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Exploitation of Heterosis in Yield and Its Components in Rice

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ABSTRACT

In present investigation, A wide range variation in estimates of heterobeltiosis and standard heterosis in positive and negative direction was observed for grain yield per plant. In case of grain yield per heterobeltiosis ranged from -26.87 (NDRK5096/F1) to 10.78 (IR2-9-B-1-5/F1) and standard heterosis varied from -22.18 (NDRK5096/F1) to 7.03 (IR2-9-B-1-5/F1) over SV1. NDRK 5026/Jaya, NDRK5026/CSR10, NDRK5026/F1, NDRK5096/F1, NDRK5088/F1, and CSRS (C) 52-1-1/F1 were found highly significant over standard variety SV2 (CSR10), while, NDRK5096/Jaya, NDRK5096/CSR10, NDRK5088/Jaya and NDRK5088/CSR10 were significant over SV2 for grain yield per plant.

Key words: *Heterosis and yield.*

INTRODUCTION

The heterosis breeding has been extensively utilized in improving the yield potential through development of hybrid cultivars in most of the allogamous crops and some autogamous crops as well. They exploitation of heterosis for developing high hybrid yielding cultivars in rice has been limited due to its autogamous nature. The presence of high heterosis for economically important characters is not only useful for developing hybrids, synthetics or composites through exploitations of heterosis but also helps in obtaining transgressive segregants for development of superior homozygous lines. In present study, the estimates of heterosis over better parent and standard variety were calculated for 14 single way crosses and 7 three way crosses to asses their genetic potential as breeding material.

MATERIALS AND METHOD

In experiment the material for present study comprised of 10 genetically diverse strains and their 21 crosses (14 single crosses, 7 three crosses). Out of which 14 single crosses and 7, three-way crosses 7 lines, 3 tester and 2 check varieties (total 33 genotypes) were used for TTC. The second set of experiment comprised of 45 genotypes including three checks. Both experiments were conducted at Research Farm of Genetics and Plant Breeding, Narendra Deva University of Agriculture & Technology, Kumarganj, Faizabad (U.P.) during Kharif, 2009. The material was sown in Randomized Block Design with three replication.

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Observations were recorded on 13 characters namely, days to 50% flowering, size of flag leaf (cm), plant height (cm), panicle bearing tillers per plant, panicle length (cm), spikelet per panicle, spikelet fertility (%), 1000-grain weight (g), biological yield (g), L:B ratio, grain yield per plant and harvest index. The data on different characters were utilized for the analysis of estimation of heterosis over better parent and standard variety2.

RESULTS AND DISCUSSION

A wide range of variation in the estimates of heterobeltiosis and standard heterosis in positive and negative direction was observed for grain yield per plant. In case of heterobeltiosis ranged from -26.87 to 7.03 per cent, and standard variety heterosis varied from 2.63 to 75.02 per cent. One cross (NDRK 5026 / F1) showed highest value of heterosis with highly significant 15 crosses were show positive heterosis over SV2 for grain yield per plant. None of the crosses showed significant heterosis in desirable direction over better parent for grain yield per plant. Days to 50% flowering, panicle length, size of flag leaf, spikelet panicle-1, filled spikelet panicle-1, biological yield plant-1, L:B ratio were also showed positive heterosis over parent and standard variety with this finding of positive study3,4 observed positive heterosis for most of the yield contributing traits. It was also noted that high heterosis over better parent was found in some lower yielding crosses when compared to other crosses which have displayed significant heterosis. This suggested that while selecting the best hybrid, beside the heterotic response over better parent, the mean performance of the crosses showed also be given due to consideration. Since heterosis estimates results from F_1-P_1 and depends more or less on the mean of the parent (P) in question, there is every possibility of getting a cross with lower mean performance, but high heterotic response. In case the parental performance in very poor, on the contrary, there can be with high mean performance but low heterosis in case parental performance of also high. The mean performance being the realized value and the heterotic response being an estimate, the former showed be given due consideration while making selection of cross combinations. Above mentioned characters has been also reported by Bisne *et al.*[1] Salem *et al.*[5].

Table 1: Heterosis (%) over better parent (BP) and standard variety (SV) for thirteen characters in rice

Crosses	Days to 50% flowering		Size of flag leaf		Plant height		Panicle bearing tillers $plant^{-1}$		Panicle length	
	BP	SV	BP	SV	BP	SV	BP	SV	BP	SV
NDRK 5026 × Jaya	4.42**	-5.83**	11.45**	36.39**	2.54	-0.2	-8.11	-12.82	15.69**	8.83**
NDRK 5026 × CSR 10	2.02*	-7.06**	6.38*	15.04**	25.51**	-8.17**	-21.62**	-25.64**	-2.07	2.84
NDRK 5026 × F_1	28.03**	3.68**	15.39**	24.79**	5.32**	5.75**	-18.92*	-23.08**	8.35**	0.03
NDRK 5096 × Jaya	8.79**	-8.90**	0.84	23.41**	12.41**	2	-5.56	-12.82	8.12**	1.71
NDRK 5096 × CSR 10	4.03**	-12.88**	-4.44	4.45	20.43**	-11.88**	-13.89	-20.51**	-14.01**	-9.70**
NDRK 5096 × F_1	23.86**	0.31	2.45	11.98**	14.36**	3.77*	-8.33	-15.38*	8.26**	0.56
NDRK 5088 × Jaya	11.03**	-4.29**	8.99**	33.38**	10.65**	-2.37	9.09	-7.69	7.31**	12.04**
NDRK 5088 × CSR 10	-7.83**	-20.55**	5.09	15.93**	16.01**	-15.11**	30.00**	0	-3.53	1.31
NDRK 5088 × F_1	15.91**	-6.13**	-5.17	4.61	12.11**	-1.09	9.68	-12.82	1.73	6.21* i
IR 63731-1-1-3-3-2 × Jaya	-5.54**	-21.47**	-2.36	19.49**	4.95**	-2.69	-9.09	-23.08**	-0.46	-2.71
IR 63731-1-1-3-3-2× CSR 10	4.06**	-13.50**	-3.75	-5.36	7.57**	-21.29**	3.12	-15.38*	-22.37**	-18.48**
IR 63731-1-1-3-3-2 × F_1	4.55**	-15.34**	-1.03	1	11.68**	3.56*	15.62	-5.13	3.98	1.63
IR2-9-B-1-5 × Jaya	-2.27*	-20.86**	-19.94**	-2.02	-8.20**	-11.58**	0	-15.38*	-16.07**	-4.89
IR2-9-B-1-5× CSR 10	-0.38	-19.33**	-24.28**	-26.14**	-5.09*	-30.55**	0	-17.95*	-23.22**	-12.99**
IR2-9-B-1-5 × F_1	-1.14	-19.94**	-21.58**	-19.97**	-3.94*	-7.48**	-15.62	-30.77**	-8.70**	3.46
IR71897-3-R-1-1-2 × Jaya	-5.78**	-19.94**	5.47*	29.07**	16.76**	-1.62	33.33**	12.82	-1.12	-1.44
IR71897-3-R-1-1-2× CSR 10	0	-15.03**	0.66	2.29	13.78**	-16.75**	12.12	-5.13	-13.09**	-8.73**
IR71897-3-R-1-1-2× F_1	13.64**	-7.98**	4.11	6.24	20.35**	1.4	24.24**	5.13	3.98	3.65
CSRS(C)-52-1-1 × Jaya	0.68	-9.20**	-6.28*	14.70**	-6.47**	-8.98**	9.09	-7.69	-7.73**	-6.55*
CSRS(C)-52-1-1× CSR 10	-14.83**	-17.18**	-18.12**	-2.92	15.84**	-15.24**	10	-15.38*	-22.15**	-18.25**
CSRS(C)-52-1-1× F_1	23.48**	0	-15.66**	0	-3.69*	0	25.81**	0	-1.26	0

Crosses	Spikelet panicle -1		Filled spikelet panicle^{-1}		Spikelet fertility		1000-grain weight		Biological yield plant^{-1}	
	BP	SV	BP	SV	BP	SV	BP	SV	BP	SV
NDRK 5026 × Jaya	6.49**	39.46**	4.21**	41.84**	-6.33**	1.8	-7.52	16.43**	19.45**	26.90**
NDRK 5026 × CSR 10	18.53**	55.22**	11.43**	51.67**	-11.07**	-2.27	-2.49	22.76**	7.79**	19.84**
NDRK 5026 × F_1	9.64**	43.58**	11.62**	51.93**	-0.89	5.85**	-16.46**	5.18	-0.06	11.81**
NDRK 5096 × Jaya	2.79*	31.70**	-1.68	31.50**	-8.37**	-0.42	-21.26**	7.06	-0.24	7.78**
NDRK 5096 × CSR 10	-1.61	26.06**	-8.06**	22.97**	-11.23**	-2.44	-16.11**	14.05**	3.14	14.67**
NDRK 5096 × F_1	1.59	30.17**	1.78	36.13**	-1.23	4.57**	-11.09**	20.88**	10.55**	23.68**
NDRK 5088 × Jaya	15.69**	45.76**	11.27**	57.96**	-1.28	8.39**	-15.39**	24.37**	3.46	-1.47
NDRK 5088 × CSR 10	26.96**	59.97**	18.85**	68.73**	-4.51**	4.94**	-19.14**	18.86**	-3.28	7.53**
NDRK 5088 × F_1	9.94**	38.52**	6.98**	51.87**	-0.12	9.66**	-17.64**	21.06**	0.03	11.91**
IR 63731-1-1-3-3-2 × Jaya	**-33.09****	**11.84****	**-33.85****	**13.96****	**-6.21****	**1.93**	**-15.72****	**-8.25**	**-35.79****	**-22.18****
IR 63731-1-1-3-3-2× CSR 10	-43.10**	-4.89**	-48.50**	-11.28**	-15.11**	-6.70**	10.97*	24.34**	-44.91**	-33.23**
IR 63731-1-1-3-3-2 × F_1	-38.62**	2.6	-39.73**	3.82*	-4.11**	1.29	14.90**	10.96*	-12.59**	5.94*
IR2-9-B-1-5 × Jaya	-47.28**	-14.98**	-53.56**	-14.45**	-7.40**	0.63	-5.21	3.19	-40.33**	-25.48**
IR2-9-B-1-5× CSR 10	-47.98**	-16.12**	-54.95**	-17.01**	-9.85**	-0.93	2.66	15.03**	-51.86**	-39.88**
IR2-9-B-1-5 × F_1	-45.85**	-12.69**	-49.82**	-7.55**	2.32	5.93**	1.41	-2.06	-18.21**	2.15
IR71897-3-R-1-1-2 × Jaya	**-29.88****	**13.01****	**-28.81****	**15.37****	**-6.05****	**2.1**	**-18.27****	**3.87**	**-34.25****	**-23.08****
IR71897-3-R-1-1-2× CSR 10	-38.73**	-1.25	-41.30**	-4.87*	-11.74**	-3.00*	-1.98	24.57**	-17.31**	-3.27
IR71897-3-R-1-1-2× F_1	-35.15**	4.53**	-33.81**	7.27**	-4.36**	2.66*	-5.5	20.10**	-27.76**	-15.49**
CSRS(C)-52-1-1 × Jaya	-38.56**	0.44	-41.12**	1.3	-7.64**	1.09	7.82	17.39**	-37.69**	-23.27**
CSRS(C)-52-1-1× CSR 10	-44.80**	-9.76**	-51.13**	-15.93**	-15.95**	-7.63**	6.55	19.39**	-6.09**	15.64**
CSRS(C)-52-1-1× F_1	-38.83**	0	-41.88**	0	-8.64**	0	-1.69	0	-18.79**	0

Crosses	L: B ratio		Harvest index		Grain yield plant^{-1}		
	BP	SV	BP	SV	BP	SV_1	SV_2
NDRK 5026 × Jaya	15.07**	9.80**	10.34	28.41**	-7.63	-4.08	56.38**
NDRK 5026 × CSR 10	13.74**	5.34*	-7.5	7.65	-18.01**	-14.86**	28.77**
NDRK 5026 × F_1	-1.74	50.51**	-4.68	10.93	-9.47	-5.99	75.02**
NDRK 5096 × Jaya	9.20**	4.2	-17.33**	0.39	-17.05**	-11.73*	20.11*
NDRK 5096 × CSR 10	6.82*	-4.33	-21.41**	-4.57	-25.87**	-21.12**	16.90*
NDRK 5096 × F_1	-21.59**	20.10**	-16.38**	1.54	-26.87**	-22.18**	23.41**
NDRK 5088 × Jaya	8.12**	6.74**	-6.5	-4.78	-9.77	-8.42	16.65*
NDRK 5088 × CSR 10	0.13	-1.15	-13.82*	-3.08	-15.82**	-14.56*	18.71*
NDRK 5088 × F_1	-22.59**	18.58**	-6.2	7.03	-10.72	-9.38	26.95**
IR 63731-1-1-3-3-2 × Jaya	-3.29	8.52**	-32.98**	-13.44*	4.23	5.3	6.34
IR 63731-1-1-3-3-2× CSR 10	-12.47**	-1.78	-43.71**	-27.29**	2.17	3.22	-13.02
IR 63731-1-1-3-3-2 × F_1	-24.50**	15.65**	-20.39**	2.82	-8.94	-8	14.09
IR2-9-B-1-5 × Jaya	-4.24	6.36**	-42.55**	-28.25**	7.36	1.8	-11.37
IR2-9-B-1-5× CSR 10	-3.78	6.87**	-45.68**	-32.15**	-4.83	-8.84	-23.49
IR2-9-B-1-5 × F_1	-30.23**	6.87**	-22.78**	-3.56	10.78	7.03	8.32
IR71897-3-R-1-1-2 × Jaya	6.37**	14.76**	-25.32**	-10.15	4.29	1.57	13.02
IR71897-3-R-1-1-2× CSR 10	2.83	10.94**	-37.65**	-24.99**	0.48	-2.14	-1.97
IR71897-3-R-1-1-2× F1	-30.32**	6.74**	-14.26**	3.15	-4.99	-7.46	15.16
CSRS(C)-52-1-1 × Jaya	-3.72	11.83**	-33.67**	-15.09*	6.6	5.04	9.81
CSRS(C)-52-1-1× CSR 10	-9.20**	5.47*	-36.58**	-18.81**	-5.63	-7.01	2.63
CSRS(C)-52-1-1× F1	-34.72**	0	-21.89**	0	1.49	0	23.49**

Table 2: 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**

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