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Combining Ability of Some Hirsute Cotton Types for Economic Traits

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ABSTRACT

Combining ability studies from 4 x 4 diallel crosses revealed that general combining ability effects were highly significant in boll weight and ginning out-turn. The specific combining ability effects were highly significant for yield and staple length. The reciprocal effects were significant for boll number. Additive type of gene action was predominant for boll weight and ginning out-turn. The 4F were higher yield and proved better general combiner for yield.

Key Words: Combining ability; Variation; Cotton

INTRODUCTION

Although remarkable accomplishment in the domain of cotton breeding has already been made by the evolution of an array of high yielding varieties. In view of the increasing demand for raw material in the local textile industry and for more foreign exchange earnings, the breeder is ought to continuously exploit the plant material for greater benefits. The results reported herein are a part of the genetic investigations being carried out in the Department of Plant Breeding and Genetics in order to find the potential of the cotton germplasm for breeding cultivars with increased yield of seed cotton showing better fibre characteristics.

MATERIALS AND METHODS

The four cotton varieties viz. Bambasa, Gossypol free seed, DPL 26 and 4F were grown in 30 x 30 cm earthen pots during December, 1997 under green house conditions. All possible crosses of parents (including selfs and reciprocals) at flowering were made. The F1 seeds of 12 hybrids alongwith selfed parents were sown in triplicate during June, 1998 at the Postgraduate Agricultural Research Station (PARS), University of Agriculture, Faisalabad.

The sowing was done following a Randomized Complete Block Design in three replications with the help of dibbler and space between and within rows was kept as 75 and 30 cm, respectively. 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 seed cotton yield per plant, number of bolls per plant and weight per boll (g) of each plant were recorded. Laboratory tests were carried out for collection of date for ginning outturn and staple length. Total produce of the plant was ginned and seed and lint ratio (ginning outturn percentage) was calculated by the following formula:

$$\text{Ginning outturn (\%)} = \frac{\text{Weight of lint}}{\text{Weight of seed cotton}} \times 100$$

Staple length (mm) was estimated by tuft method by taking the average of two tufts of each sample.

The data were analysed by variance technique as outlined by Steel and Torrie (1980) for 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 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 boll weight and ginning out-turn, as compared with SCA and RE (Tables I & II) which indicated additive type of gene action being involved in boll weight and ginning outturn (Abo-El-Zahab & Metwaly, 1979; Bhatade *et al.*, 1980; Duhoon & Singh, 1983; Singh *et al*., 1989).

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

Source of variation	D.F.	Yield of seed cotton	Bolls per plant	Boll weight	Ginning outturn	Staple length
GCA	3	96.08**	16.82**	0.63**	2.13**	7.26*
SGA	6	130.30**	6.92**	0.07**	0.50	1.70**
RE	6	149.71**	8.65**	0.04	0.33	0.28**
Error	30	10.09	0.40	0.02	0.23	0.10

** = Highly Significant (0.01), * = Significant (0.05)

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

Source of variation	D.F.	Yield of seed cotton	Bolls per plant	Boll weight	Ginning outturn	Staple length
GCA	3	-3.12*	1.30	0.07	0.21	0.71
		2.07**	13.22	51.93	31.74	37.59
SGA	6	73.98	4.01	0.03	0.17	0.99
		49.07	40.77	24.52	25.63	52.23
RE	6	69.81	4.12	0.01	0.05	0.09
		46.30	41.93	8.53	0.15	4.83
Error	30	10.09	0.40	0.02	0.23	0.10
		6.70	4.08	14.02	35.10	5.35
Total	45	150.75	9.84	0.13	0.65	1.89
	100	100.00	100.00	100.00	100.00	100.00

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

In contrast, high SCA variance than GCA for yield of seed cotton, staple length and boll/plant showed predominance of non-additive type of gene action (Duhoon & Singh, 1983; Ragtop, 1986; Mehla *et al.*, 1987; Ghafoor & Khan, 1987; El-Helw *et al.,* 1988).

GCA. 4F showed higher GCA and proved better general combiner for seed cotton yield and boll number/plant (Table III). Gossypol free seed was better general combiner for boll weight. DPL26 appeared as better general combiner with respect to ginning out-turn and staple length. It was found that high yielding parents having high GCA effects produced better hybrid combination as 4F with DPL26. It was concluded that 4F and DPL26 are better general combiners for most of the traits and should be exploited in the varietal improvement programme (Marani, 1967; Konoplya & Fursov, 1976; Singh *et al*., 1989; Hussain & Khan, 1991; Khan *et al.*, 1991).

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

Varieties	Yield of seed cotton	Bolls per plant	Boll weight	Ginning outturn	Staple Length
4 F	4.37	1.74	-0.32	-0.66	-1.41
DPL 26	0.44	0.47	-0.12	0.41	0.61
Bambasa 49	-0.84	-0.56	0.11	-0.16	0.54
Gossypol free seed	-3.99	-1.65	0.33	0.41	0.26
CD(gi-gj)	1.5885	0.3169	0.0687	0.2387	0.1590

Cotton varieties are tabulated in descending order according to their merit in yield of seed cotton per plant.

SCA. Cross DPL26 x 4F exhibited higher SCA effects for yield of seed cotton, number of bolls/plant and staple length. The higher SCA effects for boll weight were shown by the cross Gossypol free seed x DPL26. The cross of Bambasa 49 x 4F-showed higher SCA value for ginning outturn. It is concluded that the parents DPL26 and 4F had the potential for generating high yielding segregants. The results are in accordance with the findings of earlier researchers (Abo-El-Zahab & Metwaly, 1979; Desai, 1980; Hussain & Khan, 1991; Khan *et al*., 1991).

RE. The mean squares for RE were highly significant for yield of seed cotton, number of bolls/plant and staple length and non-significant for other characters. The crosses DPL26 x 4F produced higher seed cotton yield number of bolls/plants and staple length. As RE are higher lint percentage was obtained from the cross Bambasa 49 x 4F. It was concluded that single cross performance could be composited with their RE, while keeping yield and its components in view for making optimistic compromise with lint percentage (Azhar *et al*., 1983; Hussain & Khan, 1991; Khan *et al.*, 1991a, b).

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