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## Heterosis Studies in Varietal Crosses of (*Gossypium hirsutum* L.) for Certain Economic Characters

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**Abstract:** Heterosis studies were carried out in six intra specific hybrids of *G. hirsutum* L. for number of sympodial branches, number of bolls, boll weight and seed cotton yield per plant on an average performance. All hybrids gave better results than their parents. Highest increase of hybrids 69.23% for boll weight was over their parents was observed followed by 64.24% for seedcotton yield, 22.97% for number of bolls and 19.62% for number of sympodia per plant.

**Key words:** Heterosis, *G. hirsutum*, boll weight, seed cotton, yield

### Introduction

Pakistan is one of the developing countries and economy of Pakistan depends upon the Agriculture dispute substantial progress made to diversified resources, agriculture, by parts still play the most important role in the economy of Pakistan. Among the cash crops of cotton (*G. hirsutum* L.) the silver fibre of the world ranks high by contributing about 29.64% to Agriculture Sector (Anonymous, 1988a).

The importance of this crop attracted maximum attention of the Plant Breeders and their concerted and sustained efforts had been made in the past for its genetic improvement in order to have increased yield of seedcotton and as a result of these efforts, the total production on the national level increased considerably and in the year 1999-2000 Pakistan obtained million 11.241 million bales in the area of 2.903 million hectares (Anonymous, 2001).

Still Pakistan is behind the production on a unit area basis as compared with the advanced cotton growing countries of the world like U.S.A., Australia, Brazil, Israel, U. S. S. R. and Syria. For achievement of an improved cotton varieties a comprehensive information on the genetic systems controlling various economic characters of cotton plant in different cross combination is one of the short way solution to increase yield and yield components of cotton without increasing the area under cotton cultivation.

Amanturdiv *et al.* (1991) studied the yield and yield components in hybrids from diallel set of crosses involving *G. hirsutum* and *G. barbadense* varieties and hybrids proved high yielding the heterotic effect was highest in the crosses of *G. barbadense* than those of *G. hirsutum*. Mukhtiar and Khan (2000) have reported a reasonable amount of heterosis on boll weight while studying the  $F_1$  generation of *G. hirsutum* L. Chang *et al.* (2001) studied the heterotic effects of high magnitude was shown over all parents in general and over mid parents in particular all the hybrids exhibited high values of the heterosis over their respective mid parent values which ranged from 19.4 to 54.3% for bolls per plant where as the mean values increased from 18.1 to 46.5% over their better parents also observed positive heterosis values for seedcotton yield, sympodial branches, boll weight and bolls per plant. Soomro *et al.* (1999) reported nine hybrids out of 10 of upland cotton gave positive heterosis with respect to seedcotton yield per plant the maximum heterosis was recorded 52.3% and was in range of 1.5 to 52.3% for number of bolls per plant ranged from 30.7 to 41.5%, 8 hybrids infested positive heterosis for boll weight. Solangi *et al.* (2001) reported the expression of positive heterosis for bolls / plant in 10 intra specific hybrids of *G. hirsutum* x *G. barbadense* the range of increase of heterosis over mid parent and better parent was 12.0 to 118.0% and 11.0 to 109%.

Therefore, this research work was designed to generate the information to estimate the extent of heterosis in various economic characters of cotton. It will provide guide lines to the Cotton Breeders for further development of an improved cotton variety.

### Materials and Methods

The  $F_1$  seed of six intra specific hybrids of *G. hirsutum* was raised by crossing and was sown along with their respective parents in Randomized Complete Block Design (RCBD) with four replications at Cotton Research Sub-station Dadu during 1998. The row to row and plant to plant distance apart was 2.5 and 1.0 feet, respectively and length of row was 30 feet, ten plants from each cross and parental lines were randomly selected. The details of crosses are given as under:

Qalandri x K-68/9	K-68/9 x Shaheen
Qalandri x Shaheen	K-68/9 x Rehmani
Qalandri x Rehmani	Shaheen x Rehmani

The performance of hybrids was evaluated for average of seedcotton yield per plant average sympodial numbers per plant, average bolls per plant, average boll weight in grams. Analysis of variance was carried out as adopted by Steel and Torrie (1981). Heterosis over the mid parent and high parent were calculated using the formula suggested by Fehr (1987).

$$\text{Mid parent Heterosis} = \frac{F_1 - MP}{MP} \times 100$$

$$\text{Mid parent Heterosis} = \frac{F_1 - HP}{HP} \times 100$$

Where $F_1$	=	Hybrid value
MP	=	Mid parent value
HP	=	High Parent value

### Results and Discussions

Mean performance of parents and  $F_1$  hybrids for four economic characters were given in Table 1. The analysis of variance (Table 2) indicated the presence of highly significant variation for sympodia, yield, boll weight and significant variation for number of bolls per plant among the genotypes. Table 3 reflected the difference of hybrids and their parents over mid parent and better parent values indicating the possible presence of heterosis in all the traits.

**Sympodial branches per plant:** There was highly significant variation between hybrids and their mid parents for their character except one cross combination Shaheen x Rehmani, which showed decrease 6.8% over mid parent (Table 3). Qalandri x K-68/9 gave the highest increase in number of sympodial branches over their mid parent 41.1% followed by K-68/9 x Shaheen (31.2%), Qalandri x Shaheen (30.7%), Qalandri x Rehmani (13.9%) and K-68/9 x Rehmani (3.0%) respectively. The results are in full confirmation with the results obtained by Altaf *et al.* (1996), Keerio *et al.* (1996), Chang *et al.* (2001).

**Number of bolls per plant:** Number of bolls per plant is considered as one of the most important yield components and their was significant

Table 1: Mean performance of parents and F1 hybrids for four economic characters

Parent / Hybrid	No. of Sympodia per plant	Number of Bolls/plant	Boll weight (gm)	Yield in gm per plant
Qalandri	15.5	21.7	2.5	55.2
K-68/9	17.0	24.0	2.9	62.8
Shaheen	15.0	23.0	2.4	62.2
Rehmani	16.0	23.9	2.7	57.2
	15.8	23.1	2.6	59.3
Qalandri x K-68/9	23.0	31.6	3.9	112.5
Qalandri x Shaheen	20.0	30.8	4.5	99.5
Qalandri x Rehmani	18.0	24.4	4.9	92.1
K-68/9 x Shaheen	21.0	35.6	4.3	112.1
K-68/9 x Rehmani	17.0	23.4	4.9	89.9
Shaheen x Rehmani	14.5	25.4	4.4	78.7
	18.9	28.5	4.4	97.4
Average – Parents	15.8	23.1	2.6	59.3
Average – Hybrids	18.9	28.5	4.4	97.4
Increase over parent	19.62%	22.97%	69.23%	64.24%

one cross K-68/9 x Rehmani which showed decrease 2.5% both in mid and better parents (Table 3). Cross K-68/9 x Shaheen gave the highest increase in bolls per plant (51.5%) followed by Qalandri x K-68/9 (38.6%), Qalandri x Shaheen (37.5%), Shaheen x Rehmani (8.0%) and Qalandri x Rehmani (7.0%) over their mid parent. Similar results were obtained by Ansari (1994), Kowsalya and Raveendra, (1996), Soomro *et al.* (1999), Solangi *et al.* (2001).

**Boll weight in grams:** All the hybrids gave positive heterotic effects ranging from 44.4% (Qalandri x K-68/9) and 88.4% (Qalandri x Rehmani) over their mid parents and from 34.4% (Qalandri x K-68/9) to 81.4% (Qalandri x Rehmani) over their better parents (Table 3). Results obtained by authors are in full confirmation with the results obtained by Mukhtiar and Khan (2000), Chang *et al.* (2001) and Soomro *et al.* (1999).

**Seed cotton yield per plant:** In case of yield of seedcotton (Table 3), all the crosses showed high magnitude of heterosis over mid and better

Table 2: Mean squares from analysis of variance for four economic characters

Source of variance	df	Mean squares			
		Sympodia	No. of bolls	Boll weight	Yield
Rep.	3	1.2333	33.6893	0.2748	152.6866
Hybrid	9	31.3777**	84.5664*	36.5263**	1957.5855**
Error	27	6.0851	27.8819	5.6727	242.4085

\*, \*\* Significant at 5% and 1% probability

Table 3: Heterosis in various economic characters

Name of character	Name of cross combination	Female parents	Male parents	Mid parents	F1 hybrids	Percentage character increase (+) or decrease (-) over F1	
						Mid parent	Better parent
Sympodial Branches	Qalandri x K-68/9	15.5	17.0	16.3	23.0	+41.1	35.3
	Qalandri x Shaheen	15.5	15.0	15.3	20.0	+30.7	29.0
	Qalandri x Rehmani	15.5	16.0	15.8	18.0	+13.9	12.5
	K-68/9 x Shaheen	17.0	15.0	16.0	21.0	+31.2	23.5
	K-68/9 x Rehmani	17.0	16.0	16.5	17.0	+3.0	0
	Shaheen x Rehmani	15.0	16.0	15.5	14.5	-6.8	-10.34
Number of bolls per plant	Qalandri x K-68/9	21.7	24.0	22.8	31.6	+38.6	31.6
	Qalandri x Shaheen	21.7	23.0	22.4	30.8	+37.5	33.9
	Qalandri x Rehmani	21.7	23.9	22.8	24.4	+7.0	2.0
	K-68/9 x Shaheen	24.0	23.0	23.5	35.6	+51.5	48.3
	K-68/9 x Rehmani	24.0	23.9	24.0	23.4	-2.5	-2.5
	Shaheen x Rehmani	23.0	23.9	23.5	25.4	+8.0	6.2
Average boll weight in (gm)	Qalandri x K-68/9	2.5	2.9	2.7	3.9	+44.4	+34.4
	Qalandri x Shaheen	2.5	2.4	2.5	4.5	+80.0	+80.0
	Qalandri x Rehmani	2.5	2.7	2.6	4.9	+88.4	+81.4
	K-68/9 x Shaheen	2.9	2.4	2.6	4.3	+65.3	+48.2
	K-68/9 x Rehmani	2.9	2.7	2.8	4.9	+75.0	+68.9
	Shaheen x Rehmani	2.4	2.7	2.6	4.5	+73.0	+66.6
Seedcotton yield in (gm) per plant	Qalandri x K-68/9	55.2	62.8	59.0	112.5	+90.6	79.1
	Qalandri x Shaheen	55.2	62.8	58.7	99.5	+69.5	60.0
	Qalandri x Rehmani	55.2	57.2	65.2	92.1	+63.8	61.0
	K-68/9 x Shaheen	62.8	62.2	62.2	112.1	+79.4	78.5
	K-68/9 x Rehmani	62.8	57.2	60.0	89.9	+49.8	43.1
	Shaheen x Rehmani	62.2	57.2	59.7	78.7	+31.8	26.5

variation between hybrids and their mid parents for the character except parents ranges from 31.8% (Shaheen x Rehmani) to 90.6% (Qalandri x K-68/9). While in comparison with better parents, values of heterosis ranged from 26.5% (Shaheen x Rehmani) to 79.1% (Qalandri x K-68/9). The results obtained by the authors for seedcotton yield are in full confirmation with the results obtained by Soomro *et al.* (1999) and Chang *et al.* (2001).

Heterosis studies for certain economic characters were carried out on six intra specific hybrids of *G. hirsutum* L. for number of sympodial parental values. The magnitude of heterosis when compared with mid

branches, number of bolls per plant, boll weight in gms and yield in gms per plant. All hybrids exhibited positive mid parent heterosis with respect all characters under study. Only two hybrids Shaheen x Rehmani and K-68/9 x Rehmani which manifested negative heterosis for sympodial branches and number of bolls per plant respectively. However positive mid and better parents heterosis for seedcotton yield ranged from 31.8 to 90.6% and 43.1 to 79.0%, for seedcotton yield followed by 44.4 to 88.4% and 34.4 to 81.45% for boll weight, 7.0 to 51.5% and 2.0 to 48.3% for number of bolls per plant and 3.0 to 41.1% and 0.0 to 35.3% for sympodial branches. These results thus suggested that

parents used in this studies have the potential to be exploited either for hybrid crop development or selection of transgressive segregates in filial generations.

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