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Short communication

Heterosis for yield and yield components in rice (*Oryza sativa* L.)

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Abstract

Eight genetically diverse high-yielding rice cultivars selected from clusters formulated through Mahalanobis D^2 statistics were crossed in a diallel fashion. The parents and crosses were evaluated and heterosis for yield and its principal components estimated. Results suggest that yield increase was largely due to significant and favourable heterosis in yield components viz., number of spikelets panicle^{-1}, panicle length, leaf area plant^{-1} (at maximum tillering stage) and number of panicles m^{-2}. Five top heterotic crosses over their mid and better parents for each trait were identified.

Key words*:* diallel crossing, relative heterosis, heterobeltiosis

Investigations on heterosis provide fundamental information regarding the expression of cross combinations and its potential for commercial exploitation. In a previous paper, we (Vanaja et al., 2003) reported the additive and non-additive gene effects in governing yield and yield attributes for 36 entries (28 crosses and 8 parents) of rice. With a view to evaluate the heterotic crosses, the present investigation was undertaken. Although the parents of the crosses were the same as that of the previous study, the cross combinations effected were different.

In this study, eight genetically diverse high yielding cultivars, namely ‘Mattatriveni’ (P1), ‘Hraswa’ (P3), ‘Mahsuri’ (P4), ‘Vytilla 3’ (P6), ‘Kachsiung Sen Yu 338’ (P7), IR36 (P8), IR 60133-184-3-2-2 (P10) and PK 3355-5-1-4 (P11) selected from clusters formulated through Mahalanobis D^2 statistics, were crossed in a diallel fashion. The parents and crosses (28) were grown in a randomized block design with two replications at the Agricultural Research Station, Mannuthy during the *kharif* season of 1998. The soil type was lateritic loam. Each genotype was grown in a single row of ten plants with a plant and row spacing of 15 cm and 20 cm, respectively. The parents and crosses were evaluated for 17 characters including yield. F_1 values averaged over replications were used for estimating the heterosis.

Information on the number of crosses showing significant heterosis, range of relative heterosis, and heterobeltiosis and top ranking five favourable crosses are summarized in Table 1. Estimates of relative heterosis and heterobeltiosis for yield indicate that six out of the 28 hybrids gave higher yield than the mid-parent, while three hybrids were better than the respective better parents. Estimates of relative heterosis and heterobeltiosis for yield and yield components of hybrids further indicated that significant favourable heterosis in yield can be explained based on the significant and favourable heterosis in the component characters viz., number of spikelets panicle^{-1}, panicle length, leaf area plant^{-1} at maximum tillering stage and number of panicles m^{-2}. Similar results for panicle length and number of spikelets panicle^{-1} were earlier reported by Anandakumar and Rangaswamy (1986), Patnaik et al. (1991) and Mishra and Pandey (1998), implying that yield is the end-product of multiplicative interaction between yield components. Heterosis for yield, therefore, should be through heterosis for individual yield characters and/or of partial dominance of component

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Table 1. Number of crosses showing significant heterosis, range of relative heterosis and heterobeltiosis and top five heterotic crosses

Characters	Relative heterosis				Heterobeltiosis			
	Crosses showing significant heterosis (no.)[1]	Range of heterosis	Top five crosses[2]	Relative heterosis	Crosses showing significant heterosis (no.)[1]	Range of heterosis	Top five crosses[2]	Hetero-beltiosis
Number of panicles m^{-2}	12(0)	-49.7 to 1656.0	P6 x P8 P6 x P3 P11 x P6 P6 x P10 P6 x P7	1656.0** 1220.2** 781.6** 754.2** 360.5**	11(0)	-49.7 to1350.0	P6 xP8 P6 x P3 P11 x P6 P6 x P10 P6 x P1	1350.0** 959.9** 605.3** 539.3** 290.3**
Number of spikelets $panicle^{-1}$	10(4)	-62.6 to 87.1	P11 x P3 P6 x P8 P4 x P1 P10 x P8 P4 x P7	87.1** 72.5** 64.3** 45.2** 40.7**	13(10)	-65.1 to 85.9	P11 x P3 P6 x P8 P10 x P8	85.5** 63.5** 44.3**
Panicle length	13(7)	-20.3 to 28.0	P11 x P3 P6 x P8 P6 x P10 P10 x P8 P6 x P1	28.0** 24.8** 15.9** 15.7** 15.1**	15(10)	-24.5 to 24.4	P11 x P3 P7 x P3 P6 x P10 P6 x P8 P6 x P1	24.4** 11.6** 11.5** 11.2** 6.8*
Leaf area per plant at maximum tillering stage	21(1)	-83.8 to 1649.9	P6 x P8 P11 x P6 P8 x P1 P6 x P1 P6 x P7	1649.9** 731.2** 728.5** 495.9** 475.0**	20(3)	-84.6 to1311.0	P6 x P8 P11 x P6 P8 x P1 P6 x P1 P6 x P7	1310.9** 653.4** 529.0** 450.2** 351.5**
1000 grain weight	18(18)	-27.4 to 1.28	-	-	25(25)	-34.4 to -0.6	-	-
Yield	20(14)	-90.4 to 457.3	P6 x P8 P6 x P10 P6 x P1 P11 x P6 P8 x P1	457.3** 431.6** 190.5** 77.6** 74.6**	18(15)	-93.3 to 356.0	P6 x P8 P6 x P10 P6 x P1	356.0** 350.6** 108.8**

[1]frequencies of unfavourable heterosis are given parenthetically [2]showing favourable heterosis
** Significant at p<0.01; * significant at p<0.05

characters. Furthermore, none of the superior crosses showed heterosis for yield alone and no cross combination showed favourable heterosis over mid-parent and better parent with respect to 1000-grain weight. Similarly, no hybrids manifested significant negative heterosis over the mid-parent and better parent for number of panicles m^{-2}. For all other characters, majority of the crosses, however, recorded negative heterosis. This may be due to the disharmony between gene combinations among different parental lines.

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References

Anandakumar, C.R. and Rangaswamy, S.R.S. 1986. Heterosis and inbreeding depression in rice. Oryza, 23: 96-101.

Mishra, M. and Pandey, M.P. 1998. Heterosis breeding in rice for irrigated subhumid tropics in north India. Oryza, 35: 8-14.

Patnaik, R.N., Pande, K., Ratho, S.N. and Jachuck, P.J. 1991. Heterosis in relation to genetic divergence and combining ability in rice. Oryza, 28: 455-458

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