5	0.6	4.5
	Kasturi	1.3	4.2
UPRI 95-17A	HUR-PB-1S-97	0.5	3.2
	Pusa Basmati	2.9	3.5
DRR2A	Type 3	0.6	0.0
	Mugad Sugandha	0.0	0.0
	Super Basmati	0.0	0.0
	Kasturi	0.5	4.9
PMS 2A	Mugad Sugandha	0.5	2.3
	Pusa Sugandha 5	0.2	2.8

These effective maintainers can be further backcrossed with their respective F_1s to select completely sterile backcross progenies so that these can be developed as new CMS lines. It was observed that lines Kasturi, Pusa 44, Pusa Sugandha 5, Super Basmati, and Mugad Sugandha are semidwarf (plant height ranged from 91–115 cm) and thus are most appropriate for conversion. The hybrids that recorded more than 80% spikelet fertility and 70 % pollen fertility are listed (Table 2).

Table 2. Basmati restorers for four WA CMS lines.

CMS line	Effective restorers	Pollen fertility (%)	Spikelet fertility (%)
IR68890A	Pusa 25-17-251	100.0	94.8
	Taraori Basmati	96.1	97.7
	Mahisugandha	70.0	80.5
UPRI 95-17A	Taraori Basmati	92.1	88.6
	Type 3	96.4	80.6
	Super Basmati	93.8	84.0
DRR 2A	Mahisugandha	99.6	97.2
	Pusa Basmati	93.5	93.3
PMS 2A	Taraori Basmati	92.6	96.4
	Pusa Basmati	89.8	85.7
	Basmati 370	91.7	81.1
	Super Basmati	87.9	93.0
	Pusa 25-17-251	89.7	88.4
	Kasturi	87.5	91.4

Sabar et al (2007) reported that the traditional basmati lines Basmati 370, Super Basmati and Shaheen Basmati acted as restorers for certain WA CMS lines. In our investigation, in some cases, the genotype that behaved as a restorer for one CMS line was a maintainer for another CMS line. Super Basmati behaved as an effective maintainer for CMS line DRR 2A but was an effective restorer for CMS lines PMS 2A and UPRI 95-17A. Kasturi was an effective maintainer for CMS lines IR68890A and DRR 2A while it was an effective restorer for CMS line PMS 2A. The variation in behavior of fertility restoration indicates that either the fertility-restoring genes are different or that their expression varied with the genotypes of the parents or the modifiers of female background. Similar results have been reported by Rosamma and Vijayakumar (2005) and Pradhan et al (2006).

References

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