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Heterosis for Yield and Yield Component traits in Upland Rice genotypes under reproductive stage drought

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ABSTRACT: *It is imperative to know the degree and direction of hybrid vigour of a cross for its commercial exploitation. Experiment was conducted to study heterosis for different morphological traits i.e. days to 50% flowering, plant height, ear bearing tillers, panicle length, total dry matter production, harvest index, sterility, plot yield under drought stress condition with Randomized Block Design (RBD) at Central Rice Research Institute, Cuttack in 2012. Grain yield, manifested highly significant heterobeltiosis and standard heterosis in ten and thirteen crosses respectively. The highest heterotic effect among the yield components were observed for total dry matter, harvest index, panicle length and tiller number. The following crosses Mahulata x Ratna, Mahulata x Dandi, Mahulata x Swarna, Mahulata x Sahbhagi, Mahulata x Abhishek, Mahulata x Annada, Mahulata x IR 20, M55419-04 x Sahbhagi, M55419-04 x MTU 1010 showed positive significant in mid parent heterosis, heterobeltiosis and standard heterosis under water stress condition. Therefore, these crosses may be exploited for hybrid rice production and furtherit concluded that, our recent germplasm has great potential for developing new rice varieties for moisture stress condition.*

Key words: *F1, heterobeltiosis, hybrid vigor,* Oryzasativa, *standard heterosis and mid parent heterosis*

INTRODUCTION

Rice (*Oryza sativa* L.) one of the important food crop, grown on 154 million hectares worldwide in a wide range of environments (IRRI), (2004). About 45% of the world's rice is cultivated in rainfed ecosystem (IRRI), (2002). These areas often experience severe water deficits due to low and uneven rainfall distribution pattern, consequently yield has largely reduced by drought. Drought stress is a serious limiting factor to rice production and yield stability in rainfed areas and 18 million tons of rice valued at US $ 3600 million is lost annually to drought (O'Toole, 1999). Therefore, development of drought resistant cultivars will considerably improve rainfed rice production.

Heterosis breeding is a fundamental tool for the expression of various cross combinations and its potential for commercial exploitation of heterosis under different environmental conditions. Overall positive heterosis desired for yield and yield relating traits and negative heterosis for plant height and early maturity (Nuruzzaman *et al.*, 2002). Generally, heterosis is expressed in three ways according to the performance of the hybrids over its parents (mid parent and better parent heterosis) and commercially growing rice varieties (standard heterosis) in comparison with different morphological traits (Gupta, 2000). Heterosis breeding is very important genetic tool in conventional breeding for the enhancement of yield and many other yield related traits both qualitative and quantitative in all crops under stress conditions. Conventional breeding strategy, play an important role for the screening, production of high yielding hybrids and exploitation of heterosis as well as the specific combining ability of crosses. Positive heterosis for grain yield per plant and other parameters were reported by many researchers. On the other hand, positive significant heterosis was reported by Hong *et al.* (2002) and Alam *et al.* (2004) for yield and various yield contributing traits. Hybrid rice varieties have been released from different countries with greater yield potential of 15 to 20% than the commercial growing rice varieties under different environments (Yuan *et al.*, 2000). The

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main objective of the study was to evaluate rice germplasm collected from different sources for yield and yield related traits for heterosis to develop new breeding lines that can perform better in water stress conditions

MATERIALS AND METHODS

The genotypes Mahulata and M55419-04 were used as male and Ratna, Dandi, Swarna, Sahbhagi, Lalat, Abhisek, Swarna sub1, Satabdi, Annada, Saket 4, IR20, Vanaprava, IR64, Naveen, IR36 and MTU1010 were used as female for the crossing programme. Annada and Sahbhagi Dhan were used as standard check variety. All the 23 F1s, 18 parents along with the check varieties were raised in randomized block design with two replications adopting a spacing of 20 x 15 cm. Thirty days old seedlings of parents and cross combinations were transplanted with single seedling per hill in three rows of 3m length. All the recommended agronomical package of practices was followed. Reproductive stage drought stress was applied by withholding irrigation water just before panicle initiation stage and stress was maintained for 20 days. Five representative plants from each genotype in each replication were randomly selected to record observations on days to 50% flowering, plant height (cm), ear bearing tiller, panicle length, total dry matter production, harvest index, sterility and plot yield. Further, parents and the F1 generations were tested under water stress condition to find the percentage of heterosis. Observations were recorded on five randomly selected plants in parents and F1s in each replication. The means were computed for yield and other yield contributing traits, such as Days to 50% flowering, plant height, productive tillers per plant, panicle length per plant, total dry matter production, sterility per cent and grain yield per plot and heterosis was calculated by using the following formula.Average heterosis = [(F1-M.P) / M.P] x 100; Heterobeltiosis = [(F1-B.P) / B.P] x 100; Standard heterosis = [(F1-S.V) / S.V] x 100. Where, F1 = Mean value of specific cross, M.P = Mean value of mid parents, B.P = mean value of better parent, S.V = standard check variety.

RESULTS AND DISCUSSION

The heterosis per cent was observed for different traits over mid parent, better parent and standard check were presented in Table 1-4. Significant heterobeltiosis for plot yield recorded for 10 hybrids viz., M55419-04 x MTU1010 (66.34), Mahulata x Ratna (41.24%), Mahulata x Dandi (22.69%), Mahulata x Sahbhagi (35.44%), Mahulata x Abhishek (52.69%), Mahulata x Annada (36.81%), M55419-04 x Swarna (26.91%), M55419-04 x Lalat (29.13%), M55419-04 x Sahbhagi (40.73%) and M55419-04 x Saket 4 (23.45%).An estimate of standard heterosis was positively significant for 13 hybrids for plot yield, which were superior to check variety Annada. High standard heterosis for plot yield was recorded in crosses M55419-04 x MTU1010 (67.65%), Mahulata x Ratna (55.61%), Mahulata x Dandi (35.17%), Mahulata x Swarna (27.7%),Mahulata x Sahbhagi (49.22%), Mahulata x Abhishek (68.23%), Mahulata x Satabdi (23.28%), Mahulata x Annada (50.73%), Mahulata x IR20 (22.97%), M55419-04 x Swarna (27.91%), M55419-04 x Lalat (30.15%), M55419-04 x Sahbhagi (41.83%), M55419-04 x Saket 4 (24.42%). Two hybrids (M55419-04 x Ratna and M55419-04 x Naveen) showed negative standard heterosis but the values were not significant. On an average, hybrid showed superiority over inbred line in yield and yield components (data not shown). Ten hybrids showed higher tillering capacity than check cultivar SahbhagiDhan, while estimates of heterobeltiosis were significant for 8 hybrids. The best heterotic hybrids for high tillering capacity were MahulataxSwarna (42.72%), Mahulata x Sahabhagi (33.4%), Mahulata x Satabdi(29.96%), Mahulata x IR20 (30%), M55419-04 x Annada (23.73%). Hetrotic crosses for dwarf plant habit were Mahulata x Lalat(-4.47%), Mahulata x Satabdi(-4.25%),Mahulata x Saket 4(-8.39%), M55419-04 x Ratna (-5.1%), M55419-04 x Lalat (-3.93%) and M55419-04 x Saket 4 (-2.92%).The hybrids, Mahulata x Ratna (13.47%),Mahulata x SahabhagiDhan, Mahulata x Swarna Sub 1 (11.09%), M55419-04 x Abhishek (12.06%), M55419-04 x Saket 4 (9.65%) mainfested high heterobeltiosis for increased panicle length.

There were twenty three positive significant heterobeltiosis and standard heterosis for spikeletsterility percentage. Non significant positive or negative heterosis for this trait was reported by Virmani *et al.* (1981). It appeared that increase in hybrid vigour in yield were due topositive significance of yield component traits as tiller number, panicle length, spikelet number and 1000-grain weight. Estimates of heterobeltiosis for harvest index were significant for 18 hybrids. Highly heterotic hybrids for the trait were Mahulata x Abhishek (86.29%), Mahulata x Sahbhagi (75.18%), Mahulata x Annada (67.38%), M55419-04 x Sahbhagi (80.24%), M55419-04 x Ratna (69.05%), M55419-04 x Vanaprava (65.71%), M55419-04 x IR36 (65.95%) and M55419-04 x MTU1010 (73.72%).The standard heterosis was

Table 1
Mid Parent Heterosis, Heterobeltiosis and Standard Heterosis for Days to 50% Flowering and Plant Height in 23 Crosses of Rice under Reproductive Stage Drought Stress

Sl.no.	*Crosses*	*Days to 50% flowering*				*Plant height*			
		MP	*BP*	*Annada*	*Sahbhagi*	*MP*	*BP*	*Annada*	*Sahbhagi*
1	Mahulata xRatna	-12.57**	-21.13**	-7.83**	0.0	4.49*	-1.94	16.47**	-8.04**
2	Mahulata x Dandi	-8.73**	-16.49**	-2.41	5.88	2.01	-3.02	-15.19**	6.85**
3	Mahulata x Swarna	-19.9**	-20.1**	-6.63*	1.31	1.2	-9.14**	7.91**	0.1
4	Mahulata x Sahbhagi	-12.39**	-21.65**	-8.43**	-0.65	6.73**	1.8	20.91**	12.15**
5	Mahulata x Lalat	-14.44**	-20.62**	-7.23*	0.65	-4.47*	-8.64**	8.5**	0.64
6	Mahulata x Abhishek	-15.24**	-21.13**	-7.83**	0.0	0.07	-6.48**	11.07**	3.03
7	Mahulata x Swarna sub 1	-10**	-11.86**	3.01	11.76**	11.96**	-6.44**	11.12**	3.08
8	Mahulata x Satabdi	-3.01	-17.01**	-3.01	5.23	-4.25*	-11.8**	4.76	-2.83
9	Mahulata x Annada	-15**	-21.13**	-7.83**	0.0	19.58**	10.13**	30.8**	21.33**
10	Mahulata x Saket 4	-14.21**	-20.62**	-7.23*	0.65	-8.39**	-11.3**	5.35*	-2.28
11	Mahulata x IR 20	-11.91**	-18.04**	-4.22	3.92	12.1**	-3.83	14.22**	5.95*
12	M55419-04 x Ratna	1.62	0.64	-5.42	2.61	-5.1*	-6.22*	0.05	-7.19**
13	M55419-04 x Swarna	-5.2*	-15.03**	-1.2	7.19*	14.94**	8.37**	-15.61**	7.24**
14	M55419-04 x Sahbhagi	2.61	2.61	-5.42	2.61	-0.87	-1.39	6.31*	-1.39
15	M55419-04 x Lalat	4.7	0.6	0.6	9.15**	-3.93	-4.69	3.32	-4.17
16	M55419-04 x Abhishek	-5	-8.98**	-8.43**	-0.65	0.08	-1.55	5.03	-2.58
17	M55419-04 x Annada	-4.7	-8.43**	-8.43**	-0.65	4.84*	1.55	8.34**	0.5
18	M55419-04 x Saket 4	-4.4	-7.88**	-8.43**	-0.65	-2.92	-4.9*	5.78*	-1.88
19	M55419-04 x Vanaprava	4.18	2.53	-2.41	5.88	2.53	-1.97	14.65**	-6.35*
20	M55419-04 x IR 64	3.45	-0.6	-0.6	7.84**	0.22	-2.91	10.48**	2.48
21	M55419-04 X Naveen	2.93	2.6	-4.82	3.27	7.6**	7.27**	15.13**	-6.8**
22	M55419-04 x IR 36	-3.75	-7.78**	-7.23*	0.65	-12.05**	-12.83**	-5.33*	-12.18**
23	M55419-04 x MTU1010	0.32	-3.66	-4.82	3.27	-0.97	-1.99	6.76*	-0.97
	SE	2.02	2.33	2.33	2.33	2.07	2.39	2.42	2.38

* Statistically significant at 5%; ** Significant at 1%.; MP= Mid parent heterosis; BP= Heterobeltiosis; Annada= Check variety 1; Sahabhagi= Check variety 2

Table 2
Mid Parent Heterosis, Heterobeltiosis and Standard Heterosis for Ear Bearing Tiller and Panicle Length in 23 Crosses of Rice under Reproductive Stage Drought Stress

Sl.no.	*Crosses*	*Ear bearing tiller*				*Panicle length*			
		MP	*BP*	*Annada*	*Sahbhagi*	*MP*	*BP*	*Annada*	*Sahbhagi*
1	Mahulata xRatna	28.25**	12.34	35**	50.15**	15.41**	13.47**	23.31**	23.03**
2	Mahulata x dandi	18.21	12.04	13.03	25.17	2.94	-0.41	11.87*	11.62*
3	Mahulata x swarna	45.91**	42.72**	28.95*	43.41**	0.48	0.37	5.41	5.17
4	Mahulata x sahbhagi	33.72**	33.4*	20.53	34.05*	13.68**	11.09*	16.67**	16.4**
5	Mahulata x lalat	13.05	-2.33	21.23	34.83*	-7.47*	-11.51**	1.83	1.59
6	Mahulata x abhishek	-6.89	-13.15	-9.34	0.83	-7.47*	-8.48*	-3.88	-4.1
7	Mahulata x swarna sub 1	3.13	-10.36	9.69	22	15.74**	11.09*	16.67**	16.4**
8	Mahulata x satabdi	35.68**	29.96**	28.25**	42.63**	18.64**	13.48**	19.18**	18.91**
9	Mahulata x annada	17.05	11.4	11.4	23.9	-0.22	-2.61	2.28	2.05
10	Mahulata x saket 4	8.9	8.11	-2.32	8.63	2.64	1.52	6.62	6.38
11	Mahulata x IR 20	30.95*	30**	17.46	30.63*	5.22	1.2	15.07**	14.81**
12	M55419-04 x Ratna	-8.35	-10.69	7.32	19.37	0.86	-1.26	7.31	7.06
13	M55419-04 x Swarna	36.89**	20.31	37.19**	52.59**	8.2*	7.84	13.01**	12.76**
14	M55419-04 x sahbhagi	-8.86	-18.5	-7.06	3.37	-7.93*	-9.65*	-5.94	-6.15
15	M55419-04 x lalat	-28.29**	-31.2**	-14.61	-5.02	-12.21**	-16.39**	-3.79	-4.01
16	M55419-04 x abhishek	-14.18	-17.81	-6.27	4.24	12.8**	12.06**	16.67**	16.4**
17	M55419-04 x Annada	31.84**	23.73*	41.1**	56.93**	-1.57	-3.51	0.47	0.23
18	M55419-04 x saket 4	-10.54	-20.35	-9.17	1.02	10.38**	9.65**	14.16**	13.9**
19	M55419-04 x vanaprava	-20.43*	-21.96*	-11.01	-1.02	-1.13	-6.96	9.82*	9.57*
20	M55419-04 x IR 64	-6.95	-21.27	-10.22	-0.15	-9.02*	-13.75**	0.23	0.0
21	M55419-04 x naveen	7.51	5.65	20.48	34.0*	-3.78	-7.66	4.57	4.33
22	M55419-04 x IR 36	-17.65	-23.19*	-12.41	-2.59	-5.32	-8.33	-4.57	-4.78
23	M55419-04 x MTU1010	5.71	1.85	16.14	29.17*	-0.45	-2.41	1.6	1.3731
	SE	1.22	1.41	1.45	1.4	0.84	0.96	0.9	0.89

* Statistically significant at 5%; ** Significant at 1%.; MP= Mid parent heterosis; BP= Heterobeltiosis; Annada= Check variety 1; Sahabhagi= Check variety 2

Table 3
Mid Parent Heterosis, Heterobeltiosis and Standard Heterosis for Total Dry Matter Production and Harvest Index in 23 Crosses of Rice under Reproductive Drought Stress

Sl.no.	*Crosses*	*Total dry matter production*				*Harvest index*			
		MP	*BP*	*Annada*	*Sahbhagi*	*MP*	*BP*	*Annada*	*Sahbhagi*
1	Mahulata xRatna	31.47**	6.4	34.67**	28.61**	81.41**	52.25**	125.17**	65.98**
2	Mahulata x dandi	77.96**	39.79**	76.94**	68.97**	65.95**	54.37**	128.32**	68.3**
3	Mahulata x swarna	28.93**	6.36	34.63**	28.56**	81.6**	44.68**	113.99**	57.73**
4	Mahulata x sahbhagi	31.59**	20.23**	52.19**	45.33**	82.74**	75.18**	159.09**	90.98**
5	Mahulata x lalat	58.35**	40.27**	77.55**	69.54**	103.05**	57.45**	132.87**	71.65**
6	Mahulata x abhishek	12.64*	-2.26	23.72**	18.14*	101.79**	86.29**	175.52**	103.09**
7	Mahulata x swarna sub 1	52.74**	26.51**	60.13**	52.92**	44.84**	11.11	64.34**	21.13
8	Mahulata x satabdi	0.37	-20.43**	0.72	-3.82	54.33**	32.62*	96.15**	44.59**
9	Mahulata x annada	61.02**	44.12**	82.42**	74.2**	99.72**	67.38**	147.55**	82.47**
10	Mahulata x saket 4	-5.49	-22.53**	-1.94	-6.36	23.83	9.93	62.59**	19.85
11	Mahulata x IR 20	66.19**	40.66**	78.04**	70.01**	75.44**	40.19**	107.34**	52.84**
12	M55419-04 x Ratna	57.77**	47.69**	32.58**	26.6**	100.85**	69.05**	148.25**	82.99**
13	M55419-04 x Swarna	69.28**	62.2**	45.6**	39.04**	89.87**	51.67**	122.73**	64.18**
14	M55419-04 x sahbhagi	20.8**	12.18	17.47*	12.18	87.38**	80.24**	164.69**	95.1**
15	M55419-04 x lalat	34.21**	28.78**	25.78**	20.11**	78.87**	39.05**	104.2**	50.52**
16	M55419-04 x abhishek	75.36**	72.23**	60.33**	53.11**	4.88	-2.86	42.66*	5.15
17	M55419-04 x Annada	56.44**	48.44**	48.44**	41.75**	36.83**	15.0	68.88**	24.48
18	M55419-04 x saket 4	71.33**	62.89**	46.22**	39.63 **	50.53**	34.05*	96.85**	45.1**
19	M55419-04 x vanaprava	143.94**	103.94**	82.92**	74.68**	72.92**	65.71**	143.36**	79.38**
20	M55419-04 x IR 64	78.7**	48.29**	33.12**	27.12**	77.35**	65.95**	143.71**	79.64**
21	M55419-04 x naveen	76.78**	68.9**	66.47**	58.96**	46.77**	35.24**	98.6**	46.39**
22	M55419-04 x IR 36	7.02	-3.16	-13.07	-16.99*	14.99	-5	39.51*	2.84
23	M55419-04 x MTU1010	99.45**	97.76**	80.57**	72.43**	75.76**	73.72**	161.19**	92.53**
	SE	**2.1**	**2.2**	**1.99**	**2.2**	**0.2**	**0.1**	**0.1**	**0.12**

* Statistically significant at 5%; ** Significant at 1%.; MP= Mid parent heterosis; BP= Heterobeltiosis; Annada= Check variety 1; Sahabhagi= Check variety 2

Table 4
Mid Parent Heterosis, Heterobeltiosis and Standard Heterosis for Sterility Per cent and Grain Yield per Plot Component Traits in 23 Crosses of Rice under Reproductive Drought Stress

Sl.no.	*Crosses*	*Sterility per cent*				*Grain yield / Plot*			
		MP	*BP*	*Annada*	*Sahbhagi*	*MP*	*BP*	*Annada*	*Sahbhagi*
1	Mahulata xRatna	-33.76**	-35.56**	-26.76**	-32.12**	88.39**	41.24**	55.61**	58.94**
2	Mahulata x dandi	-53.98**	-57.1**	-53.88**	-57.26**	65.3**	22.69*	35.17**	38.06**
3	Mahulata x swarna	-49.13**	-52.20**	-48.62**	-52.38**	77.03**	15.91	27.7*	30.43*
4	Mahulata x sahbhagi	-64.04**	-64.04**	-61.27**	-64.1**	43.42**	35.44**	49.22**	52.4**
5	Mahulata x lalat	-70.21**	-71**	-68.83**	-71.11**	46.01**	6.46	17.3	19.8
6	Mahulata x abhishek	-62.86**	-65.05**	-57.42**	-60.54**	94.72**	52.69**	68.23**	71.82**
7	Mahulata x swarna sub 1	-67.17**	-68.64**	-62.98**	-65.69**	58.05**	1.9	12.27	14.67
8	Mahulata x satabdi	-43.96**	-44.94**	-39.09**	-45.14**	58.22**	11.9	23.28*	25.92*
9	Mahulata x annada	-64.03**	-65.28**	-52.61**	-65.41**	43.43**	36.81**	50.73**	53.95
10	Mahulata x saket 4	-43.2**	-43.34**	-52.78**	-43.55**	42.52**	4.14	14.74	17.19
11	Mahulata x IR 20	-57.12**	-58.25**	-64.97**	-56.08**	76.25**	11.61	22.97*	25.59*
12	M55419-04 x Ratna	-46.88**	-58.46**	-57.72	-56.24**	14.74	-11.31	-10.61	-8.7
13	M55419-04 x Swarna	-55.83**	-62.93**	-64.97**	-67.53**	89.66**	26.91*	27.91*	30.64*
14	M55419-04 x sahbhagi	-50.85**	-60.82**	-57.72**	-60.82**	42.77**	40.73**	41.83**	44.86**
15	M55419-04 x lalat	-56.65**	-64.66**	-64.05**	-66.68**	72.06**	29.13*	30.15*	32.93**
16	M55419-04 x abhishek	-69.98**	-77.09**	-72.09**	-74.13**	49.08**	20.85	21.8	24.41*
17	M55419-04 x Annada	-49.09**	-58.22**	-58.22**	-61.28**	15.71	15.26	16.16	18.65
18	M55419-04 x saket 4	-49.95**	-59.97**	-57.19**	-60.32**	64.11**	23.45*	24.42*	27.08*
19	M55419-04 x vanaprava	-57.52**	-68.78**	-57.41**	-60.52**	65.99**	21.49	22.44	25.06*
20	M55419-04 x IR 64	-41.65**	-46.6**	-58.75**	-61.77**	34.55*	-0.98	-0.2	1.93
21	M55419-04 x naveen	-52.55**	-58.38**	-64.62**	-67.21**	18.6	-10.27	-9.56	-7.63
22	M55419-04 x IR 36	-41.88**	-57.79**	-40.16**	-44.54**	43.08**	5.05	5.87	8.14
23	M55419-04 x MTU1010	-53.08**	-56.92**	-66.96**	-66.96**	100.42**	66.34**	67.65**	71.23**
	SE	**3.1**	**3.24**	**3.2**	**3.1**	**7.78**	**7.96**	**6.99**	**7.45**

* Statistically significant at 5%; ** Significant at 1%.; MP= Mid parent heterosis; BP= Heterobeltiosis; Annada= Check variety 1; Sahabhagi= Check variety 2

significant for 23 hybrids in comparison to standard variety Annada and 18 crosses over check cultivar Sahbhagi Dhan. Positive significant heterobeltiosis for total dry matter per plant was observed for 16 hybrids.

In some crosses, the heteroticeffect in yield was along with hybrid vigour for panicle number, total dry matter, harvest index and panicle length thus, it is obvious that hybrid vigour for yield is the result of interaction of simultaneous increase in the expression of yield components. Among the yield components, the highest heterotic effect was observed for panicle number followed by spikelet number and panicle length and similar result was observed by Mandal (1982). The major yield components in rice are numberof panicles, spikelet number, spikelet fertility percentage and 1000-grain weight (Virmani and Edwards, 1983). There are many reports showing evidence of significant positive high parent heterosis and standard heterosis for yield and yield components. Although, the hybrids had fewer effective panicles per square meter, they had significantly more filled grains per panicles and larger seeds (Virmani *et al*., 1981). Significant, positive midparent, high parent and standard heterosis were observed for one or more of yield components in a number of crosses (Peng and Virmani, 1994).

Results obtained in China and at IRRI indicate that, heterotic F1 combinations usually show an increased sink size through an increase in spikelet per panicle, spikelet fertility percentage and 1000-grain weight (Virmani and Edwards, 1983). According to Swaminathan *et al*. (1972) heterobeltiosis of more than 20% over better parent could offset the cost of hybrid seed. Thus, the crosses showing positive significant in mid parent, heterobeltiosis and standard heterosis *viz*., Mahulata x Ratna, Mahulata x Dandi, Mahulata x Swarna, Mahulata x Sahbhagi, Mahulata x Abhishek, Mahulata x Annada, Mahulata x IR 20, M55419-04 x Sahbhagi, M55419-04 x MTU 1010 may be exploited for hybrid rice production. Maximum variation was observed in heterobeltiosis and standard heterosis for yield among hybrids followed by grain number. The results indicated that possibility of obtaining more heterotic hybrids only in specific cross combinations. Therefore, with appropriate choice of parental lines it appears possible to develop F_1 rice hybrid possessing distinct yield superiority over the best-inbred lines. Yield components should be considered to increase the yield through selections.Many researchers also reported the heterosis for yield and yield related traits under both normal and stress condition (Melchinger *et al.,* 2007; Li *et al.,* 2008 and Muthuramu *et al.,* 2010).

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