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Combining Ability Analysis for Grain Yield and Other Associated Traits in Rice

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ABSTRACT

The analysis of variance for combining ability for line x tester design revealed highly significant difference among the crosses for all the traits except L:B ratio. Mean squares due to lines in respect of gca were significant for spikelets per panicle, filled spikelet per panicle and plant height. Variances due to line x testers, representing sca were found highly significant for spikelets per panicle, filled spikelet per panicle and days to 50% flowering. In line x tester analysis the estimates of σ^2 gca were higher than σ^2 sca for all 13 characters which suggested predominance of additive gene action. On the basis of gca effects, IR 63731-1-1-3-3-2, IR 2-9-B-1-5 and CSRS(C-52-1-1) were identified as most promising parents for involving in hybridization programme for obtaining desirable segregates for grain yield and other characters.A single cross, IR 2-9-B-1-5/F_1 showed significant and positive sca for grain yield per plant along with significant and desirable sca effects. This cross may be exploited for isolating desirable segregants in segregating generation.

Key words: *Combining Ability, Gene Action, and Yield.*

INTRODUCTION

The success of a recombination breeding programme in evolving superior varieties through hybridization and subsequent selection in segregating generations, the choice of promising parents for hybridization is an important pre requisite. The selection of few parents potentials as per breeding objectives is essential because analysis handling of very large number of crosses resulting from numerous parent available in germplasm collections would be an impractical and perhaps impossible task.Combining ability analysis is a useful technique for understanding the genetic worth of parents and their crosses for further exploitation in breeding programme. In addition, it also provides the idea about gene effects involved in the inheritance of various characters that is essential for deciding suitable breeding strategy for future improvement. Among the various techniques, the line × tester technique[1] has been successfully utilized for screening the germplasm to identify valuable donor parents for breeding programme in many crops including rice.

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MATERIALS AND METHODS

The material for the present investigation was derived by crossing 7 strains/varieties of rice with CSR 10 (T_1), Jaya (T_2) and their hybrid (T_3) in a line x tester mating design. A set of 21 crosses involving 7 lines and three testers T_1,T_2 and T_3 was evaluated along with their 10 diverse parents in Randomized Block Design with three replications at Research farm of Genetics and Plant Breeding, NDUAT, Kumarganj, Faizabad during *kharif* 2009.The observations were recorded for Days to 50% flowering, size of flag leaf, plant height, panicle bearing tillers per plant, panicle length, spikelet per panicle, spikelet fertility,1000-grain weight, biological yield, L:B ratio, grain yield per plant and harvest index.The data on different characters were utilized for the analysis of variance[3] line × tester analysis of combining ability[1].

RESULTS AND DISCUSSION

General combining ability

For illustrating genetic worth of parents for hybridization programme, the general combing ability effects of 10 parents (7 line + 3 testers) for eleven characters are consolidated below:

The three lines having significant with positive effects for grain yield per plant, namely, CSRS (C)-52-1-1, IR 2-9-B-1-5 and IR 63731-1-1-3-3-2 were identified as good general combiners for yield in order of merit. NDRK 5026, NDRK 5096, NDRK 5088, CSRS (C)-52-1-1 were identified as good combine for days to 50% flowering. NDRK 5026, NDRK 5088, NDRK 5096 were also identified as good combiner for panicle length, spikelet panicle^{-1}, filled spikelet panicle^{-1}, spikelet fertility, biological yield per plant.

In testers Jaya is good combiner in many characters except test weight, biological yield plant^{-1}, L:B ratio and harvest index. CSR 10 was good combiner for 1000-grain weight, while F_1 founded good combiner for days to 50% flowering. Pant height, panicle length, filled spikelet panicle^{-1}, spikelet fertility, biological yield plant^{-1}, L:B ratio and harvest index. These three tester may also be recommended for exploitation in hybridization programme aimed for exploitation in hybridization programme aimed at improving the yield components for which emerged as good general combiner.

Specific combining ability

Only one cross combination namely, IR 2-9-B-1-5 × F_1 was found good specific combiner for grain yield per plant seven crosses were identified good specific combiner for days to 50% flowering, namely NDRK 5026 × F_1, NDRK 5096 × F_1, NDRK 5088 × Jaya, IR 63731-1-1-3-3-2 × CSR 10, IR 2-9-B-1-5 × CSR 10, CSRS (C)-52-1-1 × F_1 and IR 71897-3R-1-1-2 × CSR 10. These reports has been also reported by Mahmood *et al.* [2] and Vishwakarma *et al*.[4].

Table 1: Analysis of variance for RBD

Source of variation	Replication	Treatment	Error
D.f.	2	44	88
Days to 50% flowering	0.447	1233.173**	0.882
Size of flag leaf	0.646	125.128**	1.213
Plant height	10.476	1248.023**	3.160
Panicle bearing tillers plant^{-1}	1.071	14.911**	2.339
Panicle length	2.365	84.384**	1.734
Spikelets panicle^{-1}	56.489	4301.501**	55.318
Filled spikelets panicle^{-1}	29.253	2623.355**	67.785
Spikelet fertility	11.278	959.239**	4.739
1000 grain weight	1.356	73.733**	0.092
Biological yield plant^{-1}	7.715	379.325**	5.907
L:B ratio	0.012	1.319**	0.017
Harvest index	21.196	257.325**	3.515
Grain yield plant^{-1}	1.353	79.856**	1.355

*,**Significant at 5% and 1% probability level respectively

The analysis of variance for combining ability for line x tester design revealed highly significant difference among the crosses for all the traits except L:B ratio. Mean squares due to lines in respect of gca were significant for spikelets per panicle, filled spikelet per panicle and plant height. Variances due to line x testers, representing sca were found highly significant for spikelets per panicle, filled spikelet per panicle and days to 50% flowering. In line x tester analysis the estimates of σ^2 gca were higher than σ^2 sca for all 13 characters which suggested predominance of additive gene action.

On the basis of gca effects, IR 63731-1-1-3-3-2, IR 2-9-B-1-5 and CSRS(C-52-1-1) were identified as most promising parents for involving in hybridization programme for obtaining desirable segregates for grain yield and other characters.

A single cross, IR 2-9-B-1-5/F_1 showed significant and positive sca for grain yield per plant along with significant and desirable sca effects. This cross may be exploited for isolating desirable segregants in segregating generation.

Table 2: Estimate of gca effects of parents for thirteen characters in rice

Lines	Days to 50% flowering	Size of flag leaf	Plant height	Panicle bearing tillers plant^{-1}	Panicle length	Spikelet panicle^{-1}	Filled spikelet panicle^{-1}	Spikelet fertility	1000-grain weight	Biological yield plant^{-1}	L: B ratio	Harvest index	Grain yield plant^{-1}
NDRK 5026	9.16**	3.68**	5.98**	-1.13**	1.54**	30.56**	24.99**	0.39	0.28	7.58**	0.32**	3.13**	-1.08
NDRK 5096	4.71**	0.98**	4.77**	-0.57	-0.13	13.32**	9.83**	-0.59	0.13	6.11**	-0.08**	0.73*	-5.42**
NDRK 5088	1.27**	2.03**	0.42	0.65	2.23**	32.61**	34.14**	5.13**	1.53**	2.79**	-0.04	0.82*	-2.16*
IR 63731-1-1-3-3-2	-5.73**	-0.85**	-0.22	-0.35	-1.19**	-13.52**	-13.41**	-1.99**	-0.80*	-5.17**	-0.06*	-0.97*	2.58**
IR2-9-B-1-5	-9.29**	-5.55**	-10.39**	-1.24**	-0.74*	-31.78**	-25.99**	0.46	-1.49**	-6.80**	-0.08**	-2.24**	2.51*
IR71897-3-R-1-1-2	-3.06**	0.81**	0.98	2.10**	-0.05	-11.21**	-10.30**	-0.58	0.54	-4.27**	0.03	-0.69	1.35
CSRS(C)-52-1-1	2.94**	-1.10**	-1.54*	0.54	-1.65**	-19.98**	-19.25**	-2.81**	-0.19	-0.23	-0.10**	-0.78*	2.22*
SE(Sgi) Female	0.37	0.28	0.67	0.36	0.31	0.71	0.63	0.43	0.38	0.34	0.03	0.37	0.97
SE(Sgi-Sgj) Female	0.53	0.4	0.95	0.51	0.43	1	0.89	0.61	0.53	0.48	0.04	0.53	1.37
Tester													
Jaya	-1.56**	2.94**	3.10**	0.3	0.78**	1.88**	2.26**	0.73*	-0.78**	-2.41**	-0.02	-0.03	1.86**
CSR 10	-3.89**	-1.87**	-10.88**	-0.32	-1.88**	-0.76	-4.04**	-3.13**	1.23**	-0.28	-0.17**	-1.28**	-1.53*
F_1	5.44**	-1.06**	7.78**	0.02	1.10**	-1.13*	1.78**	2.40**	-0.45	2.69**	0.19**	1.31**	-0.33
SE(Sgi) Male	0.24	0.19	0.44	0.24	0.2	0.46	0.41	0.28	0.25	0.22	0.02	0.24	0.63
SE(Sgi-Sgj) Male	0.34	0.26	0.62	0.33	0.28	0.65	0.58	0.4	0.35	0.31	0.02	0.34	0.9

*,** Significant at 5% and 1% probability level respectively

Table 3: Estimate of sca effects of parents for thirteen characters in rice

Lines	Days to 50% flowering	Size of flag leaf	Plant height	Panicle bearing tillers plant^{-1}	Panicle length	Spikelet panicle^{-1}	Filled spikelet panicle^{-1}	Spikelet fertility	1000-grain weight	Biological yield plant^{-1}	L: B ratio	Harvest index	Grain yield plant^{-1}
NDRK 5026 × Jaya	-1.44*	-0.49	-2.40*	0.7	0.51	-8.69**	-7.77**	-0.73	1.09	5.02**	-0.30**	1.88**	-0.03
NDRK 5026 × CSR 10	-0.44	-0.44	3.25**	-0.35	1.60**	10.14**	6.69**	-0.14	0.26	0.39	-0.26**	0.12	-1.31
NDRK 5026 × F_1	1.89**	0.93	-0.86	-0.35	-2.11**	-1.45	1.08	0.87	-1.35*	-5.42**	0.56**	-2.00**	1.33
NDRK 5096 × Jaya	-0.33	-0.68	1.13	0.14	0.32	0.57	-1.18	-1.53*	-0.52	-0.28	-0.05	0.22	1
NDRK 5096 × CSR 10	-2.33**	-0.1	0.58	-0.24	-0.01	-2.58*	-1.95	0.7	-1.22	0.03	-0.12*	0.75	0.33
NDRK 5096 × F_1	2.67**	0.77	-1.71	0.1	-0.3	2.01	3.13**	0.83	1.75**	0.25	0.16**	-0.96	-1.33
NDRK 5088 × Jaya	8.11**	0.49	0.9	-0.41	0.67	-4.27**	-3.55**	-0.15	1.33*	-0.23	-0.02	-0.62	-0.83
NDRK 5088 × CSR 10	-7.22**	1.42**	1.55	1.21	0.51	12.97**	11.68**	0.93	-1.72*	0.82	-0.07	0.88	-0.11
NDRK 5088 × F_1	-0.89	-1.91**	-2.44*	-0.79	-1.18*	-8.70**	-8.13**	-0.79	0.38	-0.59	0.08	-0.25	0.94
IR 63731-1-1-3-3-2 × Jaya	-3.56**	0.28	1.21	-1.41*	0.22	7.01**	7.52**	1.76*	-2.47**	0.39	0.05	-0.09	0.36
IR 63731-1-1-3-3-2× CSR 10	7.44**	-0.45	-4.27**	0.21	-1.25*	-7.54**	-7.11**	-1.34	1.65*	-5.65**	-0.07	-0.84	2.84
IR 63731-1-1-3-3-2 × F_1	-3.89**	0.16	3.06*	1.21	1.04	0.53	-0.41	-0.42	0.82	5.25**	0.02	0.93	-3.2
IR2-9-B-1-5 × Jaya	0.67	0.19	2.09	0.48	-0.8	-2.28	-3.46**	-1.74*	0.37	0.85	0.01	-0.97	-1.08
IR2-9-B-1-5× CSR 10	4.67**	-0.38	-3.78**	0.76	-0.27	-0.81	0.72	0.87	0.58	-6.38**	0.18**	-0.29	-2.3
IR2-9-B-1-5 × F_1	-5.33**	0.19	1.69	-1.24*	1.07*	3.09*	2.74*	0.87	-0.94	5.53**	-0.19**	1.26*	3.37*
IR71897-3-R-1-1-2 × Jaya	**-4.56****	**0.75**	**1.12**	**0.81**	**-0.59**	**5.90****	**5.57****	**0.49**	**-1.53***	**-0.83**	**0.12****	**0.11**	**-0.02**
IR71897-3-R-1-1-2× CSR 10	3.11**	-0.41	-0.72	-0.9	0.16	-6.11**	-4.91**	0.24	0.34	4.06**	0.18**	-0.8	1.76
IR71897-3-R-1-1-2× F_1	1.44*	-0.34	-0.4	0.1	0.43	0.2	-0.67	-0.73	1.19	-3.24**	-0.30**	0.69	-1.74
CSRS(C)-52-1-1 × Jaya	1.11	-0.54	-4.04**	-0.3	-0.33	1.76	2.86*	1.91*	1.74**	-4.93**	0.18**	-0.52	0.6
CSRS(C)-52-1-1× CSR 10	-5.22**	0.35	3.38**	-0.68	-0.74	-6.08**	-5.12**	-1.26	0.11	6.72**	0.16**	0.19	-1.22
CSRS(C)-52-1-1× F_1	4.11**	0.19	0.66	0.98	1.07*	4.32**	2.26*	-0.64	-1.85**	-1.79**	-0.34**	0.33	0.62
SE(Sij)	0.65	0.49	1.17	0.62	0.53	1.22	1.09	0.74	0.65	0.59	0.04	0.64	1.68
SE(Sij-Skl)	0.91	0.7	1.65	0.88	0.75	1.73	1.54	1.05	0.93	0.83	0.06	0.91	2.38

*,** Significant at 5% and 1% probability level respectively

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