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Genetic Studies of Cotton (*Gossypium hirsutum* L) *I*. Combining Ability and Heterosis Studies in Yield and Yield Components

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To estimate the heterosis and combining ability effects in cotton, 4 x 4 diallel cross experiment was conducted. Significant general combining ability effects were observed in seed cotton yield, bolls per plant, plant height, seeds per boll and seed index, (100 seed weight), whereas specific combining ability effects were significant for seed cotton yield, bolls per plant, boll weight, seed index and non significant for plant height and seeds per boll. Reciprocal effects were observed for seed index only. B557 was the best general combiner for seed cotton yield, bolls per plant and plant height. Heterosis and heterobeltiosis were observed for all the characters under study.

Key words: General combining ability, Specific combining ability, Hybrid, Heterosis.

Introduction

To utilize heterosis for yiel prior selection of the parents is required. These parents must posses better general and specific combining ability, so that they can be used to make hybrids. The breeder must be familiar with the type of gene action involved in the control of various characters. The information of gene action helps the breeder in predicting the performance of different hybrids. The researchers (Singh *et al* 1982; Virk and Kalsy 1982) have advocated the usefulness of general, specific combining ability and reciprocal effects in cotton. Similarly the significance of heterosis for yield and its components has also been reported by many research workers (Aslam and Khan 1983; Mithaiwala *et al* 1984; Khan 1985). These studies were designed to obtain information regarding combining ability and manifestation of heterosis in different cross combinations.

Materials and Methods

The material consisted of four cotton cultivars viz. Stoneville 112,HA-11-8,B 8890 and B557. The varieties were grown in green house of Dept. of Plant Breeding and Genetics, University of Agriculture, Faisalabad on 13 December, 1988 and crossed in a complete diallel. The seeds of all the crosses and their parents were collected and sown in Post Graduate Agricultural Research Station, Jhang Road, Faisalabad on 10 June, 1989 using randomized complete block design with four replications. Plant to plant and row to row distance was 45cm and 75cm, respectively. The crop improvement practices like fertilizer, irrigation and plant protection were followed as per recommended practices. Each row had twenty plants, and ten competitive plants excluding the border plants were selected per replication for each parent and F_1 for recording the data on seed cotton yield, bolls per plant, boll weight, plant height, seeds per boll and 100 seed weight. Analysis of variance was applied (Steel and Torrie 1980) to observe the statistical difference among different genotypes. General combining ability (GCA) effects, specific combining ability (SCA) effects and reciprocal effects were analyzed by following method 1,model 1(Griffing 1956). Heterosis and heterobeltiosis of each character were calculated in terms of percent increase (+) or decrease (-) of a hybrid against its mid parental value and high parental value, respectively. Significance of heterosis (Wynne *et al* 1970) was tested for all the characters under study.

Results and Discussion

Significant differences among the genotypes for seed cotton yield, bolls per plant, boll weight, plant height, seeds per boll and 100 seed weight were observed. Variance due to general combining ability were highly significant for yield of seed cotton, bolls per plant, plant height, seeds per boll and seed index being higher revealed that additive type of gene action was involved in the inheritance of these traits (Table 1) (Omran *et al* 1974). The specific combining ability variance were highly significant for seed cotton yield, bolls per plant, boll weight and seed index. Reciprocal effects were highly significant for seed index only.

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Among the four parents, B557 was found to be the best general combiner for seed cotton yield, bolls per plant and plant height (Table 2). Parent HA-11-8 was noted to be the best combiner for boll weight and seed index. Stoneville 112 was the best combiner for seeds per boll. B 8890 had average GCA effects for seed cotton yield, bolls per plant and seeds per boll.

The heterosis and specific combining ability effects were calculated for all the crosses, however, the crosses with high heterosis and high specific combining ability for different yield attributes are presented in Table 3. The cross HA-11-8 x B557 showed over dominance for yield of seed cotton by exhibiting heterosis over superior parent. The same cross displayed additive with partial dominance for bolls per plant. Similarly

Table 1

Analysis of variance for combining ability for various plant characters

S.O.V.	d.f	Mean Squares					
		Yield of seed cotton	Bolls per plant	Boll weight	Plant height	Seeds per boll	Seed index
G.C.A.	3	1331.406**	75.717**	0.075	483.687**	23.957**	3.076**
S.C.A.	6	561.314**	23.962**	0.149**	95.484	9.631	0.527**
Reciprocals	6	117.309	9.616	0.021	77.238	3.998	0.425**
Error	45	100.299	5.527	0.036	67.257	5.231	0.123

* Significant at 5% level; ** Significant at 1% level

Table 2

Estimates of general combining ability effects for different plant characters

Varieties	Yield of seed cotton	Bolls per plant	Boll weight	Plant height	Seeds per boll	Seed index
B 557	15.517	3.413	-0.051	9.495	0.912	-0.303
B8890	5.204	1.756	-0.006	-2.835	0.365	-0.208
HA-11-8	-7.468	-2.968	0.138	2.191	-2.536	0.921
Stoneville -112	-13.253	-2.202	-0.079	-8.853	1.260	-0.411

Table 3

Best crosses exhibiting high heterosis over mid parent (A1) over better parent (A2) and high specific combining ability (A3) for various characters studied

Crosses	Yield of seed cotton	Bolls per plant	Boll weight	Plant height	Seeds per boll	Seed index
HA-11-8	(A1) 95.15**	49.97**	11.35	-10.03	13.96	5.31
x B557	(A2)35.00*	13.17	6.45	-12.96	1.22	-0.95
	(A3)20.349	3.138	0.136	-12.218	1.807	-0.024
HA-11-8	(A1)51.71**	21.83	24.46**	26.64**	39.64**	8.62
x B8890	(A2)2.27	-11.40	19.00**	18.29	21.09*	-2.61
	(A3)9.227	1.079	0.381	3.342	1.478	0.621
B8890 x HA-11-8	(A1)15.15	-0.09	19.27**	13.67	25.65**	26.79**
	(A2)-22.17	-27.34	14.04	6.19	8.96	13.68*
	(A3)11.685	2.300	0.085	-10.605	2.940	0.685

* Significant at 5% level ; ** Significant at 1% level

significant over dominance was exhibited by the combination HA-11-8 x B 8890 for boll weight and seeds per boll. The same combination showed additive type of gene action with partial dominance for seed cotton yield and plant height. Reciprocal of this combination (B 8890 x HA-11-8) exhibited over dominance for seed index only. The best specific combination for yield of seed cotton and bolls per plant was HA-11-8 x B 557; for boll weight, plant height and seeds per boll was HA-11-8 x B 8890 and its reciprocal for seed index.

Considering the overall picture, two best crosses HA-11-8 x B 557 and HA-11-8 x B 8890 involved combination of high x average combining parents (Miller and Lee 1964; Omran *et al* 1974). The cross HA-11-8 x B 557, the best performing one for seed cotton yield and bolls per plant showed high SCA as well as high heterosis and parents involved were from diverse sources. Therefore, the performance of cross combination is largely dependent on combining ability of the parents as well as their diversity as has been emphasized in various crops (Murti and Arunachalam, 1966; Sangwan *et al* 1977). It is now obvious that the cross HA-11-8 x B 557 was identified as a specific combination for yield of seed cotton and bolls per plant; HA-11-8 x B 8890 for boll weight, plant height and seeds per boll, its reciprocal for seed index, as one of the parent was best combiner, high SCA effects and high heterosis in the combination.Therefore, their exploitation in heterosis breeding programme to bring about genetic improvement in American Cotton would be most useful. All these results were confined to the four varieties studied in this experiment.

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