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Gene Action and Combining Ability in Rice (*Oryza sativa* L.) Involving Indica and Tropical Japonica Genotypes

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A B S T R A C T

Combining ability for yield and its components was analyzed in a 8×8 diallel crosses (excluding reciprocals), involving 3 indica and 5 tropical japonica rice. The GCA and SCA were significant for all the characters, indicating the importance of both additive and dominance genetic components. All the tropical japonica genotypes exhibited good general combining ability effects for yield and most of the yield contributing traits. The parents, IR 66155-2-1-1-2 for yield, 100 grain weight, number of spikelets per panicle, medium plant height and early flowering; IR 66159-23-2-2-1 for yield, number of spikelets per panicle, panicle length, flag leaf length and medium dwarf plant height and IR 65600-81-5-3-2 for yield, 100 grain weight, number of spikelets per panicle, flag leaf length and width were good general combiners. Among the crosses, Jaya×IR66738-118-1-2, Pant Dhan-12×IR66159-23-2-2-1, Pant Dhan-12×IR66155-2-1-1-2, Pant Dhan-12×IR66736-75-1-3 and Pant Dhan-12×IR66738-118-1-2 were good specific combiner for grain yield per plant.

Introduction

The information on combining ability and gene action for different agronomic traits is important to achieve superior genotype from segregating population or in exploiting heterosis in rice. The combining ability of indigenous and tropical japonica in relation to enhance the magnitude of heterosis should be of immense value to breeder to use wide range of genetic basis for the improvement of yield and its components traits.

The combining ability analysis (Griffing, 1956) gives an idea about the relative magnitude of additive and non-additive type of gene action in expression of the traits.

Diallel analysis in rice has been reported by many workers (Shrivastava and Sheshu, 1983; Dwivedi *et al.*, 1999; Munhot *et al.*, 2000). The present investigation was made with a view to study the combining ability of

indigenous and new plant type rice cultivars for yield and its component traits.

Materials and Methods

Eight divergent parents, three high yielding indica (Pant Dhan 12, Govind and Jaya) and five japonica lines (IR 65600-81-5-3-2, IR 66155-2-1-1-2, IR 66738-118-1-2, IR 66159-23-2-2-1 and IR 66736-75-1-3) were selected for this study (Table 1). All possible, 28 crosses (excluding reciprocal) were made and part of the hybrid seeds were grown as off season crop to develop F_2 population and consisting of 28 F_1s, 28 F_2s and 8 parents. All the materials were grown in a Compact Family Randomized Block Design with three replications. Each plot of parents and F_1s were a single row and that of F_2s had six rows each of 20 plants with the spacing of 20 × 15 cm row to row and plant to plant, respectively. Observations on days to 50% flowering, plant height, number of tillers per plant, flag leaf length, flag leaf width, panicle length, number of spikelets per panicle,100 grain weight and grain yield per plant were recorded on 15 randomly selected plants from parents and F_1 and 50 plants from F_2s, avoiding border plants. The combining ability analysis was carried out according to Griffing (1956) Model 1 Method 2.

Results and Discussion

Analysis of variance (Table 2) revealed that both general (GCA) and specific (SCA) combing ability to be highly significant for all the characters in both the generations (Table 1), indicating the involvement of both additive and non-additive type of gene action in expression of the characters. The relative magnitude of estimates of GCA variance was higher than those of SCA variance for all the characters, indicating the predominance additive gene action. The proportion of additive variance (6^2g) was higher than non-additive genetic variance (6^2s) for days to 50% flowering in both F_1 and F_2, revealing the importance of additive gene effects in the expression of the characters and conferring the earlier findings of Shrivastava and Sheshu, (1983) and Dwivedi *et al.*, (1999). However, the non-additive gene action, as shown by higher estimates of 6^2s was found important for rest of the traits studies, similar to the findings reported by Dwivedi *et al.*, (1999).

Non-additive component (6^2s) was lower in magnitude in F_2 as compares to those of F_1 for number of tillers per plant, flag leaf length, flag leaf width, number of spikelets per panicle and grain yield. The decline of 6^2s in F_2 may be expected due to increase in homozygosity and reduce in hererozygosity. The estimates of relative proportion of GCA and SCA (26^2g/26^2g+6^2s) as proposed by Baker (1978) were higher than 0.50 for characters, days to 50% flowering, flag leaf length, panicle length, number of spikelets per panicle and grain yield, indicating the role of additive gene action in expression of these characters. In view of the preponderance of additive genetic components in controlling these characters, it is expected that their genetic advance through single plant selection would be quite rewarding. Whereas, for other characters *viz.*, plant height, number of tillers per plant, leaf width, and 100 grain weight, the ratio was lower than 0.50, indicating the importance of non-additive gene action in governing the traits.

The estimates of GCA effects of parents (Table 3) showed that genotype IR 66155-2-1-1-2 was the best general combiner for yield and other yield contributing traits such as number of spikelets per panicle, 100 grain weight, early flowering, reduced plant height and short flag leaf followed by IR 66155-2-1-1-2, which exhibited good general combining ability for yield, reduced plant height, number

of tillers per plant, long and narrow flag leaf, panicle length, number of spikelets per panicle and fine grain and IR 65600-81-5-3-2 showed good general combining ability for yield, number of spikelets per panicle and 100 grain weight. These tropical japonicas can be used to improve yield and its components because these lines were quite stable combiners which are evident from their high estimates of GCA over generations in diallel studies. Dwivedi and Pandey (2012) have also emphasized use of tropical japonicas having wide compatibility gene in rice improvement as well as for heterosis breeding.

The negative estimates of GCA effects are desirable for earliness and medium dwarf plant height. Among parents studied, Govind, IR 66155-2-1-1-2 and IR 66159-23-2-2-1 were proved good general combiners for earliness and short stature in both the generations. For more number of tillers Pant Dhan 12, Govind, Jaya and IR 66738-118-1-2; for short flag leaf Govind, Jaya, IR 66155-2-1-1-2 and IR 66736-75-1-3; for narrow leaf Govind, Jaya and IR 66159-23-2-2-1; for long panicle Pant Dhan 12, Jaya, IR 66738-118-1-2 and IR 66159-23-2-2-1; for number of spikeles per panicle, all tropical japonica genotypes; for bolder seed, IR 65600-81-5-3-2, IR 66155-2-1-1-2 and IR 66738-118-1-2 and other parents proved good general combiners for fine seeds. None of the parents were good general combiners for all the desirable traits studied.

The SCA effects and per se performance (Table 4) revealed that the cross combinations Jaya×IR66738-118-1-2, Jaya×IR66738-118-1-2, Pant Dhan 12×IR66155-2-1-1-2, Pant Dhan 12×IR66736-75-1-3, Pant Dhan 12×IR66738-118-1-2, Govind×IR66738-118-1-2, Jaya×IR66736-75-1-3, Jaya×IR66159-23-2-2-1, Govind×IR66155-2-1-1-2 and Govind × IR66159-23-2-2-1 were the superior specific combiners as they showed high positive significant SCA effects along with *per se* performance for yield and some of other yield components.

The cross combinations *viz.,* Jaya×IR66738-118-1-2, Pant Dhan-12×IR66155-2-1-1-2, Pant Dhan-12×IR66736-75-1-3 and Pant Dhan-12×IR66738-118-1-2 exhibited positive and significant SCA effects for yield in both F_1 and F_2 generations. The additive× additive epistatic effects involved in these crosses could be fixed by simple breeding procedure.

Table.1 Origin and varietal type of rice genotypes used in the study

S.No.	Varieties/Lines	Origin	Type
1.	Pant Dhan 12	India	Indica
2.	Govind	India	Indica
3.	Jaya	India	Indica
4.	IR 65600-81-5-3-2	IRRI, Philippines	Tropical Japonica
5.	IR 66155-2-1-1-2	IRRI, Philippines	Tropical Japonica
6.	IR 66738-118-1-2	IRRI, Philippines	Tropical Japonica
7.	IR 66159-23-2-2-1	IRRI, Philippines	Tropical Japonica
8	IR 66736-75-1-3	IRRI, Philippines	Tropical Japonica

Table.2 Analysis of variance for general (gca) and specific (sca) combining ability for nine characters in rice

S.No	Source	Generation	D.F.	Days to 50% flowering	Plant height	No. of tiller/plant	Leaf length	Leaf width	Panicle length	No. of spikelets/ panicle	100-grain weight	Grain yield/plant
1.	gca	F_1	7	275.84**	40.19**	28.63**	19.08**	0.05**	4.42**	2451.20**	0.27**	24.20**
		F_2	7	280.85**	37.30**	28.32**	15.73**	0.04**	4.48**	2491.44**	0.28**	22.98**
2.	sca	F_1	28	12.09**	23.96**	8.96**	4.07**	0.03**	0.93**	280.08**	0.08**	2.33**
		F_2	28	13.60**	24.08**	7.98**	2.70**	0.01**	1.12**	269.73**	0.09**	2.20**
3.	Error	F_1	70	1.22	1.45	0.51	0.79	0.008	0.47	2.48	0.02	0.16
		F_2	70	1.36	1.53	0.73	0.83	0.01	0.56	2.45	0.02	0.15
	6^2g	F_1		27.46	3.87	2.81	1.83	0.00	0.40	244.87	0.03	2.40
		F_2		27.95	3.58	2.76	1.49	0.00	0.39	248.90	0.03	2.28
	6^2s	F_1		10.87	22.51	8.45	3.28	0.02	0.46	277.60	0.06	2.17
		F_2		12.24	22.55	7.25	1.87	0.01	0.56	267.28	0.07	2.05
	$26^2g/(26^2g+6^2s)$	F_1		0.83	0.26	0.40	0.53	0.28	0.63	0.64	0.45	0.69
		F_2		0.82	0.24	0.43	0.61	0.38	0.58	0.65	0.43	0.69

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

Table.3 Estimate of genetic combining ability (gca) effects of F_1 and F_2 for different characters in 8 parent diallel crosses in rice

Parents	Days to 50% flowering		Plant height		No. of tiller/plant		Leaf length		Leaf width	
	F_1	F_2	F_1	F_2	F_1	F_2	F_1	F_2	F_1	F_2
Pant Dhan-12	0.26**	-0.05	3.25**	2.73**	0.49**	0.79**	0.22**	0.18**	-0.01**	0.00
Govind	-11.41**	-11.62**	-0.46**	-0.14	1.21**	1.23**	-1.01**	-0.76**	-0.07**	-0.06
Jaya	6.09**	5.98**	1.01**	0.59**	2.14**	2.13**	-1.13**	-1.5**	-0.11**	-0.09**
IR 65600-81-5-3-2	1.66**	2.08**	-0.02	0.01**	-2.1**	-2.05**	0.94**	0.94**	0.03**	0.04**
IR 66155-2-1-1-2	-2.84**	-2.42**	-2.61**	-2.97**	-1.71**	-1.89**	-1.19**	-1.24**	0.02**	0.02**
IR 66738-118-1-2	2.46**	2.18**	2.05**	2.28**	1.73**	1.49**	0.62**	0.63**	0.01**	-0.01**
IR 66159-23-2-2-1	2.82**	3.25**	-1.32**	-0.62**	0.09**	0.07	2.65**	2.26**	-0.01**	-0.01**
IR 66736-75-1-3	0.96**	0.58**	-1.9**	-1.97**	-1.85**	-1.77**	-0.91**	-0.51**	0.14**	0.12**
SE(gi)	0.09	0.11	0.14	0.13	0.06	0.06	0.08	0.07	0.001	0.001
SE(gi-gi)	0.22	0.27	0.32	0.31	0.14	0.14	0.19	0.17	0.002	0.002
5%	0.18	0.22	0.27	0.25	0.12	0.12	0.16	0.14	0.001	0.001
1%	0.23	0.28	0.35	0.33	0.15	0.15	0.21	0.18	0.0018	0.0023

Table.3 Contd.

Parents	Panicle length		No. of spikelets/panicle		100 grain weight		Grain yield/ plant	
	F_1	F_2	F_1	F_2	F_1	F_2	F_1	F_2
Pant Dhan-12	0.97**	0.99**	-9.55**	-12.35**	0.02**	0.00	0.70**	-0.78**
Govind	-0.05	-0.1	-31.56**	-31.32**	-0.29**	-0.25**	-3.25**	-3.14**
Jaya	0.25**	0.13**	-8.07**	-6.6**	-0.01**	0.01**	-0.6**	-0.58**
IR 65600-81-5-3-2	-0.19**	-0.17**	3.21**	5.07**	0.27**	0.28**	0.73**	0.68**
IR 66155-2-1-1-2	-0.53**	-0.36**	10.81**	10.16**	0.10**	0.14**	1.58**	1.60**
IR 66738-118-1-2	0.46**	0.3**	14.19**	14.46**	0.06**	0.6**	0.10**	0.10**
IR 66159-23-2-2-1	0.3**	0.49**	13.22**	13.21**	-0.03**	-0.07**	1.14**	1.09**
IR 66736-75-1-3	-1.21**	-1.28**	7.75**	7.38**	-0.13**	-0.17**	0.05**	1.03**
SE(gi)	0.04	0.05	0.23	0.21	0.001	0.001	0.015	0.013
SE(gi-gi)	0.09	0.11	0.53	0.49	0.004	0.003	0.035	0.03
5%	0.08	0.09	0.45	0.41	0.003	0.0027	0.029	0.025
1%	0.1	0.13	0.59	0.54	0.0046	0.0036	0.039	0.033

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

Table.4 Estimate of specific combining ability (sca) effects of various characters in 8 parent diallel crosses in rice

Crosses	Days of 50% flowering		Plant Height		No. of tiller/plant		Leaf length		Leaf width	
	F_1	F_2	F_1	F_2	F_1	F_2	F_1	F_2	F_1	F_2
Pant Dhan-12×Govind	-1.41	-1.57	-10.06**	-9.63**	0.39	0.15	2.75**	1.80**	0.04**	0.06**
Pant Dhan-12×Jaya	0.75	0.83	-5.34**	-4.81	6.77**	6.35**	-0.69	-1.98**	-0.27**	-0.07**
Pant Dhan-12×IR65600-81-5-3-2	-0.48	1.06	1.75	-0.37	-0.43	0.19	-1.45	-2.28	-0.11**	0.05**
Pant Dhan-12×IR66155-2-1-1-2	0.02	-0.77	2.08	1.11	-0.63	-0.13	1.57*	0.48	0.13**	0.08**
Pant Dhan-12×IR66738-118-1-2	-1.95*	-0.37	2.09	2.10	0.52	0.71	-2.53**	-1.66*	0.15**	0.03**
Pant Dhan-12×IR66159-23-2-2-1	0.35	1.89	5.38**	5.03**	0.21	-0.01	-0.96	-0.20	0.16**	0.15**
Pant Dhan-12×IR66736-75-1-3	-0.45	-3.44**	7.31**	8.61**	-2.32**	-1.10	-0.47	0.15	0.08**	0.06**
Govind×Jaya	-6.25**	6.27**	-3.55**	-3.21**	1.29**	1.15	0.62	1.83**	0.08**	-0.02
Govind× IR65600-81-5-3-2	-3.81**	-2.71**	-3.47**	4.14**	-1.08	-0.72	-1.01	-1.09	-0.03**	-0.02
Govind× IR66155-2-1-1-2	0.69	0.79	2.90*	4.58**	0.08	0.39	-1.97**	-2.02**	0.14**	0.14**
Govind× IR66738-118-1-2	-4.95**	-5.47**	2.24	1.19	-1.64**	-1.79**	-1.69**	-2.05**	-0.03**	-0.03**
Govind× IR66159-23-2-2-1	-2.31**	-2.21*	3.89**	4.20**	0.39	0.70	2.91**	1.62*	0.17**	0.15**
Govind× IR66736-75-1-3	0.45	0.13	4.72**	4.55**	-2.66**	-2.45**	-1.60*	1.16	0.04**	0.01**
Jaya×IR65600-81-5-3-2	2.35**	2.03	5.28**	4.99**	-4.65**	-4.67**	0.62	0.56	-0.08	-0.04**
Jaya×IR65155-2-1-1-2	2.52**	3.19**	7.06**	5.15**	-4.55**	-4.33**	-2.52**	-1.11	0.20**	0.21**
Jaya×IR66738-118-1-2	-0.11	0.26	1.38	1.97	-4.32**	-4.04**	0.39	-0.05	0.22**	0.06**
Jaya×IR66159-23-2-2-1	-0.48	-0.14	2.14	2.27	-5.31**	-4.94**	2.92**	2.49**	0.16**	0.13**
Jaya×IR66736-75-1-3	1.39	1.86	-0.36	0.51	-1.71**	-1.59**	3.15**	2.32**	0.29**	0.26**
IR65600-81-5-3-2× IR66155-2-1-1-2	-6.05**	-4.91**	9.55**	-9.02**	0.88	0.52	-0.40	0.30	-0.09**	-0.11**
IR65600-81-5-3-2× IR66738-118-1-2	1.65	2.16	1.80	1.37	3.30**	2.98**	0.99	0.99	-0.10**	-0.12**
IR65600-81-5-3-2× IR66159-23-2-2-1	0.95	-0.09	-0.89	-3.26*	-1.18**	-0.46	0.87	0.06	0.02*	0.01**
IR65600-81-5-3-2× IR66736-75-1-3	2.49**	3.09**	-4.84**	-5.92**	0.77	0.42	2.85**	2.19**	0.13**	0.10**
IR66155-2-1-1-2× IR66738-118-1-2	5.15**	4.33**	3.69**	3.60**	2.89**	2.45**	0.91	1.20	0.10**	0.17**
IR66155-2-1-1-2× IR66159-23-2-2-1	5.12**	7.26*	-0.12	-1.15	-1.39*	-1.55**	1.83*	1.57*	0.14**	0.07**
IR66155-2-1-1-2× IR66736-75-1-3	0.99	2.26*	5.51**	6.75**	1.38*	1.01	0.98	0.03	0.05**	-0.02**
IR66738-118-1-2× IR66159-23-2-2-1	-0.18	-0.34	-5.99**	-4.07**	0.02	-0.36	-0.32	0.45	0.00	0.05**
IR66738-118-1-2× IR66736-75-1-3	3.35**	3.33**	-3.66**	2.79**	0.83	1.15	-0.16	0.10	-0.22**	-0.09**
IR66159-23-2-2-1× IR66736-75-1-3	-2.35**	-1.74	-0.21	-1.57	3.91**	3.63**	-4.87**	-4.03**	0.02**	0.00
±S.E (Sij)	0.91	1.12	1.32	1.26	0.58	0.60	0.77	0.69	0.006	0.009
±S.E (Sij-Sik)	1.99	2.44	2.89	2.75	1.27	1.32	1.68	1.50	0.014	0.02
5%	1.78	2.20	2.59	2.47	1.14	1.18	1.51	1.35	0.01	0.017
1%	2.34	2.88	3.39	3.24	1.49	1.54	1.98	1.17	0.02	0.023

Table.4 Contd.

Crosses	Panicle length		No. of spikelets/panicle		100 grain weight		Grain yield/ plant	
	F_1	F_2	F_1	F_2	F_1	F_2	F_1	F_2
Pant Dhan-12×Govind	0.63	0.68	-13.65**	-10.80**	-0.01	-0.03**	-0.89**	-0.57**
Pant Dhan-12×Jaya	-1.58**	-1.33**	-20.80**	-21.58**	0.01	-0.12**	-0.86**	-1.16**
Pant Dhan-12×IR65600-81-5-3-2	0.66	0.63	14.21**	-2.32	0.25**	0.18**	0.06	0.24*
Pant Dhan-12×IR66155-2-1-1-2	0.35	0.33	20.78**	15.75**	0.36**	0.46**	2.74**	2.63**
Pant Dhan-12×IR66738-118-1-2	0.33	0.17	16.78**	20.62**	-0.05**	0.03**	1.62**	1.36**
Pant Dhan-12×IR66159-23-2-2-1	0.09	0.67	22.64**	24.20**	0.42**	0.53**	2.77**	2.62**
Pant Dhan-12×IR66736-75-1-3	0.48	0.06	16.81**	20.58**	-0.18**	-0.37**	1.69**	1.46**
Govind×Jaya	0.45	0.35	-14.54**	-16.78**	-0.26**	-0.24**	-2.02**	-2.15**
Govind× IR65600-81-5-3-2	1.55**	1.56**	4.36**	9.03**	0.23**	0.16**	-0.70**	-0.46**
Govind× IR66155-2-1-1-2	1.12**	0.48	-2.94	-2.65	-0.43**	-0.39**	0.65**	0.60**
Govind× IR66738-118-1-2	0.58	-1.26*	10.48**	10.21**	0.64**	0.68**	1.26**	1.19**
Govind× IR66159-23-2-2-1	0.38	-0.01	-6.85	-6.05**	-0.24**	-0.21**	0.36*	0.35**
Govind× IR66736-75-1-3	0.05	0.5	27.59**	23.65**	0.17**	0.21**	0.42**	0.17
Jaya×IR65600-81-5-3-2	0.95**	0.5	-0.46	22.25**	-0.09**	-0.13**	0.11	0.16
Jaya×IR65155-2-1-1-2	0.97**	0.65	22.27**	19.90**	-0.15**	-0.15**	0.42**	-0.03
Jaya×IR66738-118-1-2	-0.81*	-0.52	18.09**	11.69**	0.02	0.07**	3.14**	3.32**
Jaya×IR66159-23-2-2-1	0.74*	-0.45	15.50**	13.65**	-0.09**	-0.03	0.76**	0.95**
Jaya×IR66736-75-1-3	1.33**	1.61**	26.12**	23.92**	0.49**	0.58**	0.83**	0.94**
IR65600-81-5-3-2× IR66155-2-1-1-2	0.20	1.24**	-10.21**	-9.78**	0.04*	0.07**	0.27**	0.15
IR65600-81-5-3-2× IR66738-118-1-2	0.18	-0.36	-1.59	-2.43	-0.09**	-0.06**	-1.07**	-1.64**
IR65600-81-5-3-2× IR66159-23-2-2-1	-0.14	1.29**	0.31	-2.18	0.15**	0.13**	0.61**	0.12
IR65600-81-5-3-2× IR66736-75-1-3	-0.88*	-2.09**	-5.47*	-4.82*	-0.08*	0.02*	0.33*	-0.43**
IR66155-2-1-1-2× IR66738-118-1-2	-0.22	0.07	-11.38*	-7.17**	-0.05**	-0.03**	-0.41**	-0.37**
IR66155-2-1-1-2× IR66159-23-2-2-1	0.41	0.26	0.15	0.44	0.21**	0.15**	0.57**	-0.36**
IR66155-2-1-1-2× IR66736-75-1-3	-1.65**	-1.41**	-12.60**	-13.10**	-0.34**	-0.36**	-1.14**	-1.02**
IR66738-118-1-2× IR66159-23-2-2-1	-0.21	-0.01	-9.10**	-8.39**	0.46**	0.67**	-1.23**	-1.09**
IR66738-118-1-2× IR66736-75-1-3	1.62**	1.75**	-1.43	-0.71	-0.04*	-0.11**	-0.11	0.05
IR66159-23-2-2-1× IR66736-75-1-3	-1.46**	-1.03**	-19.12**	-18.18**	-0.04*	-0.20**	-0.72**	-1.23**
±S.E (Sij)	0.36	0.46	2.18	2.02	0.02	0.01	0.15	0.12
±S.E (Sij-Sik)	0.79	1.00	4.77	4.41	0.04	0.03	0.32	0.26
5%	0.71	0.90	4.27	3.96	0.04	0.02	0.29	0.24
1%	0.93	1.18	8.60	5.19	0.05	0.03	0.39	0.31

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

The cross combinations showing desirable SCA effects for days to 50% flowering (for earliness) were Govind × IR66738-118-1-2 and Govind × IR66159-23-2-2-1 in both generations, Pant Dhan-12 × IR66738-118-1-2 in F_1 and Pant Dhan-12 × IR66736-75-1-3 in F_2 generation. For flag leaf length the negative estimates of SCA are desirable. The good specific combiners for short flag leaf were Pant Dhan 12 × IR66738-118-1-2, Govind × IR66155-2-1-1-2 and Jaya × IR66159-23-2-2-1 (in F_1). For flag leaf width the negative estimates of SCA is desirable. The cross combination Govind × IR66738-118-1-2 exhibited good specific combining ability for narrow flag leaf. For length of panicle the best specific combiners were Jaya × IR66736-75-1-3 in both the generations and Govind × IR66155-2-1-1-2 and Jaya × IR66159-23-2-2-1 in F_1 generation only.

All the crosses exhibited good specific combing ability for number of spikelets per panicle except Govind × IR66159-23-2-2-1 and Govind × IR66155-2-1-1-2. The best specific combiners for bold seed size (100 grain weight) were Govind × IR66738-118-1-2, Jaya × IR66736-75-1-3, Jaya × IR66738-118-1-2 and Pant Dhan-12 × IR66155-2-1-1-2 and for fine seed size, Govind × IR66155-2-1-1-2, Govind × IR66159-23-2-2-1, Pant Dhan-12 × IR66736-75-1-3, Jaya × IR66159-23-2-2-1 and Pant Dhan 12 × IR66738-118-1-2 in F_1 generation.

Further, the majority of the crosses, showed significant SCA effects which involved good and poor general combiners, indicating additive × dominance type of gene interaction involved in the expression of characters. Few crosses Pant Dhan 12 × IR66155-2-1-1-2, Pant Dhan 12 × IR66155-2-1-1-2 and Pant Dhan 12 × IR66155-2-1-1-2 having high × high general combiners showed high SCA effects and indicating the predominance of additive × additive type of gene effect. Similar results have also been reported by Selvarani and Rangasamy, 1999, Salvaraj *et al.*, 2011 and Dwivedi and Pandey (2012).

In case, where good × good general combiners are involved for high SCA effects, these crosses would be utilized for yield improvement through single plant selection in segregating generations. But in the crosses showing high SCA effects due to good × poor 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 perspective breeding procedure for yield improvement in rice. The crosses showing high SCA effects involving poor × poor general combiners could be exploited for heterosis breeding programme.

The GCA and SCA results indicated importance of both additive and dominance genetic components in the inheritance. All the tropical japonica genotypes exhibited good general combining ability effects for yield and most of the yield contributing traits. The tropical japonica lines having wide compatibility gene therefore exhibited fertile F_1 hybrids with indica varieties. The parents, IR 66155-2-1-1-2 was good general combiner and cross Jaya × IR66738-118-1-2 was good specific combiner for grain yield per plant.

References

Baker, R.J., 1978. Issues in diallel analysis. Crop Science 18, 533-536.

Dwivedi, D.K., Pandey, M.P., Pandey, S.K., Rongbai, Li., 1999. Combining ability over environment in rice involving indica and tropical japonica lines. *Oryza* 36(2), 101-107.

Dwivedi, D.K., Pandey, M.P., 2012. Gene action and heterosis for yield and associated traits in indica and tropical

japonica crosses of rice (*Oryza sativa* L.) involving wide compatibility gene(s). International Journal of Plant Breeding and Genetics 6(3), 140-150.

Griffing, B., 1956. Concept of general and specific combining ability in relation to diallel crossing system. *Aust. J. Biol. Sci.,* 9, 463-493.

Munhot, M.K., Sarawagi, A.K., Rastogi, N.K., 2000. Gene action and combining ability for yield, grain quality and other related characters in rice. *Oryza,* 37, 1-6.

Selvaraj, C. I., Nagarajan, P., Thiyagarajan, K., Bharathi, M., Rabindran, R., 2011. Studies on heterosis and combining ability of well-known blast resistant rice genotypes with high yielding varieties of rice (*Oryza sativa* L.) *Int. J. Plant Breed. Genetics,* 5, 111-129.

Selvarani, M., Rangasamy, P., 1999. Combining ability analysis in rice. *Oryza,* 36, 208-210.

Srivastava, M.N., Seshu, D.V., 1983. Combining ability for yield and its components in rice. *Oryza*, 32, 1-5.

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