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GENETICAL ANALYSIS OF SOME YIELD COMPONENTS AND FIBER QUALITY OF TWO HYBRIDS COTTON

El-Hoseiny, H. A. ; M. H. M. Orabi and K. M. A. Baker
Cotton Res. Institute, Agric. Res. Center, Giza, Egypt.

ABSTRACT

The present study was carried out at Sakha Agric. Exp. Station Res. during the three successive seasons 2010, 2011 and 2012. The objective of this study to estimate of some genetic parameters to understand the inheritance of yield and its components of cotton crosses (Giza 90 x pima s^6) and (Giza 88 x Australian).The experiment was grown in a randomized complete blocks design with three replication. The means of the six populations; P_1, P_2, F_1, F_2, Bc_1 and Bc_2 of two cotton crosses recorded for boll weight, seed cotton yield, lint cotton yield , lint percentage, micronaire reading, fiber strength, fiber length and uniformity ratio were subjected to scaling test and six population method to detect epistasis and estimates of m, d, h, i, j and L parameters. The results indicated that the additive dominance model was adequate to demonstrate the genetic variation and its important in the inheritance of most studied traits non allelic interaction was operating in the control of genetic variation in most studied traits. The additive gene effect, wee significant for quality traits in two crosses, while the dominance were significant for seed cotton yield, lint yield and lint percentage.

INTRODUCTION

The true knowledge of the gene action for various cotton traits is useful in making decisions with regard to appropriate breeding system, which be used for the development of new cotton genotypes. The knowledge of relationships among breeding materials is essential to the plant breeders for improving this crop. Mather and Jinks (1982) reported that generation mean analysis is a quantitative genetic method be able to estimate additive, dominance and epistatic effects. Genetic analysis using generation means have been used in cotton breeding to estimate the type of gene action controling of quantitative traits. On the other hand, heterosis breeding is an important genetic tool to facilitate yield enhancement In cotton, significant positive heterosis over-mid and better parent was detected for both number of sympodial branches per plant and yield of seed cotton per plant Bhatti, *et al.,* (2006), for both lint yield and boll number per plant Garg, *et al.,* (1987). Kearsey and Jinks (1968), cleared that heterosis relative to mid-parent and better parent was found to be significantly positive for boll number per plant, seed cotton yield and lint yield per plant in the intrabarbadense crosses, while, it was negative in the intrahirsutum crosses. Crossing between genetically divergent parents are expected to have a larger genetic variance among progenies than crossing between closely related parents, Khedr (2003). The present study aims to obtain useful information about gene action and non allelic interaction gen effect of some quantitative traits as well as the extent of hybrid vigour, inbreeding depression and potance ratio in the two cotton crosses.

MATERIALS AND METHODS

The present study was carried out during the period of 2010, 2011 and 2012 growing seasons, at the Experimental Farm of the Sakha Agricultural Research Station. four varieties were used for this study namely Giza 88, Australian, Giza 90and Pima S_6. In 2010 season, the four varieties were sown and crossed to produce two F_1 hybrid seeds: cross no. 1 (Giza 88 x Australian) and cross no. 2 (Giza 90 x Pima S_6), In 2011, crossing was made between the F_1 hybrids of each cross and its two respective parents to produce the first backcross to P_1 (F_1 x P_1) and second (F_1 x P_2) to obtained backcrosses (BC_1 and BC_2). At the same time, the crossing was made among the parents to produce F_1 seeds. Some F_1 hybrids were selfed to produce the F_2 generation. In 2012, the six basic population (P_1, P_2, F_1, F_2, Bc_1 and Bc_2) of each of the two crosses were sown in a randomized complete block design with three replications. Each replicate consisted of one row of each of the parents and F_1's, two rows of each back-cross and three rows for the F_2 populations. Rows were 7 m long and 60 cm apart and 70 cm between plants. The recommended field practices were adopted all over the growing seasons. Data were recorded on individual plant basis as follows:

1. Boll weight in grams (B.W. g): The average boll weight in grams of 5 bolls picked at random from each plot.

2. Seed cotton yield, estimated as the weight of seed cotton yield and was computed in kentar/Feddan (k/fed).

3. Lint cotton yield, estimated as the weight of lint cotton yield in kentar/Feddan (k/fed)

4. Lint percentage: Ratio of lint cotton yield to seed cotton yield sample expressed as percentage using the formula

$$L\% = \frac{\text{weight of lint in sample}}{\text{weight of seed cotton in the same sample}} x100$$

5. Micronaire value (Mic): Fineness was expressed as micronaire instrument reading. The characters were measured with micromat instrument. ASTM D-3818-98

6. Fiber strength (F.S): Measured by HVI in gram / tex units. **ASTM D-3818-98**

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 = $\frac{\text{Mean length}}{\text{U.H.M}}$

Statistical and Genetic Analysis:

The analysis of variance of the six basic population (P_1, P_2, F_1, F_2, Bc_1 and Bc_2) was statistically analyzed using (RCBD) analysis of variance. The scaling tests (A, B and C) were calculated for each trait to detect the adequacy of the additive dominance model or the presence of non-allelic gene interaction according to Mather and Jinks [1]. The parameters genetic model (m, d, h, i, j and l) were computed according to Jinks and Jones [9] as follows:

[m] = mean, [d] = additive effect = BC_1 – [BC_2] = dominance effect = $F_1 - 4F_2 - ½ P_1 - ½ P_2 + 2 BC_1 + 2 BC_2$, [i] = additive x additive type of gene interaction = $2BC_1+2BC_2- 4F_2$
[j] = additive x dominance type of gene interaction = BC_1 - ½ P_1 - BC1 + ½ P2 and [i] = dominance x dominance type of gene interaction = $P_1 + P_2 + 2F_1+4F_2- 4BC_1 - 4BC_2$ whenever the additive-dominance model proved to be adequate, the phenotypic variance for each character was partitioned into additive (D), dominance (H) and environmental (E) using [1] as follows:
E =⅓ (V P_1 + V P_2 +V F_1), D = 4 VF_2 – 2 (V BC_1 + V BC_2), H = 4 (VF_2 - ½ V_D – V_E).

$$\pm T = \frac{\text{effect}}{\sqrt{\text{variance of effect}}}$$

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

$$H (F_1, B.P) \% = \frac{\overline{F_1} - \overline{B.P}}{\overline{B.P}} \times 100$$

Heterosis deviation = $\overline{F_1} - \overline{B.P}$, variance of heterosis deviation =

$$V\overline{F_1} - V\overline{B.P}$$

Heterosis from the mid-parent $H (F_1, M.P) \% = \frac{\overline{F_1} - \overline{M.P}}{\overline{M.P}} \times 100$

Heterosis deviation = $\overline{F_1} - \overline{M.P}$, variance of heterosis deviation =

$$V\overline{F_1} - \frac{1}{4}(V\overline{P_1} + V\overline{P_2})$$

Inbreeding depression; its values were measured from the following equations:

$$I..D = \frac{\overline{F_1} - \overline{F_2}}{\overline{F_1}} x100$$

Variance of inbreeding depression (V.I.D) for F_1 = $V\overline{F_1} + V\overline{F_2}$

$$t.I.D = \frac{\overline{F_1} - \overline{F_2}}{\sqrt{V.I.D}}$$

Potence ratio

Degree of dominance h_1, h_2 and h_3 for the studied characters in the F_1, F_2 and double crosses were calculated using the potence ratios according to Romero and Frey (1973) as followes:

$$h_1 = \frac{\bar{F}_1 - \overline{M}.P}{\bar{H}.P - \overline{M}.P}$$

Where: $\overline{M}.P$ = Mid parent value $\bar{HP}$ = higher parent,

RESULTS AND DISCUSSION

The means and standard errors of six population in two crosses for eight traits are presented in Table 1 with regarding to the boll weight, the mean performance of six population of two crosses exhibited insignificant differences. These trend was exhibited by the fiber quality; the results indicated that means of F_1 of the first cross were higher than either the highest parent or mid- parent value for seed cotton and lint cotton yield indicating over or partial dominance respectively. On other hand the F_1s of the second cross were less than either low parent or mid parent value for lint cotton yield, while seed cotton yield, the F_1s of second cross exhibited value which did not differ significantly than higher parent. Mean while the F_{1s} of two crosses were lower than the highest parent or mid parent for lint percentage. Many investigators were found same results and other investigators found disagreed results El-Disouqi and Zeina (2001) and Abd-El-Haleem *et al.* (2010). The means of F_2 were lower than F_1 for all traits indicating to presence the inbreeding depression

The results of the A, B and C scaling test for assessing the validity of additive–dominance model are given in Table 2. The non-allelic interaction was found to be operating genetic variation among the six population for most studied traits. Except cross number 1 for boll weight, two crosses for lint percentage and cross number 2 for micronaire reading the values of the A,B and C scaling test were not significant, indicating the absence of non-allelic interaction and additive-dominance model was adequate to demonstrate the genetic variation and it is important for inheritance of the above mentioned studied traits in such crosses. While the most of other traits exhibited the significant the three scaling test or any saling test indicated that the precise of non allelic interaction indicating that the interaction play a important role In inheritance these traits. These results are in agreement with those obtained by Esmail (2007), Abdel-Hafez *et al.*, (2007), El-Beially and Mohamed (2008) and Abd-El-Haleem *et al.* (2010).

The parameters of gene effect conducted by using six population means are presented in Table 2. The means effect (m) was highly significant for all studied traits indicating that all studied traits were quantitatively inherited. The parameters (d) additive were significant or highly significant for all quality traits except for fiber length in both crosses meanwhile the parameters (d) were insignificant for boll weight, seed and lint cotton yield and lint percentage except the cross number 1 the parameter (d) was significant. This finding disagreed with those obtained by Abd-El-Haleem *et al.* (2010)

Table 1: Mean performance of parent, F_1, F_2 and Backcross generations in two cotton crosses for all studied traits

	Boll weight		Seed cotton yield		Lint cotton yield		Lint %	
Generation	Cross 1	Cross 2	Cross 1	Cross 2	Cross 1	Cross 2	Cross 1	Cross 2
P_1	3.05 ± 0.020	2.7±0.059	276.8±3.030	149.8±13.613	113.8±1.275	48.4±4.609	41.1±7.141	35.0±0.458
P_2	3.04 ± 0.021	2.8±0.091	249.2±2.718	132.5±8.571	92.9±1.097	51.9±3.558	37.3±6.708	41.8±0.431
F_1	2.95 ± 0.014	2.8±0.064	289.2±1.860	149.1±29.895	115.2±0.802	44.1±2.896	39.8±7.211	38.91.317
BC_1	2.98 ± 0.035	2.6±0.042	253.1±6.899	116.9±9.827	99.4±2.779	45.2±3.446	39.3±10.77	53.5±13.599
BC_2	3.05 ± 0.039	2.6±0.066	236.1±6.958	100.4±6.295	88.7±2.644	46.4±8.388	37.7±10.247	49.6±7.498
F_2	3.04 ± 0.046	2.7±0.035	249.3±7.191	96.4±3.963	95.3±2.776	34.8±1.581	38.3±10.05	40.1±0.290
Generation	Micronaire value		Fiber strength		Fiber length		Uniformity ratio	
	Cross 1	Cross 2	Cross 1	Cross 2	Cross 1	Cross 2	Cross 1	Cross 2
P_1	4.1±0.049	3.5±0.057	10.2±0.084	10.95±0.139	32.90±0.167	35.83±0.170	85.24±0.090	87.64±0.376
P_2	3.5±0.047	3.9±0.119	10.5±0.094	10.64±0.094	33.95±0.183	32.79±0.506	85.84±0.133	86.49±0.295
F_1	3.8±0.042	3.6±0.080	10.2±0.075	10.71±0.127	33.02±0.179	35.56±0.215	85.38±0.113	87.26±0.230
BC_1	3.9±0.028	3.7±0.076	10.3±0.046	10.96±0.120	33.26±0.292	34.82±0.336	85.64±0.071	52.27±7.609
BC_2	3.8±0.026	4.0±0.070	10.2±0.055	10.92±0.091	34.17±0.112	33.14±0.324	86.02±0.071	86.56±0.282
F_2	3.8±0.031	3.6±0.043	10.2±0.056	10.67±0.055	33.79±0.103	34.43±0.123	85.89±0.070	85.47±1.024

Table 2: The scaling test of the additive, dominance and interaction parameters in two cotton crosses for all studied traits

Scaling test & parameter	Boll weight		Seed cotton yield		Lint cotton yield		Lint %	
	Cross 1	Cross 2	Cross 1	Cross 2	Cross 1	Cross 2	Cross 1	Cross 2
A	-0.040±0.074	-0.23±0.12	-59.9±14.25	-65.0±38.3*	-30.1±5.8*	-2.2±8.8	-2.4±23.8	33.1±27.2
B	0.110±0.082	-0.43±0.17*	-66.1±14.30	-80.8±33.6*	-30.6±5.5*	-2.9±17.4	-1.7±22.7	18.6±15.1
C	0.170±0.187	-0.40±0.22	-106.9±29.3	-194.8±63.9*	-55.8±11.3*	-49.0±10.4*	-4.9±43.8	5.7±2.9
[m]	3.040±0.046	2.67±0.04	249.3±7.2	96.4±4.0	95.3±2.8	34.8±1.6	38.3±10.0	40.1±0.3
[d]	-0.070±0.052	0.05±0.08	16.9±9.8	16.5±11.7	10.7±3.8	-1.2±9.1	1.6±14.9	3.9±15.5
[h]	-0.195±0.211	-0.17±0.23	7.1±34.9*	57.0±41.9	6.9±13.5	38.0±19.6*	1.5±50.8	46.4±31.1
[i]	-0.100±0.210	-0.26±0.21	-19.0±34.8	49.0±28.2	-4.9±13.5	43.9±19.2	0.9±50.0	45.9±31.1
[j]	-0.075±0.054	0.10±0.10	3.1±10.0	7.9±14.2	0.2±3.9	0.4±9.5	-0.3±15.7	7.3±15.5
[l]	0.030±0.2803	0.91±0.38	144.9±48.9	96.7±79.1	65.6±19.1	-38.9±37.7	3.2±73.9	-97.5±62.2
Scaling test & parameter	**Micronaire value**		**Fiber strength**		**Fiber length**		**Uniformity ratio**	
	Cross 1	**Cross 2**	**Cross 1**	**Cross 2**	**Cross 1**	**Cross 2**	**Cross 1**	**Cross 2**
A	-0.2±0.08	0.24±0.18	0.03±0.15	0.27±0.31	0.6±0.63	-1.76±0.725	0.66±0.20*	0.66±0.20*
B	0.3±0.08	0.21±0.20	-0.36±0.16	0.48±0.24	1.4±0.34	-2.07±0.850	0.82±0.23*	0.82±0.23*
C	0.0±0.17	-0.10±0.27	-0.43±0.30	-0.33±0.38	2.3±0.60	-2.03±0.843	1.72±0.39*	1.72±0.39*
[m]	3.82±0.03	3.66±0.04	10.20±0.06	10.67±0.06	33.8±0.10	34.43±0.12	85.89±0.07	85.89±0.07
[d]	0.08±0.04*	-0.19±0.10*	0.05±0.07	0.05±0.15	-0.9±0.31*	1.68±0.47*	-0.38±0.10*	-0.38±0.10**
[h]	0.15±0.16	0.43±0.29	-0.03±0.28	0.99±0.40*	-0.7±0.78	-0.56±1.11*	-0.40±0.37*	-0.40±0.37
[i]	0.12±0.15	0.55±0.27*	0.10±0.27	1.08±0.37*	-0.3±0.75	-1.81±1.05	-0.24±0.35	-0.24±0.35
[j]	-0.21±0.05	0.02±0.12	0.20±0.10*	-0.11±0.17	-0.4±0.34	0.15±0.54	-0.08±0.13	-0.08±0.13
[l]	-0.21±0.22	-1.00±0.49*	0.23±0.41	-1.83±0.71*	-1.7±1.39	5.65±2.05	-1.24±0.56	-1.24±0.56

The dominance (h) were insignificant for all studied traits except lint cotton yield and fiber strength in cross number 2 indicating the parameters (h) was less important in the inheritance of most studied traits or presence of ambidirectional dominance between two parents, while the parameter (d) additive were important in the inheritance quality traits.

With regard to the negative value of (h) were for some studied traits indicated that the alleles responsible for less value traits over dominance alleles controlling high value.

The epistasis effect additive x additive (i) was insignificant value for all traits in both cross except for micronaire value and fiber strength in cross number 2. The epistasis (j) dominance x dominance were insignificant for all traits in both crosses except for micronaire value and fiber strength in cross number 1. The epistasis (l) additive x dominance were significant for seed and cotton yield cross number 1, and cross number 2 exhibited significant epistasis (i) additive x additive for micronaire value, fiber strength, fiber length and uniformity ratio. Meanwhile, the cross number 1 exhibited significant epistasis (l) additive x dominance for uniformity ratio.

The sign of h and I were opposite in all studied traits for two crosses except for seed cotton yield and lint cotton yield in cross II indicating duplicate type of non-allelic interaction for these traits.

Table 3: Heterosis, inbreeding depression (%), potance ratio phenotypic (PCV) and genotypic (GCV) coefficient variability in two cotton crosses for all studied traits.

Traits	Crosses	Heterosis		Inbreeding Depression (%)	Potance ratio
		M.P	B.P		
Boll weight	1	-3.120	-3.279	-3.051	-0.002
	2	3.019	1.290	5.036	-0.015
Seed cotton yield	1	9.951	4.458	13.768	1447.7
	2	5.628	-0.476	35.336	274.90
Lint cotton yield	1	11.464	1.222	17.253	495.35
	2	-11.790	-14.513	21.084	37.536
Lint %	1	1.633	-3.114	3.892	4.915
	2	1.211	-7.002	-3.058	-6.315
Micronaire value	1	0.655	8.782	0.521	0.029
	2	-3.175	2.570	-0.971	0.100
Fiber strength	1	-1.301	-2.662	0.391	0.078
	2	-0.826	-2.220	0.352	-0.055
Fiber length	1	-1.212	-2.739	-2.332	0.850
	2	3.645	-0.757	3.184	7.614
Uniformity ratio	1	-0.187	-0.536	-0.597	0.192
	2	0.220	-0.434	2.053	0.439

With regarding the heterosis inbreeding depression and potance ratio, Positive heterosis % over mid parent ranged from 0.187 in the cross (1) for uniformity ratio to 11.48 for lint cotton yield, while the positive heterosis ranged from 0.22 in the cross (2) for uniformity ratio to 5.62% for seed cotton yield. Negative heterosis over mid parent were exhibited in the cross (1) by boll weight, fiber strength, fiber length and uniformity ratio while the negative heterosis, exhibited in cross (2) by lint cotton yield, micronaire value of fiber strength the negative heterosis of micronaire is desirable value.

Positive hetrosis over better parent were showed in cross I by traits of seed and lint cotton yield and micronaire value while positive heterosis of better parent in cross II exhibited by seed cotton yield, boll weight and micronaire value. These results were agreed partially with those obtained by El-Disoqui and Zeina (2001), Abd- El-Haleem *et al.* (2010) and El-Beially and Mohamed (2008)

Inbreeding depression value were positive and all traits in cross (1) except for boll weight, fiber length and uniformity ratio while the values of inbreeding depression were positive in cross II except for lint percentage and micronaire value these results were harmony with reduction in the mean in the F_2 generation of most studied traits in two crosses, this is expected as expression of heterosis in F_1 will be followed by respectivel reduction in F_2 due to the direct effect of homozygosity this finding agreed with those was obtained by Abdalla 2007

The potance ratio, the data in Table 3 showed that the potance ratio in two crosses I were positive and more than the unity for seed and lint yield these results due to the presence the dominance effect controlled the genetic system this traits, this agreed with the presence heterosis and dominance gene effect for seed and lint cotton yield.

The results also showed that the potance ratio were low than unity for boll weight, fiber strength, micronaire value and uniformity ratio in two crosses these finding due to the obscene the dominance effect the fiber length exhibited more unity in cross II while cross I exhibited low potance ration

CONCLUSION

The additive effects were important in quality traits and dominance gene effects were important in yield component. The types of epistasis were important in the genetic system controlling for all studied traits in the two crosses the heterosis % over mid-parent ranged from – 0.187 for uniformity ratio in cross I to 11.46% for lint cotton in cross I while ranged in cross II from 0.220 for uniformity ratio to – 11.79% for lint cotton yield

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التحليل الوراثى لبعض الصفات المحصولية والتكنولوجية فى هجينين من القطن

حسن أمين الحسيني ، مصطفى حسنى محمد عرابى و خالد محمد عبده بكر
معهد بحوث القطن – مركز البحوث الزراعية

اجرى هذا البحث بمحطة البحوث الزراعية بسخا مواسم ٢٠١٠، ٢٠١١ و ٢٠١٢م بغرض حساب بعض القياسات الوراثية لفهم طريقة توريث المحصول ومكوناته للهجينين (جـ ٩٠ × بيما س٦) و (جـ ٨٨ × استرالى) . وتم زراعة الست عشائر فى تجربة قطاعات كاملة عشوائية ذات ثلاث مكررات ، وتم تسجيل النتائج على الست عشائر $P_1, P_2, F_1, F_2, Bc_1, Bc_2$ وكانت الصفات المدروسة هى : متوسط وزن اللوزة ، محصول القطن الزهر، محصول القطن الشعر، نسبة التصافى %، قراءة الميكرونير، طول التيلة، متانة التيلة وكذلك نسبة الانتظام وتم اختبار مدى ملائمة النموذج additive-dominance لتوريث هذه الصفات باختبارات A,B,E وتم حساب الدلالات الوراثية m, d, h, i, j , L

وكانت اهم النتائج المتحصل عليها:

١- أظهرت النتائج أهمية المكون الغير اليلى فى وراثة معظم الصفات المدروسة.

٢- أظهرت النتائج أهمية المكون الإضافى فى توريث صفات الجودة.

٣- أظهرت النتائج أهمية المكون السيادى فى صفات المحصول.

٤- تراوحت قوة الهجين بين ١٨٧% لصفة نسبة الانتظام الى ١١.٤٦% فى محصول الشعر فى الهجين الاول بينما كان مدى قوة الهجين فى الهجين الثانى بين ٠.٢٢% لنسبة الانتظام الى ١١.٧٩% فى محصول الشعر.

قام بتحكيم البحث

أ.د / سعد احمد المرسى	كلية الزراعة – جامعة المنصورة
أ.د / طلعت احمد محمود الفقى	مركز البحوث الزراعيه