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EXPLOITATION OF HETEROSIS AND HETEROBELTIOSIS FOR YIELD AND ITS COMPONENTS IN SOME INTRA – SPECIFIC CROSSES OF WHEAT

Muhammad Iqbal, Khurshid Alam & M. Aslam Chowdhry
Department of Plant Breeding and Genetics, University of Agriculture, Faisalabad

Heterosis over mid and better parent was estimated in a five parental diallel cross for some important morphological characters. The parents used were Pak 81, PunJab 81, Kohinoor 83, LU26S and SS – 5. Grain yield per plant showed maximum heterosis over the mid parent (83. 71%) followed by spike length (23.16 %), number of tillers per plant (21.33 %), 1000–grain weight (9.23 %), plant height (8.53%) and number of spikelets per spike (8.16 %) The maximum heterobeltiosis was recorded for grain yield per plant (73.10 %) followed by the spike length (21.17%) and number of tillers per plant (20.53%).

INTRODUCTION

The discovery of male sterility and nuclear fertility restoration system in wheat has increased the possibilities of commercial exploitation of heterosis. But before such an endeavour may become a commercial reality, the information regarding heterotic response of hybrids of the parents could be efficiently utilized in the production of pure lines through hybridization.

Several studies have been made on the menifestation of heterosis in wheat crosses. The results obtained show varying degree of heterotic response depending upon the genotype of the parents used. Chowdhry et al. (2) reported that most of the F_1 generations showed higher grain yield and plant height than the parents. Singh and Singh (7)observed 50.1% hybrid vigour in the F_1 for grain yield per plant. They suggested that high heterosis in F_1 is exhibited due to general depression of inbreeding. Malik et al. (5) observed that all the hybrids exhibited a general increase over the better parents due to heterosis. Average value of increase recorded for plant height was 6.68%, 100 – grain weight 22.85% and grain yield per plant 31.1% over the better parent. A substantial magnitude of heterosis for grain weight per plant (112%), 1000 – grain weight (106%) and plant height (103%) were recorded by Ho (3) who studied 41 F_1 crosses. Bhatti et al . (1) reported that grain yield showed maximum heterosis over the mid parent (82.01%) followed by 100–grain weight (41.16 %), spike length (19.53%), tillers per plant (15.46%), plant height (9.87%) and number of spikelets per spike (8.37%). The maximum heterosis over better parent was recorded for grain yield (32.46%) and 100–grain weight (24.46%). Khan et al . (5) reported that heterotic level reached 25, 20, 3.6 and 7.3% above the better values for grain yield per plant, grain weight, number of spikelets per spike and plant height, respectively. Grain yield showed positive heterosis in 42 F hybrids (Patwary et al. (6).

MATERIALS AND METHODS

Five wheat varieties / strains namely, Pak. 18, Pb. 81, Koh–i–noor. 83, LU26S and SS–5 were crossed in a diallel fashion during 1988 in the experimental area of the department of plant breeding and genetics. All the crosses including parents were sown in three replications using randomized complete block design during 1988–89. Five meter long single rows served as experimental plots with interplant and interrow distance of 22 cm and 30 cm, respectively. Other cultural and agronomic treatments were kept constant for the entire experiment. At maturity, ten guarded plants were

randomly selected for each genotype of each replication. The data were recorded on plant height, number of tillers per plant, spike length, number of spikelets per spike, 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 (8). The tests of significance for mid and better parent were performed by the formulae as reported by Wynne et al. (9) and Khan (4), respectively.

RESULTS AND DISCUSSION

Mean performance of the parents and the hybrids is presented in table1. Highly significant differences ($P<0.01$) among the genotypes in respect of all the characters, except 1000–grain weight ($P<0.05$), have been observed which are presented in table 2. Performance of F hybrids as compared to the mid parent (MP) and better parent (BP) values are presented in table 3.

PLANT HEIGHT

Fourteen crosses showed increased height over mid parents. The range of positive heterosis varied from 0.52% (Pb. 81 x Pak. 81) to 8.53% (Pb.81 x Koh–i–noor 83 over mid parent. However, only three crosses produced significantly more height over respective parental mean. Seven out of 20 hybrids showed increased height over the respective taller parents ranging from 0.63% (Pak. 81 x LU26S) to 6.81% (Pb. 81 x Kohi . 83). However, only one cross (Pb. 81 x Koh –i– noor 83) showed significant heterobeltiosis. Almost similar findings have earlier been recorded by Chowdhry et al. (2). The results suggested that the parents Pb. 81 and Kohi. 83 seemed to possess good ability to contribute tallness to hybrid progeny as compared to other parents.

NUMBER OF TILLERS PER PLANT

The results revealed that most of the crosses showed positive heterosis over mid as well as better parents, only two crosses viz., Pak. 81 x SS–5 and Kohi. 83 x SS–5 showed negative heterosis. The range of positive heterosis varied from 0.50% (Pak. 81 x LU26S) to 21.33% (LU26S x SS–5) over mid parent and 0.46% (LU26S x Pak. 81) to 20.53% (LU26S x SS–5) over better parent. However, the hybrid LU26S x SS–5 showed 20.53% heterobeltiosis. Three crosses showed significant heterosis over the mid parents, While two showed over the better parents. Almost similar findings have earlier been reported by Bhatti et al. (1) and Malik et al. (5).

SPIKE LENGTH

All the hybrids excelled mid parent values ranging from 0.08% (LU26S x Pak. 81 and Pak. 81 x Pb. 81) to 23.16% (SS– 5 x Kohi. 83). With the exception of three crosses viz., Pak. 81 x Pb. 81, Pb. 81 x LU 26S and SS–5 x Pb. 81, all the hybrids excelled the better parent values. The values ranged from 0.38% (LU26S x Pb. 81) to 21.17% (SS–5 x Kohi. 83). Fifteen of the crosses manifested significant increase in spike length over the respective mid parents, while ten crosses showed significant heterobeltiosis. Hybrid vigour expression for this character had also been reported earlier by Malik et al. (5) and Bhatti et al. (1)

NUMBER OF SPIKELETS PER SPIKE

Considering all the hybrids 75% of them showed heterosis over mid parents while 10% exhibited heterobeltiosis. Three crosses manifested significant increase over mid parent values while none of them excelled significantly over better parent values. The positive heterosis values ranged from 0.20% (Kohi. 83 x Pb. 81) to 8.16% (SS –5 x Kohi. 83) over mid parents and zero% (Kohi. 83 x SS–5) to 3.14% (SS–5 x kohi. 83) over better parents. Heterotic effects for this trait have also been reported earlier by Singh and Singh (7) and Bhatti et al. (1).

1000 – GRAIN WEIGHT

Highest 1000 – grain weight (52.95 gms) was recorded in variety LU26S. None of the hybrids showed significantly better

Table 1. Mean Performance of Parents and F_1 Hybrids

S. No.	Parents / Crosses	Plant height	No. of tillers per Plant	Spike length	No. of spikelets per spike	1000–grain weight	Grain yield per plant
1.	Pak. 81	94.33	12.90	12.05	20.30	46.26	30.27
2.	Pb. 81	92.54	10.92	13.35	21.18	46.07	26.84
3.	Kohi. 83	89.60	12.20	11.37	19.40	39.82	23.73
4.	LU26S	91.63	15.10	12.03	18.73	52.95	30.93
5.	SS – 5	75.54	14.90	11.76	17.60	48.31	28.02
6.	Pak. 81 x Pb. 81	90.53	12.10	12.71	20.45	50.43	33.80
7.	Pak. 81. x Kohi. 83	96.78	13.22	13.61	20.18	39.48	42.16
8.	Pak. 81 x LU 26S	94.92	14.07	12.44	19.27	42.36	33.09
9.	Pak. 81 x SS – 5	83.32	13.88	13.17	20.40	43.61	32.46
10.	Pb. 81 x Pak. 81	93.93	13.43	13.93	20.94	47.14	44.77
11.	Pb. 81 x Kohi. 83	98.84	13.63	13.84	21.00	45.73	46.46
12.	Pb. 81 x LU26S	94.04	14.02	12.74	20.34	51.50	32.72
13.	Pb. 81 x SS – 5	83.01	14.09	13.62	20.67	47.69	29.13
14.	Kohi. 83 x Pak. 81	95.15	13.76	13.54	19.92	45.20	29.70

S. No.	Parents / Crosses	Plant height	No. of tillers per Plant	Spike length	No. of spiKelets per spike	1000–grain weight	Grain yield per plant
15.	Kohi. 83 x Pb. 81	93.25	13.77	13.51	20.33	44.13	34.13
16.	Kohi. 83 x LU 26S	91.42	14.13	13.02	19.30	46.03	35.13
17.	Kohi. 83 x SS – 5	86.11	13.47	13.45	19.40	43.62	43.03
18.	LU 26S x Pak. 81	86.41	15.17	12.05	18.27	50.96	32.30
19.	LU 26S x Pb. 81	95.12	14.13	13.40	20.08	48.73	31.03
20.	LU 26S x Kohi. 83	90.06	15.05	12.71	18.78	44.39	30.04
21.	LU 26S x SS – 5	83.44	18.20	13.09	18.22	49.95	29.73
22.	SS – 5 x Pak. 81	84.53	14.18	13.73	19.18	47.81	35.23
23.	SS – 5 x Pb. 81	84.31	14.07	13.22	19.78	50.85	25.65
24.	SS – 5 x Kohi. 83	83.26	14.59	14.25	20.01	45.89	31.24
25.	SS – x LU 26S	81.64	18.05	12.24.	17.78	52.57	28.24
	S. E	1.85	1.03	0.27	0.48	2.53	2.65
	Cd_1 (P<0.05)	5.22	2.91	0.77	1.35	7.21	7.54
	Cd_2 (P<0.01)	6.96	3.89	1.03	1.81	9.62	10.05

Table 2 ANALYSIS OF VARIANCE

		MEAN SQUARES					
S. O. V.	DF	Plant height	No. of tillers per plant	Spike length	No. of spikelets per spike	1000–grain weight	Grain yield per plant
Blocks	2	186.89	7.80	0.54	3.59	14.51	108.64
Genotypes	24	95.86	7.20	1.70	3.00	39.93	100.47
Error	48	10.10	3.15	0.22	0.68	19.31	21.08

* = Significant (P < 0.05)
** = Significant (P < 0.01)

Table 3. Expression of heterosis (%) and heterobeltiosis (%)

Hybrid	Plant height		No. of tillers per plant		Spike lingth		No. of spikelets per spike		1000-grain weight		Grain yield per plant	
	MP	BP	MP	BP	MP	BP	MP	BP	MP	BP	MP	BP
Pak.81 x Pb.81	–3.11	–4.03	1.60	–6.20	0.08	–4.79	–1.30	–3.35	9.23	9.01	16.28	9.71
Pak.81 x Kohi.83	5.23	2.60	5.34	2.48	16.23	12.95	1.66	–0.59	–8.27	–14.66	56.15	39.28
Pak.81 x LU26S	2.09	0.63	0.50	–6.82	3.32	3.24	–1.28	–5.07	–14.61	–20.00	8.14	6.98
Pak.81 x SS-5	–0.74	–11.67	–0.14	–6.85	10 58	9.30	7.65	0.49	–7.78	–9.73	11.36	7.24
Pb.81 x Pak.81	0.52	–0.42	12.76	4.11	9.69	4.35	0.96	–1.13	2.10	1.90	56.76	47.90
Pb.81. x Kohi. 83	8.53	6.81	17.91	11.72	11.97	3.67	3.50	–0.85	6.47	–0.74	83.71	73.10
Pb.81 x LU26S	2.12	1.68	7.76	–7.15	0.39	–4.57	1.90	–3.97	4.02	–2.74	13.26	5.79
Pb.81 x SS-5	–0.04	–10.30	9.14	–5.44	8.44	2.02	6.60	–2.41	1.06	–1.28	6.20	3.96
Kohi.83 x Pak.81	3.46	0.87	9.64	6.67	15.63	12.37	0.35	–1.87	5.02	–2.29	10.00	–1.88
Kohi.83 x Pb.81	2.39	0.77	19.12	12.87	9.30	1.20	0.20	–4.01	2.75	–4.21	34.99	27.20
Kohi.83 x LU26S	0.88	–0.23	3.52	–6.42	11.28	8.23	1.21	–0.52	–0.78	–13.07	28.54	13.58
Kohi.83 x SS-5	5.57	–3.90	–0.59	–9.60	16.25	14.37	4.87	–	–1.02	–9.71	66.27	53.57
SS-5 x Pak.81	0.70	–10.39	2.10	–4.87	15.28	13.94	1.21	–5.52	1.10	–1.04	20.86	16.39
SS-5 x Pb.81	1.53	–8.89	8.99	–5.57	5.26	–0.97	2.01	–6.61	7.76	5.26	–6.49	–8.46
SS-5 x Kohi.83	2.07	–7.08	7.68	–2.08	23.16	21.17	8.16	3.14	3.68	–5.42	20.71	11.49
SS-5 x LU 26S	–1.15	–10.90	20.33	19.54	2.86	1.75	–2.15	–5.07	3.83	–0.85	–4.21	–8.70
LU26S x Pak.81	–7.07	–8.40	8.36	0.46	0.08	–	6.40	–10.00	2.72	–3.76	5.56	4.43
LU26S x Pb.81	3.29	2.79	8.61	–6.42	5.60	0.38	0.60	–5.19	1.58	–7.97	7.41	0.32
LU26S x Kohi.83	–0.62	–1.71	10.26	–0.33	8.63	5.65	–1.52	–3.20	–4.31	–16.17	9.92	–2.88
LU26S x SS-5	1.03	–8.94	21.33	20.53	10.00	8.81	0.28	–2.72	–1.34	–5.17	0.85	–3.88

* = Singnificant (P< 0.5) ** = Highly Significant (P< 0.01)

grain weight than LU26S. Twelve crosses showed increase in grain weight over mid parent ranging from 1.06% (Pb. 81 x SS–5) to 9..23% (Pak. 81 x Pb. 81). The crosses viz. Pak. 81 x Pb. 81, Pb. 81 x Pak. 81 and SS–5 x Pb. 81, showed 9.01, 1.90 and 5.29% heterobeltiosis, respectively. The results suggest that varieties LU26S and Pak. 81 can be used in cross combinations to improve grain weight. Heterotic effects for grain weight have also been observed earlier by Ho (3) and Khan et al. (5).

GRAIN YIELD PER PLANT

All the hybrids except two viz. SS–5 x LU26S and SS–5 x Pb. 81 showed positive heterosis over parental means with values ranging from 0.85% (LU26S x SS–5) to 83.7% (Pb. 81 x Kohi. 83) and 75% of the hybrids showed positive heterobeltiosis with values ranging from 0.32% (LU26 S x Pb. 81) to 73.10% (Pb. 81 x Kohi. 83). Seven crosses showed significant increase over respective mid parent values where as five showed over better parents. These crosses provide ample scope for further manipulation to develop high yielding varieties. The results obtained also confirm the earlier observations of heterotic effects for grain yield in wheat reported by Patwary et al. (6) and Khan et al. (5).

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