Short Communication Oryza Vol. 45. No.3, 2008 (235-238)

Combining ability analysis in rice

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ABSTRACT

The performance of extensively used mating designs was studied for their ability to discriminate parental line with good or poor general combining ability in a set of crosses involving nine parents of indica rice. Based on the general combining ability estimates for 16 agro-morphological characters the line X tester analysis varied with the change of tester parents. Using tester with broader genetic base line X tester analysis could indentify relatively large number of good or poor combining parents. The combining ability revealed that none of parental line were found excellent for all the characters. Among the nine lines, Pusa-1463 (L_9) is a good general combiner for the characters days to 50% flowering, days to maturity, plant height, no. of field grain panicle^{-1}, no. of sterile grain panicle^{-1}, panicle length , biological yield plant^{-1}, grain yield plant^{-1} weight plant^{-1}, harvest index and test weight.

Key words: *Mating designs, line X tester, gca, sca, rice, selection of parents*

The analysis of combining ability provides guidelines for selecting potential breeding methods. The proper choice of parents for hybridization program is an essential step in obtaining outstanding hybrids in any crop. Combining ability analysis is an effective tool to identify the superior parents for breeding program (Sprague and Tatum 1942). Knowledge of combining ability together with *per se* performance of parent and hybrids and heterotic response, help the breeders in selecting suitable parents and crosses for use in systemic breeding program. Evaluation of parents for combining ability also provides an indication of other relative magnitude of additive and non-additive variance for characters under study. The performance of extensively used mating designs was studied for their ability to discriminate parental line with good or poor general combining ability in a set of crosses involving nine parents of indica rice.

The experimental material for the present investigation comprised of nine lines viz. Basmati 370 (L1), Taraori Basmati (L2), Shah Pasand(L3), Pusa-1173 (L4), SB-3000(L5), Pusa-1176(L6), Pusa-1121(L7), CSR-30 (L8) and Pusa-1463(L9) used as females; Three testers viz. IRBB-60 (T1), Heibao (T2) and Pusa-44 (T3) used as males and 27 hybrids obtained from line X tester design. The seeds of 27 hybrids with their parents were sown in the nursery and after 30 days old seedlings were transplanted to main field during *wet season* 2005 at Research farm of Kisan College Simbhaoli, Uttar Pradesh. The experiment was conducted in randomized block design with three replications. The twenty-seven F_1 hybrids and their twelve parents were raised in a single row plot of 3 metre length with a spacing of 20 x 20 cm. Recommended agronomical practices were followed to raise the crop. Observations were recorded on sixteen agro-morphological characters such as , days to 50% flowering, days to maturity , no. of productive tillers plant^{-1}, plant height (cm), no. of filled grains panicle^{-1}, no. of sterile spikelets panicle^{-1}, no. of spikelets panicle^{-1}, no. of primary branches panicle^{-1}, panicle length (cm), panicle straw weight (g) , panicle density , biological yield plant^{-1} (g), grain yield plant^{-1} (g), straw weight plant^{-1} (g), harvest index (%) and thousand grain weight(g).Observations were recorded for morphological and physiological trad its related to yield and grain quality. Observations were taken in randomly chosen five plants in each row. In the present investigation, combining ability analysis was done through line X tester technique.

The result of analysis of variance revealed that variance due to parents was significant for all

Table 1. Analysis of variance (ANOVA) for different morphological characters

Source of variation	d.f.	Days to to 50% flowering	Days to maturity	No. of tillers	Plant height (cm)	No. of filled grain panicle^{-1}	No. of sterile grain panicle^{-1}	No. of spikelets panicle^{-1}	No.of primary branches panicle^{-1}
Replication/ location	2	47.16	75.79	10.88	93.98	157.19	200.71	367.52	2.05
Parents	11	327.54**	286.00**	46.67**	1550.70**	306.31**	147.83**	419.65	3.06**
Females	8	127.70**	159.28**	31.83**	828.82**	275.20	98.84	403.53	2.73**
Males	2	348.00**	352.44**	75.11**	3.00	469.77**	388.11**	664.33**	2.77**
Male vs. female	1	1883.34**	1166.90**	108.00**	10423.34**	228.23	59.25	59.31	6.25**
Hybrids	26	66.49**	104.86**	50.93**	654.47**	247.57	276.27**	868.87**	1.74
Parent vs. Hybrid	1	12.68	7.25	131.41**	241.12	502.62	1165.87**	146.00	0.50
Error	76	23.34	25.45	7.47	60.09	147.10	90.45	251.88	1.05

Source of variation	d.f.	Panicle length (cm)	Panicle straw wt. (g)	Panicle density	Biological yield plant^{-1} (g)	Grain yield plant^{-1} (g)	Straw wt. plant^{-1} (g)	Harvest index (%)	1000 grain wt. (g)
Replication/ location	2	1.98	0.0006	0.12	992.41	324.85	245.26	8.85	0.34
Parents	11	14.06**	0.01**	2.14**	7673.15**	1906.77**	2643.48**	55.32**	63.65**
Females	8	10.82**	0.01**	2.73**	6257.99**	1741.33**	2010.41	43.07**	72.42**
Males	2	1.58	0.008	0.61**	11058.33**	3213.77**	2515.44**	42.74**	48.41**
Male vs. female	1	0.62	0.008	0.0005	12224.12**	616.34	7854.09**	176.45**	22.59**
Hybrids	26	8.56**	0.008	0.73**	15591.33**	2225.72**	6781.07**	33.67**	30.03**
Parent vs. Hybrid	1	101.67**	0.02**	11.28**	146056.26**	14922.44**	65225.69**	175.86**	116.65**
Error	76	3.06	0.002	0.28	2543.27	507.39	1081.23	13.95	0.33

*,** = significant at 5% and 1% level of significant

morphological characters except number of spikelets panicle^{-1}, which indicate that parents differed among themselves for all characters except only one character (number of spikelets panicle^{-1}). Variance due to females was significant for all characters except number of filled grain panicle^{-1}, number of sterile panicle^{-1} and straw weight plant^{-1}, which indicates that females differed among themselves for most of the characters except the above. Variance due to male (tester) was significant for all of the morphological characters except plant height, panicle length and panicle straw weight indicates that males differed among themselves for most of the characters. Variance due to male vs. female were significant for most of the characters except number of filled grain panicle^{-1}, number of sterile grain panicle^{-1}, number of spiklets panicle^{-1}, panicle length, panicle straw weight, panicle density and grain yield plant^{-1}. The variance due to hybrids was significant for all morphological characters except number of filled grain panicle^{-1}, number of primary branches panicle^{-1} and panicle straw weight. Similarly parents vs. hybrids was significant for most of the morphological characters except days due to 50% flowering, days to maturity, plant height, number of filled grain panicle^{-1}, number of spikelets panicle^{-1} and number of primary branches panicle^{-1}.

Crosses had good potential for yield and may be utilized for the commercial production of hybrids. Analysis of variance for combining ability revealed that lines showed sufficient variability only for morphological characters such as plant height and 1000 grain weight, while testers showed variability for 1000 grain weight only. Significant variance was found for no. of productive tillers and 1000 grain weight. This is due to non-additive gene action and thus results were in accordance with Panwar (2005).

It was observed from gca estimate for grain yield (Table 2) that among the lines, Taraori Basmati is the best combiner followed by Basmati-370. However, among the testers, Pusa-44 is observed to the best combiner for the trait. This tester was a good combiner

Table 2. gca effects of parents (females and males) for morphological characters

Parents	Days to 50% flowering	Days to maturity	No. of tillers	Plant height (cm)	No. of filled grain panicle^{-1}	No. of sterile grain panicle^{-1}	No. of spikelets panicle^{-1}	No. of primary branches panicle^{-1}	Panicle length (cm)	Panicle straw wt. (g)	Panicle density	Biological yield plant^{-1} (g)	Grain yield plant^{-1} (g)	Straw wt. plant^{-1} (g)	Harvest index (%)	1000 grain wt. (g)
Gca Effects Line																
L_1	1.07	1.38	0.04	14.59**	-2.70	-3.62	-6.31	0.09	0.37	0.05	-0.23	39.92*	15.48*	24.54*	-0.79	-0.06
L_2	2.52	0.49	1.59	4.70	-0.04	-5.62*	-5.64	0.09	0.09	0.00	-0.10	51.59*	20.53**	31.15*	-0.71	-2.35**
L_3	-0.04	-0.40	-0.19	16.59**	4.59	-2.40	-6.98	0.53	0.88	0.04	-0.36	21.36	6.86	13.48	-0.59	5.16**
L_4	-0.71	-1.17	-0.52	-3.963	-3.15	2.83	-0.42	-0.14	-0.74	-0.02	-0.06	-21.69	-8.19	-13.46	-0.08	-1.44**
L_5	-1.37	-0.95	-1.52	-4.63	3.19	3.38	6.58	-0.36	1.15	-0.03	-0.15	-24.52*	-4.36	-19.74	1.97	-0.82*
L_6	1.74	2.94	0.26	7.30**	-1.15	-0.62	-1.75	-0.66	0.15	0.00	-0.16	-21.75	-18.69*	-2.96	-3.32**	-2.58**
L_7	0.52	2.05	2.59**	2.15	0.41	-2.51	-2.09	0.20	-0.19	0.02	0.08	-1.80	3.70	-5.41	1.38	1.30**
L_8	0.63	1.16	-0.52	-2.96	-1.48	-0.95	-2.42	-0.36	-0.24	-0.01	0.29	62.03	21.53	40.59**	-1.29	-0.53*
L_9	-4.37**	-5.51**	-1.74	-19.19**	9.52**	9.49**	19.02**	0.31	-1.46*	-0.03	0.69	105.14**	-36.86**	-68.19**	3.45**	1.32**
S.E.	1.48	1.52	0.85	2.29	3.24	2.78	4.40	0.31	0.43	0.01	0.15	15.40	6.79	9.97	1.02	0.17
Tester																
T_1	-2.70	-3.28**	-0.15	5.89**	-2.78	-5.65**	-8.42**	-0.28	-0.32	-0.04*	-0.24*	-7.02	3.92	-11.22*	1.86**	1.73**
T_2	-2.63	-3.28**	0.33	4.35*	-5.89**	-2.02	-7.94**	0.05	-1.04**	0.01	0.25	-26.80**	-14.90**	-11.81*	-0.96	-0.25**
T_3	5.53**	6.57**	-0.19	10.24**	8.67**	7.68**	16.36**	0.23	1.35**	0.03	-0.01	33.83**	10.98**	23.04**	-0.90	-1.47
S.E.	1.48	0.76	0.42	1.15	1.62	1.39	2.20	0.15	0.21	0.01	0.07	7.70	3.39	4.99	0.51	0.08

Testers' name T_1=IRBB60, T_2=HEIBAO, T_3=PUSA-44, Name of lines L_1=BAS-370, L_2=TAR-BAS, L_3=SHAH-PASAND, L_4=PUSA- 1173, L_5=SB-3000, L_6=PUSA-1176, L_7=PUSA-1121, L_8=CSR-30, L_9=PUSA-1463

for the trait like panicle length, no. of spikelets panicle^{-1}, no. of filled grains panicle^{-1}, low plant height and for late duration. The good combiners for trait wise were Pusa-1463 for earliness, low plant height, no. of filled grains panicle^{-1}, harvest index and no. of spikelets panicle^{-1}; Pusa-1121 for no. of tillers plant^{-1}; Pusa-44 for panicle length, straw weight plant^{-1} and biological yield plant^{-1} . It is observed that Pusa-1463 is a good combiner for many traits.

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