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Genetic Analysis for Diallel Crosses on Egyptian Cotton (*Gossypium barbadense* L.)

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Abstract

The present experiment was carried out to assess the general combining ability (GCA) and specific combining ability (SCA) of seven important commercial cultivars of Egyptian cotton and their 21 F_1 and F_2 crosses. Significant differences among genotypes were found for all studied traits. Combining ability analysis of variance revealed significant differences for GCA and SCA effects among the parents and hybrids for almost all traits. The results suggested the presence of additive and non-additive gene action for almost all of the traits. The ratio of G.C.A/S.C.A for F_1 and F_2 hybrids decreased from unity for all characters studied. The results (G.C.A) for seven parents revealed the good combiner for lint yield/plant and fiber fineness was the parent Giza 90, while for seed cotton yield/plant and seed yield /plant was the parent Giza 87 while, for fibre strength was the parent Giza 83 for F_1 and F_2 generations. In F_1 hybrid estimates of (S.C.A.) effects revealed that significant SCA effects were observed for most crosses. Moreover, the best combinations were (Giza 86 x Giza 90) for seed cotton yield /plant and fiber fineness, (Giza 88 x Giza 83) for lint yield/plant and fibre strength. But the F_2 hybrid of the best combinations were (Giza 90 x Giza 83) for seed cotton yield/plant and fiber fineness, (Giza 86 x Giza 90) for lint yield/plant and fibre strength. It can be conclude that possibility of use the superior crosses for improving Egyptian cotton traits by breeding processes and selection in sequent generations.

Keyword: *Cotton, Gossypium barbadense, Cotton traits*

Introduction

Cotton is a warm climate crop grown in approximately 60 countries worldwide. It is cultivated from 45 North latitude to 32 South latitude by over 20 million farmers. Over 90 percent of cotton grown in the world is belong to *Gossypium hirsutum* L. or Upland cotton, while about ten percent of cotton in the world is related to the species G. barbadenes L, Goldringer *et al.* (1997). In Egypt, cotton is one of most important economic crops as it plays a vital role in our agriculture and industrial development. In recent years, the total cultivated area began to decline, which requires working to increase the production of unit area in order to compensate for the shortfall in the cultivated area. The breeders has to develop a new set of varieties with higher production, the true knowledge of gene action for various cotton treat is useful in making decisions with regard to appropriate breeding system. It is important to study the genetic diversity of Egyptian cotton varieties, which be used for the development of new cotton genotypes. Knowledge of genetic diversity and relationships among breeding materials is essential to the plant breeders for improving this crop, Mother and

Jinks (1982). Muhammad *et al.* (2013) reported additive type of gene action with partial dominance for plant height, boll weight and yield of seed cotton per plant. The increase in yield per unit area of the crop is a prime concern of breeding programmers and cotton breeders all over the world. Sprague and Tatum (1942) used the term general combining ability to designate the average performance of a line in hybrid combinations, and used the term specific combining ability to define those cases in which certain combinations do relatively better or worse than the expected on the basis of the average performance of the lines involved. The present study was undertaken to study the performance, heterosis and combining ability for studied traits in seven parents and their crosses of Egyptian cotton.

Materials and Methods

This investigation was carried out during three growing seasons; 2016, 2017 and 2018. At the Experimental Farm of Faculty of Agriculture, Al-Azhar University, Assiut Branch. Seven genetically diverse genotypes of Egyptian cotton wildly different in their agronomic characters were used as parental varieties in this study. These cultivars were Giza 88 (P_1) Giza 86 (P_2), Giza80 (P_3), Giza 90 (P_4), Giza 92 (P_5), Giza 87 (P_6) and Giza83 (P_7) were mated in a half diallel fashion. The description and origin of these genotypes is shown in Table (1).

In the (2016) season, the seven parental genotypes were sown in a field in two planting dates with two weeks apart to obtain enough flowers for crossing. Parents were crossed in all possible combinations except reciprocals to produce 21 F_1 hybrids.

In the (2017) season, these parents were crossed again in (2016/2017) season to obtain more hybrids seeds (F_1's) for all combinations. Also, the (F_1's) seed were left to gave the F_2 seeds.

In (2018) season, the forty nine genotypes (seven parents and twenty - one hybrids) from each of F_1 and F_2 were sown in a Randomized Complete Block Design (R.C.B.D) with three replications. Planting was carried out on 19 March (2018). Plants were grown on rows, 4 m long and 60 cm apart, in single seeded hill spaced at 25 cm. Each parent was represented by three rows/plot, while F_1 hybrid was represented by three row/plot and each F_2 cross was represented by five rows/plot. The agriculture practices of irrigation, fertilization, used as recommended for Egyptian cotton production. The data were recorded on the mean of ten guarded plants/plot for both of parents and F_1 hybrids, and thirty guarded plants for F_2 generation.

Table 1. The Pedigree and origin of the cotton varieties under investigation:

Genotype	Pedigree	Origin
1- Giza 88	(Giza 77 x Giza45)b	Egypt
2- Giza 86	Giza 75 x Giza 81	Egypt
3- Giza 80	Giza 66x Giza 73	Egypt
4- Giza 90	Giza83xDandra	Egypt
5- Giza 92	Giza84 (Giza 74 x Giza 68)	Egypt
6- Giza 87	Giza 89 X C.B.58	Egypt XU.S.A
7- Giza 83	Giza 67 x Giza 72	Egypt

The studied traits:

1- Plant height in centimeters.
2- Boll weight in grams.
3-Seeds cotton yield/plant in grams.
4-Seed yield/plant in grams.
5-Lint yield/plant in grams.
6-Seed index in grams: It was determined as the weight a sample of 100 seeds in grams.
7- fibre strength.
8- Fibre fineness.

Statistical analysis:

Statistical analysis was made on an entry mean basis. The variation among parents, F_1 and F_2 crosses was partitioned into general and specific combining abilities as illustrated by Griffing (1956) Method 2, Model I as shown in Table 2.

Table 2. Mean squares for the assumption of Method (2), Model (1) of Griffing's (1956) and expectation of mean squares.

Source of variation	D.F.	M.S.	Expectation Model 1
Replications	b-1	M_b	$\sigma^2_e + a\,\theta\,(b)$
Genotypes	a-1	M_v	$\sigma^2_e + b\,\theta\,(v)$
Parents	(p-1)		
Crosses	(c-1)		
Parents v.s. crosses	1		
g.c.a.	(p-1)	M_g	$\sigma_e^2 + (p+2)\left(\frac{1}{p-1}\right)\sum g_i^2$
s.c.a.	p(p-1)/2	M_s	$\sigma_e^2 + \frac{2}{p(p-1)}\sum_i \sum_j s_{ij}^2$
Error	(b-1)(a-1)	M_e	σ_e^2

Heterosis estimates:

Heterosis values was made according to (Halluer and Miranda, 1981).

A)- Heterosis from the mid-parent:

Heterosis was determined as the percentage of increase or decrease of F_1's means over the average of its parents(M.P):

$$\text{Heterosis \%} = \frac{\overline{F_1} - \overline{M.P}}{\overline{M.P}} \times 100$$

b)-Heterosis from the better-parent:

It was also determined as the percentage of increase or decrease of F_1 mean over the better parent(B.P):

$$\text{Heterosis \%} = \frac{\overline{F_1} - \overline{B.P}}{\overline{B.P}} \times 100$$

L.S.D for better parent heterosis = t× $(3M.S.E/2r)^{1/2}$

L.S.D for mid parent heterosis = t× $(M.S.E/r)^{1/2}$

Where: t is the value of tabulated t at a stated level of probability for the experimental error degrees of freedom; r is the number of replications.

Results and Discussion

The mean of the seven parental cultivars and their 21 for F_1 and F_2 hybrids were estimated for all the studied traits and the results are presented in Table 3 and 4.

Mean performance of the studied parental cultivars varied from The results reveled that mean of parents was wide extended with a range of 94.85-120.24 ($P_5 - P_2$); 2.18-2.82 (P_7 - P_2); 86.06-105.23 (P_2–P_6); 54.45-70.52 (P_7–P_6); 31.60- 40.16 (P_1–P_3) ;

3.13 – 9.16 (P_7 -P_2)); 3.05- 4.55 (P_3 – P_1) and 35.7 – 42.8 (P_4 –P_3) for plant height, boll weight, seeds cotton yield/plant, seed yield/plant, lint yield/plant, seed index, fiber fineness and fiber strength respectively. Meanwhile, means of F_1 hybrids were extended with a range 86.11 -140.22 (P_3 Xp_4)-(P_4 Xp_6); 2.25 -3.04 (P_4 Xp_5)-(P_4 Xp_7); 84.33 -114.77 (P_4Xp_5)-(P_4Xp_7); 55.89 – 80.54 (P_1 Xp_7)-(P_1 Xp_6); 20.61-56.32 (P_1 Xp_6)-(P_4 Xp_7); 3.12- 9.01 (P_2 Xp_5)-(P_1 Xp_6) 2.9-4.8(P_1 Xp_3)-(P_1 Xp_2) and 1.26-4.73 (P_1 Xp_7)-(P_1 Xp_2) for the above-mentioned traits, respectively. The F_1 mean increased over the parental mean for all studied traits. Meanwhile, means of F_2 hybrids were extended with a range 75.65 -136.76 (P_3 Xp_4) - (P_4 Xp_7); 2.04 -3.11 (P_2 Xp_3) - (P_4 Xp_7); 89.98 -120.75 (P_3 Xp_7) - (P_1 Xp_7); 44.33 – 80.78 (P_4 Xp_5)-(P_2 Xp_6); 18.17-57.18 (P_1 Xp_6) - (P_1 Xp_7); 2.22- 8.85 (P_1 Xp_7) - (P_1 Xp_6); 34.00-64.25 (P_1 Xp_7) - (P_3 Xp_6) and 22.9- 52.54 (P_4 Xp_5) - (P_3 Xp_5) for plant height, boll weight, seeds cotton yield/plant, seed yield/plant, lint yield/plant, seed index, fiber fineness and fiber strength respectively.

Combining ability:

Mean squares due to both general (G.C.A) and specific (S.C.A) combining ability were highly significant for all characters studied, indicating the importance of both additive and non-additive gene effects in the inheritance of these characters. The ratio of G.C.A /S.C.A for F1 and F_2 hybrids decreased from unity for all characters suggesting that non-additive type of gene action was more important in the inheritance of these trait or appeared to be under the central of epistatic effect. Similar results were reported by Singh *et al.* (1987), Ali *et al*. (1998), Basal and Turgut (2003), Naveed *et al.* (2004), Rauf *et al.*(2005), Ashokkumar and Ravikesavan (2008), Azhar and Naeem (2008), Abro *et al*. (2009).

A-General combining ability:

Estimates of GCA effects (gi) for F_1 and F_2 generations showed that

Giza 88 had positive and highly significant G.C.A. effects for boll weight, seeds cotton yield/plant, seed yield/plant and seed index, while it displayed a negative and highly significant G.C.A. effects for fiber fineness and fiber strength it also showed non-significant values for plant height and lint yield/plant.

Giza 86 had positive and highly significant G.C.A. effects for boll weight and fiber fineness, while it revealed a negative and highly significant G.C.A effects for seeds cotton yield/plant, seed yield/plant, lint yield/plant and fiber strength, while it non- displayed significant values for plant height and seed index.

Giza 80 had positive and highly significant G.C.A. effects for boll weight, seeds cotton yield/plant, seed yield/plant, seed index, lint yield/plant and fiber strength, while it showed a negative and highly significant G.C.A. effects for fiber fineness, while it displayed non- significant values for seed index plant.

Giza 90 had positive and highly significant G.C.A. effects for plant height, lint yield/plant and fiber strength, while it a negative displayed and highly significant G.C.A. effects for seed yield/plant and fiber fineness, while it showed non- significant values for boll weight, seeds cotton yield/plant, lint yield/plant and seed index.

Giza 92 had positive and highly significant G.C.A. effects for seed yield/plant, while it showed a negative and highly significant G.C.A. effects for plant height, lint yield/plant and fiber strength, while it revealed non- significant values for boll weight, seeds cotton yield/plant, seed index and fiber fineness.

Giza 78 showed positive and highly significant G.C.A. effects for plant height, seeds cotton yield/plant, seed yield/plant, seed index, while it gave a negative and highly significant G.C.A. effects for lint yield/plant and fiber strength, while it had non- significant values for boll weight and fiber fineness.

Giza 83 had positive and highly significant G.C.A. effects for plant height, while it a displayed negative and highly significant G.C.A. effects for seed yield/plant, seed index and fiber strength, while it had non- significant values for boll weight, seeds cotton yield/plant, lint yield/plant, fiber fineness.

In F_1 and F_2 generations showed that the P_1, P_2, P_3, P_4, P_5, P_6 and P_7 were very good combiner parents for (seed yield/plant and seed index), (boll weight and fiber strength), (seeds cotton yield/plant and fiber strength), (lint yield/plant), (plant height and seed yield/plant), (seed index and fiber strength) and (plant height and seeds yield/plant) respectively. Similar results were reported by Ali *et al*. (1998), Basal and Turgut (2003), Naveed *et al.*(2004), Rauf *et al.* (2005), Ashokkumar and Ravikesavan (2008), Azhar and Naeem (2008), Abro *et al*. (2009), Karademir *et al*. (2009), Khan *et al*. (2009), Ashokkumar *et al*. (2010), Karademir and Gençer (2010) and Singh *et al.* (2010).

B-Specific combining ability:

Specific combining ability effects of the seven parents and F_1 generation are showed in Tables 6 and 7. Concerning plant height, the crosses which had positive and highly significant S.C.A effect were (P_1 x P_5) , (P_1 x P_7) ,(P_2 x P_6),(P_3 x P_5) and (P_3 x P_6). While the crosses which had negative and highly significant S.C.A effect were (P_1 x P_2), (P_2 x P_4), (P_3 x P_4) and (P_3 x P_7). The crosses (P_3 x P_5) had the highest positive effect of plant height (Table 6).

Regarding to boll weight, the crosses, which had negative and highly significant S.C.A effect were (P_2 x P_4) and (P_2 x P_7) While the crosses which had positive and highly significant S.C.A effect were (P_1 x P_4), (P_1 x P_7), (P_2 x P_3), (P_3 x P_6) and (P_4 x P_7) (Table 6).

For seed cotton yield/plant, (P_1 x P_3), (P_1 x P_7), (P_2 x P_6), (P_3 x P_5) and (P_4 x P_7) crosses had positive and highly significant S.C.A effect and the crosses (P_1 x P_3), (P_5 xP_6) and (P_5 x P_7) were the best crosses for seed cotton yield/plant and they had the highest positive significant. Otherwise, (P_4 x P_5) cross had negative and highly significant specific combining ability effect (Table 6).

Concerning seed yield/plant, (P_5 x P_7) and (P_4 x P_6) crosses had positive and highly significant S.C.A effect. The (P_5 x P_7) cross was the best for seed yield/plant and they had positive and highly S.C.A. Otherwise P_4x P_5 cross had negative and highly significant S.C.A effects (Table 6).

For lint yield/plant, (P_1 xP_3), (P_1 x P_4), (P_1 x P_7), (P_3 xP_6), (P_3 xP_5), (P_4 xP_7) and (P_5 x P_7) crosses had positive and highly significant and S.C.A effect. But (P_1 x P_6), (P_3 x P_6) and (P_4 x P_5) crosses had negative and highly S.C.A effect (Table 7).

With regard to seed index, (P_1 x P_6), (P_2 x P_5) and (P_3 x P_7) crosses had positive and highly significant S.C.A effect. The (P_3 x P_7) cross had highest positive significant S.C.A effect. While, (P_2 x P_4) cross had negative and highly significant S.C.A effect (Table 7).

Regrinding fiber fineness, the crosses P_1 x P_2, P_1 x P_6, P_1 xP_7, P_2 x P_3 and P_6 x P_7 had a positive highly significant S.C.A effect. While the crosses which had the highest negative and highly significant S.C.A effect were P_1 x P_3 and P_2 X P_7 (Table 7).

With respect to fiber strength, (P_1 xP_3), (P_2 x P_5), (P_3 X P_4), (P_3 x P_5), (P_3 x P_6) and (P_4 x P_7) crosses had a positive and highly significant specific combining ability effect. However, P_3 x P_6 was the highest positive significant specific combining ability effect. But, (P_1 x P_7), (P_2 x P_3), (P_2 x P_4), (P_2 X P_7) and (P_3 xP_7) had negative and highly significant S.C.A effect (Table 7). These results are in harmony with those obtained by Ashokkumar and Ravikesavan (2008), Azhar and Naeem (2008), Abros *et al*. (2009), Karademir *et al*. (2009), Khan *et al*. (2009), Ashokkumar (2010), Karademir and Gençer (2010) and Singh *et al.* (2010). While, specific combining ability effects of the seven parents and F_2 generation are showed in Tables 6 and 7. Concerning plant height, the crosses which had positive and highly significant S.C.A effect were (P_1 x P_5), (P_1 x P_7), (P_2 x P_6), (P_3 x P_5) and P_4 x P_7. While the crosses which had negative and highly significant S.C.A effect were (P_1 x P_2), (P_2 x P_7), (P_3 x P_4), (P_3 x P_7), (P_4 x P_5) and (P_5 x P_6) the crosses (P_3 x P_5) had the highest positive effect of plant height (Table 6).

Regarding to boll weight, the crosses, which had negative and highly significant S.C.A. effect was (P_3 x P_2). While the crosses which had positive and highly significant S.C.A. effect were (P_2 x P_6), (P_3 x P_6) and P_4 x P_7 (Table 6).

For seed cotton yield/plant, (P_1 x P_5), (P_1 x P_7), (P_2 x P_6), (P_3 x P_5), (P_3 x P_6) and (P_4 x P_7) crosses had positive and highly significant S.C.A effect and the cross (P_4 x P_7) was the best for seed cotton yield/plant revealed the highest positive significant SCA. Otherwise, (P_1 x P_6), (P_3 xP_4), (P_3 x P_7), (P_4 x P_5) and (P_4 x P_6) showed the negative and highly significant SCA values (Table 6).

Concerning seed yield/plant, (P_2 x P_6), (P_3 x P_5) and (P_4 x P_6) crosses showed positive and highly significant S.C.A. effect. The P_3 x P_5 cross was the best for seed yield/plant which revealed positive and highly S.C.A. Otherwise P_5 x P_4 cross had negative and highly significant S.C.A effects (Table 6).

For lint yield/plant (P_1 xP_4), (P_1 x P_5), (P_1 x P_7), (P_2 xP_4), (P_4 xP_7) and P_5 x P_7 crosses revealed positive and highly significant and S.C.A effect. While the (P_1 x P_2), (P_1 x P_6) and (P_6 x P_7) crosses showed negative and highly S.C.A effect (Table 7).

With regard to seed index, (P_1 x P_6), (P_2 x P_5) and (P_3 x P_7) crosses showed positive and highly significant S.C.A effect. The (P_3 x P_7) cross revealed highest positive significant S.C.A effect. While, (P_2 x P_4) cross showed negative and highly significant S.C.A effect (Table 7).

Regrinding fiber fineness, the crosses (P_1 x P_4), (P_3 x P_4) and (P_3 x P_7) showed a positive highly significant S.C.A effect. While the crosses which showed the highest negative and highly significant S.C.A effect were P_1 x P_5, P_1 x P_7 and P_2 X P_4 (Table 7).

With respect to fiber strength, (P_1 xP_2), (P_1 x P_3), (P_3 X P_5) and (P_4 x P_7) crosses showed a positive and highly significant specific combining ability effect. However, P_3 x P_5 displayed the highest positive significant SCA effect. But, (P_1 x P_5), (P_2 x P_4) and (P_4 xP_5) showed negative and highly significant S.C.A effect (Table 7). These results are in harmony with those obtained by Naveed *et al.* (2004), Rauf *et al.*(2005), Ashokkumar and Ravikesavan (2008), Azhar and Naeem (2008).

Heterosis:

Data in Table 3 showed that there were significant values for the heterosis over mid and better parent for all studied traits, indicating that heterosis played an important role in the inheritance of these traits. For plant height (Giza 88 x Giza 80), (Giza 88 x Giza 90) (Giza 88 x Giza 83) and (Giza 90 x Giza 83) showed highly positive significant values for heterosis over mid parents. Highly positive significant value for heterosis over better parent were found in (Giza 88 x Giza 90) and (Giza 90 x Giza 92) for plant height (cm). For boll weight (Giza 90 x Giza 83) had desirable highly positive significant values for the heterosis over mid parent and better parent. (Giza 86 x Giza 87) and (Giza 90 x Giza 83) showed highly positive significant values for the heterosis over mid and better parent for seed cotton yield/plant. (Giza 86 x Giza 87) had desirable highly positive significant values for the heterosis over mid and better parent for seed yield /plant. For lint yield/plant (Giza 88 x Giza 80) had desirable highly positive significant values for the heterosis over mid and better parent. For 100 seed weight. (Giza 88 x Giza 87) and (Giza 80 x Giza 87) showed highly positive significant values for the heterosis over mid and better parent. These findings are in accordance with those of Abro *et al.* (2009), Karademir *et al.*(2009), Khan *et al.* (2009), Ashokkumar (2010), Karademir and Gençer (2010).

Table 3. Mean squares of genotypes, general combining ability (GCA) and specific combining ability (SCA) and their ratios for yield and its components in cotton for F_1 and F_2 generations.

S.O.V	df	Plant height	boll weight	Seed cotton yield/plant	Seed yield/plant	lint yield/plant	seed index	Fiber fineness	fibre strength
					F_1				
Replicates	2	2.48	0.36	0.719	1.50	0.34	0.085	0.052	0.019
Genotypes	27	32.89**	1.10**	10.84**	15.43**	17.41**	0.485**	2.80**	0.052**
GCA	6	50.88**	4.7**	32.88**	41.66**	68.05**	2.08**	7.32**	0.178**
SCA	20	245.13**	5.20**	64.65**	97.20**	88.08**	2.23**	17.84**	2.89**
Error	54	1.43	0.041	0.87	2.808	0.24	0.081	0.24	0.073
GCA / SCA		0.21	0.90	0.510	0.429	0.80	0.929	0.410	0.616
					F_2				
Replicates	2	4.08	0.051	1.875	2.23	0.55	0.105	0.082	0.075
Genotypes	27	51.89**	1.20**	19.00**	22.12**	14.70**	0.492**	11.80**	0.131**
GCA	6	160.88**	2.10**	22.14**	80.40**	62.91**	1.88**	48.98**	0.375**
SCA	20	306.11**	8.00**	103.34**	118.04**	69.39**	2.35**	57.25**	0.807**
Error	54	2.32	0.047	1.33	3.542	0.54	0.046	0.55	0.025
GCA / SCA		0.530	0.260	0.660	0.678	0.910	0.080	0.856	0.405

Table 4. Mean performances for plant height, boll weight, seed cotton yield/plant and seed yield/plant of parents and $F_1$and F_2 generations.

Traits	Plant height		boll weight		Seed cotton yield/plant		Seed yield/plant	
	F_1	F_2	F_1	F_2	F_1	F_2	F_1	F_2
P1	101.35	101.35	2.44	2.44	97.65	97.65	66.25	66.25
P2	120.24	120.24	2.82	2.82	86.06	86.06	58.12	58.12
P3	106.44	106.44	2.42	2.42	100.11	100.11	60.25	60.25
P4	139.77	139.77	2.48	2.48	99.98	99.98	60.87	60.87
P5	94.85	94.85	2.33	2.33	101.12	101.12	65.77	65.77
P6	106.15	106.15	2.25	2.25	105.23	105.23	70.52	70.52
P7	110.34	110.34	2.18	2.18	86.56	86.56	54.45	54.45
P1XP2	96.66	90.78	2.53	2.42	95.66	90.36	63.38	63.45
P1XP3	111.12	109.22	2.35	2.45	110.05	101.66	67.88	69.88
P1XP4	119.07	110.12	2.78	2.22	105.23	111.09	57.54	57.05
P1XP5	122.92	125.55	2.31	2.54	101.12	116.06	66.76	68.99
P1XP6	119.55	113.35	2.27	2.19	99.75	96.54	80.54	79.67
P1XP7	127.66	125.45	2.66	2.74	110.33	120.75	55.98	64.77
P2XP3	109.11	100.12	2.91	2.04	98.54	94.55	59.98	59.05
P2XP4	94.57	122.77	2.41	2.11	101.44	101.19	58.78	52.16
P2XP5	113.42	99.55	2.38	2.21	100.09	96.78	66.54	60.35
P2XP6	128.45	133.53	2.64	2.77	110.25	111.56	76.78	80.78
P2XP7	107.47	97.75	2.29	2.23	92.27	90.75	59.67	53.45
P3XP4	86.11	75.65	2.76	2.21	99.85	90.17	59.65	55.96
P3XP5	142.12	135.47	2.35	2.46	112.33	113.64	66.55	76.45
P3XP6	122.25	116.65	2.83	2.86	100.01	111.07	76.89	77.19
P3XP7	100.04	88.95	2.33	2.06	95.55	89.98	61.88	54.44
P4XP5	105.83	95.98	2.25	2.16	84.33	92.44	65.99	44.33
P4XP6	118.34	122.08	2.37	2.18	99.65	90.15	56.98	53.12
P4XP7	140.22	136.76	3.04	3.11	114.77	114.87	58.98	63.43
P5XP6	105.22	93.35	2.42	2.09	98.65	96.77	78.46	63.76
P5XP7	103.25	89.19	2.28	2.23	109.67	97.25	66.74	59.67
P6XP7	107.24	102.26	2.39	2.45	100.11	109.77	77.85	78.46
L.S.D5%	3.92	4.71	0.17	0.28	2.83	1.33	0.71	2.36
L.S.D1%	5.24	6.29	0.23	0.38	3.79	1.78	0.95	3.16

Table 5. Mean performances for lint yield/plant, seed index fiber strength and fiber fineness of parents and $F_1$and F_2 generations.

Traits	lint yield/plant		seed index		Fiber fineness		fibre strength	
	F_1	F_2	F_1	F_2	F_1	F_2	F_1	F_2
P1	31.6	31.6	7.55	7.55	4.55	4.55	37.25	37.25
P2	28.24	28.24	9.16	9.16	3.5	3.5	40.05	40.05
P3	40.16	40.16	6.66	6.66	3.05	3.05	42.8	42.8
P4	39.31	39.31	6.15	6.15	3.43	3.43	35.7	35.7
P5	35.45	35.45	5.44	5.44	3.65	3.65	35.8	35.8
P6	34.81	34.81	4.46	4.46	4.05	4.05	40.2	40.1
P7	32.31	32.31	3.13	3.13	3.85	3.85	40.1	40.1
P1XP2	33.38	28.31	7.55	6.62	4.8	4.73	37.15	42.22
P1XP3	43.37	33.28	8.23	7.35	2.9	3.94	44.1	51.14
P1XP4	49.09	55.35	6.23	6.04	3.85	4.34	37.45	31.19
P1XP5	35.86	48.47	6.83	7.02	3.6	2.37	38.4	25.79
P1XP6	20.61	44.32	9.01	8.85	3.55	4.42	38.75	41.19
P1XP7	54.02	57.18	5.21	2.22	3.15	1.26	34	30.84
P2XP3	39.86	36.6	5.36	4.13	4.7	4.63	34.5	37.76
P2XP4	44.16	55.34	4.44	6.00	3.85	2.96	34.15	26.71
P2XP5	34.85	37.73	3.12	5.12	4.6	4.48	38.4	35.52
P2XP6	34.67	46.78	7.65	7.97	4.7	3.7	38.5	41.19
P2XP7	33.9	38.6	5.76	5.72	3.65	4.47	35.6	30.9
P3XP4	41.5	35.51	6.11	6.28	4.44	4.52	41.8	47.79
P3XP5	46.98	38.39	5.95	6.07	4.05	3.06	43.95	52.54
P3XP6	24.22	34.98	7.64	6.74	4.35	3.22	46.25	40.13
P3XP7	34.77	36.64	6.95	7.09	3.65	4.44	37.9	36.03
P4XP5	30.26	50.96	6.99	6.66	4.05	2.7	38.3	22.9
P4XP6	44.17	38.43	6.02	6.53	4.15	3.29	38.5	44.24
P4XP7	56.32	48.94	6.75	6.83	3.9	2.45	42.05	45.43
P5XP6	55	52.88	7.14	6.93	3.95	3.08	40.75	34.08
P5XP7	44.23	38.98	6.26	6.76	4.05	4.14	36.55	41.8
P6XP7	23.56	40.00	7.01	6.89	4.6	3.05	39.55	34
L.S.D5%	2.17	2.19	1.13	1.53	0.073	0.052	0.26	0.23
L.S.D1%	2.89	2.93	1.52	2.04	0.099	0.070	0.35	0.31

Table 6. Estimates of general and specific combining ability effects for plant height, boll weight, seed cotton yield/plant and seed yield/plant in s ix cotton varieties.

Traits	Plant height		boll weight		Seed cotton yield/plant		Seed yield/plant	
	F_1	F_2	F_1	F_1	F_2	F_2	F_2	F_2
P1	-0.35	0.2	-0.01*	0.04*	1.42*	3.08*	0.51*	3.32**
P2	-1.4*	1.07	0.11**	0.08**	-3.81**	-5.19**	-2.07**	-2.33*
P3	-2.13**	-4.04**	0.06**	0.04*	1.32*	1.36*	0.74*	0.78*
P4	4.54**	7.51**	0.08**	-0.01	0.06	-0.46	-4.48**	-6.52**
P5	-2.26**	-5.17**	-0.13	-0.08**	0.42	1.24	2.51**	2.15**
P6	1.17*	2.02*	-0.05	0.01	2.58**	4.48**	7.61**	7.51**
P7	0.46*	1.59*	-0.06**	0.02	-0.98	-0.84	-3.33**	-2.59**
L.S.D5%	0.45	1.44	0.01	0.04	1.02	1.35	0.49	0.18
L.S.D1%	2.11	4.02	0.06	0.08	3.35	4.36	2.05	2.55
P1XP2	-14.44**	-19.91**	-0.05	-0.05	-2.53	-8.03*	-0.06	-0.84
P1XP3	0.75	3.64	-0.18*	0.04	6.73**	-1.62	3.11*	2.48
P1XP4	2.02	-7.01*	0.23**	-0.19	3.17*	7.97*	-3.49*	-3.05
P1XP5	12.68**	21.1**	-0.03	0.19	-1.3	11.24**	-1.26	2.52
P1XP6	5.87*	1.71	-0.16*	-0.23*	-3.83*	-9.52**	7.42*	5.54*
P1XP7	14.74**	17.42**	0.24**	0.31*	9.31**	18**	-9.2**	0.74
P2XP3	-0.21	-6.33*	0.27**	-0.37**	0.45	-0.46	-2.21	-2.7
P2XP4	-21.42**	4.77	-0.26**	-0.32*	4.61*	6.34*	0.33	-2.3
P2XP5	4.23	-5.77*	-0.07	-0.14	2.9	0.23	1.1	-0.47
P2XP6	15.83**	21.02**	0.1	0.35**	11.9**	13.77**	6.24*	12.3**
P2XP7	-4.39	-11.15**	-0.24**	-0.21	-3.52*	-3.73	0.07	-4.93**
P3XP4	-29.15**	-37.23**	0.14*	-0.15	-2.12	-9.57**	-0.13	-1.61
P3XP5	33.66**	35.27**	-0.06	0.17	10.01**	12.2**	-0.22	12.52**
P3XP6	10.36**	9.26*	0.34**	0.49**	3.47*	8.39**	5.02*	5.6*
P3XP7	-11.1**	-14.84**	-0.15*	-0.32*	-5.37*	-9.38**	0.96	-7.05*
P4XP5	-9.3*	-15.77**	-0.18*	-0.13	-16.73**	-8.84**	2.96	-12.31**
P4XP6	-0.23	3.14	-0.14*	-0.19	-2.57	-12.37**	11.15**	11.17**
P4XP7	22.41**	21.42**	0.53**	0.73**	15.11**	15.67**	1.8	9.24*
P5XP6	-6.54	-12.92**	0.12	-0.21	-3.93*	-7.45*	3.34*	-6.9*
P5XP7	-5.79*	-9.31*	0.13	-0.23*	-1.37	-4.14	14.29**	3.2
P6XP7	-7.2*	-9.31*	0.01	-0.24*	-1.07	-4.14	8.57*	3.2
L.S.D5%	4.62	5.63	0.14	0.23	3.01	4.63	3.02	3.53
L.S.D1%	9.85	11.55	0.22	0.43	6.52	8.24	8.75	10.05

Table 7. Estimates of general and specific combining ability effects for lint yield/plant, seed index fiber strength and fiber fineness in s ix cotton varieties.

Traits	lint yield/plant		seed index		Fiber fineness		fibre strength	
	F_1	F_2	F_1	F_1	F_2	F_2	F_2	F_2
P1	0.49	-0.38	0.86**	0.48**	-0.04	0.13*	-0.74*	-0.83*
P2	-1.98*	-2.48*	-0.05	0.33*	0.22**	0.34**	-1.4**	-1.1*
P3	1.76*	1.29*	0.34	-0.01	-0.23**	-0.14*	2.57**	5.18**
P4	5.44**	6.64**	-0.43*	-0.03	-0.13*	-0.2*	-0.81*	-1.63**
P5	-1.19	1.39*	-0.36*	-0.18*	0.03	-0.2*	-0.36*	-2.23**
P6	-6.32**	-5.35**	0.36*	0.29**	0.23**	-0.01	1.28**	1.19*
P7	1.81*	1.47*	-0.69**	-0.79**	-0.07	-0.16	-0.57*	-0.952*
L.S.D5%	1.75	0.44	0.35	0.11	0.10	0.13	0.35	0.852
L.S.D1%	3.88	4.33	0.445	0.28	0.21	0.33	0.985	1.28
P1XP2	-2.02	-7.25**	0.44	-0.57	0.709**	0.64*	0.41	6.11**
P1XP3	4.23**	-3.47*	0.73	0.49	-0.746**	0.08	3.39**	8.74**
P1XP4	6.27**	10.66**	-0.5	-0.79	0.103	0.79**	0.13	-4.39*
P1XP5	-0.33	9.04**	0.03	0.33	-0.302	-1.18**	0.60*	-9.19**
P1XP6	-10.45**	-14.52**	2.82**	1.89**	0.552**	0.68*	-0.67*	2.79
P1XP7	14.83**	17.67**	-1.26*	-1.64*	0.652**	-2.33**	-3.57**	-5.80**
P2XP3	3.19*	1.95	-1.23*	-2.97**	0.793**	0.57*	-5.54**	-4.36*
P2XP4	3.81*	12.76**	-3.6**	-0.56	-0.159	-0.79**	-2.51**	-8.60**
P2XP5	1.13	0.4	2.77**	3.41**	0.437*	0.73**	1.26**	0.82
P2XP6	6.08**	1.39	1.07*	1.07	0.337	-0.24	-0.26	3.06
P2XP7	-2.82*	1.19	0.2	-0.2	-0.613**	0.68*	-1.31**	-5.47*
P3XP4	-2.6*	-8.26**	-0.21	-0.06	-0.014	0.99**	1.17**	6.20**
P3XP5	9.51**	-0.12	-0.33	-0.12	0.331*	-0.46*	2.84**	11.55**
P3XP6	-8.11**	3.2*	0.67	0.17	0.431*	-0.50*	3.53**	-4.28*
P3XP7	-5.69**	-1.96	3.11**	3.5**	0.031	0.88**	-2.97**	-6.63**
P4XP5	-10.89**	4.51*	1.48*	0.49	0.23	-0.51*	0.58*	-11.28**
P4XP6	8.16**	-1.28	-0.18	-0.02	0.13	-0.12	-0.84*	6.64**
P4XP7	12.18**	6.41**	1.57*	1.27*	0.18	-0.81**	4.56**	9.59**
P5XP6	-7.99**	-0.05	0.87	0.53	-0.224	-0.33	0.93*	-2.92*
P5XP7	16.12**	6.87**	1.89*	1.51*	0.076	-0.17	2.78	-1.16
P6XP7	-8.82**	-6.87**	1.07*	1.52*	0.526**	-0.176	-0.03	-1.16
L.S.D5%	2.16	2.83	1.06	1.13	0.33	0.34	0.55	2.32
L.S.D1%	4.22	5.43	2.62	2.84	0.545	0.707	2.54	5.75

Table 8. Heterosis as percentage of mid-parents (M.P) and better Parent (B.P) in the F_1 crosses for plant height, boll weight, seed cotton yield/plant and seed yield/plant.

Traits	Plant height		boll weight		Seed cotton yield/plant		Seed yield/plant	
	M.P	B.P	M.P	B.P	M.P	B.P	M.P	B.P
P1XP2	-12.76**	-7.86*	-3.8**	-6.74**	4.14*	5.93*	1.92	-6.14*
P1XP3	6.95**	-2.39	-3.29*	-0.41	11.3**	-1.23	7.32*	-4.53
P1XP4	-1.24	13.74**	13.01**	-0.81	6.49*	-1.17	-9.47*	-4.06
P1XP5	25.3**	-3.21	-3.14*	-2.25	1.75	-1.72	1.14	-0.36
P1XP6	15.23**	-2.26	-3.2*	-3.89	-1.67	-3.6	17.77**	-3.03
P1XP7	20.61**	-4.07	15.15**	-5.33*	19.79**	-5.68*	-7.24*	-8.91*
P2XP3	-3.73	-5.74*	11.07**	-7.09**	5.86*	-7.02*	1.34	-1.77
P2XP4	-27.26**	-6.99*	-9.06**	-6.03**	9.05**	8.96**	-1.2	-1.25
P2XP5	5.46*	-10.56*	-7.57**	-8.69**	6.95**	-7.45**	7.42*	2.81
P2XP6	13.48**	-5.86*	4.14**	10.11**	15.27**	9.11**	19.37**	11.79**
P2XP7	-6.78*	-4.12	8.4**	11.35**	6.91**	-0.29	6.01*	-3.16
P3XP4	-30.05**	-11.92**	12.65**	-1.21	-0.19	-0.06	-1.5	-0.51
P3XP5	41.21**	-5.44*	-1.05	-1.86	11.64**	-0.5	5.62*	-4.2
P3XP6	15.01**	-0.14	21.2**	-3.51	-2.59	-2.43	17.6**	-7.28*
P3XP7	-7.7*	-1.77	1.3	-4.96*	2.37	-6.77*	7.9*	-4.81
P4XP5	-9.79**	16.07**	-6.44**	-3.02	-16.13**	-0.56	4.22	-3.73
P4XP6	-3.76	-12.03**	0.21	-4.64*	-2.88	-2.49	-13.27**	-6.84*
P4XP7	12.13**	-10.53*	30.47**	6.05**	23.05**	8.71**	2.29	-5.27
P5XP6	4.7*	-5.32*	5.68**	-1.72	-4.39*	-1.95	15.14**	-3.37
P5XP7	0.64	-5.97*	1.11	-3.22	16.87**	-7.2	11.03**	-8.61*
P6XP7	-0.93	-1.9	7.9**	-1.56	4.4*	-8.87**	24.59**	11.39**
L.S.D5%	4.55	5.22	2.26	4.35	3.67	4.75	5.35	6.09
L.S.D1%	10.13	11.44	3.53	5.65	6.66	7.15	10.55	11.37

Table 9. Heterosis as percentage of mid-parents (M.P) and better Parent (B.P) lint yield/plant, seed index fiber strength and fiber fineness in the F_1 crosses.

Traits	lint yield/plant		seed index		Fiber fineness		fibre strength	
	M.P	B.P	M.P	B.P	M.P	B.P	M.P	B.P
P1XP2	11.56**	-5.32	-9.63*	-8.79	19.25	5.49	-3.88	-7.24*
P1XP3	20.88**	10.66**	15.83**	-5.89	-23.68	-36.26**	10.18**	3.04
P1XP4	38.46**	-9.81*	-9.05*	-9.27*	-3.51	-15.38**	2.67	0.54
P1XP5	6.96*	-5.43	5.16	-13.97**	-12.2	-20.88**	5.13*	3.09
P1XP6	-37.93**	-4.61	50.04**	20.46**	-17.44	-21.98**	-0.24	-4.18
P1XP7	69.05**	-1.1	-2.43	-29.27**	-25	-30.77**	-12.09**	-15.21**
P2XP3	16.55**	14.84**	-32.24**	13.65**	43.51	34.29**	-16.72**	-19.39**
P2XP4	30.75**	14.08**	-42**	-16.43**	11.11	10	-9.83*	-14.73**
P2XP5	9.44**	-10.17*	-57.26**	-20.31**	28.67	26.03**	1.25	-4.12
P2XP6	9.98**	-9.44*	12.33**	25.66**	24.5	16.05**	-4.34	-4.8
P2XP7	11.97**	-6.3	-6.27	-32.91**	-0.68	-5.19	11.17**	11.22**
P3XP4	4.44	1.08	-4.61	-3.83	9.57	3.5	6.5*	-2.34
P3XP5	24.27**	-5.86	-1.65	-9.16*	20.9	10.96*	11.83**	2.69
P3XP6	-35.39**	-6.66	37.41**	16.52**	22.54	7.41	11.12**	8.06*
P3XP7	-4.04	-9.77*	41.98**	-26.5**	5.8	-5.19	-8.56*	-11.45**
P4XP5	-19.05**	-4.91	20.62**	-5.77	14.41	10.96**	7.13*	6.98*
P4XP6	19.19**	-5.72	13.48**	-13.74**	10.96	2.47	1.13	-4.8
P4XP7	57.27**	-8.9*	45.47**	24.55**	7.14	1.3	10.95	4.86
P5XP6	-39.11**	-0.9	44.24**	-9.01*	2.6	8.22	6.9	0.77
P5XP7	30.55**	-4.43	46.09**	-21.23**	8*	5.19	-3.69	-8.85*
P6XP7	-29.8**	-3.59	84.72**	-14.91**	16.46	13.58**	-1.79	-2.2
L.S.D5%	5.33	6.95	7.67	8.97	7.67	8.97	5.12	7.25
L.S.D1%	7.58	10.65	9.96	12.05	9.96	12.05	10.23	11.12

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التحليل الوراثي للهجن الدائرية في القطن المصري

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الملخص

اجريت حديثا دراسة علي القدرة العامة والقدرة الخاصة لاهم سبعة اصناف مـــن القطـــن المصري من طراز بربادنز وهي جيزة (٨٣،٨٧،٩٢،٩٠،٨٠،٨٦،٨٨) حيث تم تحليـــل تلـــك الاباء مع الجيل الاول والثاني الخاص بتلك الاباء عن طريـــق تحليـــل جـــرفن الموديـــل الاول الطريقة الثانية حيث وجدت معنوية مختلفة بين كل صفات تحت الدراسة بذلك يمكن القول ان تلذ الصفات يتحكم فيها الفعل الاضافي وغير الاضافي حيث وجد نسبة تباين القدرة العامة الي تباين القدرة الخاصة اقل من الوحدة في كل الصفات. أشارت النتائج افضل الاباء للمحـــصول القطـــن الشعر والنعومة كان هو الاب جيزة ٩٠ وكذلك وجد ايضا ان الاب ٨٧ كان افضل الابـــاء فـــي صفة محصول القطن الزهر وكذلك محصول القطن البذر ووجد الاب ٨٣ افـــضل الابـــاء فـــي صفة قوة التيلة وكذلك وجد افضل التراكيب الوراثية في الجيل الاول كانت هي جيزة(٨٦x٩٠) و(٨٨x٨٣) في صفة محصول القطن الشعر وقوة التيلة وفـــي الجيـــل الثـــاني كـــان الهجـــين (٨٣x٩٠) افضل الهجن في المحصول القطن الزهر والنعومة وكان الهجين (٨٦x٩٠) افـــضل الهحن في المحصول الشعر والنعومة والمتانة.