EXPLOITATION OF HETEROSIS FOR VARIOUS QUANTITATIVE CHARACTERS IN RICE (*ORYZA SATIVA* L.) UNDER SALINE SOIL CONDITIONS

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Abstract: The heterotic trends in rice among 28 F_1 hybrids under saline and normal soil conditions revealed that there was severe reduction in number of heterotic hybrids and the range of heterosis of all types under stressed environment than that observed under favorable soil environment. Further, the hybrid Swarna x CSRC(S) 7-1-4 manifested significant heterotic expression over mid and better-parents for number of filled grains panicle^{-1} and grain yield plant^{-1} besides showing high specific combining ability and mean performance for these traits. Similarly, the hybrid RPBio-226 x CSR-30 was also found to be heterotic over mid and better-parents for number of total tillers plant^{-1}, number of productive tillers plant^{-1}, panicle length, panicle weight and test weight along with desirable per se and combining abilities. These promising rice hybrids identified from the present study could be utilized further for commercial exploitation under saline soil conditions.

Key words: *Rice- salinity-Heterosis*

Introduction: Rice (*Oryza sativa L.*) is the most important food crop in the world, which accounts for more than 21% of the calorific needs of the world's population and up to 76% of the calorific intake of the population of South East Asia (5 and 8). Nearly 20 per cent of the world`s cultivated area (800 M ha) and nearly half of the world's irrigated lands are affected by salinity (15 and 6). The exploitation of hybrid vigour is an appropriate alternative for making further breakthrough in rice yield under these stressed conditions. Several researchers reported the occurrence of heterosis of various yield and yield components in rice. However, reports on heterosis in rice under salinity are limited. Hence, to draw valid conclusions regarding the extent of heterosis for various characters under saline as well as normal soil conditions the present study was under taken.

Materials and Methods: A diallel set of 28 hybrids along with eight parents were sown during *kharif*, 2010 under both normal and coastal saline soils of Agricultural Research Station, Machilipatnam. The saline soils were of sandy loam in texture with an average electrical conductivity of 6.3 dS m^{-1} and pH of 7.9 while the normal soil had an E.C of 2.3 dS/m and pH of 7.2. The source of irrigation was canal which was normal. Relative heterosis was expressed as per cent deviation of mean of F_1 from its mid parental value between two corresponding parents as per the formula given by (1)). Heterobeltiosis was estimated as difference between the mean of the F_1 and that of the parent with greater expression as per the formula of (4) and (7.) Standard heterosis was calculated as the per cent deviation of mean of F_1 from standard parent (SR26B) according to (14).

Results and Discussion: The hybrid with higher magnitude of (>20%) (Table 1) of all types of heterosis was SR26-B x CST-7-1 under both normal and saline conditions for number of grains per panicle. This showed the greater chances of improving grain number per panicle under saline soils by utilizing these parents as donors or exploiting the hybrid by various means of recurrent selection procedures. (11) also observed the manifestation of only relative heterosis but not the other types of heterosis under saline conditions, while mixed trend of both positive and negative heterotic effects was registered by 12, 9 and 13). The hybrids *viz.,* RPBio-226 x CSRC(S)5-2-2-5, CST-7-1 x CSRC(S)5-2-2-5 and RPBio-226 x CST7-1 had at least one parent with high *per se* test weight and combining ability (Table 1). Hence, they could be able to express heterosis over mid-parent, but were inferior to better-parent and standard check under saline soils. This is an indicative of the superiority of SR26-B under salinity. (10) also reported such differential reaction under normal and saline soils. The earlier researchers 12 and 9 reported the mixed trend of both positive and negative effects for this parameter.The grain yield is a very complex trait. It is multiplicative end product of several basic components of yield (2). Under stressed environment, the best hybrids with significantly superior magnitude of heterosis and heterobeltiosis were Swarna x CSRC(S)7-1-4 (54.86% and 19.80%) followed by CSR-27 x CSRC(S)5-2-2-5 (51.61% and 27.58%) and CST-7-1 x CSRC(S)5-2-2-5 (41.18% and 24.53% (Table 1). None of the hybrids could express significant positive standard heterosis over SR26-B and it ranged from -75.22 per cent (Swarna x CSR-27) to 17.01 per cent (SR26-B x CST-7-1). It was observed that, in most of the hybrids CSRC(S)5-2-2-5 appeared as one of the parents with good combining ability for grain yield. Heterosis in yield is reflected through heterosis in individual yield components or alternatively due to multiplicative effects, which further substantiated the present findings as seen in case of the hybrid Swarna x CSRC(S) 7-1-4). Similarly,

(3) reported that even simple dominance in respective of yield components may lead to expression of heterosis for yield. and termed it as"combinational heterosis".

Conclusions: The number of heterotic cross combinations for grain yield plant^{-1} over mid-parent and better-parents remained the same under both the soil conditions, but standard heterosis was not realized under salt stressed situation. Further, it was observed that heterosis of neither type could have been realized for spikelet fertility under saline soils. The hybrid Swarna x CSRC(S)7-1-4 was found to be promising as it manifested significant heterotic expression over mid- parent, better-parent and standard check (SR26-B) for plant height, days to 50 per cent flowering. Further, this cross combination also fared well with superiority over mid and better-parents with significant heterosis for number of filled grains panicle^{-1}, grain yield plant^{-1} besides having higher mean performance and combining ability. The hybrid RPBio-226 x CSR-30 was also found to be heterotic over mid and better-parents for number of total tillers plant^{-1}, number of productive tillers plant^{-1}, panicle length, panicle weight and test weight besides having hgh mean performance and SCA effects. Similarly, CST-7-1 x CSRC(S)5-2-2-5 was also found to be promising with significant superiority over both mid and better-parents for days to 50 per cent flowering, number of filled grains panicle^{-1} and grain yield plant^{-1}

References:

1. S. Fonseca, and F.L. Patterson , " Hybrid vigour a seven parent diallel crop in common wheat (*Triticum aestivum*)", Crop Science, 1968, 8: 85-88.
2. J.E. Grafius, "Heterosis in barley", Agronomy Journal, 1959, 5: 551-554.
3. A. Hegberg , "Heterosis in F_1 combinations in Galeopsis I and II", Indian Journal of Genetics and Plant Breeding. 1952, 29(1): 53-61.
4. G. H Liang, C. R Reddy and A. D Dayton, "Heterosis inbreeding depression and heritability estimates on systematic series of grain sorghum genotypes", Crop Science, 1971, 12: 409-411.
5. H. K.Ma, Chong and X.W. Deng, "Rice research: past, present and future", Journal of Integrative Plant Biology, 2007, 49: 729-730.
6. P. Maser,M. Gierth and J.I. Schroeder, "Molecular mechanisms of potassium and sodium uptake in plants", Plant and Soil, 2002, 247: 43-54.
7. K.Mather and J. Jinks, "Biometrical Genetics", Chapman and Hall Limited London, 1971.
8. A. Melissa, R. Fitzgerald Susan, McCouch and Robert D Hall, "Not just a grain of rice: the quest for quality", Trends in Plant Science, 2009, 14(3): 1360-1385.
9. L.L. Panwar and Mashiat Ali, "Heterosis and inbreeding depression for yield and kernel characters in scented rice", Oryza. 2010, 47(3): 179-187.
10. M.S. Sajjad, "Cytoplasmic effectfor non-salin and saline environment in rice", Pakistan Journal of Science and Industrial Research, 1986, 59-60.
11. M.S.Sajjad, "Manifestation of heterosis in rice (*Oryza sativa* L.) in saline environment", International Rice Research Newsletter, *1998*,. 13: 21-22.
12. P.Senguttuvel, "Genetic, Physio-Biochemical analysis and molecular characterization of salt tolerance in rice (*Oryza sativa* L.)", Ph. D Thesis, Tamil Nadu Agricultural University, Coimbatore, 2008.
13. S.Vennila, Y. Anbuselvam and K.Palaniraja, "Heterosis studies for yield and its components in rice (*Oryza sativa* L.)", International Journal of Recent Scientific Research, 2011, 2(9)261-262.
14. S.S. Virmani, R.C. Aquino and G.S. Khush, "Heterosis breeding in rice (*Oryza sativa* L.)", Theoretical and Applied Genetics, 1982, 63: 373-380.
15. G.Y. Zhu,J.M. Kinet and S Lutts, "Characterization of rice (*Oryza sativa* L.) F_3 populations selected for salt resistance. I.Physiological behaviour during vegetative growth", Euphytica, 2001, 121: 251-263.

Table I. Promising heterotic hybrids along with general and specific combining ability effects under saline soils

S. No	Character	Hybrid	Heterosis			*Per se* performance				GCA of the parents	Value of SCA effect
			H_1	H_2	H_3	P_1	P_2	F_1	F_2		
1	Number of tillers plant^{-1}	RPBio-226 x CSR-30	65.52**	60.00**	-27.27	4.67	5.00	8.00	8.67	Low x low	1.76**
		Swarna x CSRC(S)5-2-2-5	46.15**	31.03**	15.15	7.67	9.67	12.67	6.33	Low x high	3.23**
		CSRC(S)7-1-4 xCSRC(S)5-2-2-5	25.42**	23.33**	12.12	10.00	9.67	19.67	11.00	High x high	2.20**
2	Number of productive tillers plant^{-1}	RPBio-226 x CSR-30	65.22**	58.33**	-34.48	4.00	3.67	6.33	7.00	Low x high	1.85**
		Swarna x CSRC(S)5-2-2-5	38.10**	16.00	0.00	5.67	8.33	9.67	4.67	Low x high	2.62**
		CSR-27 x CST-7-1	20.00*	14.29	-17.24	6.33	7.00	5.33	6.00	Low x low	1.78**
3	Panicle length (cm)	RPBio-226 x CSR-30	16.94**	15.00*	-15.27	16.56	17.13	19.70	18.43	Low x low	3.83**
		SR26-B x CST-7-1	10.90*	6.95	6.95	23.25	21.59	24.87	20.43	High x low	1.79*
4	Panicle weight (g)	RPBio-226 x CSR-30	70.67**	31.87**	-22.31	1.24	2.28	2.82	2.02	Low x low	1.24**
		RPBio-226 x CST-7-1	51.44**	14.15	-27.73	1.24	2.45	2.80	2.03	Low x low	0.37*
		CSRC(S)7-1-4 x CSRC(S)5-2-2-5	21.54**	10.71	3.27	3.61	2.97	4.00	3.13	High x high	0.72**
5	No. of filled grains panicle^{-1}	Swarna x CSRC(S)7-1-4	50.54**	19.80**	12.34	80.70	136.30	163.30	111.00	Low x high	53.43**
		SR26-B x CST-7-1	37.68**	21.10**	21.10**	145.30	110.30	176.00	114.33	High x low	57.03**
		CST-7-1 x CSRC(S)5-2-2-5	20.92**	9.88	2.06	110.30	135.00	148.30	101.04	Low x high	25.46**
6	Spikelet fertility (%)	N.S.									
7	1000-grain weight (g)	RPBio-226 x CSRC(S)5-2-2-5	26.98**	3.49	-0.04	14.37	22.80	23.60	16.47	Low x high	4.29**
		RPBio-226 x CST-7-1	19.88**	2.70	-12.40	14.37	20.14	20.68	20.64	Low x high	2.90**
		RPBio-226 x CSR-30	13.79**	-1.66	-15.98**	14.37	19.72	19.39	18.72	Low x low	1.69**
8	Grain yield plant^{-1} (g)	Swarna x CSRC(S)7-1-4	54.86**	19.80*	8.24	11.06	20.22	24.22	18.56	Low x high	9.47**
		CSR-27 x CSRC(S)5-2-2-5	51.61**	27.58*	-0.92	11.87	17.38	22.17	24.22	Low x high	7.51**
		CST-7-1 x CSRC(S)5-2-2-5	41.18**	24.53*	-3.29	13.28	17.38	21.64	12.58	High x high	4.28**

H_1, H_2 and H_3 are relative heterosis, heterobeltiosis and standard heterosis, respectively
P1, P2, are first and second parents in a cross combination & F_1 and F_2 first and second filial generations.

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