Journal of Pharmacognosy and Phytochemistry

Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
JPP 2018; 7(2): 3191-3195
Received: 07-01-2018
Accepted: 08-02-2018

Ashok Jaiswal
Deparment of Genetics and Plant Breeding, N.A.U., Navsari Gujarat, India

PB Patel
Soil and Water Management Research Unit, N.A.U., Navsari, Gujarat, India

Correspondence
Ashok Jaiswal
Deparment of Genetics and Plant Breeding, N.A.U., Navsari Gujarat, India

Study of heterosis in rice (*Oryza sativa)* in relation to yield and its contributing characters under coastal salt affected soil

Ashok Jaiswal and PB Patel

Abstract
Analysis of variance indicated significant differences among the parents and hybrids for all the characters stud ied, which revealed existence of variability in the genotypes. Based on mean performance, Gurjari, GNR-3 and IET-15429 among females and GNR-2, IR-55179 and GAR-1 among males were found superior for grain yield and most of the yield attributing traits. Among hybrids, Gurjari x GAR -1, Gurjari x IET- 19347 and IET-21734 x Jaya exhibited highest mean performance for grain yield and the major yield components. In general, the parents showing superior performance gave superior hybrids and higher magnitude of heterosis in hybrid combination. Among 40 hybrids, the maximum value of heterobeltiosis for grain yield per plant was observed in cross IET-21734 x Jaya, Gurjari x GAR-1 and IET-21734 x IET-19347. On the other hand 14 hybrids exhibited significant positive standard heterosis over Dandi, while only 6 hybrids depicted significant positive standard heterosis over CST - 7-1. The highly heterotic response in these hybrids for grain yield per plant resulted due to significant positive heterosis for yield contributin g characters like panicle lengt h and number of grains per panicle.

Keywords: quantitative, heterobeltiosis, usful heterosis

Introduction
India is the largest rice growing country in the world, but its productivity per unit area by world standard is low. While in case of Gujarat, it occupies about 5% of the gross cropped area and it is grown on about 6.5 to 7.3 lakh hectares which comprises nearly 55 to 60 % of lowland and 40 to 45 % of upland situation. About 45% of the area under rice is confined to Sout h Gujarat (Anon., 2008) [1]. The salinity and sodicity are the important factors adversely affecting the soil health and crop production. It is estimated that half of the world farmers have been damaged by salt. It has been estimated that about one billion hec tare of the world land is affected by salt 60% of which is cultivated. The total salt affected area in india approximately 8.1 m ha, out of which 32 m ha coastal saline (Anon., 2009) [2]. Total salt affected area in Gujarat is 1.2 lakh ha, in south Gujarat alon e around 70,000 ha area is salt affected.

Materials and Methods
The experimental material for the present investigation consists of 14 parents (4 females and 10 males), their 40 crosses and 2 varieties *viz*., Dandi and CST-7-1 as standard checks. The seeds of these parents were obtained from Coastal Soil Salinity Research Station, Danti - Umbharat and Main Rice Research Centre, N.A.U., Navsari. Three complete sets of 56 entries comprising of 40 F_1's, 4 females, 10 males and 2 checks were evaluated during *kharif* 2012. The experiment was laid out in a randomized block design replicated three times at research station of the university *viz*., Coastal Soil Salinity Research Station, Danti - Umbharat. The parents and F_1's were represented by a single row plot of 10 plants placed at 20 cm x 15 cm spacing.

Results and Discussion
The results and discussion of fifteen quantitative traits are grouped into plant morphological traits, yield and yield attributing traits and salt tolerance traits. Mean performance, heterobeltiosis and standard check for fifteen characters is presented in Table: 2 The results indicated that the phenomenon of heterosis was of a general occurrence for almost all the characters, under study. However, the magnitude of heterosis varied with characters

Table 1: Analysis of variance (mean sum of square) for experimental design for different characters in rice

Source	D.f.	Plant height (cm)	Days to 50% flowering	Panicle length (cm)	Grain yield per plant (g)	Amylose content (%)	Protein content (%)	K^+/Na^+ ratio of shoot	K^+/Na^+ ratio of root
Replication	2	10.27	44.71	2.22	9.39	0.12	0.32	0.02	0.00009
Genotypes	53	248.52*	224.83**	19.60**	128.78**	13.20**	6.61**	8.51**	0.05**
Parents	13	211.89	509.90**	15.00**	24.17**	15.02**	5.69**	10.69**	0.02**
Females	3	224.55	83.61**	15.25*	19.26*	22.94**	2.91**	8.86**	0.03**
Males	9	230.96	524.41**	15.94**	28.49**	12.36**	7.12**	11.00**	0.02**
Females *vs* Males	1	2.31	1658.23**	5.78	0.004	15.23**	1.14**	13.36**	0.01**
Hybrids	39	260.10*	124.38**	21.40**	156.29**	12.56**	7.05**	5.26**	0.06**
Parents *vs* Hybrids	1	272.93	436.76**	9.21	415.76**	14.39**	1.33**	106.81**	0.19**
Error	106	152.76	17.97	4.94	5.47	1.08	0.11	0.02	0.0002

Plant morphological traits

Plant height is an important morphological character. The data that significant heterosis was observed in both the directions, *i.e.*, positive as well as negative for this trait. The heterobeltiosis varied from -16.30 per cent (GNR-3 x IET-22608) to 32.75 per cent (Gurjari x AT-401). Out of 40 hybrids tested, 1 hybrid over CST-7-1 registered significant standard heterosis in desirable direction the results for plant height indicate that none crosses highlighted significant negative heterosis in desired direction over better parent as dwarfness is desirable for this trait. GNR -3 x IET- 22608 showed highest heterobeltiosis in negative direction. This results reported by Sahai and Chaudhary (1991) [17], Lokaprakash *et al.* (1992) [9], Banumathy *et al.* (2003) [4], Yadav *et al.* (2004) [21], Parihar and Pathak (2008) [13], Venkatesan *et al*. (2008) [20] and Roy *et al.* (2009) [16].

With regards to days to 50 percent flowering, none hybrid showed highly significant negative heterobeltiosis in desired direction for earliness. Negative heterosis indicated earliness compared to better parent. The hybrid, Gurjari x IET-19347 was manifested numerically higher negative heterosis over better parent. The result is akin to the finding of Bhandarker *et al.* (2005) [5], Eradasappa *et al.* (2007) [6] and Venkatesan *et al.* (2008) [20].

Yield and yield attributing characters

For panicle length, five cross expressed significant positive heterosis over better parent. The hybrid, IET-15429 x GNR-2 was exhibited highest heterobeltiosis for this character. The present findings were in close association with the results reported by Pandya and Tripathi (2006) [12], Eradasappa *et al*. (2007) [6], Singh *et al*. (2007) [19] and Roy *et al.* (2009) [16].

With respect to grains per panicle, 23 crosses showed significant positive heterosis over better parent. Gurjari x IR-55179 was top ranking cross showing highly significant positive heterobeltiosis. The results were in agreement with the findings of Pandya and Tripathi (2006) [12], Parihar and Pathak (2008) [13] and Saleem *et al.* (2008) [18].

Eleven crosses depicted signif icant positive heterobeltiosis for grain yield per plant. The best performing cross for this trait was IET - 21734 x Jaya. Significant positive heterosis for grain yield has reported by Bhandarker *et al*. (2005) [5] Eradasappa *et al.* (2007) [6], Parihar and Pathak (2008) [13], Venkatesan *et al.* (2008) [20] and Roy *et al.* (2009) [16].

Salt tolerance traits

In a study of K^+/Na^+ ratio in shoot, 5 crosses gave significant positive results for heterobeltiosis. The cross showing highest percentage of heterosis over better parent was Gurjari x IET-22608. Mahmood *et al*. (2002) [10], Zhu (2007) [22] and Munns and Tester (2008) [11] also reported simi lar results in rice.

For K^+/Na^+ ratio in root, 16 crosses expressed significant positive heterosis over better parent. The hybrid, Gurjari x IET-22608 exhibited highest heterobeltiosis for this character. The present findings were in close association with the results reported by Mahmood *et al*. (2002) [10], Zhu (2007) [22] and pajuabmon *et al.* (2009) [14]

Table 2.1: Estimation of heterobeltiosis and standard heterosis for plant height, days to 50 % flowering and panicle Length in rice.

Crosses	Plant height (cm)			Days to 50 % flowering			Panicle length (cm)		
	BP	SC 1	SC 2	BP	SC 1	SC 2	BP	SC 1	SC 2
GNR-3 X IET-22608	-16.30	-15.22	-22.24*	9.68*	-0.79	-15.10**	-9.37	-9.38	-3.41
GNR-3 X AT-401	0.53	-1.15	-9.33	20.31**	8.82*	-6.87*	-2.28	-2.30	4.13
GNR-3 X GNR-2	-4.93	-3.69	-11.67	15.61**	4.57	-10.51**	-13.23	-13.24	-7.53
GNR-3 X JAYA	-3.98	-2.73	-10.78	9.80*	-0.69	-15.01**	4.25	4.24	11.10
GNR-3 X IET-19347	7.39	7.80	-1.13	7.55	-2.72	-16.75**	-20.13**	-17.47*	-12.03
GNR-3 X SPRV-1	0.24	1.53	-6.87	14.67**	3.72	-11.23**	-15.29	-15.30	-9.72
GNR-3 X GAR-1	0.18	1.48	-6.92	17.75**	6.50	-8.85**	-11.78	-7.34	-1.24
GNR-3 X IR-71895	5.74	7.11	-1.76	25.55**	13.56**	-2.82	-0.82	-0.83	5.70
GNR-3 X IR-71907	-0.69	0.60	-7.73	19.83**	8.39*	-7.24*	-7.90	-5.93	0.26
GNR-3 X IR-55179	8.55	9.96	0.86	4.14	-5.80	-19.39**	0.27	0.26	6.86
IET-15429 X IET-22608	9.87	12.68	3.35	0.59	1.16	-13.42**	8.92	3.61	10.43
IET-15429 X AT-401	8.97	7.14	-1.73	11.51**	15.05**	-1.54	14.86	9.25	16.44
IET-15429 X GNR-2	-0.54	11.86	2.60	1.61	4.84	-10.28**	29.86**	23.48**	31.65**
IET-15429 X JAYA	2.80	9.23	0.18	2.59	5.85	-9.41**	24.55**	18.47*	26.27**
IET-15429 X IET-19347	2.10	2.48	-6.00	2.43	3.09	-11.77**	9.66	13.32	20.77*
IET-15429 X SPRV-1	11.17	13.20	3.83	-0.36	1.76	-12.92**	2.01	-2.97	3.41
IET-15429 X GAR-1	-2.32	9.33	0.28	1.55	4.78	-10.33**	10.83	16.40*	24.07**
IET-15429 X IR-71895	-3.40	8.64	-0.35	9.89**	13.38**	-2.97	-10.71	-11.35	-5.51
IET-15429 X IR-71907	-12.33	-1.40	-9.57	6.62	10.01**	-5.85	-21.92	-20.25*	-15.00
IET-15429 X IR-55179	18.98*	33.82**	22.74*	-0.35	-2.06	-16.18**	-20.20	-23.64**	-18.62

Contd... Table 2.1

Crosses	Plant height (cm)			Days to 50 % flowering			Panicle length (cm)		
	BP	SC 1	SC 2	BP	SC 1	SC 2	BP	SC 1	SC 2
GURJARI X IET-22608	-2.66	-0.21	-8.47	-2.16	-2.19	-16.29**	7.80	-2.59	3.83
GURJARI X AT-401	32.75**	30.52**	19.72*	4.74	4.72	-10.38**	2.94	-3.05	3.34
GURJARI X GNR-2	18.23	21.20*	11.17	0.22	0.19	-14.26**	3.07	-12.18	-6.40
GURJARI X JAYA	6.19	8.86	-0.15	-0.60	-0.62	-14.95**	-15.83	-22.72**	-17.64*
GURJARI X IET-19347	11.15	11.56	2.33	-3.27	-3.30	-17.24**	13.79	17.58*	25.32**
GURJARI X SPRV-1	-3.41	-1.64	-9.79	5.60	5.57	-9.65**	20.65*	2.80	9.57
GURJARI X GAR-1	8.63	11.36	2.14	4.45	4.42	-10.63**	17.48*	23.35**	31.51**
GURJARI X IR-71895	11.24	14.04	4.60	7.70	7.67*	-7.86*	5.58	4.83	11.73
GURJARI X IR-71907	0.93	3.47	-5.10	8.14*	8.12*	-7.47*	-18.01*	-16.26*	-10.75
GURJARI X IR-55179	5.96	8.63	-0.37	1.44	-0.30	-14.67**	6.00	1.44	8.11
IET-21734 X IET-22608	3.95	6.61	-2.21	-2.33	-2.25	-16.35**	0.12	8.60	15.75
IET-21734 X AT-401	1.82	0.11	-8.18	19.23**	19.31**	2.11	-21.74**	-15.11	-9.52
IET-21734 X GNR-2	13.81	2.20	-6.26	5.00	5.08	-10.08**	-6.34	1.59	8.28
IET-21734 X JAYA	3.54	10.02	0.91	3.46	3.54	-11.39**	18.20*	28.18**	36.66**
IET-21734 X IET-19347	7.66	8.07	-0.88	2.99	-2.92	-16.92**	7.99	17.10*	24.85**
IET-21734 X SPRV-1	-3.94	-2.19	-10.29	2.48	2.55	-12.24**	-1.46	6.89	13.93
IET-21734 X GAR-1	-12.59	-2.16	-10.26	13.54**	13.62**	-2.76	-5.43	2.59	9.34
IET-21734 X IR-71895	-14.38	1.18	-7.20	24.74**	24.84**	6.83*	-8.74	-1.01	5.51
IET-21734 X IR-71907	-11.22	2.74	-5.76	14.67**	14.76**	-1.79	-18.15*	-11.22	-5.37
IET-21734 X IR-55179	-10.67	2.59	-5.90	1.00	-0.74	-15.05	-4.24	3.88	10.72
S Em. ±	8.74	10.09	10.09	3.00	3.46	3.46	1.57	1.81	1.81
C.D. at 5 %	17.40	20.09	20.09	5.97	6.89	6.89	3.13	3.61	3.61

Table 2.2: Estimation of heterobeltiosis and standard heterosis Grains per panicle, Grain yield per plant (g) and Amylose content (%).

Crosses	Grains per panicle			Grain yield per plant (g)			Amylose content (%)		
	BP	SC 1	SC 2	BP	SC 1	SC 2	BP	SC 1	SC 2
GNR-3 X IET-22608	38.78**	0.13	-15.85**	39.34**	47.50**	6.74	-13.70**	26.30**	-2.50
GNR-3 X AT-401	36.19**	-1.75	-17.43**	-23.32**	-18.83*	-41.26**	23.92**	25.76**	-2.91
GNR-3 X GNR-2	0.81	-15.65**	-29.11**	-19.25*	1.29	-26.69**	-18.37**	26.75**	-2.16
GNR-3 X JAYA	8.09	-0.51	-16.39**	-18.71*	-13.95	-37.72**	-0.89	23.85**	-4.39
GNR-3 X IET-19347	22.13**	-4.58	-19.81**	-33.04**	-29.12**	-48.71**	5.08	36.51**	5.38
GNR-3 X SPRV-1	-61.26**	-45.16**	-53.91**	-18.81*	-14.06	-37.81**	36.64**	80.09**	39.02**
GNR-3 X GAR-1	-8.54	-34.02**	-44.55**	-14.02	-8.66	-33.90**	-4.91	47.83**	14.12**
GNR-3 X IR-71895	50.38**	8.49	-8.82	-17.44*	-12.60	-36.75**	-3.98	39.03**	7.33
GNR-3 X IR-71907	106.20**	48.77**	25.03**	34.24**	42.10**	2.83	-1.02	38.77**	7.12
GNR-3 X IR-55179	86.30**	34.41**	12.96**	-3.81	18.44	-14.28	18.24**	53.39**	18.41**
IET-15429 X IET-22608	52.93**	38.56**	16.45**	3.02	-2.93	-29.75**	-28.42**	4.76	-19.13**
IET-15429 X AT-401	41.32**	28.03**	7.60	-3.61	-9.17	-34.27**	30.65**	32.60**	2.36
IET-15429 X GNR-2	20.00**	8.73	-8.63	28.58**	61.30**	16.73*	-15.80**	30.74**	0.92
IET-15429 X JAYA	-31.53**	-36.98**	-47.04**	-6.27	-11.68	-36.08**	9.33	53.84**	18.76**
IET-15429 X IET-19347	9.87	-0.45	-16.34**	15.28	8.62	-21.39**	7.71	51.56**	17.00**
IET-15429 X SPRV-1	-51.67**	-31.58**	-42.50**	-10.36	-8.06	-33.46**	5.20	48.02**	14.27**
IET-15429 X GAR-1	86.77**	69.22**	42.21**	3.79	10.27	-20.20**	-16.62**	29.62**	0.06
IET-15429 X IR-71895	-58.66**	62.54**	-68.52**	13.15	6.62	-22.84**	-13.06**	25.90**	-2.81
IET-15429 X IR-71907	-26.45**	-33.36**	-43.99**	12.50	6.00	-23.29**	-13.79**	21.30**	-6.36
IET-15429 X IR-55179	13..58	2.91	-13.52**	-30.92**	-14.93	-38.44**	-35.92**	-9.84	-30.40**

Contd… Table 2.2

Crosses	Grains per panicle			Grain yield per plant (g)			Amylose content (%)		
	BP	SC 1	SC 2	BP	SC 1	SC 2	BP	SC 1	SC 2
GURJARI X IET-22608	35.62	2.47	-13.88**	-5.78	5.47	-23.67**	-21.09**	15.47*	-10.86*
GURJARI X AT-401	87.85**	41.94**	19.29**	7.49	20.32*	-12.93	-19.82**	14.68*	-11.47*
GURJARI X GNR-2	-6.44	-21.72**	-34.21**	-17.49*	3.51	-25.09**	-9.06**	41.21**	9.01
GURJARI X JAYA	41.55**	30.29**	9.50	1.06	13.12	-18.14**	7.45	53.68**	18.64**
GURJARI X IET-19347	129.94**	79.65**	50.98**	78.23**	99.51**	44.39**	-23.67**	9.17	-15.72**
GURJARI X SPRV-1	-29.76**	-0.56	-16.43**	23.25**	37.97**	-0.15	-7.47	32.33**	2.16
GURJARI X GAR-1	79.22**	35.42**	13.81**	95.74**	119.11**	58.56**	-9.56*	40.60**	8.54
GURJARI X IR-71895	76.34**	33.24**	11.98*	38.79**	55.36**	12.43	-5.14	37.36**	6.03
GURJARI X IR-71907	98.75**	50.18**	26.21**	14.89	28.60**	-6.93	-14.04**	22.95**	-5.09
GURJARI X IR-55179	138.18**	79.97**	51.25**	-3.22	19.17*	-13.76*	-22.46**	10.90	-14.39**
IET-21734 X IET-22608	68.09**	18.84**	-0.12	4.21	-4.76	-31.07**	-23.89**	35.12**	4.31
IET-21734 X AT-401	-3.11	31.02**	-42.03**	4.47	-5.55	-31.65**	-14.75**	51.34**	16.83**
IET-21734 X GNR-2	67.43**	40.08**	17.73**	39.70**	75.25**	26.82**	-26.04**	31.29**	1.35
IET-21734 X JAYA	-6.94	-14.34*	-28.01**	98.73**	84.81**	33.74**	-26.48**	30.52**	0.76

IET-21734 X IET-19347	75.46**	37.08**	15.20**	93.19**	62.84**	17.84**	-23.54**	35.74**	4.78
IET-21734 X SPRV-1	-44.54**	-21.49**	-34.02**	-19.09*	-17.00	-39.94**	-22.47**	37.65**	6.26
IET-21734 X GAR-1	27.67**	-9.74	-24.14**	8.89	15.69	-16.27*	-30.61**	23.19**	4.91
IET-21734 X IR-71895	16.93*	-17.33**	-30.52**	3.20	-11.23	-35.76**	-16.14**	48.87**	14.92**
IET-21734 X IR-71907	36.63**	-3.40	-18.81**	35.98**	23.64*	-10.53	-15.20**	50.55**	16.22**
IET-21734 X IR-55179	10.62	-21.79**	-34.27**	-25.34**	-8.07	-33.47**	-23.92**	35.07**	4.27
S Em. ±	6.19	7.15	7.15	1.65	1.91	1.91	0.74	0.85	0.85
C.D. at 5 %	12.32	14.23	14.23	3.29	3.80	3.80	1.47	1.69	1.69

Table 2.3: Estimation of heterobeltiosis and standard heterosis for protein content (%), K^+/Na^+ ratio in shoot and K^+/Na^+ ratio in root in rice.

Crosses	Protein content (%)			K^+/Na^+ ratio in shoot			K^+/Na^+ ratio in root		
	BP	SC 1	SC 2	BP	SC 1	SC 2	BP	SC 1	SC 2
GNR-3 X IET-22608	5.26	-27.84**	67.62**	-59.21**	-53.61**	-54.47**	-34.26**	-22.83**	-51.03**
GNR-3 X AT-401	33.83**	-4.66	121.45**	-56.26**	-46.63**	-47.62**	-64.81**	-58.70**	-73.79**
GNR-3 X GNR-2	-45.99**	-62.05**	-11.85	-68.18**	-31.95**	-33.22**	-12.04**	3.26	-34.48**
GNR-3 X JAYA	17.13**	-19.05**	86.52**	-63.65**	-36.69**	-37.86**	-11.11**	4.35	-33.79**
GNR-3 X IET-19347	5.20	-27.88**	67.52**	-49.51**	-20.83**	-22.30**	-32.41**	20.65**	-49.66**
GNR-3 X SPRV-1	24.70**	-14.51**	98.57**	-67.84**	-46.04**	-47.04**	-40.74**	-30.43**	-55.86**
GNR-3 X GAR-1	-49.23**	-56.51**	1.02	-67.30**	-10.30*	-11.96**	-27.78**	-15.22**	-46.21**
GNR-3 X IR-71895	8.27	-25.77**	72.42**	-65.03**	-1.30	-3.14	-13.89**	1.09	-35.86**
GNR-3 X IR-71907	-34.90**	-36.19**	48.21**	-70.40**	-15.03**	16.61**	15.74**	35.87**	-13.79**
GNR-3 X IR-55179	36.25**	-2.15	127.27**	-23.03**	-0.71	-2.56	-40.00**	-11.96**	-44.14**
IET-15429 X IET-22608	53.01**	-11.79**	104.90**	-44.76**	11.60**	9.52*	-7.14*	-1.09	-37.24**
IET-15429 X AT-401	2.04	-27.31**	68.85**	53.60**	-6.27	-8.01	-35.71**	-31.52**	-56.55**
IET-15429 X GNR-2	25.28**	-11.96**	104.49**	-30.38**	48.88**	46.11**	-30.61**	-26.09**	-53.10**
IET-15429 X JAYA	-22.16**	-55.06**	4.39	-47.80**	5.44	3.48	-1.02	5.43	-33.10**
IET-15429 X IET-19347	23.72**	-28.67**	65.68**	-29.47**	42.49**	39.84**	-17.35**	-11.96**	-44.14**
IET-15429 X SPRV-1	-23.94**	-54.05**	6.74	-9.26**	83.31**	79.91**	35.71**	44.57**	-8.28
IET-15429 X GAR-1	-57.96**	-63.98**	-16.34	-59.36**	11.48*	9.41*	19.39**	27.17**	-19.31**
IET-15429 X IR-71895	1.07	-41.73**	35.34**	-42.94**	61.07**	58.07**	56.12**	66.30**	5.52*
IET-15429 X IR-71907	-28.80**	-30.21**	62.10**	-26.79**	110.18**	106.27**	22.45**	30.43**	-17.24**
IET-15429 X IR-55179	73.85**	24.85**	189.99**	-48.80**	3.43	1.51	13.33**	66.30**	5.52*

Contd… Table 2.3

Crosses	Protein content (%)			K^+/Na^+ ratio in shoot			K^+/Na^+ ratio in root		
	BP	SC 1	SC 2	BP	SC 1	SC 2	BP	SC 1	SC 2
GURJARI X IET-22608	-31.63**	-40.68**	37.79**	61.81**	84.02**	80.60**	314.55**	47.83**	57.24**
GURJARI X AT-401	-31.27**	-40.37**	38.51**	-23.08**	-6.15	-7.90	2.13	4.35	-33.79**
GURJARI X GNR-2	-36.34**	-44.77**	28.29**	13.84**	143.43**	138.91**	206.15**	116.30**	37.24**
GURJARI X JAYA	-56.01**	-61.83**	-11.34	-8.90	58.70**	55.75**	4.30	5.43	-33.10**
GURJARI X IET-19347	-22.05**	-32.37**	57.10**	9.21**	71.24**	68.06**	43.40**	-17.39**	-47.59**
GURJARI X SPRV-1	-35.02**	-43.62**	30.95**	-42.60**	-3.67	-5.46	2.63	-15.22**	-46.21**
GURJARI X GAR-1	-47.69**	-54.62**	5.41	-56.47**	19.41**	17.19**	166.20**	105.43**	30.34**
GURJARI X IR-71895	-49.82**	-56.46**	1.12	-64.03**	1.54	-0.35	17.19**	-18.48**	-48.28**
GURJARI X IR-71907	-40.87**	-42.04**	34.63**	-71.68**	-18.70**	-20.21**	49.25**	8.70*	-31.03**
GURJARI X IR-55179	-61.33**	-66.45**	-22.06**	-27.16**	-6.04	-7.78	-25.19**	9.78*	-30.34**
IET-21734 X IET-22608	13.17*	-30.83**	60.67**	-34.43**	30.06**	27.64**	44.33**	52.17**	-3.45
IET-21734 X AT-401	-35.93**	-54.35**	6.03	-51.25**	-3.31	-5.11	-51.55**	-48.91**	-67.59**
IET-21734 X GNR-2	-31.54**	-51.89**	11.75	-66.08**	-27.46**	-28.80**	32.99**	40.22**	-11.03**
IET-21734 X JAYA	-41.58**	-64.29**	-17.06*	-63.72**	-28.05**	-29.38**	70.10**	79.35**	13.79**
IET-21734 X IET-19347	-21.15**	-51.80**	11.95	10.98**	120.12**	116.03**	-1.03	4.35	-33.79**
IET-21734 X SPRV-1	26.69**	-22.53**	79.88**	-42.54**	13.96**	11.85**	29.90**	36.96**	-13.10**
IET-21734 X GAR-1	-35.01**	-44.33**	29.32**	-53.32**	28.05**	25.67**	-22.68**	-18.48**	-48.28**
IET-21734 X IR-71895	13.31*	-30.74**	60.88**	-76.56**	-33.85**	-35.08**	-22.68**	-18.48**	-48.28**
IET-21734 X IR-71907	-63.03**	-63.76**	-15.83	-66.90**	-4.97	-6.74	-29.90**	-26.09**	-53.10**
IET-21734 X IR-55179	-3.00	-30.34**	61.80**	-49.82**	-0.47	-2.32	-24.44**	10.87**	-29.66**
S Em. ±	0.24	0.27	0.27	0.11	0.12	0.12	0.01	0.01	0.01
C.D. at 5 %	0.47	0.54	0.54	0.21	0.25	0.25	0.02	0.02	0.02

*, ** significant at 5% and 1% levels of probability, respectively. BP = Better parent, SC1 = check1 (Dandi), SC2 = check2(CST-7-1)

Summary

On the basis of per performance, heterobeltiosis, standard heterosis over Dandi a nd CST-7-1, hybrids *viz.*, Gurjari x GAR-1, Gurjari x IET-19347, IET-21734 x Jaya and IET-21734 x GNR-2 were found to be the most promising for grain yield, its component traits and salt tolerance should be tested in multilocation trials and relea sed for commercial cultivation. Higher K^+/Na^+ ratio in shoot and root were found in salt tolerance genotypes. In salt tolerance genotypes revealed that these biochemical traits can be utilized as marker character in salt tolerance breeding programme in rice.

References

1. Anonymous. Annual Progress Report (Rice). AICRP on RICE, Main Rice Research Station, Nawagam, AAU, Anand, 2008.

2. Anonymous. Annual Progress Report (Rice). AICRP on Rice, Directorate of Rice Research, Hyderabad, 2009.
3. Anonymous. Annual Report. Directorate of Rice Research, Hyderabad Meredith, W. R. and R. R. Bridge 1972. Crop Sci. 2010; 12:304-310.
4. Banumathy S, Thiyagarajan K, Vaidyanathan P. Crop Res., 2003; 25(2):287-293.
5. Bhandarkar S, Rastogi NK, Arvind K. Oryza, 2005; 42(3):218-119.
6. Eradasappa E, Ganapathy KN, Satish RG, Santhala J, Nandarajan N. *Crop Res*., 2007; 34(1-3):152-155.
7. Janardhanam V, Nandrajan N, Jebaraj S. Madras Agri. J. 2004; 88(10-12):721-723.
8. Joshi B, Singh H, Pandey MP. Oryza. 2004; 41(2, 4):64-65.
9. Lokaprakash R, Shivashankar G, Mahadevappa M, Shankaregowda BT, Kulkarni RS. *Oryza,* 1992; 29:293-297.
10. Mahmood G, Sabbir G, Safraz M, Sadiq M, Bhatti MK, Mehdi M, *et al*. Asian J. Plant Sci., 2002; 2:88-90.
11. Munns R, Tester M. Annual Review of Plant Biology, 2008; 59:651-681.
12. Pandya R, Tripathi RS. Oryza, 2006; 43(2):87-93.
13. Parihar A, Pathak AR. Indian J Crop Sci., 2008; 3(1):169-171.
14. Prajuabmom A, Theerakulpisut P, Kijwijan B, Muangasan N. Res. J Agric. And Biological Sci., 2009; 5(4):423-427.
15. Punitha D, Joel AJ, Manonmani S, Thiyagarajan K. Advances in Plant Sciences. 2004; 17(1):345-348.
16. Roy SK, Senapati BK, Sinhamahapatra SP, Sarkar KK. Oryza, 2009; 46(2):87-93.
17. Sahai VN, Chaudhary RC. Oryza, 1991; 28:27-30.
18. Saleem MY, Mirza JI, Haq MA. J Agric. Res. 2008; 46(1):15-26.
19. Singh NK, Singh AK, Sharma CL, Singh PK, Singh ON. Oryza, 2007; 44(3):260-263.
20. Venkatesan M, Anbuselvam Y, Murugan S, Palaniraja K. Oryza, 2008; 45(1):76-78.
21. Yadav LS, Maurya DM, Giri SP, Singh SB. Oryza, 2004; 41(1, 2):1- 3.
22. Zhu JK. Plant Salt Stress: John Wiley & Sons, Ltd, 2007.