

## Evaluation of new CMS lines for outcrossing potential in rice

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### ABSTRACT

Twenty eight CMS lines and their maintainers were evaluated for morphological and floral characters influencing outcrossing rate. The natural outcrossing rate upto 19.22 per cent was recorded in IR 58025A. The CMS lines IR 62829A, IR 70366A, IR 70369A and IR 68888A also showed appreciable amount of natural outcrossing. IR 62829A had most of the desirable characters followed by IR 58025A, IR 70369A, IR 70369A can be used exclusively for hybrid development after studying their combining ability.

**Key words:** CMS line, rice, morphological and floral characters, outcrossing rate

Rice is a strictly self pollinated crop and natural outcrossing rate is extremely low. Higher yields in hybrid seed production depends on outcrossing rate of CMS lines and outcrossing rate is influenced by various morphological and floral characters. Among various CMS lines used in India, the CMS line IR 58025A was found to be stable with high outcrossing rate. Therefore, it was extensively used all over India in hybrid breeding programme. However, the hybrid developed by using this CMS line as female had poor cooking quality and undesirable scent. Hence, the present study was initiated to identify the new promising CMS lines with desirable characters with high outcrossing rate for possible replacement of existing CMS line IR 58025A to develop desirable heterotic F<sub>1</sub> hybrids.

Twenty eight CMS lines and their maintainers were used for this study. The experiment was laid out in randomized block design with two replications. During the crop growth, recommended package of practices were followed. The panicle exertion was expressed as the percentage of panicle of plant. The pollen and spikelets fertility were evaluated as the ratio of fertile pollens to the total pollens and as the ratio of filled spikelets to the total spikelets respectively and expressed in percentage. The length and breadth of anthers, elongation of filaments, length of stigma and style were measured under binocular microscope and expressed in mm. stigma angle was calculated by taking horizontal distance (h) between two feathery stigmas

and vertical distance (v) from the point of attachment of stigma approximately. The centre of horizontal distance was measured with the help of trigonometry ( $\angle$ ) and expressed in degrees. The extent of seed set on open pollinated panicle was expressed in percentage. The statistical analysis was done using mean values of the observations recorded on five randomly selected plants from each of the replication. The analysis and interpretation of the experimental data was done by using the method of randomized block design following the method of Panse and Sukhatme (1976).

Analysis of variance showed significant differences among the CMS lines and their maintainers for all the characters except for spikelet fertility in bagged panicles of A lines (Table 1 and 2). Taller pollen parent and clear panicle exertion would facilitate better pollen dispersal resulting in higher seed set (Taillebois and Guimaracs 1986). The plant height of A and B lines ranged from 60.60 to 80.10 cm and 76.20 to 100.00 cm respectively. In general, A lines flowered later than their corresponding maintainers but difference between A and B lines for days to 50% flowering was not more than five days. Higher number of panicles plant<sup>-1</sup> and spikelets panicle<sup>-1</sup> are necessary, as these are important yield components and likely to be imparted to the hybrid from the parent (Vidyachandra *et al.*, 1997). Mean number of panicles among A and B lines varied from 12.20 to 24.80 and 8.20 to 18.00 respectively. Among the CMS lines evaluated 17 out of 28 had more than 20

**Table 1. Analysis of variance for morphological characters of CMS lines and their maintainers in rice**

Source of variation	Degree of freedom	Mean sum of squares for										
		Days to 50% flowering	Plant height	Panicle length	Panicles panlt <sup>-1</sup>	Spikelet panicle <sup>-1</sup>	Spikelet fertility	Natural outcrossing in A lines	1000 grain wt. in B lines	Seed yield		
Replication	1	5.9821	1.2254	3.4961	5.9646	26.7430	1.2334	0.1729	0.5568	0.0234		
Treatments (A lines + B lines)	55	63.4295**	164.6888**	6.0476**	40.3948**	1887.6287**	3484.3371**	-	-	284.0414**		
A lines	27	73.4896**	73.7993**	5.9775**	26.5702**	2344.4748**	1.0874@	50.8700**	-	1.7587**@@		
B lines	27	54.6088**	58.1618**	6.1372**	13.1911**	1250.8012**	26.6563**	-	22.9932**	43.7131**		
A v/s. B lines	1	30.9687**	5494.9361**	5.5214**	1148.1601**	6747.1285**	690.3623**	-	-	2841.86**		
Error	55	0.3094	1.6396	0.3979	1.0683	3.7160	1.3174	1.3289	1.2849	0.5259		

\*\* - Significant at 1% level

@ - MSS for spikelet fertility under bagged condition

@@ - MSS for yield in lines on natural crossing.

**Table 2. Analysis of variance for floral characters of CMS lines and their maintainers in rice.**

Source of variation	Degrees of freedom	Panicle exertion	Stigma exertion	Pollen fertility	Stigma length	Style length	Angle of stigma lobes	Anther length	Anther breadth	Filament length
Replication	1	4.0904	0.3097	0.3839	0.0006	0.0050	5.3452	0.0004	0.0013	0.0002
Treatments (A lines + B lines)	55	1431.2568**	47.4850**	3924.0455**	0.0583**	0.0240**	93.7475**	0.0680**	0.0259**	0.0772**
A lines	27	396.8753**	29.9633**	21.4166**	0.0526**	0.0225**	90.3283**	0.0591**	0.0256**	0.0765**
B lines	27	104.9324**	28.9860**	7.5128**	0.0938**	0.0229**	95.2956**	0.0616**	0.0234**	0.0752**
A v/s. B lines	1	65170.3125**	1020.0449	215041.41**	0.0938**	0.0955**	144.2656**	0.4839**	0.1009**	0.1523**
Error	55	3.6697	0.9179	0.3494	0.0006	0.0008	4.8557	0.0006	0.0004	0.0007

\*\* - Significant at 1% level

Table 3. Desirable characters of promising CMS lines

CMS lines	Days to 50% flowering	Plant height (cm)	Panicles plant <sup>-1</sup>	Spikelet panicle <sup>-1</sup>	Pollen fertility %	Spikelet fertility %	Stigma length (mm)	Style length (mm)	Stigma angle (0)	Panicle exertion (%)	Outcrossing rate in CMS lines (%)	Seed yield on out crossing	Anther colour
IR 68897A	87.00	65.50	18.50	185.50	3.65	0.17	1.29	0.56	47.50	66.84	11.74	2.03	W
IR 62829A	91.00	64.30	22.80	154.00	Nil	Nil	1.74	0.44	53.10	69.42	18.99	3.31	W
IR68886A	87.50	73.70	21.00	150.00	3.61	0.22	1.13	0.71	41.10	48.28	10.02	1.87	W
IR 64608A	92.00	73.60	21.39	215.00	Nil	Nil	1.32	0.73	37.60	44.10	9.50	1.57	W
IR 68888A	88.00	72.80	18.40	170.50	0.94	Nil	1.49	0.43	49.30	66.29	15.80	2.93	W
IR 70369A	86.00	80.00	18.20	220.00	Nil	Nil	1.35	0.74	28.55	62.22	11.04	2.58	W
IR 70362A	94.00	70.00	22.20	145.00	3.39	0.22	1.07	0.66	39.50	59.48	9.76	1.42	W
IR 70366A	92.50	78.30	22.90	186.40	2.45	0.02	1.46	0.47	48.50	73.49	18.11	3.09	W
IR 58025A	96.50	73.80	20.90	182.70	Nil	Nil	1.53	0.53	49.50	70.71	19.22	3.08	W

W – White, LY – Light Yellow

panicles plant<sup>-1</sup>. Similarly for spikelets panicles<sup>-1</sup> also almost all A lines except KCMS7A and PMS 11A had more than 150 spikelets panicle<sup>-1</sup> which is a highly desirable character.

Hundred per cent pollen and spikelet sterility is a highly desirable character, the CMS lines having sterility of less than 95% are not suitable for hybrid rice production. The CMS lines, IR58025A, IR62829A, IR64608A, IR68888A and IR70369A recorded zero per cent fertility in bagged panicles. Virmani *et al.* (1980) attributed better seed set in Zhenshan 97 due to better panicle exertion. Among 28 CMS lines, only CMS 7A had complete panicle exertion. High percentage of stigma exertion is an important character which directly affect the outcrossing rate A lines. The maximum stigma exertion of more than 19.87% was recorded in IR70366A, PMS 10A and IR66707A.

White anthers in CMS lines and yellow or dark yellow anthers in maintainers are desirable as we can distinguish CMS lines and maintainers in seed production plot. The anther colour of CMS lines in present study was ranged from white (w) to light yellow directly related to outcrossing potential in CMS lines. In present study, the length of stigma and style in CMS lines ranged from 1.05 to 1.74 mm and 0.43 to 0.79 mm respectively. Similar trend was also observed by Seetharamaiah (1994) and Singh and Singh (1998). The stigma angle in A lines ranged from 29.50 to 53.10 degrees. Higher natural outcrossing is highly desirable in CMS lines as it results in higher seed yield in seed production plot. Among 28 CMS lines, IR66707A, IR62829A, IR70366A and IR58025A had (>15.00%) high percent of outcrossing rate and the seed yield in A lines ranged from 0.06 to 3.31 g plant<sup>-1</sup>. In the present study, nine CMS lines were selected as promising ones based on certain important characters (Table 3). Among nine CMS lines IR62829A, IR58025A and IR70369A were most ideal as they showed complete male sterility. IR62829A and IR58025A are already used in large scale seed production. Therefore the new promising CMS line IR70369A was identified in the present study, as it possd most of the desirable characters for enhancement of outcrossing potential.

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