SHORT COMMUNICATION

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Evaluation for stable performance of cytoplasmic male sterile lines in rice

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ABSTRACT

An experiment was conducted to evaluate the stability of cytoplasmic genic male sterility of different male sterile lines for floral traits and yield contributing characters. The CMS lines showed 100 per cent pollen sterility. The highest angle of floret opening was recorded by KJT 2A. The maximum sigma exsertion was observed the CMS line KJT 4 A while KJT 1 A, KJT 6A and KJT 7 A had predictability to performed in favorable environment. KJT 5 A had highest panicle exsertion. It was observed that KJT 4 A CMS line performed better for most of the desirable characters.

Key words: *rice, CMS lines, pollen sterility, stigma exsertion*

Hybrid rice gives an yield advantage of about 20-30 % over existing varieties. For commercial application of heterosis, the three line breeding method is most commonly used in China, India and elsewhere. The three line breeding method involves the use of cytoplasmic genic male sterile lines, its maintainer and a restorer line. Successful development of hybrid rice depends on improvement of parental lines A, B and R. Though the cytoplasmic male sterility has several advantages, it has some limitations too. These lines are highly sensitive to environmental conditions resulting in fertile pollen production which leads to selfing. Therefore, emphasis has to be given to develop region specific indigenous male sterile lines. Hence an attempt was made to evaluate different cytoplasmic genic male sterile lines for adaptability, stability of pollen and spikelet fertility for developing three line hybrids in rice.

The experimental material consisted of eight cms lines of rice, viz. KJT 1A, KJT 2A, KJT 3A, KJT 4A, KJT 5A, KJT 6A, KJT 7A and IR 58025 A were collected from Regional Agricultural Research station, Karjat for evaluation. The study was conducted during wet season 2007 at Dapoli, Maharashtra in randomized block design with four replications over five environments created through the transplanting seedling of different age i.e. 15, 20, 25, 30 and 35 days old. Seedlings were transplanted at a spacing of 20x15cm.. Each CMS line was transplanted in three rows with twenty plants per row. Recommended dose of fertilizer i.e. 100 kg N, 50 kg $P_2$05 and 50 kg K_2O ha^{-1} was applied. Observations were recorded for various floral traits and yield parameters. About 10-15 spikelets from the freshly emerged panicles of each CMS line were collected and examined under microscope with 1 % Iodine Potassium Iodide solution for pollen fertility assessment. Five panicles $plant^{-1}$ were evaluated for natural seed set percentage. The data so collected were analyzed by using stability model of Eberhart and Russell (1966).

Data revealed that the pooled mean values for the character length of filament ranged from 5.22 mm. (KJT 1A) to 7.89 mm (IR-58025 A) (Table 1). Stability performance parameters showed that the lines KJT 2A (6.59 mm) and KJT 5A (6.32 mm) had higher filament length over population mean with regression coefficient around unity and non-significant S^2di component indicating average stability for this character. Anand Kumar *et. al.* (1989) reported CMS lines in general had smaller stamens and pistil than their maintainers. All the CMS lines showed 100 per cent pollen sterility under all the five environments. There was no variability among the CMS lines for pollen sterility. In regards to angle of floret opening KJT 4 A (28.66º) recorded higher angle of floret opening than population mean with regression coefficient less than unity and non-significant S^2di components indicating

Table 1. Stability performance of floral traits of CMS lines in rice

CMS lines	Length of Filament (mm)			Pollen sterility (%)	Angle of floret opening (0)			Stigma exertion (%)			Panicle exertion (%)		
	Mean	bi	S^2di	Mean	Mean	bi	S^2di	Mean	bi	S^2di	Mean	bi	S^2di
KJT 1A	5.22	0.626	0.011	100	28.52	0.711	1.141 *	46.17	1.152	0.169	80.41	0.375	0.116
KJT 2A	6.59	1.461	-0.005	100	31.66	0.138	0.391*	44.15	1.089	0.744	80.44	0.99	1.333*
KJT 3A	5.63	0.655	0.005	100	28.03	1.397	-0.02	42.50	0.717	0.168	81.36	0.742	0.007
KJT 4A	5.30	-0.672	-0.003	100	28.66	0.413	-0.03	47.70	1.578	1.777**	81.96	1.432	4.323*
KJT 5A	6.32	1.955	-0.009	100	29.22	0.443	0.581**	44.44	0.221	0.145	82.09	0.735	-0.392
KJT 7A	5.73	1.432*	-0.008	100	27.16	1.103	0.091	46.43	1.659	-0.562	80.91	-0.004	-0.01
KJT 7A	6.41	7.282*	0.001	100	27.91	0.822	-0.092	45.89	1.309	0.805	80.64	0.82	-0.461
IR 58025A	7.89	-1.874	-0.002	100	26.62	1.974	1.158**	43.99	0.276*	-0.918	78.34	2.903	2.196**
Population mean	6.12	-	-	100	28.47	-	-	45.16	-	-	80.77	-	-
SE (m) +	0.05	1.656	-		0.37	0.635	-	0.58	0.430	-	0.59	1.305	-
CD at 5 %	0.10	-	-		0.77	-	-	1.20	-	-	1.21	-	-

adaptability under unfavorable environment. The lines KJT1 A, KJT 2 A and KJT 5A had recorded more angle of floret opening over population mean but unpredictable in performance due to significant S^2di component. Parmar *et. al.* (1979) reported that angle of floret opening varied from 25 ^{0} to 35^0. The pooled mean values of stigma exsertion ranged from 42.59 per cent (IR-58025 A) to 47.70 per cent (KJT 4A). The maximum stigma exsertion was noticed in KJT 4A followed by KJT 6A.

Stability performance revealed that the line KJT 1A and KJT 7A had recorded higher stigma exsertion over population mean with bi value around unity and non-significant S^2di indicated average stability for this trait over all the environments. Stigma exsertion is the most important trait that influences the rate of natural outcrossing in CMS line as higher stigma exsertion, ultimately increases the hybrid rice seed production. Jayanani and Rangaswamy *et. al.* (1999) reported 28.33 per cent stigma exsertion in IR 66077 A.

The pooled mean values for days to 50% per cent flowering ranged from 86.6 days (KJT 4A) to 101.65 days (KJT 6A and KJT 7 A) (Table 2). Plant height mean values of CMS lines ranged from 75.32 cm (IR 58025 A) to 86.91 cm (KJT 1A). From the data it was revealed that KJT 1 A and KJT 6 A had average stability. While KJT 7 A was suitable over favorable environment. Dushyanth and Shadakshar (2006) reported that both liner and non-linear components were significant for plant height. The mean of all population over environments in respect of panicle numbers plant^{-1} was found to be 15.64. The highest number of panicle plant^{-1} was recoded by KJT 4 A, KJT 1 A, and KJT 4 A are best suited to unfavorable environments. Even though KJT 3 A recorded less number of panicles, it had better stability over general environment. The pooled mean values for spikelets sterility per cent ranged from 99 (IP-58025 A) to 100 percent.

With regards to IR- 58025 A one can not predict the performance due to significant non-liner component. Sawant *et. al.* (2006) reported that IR 54755 A, D 297 A and IR 66707 A had complete pollen sterility and zero spikelet fertility, and hence highly stable. The maximum total number of spikelets panicle^{-1} was recorded by KJT 4 A (360.7) followed by KJT 1 A (359.9). From the data it was seen that KJT 1 A had

well adaptability in good environment while KJT 4 A had better adaptability in poor environment. Ahmed *et. al.* (1998) reported that IR 58025 A and IR 62829 A showed better performance for this character. The pooled population mean for panicle exsertion in CMS line was 80.77 per cent, while it ranged from 78.34 to 82.09 per cent. The CMS lines KJT 5 A and KJT 3 A had average stability for this trait. Pradhan and Jachuk (1993) reported that panicle exsertion varied from 64.30 per cent in PMS 1 A to 97.00 per cent in PMS 5 A. From the present investigation it was concluded that none of the line showed general adaptability for all the floral attributes and yield contributing characters over pooled environments. However. KJT 4 A performed better in most of the desirable characters and in most of the environment also, hence this line may be utilized in hybrid rice breeding programme.

Table 2. Stability performance of yield components of CMS lines in rice.

CMS lines	Days to 50% flowering			Plant height (cm)			Panicle No. plant^{-1}			Spikelet Sterility %			Total No. of Spikelets panicle^{-1}		
	Mean	bi	S^2di	Mean	bi	S^2di	Mean	bi	S^2di	Mean	bi	S^2di	Mean	bi	S^2di
KJT 1A	88.30	0.979	0.02	86.91	0.944	0.555	16.38	-1.519*	0.162	100	0.227*	-0.005	359.6	2.496	91.06
KJT 2A	93.20	1.088	0.35*	78.03	1.675	6.591*	14.99	1.693	0.605	100	0.227*	-0.005	223.5	0.624	4.763
KJT 3A	100.60	1.077	1.283**	83.78	0.787	1.447	15.01	1.084	-0.026	100	0.227*	-0.005	250.8	-0.53	-25.3
KJT 4A	86.60	0.821	0.368*	85.21	0.094*	-1.963	17.39	-0.082	-0.171	100	0.227*	-0.005	360.7	0.577	-39.4
KJT 5A	88.15	1.213	0.873**	85.44	0.68	0.46	14.58	1.206	-0.013	99.6	5.601	0.006	262.8	0.009	-45.6
KJT 6A	101.65	0.981	0.117	84.42	0.924	2.818	15.16	2.375	0.574	100	0.227*	-0.005	234.7	1.318	-10.0
KJT 7A	101.65	1.032	0.213	83.76	1.591*	-2.244	14.90	1.981	0.368	99.6	2.052	0.001	245.1	0.941	-32.3
IR 58025A	89.95	0.809	0.543*	75.32	1.307	0.445	16.72	1.262	1.132*	99	1.024	0.002*	256.5	2.571	7.049
Population mean	93.76	-	-	82.86	-	-	15.64	-	-	99.8	-	-	274.2	-	-
SE (m) +	0.41	0.131	-	0.96	0.367	-	0.47	0.859	-	0.037	1.3	-	3.66	1.7	-
CD at 5 %	0.84	-	-	1.98	-	-	0.97	-	-	0.077	-	-	7.55	-	-

*Significant at 5 % level, ** significant at 1% level.

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