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ESTIMATES OF HETEROSIS IN WHEAT (*TRITICUM AESTIVUM* L.)

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Abstract

A diallel cross involving eight varieties of wheat *(Triticum aestivum* L.) showed varying degrees of heterosis over better and mid-parent for all the characters studied. Nine crosses showed significant negative heterosis for days to heading over mid-parent. Most of the crosses showed negative heterosis for plant height over their respective taller parent. Maximum heterosis for number of spikes per plant was 141.70% and for spike length was 24.22% over better parent. For grain yield per plant Dirk x Kheri showed maximum heterosis over better and mid-parent (182.91% and 21536%, respectively).

Key words : *Trilicum aestivum* L., Heterosis, Diallel cross.

Introduction

In recent years several investigations have been made for determining heterosis in wheat (Brigglc *et al*., 1967, Bitzer and Fu, 1972; Cregan and Busch, 1978; Grant and Mckenzie, 1970; Sharma and Singh, 1978; Walton, 1971; Yadav and Murty, 1976). In Bangladesh, very few work have been done for determining heterosis in wheat. The estimation of the extent of heterosis is very much needed to exploit heterosis commercially. Brigglc (1963) reported heterosis for yield in wheat upto 84% higher than the higher yielding parent. Gyawali *et al.* (1968) using soft red, soft white and hard red winter wheat varieties reported that 10 out of 28 Fj hybrids yielded significantly more than the better parent in a space-planted experiment.

The present study was undertaken to estimate the extent and nature of heterosis and to identify the outstanding hybrid combinations in a diallel set of crosses.

Materials and Methods

Eight parents of wheat namely, Ananda, Balaka, Ciano 79, Dirk, Kanchan, Kheri, Sonalika and Sonora 64 were crossed in all possible combinations including reciprocals in 1984-85. Fifty six hybrid combinations along with the parents were grown in a randomized complete block design with three replications at the experimental farm of the Institute of Postgraduate Studies in Agriculture, Salna, Gazipur in 1985-86 winter season. In each block, the parents and F^s were planted in rows. The row to row and plant to plant

distance was 30 cm and 20 cm respectively Standard cultural practices were followed for raising the crop. Data on days to heading, plant height (cm), number of spikes/per plant, spike length (cm), 1000-kernel weight (g) and yield/ plant (g) were recorded from ten randomly selected plants from each entry in each replication. Heterosis was estimated over the better and mid-parent and expressed in percentage.

Results and Discussion

Days to heading

Most of the crosses showed negative heterosis over late parent. Only eight crosses showed positive heterosis over late parent (Table 2). Twenty three crosses showed positive heterosis over mid-parent, but only three namely, Kheri x Ananda, Kheri x Dirk and Kheri x Kanchan showed significant positive heterosis. Ciano 79 and Kheri look longer duration for days to heading than other parents (Table 1). Four crosses namely, Balaka x Kanchan, Kheri x Balaka, Sonora 64 x Ananda and Sonora 64 x Sonalika showed highly significant negative heterosis over mid- parent. Some crosses also flowered earlier than the earlier parent. Bilzer and Fu (1972) reported that most of the hybrids were later than the earlier parent in soft red winter wheat. Fonseca and Patterson (1968) reported that Fj hybrids of winter wheat were similar to the earlier parent or were intermediate in earliness.

Plant height

Ciano 79 x Ananda and Ciano 79 x Kanchan showed positive and highly significant heterosis over taller parent (Table 2). Most of the crosses showed negative heterosis over the better parent but over mid-parent most of the crosses showed positive heterosis and the range varied from 0.02 to 36.45%. Briggle *et al,* (1967), Walton (1971) and Yadav and Murty (1976) also reported positive heterosis for plant height in wheat.

Number of spikes Iplant

Eleven showed highly significant positive heterosis over belter parent (Table 2). The range of heterosis over better parent varied from 3.84 to 141.70%. Most of the crosses showed positive heterosis over mid-parent and the highest positive heterosis was observed in Kheri x Ananda (148.92%). Kheri x Ananda showed the highest positive values of heterosis over better and mid-parent as well. Bilzer and Fu (1972), Briggle *el al.* (1967) also reported positive heterosis for number of spikes/plant in wheat.

Spike length

Only jhree crosses namely, Ciano 79 x Sonalika, Dirk x Kheri and Kheri x Dirk showed highly significant positive heterosis over better parent (Table 2). It may be noted that, Dirk x Kheri showed highest values of positive heterosis over better and mid-parent. The range of positive heterosis over better and

Table 1. Mean performance of parents for different characters.

Parents	Days to heading	Plant height (cm)	No. of spikes/ plant	Spike length (cm)	1000-kemel wt. (g)	Grain yield/ plant(g)
Ananda	63.10				40.0	
Balaka	64.27	98.27	8.80	11.81	44.5	20.21
Ciano79	69.87	91.92	12.40	10.84	0	21.26
Dirk	65.13	80.89	9.95	11.51	39.6	18.53
Kanchan	66.13	120.67	11.07	9.37	0	10.30
Kheri	69.6	102.27	10.33	11.69	55.0	18.80
Sonalika	0	126.71	8.29	9.34	48.2	8.18
Sonora 64	59.7	91.55	12.49	11.14	0	23.18
	3	76.02	7.64	9.18		13.65

Table 2. Percent heterosis in Fj over belter parent (BP) and mid- parent (MP)

	Days to heading		Plant height		No. of spikcs/plant		Spike length		1000-kcmcl wt.		Grain yicld/planl	
	BP	MP	BP	MP	BP	MP	BP	MP	BP	MP	BP	MP
Ananda x Balaka	-0.11	0.81	0.16	3.50	4.27	21.98	0.85	5.16	-1.12	4.14	35.00	38.41
Ananda x Ciano 79	-7.54**	-2.84	-1.72	7.81	17.29	24.48	6.09	7.46	12.00	1256	19.10	24.26
Ananda x Dirk	-1.43	0.13	0.71	11.01*	70.55**	90.03**	8.89*	21.43**	-5.09	9.S9	27.51	6S.92*
Ananda x Kanchan	0.06	2.40	-S.92	-7.10	8.42	17.09	-0.50	0.00	-5.39	3.40	25.33	29.86
Ananda x Khcri	-7.57**	-3.04	-5.45	6.49	75.45**	80.69**	-3.55	7.70	37.25**	70.76**	65.02**	134.94**
Ananda x Sonalika	-111	0.58	-4.12	-0.72	3.84	21.84	5.84	8.93	-3.19	10.61	29.34	38.18
Ananda x Sonora 64	-3.28	-0.58	-0.94	11.71	25.00	33.82	0.42	13.00	34.25**	38.76**	11.48	33.07
Balaka x Ananda	-4.42	-3.54	-3.02	0.22	1290	32.07	0.76	5.07	9.44	15.26*	41.20	44.78
Balaka \ Ciano 79	-6.21*	-229	-4.68	1 40	16.1?	28.86	-1.21	1.74	7.64	13.91*	44.68	54.61*
Balaka x Duk	-5.42*	-4.79	-12.46**	•0.63	33.63	41.20	0.74	8.06	-4.55	5.53	70.S8**	130.22**
Balaka x Kanchan	-9.87**	-8.59**	-20.3S**	-16.13**	-14.84	-7.08	-10.35	-6.96	270	6.79	-9.97	-4.44
Balaka x Khcri	-7.23**	-3.53	-13.71**	0.02	64.27**	96.90**	-0.37	7.03	202	31.98**	5292*	120.7S**
Balaka x Sonalika	-4.82	-1.34	-0.04	-0.24	-7.13 ’	-6.79	3.41	4.82	0.56	9.61	-1.04	3.24
Balaka x Sonora 64	-3.22	0.37	-6.04	286	-0.56	23.05	-1.47	6.69	8.76	18.19**	14.91	39.96
Ciano 79 x Ananda	0.37	5.48	24.38**	36.45**	40.70	49.33	6.09	7.46	55.75**	56.53**	69.62**	76.97**
Ciano 79 x Balaka	-6.11*	-219	-6.31	-0.33	9.11	21.07	-295	-0.04	292	8.92	38.90	48.43*
Ciano 79 Diik	-5.68*	-237	-4.29	14.59	5.42	11.04	-1.82	8.23	1.09	1755	28.28	64.89
Ciano 79 Kanchan	-2.49	0.19	21.37**	35.54**	15.17	3254	-0.34	0.43	-5.19	4.10	27.66	2858
Ciano 79 Khcri	-4.82*	-4.64	-1.63	21.05**	94.27**	111.95**	0.95	11.46	-4.55	18.30*	96.33**	172.40**
Ciano 79 Sonalika	-5.30*	2.11	-4.73	1.16	-3.76	7.13	11.12**	12.93**	-7.13	6.56	8.15	20.21
Ciano 79 x Sonora 64	-5.07*	240	10.24	13.66**	40.70	59.18*	8.60*	20.83**	28.03**	31.69**	59.96*	84.21**
Duk x Ananda	0.46	2.05	202	12.46**	67.12**	86.21**	7.19*	19.54**	-4.91	10.10	89.76**	151.39**
Dixk x Balaka	2.21	2.89	-16.33**	-5.02	67.10**	76.56**	-0.83	6.38	-0.73	9.75	57.06*	111.59**
Dirk x Ciano 79	-5.40*	-207	-5.54	13.10**	39.75	47.19	-3.38	6.51	1.82	18.39**	61.47*	107.56**
Dirk x Kanchan	-4.58*	-3.85	-3.60	4.36	86.72**	93.18**	-0.25	10.73*	255	9.30	108.14**	168.93**
Diik X Khcri	-2.40	0.83	2.75	5.25	46.16*	67.15**	24.22**	24.42**	-10.00	24.S4**	182.91**	215.36**
Dirk x Sonalika	-3.93	0.22	-8.57	3.98	33.95	42.02	3.77	1272	255	4.15	38.18	91.34**
Dirk x Sonora 64	-3.42	0.80	-5.15	16.38**	34.33	58.95*	10.46*	1159*	-4.73	13.42*	87.33*	113.53**

Tabic 2 Contd.

Crosses	Days lo heading		Plant height		No. of spikcs/plant		Spike length		1000-kcmcl wt.		Grain yicld/plant	
	BP	MP	BP	MP	BP	MP	BP	MP	BP	MP	BP	MP
Kanchan x Ananda	-7.41 ••	-5.24*	-5.01	-3.11	20.72	30.37	-0.25	0.25	11.20	21.54**	22.96	27.40
Kanchan x Balaka	•4.78	-3.42	-13.20**	-8.57	-4.84	3.83	-7.18*	-3.68	3.11	7.22	-10.68	-5.19
Kanchan x Ciano 79	-5.50*	-2.89	-6.80	4.07	6.49	8.48	3.85	4.65	8.09	18.68**	48.46	49.53
Kanchan x Diric	-3.78	-3.05	0.48	8.77*	62.60**	68.22**	-4.36	6.17	-6.18	0.00	100.11**	153.56**
Kanchan x Khcri	-5.85*	-3.18	-247	7.94	51.21*	67.77**	-9.15*	0.99	-11.41	17.79*	51.44*	113.27**
Kanchan x Sonalika	-7.41 •*	-2.70	-13.25**	-8.45	-10.89	-2.45	0.43	2.84	-1.31	3.65	-14.54	-5.62
Kanchan x Sonora 64	-7.80**	-3.07	-9.99*	3.26	7.16	23.20	-7.10	4.07	-7.88	3.74	18.46	37.25
Khcri x Ananda	1.82	6.81**	3.59	16.68**	141.70**	148.92**	-8.63*	2.03	2.25	27.21**	60.22*	128.10**
Khcri x Balaka	-11.59**	-8.07**	-237	13.17**	27.98	53.40*	-7.01	-0.10	-4.04	24.12**	-5.97	35.80
Khcri x Ciano 79	-1.43	-1.24	-7.39*	13.05**	13.87	24.23	-2.17	8.00	8.84	34.89**	18.56	64.50
Khcri x Dirk	2.30	5.69*	0.07	2.51	46.52*	67.56**	18.46.**	18.65**	-26.73**	1.64	120.68*	145.99**
Khcri x Kanchan	4.21	7.16**	3.46	6.84	33.30	47.90	-12.91**	-3.18	-28.04**	-4.55	-13.46	20.60
Khcri x Sonalika	-3.12	4.27	-4.51	10.88*	16.09	39.56	-9.96*	-2.05	-30.77**	-4.89	-2152	14.54
Khcri x Sonora 64	-1.54	6.02	1.86	27.33**	64.05*	70.75*	8.56*	9.50	-0.53	21.88*	70.26*	U192*
Sonolika x Ananda	-4.07	-1.44	1.25	4.84	68.13**	97.27**	9.23*	12.42**	-2.81	11.04	67.52**	7S.9S**
Sonalika x Balaka	-9.71**	-6.40*	-295	-2.75	-22.10	-21.82	0.98	2.36	-8.25	0.00	-20.12	-16.56
Sonalika x Ciano 79	-6.35**	0.97	1.22	7.48	-15.93	-6.42	7.73	9.49*	3.94	19.26**	-30.24	-2146
Sonalika x Diric	-3.73	0.43	-4.00	9.17	37.87	46.18	10.05*	19.55**	-8.91	-7.48	37.36	90.20**
Sonalika x Khanchan	-7.20**	-2.48	-14.06**	-9.30	-23.14	-15.86	-4.53	-2.24	-4.32	0.49	-14.45	-5.52
Sonalika x Khcri	•11.11**	-4.32	•8.26*	6.51	15.85	39.27	-4.22	4.19	-8.26	26.03**	189	5110
Sonalika x Sonora 64	3.08	3.13	-1.09	8.07	37.07	70.09**	7.18	17.52**	106	19.95**	54.96**	95.05**
Sonora 64 x Ananda	-15.10**	-12.73**	-8.22	3.49	15.11	23.23	-9.14*	2,24	21.00 *	* 25.06**	-14.30	130
Sonora 64 x Balaka	-6.85**	-3.39	-4.92	4.08	-8.06	13.77	-3.59	4.39	102	10.86	-1.93	19.45
Sonora 64 x Ciano 79	-11.45**	•4.47	10.90	14.35*	53.47*	73.62**	2.52	14.06**	9.60	1172	81.70**	**11230****
Sonora 64 x Dirk	-3.38	0.85	-13.73**	5.85	22.67	45.16	11.74*	12.88**	-15.09**	1.0S	70.70*	**94.57***
Sonora 64 x Kanchan	-7.30**	**-2.54**	-12.58**	0.28	14.23	31.33	**-9.66•**	**1.19**	**-5.60**	**6.30**	**7.93**	***25.05***
Sonora 64 x Khcri	-10.39**	**-3.50**	**-11.46****	10.67*	**88.18****	**95.85*** •	**5.99**	**6.91**	***14.97***	**39.38****	**123.74****	***179.80•****
	-11.99**	**-11.94****	**-1.54**	**7.58**	**-26.90**	**-9.28**	**-3.68**	**5.61**	***-6.94***	**9.37**	**-26.53**	***-7JS2***

«*», SiOTiVEicam. at 5% and 1% level of probability respectively

mid-parent varied from 0.85 tp 24.22% and 0.43 to 24.42%, respectively. -Burloi (1972) reported positive heterosis over better parent for spike length in wheat.

1000-kernel weight

Five crosses showed highly significant positive heterosis over better parent while 18 crosses showed positive and highly significant heterosis over mid-parent (Table 2). Highest heterosis over better parent was observed in Ciano 79 x Ananda (55.75%) while over mid- parent highest heterosis was observed in Ananda x Kheri (70.76%). Bilzer and Fu (1972), Burloi (1972) and Gyawali *cl al.* (1968) reported significant positive heterosis over better parent for 1000-kernel weight in wheat.

Grain yield!plant

Forty three crosses showed positive heterosis over belter parent and 49 showed positive heterosis over mid-parent. Twelve crosses showed highly significant positive heterosis over better parent while 22 crosses showed highly significant positive heterosis over mid-parent Highest heterosis over better and mid-parent was observed in Dirk x Kheri (182.91% and 215.36%, respectively). The parents with poor mean values showed highest positive heterosis for grain yicld/plant. Bitzer and Fu (1972), Brigglc *cl al.* (1967) also reported positive heterosis for grain yicld/plant in wheat.

The present investigation revealed that varying degrees of heterosis was present for most of the characters studied over belter and mid-parent. Heterosis in yicld/plant was observed in most of the crosses. The crosses Ananda x Kheri, Balaka x Dirk, Ciano 79 x Ananda, Ciano 79 x Kheri, Dirk x Ananda, Dirk x Kanchan, Dirk x Kheri, Kanchan x Dirk, Sojialika x Ananda, Sonalika x Sonora 64, Sonora 64 x Ciano 79 and Sonora 64 x Kheri can be selected for high heterotic value for grain yield per plant.

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