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DIALLEL ANALYSIS FOR EARLINESS, YIELD COMPONENTS AND FIBER QUALITY TRAITS IN EGYPTIAN COTTON

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ABSTRACT

The aim of this investigation was to determine the combining ability among seven Egyptian cotton varieties for earliness, yield components and fiber quality traits. During 2013 growing season, all possible F_1 crosses among these varieties were produced. In 2014 growing season, the parents and F1's were evaluated in a field trial at Sids Agric. Res. Station, Beni-suef Governorate for the following: days to first flower (DFF), days to first opened boll(DFB), seed cotton yield/plant (SCY/P), lint yield/plant (LY/P), boll weight (BW), number of bolls/ plant (B/P), lint percentage (L%), fiber fineness (FF), fiber strength (FS) and upper half mean (UHM). Results indicated that the performances of most the 21 F_1 hybrids were better than their corresponded parents. The mean squares of each genotypes (G), Parents (P), Crosses (C) and (PxC) were significant or highly significant for most studied traits. Parental varieties recorded variable performances for studied traits.Giza 85 (P_1) was superior for B/P and for FF, Ashmouni (P_2) for DFF, DFB and FS, Giza 80 (P_4) for SCY/P, LY/P and L%. Giza 86 (P_5) was the best for UHM. The parental variety Giza 90 (P_4) exhibited the best mean performance for BW. Therefore, these parental varieties could be utilized cross breeding program to combine most of these traits in promising genotypes. The analysis of diallel cross indicated that, Giza 85 (P_1) exhibited promising combing ability for SCY/P, LY/P, L%, B/P and FF .Moreover, Ashmouni (P_2) was the best combiner for DFF and DFB.

Furthermore, the results revealed that Giza 75 (P_3) was the best combiner for BW. Giza 86 (P_5) was the best for FS and UHM. Results also showed that the cross P_1 x P_2 gave the highest SCA effects (Ŝij) for SCY/P, LY/P, B/P and FF. Meanwhile, the crosses P_1 x P_6, P_1 x P_7, P_3 x P_6, P_4 x P_6, P_4 x P_7 and P_5 x P_6 were desirable for FS, UHM, DFF, DFB, L% and BW, respectively.

The magnitudes of SCA variance were larger than those of GCA variance, for all studied traits except L%. These indicate the predominance of non-additive genetic variance in the inheritance of these traits. It could be concluded that earliness, fiber properties and yield components were mainly controlled by dominance variance. The ratio of GCA/SCA indicated that the GCA effects were more important than SCA effects for all studied traits, except Fiber strength. Heritability in broad sense (h^2_b) showed high values for all traits, indicating the low effect of environment on studied traits. The estimated heritability values in broad sense ($h^2_{b.s.}$%) were larger than the heritability values in narrow sense ($h^2_{n.s.}$%) for all studied traits, indicating the low effect of environment on these traits. The results also cleared that the calculated values in broad sense ranged from 65.12% to 99.27% for FF and DFB, respectively. Narrow sense ($h^2_{n.s.}$ %) ranged from 7.9% for LY/P to 77.89% for L%.

Keywords: Combining ability, Gossypium barbadense, Half diallel, Heterosis, Diallel analysis, Gene action, Egyptian cotton.

INTRODUCTION

Detection of suitable cross combination is an important task to upgrade the efficiency of breeding programs. Diallel analysis has been widely used by plant breeders and geneticists to evaluate parents and crosses. The knowledge of genetic components of any breeding materials is useful for choosing the proper breeding procedure cotton cultivars.

Abd El-Hadi et al. (2005a) found that, the magnitude of general combining ability (GCA) variance was highly significant and larger than that of specific combining ability (SCA) variance for fiber strength, fiber fineness and 2.5% span length. Their results indicated that the additive genetic effect predominated and played the major role in the expression of most studied traits. They also found that, the magnitude of GCA variance was highly significant and larger than that of SCA variance for number of days to first flower. Their results displayed that the magnitude of additive genetic variance was larger than corresponding non-additive genetic variance for number of days to first flower. They also found, that the heterosis values relative to the mid and better-parents showed significant and negative (desirable) values for earliness traits and that heterosis relative to better-parent was highly significant and positive for seed cotton yield/plant, lint yield/plant, boll weight and lint percentage. Abd El-Hadi *et al.* (2005b) reported that, the best combiner which had negative highly significant GCA effects (useful) for number of days to first flower trait was the parent Suvin. They added that for the specific combining ability effects, the crosses (6022 x Giza 70) and (Suvin x Pima S_7) were the best combinations for number of days to first flower traits which have negative and significant values.

Darweesh (2006) found that, additive gene effects mainly controlled all earliness traits. Kale *et al.* (2006) reported that, boll weight, number of bolls per plant and seed cotton yield per plant displayed high heritability values in broad sense.

Kalpande *et al* (2008) found that, the estimates of GCA effects were positive and significant for seed cotton yield per plant and some other yield contributing characters. Among the cross combinations, five crosses exhibited significant and positive SCA effects for seed cotton yield per plant. Karademir *et al* (2009) reported that, both additive and non-additive gene effects were responsible for the investigated characters. Their results indicated that fiber length and fiber fineness were influenced by additive gene effects, while fiber strength was influenced by non-additive gene effects. Khan *et al.* (2009) cleared that, the SCA genetic variances were greater than GCA for the traits, i.e. boll weight, boll number and seed cotton yield per plant, showing the predominance of non-additive gene action. Lint% was controlled by additive type of gene action due to maximum GCA variances. Darweesh (2010) stated that, the values of heritability in broad sense ranged from 93.13% for seed index to 99.52% for seed cotton yield/plant. He also found that values of heritability in broad sense was 89.31% for days to first flower traits. While, the narrow sense heritability values was 28.33% for the same trait. Also, he recorded that, the heterosis relative to mid-parent was highly significant and positive for seed cotton yield/ plant, lint cotton yield/plant and lint percentage. Khan *et al* (2010) found that genetic variances were almost greater than the environmental variances for all studied traits. Berger *et al.* (2012) reported that significant GCA and specific SCA effects were found for most fiber quality traits of cotton. El-Fesheikawy *et al.* (2012) found that, variance due to GCA and SCA were highly significant for all studied traits indicating that both additive and non-additive gene effects were play role to inheritance of these characters. The results also showed that the performances of most the 10 F_1 hybrids under study were as good as or better than their both parents. They added that, mean squares of genotypes were significant or highly significant for all studied traits except of fiber fineness and fiber strength. Saleh and

Ali (2012) cleared that, the heritability values in broad sense ($h^2b\%$) were larger than the corresponding values of narrow sense heritability ($h^2n\%$) for all studied yield and yield components traits. They also found that the heritability values in broad sense ($h^2b\%$) were larger than the corresponding values of narrow sense heritability ($h^2n\%$) for all fiber studied traits. Simon *et al.* (2013) revealed that, GCA effects were lower than SCA effects for seed yield and lint yield, suggesting that inheritance of these characters is governed mainly by non-additive gene effects.

In recent investigation to study the genetic behavior, heterosis and heritability of some earliness traits, yield and some of its components in two intra-barbadense cotton crosses. El- Fesheikawy *et al.* (2015) reported that, both additive and dominance gene effects are important in the inheritance of these characters. Significant either positive or negative heterotic effects relative to mid-parents were found for days to first flower (DFF), days to first opened boll (DFB), seed cotton yield/plant (SCY/P) and lint cotton yield/plant (LCY/P) in the first cross and for DFB, SCY/P and LCY/P in the second cross. Also they added that high to moderate heritability in broad (H^2_b %) sense estimates were associated with low and medium heritability in narrow sense (h^2_n %) in most characters in both crosses. Sorour *et al*. (2015) reported that additive effects were important for the inheritance of fiber length and fiber fineness, while dominance effects were important for inheritance of fiber strength. Negative heterotic effects relative to the mid and better parents were found for earliness traits in the crosses (Pima S_1 × C.B.58), (Suvin × G.93), (TNB × C.B.58) and ((10229 × G.86) × Suvin).

The present study was designed to estimate the type of gene action controlling the inheritance of earliness, yield components and fiber quality using seven parents diallel cross. The combining ability, heritability and heterosis estimates for these traits were also calculated to determine those parents or crosses which could be used in the improvement of earliness, high yielding and fiber quality.

MATERIALS AND METHODS

Genetic materials and Mating design:

Seven divergent Egyptian cotton genotypes were used in this investigation namely; Giza 85 (P_1), Ashmouni (P_2), Giza 75 (P_3), Giza 80 (P_4), Giza 86 (P_5), Giza 90 (P_6) and Giza 95 (P_7). These genotypes are classified as long staple and belonged to *Gossypium barbadense* L. Pure seeds of these varieties were kindly by Cotton Breeding Section, Cotton Research Institute, Agriculture Research Center at Giza, Egypt.

During 2013 growing season, the seven parents were crossed in all possible combinations, excluding reciprocals, to produce a total 21 F_1 hybrids. Crossing of parents was carried out at Sids Agric. Res. Station at Beni-Suef governorate. In 2014 season, the seven parents along with their 21 F_1's (28 genotypes) were evaluated under field conditions of Sids Agric. Res. Station. The sowing date was on April 2014. The experimental design was a randomized complete blocks (RCBD) with three replications. Each plot included 3 ridges, each was 4 m long and 60 cm apart. Hills were spaced at 25 cm within rows and seedlings were later thinned to two plants per hill. Ordinary cultural practices of cotton production were applied.

Data were recorded on the following traits: days to first flower (DFF), days to first opened boll (DFB), seed cotton yield/plant (SCY/P g), lint yield/ plant (LY/P g), boll weight (BW g), number of bolls/plant (B/P), lint percentage (L%), fiber fineness (FF), fiber strength (FS) and upper half mean (UHM mm). The fiber properties were measured in the laboratories of the Cotton Fiber Research Section, Cotton Research Institute according to (A.S.T.M.D-1448-59, D-1445-60T and D-1447-67).

Analysis of variance**:**

Statistical procedures used in this study were done according to the analysis of variance for a randomized complete blocks design as outlined by Steel and Torrie (1980).

The amount of heterosis were estimated as the percentage increase of the overall means of the F_1 hybrids over the average overall parents (M.P) or above the better parent (B.P). Therefore, the values of heterosis could be estimated from the following equations:

M.P H% = [(F_1-M.P)/M.P] x 100

B.P H%= [(F_1-B.P)/B.P] x 100

The significance of means and heterosis were determined using the least significant difference value (L.S.D) at 0.05 and 0.01 levels of significance, according to Steel and Torrie (1980).

Statistical Model:

The procedures of this analysis was described by Griffing (1956), method 2, model 1 which outlined by Singh and Chaudhary (1985). The form of the analysis of combining ability and the expectations of mean squares are presented in Table 1.

Statistical analysis:

Table 1: Form of the analysis of variance of diallel crosses mating design and expectations of mean square.

S.O.V.	**d.f**	**M.S**	**E.M.S**
GCA	p-1	Mg	$\sigma^2e + \sigma^2s + (p+2)\ \sigma^2g$
SCA	p (p-1)/2	Ms	$\sigma^2e + \sigma^2s$
Error	(g-1)(r-1)	Mé	σ^2e

p, g and r: are number of parents, genotypes and replications, respectively.
Mé: is the error mean square divided by number of replications
Ms and Mg: are the mean squares of SCA and GCA, respectively.

The mathematical model for the combining ability analysis is:

$Y_{ij} = \mu + g_i + g_j + S_{ij} + e_{ijk}$

Where:

Y_{ij} : is the value of a cross between parents (i) and (j)

μ : is population mean.

g_i, g_j : are the GCA effects

S_{ij} : is the SCA effect

e_{ijk} : is the mean error effect

Using plot means the various sums of squares are obtained as follow:

S.S. due to GCA (S_g) = $1/(P+2) [\sum(Y_{i.}+Y_{ii})^2 - 4Y^2_{..}/P]$

S.S. due to SCA (S_S) = $\sum\sum Y^2_{ij} - 1/(P+2) \sum(Y_{i.} + Y_{ii})^2 + 2Y^2_{...}/(P+1)(P+2)$

Estimation of variance components and their genetic interpretations from ANOVA Table 1 could be explained as follows:

$\sigma^2 g = (M_g - M_s)/(P+2)$, $\sigma^2 S = M_s - M_é$ and $\sigma^2 e = M_é$

In addition, the estimates of combining ability effects were determined using the following equations:

I- General combining ability effects (gi) for each line:

$g_i = 1/(P+2) [\sum(Y_{i.}+Y_{ii}) - 2Y_{..}/P]$

II- Specific combining ability effects (S_{ij}) for each cross:

$S_{ij} = Y_{ij} - 1/(P+2) [Y_{i.} + Y_{ii} + Y_{.j} + Y_{jj}] + 2Y_{..} / (P+1)(P+2)$

To test the significance of general as well as specific combining abilities effects, the critical differences were calculated as follows:

C.D. = S.E. x t

Where:

S.E.: is standard error of effects and t: is the tabulated value with the degree of freedom of error at 5% or 1% levels of probability.

Estimates of standard errors:

S.E. (g_i) = $[(P-1) \sigma^2 e/P (P + 2)]^{½}$

S.E. (S_{ij}) = $[P (P-1) \sigma^2 e/(P + 1) (P + 2)]^{½}$

RESULTS AND DISCUSSION

Mean performance:

The mean performances of the seven parents and their 21 F_1's hybrids were estimated for all studied traits and the results are presented in Table 2. The results showed that Giza 80 (P_4) was the highest yielding parent for SCY/P, LY/P and L%. The parental variety Giza 85 (P_1) exhibited the best mean performances for B/P and fiber fineness (F.F.), Ashmouni (P_2) was the earlier among group and also it was the best for fiber strength (F.S.) and the parental variety Giza 90 (P_6) exhibited the heaver bolls. With respect to the diallel crosses, the means showed that there was no specific cross, which was superior or inferior for all studied traits. The results showed that the cross P_1 x P_2 gave the highest mean for SCY/P, LY/P, B/P and FF with means of 69.93 g., 25.79 g., 23.19 and 3.7, respectively. In the same time, the results also revealed that the highest mean performances were found for the cross P_4 x P_7 for L% (42.56%), P_5 x P_6 for BW (3.43 g.). While the two crosses P_2 x P_6 and P_2 x P_3 showed the earlier ones with values of 65.6 and days 117.5 for DFF and DFB, respectively. Concerning UHM, the results revealed that the cross P_3 x P_4 gave the highest mean with value 32.77 mm. For fiber strength, three crosses *viz*., P_1 x P_6 P_3 x P_5 and P_6 x P_7 gave the same value which was the highest mean for FS (9.9).

Mean squares:

The analysis of variance of the seven parents and their 21 F_1's hybrids were made for all studied traits i.e. earliness [DFF and DFB], yield and yield component traits [SCY/P, LY/P, BW, B/P and L%] as well as some fiber properties [FF, FS and UHM] and the mean squares are presented in Table (3). The mean squares of genotypes (G) were significant or highly significant for all studied traits. Also, the parents vs. crosses mean squares (P *vs* C) were highly significant for all studied traits except for FF. Furthermore; the results indicated that the magnitudes of the crosses mean squares (C) of all studied traits were significant or highly significant.

Combining ability analysis:

Results in Table (4) showed that mean squares due to both general (GCA) and specific (SCA) combining ability were significant or highly significant for all studied traits except FF for SCA. Meanwhile, GCA mean squares was larger in magnitude than their ones of SCA for all studied traits except for FS indicating additive gene effects were more important in the inheritance of these traits than those of non-additive gene effects. In addition, the small magnitudes of mean squares of specific combining ability (SCA) with respect to their corresponding mean squares of general combining ability (GCA) may explain the absence or decrease of heterosis values over the better-parent (B.P) for most of studied traits. These results are in harmony with those reported by Abd El-Hadi et al. (2005a), El-Fesheikawy et al. (2012) and El-Kadi et al. (2013).

General ($\hat{g}_i$) and specific ($\hat{S}_{ij}$) combining ability effects:

The estimates of general combining ability effects of parents are presented in Table (5). The data indicated that P_2 and P_6 had highly negative significant GCA effects for DFF and DFB, indicating that these parents were good combiners for these traits. These results suggest that these parents (P_2 and P_6) were good combiners for a breeding program for improving earliness traits. These results are in harmony with those reported by Abd El-Hadi *et al.* (2005 b) who found also that Suvin is the best combiner. While for SCY/P, P_1 and P_2 had highly positive significant general combining ability effects. For SCY/P and B/P, the data in Table (5) showed that P_1 followed by P_2 had positive and highly significant GCA effects ($\hat{g}_i$), indicating that these parents were good combiners. For LY/P, the parent P_1 was good combiner. For BW, the parents P_6 followed by P_5, P_7 and P_3 were good combiners. Also, the parents P_7 followed by P_4, P_6, P_1 and P_5 were good combiners for L%. These results suggested that P_1, P_2, P_5 and P_7 could be used to improve yield and its components. These results are in harmony with these reported by Kalpande *et al.* (2008), Imran *et al.* (2012), El-Fesheikawy *et al.* (2012) and El-Kadi *et al.* (2013). For FF, the results showed that P_1 was good combiner and could be used to improve fiber fineness trait since they had negative general combining ability effects ($\hat{g}_i$). Regarding fiber strength, P_5 was good combiner because they had positive and highly significant general combining ability effects. Also, P_5 followed by P_3 were good combiners for UHM, so we can use the three parents i.e. P_1, P_3 and P_5 as parents in breeding programs to improve fiber quality traits. These results are in harmony with those reported by Abd El-Hadi *et al.* (2005b) and El-Kadi *et al.* (2013).

Table 2: Mean performances of parents and 21 F_1 hybrids for earliness, yield component traits and fiber quality properties.

Genotypes	DFF	DFB	SCY/P	LY/P	BW	B/P	L%	FF	FS	UHM
P_1	73.77	126.80	52.09	20.03	2.75	18.96	38.47	3.43	9.3	31.13
P_2	68.37	118.03	47.01	17.05	2.72	17.76	36.32	4.47	10.0	28.70
P_3	72.97	125.87	41.15	14.82	3.03	13.61	36.09	4.03	9.7	31.70
P_4	74.50	128.00	53.88	21.79	2.89	18.65	40.43	4.27	9.8	31.00
P_5	75.53	130.87	48.54	18.70	2.95	16.46	38.45	4.27	9.9	33.73
P_6	68.90	121.50	53.48	20.95	3.09	17.32	39.13	3.97	9.7	29.43
P_7	73.20	123.70	46.97	18.82	2.94	15.98	40.11	4.03	9.9	29.57
P_1 x P_2	66.33	117.53	69.93	25.79	3.02	23.19	36.83	3.70	9.1	31.73
P_1 x P_3	70.43	124.53	57.36	22.28	2.96	19.40	38.92	3.93	9.8	30.47
P_1 x P_4	71.30	126.63	50.65	20.85	3.10	16.35	41.21	4.00	9.1	31.43
P_1 x P_5	70.90	127.00	48.38	19.56	3.00	16.15	40.53	4.10	9.8	31.90
P_1 x P_6	69.83	128.07	50.53	20.26	3.04	16.64	40.15	3.93	9.9	30.23
P_1 x P_7	70.83	128.30	60.57	24.88	3.01	20.10	41.02	4.33	8.9	32.23
P_2 x P_3	65.97	117.50	49.78	17.61	3.26	15.26	35.31	4.13	9.5	31.67
P_2 x P_4	66.13	118.40	48.92	18.03	3.18	15.38	36.95	4.07	9.3	30.90
P_2 x P_5	68.57	118.87	50.58	18.68	3.17	15.97	36.96	4.27	9.5	32.73
P_2 x P_6	65.60	123.43	51.68	19.32	3.12	16.55	37.61	4.30	9.4	31.53
P_2 x P_7	66.27	117.80	59.58	22.78	3.13	19.07	38.11	4.23	9.4	30.13
P_3 x P_4	72.40	125.53	50.35	19.18	3.12	16.12	38.00	4.23	9.4	32.77
P_3 x P_5	74.70	128.43	51.45	19.75	3.18	16.16	38.37	4.07	9.9	32.70
P_3 x P_6	66.80	124.07	57.16	21.73	3.33	17.16	38.01	4.23	9.2	32.07
P_3 x P_7	68.23	126.47	48.21	18.98	3.23	14.95	39.41	4.33	8.9	32.17
P_4 x P_5	71.37	127.00	47.02	19.29	3.23	14.58	41.01	4.23	9.6	31.90
P_4 x P_6	69.77	120.10	39.99	16.57	2.95	13.56	41.61	4.03	9.6	30.57
P_4 x P_7	71.10	122.53	51.99	22.14	3.30	15.77	42.56	4.37	9.0	31.47
P_5 x P_6	72.07	126.10	45.63	18.28	3.43	13.32	39.96	4.27	9.3	32.67
P_5 x P_7	71.70	125.80	38.76	15.79	3.37	11.50	40.75	4.17	9.2	31.37
P_6 x P_7	68.00	125.27	47.13	19.04	3.32	14.21	40.42	4.33	9.9	29.60
LSD 5%	1.69	0.96	2.62	1.01	0.14	0.91	0.47	0.366	0.453	1.038
1%	2.26	1.28	3.49	1.35	0.18	1.21	0.63	0.490	0.606	1.388

P_1, P_2, P_3, P_4, P_5, P_6 and P_7 were; Giza 85, Ashmouni, Giza 75, Giza 80, Giza 86, Giza 90 and Giza 95, respectively.

The specific combining ability effects ($\hat{S}_{ij}$) for all studied crosses with respect to earliness traits viz., DFF and were obtained and the results are shown in Table 6. The results cleared that five out of 21 crosses i.e. (P_1 x P_2), (P_1 x P_5), (P_2 x P_3), (P_2 x P_5) and (P_2 x P_7) exhibited negative and significant (desirable) values for these traits. With regard to yield and yield component traits were obtained and the results are shown in Table 6. The results cleared that no hybrid exhibited positive and significant values for all studied yield traits. However, 8, 7, 10, 7, and 7 out of 21 crosses showed positive and significant or highly significant specific combining ability effects ($\hat{S}_{ij}$) values for SCY/P, LY/P, BW, B/P and L%, respectively. It is worth to notice that these crosses in cases of seed cotton yield /plant were a result of crossing poor x poor general combiner [(P_3 x P_4), (P_3 x P_5), (P_3 x P_6) and (P_4 x P_7)] and good x poor general combiners [(P_1 x P_3) (P_1 x P_7) and (P_2 x P_7)].

The same trend was observed in other yield component traits. Thus, it is not necessary that parents having low general combination ability effect ($\hat{g}_i$) would also contribute to low specific combining ability effects ($\hat{S}_{ij}$) .Concerning fiber quality properties, there were 1, 5, and 9 out of 21 crosses showed desirable significant specific combining ability effects ($\hat{S}_{ij}$) estimates in the cases of FF, FS and UHM properties , respectively. These results were in common agreement with the results obtained by many authors among them Abd El-Bary (2003), Abd El-Maksoud *et al*. (2000), El-Fesheikawy *et al.* (2012) and El-Kadi *et al*. (2013**).**

Heterosis:

Heterosis estimates of hybrid combinations are presented in Tables (7 and 8) Heterosis over both mid-parents (MP) in Table (7) and better parent (B.P) in Table (8) were significant or highly significant for all characters in this study. Generally, the values of heterosis for fiber quality characters were usually lower than earliness, yield and yield components traits, but it's important for the textile industry.

Regarding the earliness trait (i.e. DFF and DFB), heterosis relative to mid-parents ranged from -7.42% for the cross (P_2 x P_4) to -2.1% for the cross (P_1 x P_6) for DFF and ranged from -4.49% for the cross (P_2 x P_5) to -1.10% for the cross (P_3 x P_4) for DFB. On the other hand, heterosis relative to best parents ranged from -6.49% for the cross (P_3 x P_7) to -2.87% for the cross (P_4 x P_7) for DFF and ranged from -1.15% for the cross (P_4 x P_6) to -0.78% for the cross (P_4 x P_5) for DFB. However, for both earliness traits, 11 out of 21 crosses, *viz.*, (P_1 x P_2), (P_1 x P_3), (P_1 x P_5), (P_2 x P_3), (P_2 x P_4), (P_2 x P_5), (P_2 x P_7), (P_4 x P_5), (P_4 x P_6), (P_4 x P_7) and (P_5 x P_7) exhibited negative mid parent heterosis and 3 crosses, viz., (P_1 x P_3), (P_4 x P_5) and (P_4 x P_7) exhibited negative better parent heterosis.

Table (3): Mean squares for earliness, yield and yield components and Fiber quality traits.

S.O.V	df	DFF	DFB	SCY/P (g.)	LCY/P (g.)	BW (g.)	B/P	L %	FF	FS	UHM
Genotypes	27	25.090**	45.750**	122.6**	18.593**	0.093**	17.081**	10.409**	0.141*	0.36**	4.18**
Parents(P)	6	22.774**	54.938**	61.664**	17.004**	0.072**	10.052**	8.632**	0.327**	0.155	8.67**
Cross (C)	20	19.862**	44.171**	143.19**	18.946**	0.058**	19.653**	10.966**	0.086*	0.35**	2.55**
P. *vs C.*	1	143.556**	22.203**	76.348**	21.077**	0.925**	7.828**	9.941**	0.124	1.80**	9.65**

*, ** Denote significant at (P≤0.05) and (P≤0.01) levels of probability, respectively.

DFF: days to first flower and DFB: days to first opening boll. SCY/P: seed cotton yield/plant, LY/P: lint yield/plant, BW: boll weight, B/P: number of bolls/plant, L%: lint percentage. FF: fiber fineness, FS: fiber strength and UHM: upper half mean.

Table (4): The analysis of variance and mean squares of diallel crosses earliness, yield and yield components and Fiber quality traits.

SOV	df	DFF	DFB	SCY/P (g.)	LY/P (g.)	BW (g.)	B/P	L%	FF	FS	UHM
GCA	6	23.99**	47.613**	48.10**	7.91**	0.047**	11.48**	12.93**	0.115**	0.066*	3.528**
SCA	21	3.898**	6.003**	38.80**	5.71**	0.03**	4.041**	0.77**	0.027	0.134**	0.781**
GCA/SCA	-	6.16	7.93	1.24	1.39	1.74	2.84	16.8	4.21	0.5	4.52

*, ** Denote significant at (P≤0.05) and (P≤0.01) levels of probability, respectively.

DFF: days to first flower and DFB: days to first opening boll. SCY/P: seed cotton yield/plant, LY/P: lint yield/plant, BW: boll weight, B/P: number of bolls/plant, L%: lint percentage. FF: fiber fineness, FS: fiber strength and UHM: upper half mean.

Table (5): Parental general combining ability effects ($\hat{g}_i$) of each parent for earliness, yield and yield components and Fiber quality traits.

Parents	DFF	DFB	SCY/P (g.)	LCY/P (g.)	BW (g.)	B/P	L %	FF	FS	UHM
P_1	0.621**	1.451**	4.026**	1.746**	-0.132**	2.033**	0.377**	-0.244**	-0.083	-0.050
P_2	-2.89**	-4.779**	2.126**	-0.187	-0.054**	1.054**	-1.977**	0.063	0.024	-0.513**
P_3	0.321	0.629**	-0.972**	-0.982**	0.038*	-0.578**	-1.333**	-0.007	0.006	0.502**
P_4	1.054**	0.399**	-0.965**	0.185	-0.016	-0.268**	1.113**	0.044	-0.050	0.035
P_5	2.087**	2.480**	-2.941**	-1.026**	0.053**	-1.207**	0.254**	0.063	0.132**	1.113**
P_6	-1.30**	-0.286**	-0.698*	-0.098	0.063**	-0.599**	0.424**	-0.004	0.076	-0.576**
P_7	0.106	0.106	-0.576*	0.363	0.048**	-0.434**	1.143**	0.085*	-0.105*	-0.513**

*, ** Denote significant at ($P \leq 0.05$) and ($P \leq 0.01$) levels of probability, respectively.

DFF: days to first flower and DFB: days to first opening boll. SCY/P: seed cotton yield/plant, LY/P: lint yield/plant, BW: boll weight, B/P: number of bolls/plant, L%: lint percentage. FF: fiber fineness, FS: fiber strength and UHM: upper half mean. P_1, P_2, P_3, P_4, P_5, P_6 and P_7 were; Giza 85, Ashmouni, Giza 75, Giza 80, Giza 86, Giza 90 and Giza 95, respectively.

These crosses are considered promising crosses to be used in breeding programs for producing hybrid cotton and for improvement of earliness traits. These heterotic effects were useful because the negative heterosis for these traits is desirable. These results were in harmony with those obtained by Abd El-Hadi *et al.* (2005 a) and El-Kadi *et al*. (2013), who found that heterosis values relative to the mid and better-parent was significant and negative.

Regarding the yield and its components traits (i.e. SCY/P, LY/P, BW, B/P and L %). The crosses (P_2 x P_7), (P_1 x P_2), (P_2 x P_3) (P_4 x P_7), (P_1 x P_7), (P_6 x P_7) and (P_3 x P_6) were super for yield and yield components traits, which exhibited the greatest values of heterosis versus mid and better parents and are considered a promising crosses to be used in breeding programs for producing hybrid cotton and for improvement of yield traits. Our results are in harmony with those reported by Abd El-Bary (2003) and El-Fesheikawy *et al.* (2012 and 2015).

For fiber quality traits, the following crosses revealed the maximum values of heterosis relative to mid and better parents, namely the crosses (P_1 x P_7), (P_2 x P_6) and (P_3 x P_4) for UHM. However, the maximum values of heterosis relative to mid and better parents for FS were achieved by the crosses (P_1 x P_6) and (P_1 x P_3). Also, the crosses (P_2 x P_4) and (P_4 x P_5) had negatively (useful) but insignificant heterosis for FF. These crosses are considered promising crosses to be used in breeding programs for producing hybrid cotton and for improvement of fiber quality traits. The absence or presence of weak heterosis in these traits was expected in these genetic materials, which were developed from very narrow germplasm.Similar results were obtained by Abd El-Bary (2003) and El-Fesheikawy *et al*. (2012).

Genetic parameters and heritability:

The partitioning of genetic variance into GCA and SCA is shown in Table (9). The data indicated that GCA and SCA variances were highly significant for all studied traits. The results revealed that the magnitudes of SCA variance were positive and larger than those of GCA variance for all studied traits except lint percentage (L %). These indicated the predominance of non-additive genetic variance in the inheritance of these traits. It could be concluded that earliness, yield and its components as well as fiber properties were mainly controlled by non-additive variance. Similar results were detected by Abd El-Bary *et al*. (2008). On the other hand, El-Fesheikawy *et al*. (2015) reported that both additive and dominance gene effects are important in the inheritance of earliness, yield and its components characters.

With regard to the ratio of GCA/SCA for earliness traits, data cleared that the major role of GCA in their inheritance. These results indicated that the additive which is represented by GCA had more importance than SCA which is represented by non- additive gene effects which indicated that the additive play a major role in the inheritance of DFF and DFB. These results are in harmony with those reported by Abd El–Hadi *et al*. (2005 a), Khan *et al*. (2011) and El-Kadi *et al*. (2013).

For yield and yield components traits, the ratios of GCA/SCA indicated that the additive play a major role in the inheritance of these traits. Results are acceptance with those reported by: Imran *et al.* (2012) and Simon *et al.* (2013), while El-Fesheikawy *et al*. (2012) and El-Kadi *et al*. (2013) reported that non-additive gene effect play a major role in the inheritance of seed cotton yield and its components. For fiber quality, the ratio of GCA/SCA indicated that the GCA (additive) plays major part in the inheritance of fiber fineness and fiber length. While the ratio of GCA/SCA for fiber strength was controlled by the non-additive gene effect.

These results were in harmony with those reported by Abd El-Hadi *et al*. (2005 a), Berger *et al*. (2012) and El-Kadi *et al*. (2013). Heritability in both broad and narrow senses are presented in Table (9).

High heritability values in broad sense were detected for all studied characters which ranged from 65.12% for FF to 99.27% for DFB, indicating that superior genotypes for these characters could be identified from the expression and illustrate the importance of straight forward phenotypic selection for the improvement of these traits). Narrow-sense heritability estimates were-generally-lower than the corresponding broad sense heritability, indicating the presence of non-additive gene action. However, h^2_n% estimates ranged from 5.06 for SCY/P to 77.89% for L%. These finding are in general acceptance with those obtained by Abd El-Bary *et al*. (2008), El-Fesheikawy *et al*. (2012), Saleh and Ali (2012) and El-Fesheikawy *et al*. (2015).

Table (6): Cross-combinations specific combining ability effects ($\hat{s}_{ij}$) for earliness, yield and yield components and Fiber quality traits.

Crosses	DFF	DFB	SCY/P (g.)	LCY/P (g.)	BW(g.)	B/P	L %	FF	FS	UHM
P_1xP_2	-1.60**	-3.21**	13.10**	4.48**	0.10**	3.67**	-0.60*	-0.25**	-0.33**	0.96**
P_1xP_3	-0.71	-1.62**	3.63**	1.77**	-0.05	1.51**	0.85**	0.05	0.36**	-1.33**
P_1xP_4	-0.57	0.71**	-3.08**	-0.83**	0.15**	-1.85**	0.69*	0.07	-0.29*	0.11
P_1xP_5	-2.01**	-1.01**	-3.38**	-0.90**	-0.02	-1.11**	0.87**	0.15	0.30*	-0.50
P_1xP_6	0.32	2.83**	-3.47**	-1.14**	0.01	-1.23**	0.32	0.05	0.45**	-0.48
P_1xP_7	-0.09	2.67**	6.45**	3.03**	-0.003	2.07**	0.48	0.36**	-0.43**	1.46**
P_2xP_3	-1.66**	-2.43**	-2.04**	-0.97**	0.18**	-1.65**	-0.41	-0.06	-0.05	0.34
P_2xP_4	-2.23**	-1.30**	-2.92**	-1.72**	0.15**	-1.84**	-1.21**	-0.17	-0.16	0.038
P_2xP_5	-0.83	-2.91**	0.72	0.14	0.07*	-0.31	-0.34	0.01	-0.18	0.79**
P_2xP_6	-0.41	4.42**	-0.42	-0.14	0.01	-0.34	0.14	0.11	-0.22	1.28**
P_2xP_7	-1.15*	-1.60**	7.36**	2.86**	0.03	2.02**	-0.08	-0.05	0.03	-0.181
P_3xP_4	0.83	0.43	1.62*	0.23	0.001	0.53*	-0.80**	0.06	-0.01	0.89**
P_3xP_5	2.09**	1.25**	4.70**	2.01**	-0.01	1.52**	0.43	-0.12	0.31*	-0.255
P_3xP_6	-2.42**	-0.35	8.16**	3.06**	0.13**	1.91**	-0.10	0.11	-0.41**	0.80**
P_3xP_7	-2.39**	1.66**	-0.92	-0.15	0.04	-0.47*	0.57*	0.12	-0.52**	0.84**
P_4xP_5	-1.97**	0.04	0.25	0.39	0.09*	-0.38	0.62*	-0.01	0.03	-0.59*
P_4xP_6	-0.18	-4.09**	-9.02**	-3.26**	-0.20**	-2.01**	1.05**	-0.14	0.05	-0.232
P_4xP_7	-0.26	-2.05**	2.86**	1.84**	0.16**	0.04	1.28**	0.10	-0.37**	0.61*
P_5xP_6	1.08*	-0.17	-1.40	-0.35	0.21**	-1.31**	0.25	0.07	-0.43**	0.79**
P_5xP_7	-0.69	-0.86**	-8.39**	-3.30**	0.17**	-3.29**	0.33	-0.12	-0.32**	-0.57*
P_6xP_7	-1.00*	1.37**	-2.27**	-0.97**	0.11**	-1.19**	-0.17	0.12	0.44**	-0.65*

*, ** Denote significant at ($P \leq 0.05$) and ($P \leq 0.01$) levels of probability, respectively.

DFF: days to first flower and DFB: days to first opening boll. SCY/P: seed cotton yield/plant, LY/P: lint yield/plant, BW: boll weight, B/P: number of bolls/plant, L%: lint percentage. FF: fiber fineness, FS: fiber strength and UHM: upper half mean. P_1, P_2, P_3, P_4, P_5, P_6 and P_7 were; Giza 85, Ashmouni, Giza 75, Giza 80, Giza 86, Giza 90 and Giza 95, respectively.

Table (7): Estimates of heterosis relative to mid-parents (M.P.) of 21 F_1 crosses for earliness, yield and yield components and Fiber quality traits.

Crosses	DFF	DFB	SCY/P (g.)	LY/P (g.)	BW (g.)	B/P	L%	FF	FS	UHM
P_1xP_2	-6.66**	-3.99**	41.12**	39.10**	10.37**	26.27**	-1.5**	-6.33	-5.7**	6.07**
P_1xP_3	-4.00**	-1.42**	23.03**	27.88**	2.42	19.12**	4.41**	5.36	2.99	-3.02*
P_1xP_4	-3.82**	-0.60	-4.40*	-0.29	9.99**	-13.1**	4.45**	3.90	-4.90*	1.18
P_1xP_5	-5.02**	-1.42**	-3.85	1.01	5.21*	-8.79**	5.37**	6.49	2.43	-1.64
P_1xP_6	-2.10*	3.15**	-4.28*	-1.13	4.05	-8.27**	3.46**	6.31	4.56*	-0.17
P_1xP_7	-3.61**	2.44**	22.29**	28.08**	5.98**	15.03**	4.41**	16.07**	-7.5**	6.21**
P_2xP_3	-6.65**	-3.65**	12.93**	10.51**	13.57**	-2.71	-2.5**	-2.75	-3.73	4.86**
P_2xP_4	-7.42**	-3.75**	-4.03	-7.16**	13.37**	-15.5**	-3.7**	-6.87	-5.9**	3.52*
P_2xP_5	-4.70**	-4.49**	5.87*	4.50	11.70**	-6.65**	-1.13*	-2.29	-4.86*	4.86**
P_2xP_6	-4.42**	3.06**	2.85	1.71	7.52**	-5.65*	-0.32	1.98	-4.91*	8.49**
P_2xP_7	-6.38**	-2.54**	26.79**	27.01**	10.48**	13.03**	-0.28	-0.39	-5.03*	3.43*
P_3xP_4	-1.81	-1.10**	5.96*	4.76*	5.58**	-0.04	-0.67	2.01	-2.92	4.52**
P_3xP_5	0.61	0.05	14.73**	17.82**	6.53*	7.54**	2.97**	-2.01	1.53	-0.05
P_3xP_6	-5.83**	0.31	20.80**	21.51**	8.99**	11.01**	1.07	5.83	-5.34*	4.91**
P_3xP_7	-6.64**	1.35**	9.40**	12.82**	8.16**	1.04	3.44**	7.44	-9.2**	5.01**
P_4xP_5	-4.87**	-1.88**	-8.19**	-4.72*	10.62**	-16.9**	3.99**	-0.78	-2.37	-1.44
P_4xP_6	-2.70*	-3.73**	-25.5**	-22.5**	-1.34	-24.6**	4.60**	-2.02	-1.71	1.16
P_4xp_7	-3.72**	-2.64**	3.10	9.00**	13.09**	-8.93**	5.68**	5.22	-8.7**	3.91**
P_5xP_6	-0.21	-0.07	-10.6**	-7.82**	13.47**	-21.1**	3.01**	3.64	-5.4**	3.43*
P_5xP_7	-3.59**	-1.17**	-18.8**	-15.9**	14.54**	-29.1**	3.75**	0.40	-6.9**	-0.90
P_6xP_7	-4.29**	2.18**	-6.18**	-4.24	10.01**	-14.7**	2.01**	8.33*	1.19	0.34
LSD 0.05	1.46	0.83	2.26	0.87	0.12	0.79	0.41	0.32	0.39	0.90
0.01	1.96	1.11	3.02	1.16	0.16	1.06	0.55	0.42	0.52	1.20

*, ** Denote significant at ($P \leq 0.05$) and ($P \leq 0.01$) levels of probability, respectively.

DFF: days to first flower and DFB: days to first opening boll. SCY/P: seed cotton yield/plant, LY/P: lint yield/plant, BW: boll weight, B/P: number of bolls/plant, L%: lint percentage. FF: fiber fineness, FS: fiber strength and UHM: upper half mean. P_1, P_2, P_3, P_4, P_5, P_6 and P_7 were; Giza 85, Ashmouni, Giza 75, Giza 80, Giza 86, Giza 90 and Giza 95, respectively.

Table (8): Estimates of heterobeltiosis relative to better-parents (B.P.) of 21 F_1 crosses for earliness, yield and yield components and Fiber quality traits.

Crosses	DFF	DFB	SCY/P (g.)	LY/P (g.)	BW (g.)	B/P	L %	FF	FS	UHM
P_1xP_2	-2.97*	-0.42	34.24**	28.74**	9.83**	22.28**	-4.28**	7.77	-9.00**	1.93
P_1xP_3	-3.47**	-1.06**	10.11**	11.23**	-2.31	2.29	1.17	14.56**	1.03	-3.89*
P_1xP_4	-3.34**	-0.13	-5.99*	-4.31	7.27**	-13.8**	1.29**	16.50**	-7.17**	0.96
P_1xP_5	-3.89**	0.16	-7.12**	-2.35	1.58	-14.8**	5.34**	19.42**	-0.67	-5.43**
P_1xP_6	1.35	5.40**	-5.52*	-3.29	-1.73	-12.3**	2.59**	14.56**	2.41	-2.89
P_1xP_7	-3.23**	3.72**	16.28**	24.21**	2.49	5.89*	2.27**	26.21**	-10.14**	3.53*
P_2xP_3	-3.51**	-0.45	5.89*	3.29	7.82**	-14.1**	-2.80**	2.48	-5.33*	-0.11
P_2xP_4	-3.27*	0.31	-9.22**	-17.3**	10.03**	-17.5**	-8.62**	-4.69	-7.00**	-0.32
P_2xP_5	0.29	0.71	4.20	-0.12	7.34**	-10.1**	-3.86**	0.00	-5.33*	-2.96
P_2xP_6	-4.05**	4.57**	-3.37	-7.76**	1.08	-4.42	-3.89**	8.40	-6.33**	7.13**
P_2xP_7	-3.07*	-0.20	26.74**	21.02**	6.35**	7.36**	-4.99**	4.96	-5.67*	1.92
P_3xP_4	-0.78	-0.26	-6.56**	-12.0**	3.19	-13.6**	-6.01**	4.96	-3.41	3.36*
P_3xP_5	2.38*	2.04**	6.00*	5.58*	5.18*	-1.77	-0.19	0.83	0.34	-3.06
P_3xP_6	-3.05*	2.11**	6.87**	3.72	7.87**	-0.89	-2.86**	6.72	-5.50*	1.16
P_3xP_7	-6.49**	2.24**	2.63	0.81	6.61**	-6.46*	-1.75**	7.44	-10.14**	1.47
P_4xP_5	-4.21**	-0.78*	-12.7**	-11.5**	9.49**	-21.3**	1.44*	-0.78	-3.03	-5.43**
P_4xP_6	1.26	-1.15**	-25.8**	-24.0**	-4.53*	-27.3**	-0.91**	1.68	-2.05	-1.40
P_4xP_7	-2.87*	-0.94*	-3.51	1.58	12.13**	-15.4**	5.26**	8.26	-9.12**	1.51
P_5xP_6	4.60**	3.79**	-14.7**	-12.7**	10.90**	-23.1**	2.11**	7.56	-6.40**	-3.16*
P_5xP_7	-2.05	1.70**	-20.2**	-16.1**	14.35**	-30.1**	1.60**	3.31	-7.07**	-7.02**
P_6xP_7	-1.31	3.10**	-11.9**	-9.10**	7.34**	-17.9**	0.77	9.24*	0.34	0.11
LSD 0.05	1.69	0.95	2.61	1.00	0.14	0.92	0.47	0.37	0.45	1.04
0.01	2.26	1.28	3.49	1.34	0.18	1.23	0.63	0.49	0.61	1.39

*, ** Denote significant at ($P \leq 0.05$) and ($P \leq 0.01$) levels of probability, respectively.

DFF: days to first flower and DFB: days to first opening boll. SCY/P: seed cotton yield/plant, LY/P: lint yield/plant, BW: boll weight, B/P: number of bolls/plant, L%: lint percentage. FF: fiber fineness, FS: fiber strength and UHM: upper half mean. P_1, P_2, P_3, P_4, P_5, P_6 and P_7 were; Giza 85, Ashmouni, Giza 75, Giza 80, Giza 86, Giza 90 and Giza 95, respectively.

Table (9): Genetic variance components and heritability for earliness, yield and yield components and Fiber quality traits.

Parameters	DFF	DFB	SCY/P (g.)	LCY/P (g.)	BW (g.)	B/P	L %	FF	FS	UHM
σ^2 GCA	2.233	4.623	1.033	0.245	0.002	0.827	1.35	0.010	-0.008	0.305
σ^2SCA	3.548	5.892	37.97	5.59	0.024	3.940	0.74	0.011	0.109	0.649
$\sigma^2{}_e$	0.35	0.112	0.834	0.123	0.002	0.100	0.027	0.016	0.025	0.132
$H^2{}_{b.s}$%	95.81	99.27	97.96	98.01	92.59	98.24	99.21	65.12	78.90	90.53
$h^2{}_{n.s}$%	53.390	60.633	5.057	7.90	14.178	29.032	77.89	41.63	-12.63	43.87

DFF: days to first flower and DFB: days to first opening boll. SCY/P: seed cotton yield/plant, LY/P: lint yield/plant, BW: boll weight, B/P: number of bolls/plant, L%: lint percentage. FF: fiber fineness, FS: fiber strength and UHM: upper half mean.

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الملخص العربي

تحليل الهجن التبادلية لصفات التبكير والمحصول ومكوناته وجودة التيلة في القطن المصرى

مصطفى سعد فتح الله الأشمونى[1]، أبوبكرعبدالوهاب طنطاوى[1] ،عرفة بدرى عبدالكريم الفشيقاوى[2] وفتحى محمد إبراهيم[2]

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شتملت الدراسة على سبعة أصناف من القطن المصرى هى: جيزة 85، الأشمونى، جيزة 75، جيزة 80، جيزة 86، جيزة 90 وجيزة 95. وطبقاً لنظام التهجين الدائرى النصف كامل تم إنتاج 21 هجين جيل أول خلال موسم النمو 2013. وفى موسم النمو 2014، قيمت التراكيب الوراثية (الآباء السبعة، 21 هجين فردى) فى تجربة حقلية بتصميم القطاعات العشوائية الكاملة بثلاثة مكرارات بمحطة البحوث الزراعية بسدس حيث تم قياس الصفات الآتية: تاريخ تفتح أول زهرة، تاريخ تشقق أول لوزة على النبات، محصول القطن الزهر للنبات، محصول القطن الشعر للنبات، وزن اللوزة، عدد اللوز المتفتح للنبات، تصافى الحليج، نعومة التيلة، متانة التيلة وطول التيلة.

ويمكن تلخيص النتائج المتحصل عليها من هذه الدراسة فى النقاط التالية:

- كان متوسط مجموع المربعات الخاصة بالتراكيب الوراثية معنوى أو عالى المعنوية لكل الصفات المدروسة مما يبرهن على أن هذه التراكيب الوراثية متباينة.
- أظهر تحليل التوافق الهجينى تبايناً بين الأصناف فى القدرة العامة على التآلف حيث كان الصنف جيزة 85 لصفات محصول النبات من القطن الزهر والشعر للنبات، عدد اللوز المتفتح للنبات ونعومة التيلة بينما الصنف الأشمونى لصفات التبكير (تاريخ تفتح أول زهرة، تاريخ تشقق أول لوزة على النبات) أما الصنف جيزة 86 فقد كان أفضل الأصناف قدرة عامة على الإئتلاف لصفات لطول التيلة والمتانة فى حين كان الصنف جيزة 90 أفضل الآباء لمتوسط وزن اللوزة أما الصنف جيزة 95 فقد كان أفضل الآباء لتصافى الحليج.
- من نتائج قياس قوة الهجين وتأثيرات القدرة الخاصة للتآلف فقد أظهرت توافيق الهجن التالية تأثيرات مرغوبة مما يدل على إمكانية إستخدامها في برامج التربية لصفات التبكير [(جيزة 85xالاشمونى) ،(جيزة 85xجيزة 86)، (الأشمونىxجيزة 75)، (الأشمونىxجيزة 80)]، بينما أظهرت الهجن التالية أفضل نتائج لتحسين صفات المحصول ومكوناته وفى مقدمتها محصول القطن الزهر ومحصول القطن الشعر وعدد اللوز المتفتح الكلى للنبات وهذه الهجن هى: [(جيزة 85xالاشمونى)، (جيزة 85xجيزة 75)، (جيزة 85xجيزة 95)، (الأشمونى×جيزة 95)، (جيزة 75× جيزة 86)، (جيزة 75×جيزة 90)] كما أظهرالهجين (جيزة 85 x الاشمونى) قدرة خاصة لتحسين نعومة الألياف والهجن [(جيزة 85xجيزة 90)، (جيزة 90xجيزة 95)، (جيزة 85xجيزة 75)] للمتانة والهجن [(جيزة 85xجيزة 95)، (الأشمونىxجيزة 90)، (جيزة 85xالأشمونى)] لصفة طول التيلة.وبصفة عامة أوضح الهجينان [(جيزة 85xالاشمونى) و(الأشمونى×جيزة 95) أفضل إمكانية لإستخدامها فى تحسين معظم الصفات تحت الدراسة.
- تراوحت قيم معامل التوريث فى المعنى العام من 65.12% إلى 99.27% لصفتى نعومة التيلة وتاريخ تشقق أول لوزة على الترتيب وفى المعنى الخاص تراوحت القيم من 5.06% لصفة محصول القطن الزهر للنبات إلى 77.89% لصفة تصافى الحليج.

يمكن التوصية باستخدام توافيق الهجن و الأصناف ذات القدرة العالية على التآلف والمبكرة فى النضج والمميزة في صفاتها التكنولوجية وذات الإنتاجية العالية في إستنباط و تحسين أصناف الأقطان المصرية بإتباع برامج التربية لهذه الأغراض.