Inheritance of Vegetative, Earliness and Fiber Traits in Some Cotton Crosses

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ABSTRACT

The goal of this investigation was directed to determine heterosis, types of gene action, heritability and their interaction with locations many vegetative, earliness and fiber traits in 15F_1 hybrids of *Gossypium barbadense*, L. The parental varieties were 6022 (P_1), suvin (P_2), pima S_7 (P_3), G. 85(P_4), G. 88(P_5) and G. 70(P_6) were crossed to obtain these hybrids using a half diallel mating design. The parental varieties and their hybrids were evaluated at two locations (Sakha Agric. Res. Station and Cotton Research Experimental at Abo-Kebir - EL-Sharkia Governorate). The obtained results could be summarized as follows.

The results showed highly significant differences among all evaluated genotypes for all studied vegetative, earliness and fiber traits.

The mean performances of genotypes revealed that P_3 showed the highest parental means for fiber traits (desirable), while P_4 was that the highest for fiber strength (F.S.) on the other hand, P_2 showed the lowest means for earliness traits (desirable), while P_4 was that the lowest parent for first fruiting node (F.F.N.) (desirable).

Heterosis values versus the mid-parents ($H._{MP}$%) and better-parent ($H._{BP}$%) showed significance and desirable values for all studied traits except for uniformity ratio.

The magnitudes of general combining ability (G.C.A.) variances were highly significant and larger than those specific combining ability (S.C.A.) variances for most studied traits. These results indicted that the additive genetic effect was predominated and played the major role in the expression of most studied traits non-additive genetic effects.

The variety P_1 was the good combiner for earliness traits and P_3 was the best combiner for fiber traits and most of vegetative traits. Most studied traits showed high, intermediate or lowest estimates of heritability in broad ($h^2_{b.s}$%) and narrow ($h^2_{n.s}$%) senses.

INTRODUCTION

Cotton is considered the most important economic fiber crop in Egypt. Great efforts have been devoted to produce high yield ability, excellent quality characteristics and early cultivars. In Egypt, early maturing cultivars have several advantages over those, which mature later. These advantages include escape from the insect and disease losses usually occurring late in the growing season, in addition to increasing the average of the winter cereals and legumes. Heterosis, combining ability and genetic components of variation give useful information regarding the choice of the parents to the develop superior hybrids and for the choice of the most effective breeding methods. El-Helw (1990); Kosba *et al.* (1991); Hendawy (1994); Das and Shunmuya (1996) Amer (1998); Potdukha (2001), El-Helw *et al.* (2002)and Abd El-Bary (2003) found significant heterosis values for number of days to first flower, number of days to first opening boll, plant height and position of first fruiting node. Abo El-Yazid (1999) indicated that the amounts of heterosis versus mid-parents were significant for all studied earliness traits.

For fiber traits Abo-Arab *et al.* (1992); Tomar and Singh (1992); Amer (1998); Bharad *et al.* (2000) and Nijagun and Khadi (2001) found that the heterosis values ranged from negative to positive significant heterosis for fiber traits. They also added that the additive part of the genetic variance was more important than those of non-additive genetic variance including dominance in the inheritance of most studied vegetative, earliness and fiber traits.

The main objectives of this study were to investigate heterosis over both mid-parents, better parent, general and specific combining ability effects, genetic parameters, heritability in broad and narrow senses.

MATERIALS AND METHODS

Six cotton varieties belong to *Gossypium barbadense*, L. showed a great variability were used as parental varieties. These varieties included Three new germplasm materials; i.e. P_1 (6022) Russian cotton variety; P_2 (Suvin) Indian cotton variety and P_3 (Pima S_7) American cotton variety. The other three varieties were three Egyptian cotton varieties one of them was long staple variety, i.e. P_4 (G. 85) and two parental varieties were extra long staple, i.e. P_5 (G. 88) and P_6 (G. 70).

The pure seeds of these parental genotypes were obtained from Cotton

Breeding Section, Cotton Research Institute, Agricultural Research Center at Giza, Egypt.

In the growing season of 2002, the six parents were planted and mated in a half diallel fashion to obtain 15 F_1 hybrids. The parental varieties were also, selfed to obtain enough seeds for further investigations. In the growing season of 2003, the genetic materials obtained from hybridization and their parental varieties were evaluated in two field trial experiments at Sakha Agricultural Research Station and Cotton Research Experimental at Abo-Kebir, El-Sharkia Governorate. The experimental design used was a randomized complete blocks design with three replications in both locations. Each plot was one row 4.0-m. long and 0.6 m. wide. The distance between hills were 0.4 m. apart and were thinned to keep a constant stand of one plant per hill at seedlings stage.

Data were recorded on the following traits: Three vegetative traits i.e.: number of fruiting branches per plant (N.F.B./p.); number of vegetative branches per plant (N.V.B./p.) and plant height in centimeters (P.H. cm), three earliness traits. i.e. first fruiting node (F.F.N); number of days to first flower (N.D.F.F.) and number of days to first opening boll (N.D.F.B.) and five fiber traits i.e.: fiber strength (F.S.); fiber fineness (F.F.); span linges 50% (S.L. 50%); span linges 2.5% (S.L. 2.5%) and uniformity ratio (U.R.%).

Statistical procedures used in this study were done according to Cochran and Cox (1957). The form of the analysis of variances and the expectation of mean squares for the combined data over the two locations are presented in Table 1.

Table 1: The form of analysis of variance and the expectations of mean squares from the combined data over both locations.

S.OV.	d.f.	E.M.S.
Location	L-1	
Rep./L.	L (r-1)	
Genotypes	g-1	$\sigma^2e + r\,\sigma^2gL + rL\sigma^2g$
G. x L.	(g-1)(r-1)	$\sigma^2e + r\sigma^2gL$
Error	L (g-1)(r-1)	σ^2e

Where:

L, r and g : are number of locations, replications and genotypes, respectively.

σ^2e, σ^2g and σ^2gL: are error variance, genotypic variance and genotypes x locations interaction variance, respectively.

The amounts of heterosis were measured as the percentage deviation of the means of the F_1 hybrids over the average of the two parents ($H_{M.P}$%) or the better parent ($H_{B.P.}$%). Therefore, the values of heterosis could be estimated from the following equations:

$$H_{F1,\,M.P}\% = \frac{\overline{F}_1 - \overline{M}.P}{\overline{M}.P} \times 100$$

$$H_{F1,\,B.P}\% = \frac{\overline{F}_1 - \overline{B}.P}{\overline{B}.P} \times 100$$

The significance of heterosis was determined using the least significant difference value (L.S.D.) at 0.05 and 0.01 levels of significance, according to Steel and Torrie (1980) as followed.

$$L.S.D._{(5\%)} = t_{0.05}\, E_{d.f} \times S^{-}_{d}$$

$$L.S.D._{(1\%)} = t_{0.01}\, E_{d.f} \times S^{-}_{d}$$

Where:

$$S^{-}_{d} = \sqrt{\frac{E.M.S.}{L \times r}\left[\frac{n_1 + n_2}{n_1\, n_2}\right]}$$

E.M.S. = error mean square
$E_{d.f.}$ = degrees of freedom of error
r = number of replications.
L = number of locations
n_1 = number of genotypes involved in first mean
n_2 = number of genotypes involved in second mean.

To estimate the different genetic parameters terms of additive and non-additive genetic variances including dominance, the procedures of this analysis was described by Grifing (1956) method 2 and outlined by Singh and Chaudhary (1985).

These components i.e. σ^2g, σ^2s, σ^2gL and σ^2sL may be translocated into genetic components using the following equations:

$\sigma^2A = 2\,\sigma^2g$ $\quad$ $\sigma^2D = \sigma^2s$

$\sigma^2AL = 2\,\sigma^2gL$ $\quad$ $\sigma^2DL = \sigma^2sL$

Estimates of heritability values were determined according to the following equations:

$$h^2_{broad\ sense}\ \% = \frac{2\,\sigma^2g + \sigma^2s}{2\sigma^2g + \sigma^2s + \frac{2\sigma^2gL}{L} + \frac{2\sigma^2sL}{L} + \frac{\sigma^2e}{Lxr}} \times 100$$

$$h^2_{narrow\ sense}\ \% = \frac{2\,\sigma^2g}{2\sigma^2g + \sigma^2s + \frac{2\sigma^2gL}{L} + \frac{2\sigma^2sL}{L} + \frac{\sigma^2e}{Lxr}} \times 100$$

In addition, dominance degree ratio (D.d) was determined according to the following equation:

$$D.d = (\sigma^2D/\sigma^2A)^{1/2}$$

RESULTS AND DISCUSSION

The results of the analyses of variance for all studied traits over all two locations are presented in Table 2. The results cleared that the mean squares of the genotypes showed highly significance for all studied traits, except for fiber strength (F.S), which was only significant. While the mean squares of G. x L. were highly significant for number of fruiting branches (N.F.B.), number of vegetative branches (N.V.B) and 50% span length (S.L.50%). These results were expected where the studied genotypes included variable genetic materials of parental varieties and their F_1 hybrids. These results were very important to use the suitable genotypes for each location.

The means of the six parental varieties and their 15F_1 hybrids were estimated from the combined data over the two locations and the results are presented in Table 3.The results showed that the P_1 was the tallest parent.(desirable) and fiber fineness (F.F.) (undesirable). On the other hand, P_2 had the earliest parent (desirable),where showed the lowest mean for number of days to first flower (N.D.F.F.), number of days to first opening boll (N.D.F.B) and fiber fineness (F.F.) traits. Concerning vegetative traits, P_3 was the best parent for number of fruiting branches (N.F.B.) and number of vegetative branches (N.V.B.) On the other hand, the parental variety P_4 had the lowest mean for first fruiting node(F.F.N.) (earlier) and the highest mean for fiber strength (F.S.) (desirable). The results also cleared that the mean of fiber traits cleared that the parental variety P_3 had the highest values (desirable) for 50 % span length (S.L. 50%),25% span length(S.L. 2.5%) and uniformity ratio (U.R.%) traits. In general it was the best parental variety for most studied vegetative and fiber traits.

The means of F_1 hybrids showed that the hybrids P_2 x P_4, P_5 x P_6 and P_4 x P_5 were the best hybrids for number of fruiting branches (N.F.B.);number of vegetative branches(N.V.B) and plant height (P.H cm) traits, respectively. concerning earliness traits, the F_1 hybrid P_1 x P_2 was the best for first fruiting node (F.F.N.),number of days to first flower(N.D.F.F.) and number of days to firist opening boll (N.D.F.B.) while, It had the lowest means (desirable) with the means of 5.77, 68.89 and 118.6 for the same obvious traits, respectively.

Concerning fiber traits, the F_1 hybrid P_3 x P_6 was the highest F_1 hybrid (desirable) for fiber strength(F.S.) trait. While, P_3 x P_5 was the best F_1 hybrid for fiber fineness (F.F.) (lowest and desirable).

The amounts of heterosis for vegetative, earliness and fiber traits versus the mid-parents ($H._{M.P.}$%) and better-parent ($H._{B.P}$%) were calculated from the combined data and the results are presented in Table 4.

The result cleared that 10 F_1 hybrids showed significant positive heterosis values relative to mid-parents (H.M.P%) for number of fruiting branches (N.F.B.). The values of heterosis ranged from 2.62% for P_1 x P_5 to 12.41% for P_2 x P_4. On the other hand, F_1 hybrids showed significant positive heterosis values versus the (B.P). These value ranged from 2.4% for P_5 x P_6 to 11.24% for P_2 x P_4.

The results also revealed that 11 F_1 hybrids showed significant and highly significant positive heterosis values relative to the mid-parents ($H_{.M.P.}$%) for number of vegetative branches (N.V.B.). These values ranged from 4.73% for P_3 x P_6 to 149.61% for P_1 x P_4, In the same time the results cleared that 10 F_1 hybrids showed significant heterosis estimated for (B.P.) The values ranged from 4.73% for P_3 x P_6 to 24.80% for the F_1 hybrid P_1 x P_4.

Concerning, plant height trait. The results cleared that seven and five F_1 hybrids exhibited significant positive heterosis values relative to ($H_{.M.P.}$%) and ($H_{.B.P.}$%), respectively. It could be regarded that the values of ($H_{.M.P.}$%) ranged from 5.51% for the F_1 hybrid P_4 x P_6 to 20.61% for P_4 x P_5. While, the values of ($H_{.B.P.}$%) ranged from 4.34% for P_2 x P_6 to 19.73% for P_4 x P_5.

The highest amounts of heterosis versus mid-parents or better parent for earliness traits and fiber fineness (fiber traits) which exhibited lowest negative significant values. Therefore, these traits as one group (first fruiting nod, number of days to first flower, number of days to first opening boll and fiber fineness traits) are discussed here. The result cleared that the estimated values of $H_{M.P.}$% showed that 3, 4, 7 and 13 F_1 hybrids exhibited negative significant (desirable) values for the same obvious traits, respectively. In the respect, the results cleared that 3, 1, 4 and 4 F_1 hybrids showed negative and significant desirable values against the (B.P.)for the same previous traits. It could be noticed that the best F_1 hybrid was P_1 x P_2 which had the lowest value (desirable) of $H_{M.P.}$% and $H_{B.P.}$% for all earliness traits first fruiting node (F.F.N),number of days to first flower(N.D.F.F.) and number of days to first opening boll(N.D.F.B.). On the other hand, the best F_1 hybrid for F.F. trait was P_1 x P_6 which had negative highly significant estimates i.e.: -13.33% for ($H_{M.P.}$%) and -9.16% for $H_{B.P.}$ %. Regarding F.S., seven F_1 hybrids exhibited positive and significant heterosis values relative to mid-parents ($H_{M.P.}$%). These value, ranged from 1.63% for P_1 x P_2 to 4.1% for P_4 x P_6. On the other hand, for ($H_{B.P.}$%), five hybrids showed significant positive values ranged from 1.76% for P_1 x P_5 to 3.29% for P_4 x P_5. Concerning S.L. 50% and S.L. 2.5%, the results of $H_{M.P.}$% showed that 6 and 8 of the 15 F_1 hybrid had positive and significant estimated

values and ranged from 1.09% for P_3 x P_5 to 5.89% for P_1 x P_5 and from

0.90% for P_2 x P_5 to 5.80% for P_1 x P_6 for the same traits, respectively. On the other hand, for ($H_{B.P}$%) few F_1 hybrids showed significant positive estimates, the obtained values were 3.64% for the F_1 hybrid P_2 x P_4 for S.L. 50%, 2.04% for P_1 x P_4 and 4.21% for P_2 x P_4 for S.L. 2.5%. These results were in common agreement with the results obtained by El-Nazer, (1998); Abo-Arab *et al.* (1992), Das and Shunmuya (1996); Awad (2001); Nijagun and Khadi (2001); EL-Helw *et al.* (2002) and Chris Braden *et al.* (2003).

The results of the analysis of variances for diallel crosses for all studied traits are shown in Table 5. The results showed that the mean squares of general combining ability (G.C.A.) were significant for all studied traits except for first fruiting node (F.F.N), as well as the mean squares of specific combining ability (S.C.A.) were significant for all studied traits except for fiber strength (F.S.) trait. The interactions of general combining ability by locations (G.C.A. x L.) and specific combining ability by locations (S.C.A. x L) were significant for two trait i.e. number of fruiting branches(N.F.B.) and number of days to first flower (N.D.F.F.) for G.C.A. x L and number of fruiting branches (N.F.B.) and number of vegetative branches (N.V.B.) for S.C.A x L. These results indicated that the additive genetic variance were predominated and played the major role in the expression of most studied traits, whereas, non-additive genetic variances could not be ignored. These results were in agreement with those obtained by Ji and Zhou (1994); Carvalho *et al.* (1995); Awad (2001); Zeina *et al.* (2001); Zeina (2002); Chris Braden *et al.* (2003); Lasheen (2003) and El-Dahan *et al.* (2004).

The results of the estimates of general combining ability effects (g_i)

for vegetative, earliness and fiber traits of the parental varieties from the combined data over both locations are presented in Table 6. It could be seen noticed that the parental variety P_3 showed positive significant general combining ability (G.C.A.) effects for all fiber traits. While, the parental varietyP_1 contributed significant negative general combining ability (G.C.A.) effects for earliness traits. These results suggested that P_3 is the best combiner for fiber traits and P_1 for earliness traits. The parental variety P_6 had positive and significant general combining ability (G.C.A.) effects for number of vegetative branches(N.V.B.) and plant height (P.H.cm.) traits Therefore, it was the best combiner for vegetative traits. These parental varieties could be used to improve these traits through hybridization programs.

The estimates of specific combining ability effects (S_{ij}) for all studied combinations for all studied vegetative, earliness and fiber traits, were obtained over the two locations and the results are shown in Table 7. The results illustrated that, 3, 7 and 3 hybrids F_1 hybrids exhibited positive significant values (desirable) for number of fruiting branches (N.F.B.), number of vegetative branches (N.V.B.) and plant height (P.H. cm), respectively. Concerning fiber traits there were 1, 4, 3 F_1 hybrids showed positive significant values (desirable) for fiber strength (F.S), 50% span length (S.L. 50%), and 2.5% span length(S.L. 2.5%), respectively, but 3 F_1 hybrids showed negative significant values (desirable) for fiber fineness (F.F.) trait. On the other hand, the results indicated that earliness traits showed negative significant (desirable) in 1, 2 and 4 F_1 hybrids for first fruiting nod (F.F.N),number of days to first flower (N.D.F.F.) and number of days to first opening boll (N.D.F.B.), respectively. The results also cleared that positive values of S.C.A. effects for vegetative trait were found in some hybrids. It also noticed that the three combinations P_2 x P_4, P_1 x P_4 and P_4 x P_5 had the highest estimates for number of fruiting branches (N.F.B.),number of vegetative branches(N.V.B.) and plant height (P.H. cm.) respectively. It could be concluded that the best combination for earliness traits was the hybrid P_1 x P_2, which showed desirable negative significant S.C.A. effects for all studied earliness traits. In general, the best combinations for fiber traits were P_4 x P_5, P_1 x P_5 and P_2 x P_4, which had desirable positive significant S.C.A. effects for biber strength (F.S.),50% span length(S.L. 50%), and 2.5% span length (S.L. 2.5%), respectively.

The estimated values of genetic parameters and heritability in broad (h^2_b.%) and narrow (h^2_n.%) senses from combined data for all studied traits are presented in Table 8. The results cleared that the magnitudes of additive genetic variances (σ^2A) were larger than their corresponding non-additive genetic variances including dominance(σ^2D) for all studied traits except for number of vegetative branches (N.V.B), plant height(P.H. cm), first fruiting node (F.F.N) and fiber fineness (F.F.) traits. The obtained results indicated that both additive and non-additive genetic variances contributed in the inheritance of these studied traits. These findings could be confirmed by the dominance degree ratio (D.d.)

which was more than unity revealing the major role of over dominance in the inheritance of these traits. These results could be expected since the presence of heterosis for these traits.

Concerning heritability in broad (h^2_b%) and narrow (h^2_n%) senses the results showed that the calculated values for h^2_b% were larger than those for h^2_n% for all studied traits. These results insure the major role of over dominance gene effects in the genetic expression of these studied traits. The calculated values of h^2_b% ranged from 7.30 to95.57% for number of fruiting branches (N.F.B.) and number of days to first flower

(N.D.F.F.), respectively. However, heritability in narrow sense (h^2_n%) ranged from 0.00% for F.F.N to 85.04% for uniformity ratio (U.R.%). These results were in agreement with many investigators among them Abo-Arab *et al.* (1992); El-Feki *et al.* (1998); Rajan *et al.* (1999); El-Adl *et al.* (2000); Sorour *et al.* (2000); Zeina (2002) and Lasheen (2003).

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Table 2:Combined analysis of variance for vegetative, earliness and fiber traits of the six parents and their F_1 hybrids.

S.O.V.	d.f.	Mean of squares(M S)										
		Vegetative traits			Earliness traits			Fiber traits				
		N.F.B.	N.V.B.	P.H. cm	F.F.N	N.D.F.F	N.D.F.B.	F.S.	F.F.	S.L. 50%	S.L.2.5%	U.R. %
Locations	1	24.535*	0.032	469.029	0.071	2.649	3.503	0.016	0.042	1.858	0.978	3.500*
Rep./location	4	3.131	0.055	169.33	0.498	3.036	9.672	0.268	0.051	2.054	2.393	0.285
Genotypes	20	6.517**	2.803**	915.193**	1.175**	12.164**	12.443**	0.303*	0.347**	10.568**	10.523**	4.829**
G. x L.	20	9.604**	0.579**	211.435	0.149	0.812	0.747	0.098	0.048	2.195**	2.053	1.312
Error	80	1.973	0.105	156.027	0.303	0.411	2.032	0.145	0.070	0.408	1.387	1.071

*, ** significant at 0.05 and 0.01 levels of probability, respectively.

N.F.B./p. : number of fruiting branches per plant N.V.B./p. : number of vegetative branches per plant
P.H. cm :plant height in centimeters F.F.N : first fruiting node
N.D.F.F. :number of days to first flower N.D.F.B : number of days to first opening boll
F.S. :fiber strength F.F. : fiber fineness
S.L. 50% : 50% span lengths S.L. 2.5% : 2.5% span lengths
U.R.% : uniformity ratio

Table 3: Mean performances of the six parental varieties and their F_1 hybrids for vegetative ea rliness and fiber traits obtained form the combined data over the two locations.

Genotypes	Vegetative traits			Earliness traits			Fiber traits				
	N.F.B.	N.V.B.	P.H. cm	F.F.N.	N.D.F.F.	N.D.F.B.	F.S.	F.F.	S.L. 50%	S.L. 2.5%	U.R. %
P_1	23.04	0.00	196.58	6.50	71.88	121.96	10.22	4.55	25.63	30.88	83.22
P_2	22.56	2.71	151.63	6.27	70.88	120.65	10.05	3.53	25.97	31.37	82.35
P_3	24.46	2.75	186.46	6.67	74.68	123.86	10.52	4.20	29.85	35.08	85.23
P_4	23.04	2.54	161.13	5.57	71.24	121.33	10.87	3.88	26.65	31.83	83.73
P_5	24.13	2.67	158.79	5.87	71.54	121.51	10.02	4.00	29.05	34.30	84.75
P_6	22.46	2.75	177.71	6.40	74.38	125.07	10.15	4.15	29.68	34.87	85.10
$P_1 \times P_2$	23.08	2.58	173.33	5.77	68.89	118.56	10.30	3.68	25.88	31.45	81.35
$P_1 \times P_3$	21.58	3.00	155.63	6.13	72.95	120.79	10.45	4.10	28.27	33.83	83.70
$P_1 \times P_4$	23.17	3.17	168.96	6.47	71.56	122.15	10.42	3.90	27.05	32.48	83.37
$P_1 \times P_5$	24.46	2.88	188.75	6.03	72.10	122.54	10.40	3.93	28.95	34.43	84.05
$P_1 \times P_6$	23.79	3.21	184.75	6.10	72.87	123.15	10.23	3.77	29.20	34.78	84.08
$P_2 \times P_3$	24.92	3.21	167.08	6.57	72.60	122.87	9.95	3.63	27.63	33.02	83.55
$P_2 \times P_4$	25.63	2.92	172.92	5.87	71.74	119.91	9.77	3.77	27.62	33.17	83.32
$P_2 \times P_5$	22.92	2.58	166.89	7.47	73.45	121.38	10.0	3.63	27.70	33.13	83.52
$P_2 \times P_6$	23.67	3.08	185.42	6.27	73.23	121.74	10.20	3.63	27.67	33.10	83.70
$P_3 \times P_4$	24.71	3.04	173.75	7.27	73.19	121.69	10.10	3.83	27.97	31.18	84.30
$P_3 \times P_5$	23.82	3.04	170.83	6.33	74.13	122.30	10.35	3.63	29.77	35.05	85.00
$P_3 \times P_6$	25.17	2.88	183.33	6.60	74.25	122.41	10.62	4.07	29.30	34.62	84.90
$P_4 \times P_5$	25.04	2.54	192.92	6.43	72.83	121.33	10.35	3.87	26.28	31.48	83.48
$P_4 \times P_6$	23.83	2.67	178.75	6.43	72.85	121.64	10.42	3.90	27.35	32.48	84.18
$P_5 \times P_6$	24.71	3.54	186.67	6.60	74.61	124.18	10.37	3.85	27.67	33.10	83.63
$L.S.D._{0.05}$	0.549	0.1267	4.883	0.2152	0.2505	0.557	0.1488	0.1034	0.2497	0.4604	0.4045
$L.S.D._{0.01}$	1.346	0.3106	11.972	0.5275	0.6142	1.366	0.3649	0.2536	0.6122	1.1288	0.9919

P_1, P_2, P_3, P_4, P_5 and P_6: 6022, Suvin, Pima S7, G.85, G.88 and G.70 Table

4: The amounts of heterosis over mid-parents ($H_{.M.P}$ %) and better parent ($H_{.B.P}$%) for vegetative, earliness and fiber traits from the combined data over the two locations.

Hybrids	Vegetative traits						Earliness traits					
	N.F.B.		N.V.B.		P.H. cm		F.F.N.		N.D.F.F.		N.D.F.B.	
	$H_{.F1.MP\%}$	$H_{.F1.BP\%}$	$H_{.F1.MP\%}$	$H_{.F1.BP\%}$	$H_{.F1.MP\%}$	$H_{.F1.BP\%}$	$H_{.F1.MP\%}$	$H_{.F1.BP\%}$	$H_{F1.MP\%}$	$H_{.F1.BP\%}$	$H_{.F1.MP\%}$	$H_{.F1.BP\%}$
$P_1 \times P_2$	0.130	-1.95	90.41**	-4.80*	-0.45	-11.83**	-9.63**	-7.97*	-3.49**	-2.81**	-2.26**	-1.66**
$P_1 \times P_3$	-10.08**	-11.77**	118.18*	9.09*	-18.74**	-20.83**	-6.91*	-5.69*	-0.45*	1.49**	-1.72**	-0.96*
$P_1 \times P_4$	-0.52	-1.57	*	24.80**	-5.53*	-14.05**	7.21*	16.16**	0.00	0.45*	0.42*	0.68*
$P_1 \times P_5$	2.62*	1.37	149.61*	7.87*	6.23**	-3.98*	-2.51	2.73	0.54*	0.78*	0.66*	0.85*
$P_1 \times P_6$	3.43*	1.06	*	16.73**	-1.28	-6.02*	-5.43*	-4.69*	-0.36*	1.38**	-0.30	0.98*
$P_2 \times P_3$	5.997**	1.88	115.73*	16.73**	-1.16	-10.39**	1.55	4.78*	-0.25	2.43**	0.54*	1.92**
$P_2 \times P_4$	12.41**	11.24**	*	7.75*	10.58**	7.32*	-0.84	5.39*	0.96**	1.21**	-0.86*	-0.54*
$P_2 \times P_5$	-1.82	-5.01*	133.45*	-4.80*	7.53**	5.10*	23.06**	27.26**	3.15**	3.63**	0.29	0.68*
$P_2 \times P_6$	5.15*	4.92*	*	12.00**	12.60**	4.34*	-1.03	0.00	0.83**	3.32**	-0.88*	0.98*
$P_3 \times P_4$	4.04*	1.02	17.58	10.55*	-0.03	-6.82**	18.79**	30.52**	0.32*	2.74**	-0.74*	0.30
$P_3 \times P_5$	-1.96	-2.62*	11.24**	10.55*	-1.04	-8.38**	0.96	7.84*	1.40**	3.62**	-0.31	0.65*
$P_3 \times P_6$	7.29**	2.90*	-4.09*	4.73*	0.68	-1.68	0.99	3.13	-0.38*	-0.17	-1.65**	-1.17**
$P_4 \times P_5$	6.17*	3.77*	12.82**	-4.87*	20.6**	19.73**	12.41**	15.44**	2.02**	2.23**	-0.07	0.00
$P_4 \times P_6$	4.75*	3.43*	14.93**	-2.91	5.51*	0.59	7.44*	15.44**	0.05	2.26**	-1.27**	0.26
$P_5 \times P_6$	6.07*	2.40*	12.18**	28.73	10.95**	5.04*	7.58**	12.44**	2.26**	4.73**	0.72*	2.20**
			4.73*									
			-2.50									
			0.95									
			30.63									
L.S.D $_{0.05}$	0.4755	0.549	0.1097	0.1267	4.228	4.882	0.1863	.2152	0.2170	0.2506	0.4825	0.5572
L.S.D $_{0.01}$	1.1658	1.3463	0.2689	0.3106	10.368	11.97	0.4568	0.5275	0.5320	0.16144	1.183	1.3662

Table (4) (cont.)

Hybrids	Fiber traits									
	F.S.		F.F.		S.L. 50%		S.L. 2.5%		U.R. %	
	$H_{.F1.MP\%}$	$H_{.F1.BP\%}$	$H_{F1.MP\%}$	$H_{.F1.BP\%}$	$H_{.F1.MP\%}$	$H_{.F1.BP\%}$	$H_{.F1.MP\%}$	$H_{.F1.BP\%}$	$H_{.F1.MP\%}$	$H_{.F1.BP\%}$
$P_1 \times P_2$	1.63*	0.78	-8.91**	4.29*	0.31	-0.35	1.04**	0.26	-1.52**	-2.03**
$P_1 \times P_3$	0.77	-0.67	-6.29**	-2.38	3.53**	-3.79**	2.58**	-3.56**	-0.62*	-1.80**
$P_1 \times P_4$	3.73**	1.96*	-7.47**	0.52	3.48**	1.50	2.59**	2.04*	-0.13	-0.43
$P_1 \times P_5$	2.77*	1.76*	-8.07**	-1.75	5.89**	-0.34	3.65**	0.38	0.08	-0.83*
$P_1 \times P_6$	0.44	0.10	-13.33**	-9.16**	5.59**	-1.62*	5.80**	-0.26	-0.10	-1.20**
$P_2 \times P_3$	-3.26**	-5.42**	-6.08**	2.83	-1.00*	-7.44**	-0.62*	-5.87**	-0.29	-1.97**
$P_2 \times P_4$	-1.91*	-2.79*	1.75	6.80*	4.98**	3.64**	4.97**	4.21**	0.34	-0.49*
$P_2 \times P_5$	-0.35	-0.50	-3.59*	2.83	0.69	-4.65**	0.90*	-3.41**	-0.04	-1.45**
$P_2 \times P_6$	0.99	0.49	-5.47*	2.83	-0.56	-6.77**	-0.60	-5.08**	-0.03	-1.65**
$P_3 \times P_4$	-0.93	-3.99**	-5.20*	-1.29	-0.99*	-6.30**	-0.82*	-5.42**	-0.21	-1.09*
$P_3 \times P_5$	0.78	-1.62*	-11.46**	-9.25**	1.09*	-0.27	1.04**	-0.09	0.01	-0.27
$P_3 \times P_6$	2.85*	1.05	-2.51*	-3.10*	-1.56*	-1.84*	-1.02**	-1.31	-0.31	-0.39
$P_4 \times P_5$	4.07**	3.29*	-1.78	-0.26	-5.64	-9.54**	-4.79**	-8.22**	-0.90*	-1.50**
$P_4 \times P_6$	4.10**	2.66*	-2.86*	0.52	-2.89**	-7.85**	-2.61**	-6.85**	-0.28	-1.08*
$P_5 \times P_6$	2.83*	2.17*	-5.52**	-3.75*	-5.77**	-6.77**	-4.29**	-5.08**	-1.52**	-1.73**
L.S.D $_{0.05}$	0.1289	0.1488	0.0896	0.1034	0.2162	0.2497	0.1261	0.4604	0.3503	0.4045
L.S.D $_{0.01}$	0.3161	0.3649	0.2196	0:2536	0.5302	0.6122	0.3091	1.1288	0.8589	0.9919

*, ** significant at 0.05 and 0.01 levels of probability, respectively.

P_1, P_2, P_3, P_4, P_5 and P_6: 6022, Suvin, PimaS7, G.85, G.88 and G.70

Table 5: Combined analyses of variances and mean squares of the half diallel crosses mating design from F_1 hybrids for vegetative, earliness and fiber traits obtained from combined data over the two locations

S.O.V.	d.f.	Vegetative traits			Earliness traits			Fiber traits				
		N.F.B.	N.V.B.	P.H. cm	F.F.N	N.D.F.F	N.D.F.B.	F.S	F.F.	S.L. 50%	S.L.2.5%	U.R. %
G.C.A.	5	5.6884**	3.7380**	1101.09**	0.6919	35.0427**	29.538**	0.5724**	0.7873**	29.0487**	26.8019**	15.3988**
S.C.A.	15	6.7931**	2.4915**	853.226**	1.3355**	4.5372**	6.7484**	0.2137	0.2002**	4.4071**	5.0965**	1.3057
G.C.A. x L	5	6.5835**	0.0624	77.2743	0.1690	1.6312**	0.2790	0.062	0.0525	3.1766	3.0876	1.1389
S.C.A x L	15	10.6113**	0.7507**	256.155	0.1420	0.5398	0.9032	0.1093	0.0469	1.8674	1.7087	1.3689
Error	80	1.973	0.105	156.027	0.303	0.411	2.032	0.145	0.070	0.408	1.387	1.071

*, ** significant at 0.05 and 0.01 levels of probability, respectively.

Table 6: General combining ability effects (g_i) of parental varieties for vegetative, earliness and fiber traits obtained from the combined data over the two locations.

Parents	Vegetative traits			Earliness traits			Fiber traits				
	N.F.B.	N.V.B.	P.H. cm	F.F.N	N.D.F.F	N.D.F.B.	F.S.	F.F.	S.L. 50%	S.L.2.5%	U.R. %
P_1	-0.466*	-0.552**	4.652*	-0.136*	-0.812**	-0.324*	0.075	0.164**	-0.554**	-0.504**	-0.467**
P_2	-0.196	0.068	-7.393**	0.006	-0.869**	-0.984**	-0.165*	-0.220**	-0.827**	-0.732**	-0.823**
P_3	0.278	0.177**	-0.457	0.206*	0.984**	0.510*	0.119*	0.062*	0.959**	0.927**	0.628**
P_4	0.090	0.021	-2.207	-0.103	-0.494**	-0.540*	-0.096*	-0.017	-0.686**	-0.748**	-0.098
P_5	0.288	0.084*	-0.466	0.002	0.198*	0.141	-0.006	-0.032	0.428**	0.385*	0.286*
P_6	-0.101	0.203*	5.871*	0.027	0.993**	1.196	0.073	0.043	0.682**	0.671**	0.475*
S.E.	0.4533	0.1046	4.0315	0.1777	0.2069	0.4601	0.1229	0.0854	0.2060	0.3801	0.3340

*, ** significant at 0.05 and 0.01 levels of probability, respectively.

Table 7: Specific combining ability effects (S_{ij}) of F_1 hybrids for vegetative, earliness and fiber traits obtained from the combined data over two locations.

Hybrids	Vegetative traits			Earliness traits			Fiber traits				
	N.F.B.	N.V.B.	P.H. cm	F.F.N	N.D.F.F	N.D.F.B.	F.S	F.F.	S.L. 50%	S.L.2.5%	U.R. %
P_1 x P_2	-0.098	0.318*	0.736	-0.473*	-2.086**	-2.086**	0.085	-0.143	-0.600*	-0.522	-1.020*
P_1 x P_3	-2.070*	0.625**	-23.908**	-0.306	0.122	-1.357*	0.035	-0.008	-0.002	0.203	-0.303
P_1 x P_4	-0.406	0.948**	-8.825*	0.336*	0.205	1.058*	0.216	-0.129	0.426*	0.528	0.089
P_1 x P_5	0.795	0.594**	9.226*	-0.202	0.049	0.770	0.110	-0.081	1.213**	1.012*	0.388
P_1 x P_6	0.516	0.807**	-1.111	-0.160	0.029	0.357	-0.135	-0.322*	1.209**	1.410*	0.232
P_2 x P_3	0.994*	0.214*	-0.405	-0.014	-0.175	1.382*	-0.226*	-0.091	-0.362	-0.386	-0.097
P_2 x P_4	1.783*	0.078	7.179	-0.240	0.450*	-0.520	-0.195	0.122	1.265	1.439*	0.395
P_2 x P_5	-1.017*	-0.318*	-0.589	1.09**	1.456**	0.332	-0.051	0.003	0.236	0.273	0.212
P_2 x P_6	0.122	0.063	11.601*	-0.135	0.441*	-0.431	0.070	-0.073	-0.052	-0.047	0.205
P_3 x P_4	0.394	0.094	1.243	0.794**	0.045	-0.234	-0.145	-0.093	-0.171	-0.203	-0.073
P_3 x P_5	-0.590	0.032	-3.582	-0.244	0.292	-0.307	0.016	-0.278*	0.517*	0.531	0.245
P_3 x P_6	1.149*	-0.255*	2.582	-0.002	-0.392*	-1.251*	0.204	0.080	-0.254	-0.189	-0.045
P_4 x P_5	0.717	-0.313*	20.252**	0.015	0.468*	-0.226	0.231*	0.034	-1.323**	-1.361*	-0.547
P_4 x P_6	-0.104	-0.068	-0.252	0.140	-0.308	-0.977*	0.218	-0.602**	-0.510*	-0.647	-0.037
P_5 x P_6	0.680	0.506**	5.924	0.203	0.761*	0.891*	0.079	-0.043	-1.306**	-1.164*	-0.970*
S.E.	1.2164	0.2806	10.8176	0.7767	0.5552	1.2345	0.3298	0.2291	0.5532	1.0199	0.8962

*, ** significant at 0.05 and 0.01 levels of probability, respectively.

Table 8: Estimates of different genetic parameters in addition to heritability in broad (h^2_b%) and narrow (h^2_n%) senses for vegetative, earliness and fiber traits from the combined data.

Genetic Parameters	Vegetative traits			Earliness traits			Fiber traits				
	N.F.B.	N.V.B.	P.H. cm	F.F.N	N.D.F.F	N.D.F.B.	F.S.	F.F.	S.L. 50%	S.L.2.5%	U.R. %
σ^2A	0.366	0.252	55.478	-0.0872	3.823	3.0438	0.0528	0.0756	3.0332	2.6424	1.862
σ^2D	-1.91	0.8704	298.535	0.5968	1.999	2.9226	0.0522	0.0767	1.2699	1.6939	-0.0316
σ^2AL	-1.01	-0.172	-44.720	0.0068	0.2728	-0.156	-0.0118	0.0014	0.3274	0.3448	-0.0575
σ^2DL	8.638	0.6457	100.128	-0.161	0.1288	-1.1288	0.0357	-0.0231	1.5594	0.3217	0.2979
σ^2e	1.973	0.105	156.027	0.303	0.411	2.032	0.145	0.070	0.408	1.387	1.071
D.d	0.00	1.86	2.32	> 1.0	0.723	0.980	0.99	1.007	0.647	0.801	0.00
$h^2_{b.s}$%	7.30	76.70	82.31	87.60	95.57	94.62	71.38	92.47	80.97	88.49	85.04
$h^2_{n.s}$%	7.30	17.22	12.90	0.00	62.76	48.27	35.90	45.90	57.07	53.92	85.04

الملخص العربى

توارث الصفات الخضرية والتبكير والتيلة في بعض هجن القطن المصري

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**معهد بحوث القطن - مركز البحوث الزراعية - مصر

كان الغرض الأساسي من هذه الدراسة هو تقدير قوة الهجين وطبيعة فعل الجين والقدرة العامة والخاصة علي التآلف ودرجة التوريث في المدى الواسع والمدي الضيق. كما تم دراسة تأثير التداخل بين نظم فعل الجين والظروف البيئية المختلفة لبعض الصفات الخضرية وصفات التبكير وصفات التيلة . اشتملت هذه الدراسة علي ستة أصناف من القطن هي (1) 6022 (2) سيوفين (3) بيما س7 (4) جيزة 85 (5) جيزة 88 (6) جيزة70 بالإضافة إلى 15 هجين ناتجة بنظام التزاوج نصف الدائري . وتم تقييم جميع التراكيب الوراثية في موقعين مختلفين هما محطة البحوث الزراعية بسخا ومحطة تجارب معهد بحوث القطن بمركز أبو كبير محافظة الشرقية .

والنتائج المتحصل عليها يمكن تلخيصها فيما يلي :-

*- أظهرت جميع التراكيب الوراثية وجود فروق عالية المعنوية بالنسبة لكل الصفات الخضرية وصفات التبكير وصفات التيلة .

*- بالنسبة لمتوسطات الآباء أظهرت النتائج أن الأب الثالث بيما س7 هو الأعلى بالنسبة لصفات التيلة باستثناء صفة النعومة فقد كان الأب الرابع جيزة 85 هو الأعلى . بالإضافة إلى أن الأب الثاني سيوفين كان الأقل في متوسط الآباء بالنسبة لصفات التبكير باستثناء صفة أول عقدة فرع ثمري فقد كان الأب الرابع جيزة 85 هو الأعلى فيها .

*- بالنسبة لتقدير قوة الخلط بالنسبة لمتوسط الآباء أو الأب الأفضل أظهرت فروقا معنوية وأظهرت قيما نافعة لكل الصفات فيما عدا صفة معامل الانتظام .

*- كان التباين الراجع للقدرة العامة علي التآلف أعلي من التباين الراجع للقدرة الخاصة علي التآلف لمعظم الصفات المدروسة وهذه النتائج تشير إلى أن التفاعل الإضافي كان الأكثر تحكما في وراثة الصفات ويلعب الدور الأكبر بجانب وجود تأثير للتباين غير الإضافي شاملا السيادة.

•-الأب الأول 6022 كان ذا قدرة عامة على التآلف بالنسبة لصفات التبكير والأب الثالث بيما س7 كــان ذا قــدرة عامـــة على التآلف بالنسبة لصفات التيلة ومعظم الصفات الخضرية ، إلى جانب أن معامل التوريث فى المدى الواسع والضيق أعطى قيما مختلفة ومتباينة بالنسبة للصفات المدروسة .