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COMBINING ABILITY FOR YIELD AND YIELD COMPONENTS IN RICE (*Oryza sativa* L.)

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The combining ability for yield and yield attributes was studied using 7 x 7 diallel The results revealed the existence of GCA variance in greater magnitude than SCA variance for all the characters studied indicating the scope for improvement by exploiting the available additive components. Among parents IR 8 was the best combiner for all the traits Cult. 340 and ADT 3 for earliness and grain weight, Co. 37 for yield and IR 20 for number of grains per panicle could be the other parents.

Current rice breeding programmes are directed towards exploitation of exotic and local germplasm in improving and stabilising the yield potential. Hence proper choice of parents which can nick well to produce superior off springs is essential for rapid success in any conventional hybridization programme. Therefore the information obtained from combining ability analysis will be helpful in identifying the outstanding parents with desirable alleles. The present study was made to assess the nature of combining ability for six quantitative traits in rice using 7 x 7 diallel.

MATERIALS AND METHODS

Seven rice varieties viz., Cult. 340, ADT 3 ADT. 16, Co 33, Co 37, IR 8 and IR 20 were crossed in all possible combinations. All the 42 F_1s along with the parents were raised in Randomised Block Design with three replications during kharif 1983. Each variant consisted of a single row of 21 plants at 10 cm apart and spacing between rows was 20 cm. Observations on days to 50% flowering, plant height, productive tillers per plant, number of grains per panicle, 100 grain weight and grain yield per plant were recorded on 10 randomly chosen plants from each replication and mean values were used for statistical analysis. The combining ability analysis was carried out as per Griffing (1956) Method I Model 2.

RESULTS AND DISSCUSSION

The estimates of mean squares due to general combining ability effects were highly significant (Table 1). The estimates of GCA mean square were higher than the SCA mean square and ratio of GCA/SCA was more than unity for all the characters studied. The estimates of *gca* effects revealed that the parents Cult. 340, ADT. 3 and IR 8 showed significant *gca* effects for all the characters studied (Table 2). However only IR 8 had positive and significant *gca* effects for yield and yield components except plant height. A positive association was noticed between parental performance *per se* and *gca* effects except days to flowering. Mean values of F_1 hybrids and the respective *sca* effects for different characters are presented in Table 3. For days to flowering, the longest

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Table 1. Estimates of variance for general and specific combining ability for six characters

Due to	DF	Days to flowering	Plant height	Productive tillers per plant	Number of grains per panicle	100 grain weight (g)	Grain yield per plant (g)
General combinining ability	6	683.54**	1187.54**	43.02**	2729.35**	0.48**	189.70**
Specific combining ability	21	127.80**	57.76**	4.70**	155.32*	0 02**	19.53**
Reciprocal effects	21	35.6 9**	11.38**	2.35*	20.38**	0.02**	2.78**
Error	96	3.60	2.46	1.29	2.42	0.006	1.05
GCA : SCA		5.35:1	20.56:1	9.15:1	17.96:1	24:1	9.71:1

**Significant at 1% level *Significant at 5% level

mean duration was recorded by the cross ADT. 16 x Co. 37 (115 days) and the shortest by ADT. 3 x Co. 33 (68 days). The highest positive and significant *sca* effect was recorded in the combination ADT. 16 x Co. 37. Eight combinations exhibited significant negative effects. For plant height, the highest mean value was recorded by Cult. 340 x ADT. 3. (134.23 cm) and the lowest value by the combination Co. 33 x IR 8 (89.86 cm). The highest and positive *sca* effect for plant height was recorded by ADT. 16 x Co. 33 (9.47). The *sca* effects were positive and significant in ten combinations and in six combinations the *sca* effects were negatively significant. The mean values of hybrids for productive tillers per plant ranged from 8.07 (ADT. 3 x Co. 33) to 17.63 (IR 8 x IR 20). The cross ADT. 3 x IR 8 (2.51) recorded the highest positive and significant *sca* effect. The range of mean for number of grains per panicle in respect of the hybrids varied from 71.53 (Cult. 340 x ADT. 16) to 133.23 (Cult. 340 x IR 8). The cross ADT. 16 x IR 8 (11.28) gave the highest and positive and significant *sca* effect. Ten cc tions had significant positive *sca* effects and five other hybrids had significant negative effects The mean of hybrids for 100 grain weight ranged from 1.671 g (Co. 33 x IR 20) to 2.611 (IR 8 x IR 20). A total of three combinations showed significant positive effects while another three combinations gave significant negative effects. For grain yield per plant the mean values in respect of hybrids ranged from 15.29 g (Cult. 340 x ADT. 16) to 36.23 g (Cult. 340 x IR 8). Eight combinations recorded significant positive *sca* effects and five others recorded significant negative effects The correlation studies indicated a positive and significant correlation of grain yield per plant with productive tillers per plant, number of grains per panicle and 100 grain weight, number of per panicle with productive tillers per plant and 100 grain weight. A negative and significant association was noticed between days to flowering and plant height (Table 4).

The combining ability estimates of GCA were highly significant and was that of SCA variance for all the characters studied indicating the preponderance of additive genetic components. Chandramohan (1979) has obtained similar results whereas Ishkumar *et al.* (1975) reported greater magnitude of additive genetic components for plant height and number of grains per panicle and dominance components for grain yield.

The magnitude of additive variance was relatively high suggesting that the *per se* performance of parents may be a good indicator of their combining ability. Similar observations on closer relationship between *per se* performance and *gca* effects has been reported by Gill *et al.* (1981) and Sharma *et al.* (1984). The predominance of GCA variance over SCA variance for all characters indicates the scope for further improvement in all characters by exploitation of the available additive components Among the parents, IR 8 possessed favourable *gca* effect for plant height, number of productive tillers per plant, number of grains per panicle, 100 grain weight and grain yield per plant So this could be used as the base parent and crossed with other parents to improve the diffe.ent traits. Parents Cult. 340 and ADT. 3 Could be used to improve days to flowering and 100 grain weight, Co. 37 could bo chosen for improving the yield and IR 20 could be used for improving number of grains per panicle

The correlations among *gca* effects among parents showed positive and significant association of yield with yield components like productive tillers per plant, number of grains per panicle and 100 grain weight, and also between these components. Therefore, the parental lines having high productive tillers, number of grains per panicle and grain wheight can be useful in crossing programme since the parental performance *per se* is a good indicator for parental *gca*. Since these components had a positive significant association with grain yield, improvement in these traits will have more pronounced effect on yield.

The *gca* effects of parents and *sca* effects of their combinations revealed that only with reference to days to flowering and plant height, the direction of *sca* effect of combinations was the same as that of *gca* effects of the parents involved. For example, parents ADT. 16 and Co. 37 had positive *gca* effect for days to flowering, while parents ADT 3 and Co. 33 had negative effects for days to flowering and their respective combinations had positive and significant *sca* effects indicating additive x additive type of interaction. Although the additive gene action was predominant for other characters, the direction and magnitude of the *sca* effect with respect to their combinations was not following any set pattern indicating that these characters have greater magnitude of dominance and epistatic effect in addition to additive gene action. Therefore, it is clear that these characters are governed by genes, some having additive effect and others having epistatic effect. Hence, caution has to be taken on the reliance of *gca* alone in choosing the parents for improvement

Table 2. Mean and general combining ability effects of parents

Parents	Days to flowering		Plant height		Productive tillers per plant		Number of grains per panicle		100 grain weight		Grain yield per plant	
	Mean	gca	Mean	gca	Mean	gca	Mean	gca	Mean	gca	Mean	gca
Cult. 340	65	−7.37**	128.84	13.90**	8.13	−0.93**	82.70	−4.12**	2.25	0.11**	17.32	−1.92**
ADT. 3	70	−9.42**	123.26	10.76**	9.23	−1.51**	95.40	−6.94**	2.35	0.07**	21.24	−1.76**
ADT. 16	84	1.65**	91.32	−0.62	7.17	−1.87**	66.97	−15.11**	1.43	−0.25**	13.23	−3.86**
Co. 33	94	−3.97**	79.34	−12.24**	11.27	0.38	73.80	−4.58**	1.76	−0.16**	19.64	−1.26**
Co. 37	80	4.58**	102.93	−3.04**	10.13	0.15	93.20	−3.40**	2.16	0.03	22.57	1.21**
IR. 8	105	8.81**	97.24	−5.40**	15.17	3.38**	123.30	28.31**	2.51	0.30**	35.23	7.51**
IR. 20	102	5.72**	98.40	−3.36**	12.27	0.40	102.73	5.84**	1.97	−0.10**	22.24	0.08
SE	1.89	0.47	1.57	0.39	1.13	0.29	1.56	0.39	0.08	0.02	1.03	0.25

**Significant at 1% level

*Significant at 5% level

Table 3. Estimates of mean and *sca* effects of hybrids for six characters in 7 x 7 parent diallel

Cross	Days to flowering		Plant height		Productive tillers per plant		Number of grains per panicle		100 grain weight		Grain yield per plant	
	Mean	sca	Mean	sca	Mean	sca	Mean	sca	Mean	sca	Mean	sca
Cult. 340xADT. 3	69	-0.09	134.23	-0.87	10.13	0.96	86.30	-0.90	2.233	-0.18**	22.24	0.22
Cult. 340xADT. 15	79	4.53**	124.21	-0.04	8.67	-0.77	71.53	-8.77**	2.030	0.05	15.29	-3.41**
Cult. 340xCo. 33	75	-2.77*	119.23	6.60**	13.33	1.81*	99.20	6.18**	2.141	0.07	22.57	0.79
Cult. 340xCo. 37	85	0.38	114.23	-2.48*	14.83	1.82*	91.30	-1.20	2.221	-0.02	28.63	3.44**
Cult. 340xIR 8	94	6.69**	121.24	2.20*	14.87	-0.42	133.23	9.31**	2.421	-0.06	36.23	6.43**
Cult. 340xIR 20	93	-0.73	124.23	3.11**	10.10	-1.44	106.20	5.09**	2.122	0.07	19.63	-3.38**
ADT. 3xADT. 16	76	-5.51**	120.44	0.37	10.10	1.38	72.10	-2.98**	1.991	0.10*	18.24	-0.77
ADT. 3xCo. 33	68	-2.39*	102.15	-7.37**	8.07	-2.87*	81.30	-9.41**	2.120	-0.05	22.03	0.41
ADT. 3xCo. 37	78	0.84	120.65	4.38**	9.13	-1.52	91.80	1.86	2.171	-0.02	27.46	2.10**
ADT. 3xIR 8	92	5.22**	123.25	6.35**	16.57	2.51**	122.70	1.21	2.492	-0.07	28.24	-2.42**
ADT. 3xIR 20	85	0.97	122.45	4.95**	11.97	-0.75	99.60	1.62	2.170	-0.02	24.14	0.96
ADT. 16xCo. 33	71	-11.13*	112.64	9.47**	10.17	1.10	84.07	4.19**	1.717	-0.01	19.14	0.98
ADT. 16xCo. 37	115	20.37**	104.65	2.00*	11.83	0.38	77.60	-4.90**	1.961	0.08	24.11	1.88**
ADT. 16xIR 8	109	7.77**	107.65	3.74**	15.93	-0.89	128.10	11.28**	2.157	-0.03	31.24	5.13**
ADT. 16xIR 20	83	-9.70**	108.64	1.44	10.77	-0.06	84.07	4.68	1.782	-0.01	21.64	0.56
Co. 33xCo. 37	92	3.03**	98.64	2.17*	12.40	-0.39	99.20	5.60**	2.092	0.10*	26.45	0.84
Co. 33xIR 8	87	-7.24**	89.86	-5.35**	16.97	1.29	129.57	4.28**	1.991	0.09	27.94	-1.62*
Co. 33xIR 20	94	6.25**	93.46	0.21	13.70	0.52	110.60	6.86**	1.671	-0.14**	25.34	1.76**
Co. 37xIR 8	92	-9.69**	94.03	-2.86**	16.33	0.38	132.00	7.92**	2.352	0.04	31.84	-4.45
Co. 37xIR 20	110	2.08	99.67	-2.69**	13.90	1.53	94.00	-8.61**	1.920	-0.17**	26.40	1.31
IR 8xIR 20	91	-2.43*	99.25	-2.59**	17.63	0.70	130.00	-0.81	2.611	0.24**	33.43	1.97**
S.E.	1.89	1.17	1.57	0.96	1.13	0.70	1.56	0.96	0.08	0.05	1.03	0.63
C.D.	5.32		4.40		3.18		4.37		0.22		2.88	

* Significant at 5% ** Significant at 1%

Table 4. Correlation between parental general combining ability effects for different characters

	Plant height	Productive tillers per plant	Number of grains per panicle	100 grain weight	Grain yield
Days to flowering	-0.766**	0.670	-0.611	0.014	0.659
Plant height		-0.517	-0.186	0.279	0.255
Productive tillers per plant			0.945**	0.306	0.951**
Number of grains per panicle				0.767*	0.954**
100 grain weight					0.723*

**Significant at 1% level

*Significant at 5% level

of any character as suggested by Kadambavanasundaram (1980) in cotton.

Since both additive and non-additive genetic components are important in governing the yield and yield attributes as discussed above, biparental mating in the early generation among the selected lines or diallel selective mating (Jensen, 1970) exploiting the available genetic male sterile lines can be adopted in breeding programmes for the improvement of characters studied.

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