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HETEROSIS AND COMBINING ABILITY OF SOME EGYPTIAN COTTON GENOTYPES

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ABSTRACT

Half diallel cross among 6 Egyptian cotton genotypes (*Gossypium barbadense* L.) was done in 2016 season which produced 15 F_1 crosses seeds. Parents and their crosses were evaluated in field trial during 2017 season using randomized complete block design at Sids Research Station of Beni-Suef Governorate (ARC) to explore general and specific combining abilities effects of parents and crosses and heterotic pattern of the cross combinations. Results showed that genotypes, parents, crosses and parent *versus* crosses exhibited significant or highly significant mean squares for all studied traits. Mean squares due to GCA and SCA were significant for all studied traits. Parent Karashanky recorded desirable mean performance for days to first boll opening, number of bolls/plant, seed cotton yield/plant and lint yield/plant. The F_1 cross (Giza 90 x Giza 94) performed better than all cross combinations for days to first boll opening (119.63 day), boll weight (3.17g), seed index (9.57g) and fiber strength (10.33PI). The maximum number of cross combinations that recorded positive highly significant useful heterosis values relative to mid and better parents were observed in boll weight and lint yield followed by seed cotton yield, lint index, number of bolls per plant and seed index. The (Giza 90 x Giza 94), (Giza 95x C.B58 ×G 90) and (Karashanky x [(Giza83 x Giza80) x Giza89] x Aust.)) cross combinations exhibited highly significant positive heterosis over both mid and better parents and also showed significant SCA effects for yield and most of its component. The parents (Giza 90) and ([(Giza83 X Giza80) X Giza89] X Aust.)) were the best combiners for earliness traits, whereas (Giza 94) was the best combiner for fiber length, fiber strength and uniformity ratio. Variances due to SCA were higher than those of GCA for all studied traits. The ratios of GCA /SCA were less than unity for all studied traits, while σ^2D values were higher than σ^2A for all studied traits except seed index. These results may indicate the important role of non-additive gene action in inheritance of these traits.

Keywords: *Gossypium barbadense*, GCA, SCA, Heterosis, Half diallel, Gene Action.

INTRODUCTION

Selection of suitable parental combination is important to allocate genetic resources for the most promising crosses to increase the efficiency of breeding programs. Diallel analysis has been widely used by plant breeders to evaluate parents and crosses. Moreover, using the genetic components of any breeding materials give useful information to cotton breeders to choose the proper breeding procedure for developing improved genotypes. Ibrahim (2016) revealed that, the variety Giza 90 was the earliest genotype for first fruiting node, whereas Giza 95 had the lowest value for uniformity ratio Kaleri *et al* (2015) noticed highly significant differences among genotypes for seed cotton yield per plant, number of bolls per plant and boll weigh. Many investigators studied heterosis, general and specific combining abilities among genetic materials. Abd El-Bary *et al*. (2008), Darweesh (2010), Khalifa (2010), Amein *et al*. 2013, El-Kadi *et al*. (2013) and Hussein (2017) found that the amounts of heterosis versus mid-parents were significant for most studied traits. While, heterosis versus better-parent was not of economical importance. Imran *et al*. (2011) noticed that the magnitudes of specific combining ability variance was greater than general combining ability variance for number of days to first flower. Mohamed (2015) investigated the nature of gene action for earliness traits, he showed that additive gene action had major role in inheritance of earliness traits except for first fruiting node. El-Said (2016) revealed that, the mean squares of SCA were larger than those of GCA for all studied traits, therefore the σ^2D estimates were higher than those of σ^2A ones for these traits. He indicated that, the parent Giza 90 was seemed to be the good general combiners for first fruiting node. Zhang *et al*. (2008) studied the heterosis for fibre quality traits, they found that the range of heterosis was from -3.90 to 27.29% for fiber length, -6.37 to 35.93% for fiber strength, and -0.42 to 3.53% for fiber uniformity. Jenkins *et al.* (2012) showed that additive variances were larger than dominance variances for lint percentage, boll weight and lint yield. The present study planned to evaluate the potentiality of six cotton genotypes for improving earliness, yield and its components in addition to fiber quality traits, using half diallel crossing, to detect genetic variance and its components, heterosis and combining abilities for improvement Egyptian cotton cultivars.

MATERIALS AND METHODS

The field work of the present study was carried out at Sids

Research Station, Beni-Suef Governorate, Agricultural Research Center (ARC), Egypt, during 2016 and 2017 seasons. Six cotton genotypes belong to *Gossypium barbadense* L., as long staple; Giza 90 (P_1), Giza 94 (P_2), Giza 95 (P_3), Karashanky (P_4), C.B.58 X Giza 90 (P_5) and [(Giza83 X Giza80) X Giza89] X Australian (P_6) were used. All possible crosses without reciprocals were made among these six parents in 2016 which produced 15 combinations F_1's seeds.

The twenty-one entries included 6 parental genotypes and 15 F_1's were sown on the 5th of April 2017, in a Randomized Complete Blocks Design with three replications. Each experimental unit comprised two ridges, 4.0 m long and 0.6 m in wide (4.8 m^2). Hills were thinned at seedlings stage to keep a constant stand of one plant/hill. Recommended cultural practices of cotton production were adapted.

Data were recorded on five individual plants basis as follows: 1. First fruiting node, 2. Days to first flower, 3. Days to first boll opening, 4. Seed cotton yield per plant (g), 5. Lint yield /plant (g), 6. Boll weight (g), 7. Number of bolls per plant, 8. Lint percentage (%), 9. Seed index (g), 10. Lint index(g). while the following traits recorded on the basis of whole plot: 11. Micronaire reading (Mic.), 12. Fiber length (mm.), 13. Fiber strength (pi) and 14. Uniformity ratio (%). All fiber properties were measured in the laboratories of the Cotton Technology Research Division, Cotton Research Institute according to A.S.T.M. (1998).

The Statistical analysis of variance for a randomized complete blocks design was done as outlined by Steel and Torrie (1980). The GCA effects of parents and SCA effects of F_1 crosses were calculated according to the method described by Griffing (1956) based on method 2, model 1 (fixed model) as outlined by Singh and Chaudhary (1985).

The linear model assumed for the combining ability analysis is:

$Yij = \mu + gi + gj + Sij + eijk$

Where:

Yij: is the value of a cross between parents (i) and (j)

μ: is population mean.

gi, gj: are the GCA effects for the ith and jth parents.

Sij: is the SCA effect for the cross between parents i and j.

eijk: is the error mean effect.

Average heterosis for each F_1 cross was estimated as the deviation of F_1 mean from the mid-parents, and from the better parent and expressed in percentages. Significance of heterosis was determined using the least significant difference value (LSD) at 0.05 and 0.01 levels of probability according the following equation suggested by Singh and Chaudhary (1985).

L.S.D. for mid-parent heterosis

$= t_{\alpha} \times \sqrt{((3 \times \sigma^2 e) / (2 \times r))}$

L.S.D. for better-parent heterosis

$= t_{\alpha} \times \sqrt{((2 \times \sigma^2 e) / r)}$

Where;

$t_{\alpha,}$ σ^2 e and r are the values of tabulated t , error variance and number of replication, respectively.

RESULITS AND DISCUSSION

Significance of mean squares

The Significance of mean squares of analysis of variance for all studied traits are presented in Table (1). The evaluated cotton genotypes included parents and F_1 crosses varied highly significantly for all studied traits, however parents *versus* crosses was significant for most studied traits. The significance of mean squares due to GCA and SCA for all studied traits revealed the importance of both additive and non-additive gene action in the inheritance of these traits. These results ascertain the fact of analysis assumption for distinct genotypic back ground of parents involved. Consequently, various suggestions to be done are valid and should be conducted to fulfill the objective of the present study. These results are in the same line with those reported by Subhan *et al*. (2003) Amein *et al.* (2013) and Attia (2014).

Mean performance of genotypes

The mean performances of the six parents and their 15 F_1 crosses for all studied traits are presented in Table (2). The results indicated that Giza 90 (P_1) was the earliest in flowering with 67.97day, and was the best one for fiber fineness (3.3 Mic.). The parental variety Karashenky (P_4) was the best desirable performed genotype for days to first flower (119.4), number of bolls/plant (70.34), seed cotton yield/plant (181.11g.) and lint yield/plant (73.38g.). The parental variety (P_6) exhibited the best desirable mean performance for first fruiting node (5.87), lint percentage (43.23%) and fiber strength (10.3 PI). The parent Giza 94 (P_2) possessed the heaviest boll (2.91g) and seed (9.26 g) with longest fiber (32.03 mm) and highest uniformity (83.47%). Regarding to F_1 crosses, the results showed that, best F_1 cross was (P_1 x P_2) for days to first boll opening (119.63 day), boll weight (3.17g), seed index (9.57g) and fiber strength (10.33PI), the crosses (P_2 x P_3) and (P_2 x P_4) were the most promising for fiber fineness (3.40 mic) and fiber length (32.53mm), respectively. The cross (P_1 x P_3) was the most promising crosses for uniformity ratio (83.80%). With respect to the crosses means there was no specific cross which was superior or inferior for all studied traits. These results indicate that the crosses (P_1 x P_2) and (P_5 x P_6) were the earliest cross combinations for the days to first boll opening (119.63) and first fruiting node (5.8), respectively. Concerning yield components traits, the results revealed that the cross (P_1 x P_2) had the highest mean for boll weight (3.17g) and seed index (9.57g), the cross (P_4x P_5) possessed the highest mean for number of bolls per plant (79.96) and seed cotton yield per plant (206.21 g) and the cross (P_4 x P_6) gave the highest lint yield per plant (80.97g). The crosses (P_2 x P_6) and (P_3 x P_5) recorded the highest lint index and lint percentage with the mean values of 6.74g and 42.13%, respectively. Regarding to fiber properties, the results showed that the cross (P_1 x P_2) showed the strongest fiber (10.33PI). While, the cross (P_1 x P_3) was the highest one for uniformity ratio (83.80%), the cross (P_2 x P_3) had the finest fiber (3.4Mic) and the cross (P_2 x P_4) appeared to be the best cross in fiber length with the mean value of 32.53 mm.

HETEROSIS:

Percentages of mid and better parent heterosis are presented in Tables (3) and (4). The data showed that 11, 9 and 5 out of 15 F_1 hybrids recorded highly significant and negative heterosis relative to the mid parent for first fruiting node, days to first flower and days to first boll opening traits, respectively. However, 9, 10, 12, 12, 5, 9 and 10 out of 15 F_1 crosses showed positive and highly significant heterosis relative to the mid parent for number of bolls per plant, boll weight, seed cotton yield per plant, lint yield /plant, Lint percentage, seed index and lint index, respectively. Furthermore, 7, 9 and 5 crosses recorded highly significant positive mid parent heterosis for fiber strength, fiber length and uniformity ratio %, respectively, while two crosses exhibited highly significant and negative heterosis for micronaire value. On the other hand, the highest desirable heterotic values over better parents for FFN, DFF and DFB were obtained in crosses (P_2x P_4), (P_2x P_5) and (P_3x P_6), respectively. The crosses (P_1 x P_5), (P_3x P_4), (P_3 x P_6), (P_3 x P_5) and (P_2 x P_6) recorded the highest heterotic values over their better parents for No. B/P, BW, LY/P, L % and LI, respectively. The cross (P_4 x P_5) showed the best desirable heterotic values over the better parent for fiber length and uniformity ratio. While, the cross (P_2 x P_3) recorded the best desirable heterotic value for fiber fineness.

The cross (P_1 x P_4) obtained the highest better parent heterosis for fiber strength. Negative highly significant useful heterosis values relative to mid and better-parents were recorded for crosses (P_2x P_4) and (P_2x P_3) for first fruiting node and Micronaire value, respectively. However, positive highly significant useful heterosis values relative to mid and better parents were recorded for crosses (P_3 xP_4), (P_3x P_6) and (P_2 xP_6) for boll weight, lint yield /plant and lint index, respectively. The cross (P_4 xP_5) possessed the highest desirable mid and better parents heterosis for fiber length and uniformity ratio %, while the cross (P_1 xP_4) took the same trend for fiber strength. Therefore, it could be recommended to use these desirable materials in breeding program for improvement of these traits. These findings are in agreement with those of El-Kadi *et al*. (2013), El-Seoudy *et al.* (2014), Khalifa *et al.* (2016) and Hussein (2017)

Combining ability and gene action

The estimates of general combining ability effects (gi) of parents are presented in Table (5). The data indicated that the best parent (P_1) was displayed negative and highly significant GCA effects for days to first flower (DFF) and days to first boll opening (DFB), and the parent (P_6) seemed to be the good general combiner for first fruiting node. These results are in harmony with those reported by El-Kadi *et al*. (2013) and Khalifa *et al.* (2016). These results suggest that (P_1 and P_6) parents may be useful in breeding program for improving earliness traits. On the other hand, the parent (P_4) was considered to be excellent general combiner for

No.B/P, SCY/P and LY/P. Moreover, the parent (P_2) was found to be the best general combiner for BW and SI. The parents (P_3) and (P_6) were good general combiner for LI and L%, respectively. These results are in harmony with those reported by Ibrahim (2016). For fiber properties, Giza 90 (P_1) was a good combiner for fiber fineness. Moreover, Giza 94 (P_2) was the best general combiner for fiber length, fiber strength and uniformity ratio. So, it could be considered these parents (Giza 90 and Giza 94) as a material for improvement these traits.

The specific combining ability effects (Sij) are shown in Table (6). The data showed that 3, 9 and 5 out of 15 F_1 crosses recorded negative and significant or highly significant SCA effects for first fruiting node, days to first flower and days to first boll opening, respectively. However, 7, 3, 9, 7, 4, 3 and 4 out of 15 F_1 crosses showed positive and significant or highly significant SCA effects for number of bolls per plant, boll weight, seed cotton yield per plant, lint yield /plant, lint percentage, seed index and lint index, respectively. Concerning fiber quality properties 3, 4 and 2 out of 15 F_1 crosses showed desirable positive significant or highly significant SCA effects estimates for fiber strength, fiber length and uniformity ratio%, respectively. While, the crosses (P_2x P_3) and (P_2x P_6) had desirable negative and highly significant SCA effects for fiber fineness. Generally, the results showed that, the best of crosses were (P_3x P_6) and (P_5x P_6) for all studied earliness traits, while the best crosses were (P_1x P_2), (P_3x P_5) and (P_4x P_6) for most studied yield and its components traits. Similar findings were obtained by Imran *et al*. (2011), Baker *et al*. (2015), El-Said (2016), Khalifa *et al* (2016) and Ibrahim (2016).

Estimates of variance for general (σ^2GCA) and specific (σ^2SCA) combining abilities for all studied are presented in Table (7). The ratio between the two variances (σ^2GCA /σ^2SCA) in addition to dominance and additive variances were estimated to detect the type of gene action for inheritance of the studied traits. Results cleared that σ^2SCA values were higher than those recorded for σ^2GCA for all studied traits. Also, σ^2GCA /σ^2SCA values were less than unity for all studied traits, while σ^2D values were higher than σ^2A for all studied traits except seed index. These results indicating the important role of non-additive gene action in inheritance of these traits. Therefore, selection in advanced populations may be more appropriate for characters under non-additive genetic effects, but early populations selection may be more appropriate for characters under additive genetic effects, because effective selection in early populations of segregating material can be achieved when additive genetic effects are substantial. These findings are in accordance with those reported by Subhan *et al* (2003), Ahuja and Dhayal (2007), Ali *et al*. (2008), Saleh and Ali (2012), Sorour *et al.* (2013), Amein *et al*. (2013), Attia (2014) and Senthil *et al*. (2014)

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Table (1): Mean squares of analysis of variance for genotypes and combining ability for earliness, yield and its components as well as fiber quality traits.

S. O. V	d.f	Earliness traits			Yield and its components traits							Fiber quality traits			
		FFN	DFF	DFB	No.B/P	BW (gm)	SCY/P (gm)	LY/P (gm)	L%	SI (gm)	LI (gm)	FF (Mic)	FS (PI)	FL (mm)	U.R%
Replication	2	0.05	0.02	0.02	216.81**	0.45**	0.51	0.92	0.49	0.17	0.02	0.51**	0.17*	2.63*	1.16
Genotypes	20	0.18**	5.92**	7.57**	178.21**	0.09**	941.60**	128.00**	16.51**	1.02**	0.72**	0.12**	0.18**	3.33**	1.43**
Parents (P.)	5	0.19**	11.44**	11.81**	153.02**	0.05*	690.85**	110.65**	12.07**	1.37**	0.15**	0.05**	0.38**	2.77**	1.44*
Crosses(C.)	14	0.19**	3.91**	6.55**	164.65**	0.11**	666.86**	81.86**	19.24**	0.90**	0.94**	0.09**	0.11*	2.82**	1.21*
P. *vs*. C.	1	0.07	6.43**	0.63	494.02**	0.09*	6041.72**	860.76**	0.45	0.85**	0.32	0.83**	0.06	13.23**	4.39**
GCA	5	0.13**	4.55**	4.11**	106.99**	0.06**	473.77**	48.19**	10.84**	0.84**	0.35**	0.02**	0.05*	2.28**	0.84**
SCA	15	0.04**	1.11**	1.99**	43.54**	0.02**	260.57**	40.82**	3.72**	0.17**	0.20**	0.04*	0.06**	0.72**	0.35*
Error	40	0.01	0.03	0.07	3.39	0.01	2.19	1.30	0.47	0.03	0.04	0.01	0.02	0.23	0.14

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

Table (2): Mean performance of six parents and their 15 F_1's crosses for earliness, yield and its components as well as fiber quality traits.

Genotypes	Earliness traits			Yield and its component traits							Fiber quality traits			
	FFN	DFF	DFB	No.B/P	BW (gm)	SCY/P (gm)	LY/P (gm)	L%	SI (gm)	LI (gm)	FF (Mic)	FS (PI)	FL (mm)	U.R%
P_1	6.10	67.97	120.43	55.33	2.85	157.33	60.50	38.46	8.63	5.39	3.30	9.33	30.87	82.73
P_2	6.23	72.08	124.37	51.94	2.91	150.71	56.28	37.35	9.26	5.52	3.70	10.27	32.03	83.47
P_3	6.53	73.23	124.13	60.21	2.70	162.56	64.76	39.84	9.12	6.04	3.47	10.13	30.17	82.17
P_4	6.50	69.38	119.40	70.34	2.59	181.11	73.38	40.51	8.20	5.58	3.53	9.90	29.63	81.90
P_5	6.23	70.57	121.47	59.40	2.65	157.37	63.03	40.05	8.22	5.49	3.47	9.97	29.80	81.53
P_6	5.87	69.30	122.17	50.77	2.66	134.64	58.22	43.23	7.44	5.67	3.53	10.30	29.53	82.00
$P_1 \times P_2$	6.07	69.24	119.63	56.51	3.17	178.56	68.90	38.59	9.57	6.01	3.77	10.33	31.83	83.43
$P_1 \times P_3$	6.50	69.28	121.40	57.62	2.90	166.35	67.37	40.54	8.35	5.71	3.63	10.03	31.83	83.80
$P_1 \times P_4$	6.63	67.95	120.13	60.21	2.88	171.67	66.83	38.93	8.68	5.53	3.73	10.27	31.83	82.33
$P_1 \times P_5$	6.37	70.79	120.87	67.58	2.63	176.12	71.67	40.70	8.42	5.78	3.80	10.23	30.77	83.17
$P_1 \times P_6$	6.37	69.31	122.17	67.36	2.49	167.41	69.06	41.26	7.58	5.33	3.60	10.07	30.63	81.87
$P_2 \times P_3$	6.17	72.70	122.80	63.22	2.77	174.52	72.20	41.37	8.92	6.30	3.40	10.30	31.57	83.27
$P_2 \times P_4$	5.90	69.14	123.27	66.03	2.98	196.35	68.40	34.84	9.47	5.07	4.00	9.93	32.53	83.60
$P_2 \times P_5$	6.00	69.35	120.43	56.55	3.05	172.50	67.20	38.96	9.35	5.97	3.80	10.00	32.47	83.50
$P_2 \times P_6$	5.97	70.54	124.53	52.06	2.93	152.00	63.60	41.85	9.36	6.74	3.47	10.27	32.47	82.60
$P_3 \times P_4$	6.43	68.97	120.70	60.60	2.97	179.46	71.57	39.88	8.53	5.65	3.93	9.73	30.93	83.17
$P_3 \times P_5$	6.27	69.96	123.67	68.06	2.82	190.33	80.18	42.13	8.56	6.23	3.93	9.87	30.73	81.93
$P_3 \times P_6$	5.87	70.23	120.70	68.30	2.75	187.82	78.97	42.05	8.51	6.18	3.77	9.77	29.63	82.30
$P_4 \times P_5$	6.17	70.57	121.70	79.96	2.59	206.21	69.02	33.47	8.72	4.40	3.73	10.07	32.13	83.10
$P_4 \times P_6$	6.07	69.13	123.53	75.38	2.68	201.17	80.97	40.25	8.92	6.01	3.97	10.07	31.47	83.07
$P_5 \times P_6$	5.80	68.53	121.07	63.53	2.59	164.02	67.23	40.99	8.08	5.72	3.77	9.87	29.47	82.13
LSD 5%	0.238	0.518	0.743	5.260	0.221	4.226	3.258	1.967	0.481	0.557	0.220	0.363	1.380	1.077
LSD 1%	0.318	0.693	0.994	7.037	0.296	5.654	4.359	2.632	0.644	0.745	0.295	0.486	1.847	1.441

P_1, P_2, P_3, P_4, P_5 and P_6 are Giza 90, Giza 94, Giza 95, Karashanky, G90× C. B58 and [(G83×G80) ×G89] × Australian, respectively.

Table (3): Estimates of mid-parents heterosis (M. P %) of each cross for earliness, yield and its components as well as fiber quality traits.

Hybrids	Earliness traits			Yield and its component traits							Fiber quality traits			
	FFN	DFF	DFB	No.B/P	BW (gm)	SCY/P (gm)	LY/P (gm)	L%	SI (gm)	LI (gm)	FF (mic)	FS (pi)	FL (mm)	U.R%
P_1 x P_2	-1.62**	-1.12**	-2.26**	5.35*	10.15**	15.94**	17.99**	1.81*	6.94**	10.19**	7.62**	5.44**	1.22*	0.40
P_1 x P_3	2.90**	-1.87**	-0.72*	-0.25	4.32**	4.00*	7.56**	3.55**	-5.89**	-0.13	7.39**	3.08**	4.31**	1.64**
P_1 x P_4	5.29**	-1.04**	0.18	-4.17	5.82**	1.45	-0.17	-1.41	3.21**	0.84**	9.27**	6.76**	5.23**	0.02
P_1 x P_5	3.24**	2.20**	-0.07	17.81**	-4.35**	11.92**	16.05**	3.69**	-0.05	6.19**	12.32**	6.04**	1.43*	1.26**
P_1 x P_6	6.41**	0.99**	0.71*	26.97**	-9.66**	14.67**	16.35**	1.00	-5.66**	-3.75**	5.37**	2.55**	1.43*	-0.61
P_2 x P_3	-3.39**	0.06	-1.17**	12.74**	-1.26**	11.42**	19.29**	7.19**	-2.97**	8.97**	-5.12**	0.98**	1.50*	0.54
P_2 x P_4	-7.33**	-2.25**	1.13**	7.99**	8.32**	18.35**	5.50**	-10.51**	8.47**	-8.77**	10.60**	-1.49**	5.51**	1.11*
P_2 x P_5	-3.74**	-2.77**	-2.02**	1.58	9.70**	11.98**	12.64**	0.68	7.04**	8.53**	6.05**	-1.15**	5.01**	1.21*
P_2 x P_6	-1.38**	-0.21	1.03**	1.36	5.23**	6.53**	11.09**	3.87**	12.08**	20.34**	-4.15**	-0.16	5.47**	-0.16
P_3 x P_4	-1.28**	-3.28**	-0.88**	-7.16**	12.32**	4.44*	3.62*	-0.75	-1.54**	-2.68**	12.38**	-2.83**	3.46**	1.38**
P_3 x P_5	-1.83**	-2.70**	0.71*	13.81**	5.07**	18.98**	25.49**	5.46**	-1.22**	8.09**	13.46**	-1.82**	2.50**	0.10
P_3 x P_6	-5.38**	-1.45**	-1.99**	23.08**	2.69**	26.39**	28.42**	1.22	2.82**	5.45**	7.62**	-4.40**	-0.73	0.26
P_4 x P_5	-3.14**	0.85**	1.05**	23.26**	-1.32**	21.84**	1.19	-16.91**	6.26**	-20.57**	6.67**	1.34**	8.13**	1.69**
P_4 x P_6	-1.89**	-0.29*	2.28**	24.48**	2.29**	27.42**	23.05**	-3.88**	14.10**	6.76**	12.26**	-0.33*	6.37**	1.36**
P_5 x P_6	-4.13**	-2.00**	-0.62	15.32**	-2.63**	12.33**	10.90**	-1.56	3.24**	2.39**	7.62**	-2.63**	-0.67	0.45
LSD 5%	0.21	0.45	0.64	4.56	0.19	3.66	2.82	1.70	0.42	0.48	0.19	0.31	1.20	0.93
LSD 1%	0.28	0.25	0.86	6.09	0.26	4.90	3.78	2.28	0.56	0.64	0.10	0.42	1.60	1.25

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

Table (4): Estimates of heterosis over better-parents (B. P%) of each cross for earliness, yield and its components as well as fiber quality traits.

Hybrids	Earliness traits			Yield and its component traits							Fiber quality traits			
	FFN	DFF	DFB	No.B/P	BW (gm)	SCY/P (gm)	LY/P (gm)	L%	SI (gm)	LI (gm)	FF (mic)	FS (pi)	FL (mm)	U.R%
$P_1 x P_2$	-0.55**	1.88**	-0.66	2.13	9.05**	13.50**	13.88**	0.34	3.29**	8.92**	1.80**	0.65**	-0.62	-0.04
$P_1 x P_3$	6.56**	1.93**	0.80*	-4.29	1.66**	2.33	4.02*	1.75	-8.42**	-5.45**	4.81**	-0.99**	3.13**	1.29*
$P_1 x P_4$	8.74**	-0.02	0.61	-14.40**	0.96**	-5.21*	-8.93**	-3.91**	0.63	-0.86**	5.66**	3.70**	3.13**	-0.48
$P_1 x P_5$	4.37**	4.15**	0.36	22.14**	-7.62**	11.91**	13.72**	1.63	-2.45**	5.29**	9.62**	2.68**	-0.32	0.52
$P_1 x P_6$	8.52**	1.98**	1.44**	21.74**	-12.70**	6.40	14.16**	-4.58**	-12.18**	-6.12**	1.89**	-2.27**	-0.76	-1.05
$P_2 x P_3$	-1.07**	0.86**	-1.07**	5.00	-4.71**	7.36**	11.49**	3.83**	-3.71**	4.31**	-8.11**	0.32	-1.46*	-0.24
$P_2 x P_4$	-5.35**	-0.34	3.24**	-6.13*	2.36**	8.41**	-6.79**	-14.01**	2.23**	-9.26**	8.11**	-3.25**	1.56*	0.16
$P_2 x P_5$	-3.74**	-1.72**	-0.85*	-4.80	4.93**	9.61**	6.61**	-2.72**	0.99**	8.20**	2.70**	-2.60**	1.35	0.04
$P_2 x P_6$	1.70**	1.79**	1.94**	0.22	0.71**	0.85	9.24**	-3.20**	1.04**	18.72**	-6.31**	-0.32	1.35	-1.04
$P_3 x P_4$	-1.03**	-0.59*	1.09**	-13.84**	9.90**	-0.91	-2.47	-1.57	-6.52**	-6.36**	11.32**	-3.95**	2.54**	1.22*
$P_3 x P_5$	0.53**	-0.86**	1.81**	13.05**	4.11**	17.09**	9.27**	5.19**	-6.11**	3.16**	13.46**	-2.63**	1.88**	-0.28
$P_3 x P_6$	0.00	1.35**	-1.20**	13.44**	1.80**	15.54**	21.94**	-2.75**	-6.67**	2.28**	6.60**	-5.18**	-1.77*	0.16
$P_4 x P_5$	-1.07**	1.72**	1.93**	13.68**	-2.57**	13.86**	-5.94**	-17.39**	6.14**	-21.25**	5.66**	1.68**	7.83**	1.47**
$P_4 x P_6$	3.41**	-0.24	3.46**	7.17**	0.95**	11.08**	10.35**	-6.90**	8.82**	5.89**	12.26**	-2.27**	6.19**	1.30*
$P_5 x P_6$	-1.14**	-1.11**	-0.33	6.95*	-2.68**	4.22	6.67**	-5.19**	-1.65**	0.72*	6.60**	-4.21**	-1.12	0.16
LSD 5%	0.24	0.52	0.74	5.26	0.22	4.23	3.26	1.97	0.48	0.56	0.22	0.36	1.38	1.08
LSD 1%	0.32	0.69	0.99	7.04	0.30	5.65	4.36	2.63	0.64	0.74	0.29	0.49	1.85	1.44

*, ** significant and highly significant at 0.05 and 0.01 levels of probability, respectively.

Table (5): Estimates of general combining ability effects (gi) of six parents for earliness, yield and its components as well as fiber quality traits.

Geno.	Earliness traits			Yield and its component traits							Fiber quality traits			
	FFN	DFF	DFB	No.B/P	BW (gm)	SCY/P (gm)	LY/P (gm)	L%	SI (gm)	LI (gm)	FF (Mic)	FS (PI)	FL (mm)	U.R%
P_1	0.10**	-0.86**	-0.97**	-2.13**	0.03	-4.33**	-1.87**	-0.19	-0.10	-0.12	-0.08**	-0.08*	0.15	0.13
P_2	-0.10**	0.72**	0.82**	-4.84**	0.15**	-4.26**	-3.36**	-1.01**	0.57**	0.13*	0.01	0.14**	0.94**	0.54**
P_3	0.12**	1.02**	0.58**	0.15	0.01	1.77**	2.50**	0.90**	0.06	0.25**	-0.02	-0.03	-0.30	-0.03
P_4	0.11**	-0.61**	-0.59**	5.73**	-0.03	13.46**	2.97**	-1.25**	0.01	-0.29**	0.08**	-0.05	0.09	0.01
P_5	-0.03	0.12*	-0.27**	2.19**	-0.07**	1.81**	0.20	-0.26	-0.13*	-0.13*	0.02	-0.03	-0.28	-0.27*
P_6	-0.19**	-0.38**	0.43**	-1.10	-0.10**	-8.46**	-0.44	1.81**	-0.41**	0.15*	-0.02	0.05	-0.59**	-0.38**
SE (gi)	0.03	0.059	0.08	0.59	0.02	0.48	0.37	0.22	0.05	0.06	0.02	0.04	0.16	0.12

*, ** significant and highly significant at 0.05 and 0.01 levels of probability, respectively.

Table (6): Estimates of specific combining ability effects (Sij) of each cross for earliness, yield and its components as well as fiber quality traits.

Hybrids	Earliness traits			Yield and its component traits							Fiber quality traits			
	FFN	DFF	DFB	No.B/P	BW (gm)	SCY/P (gm)	LY/P (gm)	L%	SI (gm)	LI (gm)	FF (Mic)	FS (PI)	FL (mm)	U.R%
$P_1 \times P_2$	-0.13	-0.53**	-2.05**	1.05	0.20**	14.38**	5.59**	0.01	0.43**	0.28**	0.16*	0.24*	-0.31	0.05
$P_1 \times P_3$	0.09	-0.80**	-0.05	-2.83	0.07	-3.87**	-1.81	0.05	-0.27	-0.16	0.05	0.11	0.92*	0.98**
$P_1 \times P_4$	0.24**	-0.49**	-0.14	-5.82**	0.09	-10.23**	-2.81**	0.59	0.11	0.21	0.05	0.36**	0.53	-0.52
$P_1 \times P_5$	0.11	1.62**	0.28	5.10**	-0.12	5.86**	4.81**	1.37*	-0.01	0.30	0.17*	0.31**	-0.16	0.58
$P_1 \times P_6$	0.27**	0.64**	0.87**	8.17**	-0.24**	7.43**	2.83**	-0.14	-0.57**	-0.43*	0.01	0.06	0.01	-0.60
$P_2 \times P_3$	-0.05	1.04**	-0.44	5.48**	-0.18*	4.23*	4.52**	1.71**	-0.37*	0.19	-0.27**	0.16	-0.13	0.04
$P_2 \times P_4$	-0.30**	-0.88**	1.20**	2.71	0.07	14.37**	0.25	-2.67**	0.23	-0.51**	0.23**	-0.20	0.44	0.34
$P_2 \times P_5$	-0.06	-1.40**	-1.95**	-3.22	0.18*	2.17	1.82	0.46	0.26	0.25	0.09	-0.14	0.75	0.51
$P_2 \times P_6$	0.06	0.29	1.44**	-4.42**	0.09	-8.06**	-1.14	1.29*	0.54**	0.73**	-0.21**	0.04	1.06*	-0.27
$P_3 \times P_4$	0.01	-1.36**	-1.13**	-7.71**	0.20**	-8.55**	-2.44*	0.45	-0.21	-0.04	0.19**	-0.22	0.08	0.47
$P_3 \times P_5$	-0.01	-1.10**	1.52**	3.30*	0.08	13.97**	8.94**	1.71**	-0.03	0.37*	0.25**	-0.10	0.26	-0.49
$P_3 \times P_6$	-0.25**	-0.33*	-2.16**	6.82**	0.05	21.73**	8.36**	-0.44	0.20	0.04	0.12	-0.28*	-0.54	-0.01
$P_4 \times P_5$	-0.10	1.15**	0.73**	9.61**	-0.10	18.16**	-2.69*	-4.79**	0.18	-0.92**	-0.06	0.11	1.26**	0.64
$P_4 \times P_6$	-0.04	0.21	1.85**	8.32**	0.02	23.41**	9.90**	-0.08	0.66**	0.41*	0.22**	0.03	0.90*	0.73*
$P_5 \times P_6$	-0.16*	-1.12**	-0.93**	0.02	-0.04	-2.11	-1.07	-0.33	-0.04	-0.04	0.08	-0.18	-0.72	0.06
SE (Sij)	0.07	0.16	0.23	1.63	0.07	1.31	1.01	0.61	0.15	0.17	0.07	0.11	0.43	0.33

*, ** significant and highly significant at 0.05 and 0.01 levels of probability, respectively.

Table (7): Combining ability variance and genetic components for earliness, yield and its components as well as fiber quality traits.

Combining ability and gene action	Earliness traits				Yield and its component traits						Fiber quality traits			
	FFN	DFF	DFB	No.B/P	BW (gm)	SCY/P (gm)	LY/P (gm)	L%	SI (gm)	LI (gm)	FF (mic)	FS (pi)	FL (mm)	U.R%
σ^2 GCA	0.01	0.43	0.27	7.93	0.005	26.65	0.92	0.89	0.08	0.02	-0.003	-0.001	0.20	0.06
σ^2 SCA	0.03	1.08	1.93	40.15	0.02	258.38	39.52	3.25	0.14	0.16	0.04	0.05	0.49	0.21
σ^2 GCA / σ^2 SCA	0.42	0.4	0.14	0.20	0.3	0.10	0.02	0.27	0.59	0.11	-0.07	-0.02	0.40	0.28
σ^2 A	0.02	0.86	0.53	15.86	0.01	53.30	1.84	1.78	0.17	0.04	-0.01	-0.002	0.39	0.12
σ^2 D	0.03	1.08	1.93	40.15	0.02	258.38	39.52	3.25	0.14	0.16	0.04	0.05	0.49	0.21

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قوة الهجين والقدرة علي الائتلاف لبعض التراكيب الوراثية في القطن المصري

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يهدف هذا البحث الي دراسه قوة الهجين والقدرة العامة والخاصة علي الائتلاف لصفات التبكير والمحصول ومكوناته وصفات جودة التيلة في القطن المصري. تم اجراء التهجين بين ستة تراكيب وراثية وهي جيزة 90(P_1) ، جيزة 94 (P_2) ، جيزة 95 (P_3) ، كاراشنكي (P_4)، (جيزة 90 x 58 C.B) (P_5)، {(جيزة 83 x جيزة 80) x جيزة 89} x استرالي (P_6) . حيث تم التهجين الدائري بكل الطرق الممكنة في اتجاه واحد بين هذه الآباء السته للحصول علي خمسة عشر هجيناً من الجيل الاول وذلك خلال موسم 2016، ثم أقيمت تجربة حقلية لتقييم تلك التراكيب الوراثية بمحطة البحوث الزراعية بسدس خلال موسم 2017، وكان التصميم التجريبي المستخدم هو قطاعات كاملة العشوائية في ثلاثة مكررات.

وكانت أهم النتائج المتحصل عليها هي:

1. أظهر تحليل التباين وجود إختلافات عالية المعنوية بين التراكيب الوراثية – الآباء– الهجن– الهجن مقابل الآباء لجميع صفات الدراسة ، وكانت تباينات القدرة العامة والخاصة علي الأئتلاف عالية المعنوية لجميع صفات الدراسة وسجل الأب كاراشنكي أعلي أداء مرغوب لصفات عدد الايام حتي تشقق أول لوزة ، عدد اللوز المتفتح علي النبات ، محصول القطن الزهر و محصول القطن الشعر، وكان الهجين (P_1x P_2) أفضل الهجن لصفات تشقق أول لوزة، وزن اللوزة، معامل البذرة و متانة التيلة.
2. سجل اكبر عدد من الهجن قوة هجين موجبة وعالية المعنوية بالنسبة لمتوسط الأبوين وأفضل الأبوين لصفات وزن اللوزة و محصول القطن الشعر يليه محصول القطن الزهر ، معامل الشعر ، عدد اللوز المتفتح علي النبات ومعامل البذرة.
3. أظهرت الهجن (P_4x P_6)، (P_3x P_5)،(P_1x P_2) قوة هجين موجبه عالية المعنوية بالنسبة لمتوسط الأبوين والأب الافضل بالاضافة الي تأثيرات معنوية للقدرة الخاصة علي الائتلاف لمعظم صفات المحصول ومكوناته.
4. أعطت الآباء P_6،P_1 أعلي قدره عامة علي الائتلاف لصفات التبكير بينما أعطي الآب P_2 أفضل قدره عامه علي الائتلاف لصفات طول ومتانة التيلة ومعامل إنتظام الطول (%).
5. بينت النتائج أن قيم تباينات القدرة الخاصه علي الائتلاف اعلي من تباينات القدرة العامه علي الائتلاف وكانت النسبة بينهم أقل من الوحده لجميع صفات الدراسة، كما كانت قيم التباين السيادي أعلي من قيم التباين المضيف لجميع الصفات ماعدا صفة معامل البذرة مما يدل علي أهمية فعل الجين الغير مضيف في توارث هذه الصفات.