J. Plant Production, Mansoura Univ., Vol. 8 (12): 1439 - 1444 , 2017

Estimates of Heterosis and Gene Action for Yield Components and Fiber Traits in *Gossypium barbadense, L*

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ABSTRACT

The present work was carried out in three successive seasons from 2014 to 2016.at Sakha Experimental Station at Kafr El-Sheikh Government, Agricultural Research Center. Four cotton genotypes i.e., Giza 94, Uzbekstan1, TNB and BBB as (lines) which were crossed to two genotypes i.e., CB 58 and Giza 45 as (testers) by using the mating design line x tester. General (GCA) and specific (SCA) combining abilities and their effects as well as heterosis and heritability were estimated in parents, F_1's and F_2's populations for the traits, yield and its components and fiber properities to define the best parents and crosses to be used in breeding programs to improve cotton traits. Giza 94 x CB 58 gave the highest mean performance values in F_1's for seed and lint cotton yields/ plant, fiber length and its uniformity while, for boll weight in both F_1's and F_2's crosses for the cross of Uzbekstan1x CB 58 had the highest mean performance value in F_2's crosses for seed and lint cotton yields/ plant while for the cross BBB x CB 58, it gave the highest mean performance in both F_1's and F_2's crosss for lint %. All the tested crosses showed significant positive mid-parent heterosis. SCA variances were higher in magnitude as compared to the GCA ones. The nonadditive gene effects were larger in magnitude than the additive ones and revealed the major role in the heredity of all traits under studying. The two crosses Giza 94 x CB 58 and BBB x Giza 45 ranked first in this respect. The line Giza 94 and, the tester Giza 45 had the best ranking as combiners for almost traits. The estimated proportion contributions of used lines were higher in magnitude than those of both testers and lines by testers interactions for the following traits: seed cotton yield/ plant, fiber length and Uniformity ratio; while testers proportion contributions were higher than those estimated for lines and lines by testers interactions for boll weight, lint % and fiber strength. The higher value of broad-sense heritability (99.0%) was recorded for the trait seed cotton yield /plant and the lower value (26.12 %) was recorded for fiber length in F_2. Heritability estimates in narrow-sense ranged from 0.25 - 29.31 % for uniformity and lint %, respectively. The cross Giza 94 x CB 58 could be used in breeding program for improving seed and lint cotton yields due to both parents. Giza 94 and CB 58 varieties were first in ranking as combiners for yield and its component. In addition the hybrids BBB X CB 58 and Uzbekstan1 X CB 58 could be used for improving the same traits because one of the involved parents was good combiner.

Keywords: line x tester, cotton, gene action, combining ability.

INTRODUCTION

Unless improved methods are proposed to transfer the useful genes from diverse germplasm to the planted ones, Egyptian cotton germplasm stocks will remain limited. Breeders rely on genetic variance among parents involved in crossing to introduce unique genetic combination necessary for producing new superior genotypes. The analysis of line x tester is important system provide the genetic information which helps the breeder in choosing the suitable method for his breeding material. Therefor, understanding the genetic architecture of the breeding cotton materials has a great interest to select the desirable germplasm to be involved in an efficient breeding program aiming for fast buck and maximum genetic improvement in the productivity and fiber quality traits of cotton plant. El-Hashash (2004) found that the dominance genetic variances were higher than the additive ones for yield and yield components and useful mid and better-parents heterosis were recorded in most yield and yield components traits.

Ali (2006) found highly significant differences among all the tested genotypes for the studied traits, significant positive mid-parents heterosis values were found for most of the studied traits over all crosses. While, significant negative better-parent heterosis values were observed for most studied traits over all crosses. Tang *et al.*, (2008) Studied crosses between high quality cultivars as females and transgenic Bt cotton as males by NCII design. They denoted that heritability in narrow sense for fiber length and micnaire value, by 61.9% and 61.4%, respectively. Darweesh (2010) found that mid-parent heterosis was positive and highly significant for, seed and lint cotton yields/plant, lint %, boll weight, number of bolls/plant and seed index. Moreover, Al-Hibbiny (2011) found useful mid and better-parents heterosis for almost of the studied cotton traits. Wajid *et al* (2011) recorded that the general (GCA) and specific (SCA) combining abilities mean squares were significant for number of bolls/plant, seed cotton yield and lint %. The GCA variances were higher than SCA ones that reflects the greater importance of additive genes than non-additive in inheritance of such traits in addition to lint index. Lingaswamy *et al*., (2013) studied the importance of general and specific combining ability variances in cotton crosses and recorded the more important role of additive and non-additive gene action for the studied traits and consequently clarified their importance for the inheritance of seed cotton yield and its components. Gibely *et al* (2015) found high heritability values for seed cotton and lint cotton yields and moderate value for boll weight.

The present research was done to evaluate some genetic estimates (heterosis, combining ability, gene action and heritability) for the traits: yield, yield components and fiber quality properties in the Egyptian cotton.

MATERIALS AND METHODS

The present study was conducted at Sakha Experimental Research Station, Agric. Res. Center Kafr El-Sheakh Government, Egypt, during 2014, 2015, 2016 seasons. The genetic materials (genotypes) used in this work comprised six cotton genotypes; Giza 45 and Giza 94 belong to Egyptian cotton, in addition to Usbakstan1, TNB, BBB and CB.58. All genotypes are belonging to Gossypium barbadense. Pure selfed seeds of all genotypes were obtained from Cotton Research Institute, Agriculture Research Center, Giza, Egypt. In the first season 2014, selfed seed of these genotypes were grown according to line x tester mating system. The four genotypes G.94, Usbekstan1, TNB and BBB were used as lines (females). While, the two genotypes CB 58 and G. 45 were used as testers (males) to produce the hybrid seeds of eight F1's crosses. In the second season 2015 the six parents and eight F1's crosses seed were grown and selfed at flowering period to produce the F2's seeds. In the third season 2016 the six parents, eight F1's seeds and their F2's seeds were sown in three replications of the randomized complete block design. Each plot contained three rows. Hills were 35 cm apart within rows and one seedling was left per hill. All normal cultural practices were followed for the individual plants during the growing seasons. Data were recorded on individual plant basis for the following traits:

Yield and yield component traits

- Boll weight (B.W, gm), seed cotton yield/plant (S.C.Y/plant, gm); lint yield/plant (L.Y/plant, gm); lint percentage (L %), estimated using the following equation:

$$L\,\% = \frac{\text{Weight of lint in sample}}{\text{Weight of seed cotton in the same sample}}\ X\ 100$$

Fiber traits

- Fiber lengths in millimeter at 2.5 % span length; fiber fineness expressed as Micronaire reading; fiber strength expressed as (Pressley index) values and uniformity ratio estimated from the following equation: 50 % span length X 100 / 2.5% span length.

All fiber properties estimated in this study were kindly measured in the laboratories of fiber cotton technology division, CRI, ARC, Egypt.

Statistical analysis

The analysis of variance was performed according to Singh and Chaudhary (1979) to determine the significance of differences among genotypes (including crosses and parents). When differences are found significant, line x tester analysis can be performed.

According to Kempthorne (1957), in line x tester analysis using broad base genotypes as a tester; the general combining of lines is tested as in the top cross method because the line x tester analysis is an extension of this method where several testers are used. Therefor, to evaluate the materials used in this study, means and variances of genotypes (crosses and parents) for the studied traits were estimated. Statistical procedures used were done as described by Cochran and Cox (1957).

The means significant was canculadet by (L.S.D). Heritability was determined in both broad ($h^2b\%$) and narrow ($h^2n\%$) senses according to Allard (1960) as follows:

a. Heritability in broad sense (h^2b) :

$$h^2b = \frac{VF_2 - VE}{VF_2} = \frac{\frac{1}{2}D + \frac{1}{4}H}{\frac{1}{2}D + \frac{1}{4}H + E}$$

b. Heritability in narrow sense (h^2n) :

$$h^2n = \frac{\frac{1}{2}D}{\frac{1}{2}D + \frac{1}{4}H + E}$$

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.

RESULTS AND DISCUSSION

The analysis of variance for the six parents and their F1's and F2's crosses are presented in Table (1). The data cleared that the mean squares of genotypes, parents, and their F1's and F2's crosses were highly significant except F1's for boll weight, which indicating that the genotype variability and genetic materials were valid to proceed further analysis. The mean squares of the interaction between parent and hybrids, as an indicator to vigor heterotic effect for all hybrids, was significant or highly significant for most of the studied traits for F1's and F2's except for boll weight in F1's, F2 indicating that the variance due to the heterosis clarify the wide range of heterosis values among the hybrids for studied traits. Further partitioning of crosses mean squares i.e. line x tester analysis indicated that the difference due to both lines and testers were highly significant for most traits.

Table 1. The analysis of combining ability of line x tester for yield and fiber properties.

SOV, Genetic parameters	df	Boll weight	Seed cotton yield/plant	Lint cotton yield/plant	Lint %	Fiber fineness	Fiber strength	Fiber length (mm)	Uniformity index
Replications	2	0.140	767.45	130.96	2.01	0.019	0.001	0.10	0.10
Genotypes	21	0.067	6430.09**	1040.36**	12.06**	0.09**	0.33**	3.97**	1.79**
Error	42	0.039	222.14	40.75	3.45	0.01	0.02	0.24	0.12
Parents (P)	5	0.04**	1147.6	264.8*	6.11**	0.18	0.07*	3.38**	2.27
Crosses F_1 (C)	7	0.08**	15163.5	2128.7*	4.43**	0.04	0.02*	0.84**	1.00
P. *vs*. C F_1	1	0.003	74.9**	5.8*	6.92*	0.28**	4.89	25.55*	11.99
Lines F_1	3	0.01	11793.0**	1822.9	2.81*	0.02**	0.01	0.38*	0.92**
Tester F_2	1	0.03	49307.0**	6124.6	16.78*	0.04**	0.0002	0.12*	1.27**
Line x Tester	3	0.16**	7152.9	1102.5*	1.93**	0.06	0.03*	1.53**	0.99**
Error F_1	26	0.01	34.3	6.1	0.12	0.01	0.002	0.03	0.03
Crosses F_2 (C)	7	0.06	2045.1**	379.6	2.38	0.04**	0.18	1.43*	0.62**
P. *vs*. C F_2	1	0.13**	6681.0*	1871.3**	35.19	0.002*	0.79**	1.49	0.32*
Lines F_2	3	0.07**	641.7*	84.4**	2.06	0.04*	0.12**	1.42	0.63*
Tester F_2	1	0.17**	8030.6*	1700.5**	5.33	0.04*	0.46**	4.73	1.48*
Line x Tester	3	0.01	1453.3**	234.5	1.73	0.05**	0.16	0.34*	0.31**
Error F_2	26	0.05	307.2	55.7	1.60	0.01	0.03	0.38	0.19

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

The contribution of line x tester interaction were significant for all studied characters for F_1's and F_2's except boll weight in F_2's indicating that the two testers did not rank to theis mean performance according to the performance of their crosses.

Mean performance of parents and their F_1's and F_2's crosses for traits under study are presented in Table (2). The mean performance values of parents showed differences with range of (2.9-3.23), (155.89-200.76), (57.26-80.53), (36.19 – 40.11), (3.64-4.33), (10.13-10.51), (33.36-36.45) and (85.12-87.49) for boll weight, seed cotton yield/plant, lint cotton yield/plant, lint %, fiber fineness , fiber strength , fiber length and uniformity index, respectively. The differences among genotypes confirmed the genetic variability existed among these genotypes for the following traits; boll weight, number of bolls/plant, seed cotton yield/ plant, lint cotton yield/ plant, lint%, fiber fineness, fiber strength, fiber length and uniformity ratio. This variance cleared that different genetic background among the studied cotton genotypes.

The line Giza 94 had the highest mean performance value for seed cotton yield/plant, lint cotton yield/ plant and Lint %, while line BBB had highest mean performance values for boll weight. Tester CB.58 had the highest mean performance for boll weight, lint cotton yield/ plant and Lint % while tester Giza 45 had highest mean performance values seed cotton yield/plant.

Table 2. The average performances of parental of line x tester and their F_1's and F_2 for yield, and fiber characters.

Genotypes		Yield and yield components							
		Boll weight		Seed cotton yield/plant		Lint cotton yield/plant		Lint %	
Lines	Giza 94 (1)	3.21		200.76		80.53		40.11	
	Uzbekstan1(2)	3.22		171.11		65.78		38.44	
	TNB (3)	3.14		167.79		65.56		39.07	
	BBB (4)	3.23		198.15		78.83		39.79	
Testers	CB 58 (5)	3.22		155.89		61.58		39.50	
	Giza 45 (6)	2.93		158.22		57.26		36.19	
Mean		3.16		175.32		68.26		38.85	
		F_1	F_2	F_1	F_2	F_1	F_2	F1	F2
Crosses	1*5	3.49	3.46	311.13	198.83	117.71	82.08	37.83	41.28
	1*6	3.01	3.24	136.08	175.00	50.38	72.74	37.02	41.57
	2*5	3.11	3.24	126.42	239.25	49.31	99.58	39.00	41.62
	2*6	3.05	2.99	185.30	172.00	66.21	69.22	35.73	40.24
	3*5	2.95	3.40	156.28	239.13	60.07	97.38	38.44	40.72
	3*6	3.29	3.29	127.40	182.83	48.86	73.28	38.35	40.08
	4*5	3.07	3.33	120.66	199.18	47.90	81.62	39.70	40.98
	4*6	3.22	3.23	260.86	200.22	99.65	78.09	38.20	39.00
Mean		3.14	3.27	178.02	200.81	67.51	81.75	38.03	40.70
LSD (0.05)		0.14	0.37	9.83	29.41	4.15	12.53	0.61	3.91
LSD (0.01)		0.18	0.50	13.28	39.76	5.61	16.94	0.83	5.28

Genotypes		Fiber traits							
		Fiber fineness		Fiber strength		Fiber length		Uniformity index	
Lines	Giza 94 (1)	3.97		10.31		34.34		86.49	
	Uzbekstan1(2)	4.19		10.20		33.79		86.63	
	TNB (3)	3.85		10.43		34.58		86.67	
	BBB (4)	4.33		10.13		34.61		85.46	
Testers	CB 58 (5)	4.07		10.21		33.36		85.12	
	Giza 45 (6)	3.64		10.51		36.45		87.49	
Mean		4.01		10.30		34.52		86.31	
		F_1	F_2	F_1	F_2	F_1	F_2	F_1	F_2
Crosses	1*5	4.19	4.24	10.87	10.19	36.78	34.34	88.51	86.75
	1*6	4.08	3.98	11.02	10.65	35.76	34.65	87.36	86.66
	2*5	4.39	4.07	10.96	10.32	35.24	33.73	87.15	86.47
	2*6	4.10	3.99	11.02	10.72	36.30	34.40	87.21	86.85
	3*5	4.02	3.83	11.10	10.85	36.51	32.84	87.98	85.52
	3*6	4.21	4.01	10.98	10.64	35.56	34.13	86.83	86.50
	4*5	4.27	4.11	11.03	10.39	36.15	33.89	86.84	86.22
	4*6	4.14	3.96	10.91	10.84	36.47	35.16	87.25	86.93
Mean		4.18	4.02	10.99	10.58	36.10	34.14	87.39	86.49
LSD (0.05)		0.14	0.20	0.08	0.31	0.27	1.03	0.31	0.73
LSD (0.01)		0.19	0.27	0.10	0.42	0.36	1.40	0.42	0.98

Moreover, Giza 94 x CB.58 gave the highest mean values in F_1's for seed cotton yield/ plant, lint cotton yield/ plant, fiber length and uniformity index, while in both F_1's and F_2's crosses for boll weight. The cross of Uzbekstan1x CB 58 had the highest mean performance value in F_2's crosses for seed cotton yield/ plant and lint cotton yield/ plant and the cross BBB x CB.85 gave the highest mean performance value in both F_1's and F_2's crosses for lint %.

Heterosis over the mid-parent (M.P) and better parent (B.P) for all studied traits were presented in Table (3). The hybrid Giza94 x CB 58 had highly significant and positive heterotic effect to mid-parent (M.P) and better-parent (B.P) for seed cotton yield/plant and lint cotton yield/plant, while in mid-parent (M.P) for boll weight. For the cross Uzbekstan1x Giza 45, had highly significant it was positive heterosis relative to better parent (B.P) for seed cotton yield/plant while significant for lint cotton yield. For the cross TNB x Giza 45 it gave highly significant positive heterotic effect to better-parent (B.P) for boll weight.

Regarding to the cross BBB x Giza45 it gave highly significant positive heterosis relative to mid-parent (M.P) and better parent (B.P) for seed cotton yield/plant and lint cotton yield/plant and, also had significant positive mid-parent (M.P) heterosis for boll weight, while it showed highly significant negative heterotic effect to Better-parent (B.P) for boll weight.

Regarding to fiber fineness most of crosses showed highly significant and positive heterosis relative to mid-parent (M.P) and better-parent (B.P) while the crosses Uzbekstan1x CB 58, BBB x CB 58, BBB x Giza 45 and as well as the cross TNB x CB.58 cleared significant negative heterosis relative to better parent (B.P). For Fiber strength all crosses showed highly significant and positive heterosis relative to mid-parent

(M.P) and better-parent (B.P), for fiber length, all hybrids had highly significant positive heterosis relative to mid-parent (M.P) except TNB x Giza45 that was not significant, while three crosses only for better-parent (B.P) Giza 94 x CB 58, Uzbekstan1 x CB 58 and TNB x CB 58. Regarding to uniformity index cleared heterotic effect to mid-parent (M.P) except Uzbekstan1x Giza 45 and TNB x Giza 45.

Table 3. Heterotic effect over the mid-parent (M.P) and better-parent (B.P) for yield and fiber characters.

Genotypes	**Yield and yield components**							
	Boll weight		**Seed cotton yield/plant**		**Lint cotton yield/plant**		**Lint %**	
	M.P	**B.P**	**M.P**	**B.P**	**M.P**	**B.P**	**M.P**	**B.P**
Giza 94 X CB 58	13.03**	9.13	90.87**	85.43**	91.67**	79.54**	-3.69**	-4.42**
Giza 94 X Giza 45	-2.04	-6.40	-24.19	-32.22	-26.88	-37.44	-2.96**	-7.70**
Uzbekstan1 X CB 58	-3.23	-3.28	-22.68	-26.12	-22.56	-25.03	0.08	-1.26
Uzbekstan1 X Giza 45	-0.81	-5.28	12.53**	8.29	7.61*	0.64	-4.25**	-7.05**
TNB X CB 58	-7.40	-8.50	-3.43	-6.86	-5.51	-8.38	-2.17**	-2.71**
TNB X Giza 45	2.36	2.25**	-28.56	-36.54	-31.24	-39.33	0.53	-3.18**
BBB X CB 58	-4.70	-4.85	-31.84	-39.11	-31.77	-39.24	0.11	-0.25
BBB X Giza 45	4.65*	-0.27**	46.40**	31.65**	46.43**	26.40**	0.54	-4.00**
LSD (0.05)	0.12	0.14	8.51	9.83	3.60	4.15	0.50	0.57
LSD (0.01)	0.16	0.18	11.50	13.28	4.86	5.61	0.67	0.78
Genotypes	Fiber traits							
	Fiber fineness		Fiber strength		Fiber length (mm)		Uniformity index	
	M.P	B.P	M.P	B.P	M.P	B.P	M.P	B.P
Giza 94 X CB 58	4.24**	3.08**	5.94**	5.39**	8.66**	7.11**	3.15**	2.33**
Giza 94 X Giza 45	7.14**	2.89**	5.86**	4.87**	1.05**	-1.87	0.42**	-0.15
Uzbekstan1 X CB 58	6.19**	4.81**	7.44**	7.42**	4.95**	4.27**	1.48**	0.60**
Uzbekstan1 X Giza 45	4.73**	-2.47**	6.40**	4.85**	3.36**	-0.40	0.17	-0.32
TNB X CB 58	1.40	-1.42*	7.58**	6.42**	7.47*	5.56**	2.43**	1.51**
TNB X Giza 45	12.36**	9.83**	4.91**	4.51**	0.14	-2.42	-0.29	-0.75
BBB X CB 58	1.63	-1.47**	8.46**	8.03**	6.39**	4.47	1.82**	1.61**
BBB X Giza 45	3.83*	-5.25**	5.78**	3.85**	2.66**	0.07	0.90**	-0.27
LSD (0.05)	0.12	0.14	0.07	0.08	0.23	0.27	0.27	0.12
LSD (0.01)	0.16	0.19	0.09	0.10	0.31	0.36	0.36	0.16

***, ** Significant at 0.05 and 0.01 respectively**

Data in table (4) concerning partitioning of genetic component, indicated that, the component of variation due to SCA was higher than GCA for all traits in each of F_1's and F_2's indicating the predominance of non-additive gene action. These results concluded that the used materials had high selection history. On the other hand, GCA/ SCA ratio was less than unity for all studied traits, indicating that SCA variance was more important than GCA variance. This indicates the predominantly non–additive gene action for all traits in F_1's and F_2's. The obtained results are in harmony with those previously reached by Ali (2006) and El-Agamy *et al.* (2008).

Table 4. Partitioning of the genetic variance of the crosses. To its component, the genetic effects and heritability.

SOV, Genetic parameters	**Yield and yield components**							
	Boll weight		**Seed cotton yield/plant**		**Lint cotton yield/plant**		**Lint %**	
	F_1	F_2	F_1	F_2	F_1	F_2	F_1	F_2
GCA	-0.01	0.003	467.3	34.5	59.9	8.5	0.15	0.038
SCA	0.05	-0.01	2372.9	382.1	365.4	59.6	0.61	0.044
σ^2A	-0.01	0.01	934.6	69.0	119.7	16.9	0.29	0.076
σ^2D	0.05	-0.01	2372.9	382.1	365.4	59.6	0.61	0.044
H^2_b	86.38	0.0	99.0	59.5	98.8	57.9	88.44	7.013
H^2_n	0.0	14.32	28.0	9.1	24.4	12.8	28.73	4.438
GCA/ SCA	-0.09	-0.21	0.2	0.1	0.2	0.1	0.24	0.862
Error	0.002	0.02	11.4	102.4	2.0	18.6	0.04	0.53
SOV,Genetic parameters	Fiber properties							
	Fiber fineness		Fiber strength		Fiber length (mm)		Uniformity index	
	F_1	F_2	F_1	F_2	F_1	F_2	F_1	F_2
GCA	-0.001	-0.001	-0.001	0.002	-0.04	0.06	0.0004	0.02
SCA	0.02	0.01	0.01	0.04	0.50	-0.01	0.32	0.04
σ^2A	-0.002	-0.001	-0.001	0.003	-0.08	0.13	0.001	0.04
σ^2D	0.02	0.01	0.01	0.04	0.50	-0.01	0.32	0.04
H^2_b	68.87	44.64	76.64	56.11	94.32	23.12	90.39	29.45
H^2_n	0.00	0.00	0.00	4.02	0.00	25.75	0.25	13.34
GCA/ SCA	-0.001	-0.001	-0.001	0.002	-0.04	0.06	0.0004	0.02
Error	0.002	0.005	0.001	0.011	0.008	0.126	0.011	0.062

***, ** Significant at 0.05 and 0.01 respectively**

Results concerning the narrow and broad sense heritability are clarified in Table (4). These results revealed that broad sense heritability (h^2b%) estimates were larger in magnitude than its values of the narrow sense heritability (h^2_n%) for all of the studied traits. The highest broad sense heritability estimate in F_1 noticed for the trait seed cotton yield/ plant that gave (99.00%) and the lowest value (0.00) was for boll weight in F_2, on the other hand, narrow sense heritability, ranged from 0.25% to 28.73% in F_1 for uniformity index and lint%, respectively. Al-Hibbiny

(2004) found that values of heritability was 90 – 83% in broad sense for boll weight and seed index respectively. Gibely *et al* (2015) found high heritability value for seed and lint cotton yields and moderate value for boll weight.

Table (5) showed the general and specific effects, Data in Table (5) showed that the estimates of general combining ability (GCA) effects were significant and highly significant for most studied traits. The results revealed that Giza94 was positive and significantly greater GCA for, seed cotton yield/ plant , lint cotton yield/ plant and lint% , Fiber length and Uniformity index than the other parents, that these cultivars are good donors for improving this trait, while tester CB.58 had positive and significant general combining ability for lint cotton yield and lint% .Giza 94 x CB.58 showed positive and highly significant specific combining ability values SCA for seed cotton yield/ plant , lint cotton yield/ plant and Fiber length.

Thence, it could be concluded that selection procedures based on the accumulation of additive effects would be effective in improving these traits. But, selection advance procedures that are known to be effective in shifting gene frequency when additive variances are involved should be maximized. The results were harmony with that we obtained by Heba Hamed *et al*. (2015).

Table 5. The values of GCA and SCA effects for six parent and its F_1 and F_2 generation from line x tester for yield and fiber traits.

Genotypes		**Yield and yield components**							
		Boll weight		**Seed cotton yield/plant**		**Lint cotton yield/plant**		**Lint %**	
		F_1	**F_2**	**F_1**	**F_2**	**F_1**	**F_2**	**F_1**	**F_2**
Lines	Giza 94 (1)	0.047	0.074	55.691**	10.174	21.379**	3.577	-0.351	0.685**
	Uzbekstan1 (2)	-0.061	-0.156	22.157**	4.820	-9.751**	2.651	-0.663**	0.272
	TNB (3)	0.008	0.075	46.278**	13.888	17.891**	-4.337	0.102	-0.362
	BBB (4)	0.006	0.006	12.744**	-1.106	6.263**	-1.891	0.912**	-0.595**
LSD (0.05)		0.10	0.26	6.95	20.80	2.94	8.86	0.43	2.76
LSD (0.01)		0.09	0.36	9.39	28.12	3.97	11.98	0.59	3.73
Testers	CB 58 (5)	-0.035	0.085	-45.35**	18.292	-15.975	8.417*	0.836*	0.471
	Giza 45 (6)	0.035	-0.085	45.35**	-18.292	15.975	-8.417*	-0.836*	-0.471
LSD (0.05)		0.07	0.19	4.91	18.71	2.08	6.26	0.31	1.95
LSD (0.01)		0.18	0.50	13.28	39.76	5.61	16.94	0.83	5.28
crosses	1*5	0.178	0.024	40.987**	-6.376	15.216**	-3.746	-0.178	-0.609
	1*6	-0.178	-0.024	-40.987**	6.376	-15.216**	3.746	0.178	0.609
	2*5	0.069	0.038	15.887**	15.333	7.529**	6.766	0.801**	0.183
	2*6	-0.069	-0.038	-15.887**	-15.333	-7.529**	-6.766	-0.801**	-0.183
	3*5	-0.207	-0.027	-32.098**	9.853	-12.846**	3.632	-0.534*	-0.217
	3*6	0.207	0.027	32.098**	-9.853	12.846**	-3.632	0.534*	0.217
	4*5	-0.039	-0.035	-24.776**	-18.810	-9.899**	-6.653	-0.089	0.643
	4*6	0.039	0.035	24.776**	18.810	9.899**	6.653	0.089	-0.643
LSD (0.05)		0.14	0.37	9.83	29.41	4.15	12.53	0.50	1.84
LSD (0.01)		0.18	0.50	13.28	39.76	5.61	16.94	0.67	2.48

Genotypes		Fiber properties							
		Fiber fineness		Fiber strength		Fiber length (mm)		Uniformity index	
		F_1	F_2	F_1	F_2	F_1	F_2	F_1	F_2
Lines	Giza 94 (1)	0.015	0.092	-0.079**	-0.092	0.434**	0.288	0.346**	0.292
	Uzbekstan1 (2)	-0.015	-0.092	0.079**	0.092	-0.434**	-0.288	-0.346**	-0.292
	TNB (3)	0.037	-0.085	0.042	0.156	-0.174	-0.354	-0.541**	-0.220
	BBB (4)	0.037	-0.085	0.042	0.156	-0.174	-0.354	-0.541**	-0.220
SE gi x $t_{0.05}$		0.10	0.14	0.05	0.22	0.19	0.73	0.22	0.51
SE (gi-gj) x $t_{0.05}$		0.13	0.19	0.07	0.30	0.26	0.99	0.30	0.69
Testers	CB 58 (5)	0.101**	0.004	-0.030	-0.064	-0.604**	0.104	-0.258*	0.054
	Giza 45 (6)	-0.101**	-0.004	0.030	0.064	0.604**	-0.104	0.258*	-0.054
SE gi x $t_{0.05}$		0.07	0.10	0.04	0.16	0.13	0.52	0.15	0.36
SE (gi-gj) x $t_{0.05}$		0.19	0.27	0.10	0.42	0.36	1.40	0.42	0.98
crosses	1*5	-0.070	-0.007	-0.005	0.056	0.329*	0.075	0.213	-0.174
	1*6	-0.070	-0.007	-0.005	0.056	0.329*	0.075	0.213	-0.174
	2*5	0.061	0.103	-0.055	-0.169	0.061	0.659	-0.017	0.480
	2*6	0.061	0.103	-0.055	-0.169	0.061	0.659	-0.017	0.480
	3*5	-0.028	-0.012	0.017	-0.044	-0.216	-0.381	0.346*	-0.087
	3*6	-0.028	-0.012	0.017	-0.044	-0.216	-0.381	0.346*	-0.087
	4*5	-0.138*	-0.129	0.055	0.241	0.400**	-0.200	0.347*	-0.242
	4*6	0.138*	0.129	-0.055	-0.241	-0.400**	0.200	-0.347*	0.242
LSD (0.05)		0.14	0.20	0.08	0.31	0.27	1.03	0.31	0.73
LSD (0.01)		0.19	0.27	0.10	0.42	0.36	1.40	0.42	0.98

***, ** Significant at 0.05 and 0.01 respectively**

The Proportion contributions of lines and tester in their genetic variation were illustrated in Table (6), the results showed that the proportion contributions of strains were higher than these of testers and lines x testers interaction for the traits seed cotton yield/ plant, fiber length and uniformity ratio whereas, lines x testers interaction proportion contributions were higher than lines and testers for the traits boll weight, Lint %, fiber fineness and fiber strength. While, testers proportion were higher than those of lines and lines x testers for lint cotton yield/plant. Heba Hamed *et al*., (2015) found that proportion contribution of line contribution were importance than than tester and lines x testers contributions for all studied characters. While Al-Hibbiny (2011) found that proportion contribution of lines x tester interaction was higher than lines and testers for all studied characters, except lint percentage.

Table 6. The ratios of contribution of lines, testers and their interactions for yield and fiber characters.

Traits	Lines		Testers		Lines x Testers	
	F_1	F_2	F_1	F_2	F_1	F_2
Boll weight	52.26	6.56	5.33	42.03	88.10	5.71
Seed cotton yield/plant	56.10	13.45	46.45	33.33	20.22	30.46
Lint cotton yield/plant	36.70	9.53	41.10	63.99	22.20	26.48
Lint %	27.18	36.97	54.12	31.92	18.70	31.11
Fiber fineness	22.58	35.68	14.85	12.21	62.56	52.10
Fiber strength	27.95	27.18	0.14	36.26	71.91	36.56
Fiber length (mm)	78.57	42.54	2.11	47.25	19.32	10.21
Uniformity index	39.36	43.99	18.11	34.17	42.53	21.85

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تقدير قوة الهجين و طبيعة الفعل الجينى لمكونات المحصول وصفات التيلة في القطن الباربادنس

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أجرى هذا البحث بمزرعة محطة البحوث الزراعية بسخا - كفر الشيخ خلال مواسم 2014و2015و2016 حيث فى موسم 2014 اجريت التهجينات اللازمة باستخدام ستة تراكيب وراثية اربعة منهم وهم جيزة 94, اوزباكستان1, TNB و BBB كأمهات و تركيبين وهما CB58 و جيزة 45 كآباء لأنتاج هجن الجيل الأول بنظام تزاوج السلالة x الكشاف . وفى موسم 2015 تمت زراعة الأباء و بذور هجن الجيل الأول لانتاج بذور الجيل الثانى . و فى موسم 2016 اجرى تقييم التجربة حيث تمت زراعة الأباء و الجيل الأول و الجيل الثانى و ذلك لد\راسة قوة الهجين و القدرة على التآلف و الفعل الجينى المتحكم فى المحصول و مكوناتة. وتلخصت النتائج المتحصل عليها فى الاتى: 1- أظهر التباين لجميع التراكيب الوراثية (الأباء والهجن) وجود فروق عالية معنوية لكل الصفات المدروسة.2- أظهر الهجين جيزة 94 × CB58 أعلى متوسط فى الجيل الاول لصفات محصول القطن الزهر للنبات , محصول القطن الشعر للنبات , الطول عند 2.5 % و معامل الانتظام بينما كان اوزبكستان x CB58 الاعلى فى متوسط وزن اللوزة فى الجيل الاول و الثانى واعلى متوسط فى الجيل الثانى لصفة محصول القطن الزهر للنبات و محصول القطن الشعر للنبات بينما اعطى الهجين BBB x CB58 اعلى متوسط لتصافى الحليج لكلا الجيلين . 3- اوضحت النتائج الدور المهم لكل من تأثير الفعل الجينى المضيف و الفعل الجينى الغير مضيف لجميع الصفات تحت الدراسة حيث تفوق الفعل الجينى غير المضيف على الفعل الجينى المضيف لجميع الصفات و دلك فى الجيل الاول و الجيل الثانى مما يؤكد ان التباين الغير اضافى له دور هام فى وراثة هذه الصفات.4- كانت الهجن جيزة 94 X CB58 وBBB X CB58 افضل الهجن فى اظهار قوة الهجين بالنسبة لمتوسط الأبوين و بالنسبة لأفضل الابوين لمعظم الصفات المدروسة . وكان الصنف جيزة 94 وCB58 االافضل للاستخدام فى برامج التربية لقدرتها العالية على الائتلاف لمعظم الصفات المدروسة.5- أعطت الأصناف المستعملة كسلالات أعلى قيمة نسبة مساهمة فى التباين الكلى بالمقارنة بالأصناف الكشافة والتفاعل بينهما فى صفات محصول القطن الزهر و الطول و الانتظام بينما أعطت الأصناف المستعملة ككشافات أعلى قيمة نسبة مساهمة فى التباين الكلى بالمقارنة بالأصناف المستعملة كسلالات والتفاعل بينهما فى صفات وزن اللوزة و التصافى و المتانة.6- كانت درجة التوريث بمعناها العام اعلى من قيمة التوريث فى المعنى الضيق وكانت اعلى قيمة لها لصفة محصول القطن الزهر بقيمة 99,00 % واقل قيمة كانت لصفة الطول بقيمة 26,12% وتراوحت درجة التوريث فى المعنى الضيق بين 0,25% لصفة الانتظام الى 29.31% لصفة التصافى .