HETEROSIS AND COMBINING ABILITY IN INTERVARIETAL CROSSES OF EGYPTIAN COTTON IN DIFFERENT LOCATIONS.

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Abstract

A half diallel set among six parents of Egyptian cotton was undertaken to evaluate general and specific combining ability and their interactions with environment in three different locations. The six parents, 15 F1 hybrids and 15 F2 populations were included in three randomized complete blocks design experiments at the three locations.

Analysis of variance showed highly significant differences among genotypes for all traits except uniformity ratio. Seed cotton yield, lint yield, number of bolls/plant and boll weight were the most affected characters by the environmental variables. The average estimates of heterosis were the highest for these traits. GCA/SCA variance ratio revealed that the non-additive genetic variance was more important in the inheritance of these characters, suggesting the utilizing of heterosis to improve these characters. The additive genetic variance was the most important for lint percentage, lint index and fiber properties. Significant GCA and SCA by locations interactions were observed for several traits indicating that a range of environments is needed to better evaluate hybrid combinations. The best general combiners were; Giza 81 for most agronomic characters, Giza 83 x (Giza 72 x DelCero) for boll number and lint percentage, Giza 77 for fiber length and fiber strength traits and Giza 84 for fiber fineness. Crosses exhibiting highest SCA effects were 81 x [Giza 83 x (G.75 x Delcero], Giza 85 x Dendera for yield and number of bolls and Giza 77 x Giza 84 for fiber length.

INTRODUCTION

Most Egyptian cotton varieties have been bred by using various forms of pedigree selection with the aim of combining characters from two or more parents into a single line or lines. Results from diallel crosses are good criteria used to decide which parents or lines were to be of potential use in intended crosses. The two genetic parameters; GCA and SCA suggested by Griffing (1956) are mainly used for this purpose. Although, these two parameters have been studied in cotton by several investigators, Radwan and Abo El-Zahab (1974), Salem (1984) and Rahouma and EL-Shaarawy (1992), the scope of these tests was limited as to establish a general trend and results of this kind of research are scant in Egyptian cotton. Therefore, further studies were needed for better understanding of the nature of gene action and its interactions with environment. Baker and Verhalen (1975), El-Fawal *et al.* (1978) and El-Disoqui *et al.* (1992) calculated significant GCA by environment interactions for several agronomic and fiber properties.

The degree of heterosis and GCA versus SCA has been studied in Egyptian intervarietal cotton crosses by El-Adl *et al.* (1978) and Selim *et al.* (1979).

The main objectives of this study are to estimate the frequency and magnitude of heterosis and inbreeding depression, as well as SCA and SCA effects, variances and its interactions in three different locations. It was also of interest to determine whether conventional breeding programs could make further progress in yield, components and fiber properties through utilization of crossing between three Egyptian cotton cultivars and three promising Egyptian lines used as parents.

MATERIALS AND METHODS

Six cultivars and lines of Egyptian cotton were selected as parents. The extra-long staple cottons included Giza 77 (P_1), and Giza 84 (P_2); the long staple cottons assigned to North Egypt were Giza 85 (P_3) and Giza 81 (P_4) and the long staple cottons grown at Upper Egypt were Giza 83 x (Giza 72 x DelCero) (P_5) and Dendera (P_6). The parents; P_1., P_4 and P_6 are the commercial cultivars while, the parents; P_2 and P_3 are the newly released cultivars, while P_5 was a promising line.

In 1994, a half diallel genetic design including the six parents with the 15 F_1 hybrids and the 15 F_2 populations were grown at the three different locations of Sacolta (Sohag), Kenayate (Sharkia) and Sakha (Kafr El-Sheikh). The F1's seed were produced by hand crossing in 1992 and 1993 seasons, F_2's seed were produced by selfing the F_1 hybrids at the Agricultural Research Center in Giza in 1993 season.

Each Experiment was set as randomized complete blocks design with three replications. Plots were single rows of 6 m length and 0.6 m apart. Two plants were left per hill after thinning. The three Experiments were planted on the 26 th March, the 30 th March and the 9 th April at Sacolta, Kenayate and Sakha, respectively. All cultural practices followed the recommendations for growing cotton in Egypt in all locations. Harvesting was done once on the 15th Oct., 20th Oct. and 30 th Oct. for Sacolta, Kenayate and Sakha sites, respectively.

Data of the following traits were rcorded on individual plant basis with all plants in the plot being sampled, then averaged to obtain plot mean. The following characters were measured.

1- Seed cotton yield per plant (g). 2- Lint yield per plant (g).
3- Number of open bolls per plant. 4- Boll weight (g).
5- Lint percentage (%). 6- Seed index (g).
7- Lint index (g). 8- Micronaire reading.
9- Pressley index. 10- 2.5% span length (mm).
11- 50% span length (mm). 12- Uniformity Ratio (%).

All fiber measurements were determined under standard conditions of temperature ($21^{o}\pm2$) and relative humidity (70% ± 2), at the Cotton Research Institute in Giza.

Combined analyses over locations were carried out to test the genotype by location interactions. The statistical genetic procedure for the analysis of diallel cross pooled over locations for combining ability was done according according to Singh (1973 a and b) using Method II Model I.

Estimates of variance components for general and specific combining ability effects and interactions with locations were calculated according to Baker and Verhalen (1975).

Estimates of general and specific combining ability variances associated with each parent were calculated according to Griffing (1956) as follows :-

$$\sigma^2 gi^2 = (\hat{g}_i)^2 - \frac{(p-1)}{p(p-1)} \sigma^2 e$$

$$\sigma^2 si^2 = \left(\frac{1}{p-2}\right) \Sigma_j Si^2 j - \frac{(p-3)}{(p-2)} \sigma^2$$

Where :-

$\sigma^2 gi^2$ and $\sigma^2 si^2$ are estimates of general and specific combining ability variances associated with each parent, respectively.

gi and Si_j are the estimates of GCA and SCA effects.

Heterosis percentage (H%) was expressed as the percentage increase of the F_1 over mid-parents values (MP) and better parent values (BP).

Inbreeding depression (ID) was measured as the percentage deveiation of the F_2 performance from that of F1 in proportion to MP.

A significant F_2 deviation was interpreted as suggesting the presence of epistatic effects.

Simple correlation coefficients between GCA effects (gi) and the parental mean performances were calculated according to Steel and Torrie (1960).

RESULTS AND DISCUSSION

Combined analyses of variance for the three locations for genotypes showed highly significant differences for all studied characters except uniformity ratio which indicated that detailed analyses for most gene action could be pursued for these characters, (Table 1).

Heterosis and inbreeding depression :

The analysis of variance pursued permits the appreciation of heterosis as a goal of this work. Mean heterosis over crosses and locations is summarized in Table 2. F_1 means were higher than those of the parents for all traits except uniformity ratio. Average heterosis was greatest for seed cotton yield (24.2%), lint cotton yield (27.0%) and number of bolls/plant (18.1%) and relatively low for boll weight, lint percentage, lint index and 2.5 % span length. Better parent heterosis was detected for only seed lint index and 2.5% span length. Better parent heterosis was detected for only seed cotton yield (18.0%), lint yield (17.8%) and number of bolls/plant (13.0%). The diversity among parents was given for each trait as the ratio of the highest parent (HP) to the lowest parent (LP). Ratio ranged from (1.47%) for lint yield, to (1.04%) for uniformity ratio. It is apparent that these traits, namely lint yield, seed cotton yield and number of bolls/plant, showing the greatest range of variability among parents, with the exception of micronaire reading, displayed the highest HP/LP and showed heterosis of high magnitude. Pressley index and uniformity ratio were the only cases expressing an overall negative estimates.

Significant positive heterosis for seed cotton yield, lint yield, number of

Table 1. Combined mean squares for the analysis of variance for twelve cotton characters across three locations in F_1 and F_2 generations.

S.O.V.	DF		Seed cotton yield/plant	Lint cotton yield/plant	No. bolls/ plant	Boll weight	Lint percetage	Seed index	Lint index	micronaire reading	Pressley index	2.5% span length	50% span length	uniformity ratio
Locations (L)	2	F1	4922.30**	710.70**	706.80**	1.380**	47.65**	37.400**	18.600**	2.060**	5.910**	66.61**	27.990**	17.09
		F2	4325.80**	650.20**	639.60**	1.500**	58.43**	36.500**	16.100**	3.340**	9.720	105.78**	33.920**	5.87
Genotypes (G)	20	F1	140.14**	23.93**	51.61**	0.114**	15.68**	0.972**	0.659**	0.593**	1.268**	14.53**	3.818**	4.56
		F2	112.00**	19.31**	51.24**	0.063**	15.12**	0.739**	0.250**	0.533**	1.580**	9.97**	2.84**	3.07
Parents (P)	5	F1	79.88**	14.69**	17.56	0.041	22.99**	0.425	0.802**	1.066**	2.206**	23.74**	6.786**	xxxx(1)
		F2	79.88**	14.69**	17.56	0.041	22.99**	0.425	0.802**	1.066**	2.206**	23.74**	6.786**	xxxx(1)
Parents vs. (H)	1	F1	1229.00**	188.08**	277.20**	0.198*	7.24*	0.254	0.615*	0.018	0.090	6.720*	0.131	
crosses (C)	14	F2	640.30**	93.96**	199.10**	0.048*	1.33	0.027	0.009	0.001	0.505	1.310	0.123	
		F1	83.89**	15.51**	47.66**	0.133**	13.67**	1.216**	0.613**	0.466**	1.017**	11.800**	3.021**	
Crosses	40	F2	85.71**	15.63**	52.71**	0.072**	13.29**	0.906**	0.390**	0.381**	1.438**	5.410**	1.624**	
		F1	94.12**	12.55**	31.84**	0.120**	2.39*	0.460*	0.239**	0.124	0.466*	1.83	0.730	
G x L	10	F2	102.60**	13.88**	32.78**	0.044**	2.65**	0.267	0.159*	0.099	0.442*	1.62	0.770	
		F1	49.77**	5.77	19.45**	0.036	3.32*	0.197	0.141	0.130	0.826**	1.84	0.689	
P x L	2	F2	49.77**	5.77*	19.45**	0.036	3.32**	0.197	0.141	0.130	0.826**	1.84	0.689	
		F1	99.30*	20.22**	46.20*	0.038	11.96	0.203	0.190	0.261	0.043	0.651	1.060	
H x L	28	F2	71.80**	42.06**	47.24**	0.013	7.36**	0.225	0.147	0.070	0.252	4.830*	2.737**	
		F1	109.58**	14.42**	35.24**	0.080**	1.38	0.573**	0.278**	0.112	0.368	1.910	0.722	
C x L	120	F2	123.60**	16.55**	36.51**	0.042**	2.07*	0.294	0.166*	0.09	0.318	1.310	0.659	
Error		F1	25.01	3.44	10.62	0.033	1.37	0.267	0.120	0.114	0.268	1.460	0.681	2.98
		F2	16.60	2.39	8.01	0.021	1.12	0.191	0.099	0.082	0.314	1.39	0.567	2.52

(1) Variances were not calculated of non-significant genotypes mean squares.
*,** Significant at the 5% and 1% levels respectively.

bolls/plant and boll weight and 2.5% span length were shown by a large number of crosses, but few showed positive heterosis for micronaire, Pressley index, 50% span length and uniformity ratio.

From Table (2), individual F_2 means for all traits were similar to or higher than parental means but less or equal in some instances to their F_1 performances. Because minor estimates of F_2 deviations were obtained and were statistically nonsignificant, this suggests that additive and dominance effects were more important than those for epistatic effect in this material.

Estimates of inbreeding depression ranged from (-0.1%) for uniformity ratio to (5.57%) for lint cotton yield. Evidently, those characters that showed the greatest amount of heterosis previously also manifested the most inbreeding depression, Baker and Verhalen (1975) estimated high MP heterosis and large number of heterotic F_1's for lint yield while, negative heterosis was determined for uniformity ratio. El-Adl *et al.* (1978) reported that the highest estimate of heterosis were confronted for seed cotton yield and number of bolls/plant.

Combining ability :

Combining ability analysis of variance (Table 3) revealed highly significant levels of GCA effects for all traits. SCA effects were highly significant or significant for agronomic characters only. The interaction estimate of GCA x location were significant for all traits except micronaire reading, fiber length characters in F_1 generation and seed index, Pressley index and fiber length characters in F_2 generation. With the exception of seed cotton yield interaction estimates were quite small relative to the corresponding variance for GCA effects.

Estimates of SCA x location were significant for all traits except fiber quality characters, lint percentage in F_1 generation and seed index and lint index in F_2 generation. Such differences in GCA and SCA effects between location suggest that in most breeding material, crosses should be evaluated over a range of environments. The findings were in agreement with Baker and Verhalen (1975).

Since a fixed set of lines was studied in this experiment, it was not possible to obtain completely valid estimates of the GCA (additive) and SCA (non-additive) components of variance (Griffing, 1956). However, on the assumption that an approximate estimate was better than none, variance components were calculated and shown in Table (4). From the components, the ratio GCA to SCA showed that the GCA effects were approximately 1.13 to 4.84 times greater for lint percentage, lint index and fiber properties. This strongly implies that GCA was more important than

Table 2. Mean heterosis, number of heterotic F_1 's, inbreeding depression, number of F_2 significantly different from their F_1 's'ans mean deviation.

Character		(1) Hp/LP	Mean heterosis %	(2) Number of heterosis	Mean heterosis of better parent %	Mean inbreeding depression %	No of f2's (3) significantly different from 5%	Mean heterosis of better parent %
Seed cotton yield/plant	(g)	1.34	24.2**	10 (10)	18.0**	4.76	3 (3)	40.0
Lint cotton yield/plant	(g)	1.47	27.0**	11 (11)	17.8**	5.57	3 (3)	50.0
Number of bolls/plant		1.28	18.1**	5 (5)	13.0**	1.59	1 (1)	40.0
Boll weight		1.11	4.3*	6 (5)	2.3	3.06	None	1.0
Lint percentage	%	1.12	1.2*	3 (3)	--- (4)	0.16	None	2.0
Seed index	(g)	1.07	1.1	2 (1)	----	0.69	3 (2)	4.0
Lint index	(g)	1.22	3.0*	2 (2)	----	2.21	1 (1)	-8.0
Micronaire reading		1.35	0.5	4 (2)	----	0.01	4 (2)	3.5
Pressley index		1.13	-0.5	4 (1)	----	0.75	4 (3)	-8.0
2.5% span length	(mm)	1.15	1.4*	5 (5)	----	0.68	1 (1)	-3.0
50 % span length	(mm)	1.18	0.4	1 (1)	----	0.78	1 (1)	-7.0
Uniformity ratio	%	1.04	-1.2	5 (1)	----	-0.10	None	-4.0

(1) Ratio of the high parent versus the low parent.
(2) Number in parenthesis denotes cases of Mid-Parent heterosis in the positive direction.
(3) Number in parenthesis indicates cases of positive inbreeding depression.
(4) Not calculated since F_1 was not above the better parent.
* , ** Significant at 5% and 1% levels, respectively.

Table 3. Mean squares for general and specific combining ability and their interactions by locations.

S.O.V. (1)		Seed cotton yield/plant	Lint cotton yield/plant	No. bolls/ plant	Boll weight	Lint percetage	Seed index	Lint index	micronaire reading	Pressley index	2.5% span length	50% span length
General combining ability	F1	58.89**	12.62**	30.35**	0.049**	18.61**	0.67**	0.632**	0.624**	1.401**	17.38**	4.38**
(gca)	F2	77.63**	14.37**	28.22**	0.036**	17.00**	0.52**	0.473**	0.583**	1.652**	11.70**	3.55**
Spacific combining ability	F1	42.60**	6.42**	12.37**	0.032**	0.82	0.20*	0.083*	0.046	0.085	0.68	0.25
(sca)	F2	23.87**	3.75**	13.24**	0.016**	1.08**	0.15**	0.032**	0.045	0.152	0.43	0.11
gca x location	F1	44.28**	5.58**	21.62**	0.028**	1.65**	0.18*	0.099**	0.036	0.363**	0.82	0.32
	F2	76.58**	9.82**	19.92**	0.017**	1.27**	0.07	0.102**	0.061*	0.186	0.22	0.22
sca x location	F1	27.03**	3.76**	6.40**	0.021**	0.52	0.16*	0.074**	0.039	0.090	0.54	0.22
	F2	27.03**	2.92**	7.88**	0.012*	0.75**	0.09	0.039	0.027	0.137	0.65	0.27
Error	F1	8.33	1.15	3.54	0.011	0.46	0.09	0.040	0.038	0.089	0.49	0.23
		5.53	0.80	2.67	0.007	0.37	0.06	0.033	0.027	0.105	0.46	0.19

*,** Significant at the 5% and 1% levels respectively.
(1) gca and sca for uniformity ratio was not computed, because the mean squares of genotypes was not significant.

Table 4. Estimates of variance components for general and specifice combining ability effects and their interactions with locations in the F_1 and F_2 generations .

Traits		Variance components									
		GCA		SCA		GCA x location		SCA x location		GCA/SCA ratio	
		F_1	F_2	F_1	F_2	F_1	F_2	F_1	F_2	F_1	F_2
Seed cotton yield/plant	(g)	7.3614	7.8993	21.2048	16.8554	5.5338	9.2410	24.0810	17.0615	0.35	0.47
Lint cotton yield/plant	(g)	1.5768	1.7963	3.1100	1.9749	0.6966	1.2270	3.2645	2.2298	0.51	0.91
No. bolls/plant		3.7934	3.6675	6.0329	8.2547	2.7260	2.5048	5.0615	6.4832	0.63	0.44
Boll weight	(g)	0.0061	0.0044	0.0218	0.0112	0.0034	0.0021	0.0191	0.0101	0.47	0.39
Lint percentage	(%)	2.3262	2.1243	0.6220	0.9941	0.2056	0.1579	0.2911	0.5414	3.74	2.14
Seed index	(g)	0.0770	0.0649	0.1600	0.1261	0.0227	0.0091	0.1194	0.0727	0.52	0.51
Lint index	(g)	0.0770	0.0598	0.0682	0.0302	0.0126	0.0115	0.0633	0.0355	1.13	1.98
Micronaire reading		0.0780	0.0672	0.0424	0.0369	0.0045	0.0076	0.0352	0.0191	1.84	1.82
Pressley index		0.1752	0.2065	0.0669	0.1265	0.0451	0.0233	0.0645	0.911	2.62	1.63
2.5% span length	(mm)	2.1720	1.4619	0.5374	0.3021	0.1024	0.0270	0.4132	0.4611	4.04	4.84
50 % span length	(mm)	0.5469	0.4440	0.2417	0.0933	0.0395	0.0274	0.2012	0.2052	2.26	4.76

SCA for these traits. Therefore, the additive genetic variance component must comprise a considerable portion of the genetic variance for each of these traits. However, for yield components (except lint percentage), the SCA component exceeded that for GCA. These traits, therefore, are thought to be influenced to a greater degree by dominance genetic variance. These results are in agreement with the results reached by Salem (1984), El-Disouqi *et al.* (1992) and partially with Rahouma and El-Shaarawy (1992).

The Parental mean performances, The mean estimates of GCA effects and the correlation coefficient between these two parameters are shown in Table (5).

The GCA effects agree closely in rank with parental means for lint percentage, lint index and all fiber properties. This indicates that selection of parents for use in breeding to improve these traits may be based largely on the phenotypic performance of the parents, and also suggests the presence of considerable additive effects. Giza 81 (P4) was the best combiner for lint percentage and lint index, [Giza 83 x Delcero)] (P5) was the best combiner for lint percentage, Giza 77 (P1) had high estimates of GCA effects for Pressely index and fiber length characters.

Mean estimates of SCA effects for seed cotton yield, lint yield and number of bolls/plant are presented in Table (6), as these traits exhibited a much greater degree of average heterosis (Table 2). Moderate levels of SCA effects were observed for certain crosses. [Giza 81 x (Giza 72 x Delcero.)] (P4 x P5) had the best SCA effects for seed cotton yield, lint yield and number of bolls/plant. It could be noted also that, Giza 85 x [Giza 83 x (Giza 72 x DelCero)] had high estimates of SCA effects for number of bolls/plant.

Breeding implication :

The above results, generally demonstrate differences among crosses for yield and yield components, namely, seed cotton yield, lint yield, number of bolls per plant and boll weight which showed high levels of heterosis and relatively high inbreeding depression. Therefore, it could be concluded that most of the genetic in this material is nonadditive.

The GCA/SCA ratio for these traits confirmed that non-additive (dominance) variance component accounted for a sizable portion of the genetic variance. Hence, dominance should receive better attention in breeding programs utilizing heterosis in this material in future work. On the other hand, The results show that GCA appears to be more important than SCA for lint percentage, lint index and fiber properties.

Table 5. Parental mean performances and mean estimates of gca effects of six parents over locations, F_1 and F_2 data and correlation cofficients of gca and parents performance.

Parents (1)			Seed cotton yield/plant	Lint cotton yield/plant	No. bolls/ plant	Boll weight	Lint percetage	Seed index	Lint index	micronaire reading	Pressley index	2.5% span length	50% span length
Giza 77	(P_1)	$\overline{X}$	21.80	7.40	13.30	1.69	33.90	7.70	4.01	2.80	10.50	32.00	16.20
		F_1	-1.40*	-0.66**	-1.41**	0.05*	-0.60**	0.125*	-0.02	-0.08*	0.28**	1.34**	0.67**
		F_2	-2.00**	-0.91**	-1.67**	0.02	-0.55**	0.045	-0.04	-0.11**	0.37**	1.08	0.59**
Giza 84	(P_2)	X	21.90	7.20	13.70	1.70	32.80	7.50	3.66	2.60	10.40	31.10	15.60
		F_1	-0.52	-0.44*	-0.38	-0.01	-1.02**	-0.188**	-0.28**	-0.23**	0.23**	0.72**	0.35**
		F_2	-0.54	-0.46**	-0.04	-0.03	-0.96**	-0.133	-0.25**	-0.22**	0.21**	0.55**	0.30**
Giza 85	(P_3)	X	23.70	8.50	13.80	1.73	35.90	7.90	4.42	3.10	10.00	28.50	14.70
		F_1	0.92	0.46*	0.40	0.01	0.56**	0.029	0.11**	-0.03	-0.09	-0.60**	-0.10
		F_2	0.02	0.12	0.02	-0.01	0.52**	0.029	0.10**	0.01	-0.08	-0.44**	-0.15
Giza 81	(P_4)	X	29.30	10.60	17.00	1.85	36.50	7.70	4.45	3.30	10.20	29.30	14.60
		F_1	0.62**	1.12**	1.30**	0.03	0.78**	0.083	0.18**	0.17**	0.11	-0.10	-0.13
		F_2	2.95**	1.35**	1.45**	0.05**	0.90**	-0.020	0.14**	0.18**	0.06	-0.09	-0.10
G.83x (G.72xDel)	(P_5)	X	21.80	8.00	14.60	1.67	36.60	7.40	4.30	3.50	9.30	27.90	13.70
		F_1	-0.10	0.23	1.13**	-0.08**	1.01**	-0.221**	0.06	0.20**	-0.23**	-0.74**	-0.48**
		F_2	-0.01	0.18	0.89**	-0.06**	0.83**	-0.162**	0.06	0.14**	0.26**	-0.84**	-0.50**
Dendera	(P_6)	X	22.00	7.50	13.50	1.68	33.90	7.90	4.10	3.00	9.50	2850	14.60
		F_1	-1.52**	-0.70**	-1.04**	-0.01	-0.73**	0.179**	-0.04	-0.04	-0.30**	-0.62**	-0.30**
		F_2	-0.36	-0.28	-0.65*	0.02	-0.75**	0.246**	-0.01	0.02	-0.30**	-0.27*	-0.13
Correlation coefficient		F_1	90.36*	92.18*	78.32	43.71	99.12**	95.390*	97.52**	97.21**	95.73**	99.54**	98.07**
		F_2	91.02*	94.47**	83.27*	19.32	98.94**	86.180*	98.90**	90.46*	95.16**	98.73**	99.61**
L.S.D.	0.01		5.36	3.25	N.S.(1)	N.S.	1.93	N.S.	0.62	0.61	1.02	3.20	1.89
	0.05		3.98	2.41	N.S.	N.S.	1.44	N.S.	0.40	0.45	0.75	2.38	1.40
$(\hat{g}_i-\hat{g}_j)$	0.01	F_1	2.18	0.81	1.42	0.08	0.51	0.225	0.15	0.15	0.23	0.53	0.36
		F_2	1.78	0.44	1.23	0.06	0.46	0.190	0.14	0.12	0.24	0.51	0.33
$(\hat{g}_i-\hat{g}_j)$	0.05	F_1	1.65	0.61	1.08	0.06	0.39	0.170	0.11	0.11	0.17	0.40	0.27
		F_2	1.34	0.33	0.93	0.05	0.35	0.144	0.10	0.09	0.16	0.39	0.25

(1) Not Significant differences.

*,** Significnt at the 5 % and 1% levels respectively.

Table 6. Mean performance $(\overline{X})$ and estimates of sca effects $(\hat{S})$ for seed cotton yield/plant, lint yield/plant and No. bolls/plant over three locations.

Crosses	Seed cotton yield F1 $\overline{X}$	Seed cotton yield F1 $\hat{S}$	Seed cotton yield F2 $\overline{X}$	Seed cotton yield F2 $\hat{S}$	Lint yield F1 $\overline{X}$	Lint yield F1 $\hat{S}$	Lint yield F2 $\overline{X}$	Lint yield F2 $\hat{S}$	No. bolls/plant F1 $\overline{X}$	No. bolls/plant F1 $\hat{S}$	No. bolls/plant F2 $\overline{X}$	No. bolls/plant F2 $\hat{S}$
P_1xP_2	26.10	0.58	23.70	-0.03	8.90	0.20	8.10	0.18	13.90	-0.54	13.30	-0.94
P_1xP_3	29.20	2.24	22.90	-1.39	10.30	0.778	8.00	-0.51	15.10	-0.08	14.30	-0.01
P_1xP_4	26.70	-1.94	28.80*	1.52	9.60	-0.66	10.20*	0.50	15.70	-0.41	16.00	0.30
P_1xP_5	29.80	3.86*	21.80	-2.53*	11.00	1.70**	7.10	-0.84	16.50	0.56	13.30	-1.84*
P_1xP_6	25.40	0.88	27.40*	3.43**	8.60	0.16	9.00	0.89	14.50	0.69	14.70	1.10
P_2xP_3	32.10	4.26	25.40	-0.41	11.30*	1.49**	8.70	-0.30	18.00	1.76	16.50	0.60
P_2xP_4	31.30	1.76	30.50**	1.83	11.20*	0.72	10.90*	0.71	17.30	0.16	17.90*	0.58
P_2xP_5	29.10	2.28	28.80**	3.01*	10.60	1.02	10.30*	1.25**	18.70	1.70	19.20**	2.44**
P_2xP_6	25.60	0.20	27.40*	1.84	8.60	0.01	9.10	0.57	15.30	0.47	16.90	1.65*
P_3xP_4	30.40	-0.58	29.50*	0.07	11.40*	0.03	11.20**	0.43	18.40	0.48	17.10	-0.36
P_3xP_5	29.80	1.55	30.40**	4.05**	11.00	0.52	11.00*	1.43**	21.40**	3.62**	19.60**	2.70**
P_3xP_6	30.50	3.67*	28.80*	2.84*	11.10*	1.55**	10.20*	1.05*	16.20	0.59	16.70	1.41
P_4xP_5	35.30**	5.34**	33.30**	4.02**	13.10**	2.02**	12.20**	1.40**	21.40**	2.79**	22.20**	3.91**
P_4xP_6	30.80	2.26	27.00*	-1.85	10.90	0.69	10.10*	-0.24	17.00	0.56	16.00	-0.78
P_5xP_6	23.60	-2.22	26.40	0.43	8.50	-0.76	9.40	0.16	15.30	-0.97	15.20	-1.02
L.S.D.												
5%	8.68		6.79		2.57		3.25		5.50		4.50	
1%	11.50		9.97		3.40		4.31		7.30		3.00	
(Sij - Skl) for S												
5%		4.04		3.29		1.50		1.25		2.63		2.18
1%		5.34		4.35		1.98		1.65		3.48		3.02

Besides, the data obtained on GCA effects and its relation to the means of parents, endorse the idea that selection of parents and crosses based on their *per se* performances would also be beneficial to improve these characters.

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قوة الهجين والقدرة على الإئتلاف فى هجن صنفية للقطن المصرى فى ثلاثة مناطق مختلفة

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إستخدم نظام الهجن التبادلية بين ستة من الآباء المتباينة وراثياً لتقدير القدرة العامة والخاصة للتآلف وتفاعلها مع البيئة فى ثلاث مناطق بيئية مختلفة. وتضمنت التجربة أباء لثلاثة من الأصناف التجارية هى جيزة ٧٧ ، وجيزة ٨١ ، والدندره بالإضافة إلى ثلاثة من الأصناف الجديدة المبشرة هى جيزة ٨٤ ، وجيزة ٨٥، وجيزة ٨٣ x (جيزة ٧٢ x دلسيرو) ، بالإضافة إلى خمسة عشر هجيناً لكلا من الجيلين الأول والثانى فى تصميم القطاعات الكاملة العشوائية فى ثلاثة مكررات. وفيما يلى ملخص لأهم النتائج المتحصل عليها :-

١ - بين التحليل وجود إختلافات عالية المعنوية بين التراكيب الوراثية المختلفة لجميع الصفات عدا صفة معامل إنتظام الطول للشعرة، وكانت أكثر الصفات تأثرا بالبيئة هى محصول القطن الزهر والشعر، وعدد اللوز على النبات، ومتوسط وزن اللوزة.

٢ - كان متوسط قوة الهجين فى أعلى مستوى له لهذه الصفات، كما كان التباين الوراثى الغير مضيف أكثر أهمية فى توريث هذه الصفات. بينما كان التباين الوراثى المضيف أكثر أهمية لصفات معدل الحليج، ومعامل الشعر والصفات التكنولوجية للشعر. لوحظ أيضا وجود تفاعل لكل من القدرة العامة والخاصة للتآلف مع البيئة فى معظم الصفات مما يستوجب إستخدام مدى واسع من الظروف البيئية عند تقييم الهجن للحصول على تقديرات أكثر دقة.

٣ - أظهرت النتائج أن أفضل الآباء فى تحسين الصفات المحصولية هى جيزة ٨١ ، جيزة ٨٣ x (جيزة ٧٢ x دلسيرو) لتحسين صفات عدد اللوز / نبات ، ومعدل الحليج . والصنف جيزة ٧٧ لصفات المتانة وطول التيلة، وجيزة ٨٤ لصفة النعومة (قراءة الميكرونير).

٤ - كما أعطت الهجن جيزة ٨١ x [جيزة ٨٣ x (جيزة ٧٢ x دلسيرو)]، والهجين جيزة ٨٥ x دندره أعلى محصول من القطن الزهر والشعر. وأثبت الهجين جيزة ٧٧ x جيزة ٨٤ تفوقه فى صفة طول التيلة.