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Short Communication

# Heterosis for yield and associated traits in bread wheat [*Triticum aestivum* (L.) em. Thell.]

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The extent of heterosis depends on the magnitude of non-additive gene action and wide genetic diversity among parents. However, there are reports that in self-pollinated crops, crosses with high magnitude of additive x additive gene action effects give better segregants [1]. Heterosis over better parent may be useful in identifying true heterotic cross combinations but these crosses can be of practical utility if they show superiority over the standard/best cultivar. Therefore, present investigation has been undertaken with an aim to estimate the magnitude of heterosis over standard variety of wheat in normal as well as heat stress environment.

The present investigation consisted of eight genetically diverse parents *viz.*, Raj 3777, Raj 3765, Raj 3077, PBW 373, Raj 1482, HD 2329, WH 147 and Lok 1 and their 28 $F_1$s generated by diallel mating, excluding reciprocals. All the crosses along with parents were evaluated in randomized block design with three replications in each of the two environment *viz.*, normal [N, temperature-maximum: 32.4°C and minimum: 12.9°C (21st November, 2004) sowing and temperature - maximum: 34.1°C and minimum: 16.9°C at maturity] and high temperature [HT, temperature - maximum: 26.3°C and minimum: 8.6°C (15th December, 2004) at sowing and temperature- maximum: 38.3°C and minimum: 19.9°C at maturity] at Agriculture Research Station Farm, Bikaner during *rabi* 2004-05. Plot size was single row of two metre length with row to row spacing of 30 cm and plant to plant spacing 10 cm. The data were scored for 12 yield and associated traits *viz.*, days to heading, days to maturity, number of effective tillers per plant, plant height, spike length, number of spikelets per spike, number of grains per spike, flag leaf-area, 1000-grain weight, biological yield per plant, harvest index and grain yield per plant on a set of five randomly selected competitive plants for each genotypes. Heterobeltiosis was calculated as per standard procedure [2].

The analysis of variance revealed highly significant differences among the parental material for most of the characters in different environments as well as over environments, indicating presence of sufficient heterosis. Earlier workers [3, 4] have also reported significant variation for these characters.

Under HT environment, in cross Raj 3777 × PBW 373, the significant yield heterobeltiosis could be contributing effect of days to heading (–2.59), days to maturity (–1.89), number of grains per spike (33.46), 1000-grain weight (8.90) and harvest index (118.28). In Raj 3777 × HD 2329, the significant yield heterobeltiosis could be contributing effect of number of spikelets per spike (8.33), 1000-grain weight (24.41) and biological yield per plant (58.89). In Raj 3765 × PBW 373, significant yield heterobeltiosis could be contributing effect of days to maturity (–2.23), number of grains per spike (25.48), flag leaf area (28.96), 1000-grain weight (31.20) and harvest index (118.79). In Raj 3765 × HD2329, the significant yield heterobeltiosis could be contributing effect of days to heading (–2.63). Number of grains per spike (14.76), flag leaf area (22.96), 1000-grain weight (31.69) and harvest index (46.75). In Raj 3077 × PBW 373, significant yield heterobeltiosis could be contributing effect of days to heading (–3.02), plant height (–5.87), number of grains per spike (15.44), flag leaf area (7.71), 1000-grain weight (15.18) and harvest index (20.02). In PBW 373 × HD 2329, the significant yield heterobeltiosis could be contributing effect of plant height (–9.60). flag leaf area (30.53), 1000-grain weight (17.14) and harvest index (59.81) (Table 1). Similar results in HT environment, for these characters in wheat for heterotic effects were also reported [4, 6].

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Under normal (N) environment, in cross Raj 3777 × PBW 373, the significant yield heterobeltiosis could be contributing effect of number of grains per spike (19.70) and harvest index (17.96). In Raj 3777 × HD 2329, the significant yield heterobeltiosis could be contributing effect of plant height (–20.42) and 1000-grain weight (21.78). In Raj 3765 × PBW 373, significant yield heterobeltiosis could be contributing effect of days to heading (–6.39), plant height (–21.42), number of grains per spike (9.33) and harvest index (27.24). In Raj 3765 × HD 2329, the significant yield heterobeltiosis could be contributing effect of days to heading (–4.07), plant height (–12.23), number of grains per spike (11.41), 1000-grain weight (32.56) and harvest index (31.10). In Raj 3077 × PBW 373, significant yield heterobeltiosis could be contributing effect of days to heading (–5.26), plant height (–23.21) and 1000-grain weight (21.05). In PBW 373 × HD 2329, the significant yield heterobeltiosis could be contributing effect of days to heading (–8.61), plant height (–24.03), number of grains per spike (19.57) and 1000-grain weight (10.21) (Table 1). The results in N environment, for these characters in wheat for heterotic effects were also reported [3, 5].

In general, there was negative heterobeltiosis for yield under normal environment, while it was reversed under HT environment (Table 1). This might be due to the use of late sown varieties except HD 2329 for producing $F_1$ hybrids.

The cross Raj 3765 × HD 2329 found superior as compared to other promising crosses as it showed better performance for most of the characters under both the environmental conditions. All the crosses showing desirable heterobeltiosis for more than two characters in both the environments were considered promising for their use for yield improvement in general and particularly in high temperature environment.

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**Table 1.** Estimation of heterobeltiosis for different traits in bread wheat for six promising crosses under normal and heat stress environment

| Characters | Raj 3777 × PBW 373 | | Raj 3777 × HD 2329 | | Raj 3765 × PBW 373 | | Raj 3765 × HD 2329 | | Raj 3077 × PBW 373 | | PBW 373 × HD 2329 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | N | HT | N | HT | N | HT | N | HT | N | HT | N | HT |
| Days to heading | 0.00 | –2.59** | 5.35** | 0.44 | –6.39** | –1.29 | –4.07** | –2.63** | –5.26** | –3.02** | –8.61** | –1.30 |
| Days to maturity | 1.36 | –1.89* | 2.43** | 0.94 | –1.61 | –2.23* | 1.61 | 1.96* | 1.09 | 1.27 | –0.81 | 2.22* |
| No. of effective tillers/pl | –51.22** | –50.67** | –40.69** | –23.33** | –42.56** | –15.09 | 2.05 | –6.12 | –40.95** | –5.66 | –21.21** | –22.50* |
| Plant height | –23.90** | 0.00 | –20.42** | –11.38** | –21.42** | –10.10** | –12.23** | –1.33 | –23.21* | –5.87* | –24.03** | –9.60** |
| Spike length | –5.56** | –5.51 | –13.89** | 7.27 | –13.33** | –6.06 | –2.56 | –3.64 | –12.82** | –0.67 | –6.70** | 8.70 |
| No. of spikeletes/spike | –4.66* | 0.74 | –9.06** | 8.33* | –9.00** | –0.88 | 0.33 | –3.51 | –8.33** | –6.30 | –3.48 | 4.81 |
| No. of grains/spike | 19.70** | 33.46** | –8.89** | –43.73** | 9.33** | 25.48** | 11.41** | 14.76** | –19.78** | 15.44** | 19.57** | –2.54 |
| Flag leaf area | –32.71** | –17.19** | –26.88** | –24.21** | –35.91* | 28.96** | –41.99** | 22.96** | –18.75** | 7.71** | –35.08** | 30.53** |
| 1000-grain weight | 4.50 | 8.90** | 21.78** | 24.41** | 26.28* | 31.20** | 32.56** | 31.69** | 21.05** | 15.18** | 10.21** | 17.14** |
| Biological yield/plant | –50.61** | 16.56 | –27.61** | 58.89** | –46.45** | –21.67** | –24.62** | 7.22 | –32.85** | –1.53 | –12.17** | –23.94** |
| Harvest index | 17.96* | 118.28** | –28.18** | –3.22 | 27.24** | 118.79** | 31.10** | 46.75** | –9.31 | 20.02* | –35.12** | 59.81** |
| Grain yield per plant | –41.77* | 76.19** | –48.01** | 61.76** | –33.68** | 80.00** | –3.33 | 90.20** | –40.35** | 62.22** | –33.81** | 57.84** |

*,**Significant at 5 % and 1 % levels respectively