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Heterosis for Yield and Yield Components in Wheat (*Triticum aestivum* L.) Under Saline and Normal Environments

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Abstract: Thirty six hybrids, evolved from nine genetically diverse genotypes, were evaluated under normal and saline environments along with parental lines to determine the nature and extent of heterosis for eight characters, including grain yield per plant. The crosses Raj 3077 x Kharchia 65, Raj 3765 x Raj 3880, Job 666 x Kharchia 65, Job 666 x Raj 3880 and Kharchia 65 x Raj 3880 exhibited desirable heterobeltiosis under normal condition. Out of these, Job 666 x Kharchia 65, Job 666 x Raj 3880 and Kharchia 65 x Raj 3880 also exhibited desirable heterobeltiosis for grain yield under salinity. The heterotic crosses for yield were found to be heterotic for 1000-grain weight and harvest index. Thus, heterosis for these two characters has influenced the heterosis in yield. The heterosis for grain yield per plant of superior crosses in saline condition was mainly contributed by number of productive tillers and harvest index.

Key words: *Triticum aestivum*, salinity, heterobeltiosis, yield components.

In the recent past, plant breeders have extensively explored and utilized heterosis to boost yield in several cross pollinated crops. Heterosis being genetically controlled, it is expected to be affected by the environment. Hence, differences in the estimates of heterosis are bound to occur in different environments. In the present study efforts were made to estimate the heterosis of the yield and yield traits of some selected strains of wheat in the crosses evaluated over two environments namely, normal and saline. The parents were both salt tolerant and salt susceptible.

Materials and Methods

A set of nine parents namely Kharchia 65, Job 666, Raj 3077 (salt tolerant), Sonalika, Raj 1482, Lok-1, Raj 3765, Raj 1972 and Raj 3880 (salt sensitive) were crossed in a half-diallel fashion. Thirty six F1's, along with parents, were sown in Randomized Block Design with three replications in normal and saline environments. The pH of the saline soil was 8.6 and that of the normal soil 8.1. In each replication/environment, each parent as well as hybrid was sown in a 1.5 m long two-row plot. The spacing between rows was 30 cm, while plant spacing within row was 10 cm. Observations were recorded on seven characters on ten randomly selected plants in each plot. The plot mean was used for the estimation of heterobeltiosis (heterosis over better parent) using the

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Table 1. Estimation of heterobeltiosis for various morphological traits evaluated in normal and saline environment

Characters	Mean heterobeltiosis		SE (Bp)		Range		% crosses with desirable heterobeltiosis	
	N	S	N	S	N	S	N	S
Days to flowering	0.95	1.33	1.93	3.09	-2.62–5.73**	-7.27–7.58*	30.5	27.7
Days to maturity	2.03	3.30	2.82	3.01	-504–11.43**	-2.14–10.03**	22.2	8.3
Plant height	10.59	9.44	1.09	5.20	-13.96**–32.36**	-8.56–46.93**	22.2	27.7
No. of productive tillers	18.28	-0.98	0.60	0.68	-4.55**–55.0**	-25.0–20.0**	83.3	44.4
Grain yield per plant	-6.17	14.47	0.79	2.13	-44.92**–115.24**	-36.45**–99.28**	25.0	58.3
1000-grain weight	5.99	3.47	0.44	2.52	-9.39**–25.89**	-7.87**–16.26**	80.5	75.0
Harvest index	0.28	6.02	1.32	2.19	-16.65–35.21**	-22.32–33.83**	50.0	66.6

formulae given by Fonseca and Patterson (1968).

Results and Discussion

Analysis of variance indicated significant differences among genotypes for various characters. The magnitude of heterobeltiosis for different characters is presented in Table 1 and top five ranking hybrids are given in Table 2.

The effect of environment on estimates of heterosis is clearly seen (Table 1). The mean heterobeltiosis over the crosses showed increase in grain yield per plant and harvest index in saline environment over the normal, while in other traits they were decreased. The decrease was marginal in plant height and 1000-grain weight, similarly the mean also showed change over the environment. The lower limit of the heterosis increased in salinity. This is expected as salinity affect character expression. Sharma *et al.* (1986) reported that while the mean decreased in salinity as compared to normal, the range increased. Per cent of crosses showing desirable heterobeltiosis showed decreasing trends in days to maturity, number of productive tiller and 1000-grain weight. These parameters showed increasing trends in grain yield per plant and harvest index. Top five crosses for each characters were selected based on the desirable heterotic value.

The crosses Raj 3077 x Kharchia 65, Raj 3765 x Raj 3880, Job 666 x Kharchia 65, Job 666 x Raj 3880 and Kharchia 65 x Raj 3880 exhibited desirable heterobeltiosis for grain yield per plant under normal conditions. Out of these, Job 666 x Kharchia 65, Job 666 x Raj 3880 and Kharchia 65 x Raj 3880 also exhibited desirable heterobeltiosis for grain yield per plant under normal conditions. The absence of desirable heterosis for grain yield was observed in the crosses Sonalika x Raj 3880, Raj 3077 x Raj 3880 and Raj 3765 x Job 666 in normal condition and Sonalika x Raj 3077, Sonalika x Raj 1972, Raj 1482 x Raj 1972 and Raj 3077 x Raj 3765 under salinity.

The crosses for yield were found to be heterotic for 1000-grain weight and

Table 2. Top five crosses based on heterobeltiosis in normal and saline environments

Characters	Environment	
	Normal	Saline
Days to flowering	Lok-1 x Raj 3880	Raj 3077 x Raj 1972
	Raj 3077 x Kharchia 65	Raj 1482 x Raj 3077
	Sonalika x Job 666	Lok-1 x Raj 3765
	Raj 3077 x Job 666	Lok-1 x Raj 3077
	Lok-1 x Raj 1972	Raj 1972 x Kharchia 65
Days to maturity	Raj 3077 x Raj 1972	Raj 3077 x Kharchia 65
	Sonalika x Raj 1972	Raj 1482 x Kharchia 65
	Sonalika x Raj 3880	Sonalika x Raj 3880
	Raj 3077 x Job 666	Raj 3765 x Kharchia 65
	Raj 1482 x Raj 3765	Raj 3765 x Raj 3880
Plant height	Sonalika x Raj 3880	Lok-1 x Raj 1972
	Raj 1482 x Raj 3077	Raj 1482 x Raj 3077
	Lok-1 x Raj 1972	Raj 1482 x Lok-1
	Raj 1482 x Raj 1972	Sonalika x Raj 1972
	Job 666 x Raj 3880	Lok-1 x Raj 3880
No. of productive tillers	Sonalika x Raj 1482	Lok-1 x Raj 1972
	Raj 3077 x Raj 3765	Sonalika x Kharchia 65
	Lok-1 x Raj 3077	Sonalika x Raj 1482
	Lok-1 x Raj 3765	Sonalika x Lok-1
	Sonalika x Raj 3077	Lok-1 x Raj 3880
Grain yield per plant	Job 666 x Kharchia 65	Kharchia 65 x Raj 3880
	Job 666 x Raj 3880	Job 666 x Kharchia 65
	Kharchia 65 x Raj 3880	Job 666 x Raj 3880
	Raj 3077 x Kharchia 65	Raj 1482 x Raj 3880
	Raj 3765 x Raj 3880	Sonalika x Kharchia 65
1000-grain weight	Raj 1482 x Raj 1972	Raj 1482 x Raj 1972
	Lok-1 x Raj 3765	Lok-1 x Raj 3765
	Raj 3077 x Kharchia 65	Lok-1 x Raj 3880
	Lok-1 x Raj 3880	Raj 3077 x Raj 1972
	Job 666 x Kharchia 65	Raj 1972 x Job 666
Harvest index	Job 666 x Kharchia 65	Job 666 x Kharchia 65
	Raj 1482 x Kharchia 65	Lok-1 x Raj 3880
	Lok-1 x Kharchia 65	Lok-1 x Job 666
	Raj 3765 x Raj 3880	Raj 1482 x Raj 3880
	Kharchia 65 x Raj 3880	Job 666 x Raj 3880

harvest index. Thus heterosis for these two characters has influenced the heterosis yield. The heterosis for grain yield per plant of superior crosses in saline condition was mainly contributed by number of productive tillers and harvest index. This is supported by Singh (1989) and Singh and Sharma (1989). Earlier reports suggested that the yield *per se* in any environment was an end product of multiplicative interactions between various yield contributing characters. They also highlighted that there could be no distinct gene or set of genes and their action for yield. Thus, heterobeltiosis for yield is sum total of heterobeltiosis in various yield contributing characters which are involved in expression of heterobeltiosis for grain yield.

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