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INHERITANCE OF QUANTITATIVE TRAITS OF EGYPTIAN COTTON (*G. BARBADENSE* L.) A- YIELD AND YIELD COMPONENT TRAITS

EL-ADL, A.M.[1]; Z.M. EL-DIASTY[1]; A.A. AWAD[2]; A.M. Zeina[2] and A.M. Abd El-Bary[2]

1 Fac. of Agric., Mansoura University, El-Mansoura, Egypt.

2 Cotton Research Institute, Agricultural Research Centre.

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Abstract

The aim of this investigation was to determine the extent of heterosis and combining ability estimates and their interactions with locations for yield and yield components in Egyptian cotton. Six parental varieties namely Giza 85 (P_1), Giza 86 (P_2), Giza 89 (P_3), Giza 76 (P_4), Giza 77 (P_5) and Giza 87 (P_6) representing a wide range of variability in most of the studied traits, were utilized. The six parental varieties were crossed using a diallel crosses mating design (including reciprocals) to obtain 30 F_1 hybrids in 1996 growing season. In 1997 growing season, two experiments were carried out at both Sakha, Kafr El-Sheikh Governorate (L_1) and Kafr Saad, Damietta Governorate (L_2). Each experiment was arranged in a randomized complete block design with four replications to evaluate all genotypes, which involved six parental varieties and their possible 30 F_1 hybrids including reciprocal.

Data were recorded on 10 guarded plants randomly sampled from each plot. The studied traits were: seed cotton yield per plant, lint yield per plant, number of bolls per plant, boll weight, lint percentage, lint index and seed index.

The results of the analyses of variances indicated highly significant differences among population means for all studied traits at the two locations and combined data. Also, the genotypes by locations interactions were significant or highly significant for all studied traits except lint percentage and lint index indicating the presence of interaction between genotype and locations. The results indicated that no single parent was the best for all studied traits. Generally, the variety Giza –86 (P_2) was the highest yielding parent. The largest amount of heterosis versus mid-parents was (7.79 %) for lint yield per plant, while the lowest amount of heterosis was (0.91 %) for number of bolls per plant. Heterosis versus better parent was undesirable.

The mean squares in the F_1 hybrids for general combining ability (G.C.A.) were highly significant for all studied traits. Tests of significant of the mean squares of (G.C.A.) were larger in magnitudes than those specific combining ability (S.C.A.) and showed highly significant differances for all studied traits.

The estimates values of genetic parameters showed that the magnitudes of dominance genetic variance (σ^2D) was larger than threfore additive genetic variance ($\sigma 2A$) and reciprocal variance (σ^2r) for all studied traits with the except of boll weight.

The estimates of broad sense heritabilities were larger in magnitude than their corresponding estimates of narrow sense heritabilities for all studied traits at both the two locations and from combined data except boll weight from combined data.

Giza 86 was good combiner for most yield and yield component traits. The intrinsic performance of parental variety gave a good index of their general combining ability effects in most cases. Also (Giza 89 x Giza 77) was the best for yield and its components traits.

INTRODUCTION

The ultimate goal of a cotton breeding program is to produce new varieties that exceeds the commercial cotton varieties in yielding capacity and improved fiber properties. Exploration of hybrid vigor and the understanding of nature of gene action in cotton are considered the most important applications of the science of genetics in cotton breeding programs. On the other hand, the relationships among yield and yield component traits are complex, since they are influenced by both genetical and environmental variations, in addition to the interaction between these two factors. Therefore, an evaluation of the relative magnitudes of both genetic variances and environmental variances should be important objective for a successful breeding program. Khan and Aly (1980), El-Harony(1981), El-Kadi *et al.* (1982a), Abo El-Zahab *et al.* (1983), Singh *et al.*(1987), El-Okkia *et al.* (1989), Rahomah *et al.*(1989), and Gomaa and Shaheen (1995) reported significant heterosis over mid- parents for most yield and yield component traits, while heterosis over better-parent was different.

Heterosis depend on the presence of non-additive genetic variance, therefore the nature of gene action was studied. Singh and Singh (1981), Bains *et al.* (1982), Awad (1991), Hendawy (1994), Gomaa (1997), and Amer (1998) reported that additive gene effects were larger and significant for most tratis , while Atta *et al.* (1982), Okasha (1989), and Gomaa and Shaheen (1995) indicated that non- additive gene effects were important for some traits.

MATERIALS AND METHODS

The experiments reported herein were carried out at two locations, Sakha, Kafr El-Sheikh Governorate (L_1) and Kafr Saad, Damietta Governorate (L_2) during the two successive seasons 1996 and 1997. Six parental cotton varieties belonging to *Gossypium barbadense* L. namely Giza 85 (P_1) , Giza 86 (P_2) , Giza 89 (P_3), Giza 76 (P_4) , Giza 77 (P_5) and Giza 87 (P_6) representing a wide range of variability in most of the studied traits, were utilized.

Diallel crosses were carried out among the six cotton varieties in 1996 growing season. The parental varieties and their possible 30 F_1 hybrids (including reciprocals) were sown in 1997 at the two locations, *i.e.* Sakha (L_1) and Kafr Saad (L_2). The two experiments were arranged in a randomized complete blocks design with four replications in each location. Each plot consists of one row 4.0 m. long and 0.6 m. wide. Hills were 0.20 m. apart to insure 20 hills per row. At seedling stage, plants were thinned to keep a constant number of two plants per hill with 40 plants per row. Ordinary cultural practices were followed as usual for the cotton field in the two locations. Data were recorded on an individual guarded plants of the 36 genotypes for the following traits: seed cotton yield per plant.(S.C.Y./P.), lint yield per plant (L.Y./P.), boll weight (B.W.), number of open bolls per plant (No. O.B./P.), lint percentage (L.%), seed index (S.I.) and lint index (L.I.).

Estimates of both general combining ability (G.C.A.) and specific combining ability (S.C.A.) were computed according to Griffing (1956) designated as method (I), model (II). The combined analysis was calculated over the two locations to test the interactions of the different genetic components with the two locations. Heterosis was expressed for all studied traits as percent increase of the F_1 performance above the mid-parents and better parent.

The estimates of heritabilities were determined according to the following equations (Burton and Deven (1953)):

1. From single location :

a. h^2b (broad sense heritability) $= \dfrac{2\sigma^2 g + \sigma^2 s}{2\sigma^2 g + \sigma^2 s + \frac{\sigma^2 e}{r}} \times 100$

b. h^2n (narrow sense heritability) $= \dfrac{2\sigma^2 g}{2\sigma^2 g + \sigma^2 s + \frac{\sigma^2 e}{r}} \times 100$

2. From combined data over locations :

$$a.\ h^2b = \frac{2\sigma^2 g + \sigma^2 s}{2\sigma^2 g + \sigma^2 s + \sigma^2 r + \frac{2\sigma^2 gL}{L} + \frac{\sigma^2 sL}{L} + \frac{\sigma^2 rL}{L} + \frac{\sigma^2 e}{rL}} \times 100$$

$$b.\ h^2n = \frac{2\sigma^2 g}{2\sigma^2 g + \sigma^2 s + \sigma^2 r + \frac{2\sigma^2 gL}{L} + \frac{\sigma^2 sL}{L} + \frac{\sigma^2 rL}{L} + \frac{\sigma^2 e}{rL}} \times 100$$

Where :-

$\sigma^2 g$ general combining ability variance.

$\sigma^2 s$ specific combining ability variance.

σ^2 r reciprocal variance.

h^2_b broad sense heritability.

h^2_n narrow sense heritability.

L is the number of locations.

r is the number of replications.

RESULTS AND DISCUSSION

The results of the analysis of variance and mean squares of yield and yield component traits for all genotypes at the two locations and the combined data are presented in Tables 1 and 2. Results indicated that the magnitudes of mean squares of all studied traits were larger than their corresponding error in the two locations. The results of the F-test showed that the mean squares of the genotype were highly significant indicating the presence of large variations among studied traits, the mean squares of genotypes by locations appeared highly significant for all studied traits except lint percentage and lint index.

Amounts of heterosis for all traits were obtained from mid-parents (M.P) and better-parent (B-P.) for the two locations and from the combined data and results are shown in Tables 3 and 4. Heterosis values versus mid-parents were favorable and significant for all studied traits.The largest amount was 7.79 a for lint yield and lowest amount was-0.3 for number of bolls per plant, while better-parent heterosis amount was unfavorable and not of economic importance. These results were generally in agreement with those reported by Khan and Aly (1980), El-Harony (1981), El-Kadi *et*

Table 1. The analysis of variance and mean squares for yield and yield components traits at the two locations for the parents, F_1 hybrid and F_{1r}'s reciprocal hybrids.

S.O.V	d.f.	No. B. / P.		B. W.		L. %		S. L.		L.I.		S. C. Y. / P.		L. Y. / P.	
		L_1	L_2	L_1	L_2	L_1	L_2	L_1	L_2	L_1	L_2	L_1	L_2	L_1	L_2
Rep.	3	3.4514	7.2684	0.1286^{*}	0.0902	4.6128	0.6400	0.6978^{*}	0.1259	0.7661^{*}	0.1093	11.4653	15.5946	13.7590^{**}	1.9549
Geno.	35	11.0928^{**}	14.0567^{**}	0.1152^{**}	0.1662^{**}	15.1825^{**}	18.8715^{**}	0.7791^{**}	0.5720^{**}	1.4297^{**}	1.3332^{**}	81.0877^{**}	87.3729^{**}	13.7327^{**}	14.4965^{**}
Error	105	3.4866	3.9499	0.0424	0.0393	2.0117	1.0351	0.2292	0.0930	0.2207	0.0553	10.8088	11.7668	2.0754	2.7461

L_1 Sakha.
L_2 Kafr Saad.
* significant at 5 % level.
** significant at 1 % level.

Table 2. The combined analysis of variance and mean squares for yield and yield components traits at the two locations for the parents, F_1 hybrid and F_{1r}'s reciprocal hybrids.

S.O.V.	d.f.	No.B./P.	B.W.	L.%	S.I.	L.I	S.C.Y./P.	L.Y./P.
Rep.	6	5.3599	0.1094*	2.6264	0.4119*	0.4377**	13.5299	7.8569**
Loc.	1	137.5898**	0.7129**	113.8125**	186.8438**	28.6895**	466.1875**	80.9297**
Geno.	35	19.1282**	0.1951**	31.8792**	1.1044**	2.5846**	122.0313**	21.4437**
G. x L.	35	2.0212*	0.0863**	2.1748	0.2467*	0.1783	46.4283**	6.7854**
Error	210	3.7183	0.0409	1.5234	0.1611	0.1380	11.2878	2.4107

L_1 Sakha.
L_2 Kafr Saad.
* significant at 5 % level.
** significant at 1 % level.

Table 3. Percentage of heterosis over both mid-parents (M.P.) and better-parent (B.P.) for yield and yield components traits for the studied crosses at two locations.

Entries and Comparisons	No. B. / P.		B. W.		L. %		S. I.		L. I.		S. C. Y. / P.		L. Y. / P.	
	L_1	L_2	L_1	L_2	L_1	L_2	L_1	L_2	L_1	L_2	L_1	L_2	L_1	L_2
M. P.	12.34	13.99	3.00	2.90	35.18	36.09	9.73	8.12	5.32	4.63	36.58	39.90	12.22	14.22
Range	9.91 - 14.77	11.74 - 16.76	2.66 - 3.21	2.63 - 3.24	30.13 - 36.91	29.94 - 39.03	9.18 - 10.39	7.80 - 9.05	4.02 - 6.07	3.37 - 5.80	30.12 - 37.30	32.19 - 47.34	9.35 - 16.70	10.72 - 18.69
F_1	12.44	13.80	3.08	2.95	35.31	36.66	9.96	8.35	5.46	4.85	38.81	41.04	13.60	14.52
Range	9.70 - 15.75	9.77 - 16.82	2.85 - 3.51	2.43 - 3.32	32.05 - 37.88	32.52 - 38.92	9.47 - 11.12	7.60 - 9.13	4.63 - 6.78	3.67 - 5.72	29.84 - 47.91	32.56 - 51.38	10.14 - 16.89	11.89 - 18.88
F_{1r}	12.80	14.10	3.07	2.99	35.53	36.84	9.92	8.32	5.50	4.87	39.21	42.70	13.84	15.06
Range	10.14 - 16.56	9.74 - 18.34	2.77 - 3.36	2.74 - 3.20	32.32 - 37.88	33.63 - 39.42	9.15 - 11.20	7.62 - 8.93	4.71 - 6.80	4.15 - 5.71	29.32 - 47.91	31.50 - 55.47	10.51 - 17.76	11.54 - 18.76
$F_{1.1r}$	12.62	13.95	3.07	2.97	35.42	36.75	9.94	8.33	5.48	4.86	39.00	41.87	13.72	14.79
Range	9.70 - 16.56	9.74 - 18.34	2.77 - 3.51	2.43 - 3.32	32.05 - 37.88	32.52 - 39.42	9.15 - 11.20	7.60 - 9.13	4.63 - 6.80	3.67 - 5.72	29.32 - 47.91	31.50 - 55.47	10.14 - 17.76	11.54 - 18.88
H (F_1, M.P.) %	0.81	-1.36	2.67	1.72	0.37	1.58*	2.36*	2.83**	2.63	4.75**	6.10*	2.86	11.29**	2.11
H (F_{1r}, M.P.) %	3.73	0.79	2.33	3.10	1.00	2.08**	1.95	2.46**	3.38	5.118**	7.19**	7.02**	13.26**	5.91
L.S.D 0.05	0.893	0.950	0.099	0.095	0.678	0.487	0.229	0.146	0.225	0.113	1.815	1.894	0.796	0.915
0.01	1.180	1.256	0.130	0.125	897.000	0.643	0.303	0.193	0.297	0.149	2.400	2.504	1.051	1.210
H($F_{1.1r}$, M.P.) %	2.27	-0.29	2.33	2.41	0.68	1.83**	2.16	2.592**	3.01	4.97**	6.62**	4.94*	12.28**	4.01
L.S.D 0.05	0.827	0.880	0.091	0.088	0.628	0.451	0.212	0.135	0.208	0.104	1.681	1.754	0.737	0.847
0.01	1.093	1.163	0.121	0.116	0.830	0.595	0.280	0.179	0.275	0.138	2.222	2.318	0.973	1.120
H (F_1, B.P.) %	-15.78**	-17.66**	-4.05	-8.95**	-4.351*	-6.07**	-4.14	-7.74**	-10.05*	-16.38**	-17.95**	-13.25**	-18.56**	-22.31**
H (F_{1r}, B.P.) %	-13.34*	-15.87*	-4.36	-7.72*	-3.74	-5.61**	-4.52	-8.07**	-9.39*	-16.03**	-17.10**	-9.80*	-17.13**	-19.42**
L.S.D 0.05	1.909	2.032	0.211	0.203	1.450	1.188	0.490	0.312	0.480	0.240	3.882	4.050	1.701	1.957
0.01	2.524	2.686	0.278	0.268	1.918	1.571	0.647	0.412	0.635	0.318	5.130	5.353	2.248	2.586
H($F_{1.1r}$,B.P.) %	-14.56*	-16.77**	-4.36	-8.33**	-4.041*	-5.84**	-4.33	-7.96**	-9.72*	-16.21**	-17.55**	-11.56**	-17.84**	-20.87**
L.S.D 0.05	1.879	2.000	0.207	0.200	1.427	1.024	0.482	0.307	0.473	0.237	3.820	3.986	1.674	1.926
0.01	2.484	2.644	0.274	0.264	1.887	1.353	0.637	0.408	0.625	0.318	5.050	5.269	2.213	2.545

Table 4. Percentage of heterosis over both mid-parents (M.P.) and better-parent (B.P.) for yield and yield components traits from the combined data.

Entries and Comparisons	No.B./P.	B.W.	L.%	S.I.	L.I.	S.C.Y./P.	L.Y./P.
M.P	13.16	2.95	35.64	8.93	4.97	38.24	13.22
Rang	11.17-15.28	2.64-3.12	30.03-37.67	8.60-9.71	3.69-5.86	33.13-46.72	10.04-16.68
F_1	13.12	3.02	36.18	9.15	5.16	39.93	14.06
Rang	9.74-16.28	2.71-3.41	32. 82-38.19	8.61-10.13	4.22-6.25	31.20-48.32	11.27-16.96
F_{1r}	13.45	3.04	36.19	9.12	5.18	40.96	14.45
Rang	10.44-16.20	2.78-3.24	33.15-38.26	8.56-10.06	4.43-6.23	30.41-48.09	11.03-18.03
$F_{1.1r}$	13.28	3.03	36.18	9.13	5.17	40.44	14.25
Range	9.74-16.28	2.71-3.41	32. 82-38.26	8.56-10.16	4.22-6.25	30.41-48.32	11.03-18.03
H (F_1,M.P.)%	-0.30	2.37	1.52	2.46*	3.82*	4.42	6.35
H (F_{1r}, M.P.) %	2.20	3.05	1.54	2.13*	4.23*	7.11**	9.30**
L.SD 0.05	0.913	0.096	0.584	0.190	0.176	1.837	0.849
0.01	1.200	0.126	768.000	0.250	0.231	2.414	1.115
H ($F_{1.1r}$, M.p) %	0.91	2.71	1.52	2.24*	4.02*	5.75*	7.79*
L.S.D 0.05	0.845	0.089	0.541	0.176	0.163	1.700	0.786
0.01	1.111	0.117	0.711	0.231	0.214	2.235	1.033
H (F_1, B.P.) %	-14.14*	-3.21	-3.96*	-5.767**	-11.95**	-14.53**	-15.71**
H (F_{1r}, B.P.) %	-11.98	-2.56	-3.93*	-6.076**	-11.60**	-12.33**	-13.37**
L.S.D 0.05	1.952	0.205	1.249	0.406	0.376	3.927	1.815
0.01	2.565	0.269	1.642	0.534	0.494	5.161	2.385
H($F_{1.1r}$, B.P,) %	-13.10*	-2.89	-3.96*	-5.97**	-11.77**	-13.44**	-14.57**
L.S.D 0.05	1.921	0.201	1.230	0.400	0.370	3.865	1.786
0.01	2.525	0.265	1.616	0.526	0.486	5.079	2.347

F_{1r} : F_1 reciprocal hybrids.

$F_{1.1r}$: F_1 and F_1 reciprocal hybrids.

Table 5. The analysis of variance and mean squares of complete diallel cross for yield and yield components traits at the two location.

S.O.V.	d.f.	No. B./ P.		B. W.		L. %		S. I.		L. I.		S. C.Y. / P.		L.Y. / P.	
		L_1	L_2	L_1	L_2	L_1	L_2	L_1	L_2	L_1	L_2	L_1	L_2	L_1	L_2
G.C.A	5	11.0465**	11.3094**	0.0406**	0.1281**	22.8047**	31.3156**	0.9556**	0.7091**	2.1311**	2.1698**	97.5516**	91.0734**	17.8729**	19.5871**
S.C.A.	15	1.6190*	2.5479**	0.0182	0.0281**	0.6438	0.3023	0.1059*	0.0673**	0.0763	0.0395**	22.4534**	31.9078**	3.3766**	3.6761**
Rec.	15	1.1700	1.8821*	0.0355**	0.0261**	0.6124	0.2669	0.0302	0.0301	0.0473	0.0149	8.0978**	5.6896	1.3467*	1.0697
Error	105	0.8716	0.9875	0.0106	0.0098	0.5029	0.2588	0.0573	0.0232	0.0552	0.0138	3.6029	3.9223	0.6918	0.9154

L_1 Sakha.
L_2 Kafr Saad.
* significant at 5 % level.
** significant at 1 % level.

Table 6. Combined analysis of variances and mean squares for general and specific combining ability for complete diallel crosses analysis for yield and yield component traits.

S.O.V.	d.f.	NO.B./P.	B.W.	L.%	S.I.	L.I.	S.C.Y./P.	L.Y./P.
G.C.A	5	9.9324**	0.0690**	26.7813**	0.7143**	2.1245**	82.0813**	17.2617**
S.C.A	15	1.2136	0.0120	0.2214	0.0632	0.0315	16.9352**	1.8757**
Rec.	15	1.0546	0.0220*	0.1517	0.0208	0.0142	3.1588	0.7095
G.C.A x L	5	9.9641**	0.1234**	2.2311**	0.9445**	0.2025**	73.3874**	8.8096**
S.C.A x L	15	6.9584**	0.0895**	2.0136**	0.1872**	0.2116**	61.4776**	9.9037**
Rec x L	15	3.7720**	0.0706**	2.3031**	0.0748*	0.1349**	22.4093**	2.9924**
Error	210	0.9296	0.0102	0.3808	0.4030	0.0345	3.7626	0.8036

* significant at 5 % level.
** significant at 1 % level.

Table 7. Estimates of parental general combining ability effects for yield and yield components traits at the two locations.

Parents	NO. B. /P.		B. W.		L %		S. I.		L. I.		S. C. Y. / P.		L. Y. / P.	
	L_1	L_2	L_1	L_2	L_1	L_2	L_1	L_2	L_1	L_2	L_1	L_2	L_1	L_2
P_1	-0.4145	- 0.5984*	0.0237	-0.0176	0.5610**	0.9747**	0.3435**	-0.0375	0.3274**	0.1652**	-0.3486	-3.2376**	0.2653	-0.8873**
P_2	0.6197*	-0.3240	0.0512	0.1482**	1.3735**	1.4278**	0.3717**	0.4773**	0.5399**	0.5836**	1.7383**	1.7294**	1.2028**	1.0969**
P_3	1.4299**	1.1824**	0.0387	-0.0031	0.4918**	0.7387**	-0.2208**	-0.0740	-0.0188	0.0952**	4.4386**	4.0249**	1.5167**	2.0960**
P_4	-0.4349	-0.1774	0.0031	-0.0628*	-0.2199	-0.3596**	-0.2531**	-0.1637**	-0.2039**	-0.1756**	-0.4061	-1.5918**	-0.3317	-0.7431**
P_5	- 1.3393**	- 1.2280**	-0.0065	0.0797**	0.4093*	0.2699*	-0.1115	-0.0190	0.0239	0.0352	-3.9231**	-2.0923**	-1.3128**	-0.8309**
P_6	0.1392	1.1453**	-0.1104**	-0.1443**	-2.6157**	-3.0515**	-0.1298*	-0.1831**	-0.6684**	-0.7036**	-1.4992**	1.1674*	-1.3403**	-0.7315**
S.E	0.2460	0.2619	0.0271	0.0261	0.1869	0.1341	0.0631	0.0402	0.0619	0.0310	0.5002	0.5219	0.2192	0.2521

L_1 Sakha.
L_2 Kafr Saad.
* significant at 5 % level.
** significant at 1 % level.

Table 8. Estimates of parental general combining ability effects for yield and yield components traits from the combined data.

Variety	No.B./P.	B.W.	L.%	S.I.	L.I.	S.C.Y./P	L.Y./P.
P_1	-0.5065*	0.0031	0.7678**	0.1530**	0.2463**	-1.7931**	-0.3110
P_2	0.1478	0.0997**	1.4007**	0.4245**	0.5617**	1.7338**	1.1498**
P_3	1.3061**	0.0179	0.6152**	-0.1474**	0.0382	4.2318**	1.8063**
P_4	-0.3061	-0.0299	-0.2898	-0.2084**	-0.1898**	-0.9989	-0.5374*
P_5	-1.2836**	0.0366	0.3396*	-0.0652	0.0296	-3.0077**	-1.0719**
P_6	0.6423*	-0.1274**	-2.8336**	-0.1565**	-0.6860**	-0.1659	-1.0359**
S.E	0.2541	0.0266	0.1626	0.0529	0.0490	0.5112	0.2362

* significant at 5 % level.
** significant at 1 % level.

al. (1982-a) Abo El-Zahab *et al.* (1983), Singh *et al.* (1987), El-Okia *et al.* (1989), Rahomah *et al.* (1989) and Gomaa and Shaheen (1995).

The results of the analysis of variance of the diallel crosses for the two locations and their combined data are shown in Tables 5 and 6, respectively. Tests of significance indicated that the mean squares of (G.C.A.) were larger in magnitude than those (S.C.A) and showed highly significant differences for all studies traits. Mean of (S.C.A) were significant for most traits. The results also pointed out that reciprocal effect were present and significant for seed cotton yield per plant, lint yield per plant at (L_1), number of bolls per plant at (L_2) and boll weight at (L_1 and L_2), while it was significant only for boll weight for the combined data. The interaction of (G.C.A), (S.C.A) and reciprocals by location (G.C.A x L.), (S.C.A x L.) and (Rec. x L.) were highly significant for all studied traits. These results were expected and showed complete agreement with the means and heterosis.

This would indicate that both additive and non-additive gene action tended to interact equally with location. Also selection for these traits would not be effective in a single location and more locations would be required. Similar results were obtained by several authors, among them Singh and Singh (1980), El-Gohary *et al.* (1981), Zaitoon *et al.* (1982), Khajjdoni *et al.* (1984), El-Helw (1990), Green and Culp (1990) Esmail (1991) and Hendawy (1994).

Estimates of general combining ability (G.C.A) effects for the six cotton varieties at both locations and their combined data are given in Tables 7 and 8, respectively. Giza 86 (P_1) was a good combiner as it was the highest yielding parent for all traits except number of bolls per plant at (L_2) and boll weight (L_1). The variety Giza 85 (P_1) showed highly significant and positive (G.C.A) effect for lint percentage, seed index and lint index while, it exhibit negative (undesirable) and significant (G.C.A) effects for number of bolls per plant and seed cotton yield per plant. The variety Giza 89 (P_3) showed highly significant and positive (G.C.A) effects for most studied traits. The varieties Giza 76 (P_4), Giza 77 (P_5) and Giza 87 (P_6) were generally significant or highly significant and negative effects for most studied yield and yield component traits.

The specific combining ability (S.C.A) effect (Sij) were estimated for all yield and yield component traits at the two locations and from the combined data and results are presented in Tables 9 and 10, respectively. The results indicated that the crosses (P_1x P_3) and (P_1x P_5) at (L_2) and (P_2 x P_6) at (L_1) exhibited significant negative (S.C.A) effect for number of bolls per plant, while the cross (P_1 x P_4) and (P_3 x P_6) at

Table 9. Estimates of specific combining ability effects for the studied crosses for yield and yield components traits at two locations.

Crosses	No.B. /P.		B.W.		L. %		S. I.		L.I.		S.C.Y /P.		L.Y./ P.	
	L_1	L_2	L_1	L_2	L_1	L_2	L_1	L_2	L_1	L_2	L_1	L_2	L_1	L_2
$P_1 \times P_2$	-0.3269	0.0959	0.0750	-0.1424*	0.4969	-0.3914	0.5408**	0.2946**	0.4737**	0.1200	2.2489	-1.7810	0.8517	-0.4524
$P_1 \times P_3$	-1.0222	-1.2381*	0.0087	0.0351	0.4236	0.1628	-0.0354	-0.3452**	0.0841	-0.1738*	-1.3347	-4.1966**	0.1794	-1.4282*
$P_1 \times P_4$	-0.0711	1.6842**	0.0944	-0.0363	-0.9272*	0.2824	0.0819	0.1606	-0.1746	0.1475*	1.1500	7.0201**	0.2511	2.3409**
$P_1 \times P_5$	-0.3955	-2.3726**	-0.1210	0.0924	-0.0701	0.1740	-0.2123	0.1808	-0.1731	0.1500*	-4.7531**	-4.1810**	-1.8361**	-1.2580*
$P_1 \times P_6$	1.8560**	-0.0822	-0.0808	-0.0099	-0.2351	0.4542	-0.1727	0.0675	-0.1775	0.1033	5.7697**	-0.9607	1.6631**	-0.3107
$P_2 \times P_3$	1.0574	-0.3549	-0.1125	0.0843	-0.0039	0.1659	0.0590	0.0673	0.0420	0.0960	0.2833	-1.7552	0.5869	-0.6241
$P_2 \times P_4$	-0.3265	0.7461	0.0206	0.0128	0.4090	0.3217	-0.1850	-0.0267	-0.0088	0.0382	-3.0253**	4.0348**	-1.1314*	1.1501*
$P_2 \times P_5$	-0.1297	-0.1658	0.0652	0.0716	0.2136	0.2084	0.0446	0.0048	0.0877	0.0580	-1.2467	-1.5130	-0.3086	0.0279
$P_2 \times P_6$	-1.2282*	-0.2428	0.1079	-0.0057	0.7049	0.1561	-0.1783	-0.1410	0.0133	-0.1198	-3.4822**	-0.1110	-0.8278	0.1384
$P_3 \times P_4$	0.3295	-0.3003	-0.1019	-0.1184*	-0.2306	-0.2666	-0.0813	0.1646	-0.0124	0.0372	1.5594	-1.2357	0.9497	-1.2074
$P_3 \times P_5$	0.5026	0.1465	0.1127	0.2066**	-0.0710	0.6101*	-0.0429	-0.0202	-0.0391	0.1172	4.3347**	2.7465*	1.8458**	0.6937
$P_3 \times P_6$	0.7616	1.3007*	0.0192	0.0681	-0.6660	0.1353	0.2192	0.1690	-0.0307	0.1028	0.8358	6.6934**	0.2267	2.7609**
$P_4 \times P_5$	0.9137	0.5063	-0.0504	-0.0599	0.4457	-0.2266	-0.1356	-0.0092	0.0295	-0.0593	2.6144*	-0.6835	0.9092	-0.3138
$P_4 \times P_6$	-3036	-0.7745	0.1048	0.0128	0.3119	0.0524	0.1540	-0.1250	0.1638	-0.0355	1.4206	-2.9632*	0.5533	-1.1832*
$P_5 \times P_6$	-0.9055	0.9486	0.0269	-0.0197	0.0985	-0.2035	0.3060*	0.0852	0.1303	-0.0055	-0.3142	3.8090**	-0.1772	1.1045
S.E.	0.5610	0.5972	0.0619	0.0596	0.4262	0.3057	0.1438	0.0916	0.1412	0.0707	1.1406	1.1901	0.4998	0.5749

Table 10. Estimates of specific combining ability effects for the studied crosses for yield and yield component traits from the combined data.

Crosses	No. B./P.	B.W.	L.%	S.I.	L.I.	S.C. Y./P.	L.Y./P.
$P_1 \times P_2$	-0.1155	-0.0337	0.0528	0.4177**	0.2968**	0.2339	0.1996
$P_1 \times P_3$	-1.1301	0.0219	0.2932	-0.1948	-0.0448	-2.7657*	-0.6244
$P_1 \times P_4$	0.8066	0.0290	-0.3224	0.1212	-0.0135	4.0850**	1.2960*
$P_1 \times P_5$	-1.3841*	-0.0143	0.0019	-0.0157	-0.0116	-4.4670**	-1.5470**
$P_1 \times P_6$	0.8869	-0.0453	0.1096	-0.0526	-0.0371	2.4045*	0.6762
$P_2 \times P_3$	0.3512	-0.0141	0.0810	0.0631	0.0690	-0.7359	-0.0186
$P_2 \times P_4$	0.2098	0.0167	0.3654	-0.1058	0.0147	0.5048	0.0094
$P_2 \times P_5$	-0.1477	0.0684	0.2110	0.0247	0.0729	-1.3798	-0.1404
$P_2 \times P_6$	-0.7355	0.0511	0.4305	-0.1597	-0.0533	-1.7966	-0.3447
$P_3 \times P_4$	0.0146	-0.1101	-0.2486	0.1229	0.0124	0.1619	-0.1288
$P_3 \times P_5$	0.3246	0.1597**	0.2695	-0.0316	0.0391	3.5406**	1.2698*
$P_3 \times P_6$	1.0311	0.0436	-0.2653	0.1941	0.0361	3.7646**	1.4938**
$P_4 \times P_5$	0.7100	-0.0551	0.1095	-0.0724	-0.0149	0.9655	0.2977
$P_4 \times P_6$	-0.5391	0.0588	0.1822	0.0145	0.0641	-0.7713	-0.3150
$P_5 \times P_6$	0.0216	0.0036	-0.1510	0.1956	0.0624	1.7474	0.4637
S.E.	0.5794	0.0607	0.3708	0.1206	0.1116	1.1656	0.5387

Table 11. Estimates of different genetic parameters in addition to heritability values in broad (h^2_b%) and narrow (h^2_n%) senses for F_1 and F_{1r} reciprocal hybrids for yield and yield components traits at the two locations.

Genetic	No.B./P.		B.W.		L.%		S.I.		L.I.		S.C.Y./P.		L.Y./P.	
Parameters	L_1	L_2	L_1	L_2	L_1	L_2	L_1	L_2	L_1	L_2	L_1	L_2	L_1	L_2
$\sigma^2 g$	0.7876	0.7343	0.0019	0.0084	1.8471	2.5846	0.0709	0.0536	0.1713	0.1776	6.3089	5.0057	1.2152	1.3333
$\sigma^2 s$	0.4339	0.9060	0.0044	0.0106	0.0818	0.0253	0.0282	0.0256	0.0123	0.0149	10.9454	16.2497	1.5589	1.6030
$\sigma^2 r$	0.14920	0.44733	0.01244	0.00814	0.05472	0.00405	-0.01357	0.00343	-0.00392	0.00052	2.24744	0.88365	0.32745	0.07716
H^2_b %	66.31	62.34	26.25	60.43	87.13	95.18	87.59	83.30	86.54	96.28	80.11	84.53	79.65	81.14
H^2_n %	51.99	38.55	12.16	37.05	85.25	94.72	62.39	67.24	83.54	92.40	42.90	32.23	48.53	50.77

$\sigma^2 g$ general combining ability variance.
$\sigma^2 s$ specific combining ability variance.
$\sigma^2 r$ reciprocal variance.
h^2_b broad sense heritability.
h^2_n narrow sense heritability.
L_1 Sakha.
L_2 Kafr Saad.

Table 12. Estimates of different genetic parameters in addition to heritability values in broad (h^2_b%) and narrow (h^2_n%) senses for F_1 and F_{1r} reciprocal hybrids for yield and yield component traits from the combined data.

Genetic Parameters	No.B./P.	B.W.	L.%	S.I.	L.I.	S.C.Y. /P.	L.Y. /P.
$\sigma^2 g$	0.23032	0.00086	1.09519	-0.00459	0.08735	2.15831	0.67584
$\sigma^2 s$	0.86342	-0.00595	7.19060	0.15303	0.55536	5.98172	2.13620
$\sigma^2 r$	-0.67940	-0.01215	-0.53785	-0.01350	-0.03018	-4.81263	0.57073
$\sigma^2 gL$	0.27168	0.00309	0.02456	0.06372	-0.00010	1.16786	-0.06239
$\sigma^2 sL$	3.50059	0.04605	0.94808	0.08530	0.10283	33.51194	5.28393
$\sigma^2 rL$	1.42120	0.03020	0.96115	0.01725	0.05020	9.32340	1.09440
h^2_b %	26.55	3.24	87.34	49.63	86.80	28.56	46.63
h^2_n %	9.24	3.24	20.39	0.00	20.77	11.97	18.07

$\sigma^2 g$ general combining ability variance.
$\sigma^2 s$ specific combining ability variance.
$\sigma^2 r$ reciprocal combining ability variance.
$\sigma^2 gL$ G.S.A. by location variance.
$\sigma^2 sL$ S.C.A. by location variance.
$\sigma^2 rL$ reciprocal by location variance.
h^2_b broad sense heritability.
h^2_n narrow sense heritability.

(L_2) and (P_1x P_6) (L_1) showed significant positive (S.C.A) effect for the same trait. Two crosses (P_1 x P_2) and (P_3 x P_4) exhibited significant negative (S.C.A) effect for boll weight at (L_2). On the other hand, the cross (P_3 x P_5) exhibited significant positive (S.C.A) at (L_2) for the same trait. The cross (P_1 x P_2) exhibited significant positive (S.C.A) effect for seed index and lint index, while the cross (P_1 x P_3) exhibited significant negative (S.C.A) effect for seed cotton yield per plant. The results also showed that the crosses (P_1 x P_4), (P_3 x P_5) and (P_3 x P_6) exhibited positive (S.C.A) effects for seed cotton yield per plant and lint yield per pant.

The different genetic parameters were estimated for the two locations (L_1) and (L_2) and over both them in addition to hertibality values in broad (h2b %) and narrow (h2 n%) senses and the results are presented in Tables 11 and 12, respectively.

The results indicated that the dominance genetic variances (σ^2 D) were larger in magnitude than those of additive genetic variances (σ^2 A) for all studied traits at both locations except for boll weight at (L_1). Low values of dominance genetic variances could explain the small values of heterosis which were obtained and described earlier. Reciprocal variances (σ^2R) appeared to be present in substantial amount indicating that these effects should not be ignored when breeding or producing hybrids for improving yield and yield component traits. In the same time, (σ^2 SL) were larger than (σ^2 gL) and (σ^2 rL) for all studies traits except for lint percentage.

The obtained values of hertability in broad sense ranged from (26.25%) for boll weight at (L_1) to (96.26%) for lint index at (L_2). Similarly narrow sense hertability ranged from (12.16%) for boll weight to (94.72) for lint percentage at (L_2).

Broad sense heritability (h2b%) values ranged from (3.24%) to (87.34 %) for boll weight and lint percentage while, narrow sense heritability (h2 n%) values ranged from (0.00) to (20.77) for seed index and yield index.

These findings indicated that the studied traits would be improved through selection programs. Many investigators reported similar conclusions among then Kassem *et al.*, (1981), Singh I.P. and Singh (1981), Atta *et al.*, (1982), Gupta and Singh (1986), El-Harony (1988), Okasha (1989), Awad (1991) and Amer (1998).

REFERENCES

1. Abo El-Zahab, A.A., D.A, El-Kadi and S.A. El-Rehim. 1983. A diallel analysis of fiber and yarn properties traits in Egyptian Cotton *Gossypium barbadense* L. Annals Agric. Sc., Fac. Agric., Ain-Shams Univ., Cairo, Egypt. Vol. 28(3): 1359-1374.

2. Amer, M.E.E. 1998. Effect of salinity on the inheritance of some traits of Egyptian cotton. Ph.D. Thesis, Fac. of Agric. Mansoura University.

3. Atta, Y.T., H.Y.Awad and M.A. El-Gharbawy. 1982. Inheritance of some quantitative characters in a cotton cross Ashmouny x (Giza -72x Delcero). Agric. Res. Rev. 60(9) : 17-31.

4. Awad, A.A.M. 1991. Inheritance of earliness and economical traits in cotton Ph.D. Thesis, Fac. of Agric El-Mansoura Univ., Egypt.

5. Bains, S.S., B.R. Murky, A.B. Joski and G.S. Nanda. 1982. Genetics of lint yield, boll weight, boll number and seed index in *G. hirsutum* L. Indian J. Genet 42:134-139.

6. Burton, G.W. and E. H. Deven. 1953. Estmating hertability in tall fescue (*Festuca arundinacea*) from replicated colonial material. Agric. J. 45: 478-481.

7. El-Gohary, A.A., A.A. Sallam and M.El-Moghazi. 1981. Breeding potentials of some cultivated Egyptian cotton varieties. 1-Heterosis and combining ability of seed cotton yield and its contributing variables. Agric. Res. Rev (1981) Vol. 59 (9): 1-17, Egypt.

8. El-Harony, H.A.1981. Studies on heterosis and combining ability in *G. barbadense* L. M.Sc. Thesis. Minufiya Univ., Egypt.

9. El-Harony. H.A. 1988. Inheritance of some characters in cotton Ph.D. Thesis, Fac. Agric., Kafr El-Sheikh, Tanta Univ., Egypt.

10. El-Helw, S.S.H. 1990. Diallel analysis of major yield components of cotton culitvars (*Gossypium barbadense* L.). Ph.D. Thesis, Fac of Agric, Kafr El-Sheikh, Tanta Univ., Egypt.

11. El-Kadi, D.A., M.H. El-Shaer and M.A.H Shokry. 1982. Estimates of heterosis and inbreeding depression in diallel mating among some Egyptian cotton varieties *G.barbadense* L. Egypt. J. Genet. Cytol 11(1): 23-30.

12. El-Okkia, A.F.H., H.A. El-Harony and M.O. Ismail. 1989. Heterosis, inbreeding depression, gene action and heritability estimates in an Egyptian cotton cross (*Gossypium barbadense* L.). Communications in Sci. and Dev. Res., Vol. 28: 213-231.

13. Esmail, R.M. 1991. Breeding studies on cotton M.Sc. Thesis Menofiya Univ., Egypt.

14. Gomaa, M.A.M. 1997. Genetic studies on yield, yield components and fiber properties in three Egyptian cotton crosses. Annals Agric. Sci, Ain-Shams Univ, Cairo, 42 (1) 195-206.

15. Gomaa, M.AM. and A.M.A. Shaheen. 1995. Heterosis, inbreeding depression, heritability and type of gene action in two intra-barbadenes cotton crosses. Annals Agric. Sci., Ain-Shams Univ, Cairo, 40(1): 165-176.

16. Green, C.C. and T.W.Culp. 1990. Simultaneous improvement of yield, fiber quality and yarn strength in Upland cotton. Crop Sci. 30 : 66-69.

17. Griffing, J.G. 1956. Concept of general and specific combining ability in relation to diallel crossing systems. Australian J. of Biol. Sci., 9: 463-493

18. Gupta, M.P. and T.H. Singh. 1986. Combining ability in the F_1 and advanced generations of a diallel cross in Upland cotton (*Gossypium hirsutum* L.). Indian J. Genet., 46(2) : 345-347.

19. Hendawy, F.A. 1994. Evaluation of some genotypes at two locations using diallel analysis of *G. barbadense* and *G. hirsutum*. Menofiya J. Agric. Res., Vol. 19 No.5 (1):2225-2242.

20. Kassem, E.S., M.A. El-Morshidy, M.A. Khalifa and F.G. Younis. 1981b. Genetical analysis some agronomic characters in cotton. II-Yield and yield components Agric. Res. Rev. Vol. 59(1): 68-81.

21. Khajjidoni, S.T., K.G. Hiremath, S.N. Kadapa and J.V. Goud. 1984. Heterosis and combining ability in *Gossypium herbaceum* and *G. arboreum*. Indian J. Agric. Sci. 54(1):9-16.

22. Khan, W.S. and H. Ali 1980. Hybrid vigor for seed cotton yield and its components in *G. hirsutum* L. crosses. Pak. Cotton 24(3):225-239.

23. Okasha, A.A. 1989. Estimates of genetic variances of the major yield components in cotton. Ph. D. Thesis, Fac. of Agric., Tanta Unv., Egypt.

24. Rahoumah, M.R.A, Y.T. Atta and M.A.A. Raafat. 1989. Inheritance of some economic yield components and fiber properties in the inter- specific hybrid *Gossypium brabadense* x *Gossypium hirsutum.* Agric. Res. Rev., 67(5): 695-705.

25. Singh, D.P. and R.B. Singh. 1980. Genetics of ginning characters in Upland cotton. Indian. J. Agric. Sci., 5(7): 537-540.

26. Singh, I.P., D.P. Singh and B.S. Chabra. 1987. Heterosis and inbreeding depression for ginning characters in Upland cotton J. Cotton Res. And Dev., Vol 1(1) : 61-66.

27. Singh, I.P. and H.G. Singh. 1981. Gene action heritability and genetic advance in Upland cotton. J. Agric. Sci. 51(4) 209-213.

28. Zaitoon, M.I., I.M. Mahmoud and S. Rady. 1982. Combining ability studies in Egyptian cotton (*Gossypium barbadense* L.) Ain- Shams Univ., Fac. Of Agric. Res Bull. (1853), Egypt.

وراثة الصفات الكمية فى القطن المصرى
أ- صفات المحصول ومكوناته

على ماهر العدل[1] ، زكريا محمد الديسطى[1] ، أحمد عبدالهادى عوض[2] ، عبدالمعطى محمد زينه[2] ، عبدالناصر محمد رضوان[2]

١ قسم الوراثة – كلية الزراعة – جامعة المنصورة
٢ معهد بحوث القطن – مركز البحوث الزراعية

استخدم لهذا البحث سته اصناف من القطن المصرى التابعة للنوع *Gossypium barba-dense* L. وهى (١) جيزه ٨٥ (٢) جـ٨٦ (٣) جـ٨٩ (٤) جـ٧٦ (٥) جـ٧٧ (٦) جـ٨٧ .

وقد اختيرت هذه الاصناف نظراً لتباينها الواضح فى الصفات تحت الدراسة واجريت جميع الهجن التبادلية بين الاباء فى موسم ١٩٩٦, وفى موسم ١٩٩٧ اجريت تجربتان احدهما فى محطة البحوث الزراعية بسخا محافظة كفرالشيخ والاخرى بكفر سعد محافظة دمياط . وقد صممت كل تجربة فى قطاعات كاملة العشوائية ذات اربعة مكررات بغرض تقييم السلالات الابوية والهجن الناتجة (٣٠ هجين مشتمله الهجن العكسية) . ودونت النتائج على عينة من النباتات (عشرة نباتات) أختيرت عشوائياً من كل قطعة تجريبية وكانت الصفات المدروسة : محصول القطن الزهر للنبات ، محصول القطن الشعر للنبات ، عدد اللوز للنبات ، متوسط وزن اللوزة ، تصافى الحليج ، معامل الشعر ومعامل البذرة .

- اظهرت نتائج تحليل التباين وجود اختلافات عالية المعنوية لجميع الصفات المدروسة فى كلتا المنطقتين وكذلك التحليل المشترك كما اظهرت النتائج معنوية التفاعل بين التراكيب الوراثية والمناطق لجميع الصفات المدروسة عدا صفتى تصافى الحليج ومعامل الشعر
- أظهرت النتائج انه لايوجد صنف متفوق لجميع الصفات ولكن بصفة عامة كان الصنف جـ٨٦ أعلى الاباء محصولاً .
- كانت أعلى قيمة لقوة الهجين مقدرة على اساس متوسط الاباء هى ٧,٧٩٪ لصفة القطن الشعر للنبات بينما كانت اقل قيمه هى ٠,٩١٪ لصفة عدد اللوز للنبات وكانت قوة الهجين المقدرة بالنسبة لاعلى الاباء غير معنوية.
- أظهرت النتائج أن تباينات القدرة العامة على التآلف كانت عالية المعنوية لكل الصفات المدروسة وكانت دائماً اكبر من القدرة الخاصة على التآلف .
- أظهرت النتائج أن تباين السيادة كان أكبر من تباين الاضافة لجميع الصفات المدروسة .
- كان معامل التوريث فى المعنى الواسع أكبر منه فى المعنى الضيق للمنطقتين وكذلك التحليل المشترك عدا صفة وزن اللوزة فى التحليل المشترك .
- أعطى الهجين جـ٧٧ × جـ٨٩ افضل قدرة خاصة على التالف لجميع صفات المحصول ، كان الصنف جـ٨٦ هو افضل الاباء قدرة على التآلف وبذلك يمكن ان يستخدم هذا الصنف لتحسين صفة المحصول فى الاقطان المصرية من خلال استخدامه فى التهجينات فى برامج تربية القطن .