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Combining Ability Studies for Yield and Yield Components in Rice (*Oryza sativa* L.)

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ABSTRACT

Twenty crosses from four lines and five testers along with parents were evaluated in line x tester design for different characters in rice. Predominance of additive gene action was observed for the characters *viz*., days to 50% flowering, plant height (cm) and test weight (g). Number of ear bearing tillers per plant, panicle length (cm) and grain yield per plant (g) was controlled by non-additive gene action. Among the parents Sudu Hondarawala, IR 64 and PLA 1100 found to be good general combiners for grain yield. The crosses Sinna Sivappu x PLA 1100, PTB 33 x MTU 1075 and Sudu Hondarawala x MTU 7029 were recorded high *sca* effects for grain yield (g).

Key words : Combining ability and L x T analysis.

Rice (*Oryza sativa* L.) is life and princes among the cereals. It is the world's most important food crop. The demand for rice is increasing day by day especially in developing countries like India. To meet the growing demand there is a need to developing high yielding varieties. In breeding high yielding varieties of crop plant, the breeders often face with the problem of selecting parents and crosses. So combining ability studies are frequently used by the breeders to evaluate the parental lines for their usefulness in crosses and to assess the nature of gene action involved in their expression. The choice of parents for hybridisation should be based not only on high combining ability but also on maximum expression of desirable agronomic traits. The magnitude of heterosis provides a guide to the choice of desirable crosses. For this purpose the Line x Tester analysis of combining ability proposed by Kempthorne (1957) is commonly used to find out general and specific combiners and to study the gene action governing the inheritance of characters. Hence the present study was undertaken to assess the combining ability.

MATERIAL AND METHODS

The material for present study comprised 20 crosses of rice generated by crossing four lines (*viz*., Sinna Sivappu, PTB 33, Sudu Hondarawala and BM 71) with five testers (*viz*., IR 64, BPT 5204, PLA 1100, MTU 7029 and MTU 1075) during *rabi* 2010-11. The resultant 20 F_1s along with 9 parents were evaluated in randomised block design with three replications during *kharif* 2011 at APPRI and RARS, Maruteru farm, West Godavari district, Andhra Pradesh. Thirty days old seedlings were transplanted with one seedling per hill adopting 20 cm x 15 cm spacing. Each entry was planted in two rows of 1.5 m length. All the recommended agronomic practices were followed. In each entry, five plants were taken randomly from each replication and data was recorded for plant height at maturity (cm), no. of ear bearing tillers per plant, panicle length (cm) and grain yield per plant (g). Days to 50% flowering and test weight (g) recorded on plot basis. The mean data was analysed for combining ability (Kempthorne, 1957).

RESULTS AND DISCUSSION

The analysis of variance is for all traits revealed that sufficient variability existed in the material for all the traits studied. The variance due to lines was significant for days to 50% flowering, plant height at maturity (cm) and test weight (g) indicating their contribution to combining ability. The

Table1. Analysis of variance for combining ability for different characters in rice (*Oryza sativa* L.).

Source of variation	d. f.	Days to 50 % flowering	Plant height at maturity (cm)	No. of ear bearing tillers plant^{-1}	Panicle length (cm)	Test weight (g)	Grain yield plant^{-1} (g)
Replications	2	0.046	36.099	0.184	6.516	0.385	1.769
Genotypes	28	367.420**	1427.811**	3.501**	15.582**	19.787**	31.244**
Parents	8	582.314**	2303.772**	2.261**	14.412**	34.622**	31.366**
Parents Vs Crosses	1	4.189	4177.706**	16.864**	58.983**	0.271	61.201**
Crosses	19	296.056**	914.254**	3.321**	13.791**	14.568**	29.616**
Line effect	3	1272.489**	5343.331**	3.736	27.920	72.372**	51.499
Tester effect	4	267.142*	46.604	0.901	9.495	2.254	52.367
Line x Tester effect	12	61.586**	96.202	4.023**	11.690**	4.221**	16.562**
Error	56	5.332	84.179	0.206	3.305	0.413	2.868

*, **= Significant at 5% and 1% level, respectively.

Table 2. Estimates of general combining ability (gca) effects of lines and testers for different characters in rice (*Oryza sativa* L.)

Parents	Days to 50 % flowering	Plant height at maturity (cm)	No. of ear bearing tillers plant^{-1}	Panicle length (cm)	Test weight (g)	Grain yield plant^{-1} (g)
Lines						
Sinna Sivappu	-12.733**	13.192**	-0.625**	-1.068*	0.758**	-1.368**
PTB 33	8.933**	15.217**	0.582**	0.100	2.732**	-1.303**
Sudu Hondarawala	3.533**	-25.596**	0.115	-0.924	-2.162**	2.593**
BM 71	0.267	-2.813	-0.072	1.892**	-1.328**	0.078
SE(g_i)	0.596	2.369	0.1173	0.469	0.166	0.437
CD at 5%	1.207	4.796	0.238	0.950	0.336	0.885
Testers						
IR 64	-7.350**	1.063	0.023	0.287	0.615**	2.380**
BPT 5204	0.400	-3.394	-0.043	0.235	0.223	-1.345**
PLA 1100	5.150**	-0.044	-0.352*	-1.323*	-0.318	2.188**
MTU 7029	2.733**	1.360	-0.043	-0.291	-0.052	-1.567**
MTU 1075	-0.933	1.016	0.415**	1.092*	-0.468*	-1.655**
SE(g_j)	0.666	2.648	0.1312	0.524	0.185	0.488
CD at 5%	1.349	5.362	0.266	1.062	0.376	0.990
s^2gca	52.461**	192.501**	-0.126	0.519*	2.451**	2.620**
s^2sca	18.751**	4.007	1.272**	2.795**	1.269**	4.564**
s^2gca/s^2sca	2.797	48.041	-0.009	0.185	1.931	0.574

*, ** = Significant at 5% and 1% level, respectively.

Table 3. Estimates of specific combining ability (*sca*) effects of crosses for different characters in rice (*Oryza sativa* L.).

Crosses	Days to 50 % flowering	Plant height at maturity (cm)	No. of ear bearing tillers plant^{-1}	Panicle length (cm)	Test weight (g)	Grain yield plant $^{-1}$ (g)
Sinna Sivappu x IR 64	5.817**	-2.318	0.450	-0.778	-0.542	1.482
Sinna Sivappu x BPT 5204	4.067**	-4.000	-0.817**	-0.592	1.183**	-0.093
Sinna Sivappu x PLA 1100	-1.350	8.050	0.925**	-0.295	0.392	2.773**
Sinna Sivappu x MTU 7029	-5.267**	0.579	0.550*	0.747	-0.808*	-2.678**
Sinna Sivappu x MTU 1075	-3.267*	-2.310	-1.108**	0.917	-0.225	-1.483
PTB 33 x IR 64	-6.517**	-3.783	1.210**	2.108	0.018	0.483
PTB 33 x BPT 5204	2.400	0.308	-0.690*	-0.053	1.810**	0.108
PTB 33 x PLA 1100	-1.017	-9.609	-1.048**	-2.673*	-1.548**	-4.545**
PTB 33 x MTU 7029	4.733**	7.954	0.010	-0.024	0.285	1.370
PTB 33 x MTU 1075	0.400	5.131	0.518	0.643	-0.565	2.585*
Sudu Hondarawala x IR 64	-0.450	0.430	-1.490**	-2.992**	0.545	-0.640
Sudu Hondarawala x BPT 5204	-5.867**	3.488	1.877**	-0.269	-2.030**	-1.028
Sudu Hondarawala x PLA 1100	5.383**	-0.662	-0.015	1.662	0.578	1.479
Sudu Hondarawala x MTU 7029	-1.200	-3.400	0.410	-0.240	1.045**	2.240*
Sudu Hondarawala x MTU 1075	2.133	0.144	-0.782**	1.840	-0.138	-2.051*
BM 71 x IR 64	1.150	5.671	-0.170	1.662	-0.022	-1.325
BM 71 x BPT 5204	-0.600	0.205	-0.370	0.915	-0.963*	1.013
BM 71 x PLA 1100	-3.017*	2.222	0.138	1.306	0.578	0.293
BM 71 x MTU 7029	1.733	-5.133	-0.970**	-0.483	-0.522	-0.932
BM 71 x MTU 1075	0.733	-2.965	1.372**	-3.400**	0.928*	0.950
SE(s_{ij})	1.333	5.297	0.262	1.049	0.371	0.9778
CD at 5%	2.699	10.724	0.531	2.125	0.752	1.979

*, **= significant at 5% and 1% level, respectively.

variance due to testers was significant for days to 50% flowering only. L x T component of variance was significant for all the characters except for plant height at maturity (cm) (Table 1). The estimates of ratio between *gca* and *sca* variance indicated that predominance of additive gene action for characters *viz*., days to 50% flowering (Dijee *et al.,* 2010), plant height at maturity (cm) (Bagheri and Babaeian Jelodar, 2010) and test weight (g) (Sanjeev Kumar *et al*., 2007). The traits *viz*., panicle length (cm) and number of ear bearing tillers per plant (Selvaraj *et al.,* 2011) and grain yield per plant (g) governed by non-additive gene action (Amudha *et al*., 2011). The selection of parents with good general combining ability effects is a pre-requisite for a successful breeding programme. Of the lines evaluated Sinna Sivappu detected as good general combiner for days to 50% flowering and test weight (g). PTB 33 found to be good general combiner for number of ear bearing tillers per plant and test weight (g). Sudu Hondarawala found to be good general combiner for plant height at maturity (cm) and grain yield per plant (g) and BM 71 for panicle length (cm). Among the testers IR 64 registered as good general combiner for days to 50% flowering, test weight (g) and grain yield per plant (g). PLA 1100 was found to be good general combiner for grain yield per plant (g) while, MTU

1075 for number of ear bearing tillers per plant and panicle length (cm) (Table 2).

The specific combining ability (*sca*) effect is an average performance of a cross expressed as deviation from the population mean and is correlated with parental *gca* effects. The high *sca* effects may be associated with high hybrid vigour. The crosses Sinna Sivappu x PLA 1100, PTB 33 x MTU 1075 and Sudu Hondarawala x MTU 7029 were recorded high *sca* for grain yield per plant (Table 3). These crosses could be utilised for heterosis breeding to exploit hybrid vigour. High magnitude of *sca* effects in these crosses resulted from the combination of low x high, low x low and high x low *gca* effects of the parents. In crosses with high x low and low x low *gca* effects, the *sca* effects may be due to the dominant x recessive interaction, expected to produce desirable segregants in subsequent generations (Lingham, 1961).

The crosses showing high *sca* effects due to high x low general combiners, simple pedigree breeding would not be effective to improve the characters. Population improvement *i.e* mass selection with concurrent random mating in early segregating generations could be a prespective breeding method for yield improvement in rice. The crosses with high *sca* effects involving low x low general combiners could be exploited through heterosis breeding programme.

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