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COMBINING ABILITY ANALYSIS OF SOME PLANT CHARACTERS IN *HIRSUTUM* SP.

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Combining ability analysis of the data regarding yield of seed-cotton, number of bolls, boll weight, seed index and lint index revealed that both general and specific combining ability effects were significant in the expression of almost all the characters. However, proportion of variance components due to gca remained greater remained greater for yield of seed-cotton and number of bolls. The inheritance of boll weight, seed index and lint index was shown to be conditioned by genes acting non-additively. Line A 8100 proved to be the best general combiner for yield of seed-cotton and number of bolls, whereas PD 695 remained better for seed and lint indices. For boll weight the parent AUH 50 showed its superiority for general combining ability.

INTRODUCTION

Now-a-days numerous biometrical techniques are available to a research worker which greatly help assess the plant material regarding the existence of variability and its genetic basis. Analysis of the data following combining ability technique (Griffing, 1956) is one of them, and has been followed here to study the inheritance pattern of variation in different plant characters in cotton belonging to *hirsutum* sp. The results reported herein is a part of the genetic investigations being carried 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

A sample of four unrelated and distinguishable cotton varieties/lines (AUH 50, A 8100, BW-76 31DH and PD 695) was taken and planted in the glasshouse during the month of December, 1990. Inbuilt steam heaters were used to maintain temperature (80-120 °F) conducive for plant growth and development, and day length was supplemented by lighting mercury vapour lamps of 400 watts each during the months of December and January. When the parental lines started to flower during February/March, these were crossed according to diallel system of crossing. To collect sufficient F_1 seed of each of the crosses all the floral buds available were crossed; some of them were also selfed. All the necessary precautions were made at the time of emasculation and pollination to eliminate the chances of stray pollen contamination.

During the ensuing crop season, the seeds of the twelve hybrids (including single and reciprocals) and the four parents were field-planted in four replications following randomised complete block design of layout. Each of the 16 entries was sown in a single row each 3 m long having eleven plants spaced 30 cm within the row and 75 cm apart between the rows. During the studies, normal agronomic practices were adopted. At the time of maturity two plants, one at each end of the row, were left non-experimental and the remaining nine consecutive plants were taken for recording the data. Number of bolls produced on each plant of the family were counted and picked to record yield of seed-cotton per plant. The data regarding average boll weight, seed index and lint index were recorded in the cotton laboratory.

The mean values of each of the 16 genotypes in each replication were subjected to usual analysis of variance technique to determine the genotypic differences for the characters under study. Combining ability analysis of the data was made following 'method 1' and 'model 11' of Griffing's approach (Griffing, 1956).

effects remained significant only for boll weight and lint index.

The greater percentage of variance (Table 2) for seed-cotton yield (54.96) and number of bolls (48.82) appeared to be due to gca effects, whereas higher variances for boll weight (50.00) and seed index (60.91) was the result of sca effects, and by contrast the greater magnitude of variance for lint index (96.99) was due to reciprocal effects. These results suggest that inheritance pattern of different plant characters was conditioned by different genetic systems, and may be important from breeding point of view. The importance of gca and sca effects for the exploitation of variation existed in different plant characters has been discussed

Table 1. Mean squares for combining ability analysis for yield of seed cotton and its components

Variation due to	Df	Yield of seed cotton	Number of bolls	Boll weight	Seed index	Lint index
gca	3	2845.64**	277.93**	0.13**	0.59**	0.82**
sca	6	280.01**	10.71**	0.05**	0.10	0.63**
Reciprocals	6	90.54	6.99	0.05**	0.10	0.29**
Error	45	84.97	8.61	0.01	0.05	0.05

** denotes differences highly significant.

RESULTS AND DISCUSSION

The genetic variation existed in each of the characters was partitioned into general and specific combining ability (gca and sca, respectively) as suggested by Sprague and Tatum (1942), and into reciprocal effects (Griffing, 1956). The results (Table 1) showed that gca effects were significant ($P \leq 0.01$) for all the characters, sca effects were significant for yield of seed-cotton, boll weight and lint index, whilst reciprocal by Baker and Verhalen (1975), Desai *et al.* (1980) and Ghafoor and Khan (1987). Falconer (1981) stated that the presence of preponderance effect of the additive genes is an indication of high breeding value (h^2_{ns}) for yield of seed-cotton and number of bolls per plant, and suggests that the plant population may be amenable to selection resulting in rapid and effective improvement in these characters. By contrast in case of boll weight, seed index and lint index, selection of the superior plants would be rather difficult, and the breeder is ought to be careful while handling the segregating material.

8100 (Table 4) revealed to be the best for yield of seed-cotton and number of bolls and this increased performance of the hybrid might have resulted due to the best gca of A 8100 for both the characters. The same situation holds true for cross AUH 50 x PD 695 for boll weight, and BW-76 31DH x PD 695 for lint index which involved at least one good combiner for the character-expression. By contrast, the superiority of the combination AUH 50 x A 8100 for seed index seems to be of interest where both the parents, in the limits of the present study, were poor general combiners. Thus it is obvious that parent with low or poor general combining ability may have the potential to produce good hybrids, a suggestion given by Baluch and Chang (1970).

Table 2. Estimation of components of variation for yield of seed cotton and its components

Variation due to	Yield of seed cotton	%	Number of bolls	%	Boll weight	%	Seed index	%	Lint index	%
gca ($\sigma^2 g$)	345.08	54.96	8.67	48.82	0.01	12.50	0.07	9.30	0.10	0.61
sca ($\sigma^2 s$)	195.04	31.06	2.10	11.82	0.04	50.00	14.12	60.91	0.34	2.09
Recip. ($\sigma^2 r$)	2.79	0.44	-1.62	-9.12	0.02	25.00	8.48	36.58	15.79	96.99
Error ($\sigma^2 e$)	84.97	13.53	8.61	48.48	0.01	12.50	0.51	2.20	0.05	0.31

Table 3. Estimate of general combining ability of four parental lines for yield of seed cotton and its components

Varieties	Yield of seed cotton	Number of bolls	Boll weight	Seed index	Lint index
A 8100	28.05	8.75	0.09	-0.28	-0.45
PD 695	-12.42	-4.01	0.06	0.22	0.26
AUH 50	-9.23	-2.78	0.33	-0.08	0.01
BW-76 31DH	-6.39	-1.96	-0.18	0.15	0.19
S.E. (G_iG_j)	9.25	2.94	0.11	0.23	0.22

The comparison revealed that the parent A 8100 with its highest positive value for yield of seed-cotton and number of bolls proved to be the best general combiner for the characters (Table 3). For the manifestation of boll weight the parent AUH 50, and for seed and lint indices variety PD 695 attained the first position in the ranking order, as far as their gca is concerned. The parent BW-76 31DH was shown to be the poorest combiner for all the characters. These results suggest that the three parental lines, i.e. A 8100, PD 695 and AUH 50 may serve as source material in the production of promising segregating population. For example, specific combination of AUH 50 x A 8100 (Table 4) revealed to be the best for yield of seed-cotton and number of bolls and this increased performance of the hybrid

Table 4. Estimates of specific combining ability (sca) and reciprocal effects for yield of seed cotton and its components. (The results given in the parentheses are the reciprocal effects of crosses)

Cross combination	Yield of seed cotton	Number of bolls	Boll weight	Seed index	Lint index
AUH 50 x A 8100	19.82	4.58	0.13	0.44	0.38
	(-4.89)	(-3.67)	(0.29)	(-0.11)	(-0.30)
AUH 50 x PD 695	3.85	0.06	0.22	0.06	0.04
	(7.34)	(1.65)	(0.03)	(0.09)	(-0.16)
A 8100 x BW-76 31DH	0.36	1.10	-0.07	-0.10	-0.15
	(-2.98)	(0.63)	(0.02)	(0.00)	(0.12)
A 8100 x PD 695	-0.82	0.45	-0.01	-0.32	-0.23
	(7.33)	(1.29)	(0.08)	(0.16)	(4.47)
BW-76 31DH x PD 695	-1.67	1.30	-0.10	0.36	0.53
	(10.35)	(2.29)	(0.23)	(0.22)	(0.05)
AUH 50 x BW-76 31DH	-8.92	-1.47	-0.01	-0.20	-0.05
	(-4.90)	(-2.65)	(0.15)	(0.46)	(0.43)
S.E. (S_{ij} - S_{ik})	16.02	5.09	0.20	0.39	0.38
S.E. (r_{ij} - r_{ik})	18.49	5.89	0.23	0.45	0.45

The reciprocal cross AUH 50 x A 8100 for boll weight and AUH 50 x BW-76 31DH for lint index with their values were shown to be the best combinations. Significant reciprocal differences for boll weight and lint index (Table 1) suggested that the single crosses involving these lines could not be composited with their reciprocals if boll weight and lint index are used as a criterion of high yielding plant as has been suggested in case of wheat (Azhar *et al.*, 1984).

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