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Estimation of heterotic effects for yield and its components in bread wheat (*Triticum aestivum* L.)

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Abstract

Heterosis was estimated over mid and better parents, for yield and some important yield components in 20 crosses o wheat involving one local variety viz. Inq. 91 and four promising lines viz. 6039-4, 8284, 4943 and 4770. Grain yield p plant showed maximum heterosis over the mid parent (44.30%) followed by 1000-grain weight (28.65%), plant heig (13.40%) and number of tillers per plant (12.23%). The maximum heterobeltiosis was recorded for grain yield per pla (34.54%), 1000-grain weight (23.52%), number of tillers per plant (11.20%) and plant height (6.60%).

Introduction

Wheat (*Triticum aestivum* L.) occupies a prominent position in the cropping system of the country since it is the staple food for our population. The importance of wheat "King of Cereals" is increasing day by day due to increased human population pressure on the scarce land. So, it is the need of the time to boost up per acre wheat productivity in order to cope with the problem of increasing population at alarming rate. Several studies have been made on the manifestation of heterosis in wheat crosses. The phenomenal success demonstrated in maize (*Zea mays* L.) and sorghum (*Sorghum bicolor* L. Moench) hybrids in commercial cultivation in the USA and other countries has inspired scientists to investigate the success of such phenomenon in wheat. The results obtained show varying degree of heterosis depending upon the genotypes of the parents used.

Halloran (1975) analysed data from two eight-parent diallels in the F_1. He indicated genes for tiller number, plant height, grain weight per plant and 1000-grain weight causing heterosis. Cregan and Busch (1978) crossed eight adapted high yielding spring wheat parents in a diallel to produce 28 hybrid population. The F_1 yield exhibited mid parent heterosis from 5 to 58 percent and high parent heterosis from -17 to 41 percent. Malik *et al.* (1981) observed that all the hybrids exhibited a general increase over the better parent of 6.78, 35.81, 21.40, 2.22, 22.85 and 31.16 percent for plant height, number of tillers per plant, spike length, number of grains per spike, 100-grain weight and grain yield per plant, respectively, due to heterosis. Gautam and Jain (1985) studied 7 parents and 21 F_1s of diallel cross. Average heterosis over the mid parental value was 57 percent for grain yield, 10 percent for 100-grain weight and 9 percent for plant height. A significant heterosis for grain yield per plant (from 77.15 to 160.43%) was reported by Patwary *et al.* (1986).

Iqbal *et al.* (1990) estimated heterosis over mid parent and better parent in a 5 parent diallel cross for some important morphological characters. Grain yield per plant showed maximum heterosis over the mid parent (83.71%) followed by number of tillers per plant (21.33%), 1000-grain weight (9.23%) and plant height (8.53%). The maximu heterobeltiosis was recorded for grain yield per pla (73.10%) followed by number of tillers per plant (20.53% El-Hennawy (1996) reported heterosis in F_1 hybrids f grain yield ranging from -70.82 to 72.75 percent and fro -79.24 to 61.3 percent over mid and better parent respectively. Khan and Khan (1996) estimated hetero over mid and better parents for yield and its components 10 crosses of wheat. Number of tillers showed maximu heterosis over the mid parent (31.91%) followed by gra yield per plant (19.41%), 1000-grain weight (17.32% number of grains per spike (11.37%) and plant heig (5.23%). The maximum heterobeltiosis was recorded f grain yield per plant (19.08%), number of tillers per pla (15.82%) and number of grains per spike (10.27%). The studies were planned to derive information for t manifestation of heterotic effects on yield and component. These information could play a significant r to select/evolve high yielding wheat genotypes as hyb or pure lines selected from segregating generations of th hybrids combinations.

Materials and Methods

The present research work was carried out in experimental area of the Department of Plant Breeding Genetics, University of Agriculture, Faisalabad. Five wh varieties/lines viz., Inqulab-91, 6039-4, 8284, 4943 4770 were sown in the field during the crop season 19 97 and were crossed in a diallel fashion. All precautio measures were taken to avoid contamination experimental material during crossing. All possible cro were made to generate the material for study. During next sowing season (1997-98) the seeds of F_1 hyb along with their parents were sown in the field triplicated randomized complete block design. varieties/lines were assigned at random to experim units in each block having 5 meter long single row. Ro row and plant to plant distances were 30 and 15 respectively. Two seeds per hole were dibbled and thinned to one plant per hole. One row of 5 m length s as an experimental unit. For the entire experiment ot cultural and agronomic treatments were kept uniform. At maturity ten guarded plants from each row, in each replication were selected randomly to record data for plant height, number of tillers per plant, 1000-grain weight and grain yield per plant.

Statistical analysis was done on the basis of means of ten plants for each character by using standard techniques as described by Steel and Torrie (1980). The percent increase (+) or decrease (-) of F_1 over mid and better parents was calculated to observe possible heterotic effect for all the traits following Fonseca and Patterson (1968). The tests of significance for mid and better parents were performed by the formulae as reported by Wynne *et al.* (1970). These studies were planned to derive information for the manifestation of heterotic effects on yield its component. These information could a significant role to select high yield wheat genotypes as hybrid or pure line selected from segregation generations of these hybrids combinations.

Results and Discussion

The analysis of variance for all the characters is presented in Table 1 which indicates that mean differences among parents and F_1 hybrids were highly significant. Table 2 reflects a detailed account of heterotic effects for various characters studied.

Plant height: Fifteen out of twenty F_1 hybrids were taller than their respective mid Parents and their heterosis ranged from 0.13 percent (4943 x 8284) to 13.40 percent (8284 x Inq. 91). Eight crosses showed highly significant increase while three crosses showed significant increase over respective mid parent values. Only four crosses were found to out yield their better parents. The cross, 8284 x Inq. 91, showed the maximum (6.60%) significant heterobeltiosis. The negative estimates of heterosis and heterobeltiosis for plant height are preferred over their mid and better parents, respectively, in wheat breeding programme.

Tillers per plant: The result revealed that two out of twenty crosses showed positive significant heterosis over their mid parents. The values of positive heterosis is 11.61 percent (6039-4 x 4770) and 12.23 percent (8284 x 4943). These two crosses have also increased number of tillers per plant than their better parents but with non-significant results. Similar results have also been reported by Malik *et al.* (1981), Iqbal *et al.* (1990) and Khan and Khan (1996).

1000-Grain weight: All the F_1 crosses showed increased 1000-grain weight over mid parents ranging from 5.44 percent (Inq. 91 x 8284) to 28.65 percent (4770 x 6039-4). All crosses gave highly significant heterotic effects over

Table 1: Analysis of variance for various quantitatively inherited traits in wheat.

S.O.V.	df	Plant height	Tillers per	1000-grain weight	Grain yield per plant
Replication	2	198.011**	4.066^{NS}	21.260**	3.598^{NS}
Genotypes	24	89.903**	6.761**	37.361**	15.719**
Error	48	11.862	1.833	3.286	4.149

Table 2: Heterotic effects for plant height, number of tillers per plant, 1000-grain weight and grain yield per plant.

Crosses	Plant height		Tillers per plant		1000-grain wt.		Grain yield per plant	
	Mid	Better	Mid	Better	Mid	Better	Mid	Better
Inqulab-91 x 6039-4	4.87*	-3.33^{NS}	-18.59*	-26.72**	18.57**	6.99*	14.39*	-0.34^{NS}
Inqulab-91 x 8284	6.09**	-0.27^{NS}	-9.19^{NS}	-13.25^{NS}	5.44*	3.84^{NS}	21.65**	-0.18^{NS}
Inqulab-91 x 4943	8.02**	-1.71^{NS}	-17.06*	-20.06*	11.58**	6.54**	-4.39^{NS}	-6.70^{NS}
Inqulab-91 x 4770	9.70**	-2.89^{NS}	-16.63**	-26.67**	10.73**	3.78^{NS}	7.36^{NS}	6.33^{NS}
6039-4 x Inqulab-91	6.01**	-2.28^{NS}	-10.05*	-19.04*	8.32**	-2.25^{NS}	-4.41^{NS}	-16.72*
6039-4 x 8284	3.66*	1.51^{NS}	-12.05*	-23.97**	13.84**	4.14^{NS}	42.10**	32.41**
6039-4 x 4943	4.68*	3.21^{NS}	-7.75^{NS}	-19.63**	12.01**	-3.00^{NS}	22.22**	9.09^{NS}
6039-4 x 4770	6.34**	1.72^{NS}	11.61*	8.74^{NS}	14.56**	9.99**	28.82**	11.31^{NS}
8284 x Inqulab-91	13.40**	6.60*	-6.01^{NS}	-10.21^{NS}	11.35**	9.67**	28.05**	5.07^{NS}
8284 x 6039-4	1.54^{NS}	-0.56^{NS}	-12.14*	-24.06**	20.06**	9.84**	44.30**	34.54**
8284 x 4943	-1.66^{NS}	-5.02*	12.23*	11.20^{NS}	5.72*	-0.50^{NS}	39.70**	17.21*
8284 x 4770	3.67^{NS}	-2.79^{NS}	-5.80^{NS}	-20.34**	14.27**	8.65**	31.18**	6.82^{NS}
4943 x Inqulab-91	6.05**	-3.50^{NS}	-20.96*	-23.82*	7.69**	2.82^{NS}	-3.82^{NS}	-6.44^{NS}
4943 x 6039-4	-3.03^{NS}	-4.39*	-28.23**	-37.47**	16.79**	1.15^{NS}	9.04^{NS}	-2.68^{NS}
4943 x 8284	0.13^{NS}	-3.29^{NS}	-6.13^{NS}	-6.99^{NS}	9.60**	3.15^{NS}	20.93**	1.46^{NS}
4943 x 4770	0.50^{NS}	-2.53^{NS}	-17.29*	-29.52**	12.12**	0.65^{NS}	-1.06^{NS}	-4.66^{NS}
4770 x Inqulab-91	6.29**	-5.92**	-27.70**	-36.41**	13.36**	6.24*	-23.86**	-24.59**
4770 x 6039-4	-1.65^{NS}	-5.99**	-20.40**	-22.44**	28.65**	23.52**	20.51**	4.13^{NS}
4770 x 8284	-1.42^{NS}	-7.57**	-16.40*	-29.30**	13.53**	7.95**	16.04*	-5.50^{NS}
4770 x 4943	-3.54^{NS}	-6.50**	-25.31**	-36.36**	9.37**	-1.49^{NS}	-23.31**	-26.10**

** = Highly significant; * = Significant; N.S. = Non-significant mid parents except two crosses. Eighty percent crosses expressed positive heterosis over better parents. Seven crosses showed highly significant increase while two crosses showed significant increase over better parents. The results are in agreement with the findings of Halloran (1975), Iqbal *et al.* (1990) and Khan and Khan (1996).

Grain yield per plant: Fourteen crosses exhibited positive heterosis over their mid parents ranging form 7.36 percent (Inq. 91 x 4770) to 44.3 per cent (8284 x 6039-4). Fifty percent crosses out yielded their better parents. Two crosses showed highly significant increase while one cross showed significant increase over better parent. All the negative estimates of heterobeltiosis are not desirable. Similar results have also been obtained by Malik *et al.* (1981), Iqbal *et al.* (1990), El-Hennawy (1996) and Khan and Khan (1996).

A review of all the results suggested that the crosses 6039-4 x 8284, 8284 x 6039-4 and 4770 x 6039-4 exhibited remarkable heterosis over mid and better parents for 1000-grain weight and grain yield per plant and may be considered for selection as hybrids or pure line wheat varieties after achieving desired homozygosity.

References

Cregan, P.B. and R.H. Busch, 1978. Heterosis, inbreeding depression and line performance in crosses of adapted spring wheat. Crop Sci., 18: 247-251.

El-Hennawy, M.A., 1996. Heterosis and combining ability in diallel crosses of eight bread wheat varieties. Bull. Fac. Agri,. Univ. of Cairo, 47: 379-392.

Fonseca, S. and F.L. Patterson, 1968. Hybrid vigor in seven parent diallel cross in common winter wheat (*Triticum aestivum* L.). Crop Sci., 8:85-88.

Gautam, P.L. and K.B.L. Jain, 1985. Heterosis for various characters in durum wheat. Ind. J. Genet. Pl. Br., 45:159-165.

Halloran, G.M., 1975. Heterosis in wheat. Zeitschrift für Pflanzenzüchtung, 74: 18-27.

Iqbal, M., K. Alam and M.A. Chowdhry, 1990. Exploitation of heterosis and heterobeltiosis for yield and its components in some intra-specific crosses of wheat. Pak. J. Agri. Sci., 27: 73-79.

Khan, M.A. and A.S. Khan, 1996. Heterosis studies for yield and yield components in some crosses of bread wheat (*Triticum aestivum* L.) Pak. J. Agri. Sci., 33: 66-68.

Malik, A.J., S. M. Sheedi and M.M. Rajpur, 1981. Heterosis in wheat (*Triticum aestivum* L.). Wheat Information Service, 53: 25-29.

Patwary, A.K., M.U. Ghani and M.M. Rahman, 1986. Heterosis in wheat. Ind. J. Agri. Sci., 56: 382-384.

Steel, R.G.D. and J.H. Torrie, 1980. Principles and procedures of statistics: a biometrical approach. McGraw Hill Book Co. Inc. New York.

Wynne, J.C., D.A. Emery and P.W. Rice, 1970. Combining ability estimates in *Arachis hypogaea* L. II. Field performance of F_1 hybrids. Crop. Sci., 10:713-715.