

## HYBRID VIGOUR IN INTERVARIETAL CROSSES OF UPLAND COTTON

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### Abstract

Heterosis studies were undertaken in seven intervarietal F<sub>1</sub> hybrids of *Gossypium hirsutum* L., for number of sympodia, number of monopodia, number of bolls, boll weight, ginning outturn percentage, staple length and seed cotton yield. Mean squares revealed that all the hybrids and their parents were significantly ( $P < 0.01$ ) different for all the characters except boll weight. All the hybrids manifested hybrid vigour over their mid parent values for all the characters under study except monopodia per plant, where four hybrids also exhibited positive heterotic effect. Majority of the hybrids transgressed over their better parent values and all the hybrids showed heterobeltiotic effects for seed cotton yield per plant. The hybrid of Qalandari X CIM-109 out yielded the performance than the other crosses, the values being 100.56 and 89.24 % in comparison to their mid and better parent values respectively. The results indicate that all the cross combinations could be utilized for getting higher yield as hybrid production.

### Introduction

Cotton is the most important fibre crop which plays a vital role in the economy of Pakistan. The utility of cotton crop has attracted maximum attention from plant breeders and their concrete efforts have led to evolution of high yielding and better qualitative varieties which are largely responsible for cotton production in the country. The need for genetic improvement of cotton is even greater today than in the past. The conventional methods of breeding have contributed towards the improvement of cotton plant. The success of these methods, depend mainly upon the availability of genetic variability according to our requirements. Greater variability offers the numerous alterations that could successfully be combined in one variety. In this regard new approaches are being utilized for hybridization both for variety development and commercial exploitation of heterosis. The manifested heterosis is considered to be of importance which has been investigated by many workers in different crops. In cotton Khan & Ali (1980) studied hybrid vigour for seed cotton yield and its components. They reported an increase of about 142.1 % in seed cotton yield due to heterotic effects in the F<sub>1</sub> hybrid of *hirsutum* cotton. The magnitude of the heterosis largely depends on the genetic diversity between the parents. It is known that genetically diverse varieties manifest more hybrid vigour as compared to closely related ones. Mithaiwala *et al.*, (1984) and Khan *et al.*, (1984) reported that the hybrids showed maximum superiority in yield than the other traits studied. The present investigation was therefore, undertaken to estimate the extent of hybrid vigour in intervarietal hybrids of upland cotton.

**Table 1. Average performance of F<sub>1</sub> Hybrids and their parents for important characters of cotton, *Gossypium hirsutum* L.**

Genotypes	Sympodial branches per plant	Monopodial branches per plant	No. of bolls per plant	Boll weight (gms)	Ginning outturn percentage	Staple length	Seed Cotton per plant (gms)
Qalandari x Shaheen	18.2	1.7	28.0	2.8	34.6	27.0	78.4
Qalandari x Rajhans	16.2	2.3	21.5	2.9	34.2	26.7	62.3
Qalandari x CIM-109	18.2	1.7	37.0	2.9	34.9	28.5	107.3
Shaheen x Rahmani	14.9	2.1	20.5	2.8	34.0	27.0	59.4
Saheen x NIAB-78	18.2	2.4	24.5	3.1	34.6	27.2	68.6
NIAB-78 x Rajhans	16.9	1.1	23.2	2.6	34.6	26.8	72.1
NIAB-78 x CIM-109	19.9	1.3	31.5	2.7	35.0	28.0	84.4
Qalandari	14.5	2.5	21.0	2.4	33.7	26.6	50.4
Shaheen	17.6	1.6	19.5	2.7	34.5	26.6	52.6
Rajhans	16.1	2.3	17.5	2.2	33.6	27.0	38.5
CIM-109	16.3	1.2	21.5	2.7	34.6	25.9	56.7
Rahmani	20.3	2.5	17.5	2.5	35.1	27.2	42.0
NIAB-78	17.6	1.1	16.5	2.6	34.5	26.6	42.9
S.E.	0.77	0.20	2.28	0.200	0.200	0.34	6.23
C.V.	8.90	23.28	19.85	14.29	1.20	2.56	19.87
Cd <sub>1</sub>	2.19	0.56	6.54	---	0.57	0.97	17.88
Cd <sub>2</sub>	2.93	0.76	8.77	---	0.76	01.13	12.96

## Materials and Methods

The experimental material comprised of seven intra *hirsutum* crosses viz, Qalandari x Shaheen, Qalandari x Rajhans, Qalandari x CIM-109, Shaheen x Rahani, Shaheen x NIAB-78, NIAB-78 x Rajhans and NIAB-78 x CIM-109 and their parents. All the  $F_1$  seed alongwith their parental lines were raised in Randomized Complete Block design with four replications. The sowing was done by dibbling method in rows of five metre length. Four rows of each genotype per replication were sown at 25 cm distance between plants and 70 cms within rows. All  $F_1$  plants from each cross and ten plants from each parental genotype were randomly selected for the observations of number of sympodial branches per plant, number of monopodial branches per plant, number of bolls per plant, boll weight, ginning outturn percentage, staple length and yield of seed cotton per plant. The entire data was subjected to statistical analysis as per design of the experiment. The mean hybrid values were compared with the mean mid and better parent values to calculate the magnitude of heterosis.

## Results and Discussion

Mean squares of all the characters studied (Table 2), show that all the traits are significantly different at 1% level for genotypes except boll weight. Data on average performance of hybrids and their parents for all the characters (Table 1) reveal that generally hybrids gave the best performance in comparison to their parents for most of the characters. Yield which is the sum of all the characters showed significant increase in all the hybrids. The cross combination of Qalandari x CIM-109 out yielded all hybrids followed by NIAB-78 x CIM-109.

The data regarding percentage increase or decrease over mid and better parent values (Table 3) reveal that all  $F_1$  hybrids showed increase in sympodial branches per plant than their mid parents, whereas, five hybrids transgressed than their better parents. The hybrid of the cross Qalandari x CIM-109 gave maximum values of 18.18 and 11.65% over mid and better parents respectively followed by the cross NIAB-78 x CIM-109 with 17.75 and 13.06% over mid and better parents respectively.

Regarding the character monopodial branches per plant a positive heterosis was found in three hybrids of the crosses Shaheen x NIAB-78, NIAB-78 x CIM-109 and Shaheen x Rahmani over their respective mid parents and two of them also exceeded their better parents. The maximum increase of 77.78% and 50.00% over mid and better parents, was found in the cross Shaheen x NIAB-78.

The data for number of bolls per plant showed that all the hybrids transgressed than their mid as well as better parent values, which ranged between 10.81% to 76.19% over their mid parent and 2.38% to 76.19% to 76.19% over their mid parent and 2.38% to 76.19% over better parents, respectively. The maximum increase in number of bolls per plant of 74.12 and 72.09% over its mid and better parents was observed in the hybrid of the Qalandari x CIM-109 followed by the hybrid NIAB-78 x CIM-109 which increased by 68.00% and 50.00% over its mid and better parent values. The results indicated that over dominance of genes played an important role in the inheritance of this character.

The results of boll weight indicated that mostly all the  $F_1$  hybrids showed transgressive segregation. The heterotic values ranged between 3.84% to 26.09% with an average

Table 2. Mean squares of F<sub>1</sub> generation and their parents for important characters of cotton, *Gossypium hirsutum* L.

Source	D.F.	No. of sympodial branches per plant	No. of monopodial branches per plant	No. of bolls per plant	Boll weight (gms)	G.O.T. %	Staple length	Yield of seed Cotton per plant (gms)
Replications	3	7.32	0.14	21.43	0.19	0.54	0.63	162.35
Genotypes	12	12.16	1.26	140.96	0.20	0.83	1.48	1511.09
Error	36	2.38	0.18	20.84	0.15	0.17	0.48	155.38

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p&lt;0.01 NS = Non - significant

Table 3. Percentage Increase (+) or decrease (-) of F<sub>1</sub> Hybrids over their mid and better parent values for important characters of cotton, *Gossypium hirsutum* L.

S.No. F <sub>1</sub> Hybrids	Sympodial branches per plant		Monopodial branches per plant		No. of bolls per plant		Boll weight		Ginning Outturn percentage		Staple length		Seed cotton yield per plant	
	Mid	Better	Mid	Better	Mid	Better	Mid	Better	Mid	Better	Mid	Better	Mid	Better
1. Qalandari x Shaheen	+13.39	+03.41	-17.07	-32.41	+38.27	+33.33	+12.00	+03.70	+01.47	+0.29	+1.50	+1.50	+52.23	+49.04
2. Qalandari x Rajhans	+05.88	+00.62	-04.16	-08.00	+11.69	+02.38	+26.09	+20.83	+02.09	+1.48	-0.37	-1.11	+40.31	+23.61
3. Qalandari x CIM-109	+18.18	+11.65	-05.55	-32.00	+74.12	+72.09	+16.00	+07.40	+02.64	+0.86	+8.77	+7.14	+00.56	+89.24
4. Shaheen x Rahmani	+21.16	-26.60	+02.44	-16.00	+10.81	+05.13	+07.69	+03.70	-02.29	-3.13	+1.49	00.00	+25.58	+12.93
5. Shaheen x NIAB-78	+03.40	+03.40	+77.78	+50.00	+16.11	+25.64	+20.76	+16.29	+00.29	-0.29	+2.64	+2.25	+43.51	+30.41
6. NIAB-78 x Rajhans	+00.59	-03.97	-35.29	-52.17	+36.76	+32.85	+08.33	00.00	+01.76	+0.29	+0.00	-0.74	+77.14	+68.06
7. NIAB-78 x CIM-109	+17.75	+13.06	+13.04	+08.33	+68.00	+50.00	+03.84	00.00	+02.94	+1.16	+6.87	+5.26	+69.48	+48.85
Average	+05.43	+00.22	+04.45	-11.69	+39.69	+32.21	+13.53	+07.41	+01.27	+0.17	+2.98	+2.04	+58.40	+46.02

of +13.53% over mid parents and between 3.70 to 20.83% with an average of +7.41% over better parents. In this respect most successful hybrid of the cross was Qalandari x Rajhans which increased its boll weight over mid and better parent values by 26.09% and 20.83% respectively. The second most successful hybrid was Shaheen x NIAB-78 which showed heterotic effects of 20.76% and heterobeltiosis of 16.29%. Regarding ginning outturn percentage, all the F<sub>1</sub> hybrids exceeded their mid parent values except one hybrid, while in five hybrids heterobeltiotic effect was also found in this regard. The values varied from 2.29% to 2.94% as compared to their mid parent values and -3.13% to 1.48% as compared to their better parent values. The highest heterotic values were observed in the cross of NIAB-78 x CIM-109 by increasing its ginning outturn percentage by 2.94% and 1.16% over mid and better parent values, respectively.

The data for the staple length (Table 3) showed that six out of seven F<sub>1</sub> hybrids were superior to their mid parents, while four of the hybrids exhibited heterobeltiosis. The highest increase in staple length (8.77% and 7.14%) over mid and better parent values, respectively, was observed in the hybrid Qalandari x CIM-109.

The results regarding seed cotton yield indicate that all the hybrids showed positive and transgressive heterosis values which varied from 12.93% to 89.24% over their better parents also. The maximum seed cotton yield was observed in the hybrid Qalandari x CIM-109 which showed an increase of 100.56% and 89.24% over its mid parent and better parent values respectively. The second high yielding hybrid was NIAB-78 x Rajhans which showed heterosis of 77.14% and heterobeltiosis of 68.06% in seed cotton yield. These findings indicate dominance and over dominance for the inheritance of this trait.

The results of the present investigation indicates that all the F<sub>1</sub> hybrids of *hirsutum* cotton exhibited various level of heterosis for different characters. The results obtained are supported by the investigations made by Rakhmenov (1981), Ahmad & Channa (1981), Soomro *et al.*, (1982) and Azhar *et al.*, (1982) who found that hybrid values were superior than their parental means for different characters of cotton. Similarly, Aslam & Khan (1983) observed the degree of heterosis, heterobeltiosis and inbreeding depression in some intraspecific crosses of cotton. They reported that most of the crosses exhibited not only heterotic but also the heterobeltiotic effects for almost all the characters studied. The heterotic and heterobeltiotic estimates ranged between 4.22 to 82.79% and 22.25 to 73.46%, respectively for seed cotton yield. However, present results are further supported by Mithaiwala *et al.*, (1984) who found heterosis in eight intraspecific crosses of *G. hirsutum* L., and reported that seven crosses manifested heterosis. They further reported that the hybrids showed maximum superiority in yield than the other traits studied. The observations of Khan *et al.*, (1984), Vetchinkina *et al.*, (1985), Pavlovskaya *et al.*, (1985), Khan (1986), Udaya Kumar (1986), Sarwar *et al.*, (1986), Mirza (1986) and Tiwari *et al.*, (1987) also supported the present findings. Malik *et al.*, (1987) also found various degrees of heterosis in F<sub>1</sub> hybrids for all the characters studied while analysing six intraspecific crosses of *Gossypium hirsutum* L. It could be concluded that the F<sub>1</sub> hybrid of the cross Qalandari x CIM-109 proved to be a superior than all the others in respect of sympodial branches per plant, number of bolls per plant, staple length and seed cotton yield per plant. It would suggest that hybrid vigour could be exploited successfully towards getting high yield in cotton.

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