GENETIC BEHAVIOR OF YIELD AND FIBER TRAITS
IN SOME BARBADENSE COTTON CROSSES

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Abstract

This investigation was carried out at Sakha Experimental Station, Agricultural Research Center during four seasons 2013, 2014, 2015 and 2016. Five populations (P_1, P_2, F_1, F_2 and F_3) for the four barbadense cotton crosses namely (Uzbekstan1 x C.B 58), (TNB x C.B 58), (BBB x C.B 58) and (Giza 94 x Giza 45) were used in this investigation to study the genetic behavior of yield and its components and fiber traits. The aim of the present investigation was to study heterosis, inbreeding depression and type of gene action in four intra-specific crosses to obtain additional information about some genetic parameters to help the breeder to select effective breeding methods. The results showed that the potence ratio estimates indicated over dominance for seed cotton and lint yield/plant, boll weight, lint percentage and number of bolls/plant, while the quality traits exhibited partial dominance. Highly significant positive heterotic effects relative to mid-parent and better parent were obtained for seed cotton yield, lint cotton yield and number of bolls/plant, while it was for lint percentage. The inbreeding depression effects were highly significant for number of bolls/plant, seed cotton yield and lint cotton yield. Highly significant values of additive and dominance were found for seed cotton yield, lint cotton yield and number of bolls/plant. Dominance effects for Micronaire value and fiber length were of greater magnitude than additive effects. Highly significant epistasis values were found for additive x additive and dominance x dominance with complementary action with non additive effect. High broad sense heritability values were calculated for all studied traits, while narrow sense heritability values were of low values for seed cotton and lint cotton yield. on the other hand the fiber quality traits exhibited high values in three crosses as well as the heritabilities of regression

INTRODUCTION

Cotton is considered one from the most important cash crops in Egypt hence great efforts have been devoted to increase the yield, its components and fiber properties through breeding programs which depends on the knowledge concerning multiple factors such as heterosis, inbreeding depression and the nature of the interactions of gene controlling the quantitative traits. Many authors studied these factors. El-Desouqi *et al.,* (2000) pointed out to the occurrence of positive and significant heterosis relative to mid-parents for boll weight, seed index in two crosses

and lint yield /plant in the first cross. Meanwhile, significant positive heterosis relative to better parent was detected for seed index in the second cross. On the other hand, they found significant positive inbreeding depression in F_2 and F_3 generations for boll weight, seed index and lint index in the second cross. The additive gene effects were significantly positive for seed cotton yield /plant, lint yield /plant and boll weight in the two crosses. Whereas, dominance gene effects were significant for most studied traits in cross I. Epistatic components were greater in magnitude than additive or dominance components for most studied traits. El-Disouqi and Zeina (2001) reported that the roles of non-allelic interaction were governing most of studied traits in two crosses. The additive gene effects were significantly positive or negative for all studied traits except seed cotton yield / plant in cross I and dominance gene effects were important in the inheritance of most studied traits in both crosses and were relatively high in magnitude compared with additive effects in all variables. They also added that, heritability values in narrow sense were low (23.22%) for seed cotton yield /plant in cross I. Zeina (2002) stated that additive genetic variances accounted for the major proportion of phenotypic variance for all traits studied. He also added that, this resulted confirm the high heritabilities in narrow sense for all studied traits, suggesting the high values of additive genetic variances and small values of environmental variances in these respect. Soliman (2003) reported highly significant positive heterosis relative to mid and better-parents for seed cotton yield /plant, lint yield /plant, fiber strength and fiber length in all crosses. Also, highly significant positive inbreeding depression values were detected in F_2 and F_3 generations for most studied traits. All types of gene action effects were significant for yield, its components and fiber properties. While, dominance and epistatic effects were higher in magnitude than additive in some traits. Abou El-Yazied *et al.,* (2008) found highly significant positive heterosis relative to mid-parent for most studied traits in the two crosses. In addition, heterosis relative to the better parent was significantly positive for boll weight, lint yield/plant, lint percentage and 2.5% span length in cross I and for all studied traits in cross II except number of bolls/plant and fiber strength. Highly significant positive inbreeding depression values were recorded in F_2 and F_3 for boll weight, seed cotton yield / plant lint yield/plant and 2.5% span length in the two crosses as well as, lint percentage, number of bolls/plant and fiber fineness in cross I and seed index in cross II. Over dominance appeared to be controlling most studied traits in F_1 hybrids and F_2 generations in the two crosses and the other remaining traits were controlled by partial dominance.

MATERIALS AND METHODS

This study was carried out at Sakha Experimental Station, Agricultural Research Center during the four growing seasons 2013, 2014, 2015 and 2016. Crossing is used between Uzbekstan1 with C.B 58, TNB with C.B 58, BBB with C.B 58, and Giza 94 with Giza 45.

In (2013), the parental genotypes were crossed to obtain F_1 seeds. In the second season (2014), the hybrid seeds of the four crosses were sown to give the F_1 plants. These plants were selfed to produce F_2 seeds. Moreover, the same crosses were made to have enough F_1 seeds. The new hybrid seeds and part of seeds obtained from F_1 selfed plants (F_2 seeds) were kept to the final experiment. In (2015) the F_1 and F_2 plants were selfed to produce F_2 and F_3 seeds, respectively. In the fourth season (2016) the obtained seeds of the five populations (P_1, P_2, F_1, F_2 and F_3) of the four crosses were evaluated using randomized complete blocks design with three replications. Each non-segregating generation (P_1, P_2 and F_1) was consisted of five rows, while F_2 and F_3 contained 30 Rows. Each row was 4.2 m in length, and 60 cm in width. Hills were spaced 70 cm within row and plants were thinned to one plant / hill. All the agronomic practices were done according to the ordinary cotton culture. Data and measurements were recorded for nine characters on individual guarded plants, (30 for each of P_1, P_2 and F_1 and 160 for each of F_2 and F_3), to study performance of the nine following traits:

I- Yield and its components including boll weight, number of bolls /plant, seed cotton yield/plant, lint cotton yield / plant, lint percentage.

II- Fiber properties including fiber fineness as Micronaire reading, fiber strength as Pressely index and fiber length (2.5% span length in mm).

Statistical and Genetic Analysis:

1- Estimates of gene effects:

The analysis of variance of the five basic populations (P_1, P_2, F_1, F_2, and F_3) was statistically analyzed using (RCBD) analysis of variance. The parameters of the genetic model (m, d, h, i and l) were computed according to Jinks and Jones (1958) as follows:

[m] = F_2 mean performance S.E. (m) = $(V_m)^{1/2}$

[d] = additive effect = ½ ($P_1 - P_2$) S.E. (d) = $(V_d)^{1/2}$

[h] = dominance effects = 1/6 (4 F_1 + 12 F_2 – 16 F_3)S.E. (h) = $(V_h)^{1/2}$

[i] = additive x additive type of gene interaction = $P_1 - F_2 + ½ (P_1 - P_2 + h)$ S.E. (i)=$(V_i)^{1/2}$

[l] = dominance x dominance type of gene interaction = 1/3 (16 F_3 - 24F_2 + 8 F_3)

S.E. (l) = $(V_l)^{1/2}$

2-   Heritability estimates:

a.   Heritability in broad sense (h²b) : $h^2b = \dfrac{VF_2 - VE}{VF_2} = \dfrac{\frac{1}{2}D + \frac{1}{4}H}{\frac{1}{2}D + \frac{1}{4}H + E}$ x100

b.   Heritability in narrow sense (h²n) : $h^2n = \dfrac{\frac{1}{2}D}{\frac{1}{2}D + \frac{1}{4}H + E}$ x100 (Allard, 1960)

Where:

V$_E$ is the environmental variance calculated as the average variance of P$_1$, P$_2$ and F$_1$

VF$_2$ is the total phenotypic variance in F$_2$.

c.   Parent–offspring regression, i.e. regression of F$_3$ line means on their corresponding F$_2$ plant values (b). $b = \dfrac{Cov.F_2/F3}{VF_2} = \dfrac{\frac{1}{2}D + \frac{1}{8}H}{\frac{1}{2}D + \frac{1}{4}H + E}$

3- Expected genetic advance under selection:

Genetic advance was calculated according to Johanson *et al.,* (1955) as follows:

G.S. = K x Q$_P$ x h²n

Where: G.S = expected genetic advance from selection

K = selection differential with a value of 2.06 under 5% selection intensity.

Q$_P$ =   phenotypic standard deviation

h²n = Heritability in narrow sense.

Expected genetic advance as percentage: G.S% = $\dfrac{G.S}{\overline{F_2}}$ x 100

Means and variances were computed, and then the following estimates were calculated:

Heterosis was calculated as percent increase (+) or decrease (-) over mid-parents (H$_{MP}$ %) and better parents (H$_{B.P}$ %). The heterosis measurements were calculated by the following equations:

Heterosis over the mid-parents (H.M.P %) = $\dfrac{\overline{F_1} - \overline{MP}}{\overline{MP}}$ x 100

Heterosis over the better-parent (H.B.P %) = $\dfrac{\overline{F_1} - \overline{B.P}}{\overline{B.P}}$ x 100

Inbreeding depression from F$_1$ to F$_2$ (I.D.F$_2$%) $= \dfrac{\overline{F_1} - \overline{F_2}}{\overline{F_1}} x100$

Inbreeding depression from F$_1$ to F$_3$ (I.D.F$_3$%) $= \dfrac{\overline{F_1} - \overline{F_3}}{\overline{F_1}} x100$

Nature and degree of dominance were determined by means of potence ratio method outlined by Smith (1952), which can be defined as follows:

Potence ratio in F$_1$ (P.R.F$_1$) = $\dfrac{\overline{F}_1 - \overline{M.P}}{1/2(\overline{P}_1 - \overline{P}_2)}$

Potence ratio in F$_2$ (P.R.F$_2$) = $\dfrac{2(\overline{F}_2 - \overline{M.P})}{1/2(\overline{P}_1 - \overline{P}_2)}$

The population means and variances were used to compute the scaling tests C and D and to estimate the type of gene effects according to Mather and Jinks (1982).

Estimation of both scaling tests and gene effects were tested for significance from zero using student's *t*- test .Scaling test for independence of genetic from environmental effects variance of non-segregating generations i.e., P$_1$,P$_2$ and F$_1$ ratio , if proves significance there is genotypes x environment interaction

F = *VP$_1$ / VP$_2$*, *VP1 / VF$_1$* and *VP$_2$ / VF$_1$*

Where

$\overline{F}$ is the mean of F$_1$ cross.

$\overline{MP}$ is the mean of the parents.

$\overline{BP}$ is the mean of the better parent.

RESULTS AND DISCUSSION

The estimation of variances of the two parents and F$_1$ were computed to clear the genotype-environment interaction. The data in (Table 1) showed scaling test genotype-environment interaction for eight traits of four Egyptian cotton crosses.

The data in (Table 1) showed that the F-ratios between VP$_1$/ VP$_2$ were insignificant for all studied traits in the four crosses which indicated that the interaction between the parents were insignificant, while it was significant for seed cotton yield in cross II. The ratio of VP$_1$/ VF$_1$ and VP$_2$/ VF$_1$ were highly significant for boll weight, number of bolls, seed cotton yield, lint cotton yield and lint percentage in cross I, also it were highly significant for seed and lint cotton yield in cross III. These results indicated significant interaction in these traits.

The five generations of the four crosses included their parents, F$_1$'S, F$_2$'S and F$_3$'S generations and their performance were presented in (Table 2). The results showed significant differences between the means of the two parents for number of bolls /plant , seed cotton yield and lint cotton yield in the four crosses.

Table 1 . Scaling test for genotype x environment interaction for eight studied
characters in four Egyptian cotton crosses

Parameters	Characters							
	B.W	No.Boll	S.C.Y	L.C.Y	L%	Mic	F.S	F.L
Cross I								
$F=VP_1/VP_2$	0.423	0.693	0.911	1.217	0.179	1.187	1.292	1.185
$F=VP_1/VF_1$	1.195	2.133*	2.702**	2.298**	1.031	0.440	0.532	0.750
$F=VP_2/VF_1$	2.826**	3.077**	2.965**	1.888	5.746**	0.371	0.412	0.633
Cross II								
$F=VP_1/VP_2$	0.658	0.707	2.013*	1.154	0.236	0.957	0.982	1.187
$F=VP_1/VF_1$	0.807	1.234	2.369*	1.624	0.772	0.418	0.460	0.473
$F=VP_2/VF_1$	1.227	1.744	1.177	1.408	3.266**	0.437	0.469	0.399
Cross III								
$F=VP_1/VP_2$	0.258	0.808	1.288	1.000	0.682	1.856	1.720	1.441
$F=VP_1/VF_1$	0.192	1.485	2.569**	2.590**	1.547	0.349	0.361	0.356
$F=VP_2/VF_1$	0.744	1.839	1.994*	2.590**	2.268*	0.188	0.210	0.247
Cross IV								
$F=VP_1/VP_2$	1.473	1.033	1.593	1.675	1.501	1.489	1.142	0.562
$F=VP_1/VF_1$	0.350	0.892	1.721	2.248*	1.873	0.627	0.529	0.524
$F=VP_2/VF_1$	0.238	0.864	1.081	1.342	1.248	0.421	0.463	0.932

* significant and ** high significant at 5% and 1% respectively.

Regarding boll weight, the differences between two the parents of these crosses were not clear, while for lint percentage the differences between the two parents of these crosses were clear only in cross IV and cross I. Concerning the quality traits (micronaire value, fiber length and fiber strength), the differences between their parents were not clear. The performances of the F_1'S were of higher values for number of bolls per plant, seed and lint cotton yield per plant and lint percentage than its parents and the F_2'S and F3'S in four crosses. These results reflected the presence of heterotic effect and higher dominance gene controlling of these traits. The F_1'S of the two crosses III and IV were the best F_1'S.

The highest means of F_2'S were exhibited in cross III and cross IV. These results may be attributed to its first parents which were varieties BBB for cross III and Giza 94 for cross IV. The data of potence ratio, heterosis, inbreeding depression, heritability and genetic advance of the four crosses are given in (Table 3). With respect to potence ratio, the results cleared the presence of over dominance for yield and yield components in F_1 hybrids in the four crosses except for lint percentage in cross IV.

No dominance effects were obtained in F_1 for quality traits exhibited no dominance. Concerning these results, if the parental value and F_1 or F_2 generally were nearly equal then the relatively small error in estimation could magnify the potence values (Petr and Fery 1966), also could be obtained from the failure of parents of equal phenotypic values to carry the same dominant and duplication genes in different genomes may underestimate or over estimate the potence ratio which could exist if the genes were acting in diploid state. Over dominance for yield components were obtained by El-Hoseiny *et al.,*(2013).

Table 2. Mean and their standard errors of five populations for eight characters.

		B.W	No.Boll	S.C.Y	L.C.Y	L%	Mic	F.S	F.L
Cross I	P_1	3.22±0.03**	53.28±1.29**	171.11±4.02**	65.78±1.51**	38.46±0.10**	4.19±0.02**	10.20±0.02**	33.79±0.08**
	P_2	3.22±0.04**	48.56±1.18**	155.89±3.54**	61.58±1.39**	39.52±0.07**	4.07±0.06**	10.21±0.02**	33.36±0.08**
	F_1	3.45±0.02**	70.16±1.49**	242.34±5.52**	100.08±2.28**	41.30±0.12**	4.13±0.02**	10.21±0.02**	33.58±0.05**
	F_2	3.20±0.02**	57.77±1.83**	167.89±5.41**	69.09±2.29**	41.01±0.10**	3.92±0.04**	10.27±0.05**	34.15±0.17**
	F_3	3.10±0.02**	56.44±2.63**	163.20±7.72**	63.60±3.02**	38.98±0.16**	4.28±0.06**	10.34±0.04**	34.00±0.08**
Cross II	P_1	3.14±0.03**	53.59±1.29**	167.79±3.51**	65.56±1.36**	39.08±0.08**	3.85±0.03**	10.43±0.02**	34.58±0.12**
	P_2	3.22±0.04**	48.56±1.18**	155.89±3.54**	61.58±1.39**	39.52±0.07**	4.07±0.06**	10.21±0.02**	33.36±0.08**
	F_1	3.15±0.04**	68.59±1.88**	215.17±5.17**	86.59±2.10**	40.24±0.11**	3.96±0.03**	10.32±0.02**	33.97±0.08**
	F_2	3.03±0.04**	50.27±2.10**	148.72±6.20**	58.54±2.10**	39.45±0.20**	3.89±0.03**	10.14±0.03**	33.37±0.09**
	F_3	2.90±0.04**	48.64±3.33**	139.08±9.59**	50.95±3.64**	36.46±0.23**	4.60±0.05**	10.01±0.05**	34.01±0.11**
Cross III	P_1	3.23±0.02**	61.37±1.42**	198.15±4.64**	78.83±1.89**	39.77±0.10**	4.33±0.03**	10.21±0.02**	34.61±0.07**
	P_2	3.22±0.04**	48.56±1.18**	155.89±3.54**	61.58±1.39**	39.52±0.10**	4.07±0.04**	10.13±0.02**	33.36±0.07**
	F_1	3.23±0.05**	102.69±2.38**	330.86±7.73**	137.99±3.20**	41.72±0.12**	4.20±0.02**	10.17±0.01**	33.98±0.05**
	F_2	3.31±0.02**	84.54±2.52**	279.30±8.36**	111.24±3.25**	39.95±0.14**	4.21±0.03**	10.09±0.03**	34.27±0.04**
	F_3	3.08±0.02**	69.91±2.12**	213.57±6.33**	82.50±2.48**	38.60±0.14**	4.00±0.03**	10.38±0.04**	34.23±0.06**
Cross IV	P_1	3.21±0.02**	85.80±9.26**	275.76±3.86**	110.62±1.62**	40.11±0.12**	3.97±0.05**	10.51±0.03**	36.45±0.08**
	P_2	2.93±0.02**	54.15±7.36**	158.22±3.61**	57.26±1.33**	36.18±0.08**	3.64±0.03**	10.31±0.02**	34.34±0.06**
	F_1	3.26±0.03**	101.73±10.09**	331.11±5.31**	126.65±2.05**	38.25±0.08**	3.81±0.03**	10.41±0.02**	35.39±0.06**
	F_2	3.11±0.02**	63.93±7.10**	197.59±4.53**	74.21±1.63**	37.68±0.19**	3.60±0.13**	10.49±0.01**	34.96±0.05**
	F_3	3.50±0.02**	44.95±6.70**	156.66±5.61**	62.13±2.23**	39.70±0.15**	4.34±0.08**	10.92±0.02**	35.77±0.07**

* significant and ** high significant at 5% and 1% respectively.

Regarding the potency ratio in F_2 , the results in (Table 3) indicated over dominance for all traits in cross I and cross II and yield components in cross III, these agreed with those obtained by Abou El-Yazied *et al.* (2008) who stated that over dominance controlled inheritance of seed cotton yield /plant and lint cotton yield / plant.

Table 3. Genetic parameters for four Egyptian cotton crosses

Trait	Potence ratio		Heterosis		Inbreeding depression		Heritability%			Genetic advance	
	F_1	F_2	M-P	B-P	F_2	F_3	B.S	N.S	b%	Value	%
Cross I											
B.W	4.82	-3.00	5.91	4.63	7.32	10.21	66.13	42.44	38.07	1.96	61.12
No.Boll	8.16	5.80	37.79	31.69	17.66	19.55	90.11	2.19	4.67	8.23	14.24
S.C.Y	10.36	1.15	48.22	41.63	30.72	32.66	87.38	0.64	1.89	7.13	4.24
L.C.Y	17.34	5.15	57.16	52.14	30.97	36.46	88.74	1.10	5.25	5.19	7.52
L%	4.36	7.63	5.93	4.51	0.71	5.64	80.53	47.77	49.37	9.49	23.14
Mic	0.00	-7.13	0.00	1.47	5.18	-3.62	80.76	42.56	53.86	3.18	81.18
F.S	0.00	81.00	0.00	-0.02	-0.7	-1.35	96.91	0.00	65.37	-0.72	-6.98
F.L	0.00	5.24	0.00	-0.65	-1.70	-1.26	96.83	42.17	42.32	14.94	43.74
Cross II											
B.W	-0.81	-7.82	-0.97	2.15	3.77	8.044	81.42	0.00	27.79	-7.57	-249.79
No.Boll	6.97	-0.64	34.29	27.99	26.72	29.08	90.66	1.88	4.67	8.11	16.13
S.C.Y	8.96	-4.41	32.95	28.25	30.88	35.36	91.60	0.57	2.19	7.32	4.92
L.C.Y	11.57	-5.06	36.20	32.07	32.39	41.16	91.02	1.20	6.34	5.91	10.09
L%	4.32	1.36	2.40	1.84	1.977	9.402	95.78	0.00	41.56	-27.05	-68.57
Mic	0.00	-1.22	0.00	2.86	1.689	-16.21	70.46	54.38	48.77	3.50	89.91
F.S	0.00	-3.19	0.00	-1.07	1.728	2.958	90.38	80.20	61.43	4.94	48.76
F.L	0.00	-1.96	0.00	-1.77	1.766	-0.126	79.71	54.38	60.50	9.97	29.89
Cross III											
B.W	1.27	34.60	0.20	0.04	-2.48	4.81	56.33	5.92	39.99	0.29	8.78
No.Boll	7.46	9.24	86.84	67.35	17.68	31.92	91.07	3.40	8.97	17.67	20.90
S.C.Y	7.28	9.68	86.91	66.98	15.59	35.45	91.61	1.11	3.67	19.18	6.87
L.C.Y	7.86	9.52	96.54	75.04	19.38	40.21	90.66	2.66	8.69	17.81	16.01
L%	16.15	4.68	5.23	4.89	4.25	7.48	89.36	15.58	41.17	4.59	11.48
Mic	0.00	0.23	0.00	3.15	-0.35	4.72	73.84	70.83	58.20	3.67	87.02
F.S	-0.08	-4.13	-0.03	-0.42	0.78	-2.07	89.75	63.53	47.14	3.46	34.33
F.L	0.00	0.93	0.00	-1.81	-0.85	-0.73	44.71	72.51	73.67	5.47	15.95
Cross IV											
B.W	1.31	0.57	6.10	1.36	4.49	-7.49	60.31	79.60	31.76	2.79	89.55
No.Boll	2.01	-0.77	45.38	18.57	37.16	55.82	86.17	14.45	23.59	43.31	67.76
S.C.Y	1.94	-0.66	52.59	20.07	40.32	52.69	82.92	4.98	8.47	46.45	23.51
L.C.Y	1.60	-0.77	50.88	14.49	41.86	50.94	79.86	13.47	18.76	44.47	60.40
L%	-0.23	0.46	-1.17	-6.00	-2.39	-5.31	95.65	79.82	56.03	21.08	54.60
Mic	0.00	-2.45	0.00	4.58	5.36	-14.13	70.79	69.32	43.18	4.01	111.35
F.S	0.02	1.50	0.02	-0.94	-0.70	-4.90	56.26	77.61	42.57	21.89	21.89
F.L	-0.01	-0.83	-0.01	-2.90	1.23	-1.06	55.51	78.68	45.13	7.26	20.78

On the other hand, partial dominance controlled the quality traits in cross III and all traits in cross IV except micronaire value and fiber strength.

The values of heterosis over mid-parent and better parent were presented in (Table 3). The data showed significant positive heterotic mid-parents and better parent effects for number of bolls /plant, seed cotton yield/plant and lint cotton yield/plant in the four studied crosses, while boll weight and lint percentage existed with small amount values. These results were in harmony with those obtained by Abd-El-Haleem *et al.,* (2010). Moreover, that quality traits did not exhibit heterotic effect. This finding was in disagreement with those obtained by Abdalla (2007).

Regarding inbreeding depression, the data in (Table 3) showed significant positive inbreeding depression in F_2 and F_3 for number of bolls /plant, seed cotton yield/plant and lint cotton yield/plant in the four studied crosses. These results suggested the accumulation of additive gene effects, which in turn increases the mean expression of these characters. These results were in agreement with those obtained by Abou El-Yazied *et al.,*(2008).

Lint percentage exhibited positive small amount of inbreeding depression in F_2 of all crosses except for cross IV had negative small amount, while the inbreeding depression of lint percentage in F_3 were positively by moderate except for cross IV. The inbreeding depression for micronaire values in F_2 were positively moderate in crosses I and IV, while in F_3 it was positive and moderate in crosses III. On the other hand, the inbreeding depression for crosses I, II and IV were exhibited negative significant values.

Concerning heritability estimates in broad and narrow senses as well as index of regression F_2 on F_3 generations, (Table 3) showed relatively highly values of broad sense heritability for all studied traits in the four studied crosses except fiber strength in cross III which was of moderate value. Narrow sense heritability were of highly values for micronaire reading, pressely index and fiber length in crosses II, III and IV. The boll weight exhibited high narrow sense in cross IV, while it was moderate in cross I and cross III.

The narrow sense heritability of number of bolls /plant, seed cotton yield/plant and lint cotton yield/plant were of low values. Different results were obtained by El-Beially and Mohamed (2008). Concerning the heritability in F_3 as (b) of regression, indicated very low values of heritability in the four crosses, while the traits of lint percentage, micronaire value, fiber strength and fiber length exhibited high values in the four crosses. Boll weight was of moderate heritability value in the four crosses.

The expected genetic advance from selection of five percentage of better performance of the F_2 population for boll weight ranged from 0.29 in cross III to 2.29 in cross IV, while it was of negative value in cross II. The genetic advance of number

of bolls /plant ranged from 8.11in crosses II to 43.31 in cross IV. Genetic advance of seed and lint cotton yield/plant ranged from 7.13 and 5.19 in cross I to 43.31 and 46.95 in cross IV. The range of genetic advance for lint percentage limited from 3.50 in cross II to 21 in cross IV. These results indicated that the main part of genetic effect in these crosses was nonadditive. At the same time, the high level of heterosis for number of bolls /plant, seed cotton yield/plant and lint cotton yield/plant and positive inbreeding depression for these traits suggested that the major part of genetic affect in these crosses were nonadditive.

The scaling tests of C and D to test non-allelic interaction together with five parameters, model and type of epistasis were given in (Table 4). The results in (Table 4) indicated the presence of non-allelic interaction for all traits in the four studied crosses, since one or both of C and D showed significance except the trait of number of bolls/plant in cross I which exhibited insignificant for the two tests of C and D indicating that the non-allelic interaction was absence in controlling the heritance for this trait.

These results may be taken as an evidence for failure of simple genetic model to certain genetic variation for these characters in the corresponding crosses. Therefore, the five parameters model was applied in order to assess the genetic interaction type controlling the genetic variation. The data in (Table 4) showed that the additive gene effects (d) were significant for all traits in the four crosses except for boll weight in the three crosses I,II, and III, lint percentage in cross III as well as fiber strength in cross I. These results were in harmony with those obtained by Khedr (2003). While dominance effects (h) were significant for all traits in all crosses except for number of bolls/plant in crosses I and II as well as pressely index and fiber length in cross I. The results in Table (4) suggested that the dominance effects were greater in magnitude than additive effects for all traits in all crosses except fiber length in all crosses which exhibited greater magnitude for additive gene effect than dominance effect for fiber length. Regarding the epistatic component, Table (4) revealed that the component (i) additive x additive was positive and highly significant for seed cotton yield/plant and lint cotton yield/plant in the four crosses except in cross III in which the component (i) was negative and highly significant for seed cotton and lint cotton yield/plant.

Table 4. Mother scales and genetic effects for eight studied characters in four Egyptian cotton crosses

Traits	Mother scale		Genetic effect			
	C	D	d	h	i	l
Cross I						
B.W	-1.71±0.11**	-0.622±0.10**	-0.002±0.02	0.36±0.07**	1.45±0.22**	0.13±0.08
No.Boll	-11.08±8.08	8.388±11.29	2.36±0.87**	11.80±7.98	25.96±20.65	-2.72±6.81
S.C.Y	8.39±11.29	-140.114±24.88**	7.61±2.68*	62.15±23.56**	173.50±61.55**	-1.47±20.28
L.C.Y	-51.19±10.42**	-11.156±13.09	2.10±1.03*	35.31±9.39**	53.38±25.12**	3.10±8.17
L%	3.46±0.47**	-4.101±0.69**	0.53±0.06**	5.62±0.48**	-10.08±1.21**	4.37±0.41**
Mic	-0.86±0.16**	1.025±0.244**	0.06±0.03*	-0.83±0.17**	2.51±0.42**	-0.71±0.15**
F.S	0.27±0.21	0.416±0.191*	-0.002±0.02	-0.23±0.15	0.19±0.47	-0.24±0.14
F.L	2.29±0.70**	0.542±0.486	0.22±0.06**	0.02±0.41	-2.33±1.45	0.46±0.43
Cross II						
B.W	-0.54±0.17**	-0.84±0.18**	-0.04±0.03	0.44±0.13**	-0.40±0.37	0.39±0.13**
No.Boll	-38.27±9.36**	-8.11±14.09	2.51±0.88**	16.55±9.91	40.21±24.96	4.06±8.20
S.C.Y	-159.14±27.32**	-64.79±40.64	5.95±2.49**	70.00±28.64**	125.80±72.57**	28.57±23.78
L.C.Y	-66.18±10.61**	-40.43±15.43*	1.99±0.97**	38.94±10.90**	34.33±27.78	19.90±9.09**
L%	-1.29±0.85	-11.66±1.00**	-0.22±0.06**	8.50±0.73**	-13.81±2.04**	7.12±0.64**
Mic	-0.27±0.15	2.70±0.22**	0.11±0.03**	-1.85±0.15**	3.96±0.38**	-1.63±0.14**
F.S	-0.71±0.13**	-0.86±0.21**	0.11±0.02**	0.46±0.15**	-0.20±0.36	0.68±0.12**
F.L	-2.40±0.41**	1.37±0.48*	0.61±0.07**	-1.31±0.34**	5.03±0.93**	-0.09±0.33
Cross III						
B.W	0.33±0.14*	-0.77±0.11**	0.01±0.02	0.57±0.08**	-1.47±0.25**	0.58±0.09**
No.Boll	22.84±11.31*	0.64±10.10	6.40±0.93**	51.11±7.75**	-29.60±24.00	16.19±7.43**
S.C.Y	101.42±37.29**	-58.36±30.91	21.13±2.92**	209.66±24.32**	-213.04±77.69**	98.07±23.83**
L.C.Y	28.57±14.67*	-32.89±12.07**	8.62±1.17**	94.47±9.51**	-81.94±30.37**	43.94±9.33**
L%	-2.95±0.64**	-4.79±0.64**	0.13±0.07	4.77±0.48**	-2.45±1.40	2.96±0.45**
Mic	0.059±0.12	-0.832±0.14**	0.13±0.02**	0.56±0.10**	-1.18±0.27**	0.82±0.10**
F.S	-0.32±0.11**	0.10±0.15**	0.04±0.02	-0.72±0.11**	1.76±0.28**	-0.64±0.10**
F.L	1.16±0.20**	0.42±0.27	0.63±0.05**	-0.08±0.18	-0.99±0.45**	1.17±0.18**
Cross IV						
B.W	-0.21±0.10*	1.64±0.08**	0.14±0.01**	-0.94±0.06**	2.47±0.19**	-0.84±0.06**
No.Boll	-87.71±6.60**	-88.02±7.64**	15.82±0.83**	75.81±5.50**	-0.41±15.26	75.71±5.059**
S.C.Y	-305.83±21.65**	-202.55±24.75	58.77±2.64**	198.18±17.83**	137.71±49.06**	201.60±16.27**
L.C.Y	-126.65±7.89**	-66.61±9.71**	26.68±1.05**	67.16±6.92**	75.44±18.49**	77.80±6.23**
L%	2.71±0.55**	5.31±0.68**	1.96±0.07**	-5.01±0.56**	12.30±1.73**	-1.19±0.54**
Mic	-0.82±0.14**	2.56±0.17**	0.17±0.03**	-1.84±0.12**	4.50±0.32**	-1.51±0.12**
F.S	0.30±0.08**	1.90±0.11**	0.10±0.02**	-1.21±0.07**	2.14±0.18**	-1.02±0.07**
F.L	-1.75±0.24**	2.37±0.32**	1.06±0.05**	-1.87±0.22**	5.49±0.56**	0.24±0.21

d = additive, h = dominance, i = additive x additive, l = dominance x dominance

The lint percentage exhibiting negative and highly significant epistatic component (i) in the two crosses I and II , while was positive and highly significant in cross IV.

The epistatic component (i) was insignificant for number of bolls/plant in the four crosses, while boll weight was positive and highly significant in cross I and cross

IV. On the other hand, the component (i) was negative, and highly significant in cross III.

Positive and highly significant (additive x additive) epistatic effects were obtained for Micronaire values in the four crosses except cross III, pressely index in the two crosses (III and IV), and fiber length in two crosses (II and IV), while the same epistatic effects negative and highly significant in crosses (III and IV) . From these results complementary epistasis were noticed as revealed by no differences in sign of d and (I) in crosses, which exhibited significant epistatic effects in most characters. Bhatti *et al.,* (2006)

On the other hand, table (4) revealed that (dominance x dominance) epistatic effects were insignificant (in cross I) for all studied characters except for lint% which was positively significant and Micronaire values (negatively significant). Meanwhile, in crosses II , III and IV those epstatic effects were highly significant for traits for number of bolls/plant (in cross II) and fiber length (in the two crosses II and IV). Complementary epistasis was noticed as revealed by no differences in sign between h and l in most traits.

CONCLUSION

The differences between the parental lines for seed cotton yield and lint cotton yield were highly significant , this observation plus the relatively high level of heterosis , the presence over of dominance and significant inbreeding depression verified by significant non additive dominance component and complementary action of component epastasis of dominance x dominance as well as little magnitude for additive component with this material suggested that for improving these traits effective breeding method and severe selection must be used to produce desirable strains.

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السلوك الو راثي لصفات المحصول والجودة في بعض هجن القطن الباربادنس

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اجري هذا البحث بمحطة البحوث الزراعية بسخا محافظة كفر الشيخ خلال اربعة مواسم زراعية (٢٠١٣،٢٠١٤،٢٠١٥و ٢٠١٦) لتقييم العشائر الخمسة (P₁, P₂, F₁, F₂ and F₃) لأربعة هجن تتبع القطن الباربادنس و هى :

(Uzbekstan1 x C.B 58) ، (TNB x C.B 58) ، (BBB x C.B 58) و (جيزة ٩٤ x جيزة ٤٥) وذلك لدراسة السلوك الوراثي للمحصول ومكوناته وصفات التيلة من حيث قوة الهجين والانحدار(الانخفاض) الوراثي بقيمة التربية الداخلية وكذلك الفعل الجيني ولاعطاء المربي المعلومات الوراثية التي تساعده علي اختيار طريقة التربية المناسبة وكانت اهم النتائج المتحصل عليها كما يلي:

١- تشير النتائج الي ان درجة السيادة الفوقية تتحكم في العلاقة بين الاليلات التي تحكم صفات محصول الزهر ومحصول الشعر ، وزن اللوزة ، تصافي الحليج وعدد اللوز المتفتح علي النبات – بينما كانت درجة السيادة الجزئية هى التى تحكم العلاقة بين اليلات صفات الجودة .

٢- اظهرت قوة الهجين بالنسبة لمتوسط الابوين او الاب الأفضل نتائج موجبة عالية المعنوية لصفات المحصول الزهر والشعر وعدد اللوز المتفتح على النبات – بينما كان التأثير لقوة الهجين سالبة وذلك لصفة تصافى الحليج .

٣- كان الانخفاض الوراثى نتيجة التربية الداخلية عالى المعنوية لصفات المحصول الزهر والشعر وعدد اللوز المتفتح على النبات.

٤- كان التأثير الجينى الاضافى والسيادى عالى المعنوية المحصول الزهر والشعر ، عدد اللوز المتفتح على النبات ، قراءة الميكرونير ، وطول التيلة مع وجود الاهمية النسبية للفعل الجينى السيادى على الفعلى الاضافى.

٥- كان التفوق من النوع الاضافى × الاضافى ، السيادى × السيادى عالى المعنوية مع وجود التكامل بينه وبين التأثير الغير اضافى.

٦- كانت الكفاءة الوراثية بمعناها الواسع ذات قيم مرتفعة لمعظم صفات المحصول والجودة – بينما كانت الكفاءة الوراثية منخفضة بمعناها الضيق لمحصول الزهر والشعر الا انها كانت عالية لصفات الجودة فى الهجين الثانى و الثالث و الرابع.

٧- كانت الكفاءة الوراثية فى الجيل الثالث مرتفعة.