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Genetic Analysis of some Quantitative Characters in Egyptian Cotton

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ABSTRACT

This study was carried out at Sakha Agricultural Station, ARC. during four seasons (2014 - 2017). Genetic analysis of F_1, F_2 and F_3 made used to estimate the genetic variability and some genetic parameters that clarify the nature of gene action controlling inheritance of yield, its components and fiber quality of two Egyptian cotton crosses. Significant differences among the five populations (two Parents, F_1, F_2 and F_3) were detected in both crosses for most studied indicating the parental genotypes exhibited sufficient genetic variability for further genetic studies. Hybridization increased the variation in F_2 generation in both crosses compared with the parents for most of the studied traits indicating the effectiveness of hybridization in inducing the variabilities in the genetic materials. Among the four parents involved in this study, Giza 96 variety showed the highest values for productivity traits while Giza 93 had the best fiber quality traits. Concerning the gene effects, results indicated that the studied traits were quantitatively inherited. The additive effect (d) showed significant positive values for seed cotton yield, lint cotton yield, lint percentage, Fiber length and uniformity ratio in both crosses while the dominance effect (h) showed significant values for seed cotton yield, lint percentage, fiber strength and uniformity ratio in cross I and lint cotton yield, fiber strength and uniformity ratio in cross II . The epistatic effects showed that, Additive x additive interaction was prevalence for the inheritance of most traits while dominance x dominance interaction was less important. The results exhibited significant differences among the five generations (tow Parents, F_1, F_2, and F_3) in both crosses for boll weigh, and lint cotton yield traits indicating that the parental genotypes exhibited genetic variability valid for further genetic studies. Hybridization increased the variability in F_2 generation in both crosses as compared with their parents for seed cotton yield lint, cotton yield and micronaire in cross I and seed cotton yield in cross II. The studied traits indicated the effectiveness of hybridization in inducing variabilities in the studied materials. Concerning the gene effects results indicated that the studied traits were quantitatively inherited. The additive effect (d) showed significant positive values for boll weigh, seed cotton yield , lint cotton yield, lint percentage, fiber length and uniformity ratio traits while the dominance effect (h) showed significant values for seed cotton yield, lint percentage and uniformity ratio traits and it was larger in magnitude than the additive effect effect (d) in both crosses for all studied traits except boll weight and micronaire in cross I and cross II and Fiber strength in cross II. The epistatic effects showed that, additive x additive interaction (i) was prevalence for the inheritance of seed cotton yield, lint cotton yield, lint percentage and fiber length traits in cross I and boll weight and fiber strength in cross II, while dominance x dominance interaction (I) was larger important for lint cotton yield, lint percentage, fiber length and uniformity ratio in cross I and micronaire and uniformity ratio in cross II. Broad sense heritability showed high values for uniformity ratio in cross I and boll weight and seed cotton yield in cross II while it was relatively moderate values for boll weight, seed cotton yield, lint cotton yield, lint percentage, micronaire and fiber length in cross I and lint cotton yield, lint percentage and micronaire, while heritability in narrow sense and Parent–off spring regression showed low values for lint percentage, micronaire, fiber strength, fiber length and uniformity ratio in cross I and boll weight, seed cotton yield, lint cotton yield, lint percentage and fiber strength in cross II of the studied traits. The expected genetic advance from selecting the desired 5% of the F_2 showed high values for fiber length in cross I and cross II, while moderate values were recorded for lint percentage in both crosses, while showed low values for other traits. The results partial dominance for lint cotton yield, lint percentage, micronaire, fiber strength, fiber length and uniformity ratio in cross I and seed cotton yield, lint cotton yield, lint percentage, micronaire, fiber length and uniformity in cross II while for boll weight and seed cotton yield in cross I and boll weight fiber strength and uniformity showed over dominance. Dominance was towards the higher parent in most cases. Inbreeding depression values were positive for boll weight and micronaire in cross I and boll weight, lint percentage and micronaire, these results were in harmony with the recorded reduction in the mean performance in F_2 generation. Mid-parent heterosis in F_1 populations was low for lint cotton yield, lint percentage and micronaire in cross I and lint cotton yield, lint percentage, micronaire, fiber strength, fiber length and uniformity ratio in cross II. Generally the pervious results exhibited that the important the each dominance and additive effects for controlling of genetic behavior for most traits. Thus, the recurrent selection and selection in later generation my be increase the genetic advance

Keywords: Cotton, Gossypium barbadense, Hybridization, Gene effects, Genetic parameters

INTRODUCTION

Egyptian cotton breeders mainly directed their efforts towards produce high yield varieties with improving fiber properties, early maturing and wide adaptation at different environments. The chosen hybridization method has been utilized effectively in developing most the present commercial Egyptian varieties; most of these varieties were isolated throughout individual plant selection following hybridization Soliman *et al.*,(2013) and Orabi *et al*., (2016).

Selecting the desirable parents to be used in hybridization depends on the variability of the desirable traits exist in the germplasm; increase genetic variability in the population, the more rapid progress can be caught. Introgression and hybridization are of great importance as effective tools for increasing the genetic variability in the Egyptian cotton gene pool.Using exotic germplasm belonging to G. barbadense from other producing areas is one of the suggested solutions to increase genetic variability and introduce possible new source of favorable alleles by crossing it with the Egyptian varieties to incorporate new combinations of favorable alleles in the population that facilitate and increase the efficiency of selection (El-Feki *et al*., 2012; Hamed *et al*., 2015 and Amer, 2017).

The success of selection in plant breeding program mainly depends on the nature and magnitude of gene action present in the material being handled by the breeder. However, the estimation of variance components, heritability and expected genetic advance upon selection enable the breeder to foresee the reliability of selection for the desired traits. Several studies investigated the type of gene action, heritability, expected genetic advance upon selection heterosis and inbreeding depression in the Egyptian cotton (Mohamed *et al*., 2001; Esmail, 2007; Abd El-Haleem *et al.*, 2010; Nazmey, 2012; El-Hoseiny *et al*., 2013 and Amer *et al*., 2016).

The objectives of present investigation are to study the mean performance and variability of the two cotton crosses in five population (tow parents, F_1, F_2 and F_3), and to obtain useful information about gene action and non-allelic interaction gene effects of some quantitative traits as well as the extent of heterosis, inbreeding depression and potence ratio in two cotton crosses.

MATERIALS AND METHODS

The present study was carried out at Sakha Agricultural Station during 2014 - 2017 growing seasons. In the season 2014, pure seeds of four diverse cotton genotype which included two Egyptian extra-long staple varieties Giza 93 and Giza 96 and one exotic variety, Australian 24202 and G.93 x Suvin were sown on 26th of April and crossed at flowering state to produce F_1 seed of two hybrids, Giza 93 x Australian 24202 cross I and Giza 96 x (Giza 93 x Suvin) cross II.

In 2015 growing season, F_1 seeds were sown as individual plants and at flowering time were selfed to produce F_2 seed. In 2016 F_2, seeds weresown as individual plants and were selfed at flowering to produce F_3 seed.

In 2017 season, the five basic populations (P_1, P_2, F_1, F_2, and F_3) for each of the two crosses were sown in the field on 28th of April, plots consisted of four rows for each of the parents and F_1's and 10 rows for F_2 and F_3 populations. Rows were 4 m long and 65 cm apart and 50 cm between plants. The recommended field practices were adopted all over the growing seasons. Data were recorded on individual plant basis for the following traits:

1. **Boll weight (BW):** Average weight in grams of 10 bolls are random sample for each plant.
2. **Seed cotton yield/Plant (SCY):** The weight of seed cotton yield /plant in grams.
3. **Lint cotton yield/ Plant (LY):** The weight of lint cotton yield /plant in grams.
4. **Lint percentage (L %):** The ratio of lint to seed cotton yield / plant expressed as percentage estimated using the formula:

L% = (Lint cotton yield / plant ,seed cotton yield/ plant)x 100

5. **Micronaire value (Mic.):** Fineness was expressed as micronaire instrument reading and was measured with micromat instrument. ASTM D-3818-98.
6. **Fiber strength (FS):** Expressed as Pressely index and measured by the HVI in gram / tex units.
7. **Fiber length (upper half mean):** Measured by HVI in (mm). ASTM D-3818-98.
8. **Uniformity ratio (U.R):** Determined as follows:

U.R = Mean length / U.H.M.

Statistical and Genetic Analysis:

1-Scaling tests:

Adequacy of scale must satisfy two conditions namely, additivity of gene effects and independence of heritable components from non-heritable ones. Mather (1949) and Hayman and Mather (1955) gave the following tests for scale effects:

$$C=4\overline{F2}-2\overline{F1}-\overline{P1}-\overline{P2};\ V_C=16V(\overline{F2})+4V(\overline{F1})+V(\overline{P1})+V(\overline{P2}).$$

$$D=4\overline{F3}-2\overline{F2}-\overline{P1}-\overline{P2};\ V_D=16V(\overline{F3})+4V(\overline{F2})+V(\overline{P1})+V(\overline{P2}).$$

When the scale is adequate, the values of C and D should be zero within the limits of their respective standard error. The significance of any one of scales is taken to indicate the presence of non-allelic interaction i.e. D provides a test largely of "i" interaction (additive x additive) and C for "l" type (dominance x dominance).

2-Estimates of gene effects:

The analysis of variance of the five basic populations (P_1, P_2, F_1, F_2, and F_3) was statistically analyzed using (RCBD) . The parameters genetic model (m, d, h, i and l) were computed according to Jinks and Jones(1958)as follows:

[m] = F_2 mean performance;S.E. (m) = $(V_m)^{1/2}$

[d] = additive effect = ½ ($p_1 - p_2$) ;S.E. (d) = $(V_d)^{1/2}$

[h] = dominance effects = 1/6 (4 F_1 + 12 F_2– 16 F_3) ;S.E. (h) = $(V_h)^{1/2}$

[i]=additive x additive type of gene interaction = $p_1 - F_2 + ½(p_1 - p_2 + h)$

S.E. (i)=$(V_i)^{1/2}$

[l]=dominance x dominance type of gene interaction = 1/3(16 F_3-24F_2+ 8F_3)

S.E. (l) = $(V_l)^{1/2}$

3-Heritability estimates:

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

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

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

$$h^2n = \frac{\frac{1}{2}D}{\frac{1}{2}D + \frac{1}{4}H + E}$$ (Allard, 1960)

Where:

V_E is the environmental variance = the mean variance of P_1, P_2 and F_1.

V $F_2$is the total phenotypic variance in F_2.

c.Parent–offspring regression, i.e. regression of F_3 line means on their corresponding F_2plant values (b).

$$b = \frac{Cov.F_2 / F3}{VF_2} = \frac{\frac{1}{2}D + \frac{1}{8}H}{\frac{1}{2}D + \frac{1}{4}H + E}$$

4-Expected genetic advance under selection :

Genetic advance calculated according to Johanson *et al.* (1955) as follows:

G.S. = K x Q_P x h^2n

Where:

G.S = expected genetic advance from selection.

K = selection differential with a value of 2.06 under 5% selection intensity.

Q_P = phenotypic standard deviation

h^2n = Heritability in narrow sense.

Expected genetic advance as percentage:

G.S% = (G.S / $\overline{F2}$) x 100

5-Potence ratio(P):

Nature and degree of dominance were calculated using the potence ratio according to Romero and Frey (1973) as follows:

$$P = \frac{\overline{F}_1 - \overline{M.P}}{\overline{H.P} - \overline{M.P}}$$

Where: $\overline{M.P}$ **= mid parent value.**

$\overline{HP}$ **= higher parent value.**

6-Inbreeding depression: Measured from the following equation:

$$\textbf{I.D\%} = (\overline{F}_1 - \overline{F}_2 / \overline{F}_1) \times 100$$

7- **Heterosis**was estimated as the percentage increase of F_1mean over the parents means(M.P).

$$\textbf{H (F}_1\textbf{, M.P) \%} = \frac{\overline{F}_1 - \overline{M}.P}{\overline{M}.P} \times 100$$

RESULTS AND DISCUSSION

Mean squares of the studied traits for the two cotton crosses are presented in Table (1). Data showed significant differences among the five population (P_1, P_2, F_1, F_2 and F_3) for boll weight and fiber the studied traits in both crosses which indicated that the parental genotypes exhibited a considerable amount of genetic variability valid for further genetic studies. Results were agreement with those reported by (Auld, *et al.*, 2000; Lee, *et al.* 2006;Brown *et al.*, 2013 and Patel *et al.*, 2014) and in Egyptian cotton (Mohamed *et al.*, 2001; Esmail, 2007; Abd El-Haleem *et al.,* 2010; Nazmey, 2012; El-Hoseiny *et al.*, 2013 and Amer *et al.*, 2016).

Mean performance:

Means, standard errors and phenotypic variance of the five populations (P_1, P_2, F_1, F_2 and F_3) for the two crosses are presented in Table (2).Results showed that hybridization increased the variabilitise in F_2 generation in both crosses as compared with their parents for boll weight, seed cotton, lint cotton and fiber length which reflects the effectiveness of hybridization in inducing variability in the studied materials.

Table 1. Mean squares of the studied traits for two cotton crosses

S.O.V	d.f	B.W	S.C.Y/P	L.Y/P	L%	Mic.	Press.	F.L	U.R%
				Cross I G.93 x Australian 24202					
Reps	2	0.011*	152.90**	15.17*	0.224*	0.087*	0.001*	0.041*	0.093*
Genotypes	4	0.026**	125.55**	52.66*	18.47**	14.01**	0.806**	1.018**	5.088**
Error	8	0.003	98.83	9.85	0.73	0.142	0.024	0.026	0.049
				Cross II G. 96 x (G.93 x Suvin)					
Reps	2	0.021*	342.78*	48.33*	1.946*	0.152*	0.005*	0.018*	0.013*
Genotypes	4	0.116**	316.64**	46.50**	4.724**	1.597**	0.196**	0.719**	1.475**
Error	8	0.006	103.51	14.93	0.252	0.069	0.008	0.008	0.023

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

Among the four , Giza 96 variety showed the highest values for productivity traits while Giza 93 gave the best fiber quality traits, indicating the possibility of using these two parents in breeding programs to improve the mean performance of the studied traits.

On the contrary, the Australian variety 24202 showed lower values for most traits except for lint % and lint yield /plant which gave the highest values.

In cross I, F_1 gave the heavier value for boll weight (3.23 g) and seed cotton yield (147.88 g) while F_3 gave the lowest yield (130.31 g). The Australian variety 24202 had the highest values for lint yield and lint% (58.34g and 40.65%, respectively) whereas, Giza 93 had the lowest values for both traits (47.39 g and 33.97%, respectively).

On the contrary, Giza 93 gave in the best fiber quality as it gave 3.33 , 11.57, 36.95 and 86.61 for the traits micronaire value, Pressely index, fiber length and uniformity ratio, respectively; whereas, Australian 24202 gave the lower values of fiber properties 4.76, 10.23, 30.99 and 83.46, respective

In cross II, F_1 population induced the highest boll weight (3.50 g), for seed cotton and lint yield/ plant, F_3 gave the highest value for seed cotton yield / plant (157.26 and 59.58 g, respectively) while the . Giza 96 variety had the highest lint% (39.59) whereas, F_2 population and F_3 population (36.21% and 37.89 %, respectively); F_1 population showed the finest fiber as it gave micronaire reading 3.50 while the line (Giza 93 x Suvin) gave the lowest fineness (4.14); F_3 population had the highest fiber strength (11.59 Press.) whereas F_2 population gave the lower value (10.37 Press.); Giza 96 variety had the highest values for fiber length and uniformity ratio (36.07 mm and 87.22%, respectively); whereas, the line (Giza 93 x Suvin) showed the lowest values (34.52 mm and 85.60%, respectively).

Results of scaling tests C and D for the studied traits were presented in Table (3). Data showed that the scaling test D were highly significant in most studied traits while D was insignificant for in both crosses indicating the presence of dominance x dominance allelic interaction for the inheritance of this trait.

Additive x additive interaction was prevalence for the inheritance for in both crosses while dominance x dominance interaction was less important for the inheritance of such traits.

Gene Effects:

Data presented in Table (4) concerning the gene effects in both cotton crosses for the studied traits revealed that mean effect of F_2 performance (m) was highly significant for all traits in both crosses. Initially, it is clear that these traits were quantitatively inherited. Also The additive gene effect (d) showed significant positive significant for seed cotton yield, lint cotton yield fiber length and uniformity ratio in cross I and seed cotton yield ,lint cotton ,lint percentage, fiber length, and uniformity ratio . Dominance gene effect (h) gave significant values for seed cotton yield, lint percentage fiber strength and uniformity ratio in cross I and lint percentage, fiber strength and uniformity ratio cross II . Moreover, the dominance (h) showed larger magnitude than the additive (h) in both gene effect crosses for most of the gene effect studied traits, indicating that dominance gene effects play the major role in controlling the genetic variance for studied traits.

Table 2. Mean performance and variance of parents, F_1, F_2 and F_3 generations in two cotton crosses for the studied traits

Traits	Parameter	P_1	P_2	F_1	F_2	F_3	$L.S.D_{0.05}$
Cross I G.93 x Australian 24202							
B.W	Mean±S.E	3.04 ±0.032	3.05 ± 0.037	3.23 ± 0.031	3.02 ± 0.032	3.10 ± 0.031	0.112
g	Variance	0.03	0.04	0.03	0.06	0.05	
S.C.Y	Mean±S.E	140.58 ±8.11	141.73 ±6.99	147.88 ± 5.76	143.32 ± 2.85	130.31 ±4.27	N.S
g/plant	Variance	1972.87	1468.78	244.39	1996.03	1096.34	
L.Y	Mean±S.E	47.39 ±2.572	58.34 ±2.966	52.50 ±1.049	52.79 ± 2.110	49.13 ±1.618	6.63
g/plant	Variance	198.51	263.95	33.00	267.14	157.00	
L%	Mean±S.E	33.97 ±0.326	40.65 ±0.207	36.64 ±0.211	35.85 ± 0.250	37.71 ±0.272	0.853
	Variance	3.18	1.28	1.33	3.76	4.43	
Mic.	Mean±S.E	3.33 ± 0.043	4.76 ± 0.062	3.80 ± 0.034	3.93 ± 0.046	3.85 ± 0.036	0.160
	Variance	0.06	0.12	0.03	0.13	0.08	
Press.	Mean±S.E	11.57 ±0.073	10.23 ±0.091	11.27 ±0.140	10.47 ± 0.041	11.40 ±0.043	0.198
	Variance	0.08	0.13	0.29	0.17	0.10	
F.L mm	Mean±S.E	36.95 ±0.206	30.99 ±0.130	34.74 ±0.126	34.49 ± 0.153	35.17 ±0.135	0.460
	Variance	1.27	0.51	0.48	1.41	1.10	
U.R%	Mean±S.E	86.61 ±0.191	83.46 ±0.133	85.95 ±0.081	86.58 ± 0.145	86.06 ±0.103	0.437
	Variance	1.10	0.53	0.19	1.27	0.63	
Cross II G. 96 x (G.93 x Suvin)							
B.W	Mean±S.E	3.14 ± 0.046	3.10 ± 0.031	3.50 ± 0.039	3.05 ± 0.041	3.23 ± 0.038	0.118
g	Variance	0.06	0.03	0.04	0.10	0.08	
S.C.Y	Mean±S.E	147.02 ± 7.85	130.9 2±4.99	145.28 ±3.59	154.45 ± 6.20	157.26 ±5.13	18.36
g/plant	Variance	1850.85	748.67	388.35	2306.04	1581.89	
L.Y	Mean±S.E	58.10 ±3.059	49.48 ±1.941	54.00 ±1.374	55.81 ± 2.188	59.58 ±2.005	N.S
g/plant	Variance	280.76	113.00	56.64	287.35	241.25	
L%	Mean±S.E	39.59 ±0.203	37.76 ±0.379	37.15 ±0.148	36.21 ± 0.219	37.85 ±0.193	0.769
	Variance	1.23	4.31	0.66	2.89	2.24	
Mic.	Mean±S.E	4.05 ± 0.040	4.14 ± 0.042	3.50 ± 0.041	3.85 ± 0.033	4.13 ± 0.028	0.121
	Variance	0.05	0.05	0.05	0.06	0.05	
Press.	Mean±S.E	11.36 ±0.069	11.40 ±0.074	10.97 ±0.115	10.37 ± 0.032	11.59 ±0.030	0.164
	Variance	0.07	0.08	0.20	0.10	0.05	
F.L mm	Mean±S.E	36.07 ±0.078	35.27 ±0.118	34.52 ±0.209	35.56 ± 0.062	35.88 ±0.106	0.376
	Variance	0.18	0.42	1.31	0.23	0.68	
U.R%	Mean±S.E	87.22 ±0.054	86.29 ±0.099	85.60 ±0.235	87.03 ± 0.072	87.03 ±0.098	0.321
	Variance	0.09	0.29	1.66	0.31	0.58	

Table 3. Scaling test values of the studied traits for two cotton crosses

Traits	Scaling Test	Cross I G.93 x Australian 24202	Cross II G. 96 x (G.93 x Suvin)
B.W	C ± S.E	-0.4700 ± 0.1493	-1.0300 ± 0.1902
g	D ± S.E	0.3667^{**} ± 0.1459	0.5600^{**} ± 0.1803
S.C.Y	C ± S.E	22.5400 ± 26.0688	39.2800± 27.4477
g/plant	D ± S.E	-36.8300 ± 23.2411	40.1900± 25.7337
L.Y	C ± S.E	0.4220 ± 9.5422	7.6700 ± 9.8643
g/plant	D ± S.E	-14.8060 ± 8.6655	19.1000^{*} ± 9.4294
L%	C ± S.E	-4.4800 ± 1.1525	-6.8167 ± 1.0205
	D ± S.E	4.5000^{**} ± 1.2576	1.6133^{*} ± 0.7867
Mic.	C ± S.E	0.0233 ± 0.2107	0.1900 ± 0.1639
	D ± S.E	-0.5600 ± 0.1870	0.6333^{**} ±0.1403
Press.	C ± S.E	-2.4600 ± 0.3436	-3.2367 ± 0.2815
	D ± S.E	2.8633^{**} ± 0.2236	2.8533^{**} ± 0.1702
F.L	C ± S.E	0.5133 ± 0.7055	0.6800 ± 0.5058
mm	D ± S.E	3.7700^{**} ± 0.6673	-0.1467 ±0.4641
U.R%	C ± S.E	4.3267^{**} ± 0.6465	2.4033^{**} ± 0.5627
	D ± S.E	1.0100 ± 0.7044	- 0.4300 ± 0.4336

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

Some traits showed negative values in both crosses in such as boll weight and fiber length and micronaire readying , these negative values of (h) that revealed that the alleles controlling less value of traits were over dominant those responsible for high value. Morever, the absence of significant (h) component indicated no dominance genetic differences or presence of ambidirectional dominance between the two parents in both crosses and the dominant effect were not important in the genetic control of such insignificant traits in the studied crosses. Results were in agreement with those found by Mohamed *et al*., 2001; Abd El-Haleem *et al*., 2010; Nazmey, 2012 and Amer *et al*., 2016 and disagreed with those of El-Disouqi and Ziena, 2001and El-Hoseiny *et al*., 2013.

When the additive gene effects are larger than the non-additive for a trait, selection in early segregating generations would be effective for improving this trait, while if the non-additive portion is larger than the additive, improving the trait need intensive selection through later generations, when epistatic effects are significant for a trait, there is possibility of obtaining desirable segregations through inter-mating in early segregations by breaking undesirable linkage or it is suggested to adopt recurrent selection handling crosses for rapid improvement such trait (Jagtap, 1986).

Table 4. Gene effects in two cotton crosses for the studied traits

Traits	m	d	h	i	l
		Cross I (G.93 x Australian 24202)			
B.W	3.02** ± 0.032	0.002 ±0.024	- 0.074 ±0.105	0.982** ±0.313	- 0.259 ±0.109
S.C.Y	147.88** ± 5.76	9.577** ±3.355	43.810** ±16.329	105.83** ±52.027	40.490** ±19.47
L.C.Y	52.79** ± 2.110	5.472** ±1.963	9.576 ±6.075	20.304 ±19.163	1.002 ±7.173
L%	35.85** ± 0.250	3.343** ±0.193	4.420** ±0.892	11.973** ±2.535	10.433** ±0.887
Mic.	3.93** ± 0.046	- 0.712 ±0.038	0.132 ±0.135	- 0.778 ±0.426	1.046** ±0.152
Press.	10.47** ± 0.041	0.667 ±0.358	1.946** ±0.169	7.098** ±0.545	- 0.986 ±0.207
F.L	34.49** ± 0.153	2.977** ±0.122	-1.654 ±0.480	4.342** ±1.460	3.526** ±0.515
U.R%	86.58** ± 0.145	1.573** ±0.116	0.968** ±0.403	- 4.422 ±1.303	3.194** ±0.463
		Cross II G. 96 x (G.93 x Suvin)			
B.W	3.05** ± 0.041	0.022 ±0.028	- 0.163 ±0.132	2.120** ±0.399	- 0.502 ±0.135
S.C.Y	154.45** ± 6.20	8.050** ±3.654	13.610 ±18.627	9.45 ±57.461	3.813 ±20.035
L.C.Y	55.81** ± 2.188	4.308** ±1.811	11.243 ±6.971	15.240 ±20.840	2.838 ±7.463
L%	36.21** ± 0.219	0.918** ±0.215	3.737** ±0.683	11.240** ±2.072	0.375 ±0.785
Mic.	3.85** ± 0.033	- 0.042 ±0.029	- 0.986 ±0.102	0.591 ±0.318	0.474** ±0.114
Press.	10.37** ± 0.032	0.018 ±0.051	2.850** ±0.128	8.120** ±0.430	- 2.478 ±0.169
F.L	35.56** ± 0.062	0.200** ±0.071	- 1.542 ±0.339	-1.102 ±0.936	0.189 ±0.329
U.R%	87.03** ± 0.072	0.138** ±0.056	0.971** ±0.338	-3.778 ±1.0	0.611** ±0.302

m=F_2 mean performance; d=additive; h=dominance; I=additive x additive and l=dominance x dominance.

The epistatic effects, additive x additive (i) were positive and significant for boll weight, seed cotton yield / plant, lint% micronaire reading and fiber length in cross I in addition to boll weight, lint% and pressely index in cross II. In addition, dominance x dominance (l) were positive and significant for seed cotton yield/ plant, lint%, fiber length and uniformity ratio in cross I, as well as micronaire reading and uniformity ratio in cross II indicating the important role of these interactions in the inheritance of such traits, whereas the rest of traits showed insignificant values and less important role for epistatic effects in inheritance of these traits. There results were agreement with those reported by Esmail, 2007; Abd El-Haleem *et al.,* 2010; Nazmey, 2012 and Amer *et al*., 2016.

Genetic Parameters:

Data concerning the genetic parameters i.e. heritability estimates, expected genetic advance from selection, potance ratio, inbreeding depression and heterosis of both crosses are presented in Table (5). Broad sense heritability (h^2b) in cross I showed relatively moderate values (30%≤ h^2b≥ 60%) for all studied traits except pressely index that gave low value; while in cross II h^2b values were moderate for the traits boll weight, seed cotton and lint yields/plant, while the rest of traits gave low values (less than 30%). Heritability in narrow sense (h^2n) showed moderate values for fiber length and uniformity ratio in cross I, while the rest traits gave low values in both crosses .Parent–offspring regression, i.e. regression of F_3 line means on their F_2 plant values (b) showed high values (more than 60%) for pressely index and fiber length in cross I as well as micronaire reading and pressely index in cross II, while moderate value was observed for uniformity ratio in cross I only; the rest traits showed low values. High to moderate values of heritability estimates indicating that efficiency selection for improving such traits could be practiced on individual plant basis during early segregating populations; while low values indicating that selection must be practiced in late segregating generation. Results were in the same line with those reported by: El-Disouqi and Ziena, 2001; Mohamed *et al*., 2001; Abou El-Yazied *et al*., 2008; Nazmey, 2012 and Amer *et al*., 2016.

Table 5. Heritability estimates, expected genetic advance from selection, potance ratio, inbreeding depression and heterosis in two cotton crosses for the studied traits.

Traits	Heritability %			G.s %	P %	I.D %	Heterosi M.P
	h^2b	h^2n	b				
			Cross I (G.93 x Australian 24202)				
B.W	45.16	00	-73.79	-5.58	2.10	6.46	5.97
S.C.Y	38.44	00	0.42	-0.19	3.76	-3.18	1.53
L.Y	38.18	00	-0.93	-13.67	0.07	-0.55	-0.69
L%	48.57	19.04	26.49	28.74	-0.20	2.14	-1.80
Mic.	46.40	13.94	13.44	33.73	-0.34	-3.38	-6.06
Press.	00	25.18	70.59	20.90	0.56	7.11	3.43
F.L	46.48	41.46	70.14	74.49	0.26	0.74	2.28
U.R%	52.05	48.08	55.48	16.62	0.58	-0.72	1.08
			Cross II G. 96 x (G.93 x Suvin)				
B.W	55.52	19.30	-62.61	53.67	1.62	12.81	12.24
S.C.Y	56.81	0.40	0.23	3.33	0.78	-6.31	4.54
L.C.Y	47.75	1.44	0.50	11.64	0.05	-3.35	0.39
L%	28.44	28.88	-0.50	36.03	-0.66	2.53	-3.94
Mic.	21.77	9.58	66.21	16.70	-0.48	-9.86	-14.53
Press.	00	1.52	60.49	0.96	2.27	5.52	-3.59
F.L	0	00	-19.87	-24.02	-0.77	-3.03	-4.83
U.R%	00	00	-33.72	-0.78	-1.26	-1.67	-1.90

h^2b: heritability in broad sense, h^2n: heritability in narrow sense, b: heritability in F_3, G.s: expected genetic advance from selection; P%:potance ratio; I.D %: inbreeding depression and heterosis as mid-parent.

The expected genetic advance from selection the desired 5% of the F_2 population showed high values for the traits fiber length (74.49%) in cross I and boll weight (53.67%) in cross II; while moderate values were recorded for the traits L%, micronaire reading and pressely index in cross I, and L% in cross II. Whereas the rest of traits showed low values in this respect. It is worth mentioning that the high values of the predicted gain from selection were linked with high estimates of heritability indicated that improving these traits were more effective throughout selection. Many authors reached to the same results (Mohamed *et al*., 2001; Abou El-Yazied *et al*., 2008; El-Hoseiny *et al*., 2013 and Amer *et al*., 2016).

Potance ratio (P) was used to determine the degree of dominance as follows: Complete dominance or over dominance when P equal exceed ±1.0, partial dominance when P is between ± 1.0, except zero which indicates absence of dominance. Positive and negative signs indicate the direction of dominance to either higher or lower parent, respectively (Smith, 1952). Data concerning potence ratio (P) for the two crosses in this study are presented in Table (5). Data revealed partial dominance for most of the studied traits in both crosses except for boll weight and seed cotton yield in cross I as well as boll weight, pressely index and uniformity ratio in cross II that showed over dominance. The direction of dominance was towards the higher parent in most of the studied traits except for lint % and micronaire reading in both crosses and fiber length in cross II that showed dominance towards the lower parent. These results were in agreement with those reported by El-Disouqi and Ziena, 2001; Mohamed *et al*.,2001; Nazmey, 2012; El-Hoseiny *et al*., 2013 and Amer *et al*., 2016.

Inbreeding depression values were positive for the traits boll weight, lint%, micronaire reading and pressely index in both crosses as well as fiber length in cross I, these results were in harmony with the recorded reduction in the mean performance in the F_2 generation of most studied traits in both crosses, this expected as the expression of heterosis in F_1 will be followed by respective reduction in F_2 due to the direct effect of homozygosity, this findings were in harmony with those obtained by Nazmey, 2012; El-Hoseiny *et al*., 2013and Amer *et al*., 2016.

Mid-parent heterosis in F_1 populations were low for most studied and fiber traits in both crosses in this study (Table 5). Data revealed Positive values of mid-parent heterosis for all traits in cross I (except for lint yield and lint% that gave negative values), as well as boll weight, seed cotton yield, lint yield and micronaire reading in cross II reflecting the positive heterotic effects for these traits; the effects were insignificant in most cases. Similar positive or negative heterotic effects were recorded for cotton traits (El-Disouqi and Ziena, 2001; Abd-El-Haleem *et al*., 2010 and El-Hoseiny *et al*., 2013).

CONCLUSION

Out of the present study, it could be concluded that hybridization increased the variability in F_2 populations in both crosses compared with parents for the studied traits.Genetic analysis revealed that the studied traits were effected by under both of additive and dominance gene effects, the dominance components of genetic variation exceeded surpassed the additive component suggesting higher degree of dominance action and hence selection should be delayed to later generations and hybrid vigor might be fruitful for progress in case of such traits.

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التحليل الوراثى لبعض الصفات الكمية فى القطن المصرى

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اجرى هذا البحث بمحطة البحوث الزراعية بسخا لأربعة مواسم (٢٠١٤-٢٠١٧) حيث تم اختيار ٤ تراكيب وراثية من القطن الباربادنس وهى: الصنفين جيزة ٩٣ وجيزة ٩٦ من الأصناف المصرية فائقة الطول والهجين (جيزة ٩٣× سيوفين) والصنف الأسترالى ٢٤٢٠٢ لانتاج هجينين الهجين الأول جيزة ٩٣x استرالى ٢٤٢٠٢ والهجين الثانى جيزة ٩٦ x (جيزة ٩٣ x سيوفين) والحصول على بذرة الجيل الاول فى موسم ٢٠١٤ وفى الموسم التالى تم زراعة النباتات الفردية واجراء عملية التلقيح الذاتى للحصول على بذرة الجيل الثانى وفى موسم ٢٠١٦ تم زراعة النباتات الفردية واجراء التلقيح الذاتى للحصول على بذرة الجيل الثالث وفى موسم ٢٠١٧ تم تقييم كلا من أباء وجيل أول وجيل ثاني والجيل الثالث فى تجربة احتوت على ٤ خطوط لكلا من الاباء والجيل الاول و١٠ خطوط للجيلين الثانى والثالث طول الخط ٤ متر وعرضه ٦٥ سم والمسافة بين الجور ٥٠ سم وتم تسجيل البيانات على النباتات الفردية لصفات وزن اللوزة و محصول القطن الزهر ومحصول القطن الشعر للنبات وتصافى الحليج والنعومه مقدرة بقراة الميكرونير والمتانة والطول ومعامل الانتظام .وكانت أهم النتائج المتحصل عليها كما يلي: ١-أظهر التباين للاجيال (الآباء والجيل الأول والثاني والثالث) وجود فروق معنوية عاليه لمعظم الصفات المدروسة مما يشير الى وجود اختلافات ورثية بين الاباء تسمح باجراء دراسات وراثية متقدمه .٢ -أدى التهجين إلى زيادة التباين فى الجيل الثانى فى كلا الهجنين مقارنة بالاباء فى معظم الصفات المدروسة مما يدل على فاعلية التهجين فى استحداث التباين فى التراكيب الوراثية المستخدمه. .٣- اظهر التحليل الوراثي أن الصفات المدروسة كانت صفات كمية فى توارثها وقد اظهر المكون الاضافى قيم معنوية موجبة لبعض الصفات (محصول النبات من القطن الزهر والشعر، التصافى، طول التيلة، الأنتظام) بينما اظهر المكون السيادى قيم معنوية لمعظم الصفات وهى محصول القطن الزهر، التصافى، المتانة والأنتظام فى الهجين الأول بالأضافة الى التصافى، المتانه والأنتظام فى الهجين الثانى وكانت قيم المكون السيادى اعلى من المكون الاضافى فى كلا الهجنين لمعظم الصفات٤- دلت نتائج التفوق ان التفاعل الاضافى × الاضافى موجب ومعنوى للصفات وزن اللوزة، محصول القطن الزهر، التصافى، طول التيله فى الهجين الأول وكذلك وزن اللوزة، التصافى والمتانه فى الهجين الثانى بينما كان التفاعل غير معنوى لباقى الصفات. بينما التفاعل السيادى × السيادى كان اقل منه فى القيمة وكان معنويا للصفات محصول القطن الزهر، طول التيله والأنتظام فى الهجين الأول بالأضافة الى النعومه والأنتظام فى الهجين الثانى ولم يكن التفاعل معنويا لباقي الصفات في كلا الهجينين ٥- أظهرت درجة التوريث بالمعنى الواسع قيما متوسطة لكل الصفات (ما عدا المتانه فى الهجين الأول وكذلك وزن اللوزة ومحصول القطن الزهر والشعر فى الهجين الثانى) بينما أعطت درجة التوريث بالمعنى الضيق قيما منخفضة لكل الصفات (ماعدا طول التيلة والانتظام في الهجين الأول .٦- اظهر التحسين المتوقع من انتخاب ٥٪ من نباتات الجيل الثانى قيما عالية لعدد قليل من الصفات (طول التيلة فى الهجين الأول متوسط وزن اللوزة فى الهجين الثانى) بينما كانت القيم متوسطة لبعض الصفات الاخرى وهى(التصافى لكلا الهجينين والنعومه والمتانه فى الهجين الأول) بينما اظهر قيم منخفضة لباقى الصفات.٧- أظهرت النتائج وجود سيادة جزئية لمعظم الصفات المدروسة لكلا الهجنين باستثناء متوسط وزن اللوزة ومحصول القطن الزهر فى الهجين الأول ومتوسط وزن اللوزة، المتانه والأنتظام فى الهجين الثانى والتى اظهرت سيادة فائقة. وكان اتجاه السيادة نحو الاب الافضل فى معظم الصفات المدروسة.٨- اظهر الانخفاض الناتج عن التربية لداخلية قيما موجبة لمعظم الصفات المدروسة بينما اظهرت نتائج قوة الهجين لمتوسط الابوين فى الجيل الاول قيم موجبة منخفضة وغير معنويه لمعظم الصفات .٩- وبصفه عامه فان التهجين أدى إلى زيادة الاختلافات في كلا الهجنين مقارنة بالإباء وان كلا من الفعل الاضافى والسيادي كان لهما اثر في وراثة الصفات المختلفة وزيادة اثر الفعل السيادي مما يدل على أن الانتخاب في الأجيال المتاخره يكون أكثر فاعليه في تحسين تلك الصفات .