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Evaluation of Some Cotton Strains for Their Combining Ability in important Genetic Traits

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ABSTRACT

General and specific combining ability effects were highly significant for all the traits. Reciprocal effects were significant only for plant height. Plant height and fibre fineness were found being controlled through non-additive type of gene action; whereas, seed and lint indices appeared being controlled additively. 4 F produced maximum general combining ability effects for plant height, DPL-26 for fibre fineness and Gossypol free seed for seed and lint indices. Bambasa-49 x DPL-26 produced maximum specific effects for plant height, Bambasa-49 x Gossypol free seed for seed index, Gossypol free seed x DPL-26 for lint index and DPL-26 x 4F for fibre fineness.

Key Words: General combining ability; Specific combining ability; Reciprocal effects; Gene action

INTRODUCTION

Combining ability analysis provides sound footings to the hybridization programmes especially directed to improve the characters, the genetic correlations of which with yield, have been well established in literature. Another important advantage is drawn from this analysis by selecting superior crosses, making a cut short to economize time, labour and capital. Fibre fineness is related to quality of the fibre. The finer fibres generally give a smoother, stronger and superior yarn. Consequently, fine fibre cotton is used in making better grades of yarn. Plant height, seed index, lint index and fibre fineness are included in the present studies to achieve the above objectives.

MATERIALS AND METHODS

The four cotton varieties viz, Bambasa-49, Gossypol free seed, DPL-26 and 4F were grown in 30 x 30 cm earthen pots during December 1997 under greenhouse conditions. All possible crosses (including selfs and reciprocals) at flowering were made. The F1 seed of 12 hybrids alongwith selfed parents was sown in triplicate during June 1998 at the Postgraduate Agricultural Research Station (PARS), University of Agriculture, Faisalabad. The sowing was done with the help of dibbler and space between and within rows was kept as 75 and 30 cm, respectively, following Randomized Complete Block Design. After germination, plants were thinned to one plant per hill. To eliminate the competitive advantage, one plant on either side of the row was treated as non-experimental. At maturity, the data for plant height, fibre fineness, seed and lint indices of each plant were recorded. Laboratory tests were carried out for fibre fineness, seed and lint indices. Plant height was recorded from the ground level to the tip of the plant. Weight of the 100 seeds was treated as seed index. Total produce of the plant was ginned and lint index was calculated by the following formula:

$$\text{Lint Index} = \frac{\text{Seed Index x Lint Percentage}}{100 - \text{Lint Percentage}}$$

Fineness as micronaire value was determined with the help of Sheffield micronaire.

The data were analysed by variance technique as outlined by Steel and Torrie (1980) for level of significance among F1 hybrids and their parents. Analysis of combining ability effects were performed by model II, method I as described by Griffing (1956).

RESULTS AND DISCUSSION

The data showed significant genetic differences among all genotypes of parents and F1's for all characters. The total genetic variability was partitioned into various components attributable to general combining ability (GCA) and specific combining ability (SCA) as defined by Sprague and Tatum (1942) and reciprocal effects (RE) according to Griffing (1956). The data showed that the variance due to GCA was highly significant and greater in magnitude for seed and lint indices, as compared with SCA and RE (Tables I & II), which indicated additive type of gene action being involved in seed and lint indices (Meredith & Bridge, 1972; Patil, 1973; Bhatade *et al.,* 1980; Deshmukh *et al.,* 1980; Bhatade & Bhale, 1983; Duhoon & Singh, 1983; Ghafoor & Khan, 1987; Ashirkulov, 1989; Khan *et al.,* 1991). In contrast, high SCA variance than GCA for plant height and fibre fineness, showed predominance of non-additive type of gene action, which is well supported by earlier workers (Patel, 1973; Waldia *et al.,* 1984; Singh *et al.,* 1987).

GCA. The results about GCA effects have been presented in Table III. 4F showed higher GCA and proved better general combine for plant height. The Gossypol free seed was better general combiner for seed and lint indices. DPL-26 appeared as better general combiner as to fibre fineness (Khan & Khan, 1985; Ghafoor & Khan, 1987; Khan *et al.*, 1991).

Table I. Mean squares due to GCA, SCA and RE in *G. hirsutum* in 4 x 4 diallel cross

Source of variation	D.F.	Plant height	Seed index	Lint index	Fineness
GCA	3	179.23**	5.28**	2.36**	0.03**
SCA	6	78.04**	0.41**	0.12**	0.03**
RE	6	289.06**	0.08	0.03	0.01
Error	30	20.09	0.08	0.02	0.01

** = Highly significant. (= 0.01)

Table II. Estimates of components of variance* and their percentages due to GCA, SCA and RE in *G. hirsutum***

	D.F.	Plant Height	Seed Index	Lint Index	Fineness
GCA	3	13.21	0.61	0.11	-0.0002
		6.49	68.57	54.90	0.81
SCA	6	35.66	0.20	0.06	0.01
		17.53	22.69	31.26	58.47
RE	6	134.48	0.001	0.004	0.003
		66.10	0.15	1.94	11.69
Error	30	20.09	0.08	0.02	0.008
		9.88	8.59	11.90	30.65
Total	45	203.44	0.89	0.20	0.02
	100	100.00	100.00	100.00	100.00

*= Upper values denote variance estimates, **= Lower values deonte variance component in percentage

Table III. Estimates of GCA effects in *G. hirsutum*

Varieties	Plant Height	Seed Index	Lint Index	Fineness
4 F	4.76	-1.06	-0.75	-0.02
DPL 26	-5.87	-0.21	0.00	0.07
Bambasa 49	2.74	0.59	0.25	-0.07
Gossypol Freeseed	-1.63	0.68	0.50	0.02
CD(gi-gj)	2.2412	0.1385	0.663	0.436

SCA. Table IV indicates that cross Bambasa x DPL-26 exhibited higher SCA effects for plant height. The higher SCA effects for seed index and fibre fineness were shown by the Cross Bambasa-49 x Gossypol free seed. The Cross of Gossypol free seed x DPL-26 showed higher SCA value for lint index. It is concluded that the parents, Gossypol free seed and Bambasa-49xGossypol Free Seed had the potential for generating high seed index and fibre fineness segregants. Their specific crosses may be used in breeding programme directed to evolve high yielding better quality genotypes. These results are in support of previous work (Khan & Khan, 1985; Ghafoor & Khan, 1987; Singh *et al.,* 1987)

Table IV. Estimates of SCA effects in *G. hirsutum*

Cross Combination	Plant height	Seed index	Lint index	Fineness
DPL 26 x 4F	4.41	0.36	-0.02	0.03
Bambasa 49 x G. Freeseed	0.24	0.47	0.21	0.13
Bambasa 49 x 4F	3.34	0.07	0.15	0.06
Bambasa 49 x DPL26	7.07	-0.13	-0.03	-0.13
G.Freeseed x 4F	-2.45	-0.54	-0.29	-0.19
G.Freeseed x DPL 26	0.77	0.43	0.30	0.10
CD (Sij – Sik)	3.8819	0.2398	0.1322	0.0755
CD (Sij –Sk1)	3.1695	0.1958	0.1079	0.616

Cross combinations are tabulated in descending order to their merit in the yield of seed cotton per plant

RE. The mean squares for RE were highly significant for plant height. The Cross Bambasa-49 x Gossypol free seed produced higher plant height and seed index. Higher RE for lint index were obtained from the cross Gossypol free seed x 4F. Whereas, hybrid Gossypol free seed x 4F gave better values for fibre fineness. These results (Table V) suggested that single cross performance could be composited with their RE if yield and lint and their components are considered (Abo-El-Zahab & Metwaly, 1979; Bhatade & Bhale, 1983; Ghafoor & Khan, 1987; Khan & Khan, 1985).

Table V. Estimates of RE in *G. hirsutum*

Cross combinations	Plant height	Seed index	Lint index	Fineness
DPL-26 x 4F	-7.98	0.07	0.07	0.12
Bambasa 49 x G.Freeseed	25.86	0.43	0.15	0.08
Bambasa 49 x 4 F	-3.01	-0.01	0.12	0.13
Bambasa 49 x DPL-26	8.40	-0.06	-0.80	-0.03
G.Freesed x 4F	-6.32	0.18	6.07	0.04
G.Freeseed x DPL-26	-3.71	-0.11	0.02	-0.02
CD Rij - rkl	4.4824	0.2769	0.1526	0.872

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