GENETIC ANALYSIS OF SOME QUANTITATIVE TRAITS IN COTTON

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Abstract

The main objective of the present investigation is to obtain wide genetic variation by using line x tester analysis involving two selected testers as male parents, namely, Austuralian and Karashneky and four Egyptian cotton cultivars as females (lines) namely Giza80, Giza85, Giza90 and Giza87 (G.barbadense). Eight F1's, the two tester varieties and the four line cultivars were grown in a randomized complete block design with three replications in 2006 season to evaluate combining abilities and nature of gene action.

Genotypes mean squares were highly significant for all traits except for lint percentage (L %), lint index (LI) and uniformity index (U.I). Parents mean squares revealed highly significant differences for all studied traits except for lint percentage (L %) and lint index (LI). Higher estimates of dominance (O2d) variance than additive variance (O2A) were recorded and low narrow sense heritability values (h%n.s) and low magnitude of the ratio Q2gca/Q2sca (less than unity) were found for first fruiting node (FFN), seed cotton yield (SCY), lint yield (LY), lint percentage (L%), seed index (SI), lint index (LI), micronair value (Mic), pressly index (PI) and Upper half mean (U.H.M). On the other hand days of first flower (DFF), boll weight (BW) and uniformity index (U.I) recorded high estimates of additive variance (O2A) and narrow sense heritability (h%n.s). For the testers, Australian and Karashneky varieties were good combiners for first fruiting node (FFN), days of first flower (DFF), seed cotton yield (SCY), lint yield (LY) and uniformity index (U.I). Among female parents the variety Giza85 was the best combiner for days of first flower (DFF), seed cotton yield (SCY), lint yield (LY), seed index (SI) and uniformity index (U.I). Giza87 was the best general combiners for fiber traits. Giza90 was the best general combiner for boll weight (B.W), seed index (SI) and uniformity index (U.I). Giza80 was the best combiner for first fruiting node (FFN), days of first flower (DFF), boll weight (BW), seed cotton yield (SCY), lint yield (LY), micronair value (Mic) and pressly index (PI).

It could be concluded that the hybrid (Australian x Giza85) and (Karashneky x Giza85) may be used for the improvement of seed cotton yield (SCY), lint yield (LY), seed index (SI) and Upper half mean (U.H.M), while (Australian x Giza80) and (Karashneky x Giza80) hybrids were the best for the improvement of seed cotton yield (SCY), lint yield (LY) and pressly index (PI).

INTRODUCTION

Most of the Egyptian cotton varieties are morphologically similar and their yield capacity is generally equal. This is due to insufficient genetic variations among them's. Since the continual use of such genetic resources in breeding programs decreased the genetic variation. Therefore, it should be carefully chosen the new genetic sources belonging to *Gossypium barbadense. L* as parental lines in the breeding program.

Line by tester technique is used extensively in cotton to assess the parental lines in terms of their ability to be combined in hybrid combinations. With this method the total genetic variation is partitioned to general and specific combining ability (GCA and SCA) effects. GCA is mainly used to estimate the additive gene action which plays the most important rote in cotton breeding programme for the improvement of cotton traits. SCA is used to estimate dominance and epistasis which helps the breeder in choosing the suitable hybrids for his breeding to introduce hybrid cotton.

The general objective of this study is to determine the magnitude of general and specific combining abilities and provide information about the genetic variance for some traits in some cotton hybrids belonging to *Gossypium barbadense. L.* El-Debaby et al., (1997) reported that the additive genetic variance was the most important for lint percentage (L%), lint index (LI) and fiber properties. Mohamed et al., (2000) reported that the additive gene effect was greater than the dominance gene effect for seed cotton yield/ plant (SCY) , lint yield/plant (LY), lint percentage (L %), lint index (LI) and all fiber traits. El-Adl et al., (2001) found that general combining ability (GCA) effects were larger in magnitude than those of specific combining ability (SCA) and showed highly significant differences for all studied traits. Laxman and Genesh (2003), revealed that specific combining ability (SCA) variance was higher than general combining ability (GCA) for boll weight (BW), seed cotton yield (SCY) , seed index (SI), lint index (LI) and halo length. Abd EL- Hadi et al., (2005) showed that specific combining ability (SCA) effect was highly significant and larger than those of general combining ability (GCA) for all studied traits. Ismail et al., (2005) reported significant positive general combining ability (GCA) effects for seed cotton yield and most of its contributing variables.

MATERIALS AND METHODS

The two cotton testers Austuralian and Karashneky were used as male parents (tester). Four Egyptian cotton varieties namely, Giza 80, Giza 85, Giza 90 and Giza 87 which were chosen as female parents (Lines). Both testers and lines are belonging to *Gossypium barbadense L.*

The female parents were top-crossed to common male parents in 2005 season at Seds experiment station, Agricultural Research Center to produce eight F1 hybrids. Parents and their hybrids were grown in 2006 season in a randomized complete block design with three replications to evaluate the parents and their F1's for yield and its components.

Each plot consisted of two rows 4m long and 0.6m wide. Hills were 0.20m apart. The hills were thinned to tow plants/hill. All the agriculture practs were done as recommended.

A representative random sample of ten individual guarded plants per plot were tested to estimate the following traits.

1- Height of first fruiting node (F.F.N).
2- Number of days to first flower (D.F.F).
3- Boll weight in grams (BW / g).
4- Seed cotton yield / plant in grams (Scy / P).
5- Lint cotton yield / plant in grams (LY / P).
6- Lint percentage (L %).
7- Seed index in grams (SI).
8- Lint index in grams (LI).
9- Micronaire reading (Mic).
10- Pressly index (PI).
11- Upper half mean (U.H.M).
12- uniformity index. (U.I).

The analysis of variance was performed according to Steel and Torrie (1980), while Line x Tester analysis was calculated according to Kempthorne (1957). Heritability in narrow sense ($h^2_{n.}$ %) and broad sense ($h^2_{b.}$ %) were determined as described by Al-jiboury *et al* (1958).

RESULTS AND DISCUSSION

The present investigation aimed to obtain wide genetic variation by chosing the new genetic resource belonging to *Gossypium barbadense L* to make hybrid combinations and by partitioning the total genetic variation of this material to general and specific combining ability to estimate the additive, dominance and epistatic portions.

Analysis of variance for all studied traits are given in Table (1). Genotypes mean squares were highly significant for all traits except for lint percentage (L %), lint index (LI) and uniformity index (U.I). Parents mean squares were recorded for all studied traits except for lint percentage (L %) and lint index (LI). Parents Vs crosses (P.Vs.C) mean squares were found to be significant for boll weight (BW), seed cotton yield

(SCY), lint yield (LY), seed index (SI), lint index (LI) and uniformity index (U.I). Variance values due to specific combining ability (SCA) for hybrids were highly significant for all studied traits except for lint percentage (L %), lint index (LI) and uniformity index (U.I). Lines (Females) (GCA) mean squares were highly significant for first fruiting node (F.F.N), days to first flower (D.F.F), boll weight (BW), micronaire value (Mic) and uniformity index (U.I). Highly significant tester (GCA) mean squares were observed for boll weight (BW), lint percentage (L %), pressly index (PI) and uniformity index (U.I). Significant line x tester mean squares were recorded for seed cotton yield (SCY), lint yield (LY), seed index (SI), micronaire value (Mic), pressly index (PI), Upper half mean (U.H.M) and uniformity index (U.I) Table (1).

It is to be noted that, significant mean squares of some studied traits for genotypes, parents and hybrids indicated that genetic variability for the majority of these traits was existed. While the traits which showed significant parents vs crosses indicated the presence of heterotic effects in some cases. Similar results were reported by El-Feki et al., (1994), Mohamed et al., (2000) and Zeina et al., (2001)

Specific combining ability (SCA) variance was higher than general combining ability (GCA) variance was observed. The higher estimates of dominance (O^2_d) than additive variance (O^2_A) and low narrow sense heritability (h%n.s) and low magnitude of the ratio O^2_{gca}/ O^2_{sca} (less than unity) suggested the superiority of non-additive gene action for first fruiting node (F.F.N), seed cotton yield (SCY) , lint yield (LY), lint percentage (L%), seed index (SI), lint index (LI), micronaire value (Mic), pressly index (PI) and Upper half mean (U.H.M).It mean that, this material could be used for introducing hybrid cotton rather than for introducing varieties for those traits. Days to first flower (D.F.F), boll weight (BW) and uniformity index (U.I) showed high estimates of GCA variance, additive variance (O^2a) and narrow sense heritability values (h%n.s) indicating the predominance role of additive gene action for these traits. These finding are important in planning cotton breeding methods to produce early cotton varieties with heavy bolls.

Mean performance for all studied characters of the genotypes are presented in Table (2). It was clear that the female Giza90 and Giza80 gave high mean performance for first fruiting node (F.F.N), days to first flower (D.F.F), boll weight (BW), seed cotton yield (SCY) , lint yield (LY) and lint percentage (L%).Giza87 recorded higher mean performance for fiber quality than the other female parents. The male parent Karashensky showed higher mean performance for first fruiting node (F.F.N), days to days to first flower (D.F.F), seed cotton yield (SCY) , lint yield (LY) and seed index (SI) compared with Austuralian male. The best hybrids were P1 x P5 (Austuralian x G85) for seed cotton yield (SCY) , lint yield (LY), seed index (SI) and uniformity index (U.I), cross P2 x P5 (Austuraliann x G87) for fiber properties, cross

P4 x P5 (Austuralian x G80) for first fruiting node (F.F.N) and days to first flower (D.F.F), cross P3 x P6 (Karashneky x G90) for first fruiting node (F.F.N), lint percentage (L%), lint index (LI) and cross P4 x P6 (Karashneky x G80) for first fruiting node (F.F.N), days to first flower (D.F.F) and boll weight (B.W) (Table 2).

Estimates of general combining ability effects (GCA) for all studied traits are presented in Table (3). Giza85 showed the best general combining ability effects (GCA) for days to first flower (D.F.F), boll weight (B.W) seed cotton yield (SCY) , lint yield (LY), seed index (SI) and uniformity index (U.I). Whereas, Giza87 was the best general combiner for fiber traits. Giza90 was the best general combiners for boll weight (BW), seed index (SI) and uniformity index (U.I). Giza80 was the best combiner for first fruiting node (F.F.N), days to first flower (D.F.F), boll weight (BW), seed cotton yield (SCY), lint yield (LY), micronaire value (Mic) and pressly index (PI). Among the males (testers), Table (3) revealed that Austuraliann and Karashneky varieties were good combiners for first fruiting node (F.F.N), days to first flower (D.F.F), seed cotton yield (SCY) , lint yield (LY) and uniformity index (U.I). Therefore it could be stated that, Giza90, Austuralian and Karashnesky may be good combiners for introducing varieties rather than producing hybrid cotton.

Estimates of specific combining ability (SCA) effects for studied traits are given in Table (4). The results indicate that all SCA effects concerning first fruiting node (F.F.N), days to first flower (D.F.F), boll weight (BW), lint percentage (L%), lint index (LI), micronaire value (Mic) and uniformity index (U.I) were not significant for all hybrids. While hybrids (Austuralian x G85) and (Karashneky x G85) showed significant differences SCA effects for seed cotton yield (SCY), lint yield (LY), seed index (SI) and Upper half mean (U.H.M). However the crosses (Australian x G80) and (Karashneky x G80) recorded significant differences for seed cotton yield (SCY), lint yield (LY) and pressly index (PI). Generally, it could be concluded that the two varieties Australian and Karashneky are good combiners and can be used in cotton breeding programs to increase the genetic variability and/or to wide the genetic base of the Egyptian cotton germplasm.

Table 1. Mean square estimates for yield components and fiber properties.

S.O.V	df	F.F.N	D.F.F	BW	SCY	LY	L%	SI	LI	Mic	PI	U.H.M	U.I
Genotypes (G)	13	0.844**	79.628**	0.152**	1055.737**	160.196**	3.442	0.343**	0.211	0.091**	1.056**	5.317**	3.760
Parents (P)	5	0.933**	127.967**	0.192**	850.719**	140.958**	3.327	0.263**	0.083	0.138**	0.735**	9.923**	3.822**
P. Vs .C	1	0.018	14.000	0.053**	3590.723**	551.573**	0.258	0.883**	0.531*	0.015	0.016	1.031	1.727**
Crosses (C)	7	0.899**	54.476**	0.137**	840.038**	118.026**	3.980	0.323**	0.256	0.068**	1.434**	2.640**	4.007
Lines (L)	3	1.486**	113.667**	0.263**	830.686	100.387	7.267	0.394	0.209	0.112**	1.128	0.870	3.907**
Tester (T)	1	0.375	2.667	0.107**	796.723	118.415	0.267**	0.0004	0.006	0.0104	3.682**	1.927	13.054**
(L x S)	3	0.486	12.556	0.021	863.827**	135.536**	1.931	0.359**	0.387	0.043*	0.992**	4.648**	1.092**
Error	26	0.284	7.804	0.023	50.513	12.318	3.538	0.059	0.264	0.0172	0.141	0.543	1.053
$σ^2$ gca		0.016	1.873	0.0005	-6.869	-1.721	0.0828	-0.0004	-0.001	0.0001	0.0141	0.1247	0.1288
$σ^2$ sca		0.0674	1.584	-0.0007	271.104	41.0725	-0.5357	0.1000	0.0411	0.0085	0.284	1.3682	0.01280
$σ^2$ A additive		0.0320	3.745	0.0105	-13.738	-3.441	0.1655	-0.0082	-0.017	0.0018	0.0281	-0.249	0.2576
$σ^2$ D dominance		0.0674	1.584	-0.0007	271.104	41.0725	-0.5357	0.1000	0.041	0.0085	0.284	1.368	0.0128
$σ^2$ gca/ $σ^2$ sca		0.2374	1.182	0.7143	0.0253	0.0418	0.1545	0.0004	0.02	0.106	0.049	0.0911	10.063
h_{ns}%		16.49	47.23	60.0	5.01	8.25	20.45	7.35	15.59	11.25	7.84	19.19	41.45
h_{bs} %		51.24	67.20	56.0	93.86	90.16	45.75	82.3	21.24	64.38	86.9	86.07	43.51

*,**Significant at the 5% and 1% level of probability, respectively.

Table 2. Mean performance of lines.

Genortypes	F.F.N	D.F.F	BW	SCY	LY	L%	SI	LI	Mic	PI	U.I	U.H.M
P1(G85)	8	74	3.0	84.10	31.04	37.00	9.6	5.64	3.9	10.7	31.0	87.2
P2 (G87)	8	79	2.6	72.67	28.65	36.31	9.2	5.99	3.7	11.8	33.7	88.2
P3 (G90)	6	65	3.2	123.00*	48.43	39.35	8.7	5.68	4.2	10.3	30.0	86.2
P4 (G80)	6	63	3.2	96.71	38.36	39.61	9.4	5.64	4.3	10.5	30.1	85.8
P5 (Australian)	6	67	2.9	90.04	34.63	38.15	9.2	5.94	3.9	9.8	29.1	85.2
P6 (Karashnesky)	6	63	2.7	97.19	37.15	38.25	9.4	5.85	4.2	9.6	28.7	85.7
P1 x P5	8	68	2.8	145.74**	55.05	37.79	10.1	6.20	3.9	11.2	32.5	87.3
P2 x P5	8	70	2.6	121.60**	46..41	38.19	9.6	5.97	3.8	11.7	34.0	88.4
P3 x P5	7	67	2.9	116.13	45.10	38.89	9.0	5.76	4.2	10.7	30.2	85.6
P4 x P5	6	63	2.9	91.01	36.25	39.79	9.3	6.18	4.1	9.6	30.4	85.7
P1 x P6	7	71	2.8	110.20*	41.50	37.68	9.6	5.79	4.0	9.9	29.4	85.8
P2 x P6	7	74	2.6	95.79	35.21	36.78	9.5	5.54	3.7	9.7	31..2	85.9
P3 x P6	6	65	3.1	113.45*	45.71	40.18	9.5	6.42	4.1	10.4	31.2	88.2
P4 x P6	6	62	3.2	108.95*	42.62	39.17	9.6	6.33	4.1	9.7	30.1	87.0
LSD 1%	1.209	6.338	0.345	16.120	7.963	4.267	0.552	1.165	0.298	0.851	1.672	2.328
LSD 5%	0.894	4.689	0.255	11.930	5.890	3.157	0.408	0.862	0.220	0.630	1.237	1.722

*,**Significant at the 5% and 1% level of probability, respectively.

Table 3. General combining ability effects for characters studied.

Line & Tester	F.F.N	D.F.F	BW	SCY	LY	L%	SI	LI	Mic	PI	U.I	U.H.M
Tester												
Australian	0.425**	-0.633*	0.067	5.762**	2.221*	0.105	-0.004	0.016	0.021	0.192	0.283	-0.738*
Karashnesky	-0.425**	0.633*	-0.067	5.762**	2.221*	-0.105	-0.004	-0.016	-0.021	-0.192	-0.283	0.738*
SE (g^i)	0.454	0.306	0.044	2.052	1.013	0.543	0.070	0.148	0.038	0.108	0.213	0.296
L.C.D 1%	0.394	0.796	0.113	5.253	2.593	1.390	0.179	0.379	0.097	0.276	0.545	0.758
L.C.D 5%	0.302	0.600	0.086	4.022	1.985	1.064	0.137	0.290	0.074	0.212	0.417	0.580
Line												
G85	0.225	3.000**	-0.267**	15.111**	4.795**	-0.823	0.329**	-0.014	-0.063	0.233	0.233	-0.929*
G87	0.358	1.833	-0.067	-4.161	-2.673	-1.075	0.029	-0.252	-0.163**	0.400**	0.633*	-0.829*
G90	0.125	-1.667	0.150*	1.933	1.922	0.974	-0.288**	0.079	0.104	0.217	-0.350	0.938*
G80	-0.708**	-3.167**	0.183**	-12.883**	-4.045**	0.924	-0.071	0.187	0.121*	-0.850**	-0.517	0.821
SE (g^i)	0.218	1.141	0.062	2.902	1.433	0.768	0.099	0.210	0.054	0.153	0.301	0.419
LSD 1%	0..559	2.921	0.159	7.429	3.668	1.966	0.253	0.538	0.138	0.392	0.771	1.073
LSD 5%	0.427	2.236	0.122	5.688	2.809	1.505	0.194	0.412	0.106	0.300	0.590	0.821

***Significant at the 5% and 1% level of probability, respectively.

Table 4. Specific combining ability effects for traits studied.

Hybrids	F.F.N	D.F.F	BW	SCY	LY	L%	SI	LI	Mic	PI	U.H.M	U.I
Aus x G85	0.375	-1.333	0.050	12.010**	4.552*	-0.049	0.321*	0.188	-0.104	0.275	1.267**	0.004
Aus x G87	0.042	-1.167	0.050	7.145	3.380	0.600	0.054	0.196	0.096	0.408	-0.367	0.471
Aus x G90	-0.292	1.333	-0.033	-4.422	-2.525	-0.752	-0.229	-0.344	0.029	-0.242	-0.750	-0.563
Aus x G80	-0.125	1.167	-0.067	-14.733**	-5.408**	0.205	-0.146	-0.040	-0.021	-0.442*	-0.150	0.089
Kar x G85	-0.375	1.333	-0.050	-12.010**	-4.552*	0.049	-0.321*	-0.188	0.104	0.275	-1.267**	-0.004
Kar x G87	-0.042	1.167	-0.050	-7.145	-3.380	-0.600	-0.054	-0.196	-0.096	-0.408	0.367	-0.471
Kar x G90	0.292	1.333	0.033	4.422	2.525	0.752	0.229	0.344	-0.029	0.242	0.750	0.563
Kar x G80	0.125	-1.167	0.067	14.733**	5.408**	-0.205	0.146	-0.040	0.021	0.442*	0.150	-0.088
SE	0.308	1.613	0.088	4.103	2.026	1.086	0.141	0.297	0.076	0.217	0.426	0.593
LSD 1%	0.788	4.129	0.225	10.504	5.187	2.780	0.361	0.760	0.195	0.556	1.091	1.512
LSD 5%	0.604	3.161	0.172	8.042	3.971	2.129	0.276	0.582	0.149	0.425	0.835	1.162

**Significant at the 5% and 1% level of probability, respectively.

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التحليل الوراثى لبعض الصفات الكمية فى القطن

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معهد بحوث القطن – مركز البحوث الزراعية – الجيزة

أجرى هذا البحث بغرض زيادة التباين الوراثى فى القطن المصرى من خلال اختيار تراكيب وراثيه من اصناف القطن الباربادينس وهما الصفين الاسترالى وكاراشنكى اللذان استخدما كأصناف كاشفة (أباء) ، وجيزة٨٥ و جيزة٨٧ وجيزة٩٠ وجيزة٨٠ (أمهات) وذلك من خلال التهجين بين الآباء والامهات فى محطة البحوث الزراعية بسدس (بنى سويف) وتم الحصول على ٨ هجن من الجيل الاول تم تقييمها بعد ذلك مع الأصناف الكاشفة فى تجربة قطاعات كاملة العشوائية من ثلاثة مكررات فى عام ٢٠٠٦ وذلك بغرض حساب القدرة العامه والخاصه على التآلف وكذلك تقدير طبيعة الفعل الجينى ، وكانت أهم النتائج المتحصل عليها هى:

١. أظهر جدول تحليل التباين أن هناك فروق معنوية بين التراكيب الوراثية المستخدمة وذلك لجميع الصفات المدروسة عدا صفتى تصافى الحليج ومعامل الشعر. كذلك أظهرت الآباء فروق معنويه للصفات المدروسة عدا صفتى تصافى الحليج ومعامل الشعر.

٢. دلت النتائج على أن تباين الفعل الجينى السيادى أكبر من تباين الفعل الجينى المضيف علاوة على انخفاض المكافئ الوراثى فى المعنى الضيق وذلك لصفات ارتفاع عقدة اول فرع ثمرى ومحصول القطن الزهر والشعر وتصافى الحليج ومعامل البذرة والشعر وقراءة الميكرونير ومتانة التيلة وطول التيلة .

٣. أوضحت النتائج أن الصنفين الكاشفين الاسترالى وكاراشنكى لهما قدرة عامة على التألف لصفات ارتفاع عقدة أول فرع ثمرى وتاريخ تفتح أول زهرة ومحصول القطن الزهر والشعر ومعامل انتظام الطول.

٤. اظهرت النتائج ان الصنف جيزة ٨٥ له قدرة عامة على التآلف لصفات تاريخ تفتح اول زهرة ومحصول القطن الزهر والشعر ومعامل البذرة وانتظام الطول بينما أظهر الصنف جيزة ٨٧ قدرة عامة على التآلف لصفات التيلة اما الصنف جيزة ٩٠ فقد اظهر قدرة عامة على التألف لصفة متوسط وزن اللوزة ومعامل البذرة وانتظام طول التيلة كذلك اظهر الصنف جيزة ٨٠ قدرة عامة التآلف لصفات ارتفاع عقدة أول فرع ثمرى وتاريخ تفتح اول زهرة ومتوسط وزن اللوزة ومحصول القطن الزهر والشعر وقرأة الميكرونير ومتانة التيلة.

٥. دلت النتائج على ان الهجين (استرالى × جـ ٨٠) والهجين (كاراشنكى × جـ ٨٥) يمكن استخدامهما فى برامج التربية وذلك لتحسين صفات محصول القطن الزهر والشعر ومعامل البذرة وطول التيلة بينما الهجينين (استرالى × جـ٨٠) والهجين (كاراشنكى × جـ٨٠) يمكن استخدامهما لتحسين محصول القطن الزهر والشعر ومتانة التيلة.

٦. نستنتج من الدراسة أن الصنف الأسترالى وكاراشنكى يمكن استخدامهما فى برامج التربية وذلك لتوسيع القاعدة الوراثية من خلال عمليات التهجين.