STUDIES ON INDUCED VARIABILITY IN EGYPTIAN COTTON

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Abstract

The present investigation was undertaken to study the genetic behaviour of some economic characters in two intervaroetial Egyptian cotton (*Gossypium barbadense* L.) crosses, namely Giza 80 x 5904 E (cross I) and Giza 45 x 5904 E (cross II). Six populations, namely P_1, F_1, F_2, BC_1, BC_2 and P_2 for each cross were studied for estimating genetic variance, stability, heritablity and expected genetic advance upon selection.

Heterosis was significant positive for number of fruiting branches, seed cotton yield per plant and fiber strength in the two crosses. Also it was significant positive for number of bolls per plant in cross I and for boll weight in cross II. Inbreeding depression was significant positive for number of fruiting branches and boll weight in cross II and for fiber strength in cross I. Epistatic value (E_1) was positive and significant for boll weight and seed cotton yield per plant in cross I and for number of bolls per plant, lint percentage and fiber strength in cross II. Meanwhile epistatic value (E_2) was positive and significant for seed cotton yield only in cross I. All genetic variance was due to additive variance for number of fruiting branches and fiber strength in cross II and for lint percentage in the two crosses. All genetic variance was due to dominance variance for number of bolls per plant and seed cotton yield per plant in the two crosses, for boll weight and fiber fineness in cross II and for fiber strength in cross I. On the other hand dominance variance was greater than additive variance for number of fruiting branches in cross I only.

Heritability estimates were greater for number of bolls per plant in both crosses, for seed cotton yield per plant in cross I and for fiber strength in cross II. Whereas these estimates were low to intermediate for number of fruiting branches, lint percentage, boll weight and fiber fineness in both crosses. The expected genetic advance estimates showed high to moderate values for number of fruiting branches and lint percentage in the two crosses and for fiber strength in cross II.

Introduction

Biomectrical estimation of genetic parameters governing yield and yield components have been obtained by several cotton workers. Both additive and dominance gene effects were found to be important, their relative importance varying from trait to another and cross to another. The genetic include the presence of heterosis (inbreeding depression and epistasis), partitioning of phenotypic variance, stability, heritability, expected genetic advance upon selection and the nature of gene action. These studies were carried out for number of fruiting branches, number of bolls per plant, boll weight, seed cotton yield per plant, lint percentage, fiber fineness and fiber strength in two crosses Giza 80 x 5904 E and Giza 45 x 5904 E.

Results of this study had been discussed by many workers. Bedair (1971) found highly significant positive heterosis and inbreeding depression for lint percentage. All genetic variance was due to additive variance in two crosses studied. The estimate of broad sense heritability of number of bolls per plants was 47.4%, while the estimates of narrow sense were zero. Patil and Mesinka (1971) concluded that non additive effects were predominant for boll weight, number of bolls per plant and lint percentage. Meredth and bridge (1972), reported that heterosis was detected for seed cotton yield per plant, boll weight, number of bolls per plant, fiber fineness and fiber strength. Additive effects were predominant for lint percentage, although dominance was greater for boll weight. Innes (1974) indicated that most of genetic variance for fiber strength was additive with a low degree of dominance, while dominance variance was only important for fiber fineness. Baker and Verhalen (1975) indicated that heterosis was not evident for fiber strength or fiber fineness. They also found that the mean inbreeding depression effects were small, but significant for lint percentage, while it was insignificant for fiber strength. Additive and dominance genetic variance were of approximately equal importance for lint percentage, but dominance variance was more important for seed cotton yield. Kassem et al. (1981) found significant heterosis and inbreeding values for lint percentage and boll weight. Narrow sense heritability of relatively high values were obtained for lint percentage. El-Kilany and Al-Mazar (1985) negative and significant for heterosis effects and inbreeding depression were computed for boll weight and lint percentage. Additive and dominance genetic effects were present, controlling the inheritance of these traits. Relatively high heritability estimates were obtained for lint percentage, while moderate or low estimates were computed for boll weight. Ismail (1985) highly significant heterosis for boll weight and lint percentage were competed. Additive and non-additive genetic effects were highly significant for boll weight, while epistasis effects were not significant for lint percentage. Heritablity values in narrow sense ranged about 85% in both traits. Raafat (1986a) in an Egyptian cross, found that heterosis was noticed for boll weight and lint percentage, while inbreeding depression obtained for boll weight and number of fruiting branches. Epistatic values were negative and significant for number of fruiting branches only, the same author (1986b) found absence of additive variance for number of bolls per plant, boll weight and seed cotton yield per plant. Heritablity values were low to moderate for lint percentage, seed cotton yield per plant

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and number of bolls per plant. Haikal (1987) noticed in two crosses that heterosis and inbreeding depression were significant for boll weight. whereas these parameters and epistatic effects turned out to insignificant for lint percentage and seed cotton yield per plant. About all genetic variance was due to additive effect for these traits. Moderate estimates of heritablity and genetic advance were recorded.

Gencer and Kaynak (1994) found that variances among the varieties and lines were significant for number of bolls per plant, seed cotton yield, fiber fineness and fiber strength. The additive genetic variance were more pronounced than the dominance genetic variances for the same traits. On the other hand number of bolls, boll weight, seed cotton yield, ginning percentage and fiber fineness demonstrated positive heterosis values. Kapoor, (1994) found that epistasis was to be an integral part in the genetic control of seed cotton yield per plant, number of bolls per plant, boll weight and ginning out turn. The higher magnitude of non-additive genetic component than additive component was observed, though additive component was significant for seed cotton yield, boll weight and fiber ginning out turn. Bing et al. (1995) results indicated that dominant variance was the major portion of the phenotypic variance for lint yield, lint percentage and boll size. A small proportion due to additive variance for fiber traits. However, relatively high values of narrow-sense heritabilites for lint yield and yield component indicated that a sufficient proportion of additive genetic variance might be available in F_2 hybrids for effective selection.

Materials and Methods

Crosses were made in first season between 5904 E (Russian cotton) as a male and each of Giza 80 and Giza 45 (Egyptian cotton) as female (cross I and cross II, respectively). In second season, the three parents and the two F_1 plants were sown. In that season, both parents were selfed and F_1 plants were also self fertilized to give the F_2 seeds and were crossed to both parents to give the back-cross seeds. In the third season, the six populations of each cross (P_1, F_1, F_2, BC_1, BC_2 and P_2) were grown in randomized complete block design with four replications at Sakha Experimental Station. Observations were recorded on individual plants of each progeny for the traits, namely, number of fruiting branches, number of bolls per plant, boll weight, seed cotton per plant, lint percentage, fiber fineness and fiber strength.

Statistical Procedure

i. The means ($\bar{x}$), the variance (S^2), the standard deviation (S) and the coefficient of variation (c.v.).

ii. Heterosis: determined as the increase percentage of F_1 over mid-parent value.

$$\text{Heterosis deviation} = \frac{F_1 - \frac{1}{2}(P_1 + P_2)}{\frac{1}{2}(P_1 + P_2)} \times 100$$

iii. Inbreeding depression: expressed as the deviation of the F_2 generation mean from the F_1 mean.

$$\text{Inbreeding depression} = \frac{\bar{F}_1 - \bar{F}_2}{\bar{F}_1} \times 100$$

iv. Test of epistasis:

$$E_1 = \bar{F}_2 - 1/2\bar{F}_1 - 1/4\bar{P}_1 - 1/4\bar{P}_2$$

$$E_2 = \overline{BC}_1 + \overline{BC}_2 - \bar{F}_1 - 1/2\bar{P}_1 - 1/2\bar{P}_2$$

where E_1 and E_2 are the two estimates of epistatic deviation.

v. Partitioning of the total phenotypic variance into its components, by using formula derived by (Mather, 1949).

$$VF_2 = \frac{1}{2} D + \frac{1}{4}H + E$$
$$VBC_1 = \frac{1}{4} D + \frac{1}{4}H + E$$
$$VBC_2 = \frac{1}{4} D + \frac{1}{4}H + E$$

The environmental variance was estimated as follows:

$$E = \sqrt[3]{VP_1 . VP_2 . VF_1}$$

By solving the above equation simultaneously, estimates of additive variance (½D) and dominance variance (¼H) were obtained.

vi. Stability of characters: one can identify the stable characters, which can be considered s varietal characteristics with E/TP of 0.5 or less.

$$\text{The ratio} = \frac{E}{TP} = \frac{\text{Environmental variance}}{\text{Total phenotypic variance}}$$

vii. Heritability estimates (h^2):

$$h^2 \text{ (broad sense)} = \frac{\frac{1}{2}D + \frac{1}{4}H}{\frac{1}{2}D + \frac{1}{4}H + E}$$

$$h^2 \text{ (narrow sense)} = \frac{\frac{1}{2} D}{\frac{1}{2}D + \frac{1}{4}H + E}$$

vii. Expected genetic advance upon selection (Gs): The highest 5 percent of the F_2 plants as follows:

$$Gs = (K)\ (\sigma A)\ (h^2) \quad \text{(Allard, 1960)}$$

where K selection differential (2.06), σ A = phenotypic standard deviation of F_2 and h^2 = heritability in narrow sense.

Results and Discussion

The main objective of this research was the genetical study of some economic traits in two crosses of *Gossypium barbadense*, Egyptian variety Giza 80 x Russian variety 5904 E (cross I) and Egyptian variety Giza 45 x Russian variety 5904 E (cross II) to induced variability. These genetical studies included determination of gene action, heritability and expected genetic advance upon selection. All traits studied showed significant genetic variance in F_2 population in both crosses except boll weight and fiber fineness in cross I.

Heterosis, Inbreeding Depression Epistasis and Genetic Variance

Number of Fruiting Branches

Table (1) shows the parental statistics of this trait in the two crosses. The mean number of fruiting branches was 16.2 and 17.4 for Giza 80 and 5904 E, respectively in cross I and it was 18.6 and 17.4 for Giza 80 and 5904 E, respectively in cross II. Heterosis compared from mid-parent value was significant positive in the two crosses. Inbreeding depression was positive in both crosses, being significant in cross II only. Both epistasis E_1 and E_2 were negative and insignificant, except E_2 in cross II, being highly significant. These results are in agreement with (Raafat, 1986a) in his intervarietal cross.

Table (3) shows the total phenotypic variance partitioned for its components. Both additive and dominance genetic variance were positive in cross I. The values indicate also that the greater portion of the total genetic variance was dominance in this cross. Whereas the negative estimate of the dominance variance indicated zero in cross II. In turn this meant that all genetic variance was additive in this cross.

Number of Bolls per Plant

Data in Table (1) indicated that the mean number of bolls per plant was 16.2 and 14.7 for Giza 80 and 5904 E, respectively in cross I and it was 19.0 and 14.7 for the same parents respectively in cross II. The obtained results showed positive heterotic effects in both crosses compared to mid-parent value for number of bolls per plant, showing high significance in cross I and insignificant in cross II (Meredith and Bridge, 1972 and Gencer and Kaynak, 1994). In the present study, inbreeding depression was insignificant in the two crosses, showing positive value in cross I and negative value in cross II. The two epistasis (E_1 and E_2) were positive and insignificant in the two crosses except (E_1) in cross II, which was highly significant. Raafat (1986a) obtained insignificant inbreeding depression and epistatic effects for this trait.

It is apparent from results presented in Table (3) that the additive genetic variance were negative values and therefore considered zero. All genetic variance was considered therefor to be due to dominance effect of genes in both crosses. These results coincide with the results observed by (Patil and Mensinkai, 1971; Raafat, 1986b, Kapoor, 1994 and Bing Tang et al., 1995).

Boll weight

It is apparent from data presented in Table (1) that boll weight gave a mean of 2.1 for Giza 80 compared to 2.3 for 5904 E in cross I and gave a mean of 2.2 for Giza 45 compared to 2.3 for 5904 E in cross II. The data showed negative and insignificant heterotic effect in cross I whereas it was positive and significant in cross II compared to mid-parent value for boll weight. Meredith and Bridge (1972), Kassem et al. (1981), El-Kilany and Al-Mazar (1985), Raafat (1986a) and Gencer and Kaynak (1994) recorded significant heterosis for this trait as obtained in cross II. Inbreeding depression for boll weight showed highly significant values in both crosses, showing negative value in cross I and positive value in cross II. The two epistasis values (E_1 and E_2) were positive in cross I, showing highly significant value for E_1 and insignificant value for E_2. Meanwhile, epistasis values were negative in cross II, showing highly significant value for E_1 and insignificant for E_2. These findings are in agreement with Kassaem et al. (1981), El-Kilany and Al-Mazar (1985), Raafat (1986a) and Kapoor (1994).

Partitioning the total phenotypic variance for its components, showed genetic variance was estimated zero in cross I as reported by (Raafat, 1986b). On the other hand the additive genetic variance was negative value in cross II and therefore estimated zero, thence all genetic variance was considered therefore to be due to dominance effect of genes. This is in accordance with Patial and Mansinkai (1971), Kapoor (1994) and Bing Tang et al., (1995).

Seed Cotton Yield per Plant

Table (1) shows the parental statistics of the trait in both crosses. The mean of seed cotton yield per plant in Giza 80 was 33.9, whereas in 5904 E it was 33.8 in cross I on the average. This trait in Giza 45 was 40.4 whereas it averaged 33.8 for 5904 E in cross II. In the two crosses seed cotton yield per plant showed positive heterosis values compared with mid-parent values, showing highly significance in cross I and insignificant in cross II. These results are in agreement with Meredith and Brideg (1972) and Gencer and Kaynak (1994). Whereas inbreeding depression was positive and insignificant in the two crosses. Both epistasis (E_1 and E_2) were significant positive in cross I, while in cross II it was insignificant positive. Raafat (1986a) found insignificant heterosis, inbreeding depression and epistasis (E_1 and E_2) for seed cotton yield per plant, meanwhile (Kapoor, 1994 found high epistasis.

The negative estimate of the additive variance in connection with seed cotton yield per plant indicated zero variance. In turn this meant that all genetic variance was dominance in the two crosses. These findings are in agreement with Baker and Verhalen (1975), Raafat (1966b), Kapoor (1994) and Bing Tang et al. (1995).

Lint Percentage

Table (1) indicated that the mean of lint percentage was 38.6 and 33.6 for Giza 80 and 5904 E, respectively in Cross I and it was 29.8 and 33.6 for Giza 45 and 5904 E respectively in Cross II. The amount of heterosis from mid-parent value was insignificant positive in both crosses. These results coincide with the results obtained by (Haikal, 1987). Inbreeding depression was insignificant in both crosses also, being positive value in cross I and negative value in Cross II. Both epistasis (E_1 and E_2) were insignificant negative in Cross I. The data in cross II showed significant positive value for E_1, whereas E_2 was insignificant. Ismail (1985), Raafat (1986) and Haikal (1987) found insignificant inbreeding depression and epistasis for lint percentage.

The data for partitioning of phenotypic variance, gave positive additive genetic variance in the two crosses. The dominance genetic variance were negative and therefore estimated zero. All genetic variance was considered therefore to be due to additive effect of genes in both crosses. These finding are in agreement with the results of other workers such as Bedair (1971), Meredith and Bridge (1972), Haikal (1987) and Gencer and Xaynak (1994).

Fiber Fineness

Results in Table (2) shows the parent of statistics of this trait in both crosses. The mean of fiber fineness was 3.2 for the two parents in cross I and it was 2.6 and 3.2 for Giza 45 and 5904 E, respectively in Cross II. From the values obtained for heterosis, inbreeding depression and epistasis, it appears that all values showed insignificant epistasis results. This is in accordance with Baker and Verhalen (1975).

Partitioned the total phenotypic variance for its components, showed genetic variance was negative and therefore estimated zero in cross I. Meanwhile, the value of additive genetic variance was negative in cross II and therefore estimated zero. Thence all genetic variances was considered therefore to be due to dominance effect of genes in this cross as reported by Innes (1974).

Fiber Strength

Table (1) give the parental statistics of fiber strength in both crosses. The mean average of cross I was 9.6 for Giza 80 compared to 9.3 for 5904 E. Whereas in cross II it was 10.7 for Giza 45 compared to 9.3 for 5904 E. Heterosis estimates from mid-parent were highly significant positive in the two crosses. This is accordance with Meredith and Bridge (1972). Furthermore, the inbreeding depression was positive in both crosses, being highly significant in cross I. Both epistasis (E_1 and E_2) were highly significant in the two crosses, except E1 in cross II which was significant positive.

Data in Table (3) indicated that estimates were positive for dominance genetic variance and additive genetic variance in cross I and II, respectively. On the other hand these values were negative in cross II and I, respectively. Therefore this meant that all genetic variance was dominance in cross I and additive in cross II. Innes (1974) and Gencer and Kaynak (1994) found that most of genetic variance for this trait was additive variance.

Heritability and Expected Genetic Advance upon Selection

Heritability Estimates

The heritability estimates in the broad sense could be arranged in ascending order as follows: number of fruiting branches with (39.93% and 19.9%) in cross I and II, respectively, number of bolls per plant with (62.19%) in cross I and (50.17%) in cross II, boll weight with (zero) in cross I (genetic variance estimates was zero) and (7.14%) in cross II, seed cotton yield per plant with (63.21%) in cross I and (34.34%) in cross II, lint percentage with (27.14%) in cross I and (13.90%) in cross II, fiber fineness with (zero) in cross I (genetic variance estimates was zero) and (15.0%) in cross II and fiber strength with (12.9%) in cross I and (50.0%) in cross II, (Table 4). These are respectively moderate to high heritabilities in all traits except boll weight, lint percentage and fiber fineness in cross II and fiber strength in cross I, being low estimate because environmental variance was high (Table 3).

Heritability estimates in the narrow sense were absent in most of the traits under study (additive variance estimates were negative) except number of fruiting branches with (6.75%) in cross I and (13.91%) in cross II, lint percentage with (27.14%) in cross I and (13.90) in cross II and fiber strength with (50.0%) in cross II (Bing Tang et al., 1995).

Expected Genetic Advance Upon Selection

The expected genetic advance from selecting the top 5% of the population in F_2 was 7.02 for umber of fruiting branches or (38.15%) in cross I, 1.89 or (10.50%) in cross II. It was also 1.10 for lint percentage or (4.43%) in cross I, 0.89 or (2.69%) in cross II and also 0.90 for fiber strength or (8.41%) in cross II. No advance is expected from selection of the top 5% of the F_2 populations for number of bolls per plants, boll weight, seed cotton yield per plant, fiber fineness in both crosses and for fiber strength in cross I, this is due to its zero value at least for extremely low heritability. These results for boll weight and lint percentage are in conformity with Bedaire (1971), El-Kilany and Al-Mazar (1985), Raafat (1986b) and Haikal (1987) they reported low to moderate heritability estimates.

Stability of Characters

Examining the values of stability listed in Table (3). In general a character with E/TP of 0.5 or less can be considered useful in differentiating between varieties. If so, then number of bolls per plant, will be an excellent varietal characteristic (E/TP = 0.437). Seed cotton yield per plant is the second character with (E/TP = 0.512), fiber strength with (E/TP = 0.6855), number of fruiting branches with (E/TP = 0.701), lint percentage with (E/TP = 0.795), boll weight with (E/TP = 0.964) and the last trait is fineness with (E/TP = 0.965), respectively. Only the first trait considered as varietal characteristic. Haikal (1987) found that seed cotton yield, boll weight and lint percentage should be considered of very limited value in that respect in his intervarietal crosses.

In general the results showed nearly equal for the most of traits under study in the two crosses, because this study was based on one local environment. Thence these crosses must be sown under another local environment. Thus the different between values for traits can appears.

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Table 1. Statistical values in the parents, F_1, F_2, BC_1 and BC_2 populations in both crosses for the characters under study.

Population	Cross I				Cross II			
	X	S^2	S	C.V.%	X	S^2	S	C.V.%
No. of fruiting branches								
P_1	16.2	10.70	3.27	20.19	18.60	17.31	4.16	22.37
BC_1	16.8	17.44	4.18	24.88	17.60	15.40	3.92	22.27
F_1	20.6	15.95	3.99	19.37	20.10	13.56	3.68	18.31
F_2	18.4	25.47	5.05	27.45	18.00	21.25	4.61	25.61
BC_2	19.6	31.78	5.64	28.78	15.20	11.90	3.45	22.70
P_2	17.4	20.99	4.58	26.32	17.40	20.99	4.58	26.32
Number of bolls per plant								
P_1	16.2	25.27	5.03	31.05	19.0	50.55	7.11	37.42
BC_1	24.5	260.51	16.14	65.88	18.7	59.64	7.72	41.28
F_1	27.6	106.28	10.31	37.36	18.4	50.16	7.08	38.48
F_2	23.0	90.86	9.53	41.43	21.0	67.27	8.20	39.05
BC_2	24.8	83.21	9.12	36.77	21.8	105.60	10.28	47.16
P_2	14.7	14.85	3.85	26.19	14.7	14.85	3.85	26.19
Boll weight								
P_1	2.1	0.09	0.30	14.29	2.2	0.09	0.30	13.64
BC_1	2.1	0.12	0.35	16.67	2.3	0.14	0.37	16.09
F_1	2.0	0.17	0.41	20.50	2.5	0.11	0.33	13.20
F_2	2.4	0.15	0.39	16.25	2.2	0.14	0.37	16.82
BC_2	2.4	0.11	0.33	13.75	2.4	0.15	0.39	16.25
P_2	2.3	0.21	0.46	20.00	2.3	0.21	0.46	20.00
Seed cotton yield per plant								
P_1	33.9	136.54	11.69	34.48	40.40	313.13	17.70	43.81
BC_1	62.2	1669.28	40.86	65.69	46.40	309.40	17.59	37.91
F_1	55.8	492.67	22.20	39.78	49.00	380.21	19.50	39.80
F_2	54.5	528.90	23.00	42.20	47.50	358.50	18.93	39.85
BC_2	60.4	406.12	20.15	33.36	51.84	631.52	25.13	48.48
P_2	33.8	109.54	10.47	30.98	33.80	109.54	10.47	30.98
Lint percentage								
P_1	38.6	6.13	2.48	6.42	29.8	5.39	2.32	7.79
BC_2	33.9	7.11	2.67	7.88	32.6	10.28	3.21	9.85
F_1	36.3	3.89	1.97	5.43	32.2	11.95	3.46	10.75
F_2	36.1	8.18	2.86	7.92	33.1	9.64	3.10	9.37
BC_2	36.3	6.02	2.45	6.75	32.2	6.92	2.63	8.17
P_2	33.6	8.89	2.98	8.87	33.6	8.89	2.98	8.87
Fiber fineness								
P_1	3.2	0.41	0.64	20.00	2.6	0.07	0.26	10.00
BC_1	3.2	0.21	0.46	14.38	2.9	0.18	0.42	14.48
F_1	3.4	0.42	0.65	19.12	2.9	0.19	0.44	15.17
F_2	3.3	0.37	0.61	18.48	3.0	0.20	0.45	15.00
BC_2	3.5	0.53	0.73	20.86	3.2	0.24	0.49	15.31
P_2	3.2	0.37	0.61	19.06	3.2	0.37	0.61	19.06
Fiber strength								
P_1	9.6	0.43	0.66	6.88	10.7	0.46	0.68	6.36
BC_2	9.8	0.43	0.66	6.73	10.4	0.65	0.81	7.79
F_1	10.6	0.13	0.36	3.40	10.9	0.33	0.57	5.23
F_2	9.3	0.31	0.56	6.02	10.7	0.76	0.87	8.13
BC_2	9.3	0.36	0.60	6.45	8.7	0.44	0.66	7.59
P_2	9.3	0.36	0.60	6.45	9.3	0.36	0.60	6.45

Table 2. Heterosis, inbreeding depression and epistasis E_1, E_2 for all characters in the two crosses.

Treatment	Genetic means			Heterosis	Inbreeding	Epistasis	Epistasis
	M.P.	F_1	F_2	%	depression %	(E_1)	(E_2)
No. of fruiting branches							
Cross I	16.8	20.6	18.4	22.62*	10.68	-0.30	-1.00
Cross II	18.0	20.1	18.0	11.67*	10.45*	-1.05	-5.30**
Number of bolls per plant							
Cross I	15.5	27.6	23.0	78.06**	16.67	1.48	6.25
Cross II	16.9	18.4	21.0	8.88	-14.13	3.38**	5.25
Boll weight							
Cross I	2.2	2.0	2.4	-9.09	-20.00**	0.30**	0.30
Cross II	2.3	2.5	2.2	8.70*	12.00**	-0.18**	-0.05
Seed cotton yield per plant							
Cross I	33.9	55.8	54.5	64.60**	2.33	9.68*	32.95*
Cross II	37.1	49.0	47.5	32.08*	3.06	4.45	12.14
Lint percentage							
Cross I	36.1	36.3	36.1	0.55	0.55	-0.10	-2.20
Cross II	31.7	32.2	33.1	1.58	-2.80	1.15*	0.90
Fiber fineness							
Cross I	3.2	3.4	3.3	6.25	2.94	0.00	0.10
Cross II	2.9	2.9	3.0	0.00	-3.45	0.10	0.30
Fiber strength							
Cross I	9.5	10.6	9.3	11.58**	12.26**	-0.73**	-0.95**
Cross II	10.0	10.9	10.7	9.00	1.83	0.30*	-1.80*

M.P. = mid parent.

*, ** Significant at 0.05 and 0.01 levels, respectively.

Table 3. Partitioning of phenotypic variance into its components in the two crosses.

Treatment	Variance					F-test	E/TP
	Pheno-typic (TP)	Geno-typic	Additive (1/2 D)	Dominance (1/4 H)	Environ-mental (E)		
No. of fruiting branches							
Cross I	25.47	10.17	1.72	8.45	15.30	**	0.6007
Cross II	21.25	4.23	15.20	-10.97	17.02	**	0.8009
Number of bolls per plant							
Cross I	90.86	56.69	-162.00	218.69	34.17	**	0.3760
Cross II	67.27	33.75	-30.70	64.45	33.52	**	0.4983
Boll weight							
Cross I	0.15	---	---	---	0.15	N.S	1.0000
Cross II	0.14	0.0.1	-0.01	0.02	0.13	**	0.9286
Seed cotton yield per plant							
Cross I	528.90	334.31	-1017.60	1351.91	194.59	**	0.3679
Cross II	358.50	123.12	-233.92	347.94	235.38	**	0.6566
Lint percentage							
Cross I	8.18	2.22	3.23	-1.01	5.96	**	0.7286
Cross II	9.64	1.34	2.08	-0.74	8.30	**	0.8610
Fiber fineness							
Cross I	0.37	-0.03	---	----	0.4	N.S.	1.0800
Cross II	0.20	0.03	-0.02	0.05	0.17	**	0.8500
Fiber strength							
Cross I	0.31	0.04	-0.17	0.21	0.27	**	0.8710
Cross II	0.76	0.38	0.43	-0.05	0.38	**	0.5000

F-test = Test of significant of the difference between F2 variance and environmental variance.

** Significant at 0.01 level.

N.S. = Insignificant.

Table 4. Heritability percentage and response to selection in the two crosses

Treatment	heritability		Genetic advance	
	Broad	Narrow	GS	GS%
Number of fruiting branches				
Cross I	39.93	6.75	7.02	38.15
Cross II	19.91	19.91	1.89	10.50
Number of bolls per plant				
Cross I	62.39	0.00	0.00	0.00
Cross II	50.17	0.00	0.00	0.00
Boll weight				
Cross I	0.00	0.00	0.00	0.00
Cross II	7.14	0.00	0.00	0.00
Seed cotton yield per plant				
Cross I	63.21	0.00	0.00	0.00
Cross II	34.34	0.00	0.00	0.00
Lint percentage				
Cross I	27.14	27.14	1.60	4.43
Cross II	13.90	13.90	0.89	2.69
Fiber fineness				
Cross I	0.00	0.00	0.00	0.00
Cross II	15.00	0.00	0.00	0.00
Fiber strength				
Cross I	12.90	0.00	0.00	0.00
Cross II	50.00	50.00	0.90	8.41