

GENETICAL STUDIES ON SOME CROSSES OF COTTON *Gossypium barbadense*

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ABSTRACT

The studying of gene action would be of great importance to plant breeders as it provides information about possible improvement of different yield, yield components and fiber properties traits. Hence, this investigation has been done to partition the genetic variance to its components through studies on different generations of two cotton crosses i.e. Giza 88 x Pima S6 (Egyptian x American variety) and Giza 45 x Suvin (Egyptian x Indian variety) at Sakha Agricultural Station, during three successive growing seasons (2008-2010).

The results showed presence of significant differences among generations in the two crosses for all studied traits. These findings reflected the presence of heterotic effects and the higher frequency of dominant genes controlling these traits. Also, F₃'s generation showed superiority for most studied traits compared with the F₂'s generation values in two crosses. These results indicated that the parents Suvin, Pima S₆, Giza 88 and Giza 45 could had transmitted their performances to their offspring, hence could be utilized these parents in cotton breeding program for improving these traits. Highly significant positive heterosis was observed relative to mid-parents for most studied traits. In addition, heterosis relative to the better parent was significantly positive for all studied traits in the two crosses except for seed index, 2.5% span length, fiber fineness and fiber strength in cross I. As well as, seed index only in cross II. Moreover, positive highly significant heterosis relative to better-parent were obtained for number of opening bolls / plant and lint percentage in cross I and for all studied traits except, boll weight, seed index , 2.5% span length and fiber strength in cross II. Highly significant positive inbreeding depression values were observed in F₂ and F₃ generations for most of yield and fiber quality traits with respect to the studied two crosses. Over dominance appeared to be controlling most studied traits in F₁ hybrids and F₂ generations in the two crosses and the other remaining traits were controlled by partial dominance.

The mean effect of F₂ performance (m) was highly significant for all studied traits in the two crosses. Also, the additive gene effects (d) were significant or highly significant positive for all studied traits except uniformity ratio in cross II. While, Dominance effects (h) were positive and highly significant for number of opening bolls/ plant, lint cotton yield /plant and lint percentage in two crosses and for 2.5% span length and uniformity ratio in cross II. Therefore, the presence of both additive and non-additive gene action for most studied traits with some exceptions for certain crosses, indicated that selection procedures based of the accumulation of additive effects should be successful in improving these traits.

Finally, all types of gene action effects (d, h and epistasis) were highly significant or significant, but additive x additive component (i) epistatic effect was significant and higher in magnitude compared to other components. Therefore it could be concluded that the gene action played a major role in the inheritance of these traits.

INTRODUCTION

Determine the amount of variations and further partition the genetic variance to its components in order to understand the nature of gene action of some quantitative traits to increase the yield capacity and improve fiber traits through breeding programs which depends on the knowledge concerning multiple factors such as heterosis, inbreeding depression and the nature of the interactions of genes controlling the quantitative traits. Many authors studied these factors. El-Akheldar (2001) and 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 23.22% for seed cotton yield/plant in cross I. While, Soliman (2003) stated that highly significant positive heterosis relative to mid and better -parents for seed cotton yield /plant, lint yield /plant, fiber strength and 2.5% span length in all crosses were observed. Also, highly positive significant inbreeding depression values in F2 and F3 generation for all most studied traits. All types of gene action effects were significant for yield and cotton properties. While, dominance and epistatic effects were higher in magnitude than additive in some traits. On the other hand, Soomro *et al.* (2006), stated that heterosis for seed cotton yield ranged from -21.72 to +196.67 and -36.70 to +159.3 over MP and BP, respectively. In addition, they obtained that very low and negative level of heterosis and heterobeltiosis were expressed for yield and yield components traits.

About El-Yazied *et al* (2008) studied genetic variances in different generations of two cotton crosses for some yield, yield components and fiber properties traits and recorded that highly significant positive inbreeding depression in values F2 and F3 for boll weight, seed cotton yield /plant, lint cotton 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 F1 hybrids and F2 generations in the two crosses and the other remaining traits were controlled by partial dominance. Results of scaling test (C and D) suggested the presence of non-allelic interaction for boll weight, seed index, lint index, fiber strength and fiber fineness in the two crosses.

The present investigation target to study the heterosis, inbreeding depression and type of gene action in some quantitative traits in two intra-specific crosses to identify about the appropriate selection system in the breeding program.

MATERIALS AND METHODS

This investigation was carried out at Sakha experimental Farm, Sakha Agricultural Research Station, ARC, Egypt, during the 2008, 2009 and 2010 growing seasons. Crossing is used between four cotton genotypes belonging to *Gossypium barbadense* L. Where, (Giza 88 x Pima S6) cross I and (Giza 45 x Suvin) cross II. In the same time, the parental lines selfed to obtain pure seed for the next growing season.

The filial generations F_1 , F_2 and F_3 were obtained, the five populations, P_1 , P_2 , F_1 , F_2 and F_3 of each cross were evaluated through 2009 season in a randomized complete block design with three replications. Each replicate consisted of 15 rows. The non-segregating generations (P_1 , P_2 and F_1) were representative in one row. Meanwhile, F_2 and F_3 generations in 6 rows. Each row 7 meter along and 0.65 m in a wide and comprised 20 hills. Each hill was spaced 35 cm apart and comprised one plant. Data and measurements were recorded for ten characters on individual plants. 40 individual guarded plants for non segregating generation (P_1 , P_2 and F_1), 120 individual guarded plants and 300 individual guarded plants for the segregating generations (F_2 and F_3) were selected at random then guarded plants from each plot selected at random, to study performance of the ten following traits:

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

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

Statistical procedure:

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

$$\text{Heterosis over the better-parent (H.B.P \%)} = \frac{F_1 - EP}{EP} \times 100$$

$$\text{Inbreeding depression from } F_1 \text{ to mid-parents (ID.M.P \%)} = \frac{\overline{F_1} - \overline{MP}}{\overline{MP}} \times 100$$

$$\text{Inbreeding depression from } F_1 \text{ to } F_2 \text{ (I.D. } F_2 \text{ \%)} = \frac{\overline{F_1} - \overline{F_2}}{\overline{F_1}} \times 100$$

$$\text{Inbreeding depression from } F_1 \text{ to } F_3 \text{ (I.D. } F_3 \text{ \%)} = \frac{\overline{F_1} - \overline{F_3}}{\overline{F_1}} \times 100$$

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

$$\text{Potence ratio in } F_1 \text{ (P.R.F}_1\text{)} = \frac{\bar{F}_1 - \bar{M.P}}{\frac{1}{2}(\bar{P}_1 - \bar{P}_2)}$$

$$\text{Potence ratio in } F_2 \text{ (P.R.F}_2\text{)} = \frac{2(\bar{F}_2 - \bar{M.P})}{\frac{1}{2}(\bar{P}_1 - \bar{P}_2)}$$

The test which determines the presence or absence of non-allelic interaction and their type is known as scaling test. Mather (1949) gave the following scaling tests which were used in five populations.

$$C = 4 F_2 - F_1 - P_1 - P_2 \qquad D = 4 F_3 - 2 F_2 - P_1 - P_2$$

The variance means for these estimates are obtained as follows:

$$VC = 4 VF_2 + 2 VF_1 + VP_1 + VP_2 \qquad VD = 4 VF_3 + 2 VF_2 + VP_1 + VP_2$$

Where:

VC and VD are the variances of the two different effects and VP₁, VP₂, VF₁, VF₂ and VF₃ are the variances of mean for the non-segregating and segregating generation populations.

Estimates of gene effects, means and variances of populations for P₁, P₂, F₁, F₂ and F₃ generations were used to estimate the type of gene action for the two studied crosses.

Hayman (1958) gave five parameters of gene effects to estimate the components of genetic variance by using the means and variances of the five populations in each single cross as follows:

$$m = F_2 \qquad d = \frac{1}{2} P_1 - \frac{1}{2} P_2$$

$$h = \frac{1}{6} (4 F_1 + 12 F_2 - 16 F_3)$$

$$i = P_1 - F_2 + \frac{1}{2} (P_1 - P_2 + h) - \frac{1}{4} l$$

$$l = \frac{1}{3} (16 F_3 - 24 F_2 + 8 F_1)$$

Where, the parameters m, d, h, i, and l refer to mean effects, additive, dominance, additive x additive and dominance x dominance gene effects, respectively.

The variance of these estimates is obtained as follows:

$$V_m = VF_2 \text{ Where } VF_2 = \frac{VF_2}{\text{NO. of plants in } F_2}$$

and by similar way for all the different genotypes; parents, F₁'s and F₃.as follows:

$$V_m = VF_{2,3} \qquad V_d = \frac{1}{4} (VP_1 + VP_2)$$

$$V_h = \frac{1}{36} (16 VF_1 + 144 VF_2 + 256 VF_3)$$

$$V_i = VP_1 + VF_2 + \frac{1}{4} (VP_1 + VP_2 + V_h) + \frac{1}{16} V_L$$

$$V_l = \frac{1}{9} (259 VF_3 + 576 VF_2 + 64 VF_1)$$

Where, V_m , V_d , V_h , V_l and V_L are the variances of the different effects and VP_1 , VP_2 , VF_1 , VF_2 are the variances of the mean for different populations.

RESULTS AND DISCUSSION

The mean performances and standard errors of five generations in this investigation which include four parents and their $2F_1$ hybrids, $2F_2$ and $2F_3$ generations are presented in Table 1. The results showed that the genotype Pima S_6 gave the highest values for all studied yield and yield components traits except for lint percentage and bolls weight followed by Suvin for all studied yield traits. Whereas, varieties Giza 45 and Giza 88 exhibited to be the best for all fiber quality traits.

Moreover, F_1 of the hybrid Giza 88 x Pima S_6 was the best for most studied yield and yield components and fiber quality traits. Also, F_1 and F_3 generations of the hybrid Giza 45 x Suvin showed best values for all studied yield and fiber quality traits except for seed index and fiber fineness which it were high in F_2 generation. These findings reflected the presence of heterotic effects and the higher frequency of dominant genes controlling these traits. Also, F_3 's generation showed superiority for most studied traits compared with the F_2 's generation values in two crosses. These results indicated that the parents Giza 88, Giza 45, Pima S_6 and Suvin could had transmitted their performances to their offspring, hence could be utilized for the improving these traits. These results were in agreement with those obtained by El-Disouqi and Zeina (2001), Soliman (2003) and Abou El Yazied *et. al.* (2008).

The values of heterosis for mid and better-parents, inbreeding depression and potence ratio in cross 1 were calculated and presented in Table 2. The results showed highly significant positive heterosis relative to mid-parents for all studied traits in the two crosses except for seed index, fiber fineness and fiber strength in cross I. As well as, all studied traits in cross II. Moreover, positive highly significant heterosis relative to better-parent were obtained for most studied traits in cross I and for all studied traits except, 2.5% span length and fiber strength in cross II.

Table (2): Heterosis from mid and better parents, in breeding depression and potence ratio in five populations for yield and yield components and fiber traits in the two cotton crosses.

Parameters	Characters									
	N.O.B/ P	S.C.Y/ P	L.C.Y/ P	L.P	B.W	S.I	2.5% S.L	F.F	F.S	U.R%
Cross I (Giza 88 x Pima S₆)										
H.M.P	3.89**	2.51**	7.95**	5.17**	1.91**	0.20	-4.59**	-1.93	2.11	0.78**
H.B.P	3.45**	-3.33**	-11.72**	1.05**	-3.03*	-1.09	-1.77**	-0.36	0.09	0.11
ID from M.P	3.75**	2.45**	7.34**	4.91**	1.87	.20	-4.81**	-1.96	2.06*	0.779**
ID from F ₂ %	2.22**	7.26**	11.53**	4.68**	-3.12*	0.51	-2.11**	-6.79*	6.79**	-1.00**
ID from F ₃ %	5.528**	0.54**	7.44**	4.91**	-3.12*	2.02	-1.51**	-7.14*	5.23**	0.75**
Potence ratio in F ₁	9.0	-0.415	-4.07	1.26	-0.37	-0.15	-1.60	1.22	1.05	1.16
Potence ratio in F ₂	7.33	1.63	-4.59	0.12	-2.00	0.46	-1.80	-6.00	-4.79	-0.66
Cross II (Giza 45 x Suvin)										
H.M.P	3.63**	18.04**	29.21**	9.8**	16.23**	-6.17**	6.83**	5.26**	2.85*	1.75**
H.B.P	3.158**	3.48**	11.36**	7.75**	1.49	-8.70**	0.27	0.002**	0.09	1.69**
ID from M.P	3.49**	15.28**	22.61**	8.93**	13.97**	-6.57**	6.39**	5.0*	2.77**	0.95**
ID from F ₂ %	4.95**	6.20**	13.59**	8.49**	2.35	-0.76	2.18**	-3.33	0.91	0.22
ID from F ₃ %	4.665**	3.50**	10.69**	7.50**	2.06	0.11	2.45**	-6.66**	1.0	0.55**
Potence ratio in F ₁	8.0	-1.28	-1.82	-4.91	-1.12	2.22	1.05	-3.0	1.03	31.00
Potence ratio in F ₂	-6.67	-1.52	-1.45	-0.49	-1.86	3.93	1.38	-10.0	1.39	54.00

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

N.O.B/P = Number of opening bolls per plant

S.C.Y/P = Seed cotton yield per plant in g.

L.C.Y/P = Lint cotton yield per plant in g.

B.W. = Boll weight in g.

2.5% S.L. = 2.5% span length

F.S = Fiber strength

H.M.P. = Heterosis from mid parent

ID = Inbreeding depression

L.P = Lint percentage

S.I = Seed index

F.F = Fiber fineness

U.R% = Uniformity ratio

H.M.B = Heterosis from better parent

Concerning inbreeding depression, the results indicated highly significant positive inbreeding depression in mid-parents, F₂ and F₃ generations for all yield and fiber quality traits except, boll weight, seed index and fiber fineness in the two crosses as well as 2.5% span length in cross I and fiber strength in cross II. The reduction in performance of the F₂ and F₃ generations with respect to their corresponding F₁ hybrids was negatively associated with the amounts of heterosis obtained in these hybrids. When the large amount of heterosis is obtained for any trait, large inbreeding depression can occur and may be due to fixation of unfavorable recessive genes in F₂ and F₃ generation, i.e. the depression of dominance effects of genes. El-Helw (2002) reported highly significant positive heterotic effects relative to mid-parents for seed cotton yield /plant, lint cotton yield /plant and boll weight and highly significant positive inbreeding depression values for seed cotton yield /plant, lint cotton yield /plant and lint percentage.

With respect to potence ratio, the results illustrated presence of over-dominance for most studied traits in F₁ hybrid and F₂ generations in the two crosses. El-Akhedar (2001) stated that the over-dominance controlled inheritance of seed and lint cotton yield/plant in the two crosses, seed index in

the second cross and fiber fineness in the first cross. While, partial dominance controlled the rest of the traits. Also, he indicated that additive, dominance and most types of epistatic effects controlled the inheritance of fiber fineness. Concerning these results, could be obtained from the failure of the parents of equal phenotypic values to carry the same dominant and duplication genes in different genomes may underestimate or overestimate the potence ratio which would exist if the genes were acting in a diploid state.

Concerning of scaling tests C and D for the studied traits are presented in Table 3 The results revealed that, the C were highly significant for all studied traits in the two crosses except seed index, 2.5% span length and fiber fineness in cross I as well as fiber strength in cross II. The results assured that there were non- allelic interaction inheritance of these traits, more particularly, additive x additive type of gene action plays role in governing these traits.

Table (3): Scaling test values for yield and yield components and fiber traits in two cotton crosses ten studied traits in the two cotton crosses

Traits		Cross I	Cross II
N.O.B./P	C	-4.4** \pm 0.31	6.74 ** \pm 0.32
	D	-0.60* \pm 0.28	-4.0** \pm 0.28
S.C.Y/P	C	-26.61** \pm 0.61	6.58** \pm 0.57
	D	18.99** \pm 0.52	33.06** \pm 0.50
L.C.Y/P	C	-14.34** \pm 0.46	-4.10** \pm 0.42
	D	3.42** \pm 0.36	13.3** \pm 0.34
L.P	C	-3.39** \pm 0.41	-6.33** \pm 0.41
	D	-3.43** \pm 0.32	1.91** \pm 0.33
B.W	C	21.19** \pm 0.61	0.63** \pm 0.19
	D	2.99 \pm 0.52	0.83** \pm 0.18
S.I.	C	-0.16 \pm 0.39	-0.92* \pm 0.38
	D	-0.66* \pm 0.33	-1.38** \pm 0.31
2.5% S.L	C	-0.40 \pm 0.38	1.49** \pm 0.37
	D	-2.60** \pm 0.33	2.70** \pm 0.30
F.F	C	0.65 \pm 0.26	0.70* \pm 0.25
	D	0.31* \pm 0.24	0.90** \pm 0.23
F.S	C	-2.51** \pm 0.39	0.21 \pm 0.41
	D	-0.35 \pm 0.32	0.37 \pm 0.33
U.R%.	C	-2.2** \pm 0.15	2.3** \pm 0.14
	D	0.48 \pm 0.10	1.50** \pm 0.09

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

N.O.B/P = Number of opening bolls per plant

S.C.Y/P = Seed cotton yield per plant in g.

L.C.Y/P = Lint cotton yield per plant in g.

B.W. = Boll weight in g.

2.5% S.L. = 2.5% span length

F.S = Fiber strength

L.P = Lint percentage

S.I = Seed index

F.F = Fiber fineness

U.R% = Uniformity ratio

Also, D values, were highly significant for all yield and its components traits under study in the two crosses except boll weight and uniformity ratio in the cross I, and fiber strength in the two crosses. These conformed that, the non-allelic interaction played role in the inheritance of these traits, more particularly dominance x dominance type of gene action played role in governing these traits.

Generally, test of significance for one or two scales indicated that the additive-dominance model was inadequate. In other words, these results indicate the role of non-allelic interaction (interaction of non-allelic gene at different loci) governing these traits. Similar results and conclusion have been recorded by El-Helw (2002) and Abou El Yazied *et. al.* (2008).

The data in Table 4 showed that the mean effect of F_2 performance (m) were highly significant for all studied traits in the two crosses. Initially, it was noted that these characters were quantitatively inherited. Also, the additive gene effects (d) were significant or highly significant positive for all studied traits except uniformity ratio in cross II. Dominance effects (h) were positive and highly significant for number of opening bolls/ plant, lint cotton yield /plant and lint percentage in two crosses and for 2.5% span length and uniformity ratio in cross II. Therefore, the presence of both additive and non-additive gene action for most studied traits with some exceptions for certain crosses, indicated that selection procedures based of the accumulation of additive effects should be successful in improving these traits. To maximize selection advance, procedures that are effective in shifting gene frequency when both additive and non-additive genetic variances are involved would be preferred. (El- Akhedar and El- Mansy, 2006) stated that overall epistasis play important role in the inheritance of all yield and its component traits except for boll weight as well as fiber properties. Finally, all types of gene action effects (d, h and epistasis) were highly significant or significant, but additive x additive component (i) epistatic effect was higher in magnitude and played a major role in the inheritance of these traits. Also, the results revealed that, duplicate epistasis as revealed by difference in signs of h and L in crosses which exhibited significant epistasis for lint cotton yield per plant and seed index in two crosses and number of opening bolls /plant, lint percentage, fiber strength and uniformity ratio in cross II as well as 2.5% span length and fiber fineness in cross I. In duplicate type of epistasis (the ratio 15:1) identical substance of substances interchangeable in effect are presumably produced by the dominant alleles at both loci. Meanwhile, complimentary type of gene interaction was observed for seed cotton yield /plant and boll weight in two crosses and number of opening bolls /plant , lint percentage, fiber strength and uniformity ratio in cross I and for 2.5% span length and fiber fineness in cross II only where similar signs were obtained for both h and L. In complementary type of epistasis (the ratio 9:7) they probably produce different substances both of which were needed for the phenotypic manifestations of some property. Similar results were reported by EL-Akhedar (2001), El-Helw (2002) and Soliman (2003).

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دراسات وراثية علي بعض هجن القطن الباربادنس

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تمثل دراسة تأثير فعل الجين اهمية قصوى لمربي النبات حيث تمده بالمعلومات اللازمة لتحسين صفات المحصول ومكوناته وكذا صفات الجودة. ومن ثم فقد اجري هذا البحث لتقسيم التباين الوراثي الي مكوناته من خلال دراسة الأجيال المتعاقبة لهجينين من القطن هما جيزة 88 × بيما س6 و جيزة 45 × سيوفين بمحطة البحوث الزراعية بسخا خلال ثلاثة مواسم زراعية (2010- 2008)

وكانت أهم النتائج المتحصل عليها كما يلي:-

- أظهرت النتائج وجود اختلافات معنوية بين الأجيال المتعاقبة داخل كل هجين بالنسبة لكل الصفات المدروسة. وهذا راجع لتأثير قوة الهجين وتأثير السيادة التي تحكم توريث هذه الصفات. وايضا ظهر تفوق الجيل الثالث لمعظم الصفات المدروسة بالمقارنة بقيم الجيل الثاني في كلا الهجينين.
- وقد اوضحت النتائج قدرة الآباء سيوفين و بيما س6 و جيزة 88 و و جيزة 45 على توريث ونقل صفاتها الى الأجيال المتعاقبة وبالتالي يمكن الاستفادة من هذه الآباء في برامج تربية القطن لتحسين هذه الصفات.
- لوحظ وجود قوة هجين موجبة وعالية المعنوية بالمقارنة بمتوسط الأبوين لمعظم الصفات المدروسة. وكذا بالمقارنة بالأب الأفضل في كلا الهجينين ماعدا صفات دليل البذرة و متوسط الطول عند 2.5% ونعومة و متانة التيلة في الهجين الأول بالإضافة الى صفة دليل البذرة فقط في الهجين الثاني. علاوة على ذلك فقد وجدت قوة هجين موجبة وعالية المعنوية بالمقارنة بالأب الأفضل بالنسبة لصفات عدد اللوز المتفتح / نبات وتصافي الحليج في الهجين الأول ولكل الصفات المدروسة في الهجين الثاني ما عدا صفات متوسط وزن اللوزة و دليل البذرة و متوسط الطول عند 2.5% و متانة التيلة.
- كانت قيم الإنخفاض الناتج عن التربية الداخلية بالنسبة لمتوسط الآباء والجيل الثاني والثالث موجبة وعالية المعنوية لكل الصفات المدروسة ماعدا صفات متوسط وزن اللوزة و دليل البذرة و نعومة التيلة في كلا الهجينين بالإضافة الى متوسط الطول عند 2.5% في الهجين الأول و متانة التيلة في الهجين الثاني.
- تحكمت السيادة الفائقة في توريث معظم الصفات المدروسة في كلا من الجيل الأول الهجين والثاني أما باقي الصفات فقد تحكمت في توريثها السيادة الجزئية.
- أوضحت نتائج اختبار الـ Scaling وجود تفاعل غير اليلى (تفوق) لمعظم الصفات المدروسة في كلا الهجينين مما يدل على أهمية دور الفعل الوراثي التفوق في وراثة هذه الصفات.
- كان متوسط اداء الجيل الثاني عالي المعنوية لكل الصفات المدروسة في كلا الهجينين. وايضا كان التأثير الإضافي معنوياً أو عالي المعنوية لكل الصفات المدروسة ماعدا صفة انتظام التيلة في الهجين الثاني بينما كان التأثير السيادةى موجب وعالي المعنوية لصفات عدد اللوز المتفتح / نبات و محصول القطن الشعر / نبات وتصافي الحليج في كلا الهجينين و صفة متوسط الطول عند 2.5% و انتظام التيلة في الهجين الثاني. علاوة على وجود كلا من التأثير الإضافي وغير الإضافي للجين لمعظم الصفات تحت الدراسة مع بعض الاستثنائات في كلا الهجينين مما يدل على امكانية اجراء الانتخاب المعتمد على التأثير الإضافي المكمل في تحسين هذه الصفات. ولكن من بين مكونات التفوق كان التأثير الإضافي x الإضافي موجب ومعنوي واكثر أهمية ولعب دور كبير في توريث هذه الصفات.

قام بتحكيم البحث

كلية الزراعة – جامعة المنصورة
مركز البحوث الزراعية

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Table (1): Means and their standard errors of the five populations for yield and yield components and fiber traits in two cotton crosses

Crosses		N.O.B/P	S.C.Y/P	L.C.Y/P. g	L.P %	B.W	S.I	2.5% S.L.	F.F	F.S	U.R%
Cross I (G.88 x P. S ₆)	P ₁	34.83±0.06	101.01±0.160	38.60±0.137	38.21±0.119	2.98±0.020	9.75±0.076	35.8±0.065	3.01±0.025	10.89±0.119	89.70±0.096
	P ₂	34.54±0.06	114.00±0.166	40.14±0.134	35.21±0.104	3.30±0.018	10.01±0.087	33.80±0.069	3.32±0.03	10.46±0.117	88.50±0.107
	F ₁	36.0±0.05	110.20±0.151	42.5±0.120	38.61±0.105	3.20±0.016	9.90±0.083	33.20±0.067	3.30±0.06	10.90±0.113	89.8±0.089
	F ₂	35.2 ±0.07	102.20±0.120	37.6±0.084	36.81±0.079	3.30±0.043	9.85±0.082	33.9±0.086	2.98±0.07	10.16±0.067	88.9±0.081
	F ₃	34.01±0.06	109.60±0.101	39.34±0.064	35.89±0.059	3.30±0.043	9.70±0.065	33.70±0.064	2.80±0.062	10.33±0.057	89.12±0.059
Cross II (G. 45 x Suvin)	P ₁	33.26±0.06	83.14±0.157	29.18±0.118	35.10±0.104	2.50±0.018	9.46±0.093	36.60±0.06	2.8±0.024	10.99±0.109	88.40±0.108
	P ₂	32.94±0.06	110.36±0.083	40.32±0.104	36.53±0.109	3.35±0.019	10.00±0.094	32.11±0.060	2.99±0.02	10.40±0.139	88.30±0.110
	F ₁	34.3±0.062	114.20±0.129	44.9±0.112	39.33±0.106	3.4±0.021	9.13±0.085	36.7±0.082	3.0±0.051	11.0±0.122	89.90±0.106
	F ₂	32.6±0.07	107.12±0.120	38.8±0.082	35.99±0.079	3.32±0.047	9.20±0.079	35.8±0.078	3.10±0.06	10.90±0.070	88.70±0.069
	F ₃	32.7±0.06	110.20±0.102	40.10±0.065	36.39±0.061	3.33±0.038	9.12±0.058	35.90±0.059	3.21±0.05	10.89±0.061	89.4±0.054

N.O.B/P = Number of opening bolls per plant

L.C.Y/P = Lint cotton yield per plant in g.

B.W. = Boll weight in g.

2.5% S.L. = 2.5% span length

F.S = Fiber strength

S.C.Y/P = Seed cotton yield per plant in g.

L.P % = Lint percentage

S.I = Seed index

F.F = Fiber fineness

U.R% = Uniformity ratio

Table (4): The estimate of gene effects and type of epistasis five populations for yield and yield components and fiber traits in two cotton crosses

Traits	Crosses	Gene effects					Type of epistasis
		m	d	h	i	L	
N.O.B./P	I	35.20**+0.08	0.15**+0.04	3.71**+0.22	-4.21**+0.72	2.66**+0.23	Compl.
	II	32.6**+0.07	0.15**+0.04	0.87**+0.21	5.07**+0.44	-0.03+0.22	Dupl.
S.C.Y./P	I	102.20**+0.12	-6.50**+0.12	-14.40**+0.37	60.8**+0.43	-30.27**+0.56	Compl.
	II	107.12**+0.12	-13.61**+0.09	-3.39**+0.37	35.31**+1.16	-48.16**+0.16	Compl.
L.C.Y./P	I	40.56**+0.08	-0.77**+0.01	2.54**+0.25	0.88**+0.37	-9.33**+0.82	Dupl.
	II	38.8**+0.007	-5.57**+0.08	0.6**+0.25	23.2**+0.8	-20.70**+0.86	Dupl.
L.P	I	36.80**+0.08	1.50**+0.08	3.64**+0.23	-0.05+0.76	4.74**+0.08	Compl.
	II	35.99**+0.08	-0.72**+0.08	1.19**+0.24	10.99**+0.58	-3.76**+0.79	Dupl.
B.W.	I	3.30**+0.04	-0.16**+0.01	-0.07+0.26	-0.45+0.13	-0.27+0.41	Compl.
	II	3.32**+0.05	-0.43**+0.01	-0.027+0.14	0.267+0.18	-1.30**+0.13	Compl.
S.I	I	9.85**+0.08	-0.13*+0.06	0.43+0.24	0.15+0.26	-0.66+0.77	Dupl.
	II	9.20**+0.10	-0.27**+0.09	0.16+0.22	0.22+0.26	-0.61+0.73	Dupl.
2.5% S.L	I	33.90**+0.09	1.00**+0.05	0.07+0.35	3.67**+0.26	-2.93**+0.78	Dupl.
	II	35.80**+0.08	2.24**+0.04	0.80**+0.23	1.61**+0.74	2.94**+0.06	Compl.
F.F	I	2.91**+0.06	-0.06**+0.11	-0.28+0.18	-0.35**+0.17	0.16+0.55	Dupl.
	II	3.1**+0.06	-0.05**+0.02	-0.33+0.18	0.27+0.55	-0.58**+0.17	Compl.
F.S	I	10.16**+0.04	0.22**+0.09	0.04+0.22	0.25+0.28	2.88**+0.69	Compl.
	II	10.90**+0.04	0.29**+0.09	0.01+0.23	0.42+0.29	-0.11+0.72	Dupl.
U.R.%	I	88.9**+0.08	0.60**+0.07	0.013+0.23	3.57**+0.76	0.513+0.27	Compl.
	II	89.70**+0.07	0.05+0.07	0.93**+0.21	-1.065+0.68	-0.516+0.26	Dupl.

*, ** significant and highly significant at 5% and 1% statistically probability levels, respectively