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Short Communication

Basmati type restorers and maintainers for two cytosterile lines of rice (*Oryza sativa* L.)

S. K. Pradhan[1], L. K. Bose[1] and S. C. Mani

Deptt. of Genetics and Plant Breeding, G. B. Pant University of Agriculture and Technology, Pantnagar 263 145

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Low yielding aromatic rices have been the major casualty of green revolution where the main emphasis was on yield rather than quality. A large number of aromatic rices have already been lost and many are on the verge of extinction. The development of rice hybrids and release of aromatic hybrid Pusa RH 10 inspired the breeders to develop *basmati* hybrids as well. In three-line system of hybrid development, it is essential to have effective restorers and stable cms lines, which can produce heterotic hybrids. The low frequency of restorer lines among *basmati* rice cultivars is a serious handicap to develop *basmati* rice hybrids as only 9% of total *basmati* genotypes have been reported to possess restorer genes [1]. The purpose of identification maintainers was to transfer the male sterility cytoplasm into the genetic background of locally adopted varieties through backcross breeding to develop new *basmati* cms lines, while the purpose of identification of restorers was to find out suitable fertility restorers among the locally adopted varieties for the existing *basmati* cms lines as a short term strategy for the hybrid *basmati* breeding programme.

Sixty four F_1 hybrids were produced by hybridizing Pusa 3A and IR 58025A cms lines with 32 elite *basmati* genotypes during wet season of 2001. In 2002 wet season, the F_1s and parents were evaluated in randomized complete block design with three replications. Twenty-five days old single seedling was transplanted in three rows of 3m length plot at 20 × 10 cm spacing. Observations on pollen and spikelet fertility were recorded for each F_1 hybrid. Pollen fertility was recorded by using 1% iodine potassium iodide (IKI) stain. Before anthesis five panicles of each F_1 plant were bagged to avoid contamination from foreign pollen. Seed set percentage was recorded by counting the number of filled grains in a panicle. Based on fertility index [2, 3] the test genotypes were classified as effective restorers (> 80% pollen and spikelet fertility), Partial or weak restorers (21-79% pollen and spikelet fertility), weak maintainers (11-20% pollen and spikelet fertility) and effective maintainers (0-10% pollen and spikelet fertility).

The results indicated that pollen sterility percentage varied from 8.3 to 100% among F_1 hybrids. High pollen sterility (>80%) was recorded in 24 hybrids. The spikelet sterility ranged from 15.8 to 100%. Complete spikelet sterility was observed in nine hybrids *viz.*, Pusa 3A × T3, Pusa 3A × BTCE 10-98, Pusa 3A × Pusa 1280-1-2-1, Pusa 3A × UPRI 93-63-2, Pusa 3A × HKR 98-476, Pusa 3A × IET 15391, IR 58025A × Pusa 1280-1-2-1, IR 58025A × UPR 1840-31-1-1 and IR 58025A × RP 3644-121-112-4. However, low spikelet sterility was observed in cross Pusa 3A × IET 15392, Pusa 3A × RP 3644-41-9-5-5, Pusa 3A × RP 3644-36-15-8-4, Pusa 3A × TM 970267, IR 58025A × RP 3135-17-12-88, IR 58025A × Pusa 2512-97-83-98-4 and IR 58025A × Taraori Basmati.

On the basis of pollen as well as spikelet sterility recorded on F_1 hybrids (Table 1), the male parents were classified as fertility restorers, partial restorers, weak maintainers and maintainers for the cms line Pusa 3A and IR 58025A. The genotypes namely RP 3644-36-15-8-4, RP 3644-41-9-5-5, IET 15392, TM 970267 and RP 3644-41-9-5-5 were identified as fertility restorers for the cms line Pusa 3A. Results indicated that the basmati lines HKR 97-401, T3, UPR 2268-5-2, BTCE 10-98, Pusa 1280-I-2-I, UPRI 93-63-2, Pusa 251 I-97-107, HKR 98-476, TM 96140, IET 13549 and IET 15391 were found to be good maintainers for the cms line Pusa 3A. Among the basmati lines, five genotypes were classified as weak maintainers. Other 12 lines behaved as partial restorers for this cms line. Similarly, the basmati lines *viz.*, RP 3135-17-12-88, Pusa 2512-97-83-98-4 and Taraori Basmati were identified as restorers against IR 58025A background, while RP 3644-36-15-8-4, BTCE 10-98, Pusa 1280-1-2-1, UPRI 93-63-2, UPR 1840-31-1-1, NDR 6110, NDR 6111, IET 15392, IET 15391 and RP 3644-121-112-4 were found to be good maintainers for this cms line. Among all these lines, only genotype RP 3135-17-12-88 was found to be weak maintainer. Rest 24 genotypes behaved as partial restorers.

It is observed from the present study that four *basmati* type genotypes *viz.*, Pusa 1280-1-2-1, BTCE 10-98, IET 15391 and UPRI 93-63-2 behaved as effective maintainers against both the cms lines. But none of the restorers were found to be effective restorers against

[1]Present address: Crop Improvement Division, Central Rice Research Institute, Cuttack 753 000

Table 1. Mean pollen and spikelet fertility of F_1 hybrids of rice

Genotype	Against Pusa 3A			Against IR 58025A		
	Pollen fertility (%)	Spikelet fertility (%)	R/PR/PM/M	Pollen sterility (%)	Spikelet sterility (%)	R/PR/PM/M
HKR 97-401	2.3	3.3	M	80.7	62.3	PR
T_3	0.3	0.0	M	72.3	56.0	PR
UPR 2268-5-2	9.0	2.9	M	22.3	25.0	PR
RP 3644-36-15-8-4	86.7	81.1	R	0.0	1.4	M
RP 3392-75-5-11-1	83.7	76.3	PR	57.0	61.0	PR
RP 3644-41-9-5-5	86.0	84.0	R	81.0	63.3	PR
BTCE 10-98	0.3	0.0	M	4.3	5.7	M
Pusa 2504-1-26	82.3	72.0	PR	88.3	68.7	PR
Pusa 1280-1-2-1	0.0	0.0	M	0.0	0.0	M
Pusa 2504-1-3-1	72.7	73.7	PR	76.7	59.3	PR
RP 3135-17-12-88	17.0	12.4	PM	84.7	80.5	R
RP 3392-32-8-3-3	16.0	14.4	PM	10.7	23.3	PR
Pusa 1235-95-73-1	77.7	72.3	PR	74.0	58.1	PR
Pusa 2503-693-1	74.0	72.3	PR	70.7	63.3	PR
UPRI 93-63-2	0.0	0.0	M	4.3	2.7	M
UPR 1840-31-1-1	58.3	25.7	PR	0.0	0.0	M
UPR 2268-4-1	73.0	68.0	PR	75.7	59.1	PR
NDR 6111	13.3	12.7	PM	7.0	4.8	M
Pusa 25 12-97-83-98-4	72.3	64.2	PR	82.7	80.9	R
Pusa 25 11-97-107	66.0	23.4	PR	87.3	73.8	PR
Taraori Basmati	91.7	62.5	PR	83.0	83.8	R
UPR 2268-3-3	74.3	65.5	PR	64.0	39.2	PR
HKR 98-476	4.0	0.0	M	62.3	61.3	PR
NDR 6110	80.7	77.0	PR	15.0	3.4	PM
TM 96140	8.3	6.1	M	81.7	63.9	PR
IET 13549	2.7	0.0	M	71.7	48.0	PR
IET 15392	87.7	84.2	R	19.0	5.0	PM
IET 14131	41.7	21.3	PR	68.3	41.3	PR
IET 15391	0.0	0.0	M	3.3	2.7	M
TM 970267	80.3	80.8	R	74.3	44.0	PR
Hasan Sarai	37.3	57.8	PR	65.7	47.3	PR
RP 3644-121-112-4	13.0	12.3	PM	0.0	0.0	M

R-Restorer; PR-Partial Restorer; M-Maintainer; PM-Partial Maintainer

both the cms background. Also, some lines that were identified as maintainers against Pusa3A background behaved as partial restorers against IR58025A cms line. Such a differential response of the same genotype with two cytosterile lines having similar source of cytoplasm could be due to the nuclear genes interactions in different ways.

In the present investigation, Pusa 3A × RP 3392-75-5-11-1, Pusa 3A × NDR 6110, Pusa 3A × RP 3135-17-12-88, Pusa 3A × Pusa 2504-1-26, Pusa 3A × Pusa 2503-693-1, Pusa 3A × 2511-97-107, IR 58025A × UPR 2268-5-2 and IR 58025A × Pusa 2511-97-107 showed more than 70% but below 80% pollen and spikelet fertility. It has been reported by several workers [4-6] that pollen as well as spikelet fertility are highly influenced by environmental conditions. Thus a partial restorer in one environment may behave like complete restorer at another environment. Similarly, the partial or weak maintainer lines under the environment favoring pollen sterility may behave like maintainer lines. The lines restoring fertility between 30 to 59 % can be safely rejected from the breeding programme.

From the present investigation it is suggested that the promising *basmati* type genotypes *viz.*, Pusa 1280-1-2-1, BTCE 10-98, IET 15391 and UPRI 93-63-2 were identified as effective maintainers against both the cms lines and can be used to develop new cms lines through recurrent backcrossing. The effective restorers namely RP 3644-36-15-8-4, RP 3644-41-9-5-5, IET 15392, TM 970267 and RP 3644-41-9-5-5 against Pusa 3A background while RP 3135-17-12-88, Pusa 2512-97-83-98-4 and Taraori basmati against IR 58025A may be utilized in basmati hybrid breeding programme.

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