

Evaluation of stable performance of cytoplasmic genic male sterile lines in rice

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ABSTRACT

The experiment was conducted to evaluate the stability of Cytoplasmic Genic Male Sterility of different male sterile lines and their maintainers for pollen and spikelet fertility. A total of thirty five CMS lines and twenty four maintainer lines were raised during June 2003. Of the thirty five CMS lines, DRR 6A, DRR 7A, PMS 17 A, APMS 6A, COMS 14A, COMS 15 A, KCMS 13 A, RTN 2 A, RTN 3 A, RTN 6A, RTN 11 A, RTN 13 A, RTN 14 A, RTN 17A, RTN 18 A and IR 68888A were completely pollen sterile. For all other CMS lines spikelet fertility ranged from 0.5 per cent to 6.5 per cent. The CMS lines DRR 3A, DRR 6A, DRR 7A, PMS 17A, COMS 14 A, COMS 15 A, KCMS 13A, RTN 2 A, RTN 3A, RTN 6A, RTN 13 A, RTN 18 A, IR 58025 A and IR 68888A were exhibited above 70 per cent of panicle exertion. Twenty two sterile CMS lines had more than 35 per cent out crossing. Stigma exertion of more than 30 per cent was observed for the CMS lines DRR 3A, DRR 5A, DRR 6A, DRR 7A, PMS 17A, COMS 14A, COMS 15A, Pusa 3A, KCMS 13A, IR 75601A, RTN 2A, RTN 3A, RTN 6A, RTN 17A, RTN 18A and IR 68888A. The CMS lines viz., DRR6A, DRR7A, PMS17A, COMS14A, COMS15A, RTN 2 A, RTN 3A, RTN 6A, RTN 18A, IR 68888A were found promising for the characters viz., pollen sterility, panicle exertion, stigma exertion, natural out crossing and medium duration which offer scope of utilizing these male sterile lines for the development of three line hybrid with high yield in rice.

Key words: Rice CMS lines, pollen sterility, stigma exertion, out crossing

Hybrid rice giving an yield advantage of about 20-30% over high yielding homozygous varieties (Yuan, 2002) is a better choice. For commercial application of heterosis, the three line breeding method is the most commonly used in China and elsewhere. The three-line breeding method involves the use of cytoplasmic genic male sterile line (CGMS), its maintainer and a restorer line. Successful development of hybrid rice depends on improvement of parental lines A, B and R. The search for alternate sources of CMS in hybrid rice breeding is a priority because more than 90 per cent of the hybrids released throughout the world are based on a single sterile cytoplasm wild abortive (WA). Hence an attempt was made to evaluate different rice Cytoplasmic Genic Male Sterile (CGMS) lines and their maintainer lines for adaptability, stability of pollen and spikelet fertility, agronomic characteristics for developing three lines hybrids in rice.

Thirty five CMS lines and maintainer lines were

obtained from Directorate of Rice Research, Hyderabad, India for evaluation. The CMS lines were raised at Paddy Breeding Station, Tamil Nadu Agricultural University, Coimbatore, India during June 2003. Two-three (2-3) pairs of each CMS and maintainer lines were planted side by side in single row plots having 12 hills per row with a spacing of 20x20 cm apart. Observations were recorded for days to fifty flowering, plant height, panicle number plant⁻¹, panicle length (cm), pollen sterility (%), panicle exertion (%), stigma exertion (%), natural seed set (%). About 10-15 spikelets from the freshly emerged panicles of all the 12 plants were collected and examined under microscope with 1% Iodine Potassium Iodide (IKI) solution for pollen fertility assessment. Five panicles plant⁻¹ were evaluated for natural seed set per cent. Panicles emerging from the sheath were bagged with butter paper bags prior to anthesis to prevent cross-pollination. Bagged panicles were harvested to assess seed setting per cent.

The result showed that (Table 1) out of thirty five CMS lines evaluated, thirty two had more than 95 per cent pollen sterility. Out of thirty two sterile CMS lines, sixteen CMS lines viz., DRR 6A, DRR 7A, PMS 17A, APMS 6A, COMS 14A, COMS 15A, KCMS 13A, RTN 2A, RTN 3A, RTN 3A, RTN 6A, RTN 11A, RTN 13A, RTN 14A, RTN 17A, RTN 18A and IR 68888A

were completely pollen sterile. According to Hossain and Li, (2002) high pollen sterility (99.00 – 99.9 per cent) was observed in CMS lines DRR 3A, CRMS 45A, Pusa 3A, IR 75601A, RTN 4A, RTN 5A and RTN 10A. High pollen sterility in CMS lines also been observed by Pradhan and Jachuck, 1993; Kalaiyarasi *et al*, 2001; Kumar *et al*, 1996.

Table 1. Evaluation of different rice CMS lines for pollen sterility and other floral traits

CMSLines	Days to 50 % flowering	Plant height (cm)	Panicle number plant ⁻¹	Panicle length (cm)	Pollen sterility %	Panicle exertion %	Stigma exertion %	Natural out crossing %	Spikelet fertility %
DRR 3A	97	53.6	10.6	16.6	99.25	72.0	32.0	27	0.8
DRR 4A	88	41.5	7.6	18.8	98.00	68.9	29.0	28	1.2
DRR 5A	87	46.0	9.4	18.6	92.50	63.9	30.0	18	6.5
DRR 6A	93	41.4	10.1	14.5	100.00	77.0	37.5	50	0.0
DRR 7A	90	47.1	12.1	16.5	100.00	70.5	38.8	42	0.0
DRR 8A	94	64.3	11.2	18.8	94.80	54.2	19.0	27	5.5
APMS 6A	100	64.6	11.5	20.6	100.00	63.2	17.3	40	0.0
PMS 17A	96	58.2	11.6	17.5	100.00	80.8	35.3	52	0.0
COMS 14A	94	47.3	10.4	16.1	100.00	73.9	32.5	47	0.0
COMS 15A	98	53.6	10.6	17.9	100.00	76.9	32.0	42	0.0
CRMS 45A	92	46.5	7.3	18.9	99.00	52.6	19.6	35	0.6
Pusa 3A	110	50.7	8.3	18.8	99.25	55.6	36.1	36	0.8
Pusa 6A	113	52.4	11.0	20.7	98.00	58.5	11.2	26	1.6
KCMS 13A	113	53.3	12.0	20.6	100.00	78.1	35.3	26	0.0
IR 73318A	110	48.6	8.6	20.0	94.30	59.0	18.3	18	3.8
IR 73323A	110	50.0	11.0	17.6	98.25	59.7	17.5	38	2.2
IR 73328A	115	57.0	9.6	15.2	98.30	56.0	19.1	18	2.4
IR 75594A	112	38.3	5.4	21.1	96.50	63.0	19.1	38	3.6
IR 75601A	104	42.3	11.6	20.3	99.25	52.0	36.4	35	0.4
IR 75603A	105	36.6	5.2	22.0	98.00	67.0	18.8	35	1.0
IR 75608A	113	49.3	9.1	20.2	96.55	67.6	18.6	39	2.6
RTN 2A	90	52.0	16.3	20.1	100.00	79.9	33.7	42	0.0
RTN 3A	95	53.0	18.6	21.5	100.00	79.2	32.3	38	0.0
RTN 4A	115	52.1	11.6	19.3	99.00	60.5	17.1	18	0.7
RTN 5A	111	51.4	13.2	19.3	99.00	68.0	18.3	38	0.5
RTN 6A	95	54.4	14.7	18.6	100.00	80.5	33.8	48	0.0
RTN 10A	100	55.1	15.2	20.6	99.00	50.0	15.3	18	1.0
RTN 11A	114	55.0	13.6	18.5	100.00	53.0	23.9	21	0.0
RTN 13A	110	54.3	13.3	18.0	100.00	78.0	26.8	39	0.0
RTN 14A	116	56.0	11.0	18.5	100.00	68.5	22.0	35	0.0
RTN 17A	113	55.6	13.8	20.1	100.00	60.7	49.3	19	0.0
RTN 18A	89	54.4	15.6	20.1	100.00	79.2	32.0	37	0.0
IR 58025A	111	54.4	14.2	18.0	98.25	74.8	23.2	36	1.8
IR 68897A	93	44.4	9.0	20.0	98.25	67.1	28.6	13	2.6
IR 68888A	93	48.8	13.1	20.0	100.00	77.0	33.2	48	0.0

The CMS lines with complete pollen sterility had reduced anthers and did not set any seed in bagged panicles. For all other CMS lines spikelet fertility ranged from 0.5 per cent to 6.5 per cent. Twenty two CMS lines exhibited out crossing of more than 35% (Table1). Out crossing percentage was maximum for the sterile CMS line *viz.*, PMS 17 A followed by DRR 6A, IR 68888A, RTN 6A and COMS 14 A. The CMS lines DRR 3A, DRR 6A, DRR 7A, PMS 17A , COMS 14 A, COMS 15 A, KCMS 13 A, RTN 2 A, RTN 3A, RTN 6A, RTN 13 A, RTN 18 A, IR 58025A and IR 68888A were exhibited above 70 per cent of panicle exsertion (Ramesha *et al.*,1998). Stigma exsertion of above 30 per cent was observed for the CMS lines DRR 3A, DRR 5A, DRR 6A, DRR 7A, PMS 17A, COMS 14A, COMS 15A, Pusa 3A, KCMS 13A, IR 75601A, RTN 2A, RTN 3A, RTN 6A, RTN 17A, RTN 18A and IR 68888A. The CMS lines *viz.*, DRR6A, DRR7A, PMS17A, COMS14A, COMS15A, RTN 2 A, RTN 3A, RTN 6A, RTN 18A , IR 68888A were found promising for the characters for pollen sterility, panicle exsertion, stigma exsertion and natural out crossing which offer scope for development of three line high yielding hybrids with good grain quality in rice.

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