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Short Communication

Line × tester analysis of combining ability in rice (*Oryza sativa* L.)

L. L. Panwar

Agricultural Research Station, Ummedganj P. O. Box 7, GPO Nayapura, Kota 324 001

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Rice (*Oryza sativa* L.) is the most important food crop of India, occupying 44.9 m ha with a total production of 89.4 m t and the average productivity of 1.9 t ha^{-1}. The average productivity of rice in India is low (1.9 t ha^{-1}) in contrast to nearly 6.0 t ha^{-1} in China [1]. The combining ability studies provide useful information for the selection of high order parents for effective breeding, besides elucidating the nature and magnitude of gene interaction involved in the inheritance of various characters.

The experimental material for the present investigation comprised three lines *viz.*, IET 13846 (L_1). IET 15391 (L_2) and IET 11819 (L_3) used as females; ten testers *viz.*, Pusa Basmati-1 (T_1), Taraori Basmati (T_2), Kasturi (T_3), Basrnati 370 (T_4), Mahi Sugandha (T_5), Pakistani Basmati (T_6), IR 64 (T_7), Ratna (T_8), Suraksha (T_9) and Narendra 359 (T_{10}) used as males and 30 hybrids obtained from line × tester mating design. These 30 F_1's along with 13 parents were planted in a randomized block design with three replications at Agricultural Research Station, Ummedganj, Kota (Rajastnan) during *kharif* 2001, under irrigated transplanted condition. Each plot consisted of single row of 5.0 m length with spacing of 20 cm × 15 cm. The observations were recorded on ten randomly selected plants from each treatment in each replication for 11 characters. The combining ability analysis was carried out following the method suggested by Kempthorne [2]. Economic heterosis was estimated as per cent gain in grain yield of the F_1 over the standard check Pusa Basmati-1.

The analysis of variance for combining ability revealed highly significant differences among the genotypes in respect of all the characters (Table 1). The significance of mean squares due to lines (females) and testers (males) indicated prevalence of additive variance for all the characters. The significance of mean squares due to line × tester for all the characters provided a direct test indicating that non-additive variance was important for majority of the characters. The predominance of *sca* variances for all the characters suggested that dominance and epistatic gene interactions were important for controlling these traits, confirming the earlier findings [3 and 4].

The estimates of general combining ability effects of lines and testers (Table 2) revealed that the line IET 13846 and the testers Kasturi, Basmati 370, Pusa Basmati-1, Taraori Basmati and IR 64 were good general combiners for grain yield $plant^{-1}$. The superiority of Basmati 370 and Pusa Basmati-1 as good general combiners for grain characters has been reported earlier [5]. It may be suggested that multiple crossing programme involving Kasturi, Basmati 370, Pusa

Table 1. Analysis of variance for line × tester analysis in rice

Source	df	Days to 50% flowering	Days to maturity	Plant height (cm)	Productive tillers $plant^{-1}$	Panicle length (cm)	Filled grains $panicle^{-1}$	Spikelet fertility (%)	Biological yield $plant^{-1}$ (g)	Harvest index (%)	1000-grain weight (g)	Grain yield $plant^{-1}$ (g)
Lines (L)	2	154.71**	61.73**	178.03**	7.76**	9.73**	3525.79**	130.61**	973.82**	259.67**	1.52**	97.57**
Testers (T)	9	78.48**	59.98**	137.93**	46.90**	12.67**	7251.29**	51.19**	1083.29**	239.09**	12.31**	105.09**
L × T	18	106.43**	86.13**	528.18**	13.31**	7.99**	2712.74**	42.57**	1294.14**	146.93**	11.92**	21.88**
Error	84	0.34	0.34	0.10	0.05	0.09	0.04	0.03	0.02	0.04	0.03	0.03
δ^2 *gca*/δ^2 *sca*		2.8×10^{-3}	6.3×10^{-3}	15×10^{-3}	43×10^{-3}	11×10^{-3}	30×10^{-3}	11×10^{-3}	3.8×10^{-3}	14×10^{-3}	2.5×10^{-3}	0.56

* and ** significant at P = 0.05 and 0.01, respectively.

Table 2. Combining ability effects of important parents and the best crosses for grain yield and its component traits with economic heterosis and *per se* performance in rice

Parents	Days to 50% flowering	Days to maturity	Plant height (cm)	Productive tillers plant^{-1}	Panicle length (cm)	Filled grains panicle–1	Spikelet fertility (%)	Biological yield plant^{-1} (g)	Harvest index (%)	1000-g rain weight (g)	Grain yield plant^{-1} (g)	*Per se* performance	*gca* effect		Heterosis	
													Female	Male	Heterobeltiosis	Economic heterosis over PB-1
Line																
IET 13846 (L_1)	–2.6**	–1.47**	0.40**	0.25**	0.47**	11.13**	2.30**	–1.28**	1.85**	–0.08*	1.86**					
SE ±	0.12	0.12	0.07	0.05	0.06	0.04	0.03	0.03	0.04	0.03	0.04					
SE (g_i-g_j) lines	0.15	0.15	0.08	0.06	0.08	0.05	0.04	0.04	0.05	0.04	0.05					
Testers																
Pusa Basmati-1 (T_1)	–3.54**	–3.60**	1.12**	–1.34**	1.27**	35.75**	2.27**	–8.51**	4.38**	1.49**	2.01**					
Taraori Basmati (T_2)	–0.10	–0.38	1.75**	0.58**	0.74**	–22.89**	–3.31**	–10.83**	6.41**	1.47**	1.98**					
Kasturi (T_3)	–3.77**	–3.16**	2.17**	–0.88**	1.65**	–1.57**	–0.12*	–8.69**	6.87**	0.58**	4.69**					
Basmati 370 (T_4)	1.12**	1.18**	2.24**	1.50*	1.06**	11.40**	–1.13**	3.67**	1.78**	–1.45**	3.39**					
IR 64 (T_7)	4.12**	4.18**	–3.24**	3.79**	1.06**	9.56**	4.39**	23.61**	–5.57**	0.32**	0.75**					
SE ±	0.20	0.20	0.11	0.08	0.11	0.07	0.05	0.05	0.07	0.05	0.06					
SE (g_i-g_j) testers	0.27	0.27	0.15	0.11	0.14	0.10	0.07	0.07	0.09	0.07	0.09					
Best Crosses																
IET 13846 × Pusa Basmati-1	–5.38**	–5.53**	5.45**	3.53**	–0.21	9.88**	–0.81**	30.66**	–5.88**	1.88**	3.45**	32.83	1.86"H	2.01"H	9.80**	9.80**
IET 11819 × Kasturi	–4.13**	–3.71**	2.84**	–1.59**	–1.19**	19.84**	0.58**	–12.11**	7.85**	–0.10	3.50**	31.97	–1.74**L	4.69"H	10.13**	6.92**
IET 13846 × IR 64	–0.29	–1.24**	–9.10**	0.77**	0.12	30.87**	0.07	–7.30**	4.65**	–2.60**	3.77**	31.90	1.86**H	0.75**H	9.74**	6.69**
IET 13846 × Kasturi	–4.60**	–4.76**	–1.31**	2.33**	–0.53*	15.83**	1.08**	8.87**	–3.87**	1.50**	1.13**	30.93	1.86**H	4.69**H	7.28**	3.44**
IET 13846 × Taraori Basmati	–2.07**	–1.69**	–12.09**	–3.25**	–0.40	42.59**	3.07**	–12.02**	6.17**	–2.26**	1.28**	30.63	1.86**H	1.98**H	8.23**	2.44**
SE ±	0.41	0.41	0.22	0.16	0.21	0.15	0.11	0.10	0.14	0.11	0.10					
SE (S_{ij}-S_{kl})	0.57	0.57	0.31	0.22	0.30	0.20	0.15	0.14	0.19	0.15	0.16					

* and ** significant at P = 0.05 and 0.01, respectively.

Basmati-1, Taraori Basmati, IET 13846 and IR 64 as parents may be taken up to generate desirable segregants for selection. Among the 30 crosses studied, 14 crosses exhibited positive significant *sca* effects for grain yield plant^{-1}. Out of these 14 cross combinations showing significant *sca* effects, 8 crosses involved one parent with high *gca* effects and other having either high or low combining ability effect, indicating additive as well as non-additive genetic actions operating in the *per se* crosses. These results are in conformity with the earlier findings [6 and 7].

The *per se* performance, *gca* effects of parents, heterobeltiosis and economic heterosis in 5 superior cross combinations that exhibited positive significant *sca* effects (Table 2) indicated that the high performance hybrids need not be the ones with high *sca* effects and *vice-versa*. These results are similar to earlier findings [3 and 4]. The cross combinations *viz.*, IET 13846 × Pusa Basmati-1, IET 13846 × IR 64, IET 13846 × Kasturi and IET 13846 × Taraori Basmati had high *per se* performance with significant *sca* effects for grain yield, high to moderate heterosis and both the parents of these crosses were good general combiners. By resorting to pedigree breeding technique, these crosses may be exploited to obtain desirable segregants for grain yield and its components. The cross IET 11819 × Kasturi resulted from one good and one poor general combiner. Random mating and selection among the segregants could lead to transgressive desirable segregants in later generations.

References

1. **Swaminathan M. S.** 1998. Rice and national food and livelihood security. Silver Jubilee Endowment Lecture at Punjab Agril. Univ., Ludhiana.
2. **Kempthorne O.** 1957. An Introduction to genetic statistics. John Wiley and Sons Inc., New York, USA.
3. **Rahman M., Patwary A. K. and Miah A. J.** 1981. Combining ability in rice. Indian J. Agric. Sci., **51**: 543-546.
4. **Satyanarayana P. V., Reddy M. S. S., Ish Kumar and Madhuri J.** 2000. combining ability studies on yield components in rice. Oryza, **37**: 22-25.
5. **Armugachamy S., Vairavan S., Vivekanandan P. and Palanisamy S.** 1992. Aromatic and quality rice improvement in Tamil Nadu, India. Int. Rice Res. Newsl., **17**: 11-12.
6. **Peng J. Y. and Virmani S. S.** 1990. Combining ability for yield and four related traits in relation to breeding in rice. Oryza, **27**: 1-10.
7. **Hasib K. M., Ganguli P. K. and Kole P. C.** 2001. Combining ability analysis for panicle traits in aromatic rices. Oryza, **38**: 95-98.