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TRIALLEL CROSSES ANALYSIS FOR SOME QUANTITATIVE CHARACTERS IN *Gossypium barbadense* L.

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ABSTRACT

This study was carried out through three successive growing seasons (2003, 2004 and 2005). Thirty triallel crosses were combined among five parental lines belong to *Gossypium barbadense* L. were evaluated at Sids Agricultural Research Station to estimate general and specific combining abilities for yield, yield components and some fiber properties. The nature of gene action that controlling the inheritance of the studied characters were also estimated.

The results showed that the performances of most triallel crosses were as good as or better than their both grand parents or/and their third parent. The mean squares of genotypes were highly significant for all studied characters which were mainly due to the variances among the parents as well as the variances among the triallel crosses. The mean squares of general and specific combining abilities were significant for first and second kind for most traits. Significant positive general effects of h_i and g_i revealed that the selection of P3 or P5 as a grand parent and P1 or P2 as a third parent would be more benefit to improve SCY and LY characters in the breeding programs. The triallel crosses (15 x 2), (34 x 2), (35 x 2) and (45 x 2) were positive and significant for yield and its components, (25 x 4) for MIC, PI, UHM and UI, (12 x 4) and (23 x 4) for PI, UHM and UI. The results also showed that the specific effects of the triallel crosses (t_{ijk}) were predominately affected by the specific effects of second kind effects (s_{ij}) (third parent) rather than the first kind (d_{ij}) (single hybrids) and partially by the general effects of first and second kind. The magnitudes of dominance variances were larger than those of the additive variances for all studied traits except for MIC and UHM traits. Concerning the epistatic variances, the results indicated that the additive x dominance type of epistasis played the major role in controlling the inheritance of the studied characters of the triallel crosses. Therefore, recurrent selection might be useful in improving the studied characters of the triallel crosses in the breeding programs.

INTRODUCTION

Selection and breeding procedures for the desirable characters of cotton are largely depending on the type and relative amounts of genetic variance components in the population. Most of the Egyptian cotton varieties morphologically and in their yield production were similar due to insufficient genetic variation among them. Since, the continual use of such genetic resources has narrowed the genetic variation. Therefore, new genetic sources other than Egyptian genotypes, belong to *G. barbadense* L., should be carefully chosen and involved as parental lines in the breeding programs. Diallel or line by tester technique is used extensively in cotton to clarify the parental lines in terms of their ability to be combined in hybrid combinations. With this method the total genetic variation is partitioned not two main parts; the variance of general combining ability which includes the additive genetic portion, and that for specified combining ability which is usually defined to include non-additive genetic portion arising largely from dominance and epistatic variances. Many investigators studied general and specific combining abilities among them; El-Feki and Abdel-Gelil (2001), Hemaida *et al.* (2001), Zeina *et al.* (2001), Lasheen (2003) and Lasheen *et al.* (2003). Recently, Egyptian cotton breeders have tried to recombine more than two parental lines through hybridization in their breeding programs. A three-way crosses or a triallel technique is a product of three parents, for instance (A x B). The theoretical aspect of triallel analysis has been dealt with by Rawling and Cockerham (1962), Hinkelmann (1965), Ponnuswamy (1972) and Singh and Chaudhary (1985). Comparable to the previous mentioned techniques, three-way crosses analysis provides additional informations regarding epistatic components of variances and the effect of order in which the parents are involved in crosses. Abdel-Bary (2003) in a study on triallel crosses of Egyptian cotton concluded that most of the studied traits were mainly influenced by additive and additive by additive gene action, while dominance and other epistatic effects played the minor role in the inheritance of these traits. However, in another study, Yehia (2005), revealed that the magnitudes of additive genetic variances were positive and larger than these dominance genetic variances for all studied characters. In addition, the type of epistatic variances additive by dominance were positive and played the major role in inheritance of most studied traits.

The main purpose of this investigation is to estimate general and specific combining abilities for yield, yield components and some fiber properties and to determine the nature of gene action that influence the inheritance of these traits.

MATERIALS AND METHODS

Five cotton genotypes belong to *Gossypium barbadense* L. were used in this study. three of them are Egyptian cotton varieties; (G. 90) a long staple cotton cultivated in Upper Egypt characterized by high yielding ability, (G. 83) long stable variety grown in a district area in south Egypt characterized by early maturing and (G. 85) a long staple variety that grown in north Egypt exhibited higher fiber strength and lower micronaire value. The other two varieties were the American long staple Pima cotton ($P.S_6$) and ($P.S_4$). The first one showed high lint percentage and early maturing and the second one exhibited higher yield and lower micronaire value.

In the growing season (2003), the five parents were included in a diallel mating system to obtain 10 single crosses (no reciprocals). In the next growing season (2004), the single crosses were subjected in a triallel mating system. Whereas, the parent should not be crossed more than one in the same three way crosses to get 30 crosses = [n (n-1) (n-2)/2], where n is the number of parents. In 2005 growing season the 30 crosses and the five parents were evaluated in a randomized complete blocks design experiment with three replications at Sids Agricultural Research Station. Each plot was one row 4 m. long, 0.6 m. wide and 10 hills/row. One plant lift per hill and ordinary cultural practices were followed as the recommendations.

Data of the individual plants were recorded for the following traits; seed cotton yield/plant in gm. (SCY), lint yield in gm. (LY), lint percentage (%), seed index in gm. (SI), lint index in gm. (LI), micronaire value for fiber fineness and maturity (MIC), pressley index for fiber strength (PI), upper half mean (UHM) as a measure of span length in mm. and uniformity index (UI). The fiber properties were measured in the laboratories of Cotton Fiber Research Section, Cotton Research Institute.

Analyses of variance were done according to Steel and Torrie (1980). The theoretical aspect of three way crosses analysis has been dealt with by Rawling and Cockerham (1962), Hinkelmann (1965), Pounswamy (1972) and outlined by Singh and Chaudhary (1985). Considering y_{ijkl} as the measurement recorded on a triallel cross $G_{(ij)k,}$ the statistical model takes the following form:

$$y_{ijkl} = m + b_i + h_i + h_j + d_{ij} + g_k + s_{ik} + s_{jk} + t_{ijk} + e_{ijkl}$$

Where:

Y_{jkl}:Phenotypic value in the i^{th} replication on the ij^{th} cross (grand parents) mated to K^{th} parent.

m:Grand mean

b_i:Effect of i^{th} replication.

h_i:General line effect of i^{th} parent as grand parent (first kind general line effect).

d_{ij}:Two-line (i x j) specific effect of first kind (grand parents).

g_k:General line effect of K as parent (second kind effect).

S_{ik}:Two-line specific effect where i is a grand parent and K is the third parent. Hence specific effects of second kind.

t_{ijk}:Three-line specific effect.

e_{ijkl}:Error effect.

The form of the analysis of variances and the expectations of the mean squares will take the following form:

Sov	df	EMS
Due to *g* ignoring *h*	v-1	
Due to *h* eliminating *g*	v-1	$\sigma^2_e + [rv(v-2)(v-3)/(v-1)^2] \sum h^2_i$
Due to *d* ignoring *s*	v (v-3)/2	
Due to *s* eliminating *d*	v^2-3v + 1	$\sigma^2_e + [r/(V^2-3v+1)] \sum\sum s_{ij} [(V^2-5v+5) s_{ii} - s_{ii}]$
Due to *t*	v (v^2-6v+7)/2	$\sigma^2_e + [2r/v(v^2-6v+7)] \sum\sum\sum t_{iik}^2$
Due crosses	p-1	$\sigma^2_e + [2r/v(v-1)(v-2)-2] \sum\sum\sum C^2_{iik}$
Due to *g* eliminating *h*	v-1	$\sigma^2_e + [rv(v-3)/(v-1)] \sum g^2_i$
Due to *d* eliminating s	v(v-3)/2	$\sigma^2_e + [2(v-1)(v-4)/v(v-3)^2] \sum\sum d^2_{ij}$
Error	(r-1)(p-1)	σ^2_e

In this table v stands for the number cf varieties (=5) and P is the number of triallel crosses (= 30).

Further, form the expected mean squares it is evident that the effects are to be tested against error mean squares using appropriate degrees of freedom.

RESULTS AND DISCUSSION

The mean performances of the five parents and their 30 three-way hybrids were estimated and the results are presented in Table 1. The results showed that the parent $P.S_4$ (P5) was the highest yielding parent for SCY and LY characters, while it was lower for line percentage comparable with G. 90 (P1), G. 85 (P2) and $P.S_6$ (P4). Concerning fiber properties, the parental variety G. 85 (P2) exhibited the best mean performances comparable to the other for MIC, PI, UHM and UI traits.

Table 1:The mean performances of the parents and their three way crosses for yield, yield components and some fiber properties.

Trait. Gen.	SCY Gm.	LY Gm.	LP %	SI Gm.	LI Gm.	MIC.	PI	UHM mm.	UI
G. 90 (P1)	55.5	22.0	39.6	10.0	6.55	4.2	10.1	29.7	85.0
G. 85 (P2)	58.2	23.5	40.4	10.0	6.78	4.0	10.4	31.0	86.9
G. 83 (P3)	44.0	16.5	37.6	9.5	5.70	4.2	10.3	30.3	85.2
P. S6 (P4)	49.1	19.4	39.6	9.9	6.46	4.6	10.3	31.1	86.4
P. S4 (P5)	63.6	24.5	38.5	10.3	6.45	4.2	10.2	31.6	86.1
12 x 3*	44.5	17.9	40.2	9.9	6.68	4.2	10.3	30.7	85.8
12 x 4	71.2	28.0	39.3	9.7	6.30	4.2	10.2	30.4	86.7
12 x 5	556.1	21.6	38.6	9.3	5.86	4.2	10.1	30.6	85.1
13 x 2	69.8	27.4	39.3	10.2	6.57	4.2	9.7	31.9	84.1
13 x 4	47.4	18.6	39.3	9.9	6.43	4.4	10.5	31.0	85.8
13 x 5	44.8	17.8	39.8	9.3	6.13	4.0	10.0	30.1	86.2
14 x 2	78.5	31.8	40.5	9.5	6.50	4.3	10.0	30.5	85.0
14 x 3	54.3	21.1	38.8	9.7	6.12	4.1	10.3	31.6	83.8
14 x 5	58.3	22.9	39.2	9.4	6.08	4.3	10.0	31.8	84.8
15 x 2	64.2	25.0	38.9	9.8	6.22	4.5	10.1	30.8	85.3
15 x 3	58.7	22.7	38.7	9.8	6.16	4.3	9.9	31.2	85.8
15 x 4	57.3	22.5	39.3	9.8	6.32	4.1	10.2	31.4	86.7
23 x 1	61.2	24.3	39.7	10.1	6.66	4.3	9.9	30.2	85.7
23 x 4	72.4	29.1	40.2	9.9	6.65	4.2	9.8	31.0	84.6
23 x 5	80.1	31.9	39.8	10.4	6.86	4.3	9.9	30.9	85.3
24 x 1	78.1	30.2	38.6	9.7	6.09	4.3	10.0	30.7	85.5
24 x 3	56.0	22.4	39.9	9.8	6.50	4.2	10.1	31.2	86.6
24 x 5	56.2	21.9	38.8	9.4	5.99	4.1	10.0	30.7	85.7
25 x 1	83.2	32.7	39.3	10.7	6.93	4.4	9.9	31.2	85.6
25 x 3	45.4	17.8	39.1	9.8	6.30	4.4	10.1	30.9	86.5
25 x 4	65.0	25.2	38.7	9.8	6.17	4.5	10.1	30.7	86.2
34 x 1	92.1	35.1	38.2	9.7	5.97	4.5	9.8	31.3	87.4
34 x 2	92.7	35.4	38.2	9.8	6.04	4.5	9.9	30.9	85.6
34 x 5	79.9	30.9	38.6	9.7	6.11	4.4	9.5	31.7	83.8
35 x 1	89.8	34.9	38.9	10.2	6.47	4.5	9.7	31.3	86.1
35 x 2	92.1	37.2	40.4	9.8	6.63	4.2	10.1	31.6	84.0
35 x 4	81.6	31.3	38.4	9.8	6.12	4.5	10.3	31.6	84.6
45 x 1	80.4	29.4	36.6	9.8	5.64	4.4	10.1	32.3	84.6
45 x 2	66.1	25.4	38.5	9.8	6.12	4.2	10.3	31.4	85.4
45 x 3	81.2	31.7	39.0	10.1	6.48	4.5	9.8	30.8	85.3
LSD 0.01	9.47	3.97	1.29	0.45	0.35	0.26	0.26	1.05	1.43
LSD 0.05	7.13	2.99	0.97	0.34	0.26	0.20	0.20	0.79	1.08

***12 x 3 means (P1 x P2) x P3 and so on..**

With respect to the triallel crosses, it could be noticed that the crosses; (23 x 5) and (25 x 1) exhibited high performances for yield and yield components characters, (15 x 4) was the best for fiber properties. The results also revealed that the crosses which contained the single hybrids of (3 x 4) or (3 x 5); (34 x 1), (34 x 2), (34 x 5), (35 x 1), (35 x 2) and (35 x 4) showed high SCY and LY. It could be also, concluded form the previous results that the performances of most triallel crosses were as good as or better than their both two grand parents or/and their third parent. Therefore, further analysis should be used to clarify the combining ability of the five parents and their three-way crosses for the studied characters.

The analysis of variances of the five parents and their 30 triallel crosses are made and the results are shown in Table 2. The mean squares of genotypes were highly significant for all studied traits which were basically due to the variances among the parents as well as the variances among the triallel crosses, while the variances attributed to the parents vs. crosses were detected for most traits except LP and SI. Further analyses of the triallel crosses revealed that the mean squares due to *h* eliminating *g* were highly significant for all traits except for UI, while the mean squares due to *g* eliminating *h* were observed for all characters except for LP, MIC and SL suggesting the presence of the additive variance in the inheritance of these traits, subsequently the selection through the advanced segregating generations would be efficient to improve these characters. The mean squares due to *s* eliminating *d* showed highly significance for all traits except for UHM, while the mean squares due to *d* eliminating *s* were determined for all traits except for MIC and UHM. On the other hand, the mean squares due to *t* were highly significant for all traits. These results indicated that the contribution of dominance, dominance by dominance and additive by dominance in the genetic expression of these traits. These results are partially agreement with those obtained by Abdel-Bary (2003) and Yehia (2005).

The estimates of general combining ability effects of first kind (h_i) and second kind (g_i) of parental varieties were calculated and the results presented in Table 3. Highly significant positive first kind effects (h_i) of P3 and P5 were detected for SCY and LY characters, indicating that these parents were good combiners for the mentioned traits when used as grand parents. Also, P2 was the best combiner as grand parent for LP, SI and LI traits. Moreover, P1 was the best combiner for MIC and PI, while P4 and P5 showed highly significant positive effects for UHM character. On the other hand, the second kind effects (g_i) were observed for P3 and P5 for SCY and LY characters. The finding suggested that they were good combiners when used as the third parent in the three-way crosses. In the same time, P4 showed highly significant positive second kind effect for PI trait. It could be concluded that the selection of P3 or P5 as grand parents and P1 or P2 as third parent would be more benefit for improving SCY and LY characters in the breeding programs.

Table 2:The analysis of variances and the mean squares of triallel crosses for yield, yield components and some fiber properties.

Traits / S.O.V	d.f	SCY gm.	LY gm.	LP %	SI gm.	LI gm.	MIC	PI	UHM mm.	UI
Rep.	2	2.164	0.054	0.090	0.045	0.029	0.014	0.042	3.006**	0.002
Genotypes	34	679.7**	101.1**	2.073**	0.254**	0.332**	0.075**	0.147**	0.932**	2.831**
Parents (P)	4	379.3**	59.12**	3.672**	0.204**	0.774**	0.137**	0.041*	1.655**	1.896**
P.VS.C	1	2030**	301.6**	0.027	0.126	0.338*	0.065*	0.610**	1.244*	2.452*
Crosses (C)	29	674.6**	99.97**	1.923**	0.265**	0.271**	0.067**	0.145**	0.821**	2.974**
Due to *h* eliminating *g*	4	1178**	163.2**	4.514**	0.448**	0.760**	0.090**	0.125**	2.019**	0.582
Due to *g* eliminating *h*	4	358.7**	53.32**	1.082	0.135*	0.149*	0.013	0.084**	0.40	1.388*
Due to s eliminating *d*	11	1495**	222.8**	1.901**	0.500**	0.204**	0.63**	0.395**	0.533*	7.851**
Due to *d* eliminating s	5	781.1**	124.6**	6.644**	1.147**	0.648**	0.60**	0.346**	0.643**	14.98**
Due to *t*	5	1681**	226.8**	11.38**	1.220**	0.494**	0.168**	0.648**	2.299**	8.918**
Over all error	68	19.15	3.372	0.607	0.044	0.051	0.015	0.015	0.235	0.439
Triallel error	58	18.50	3.220	0.633	0.40	0.054	0.016	0.014	0.210	0.448

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

Table 3: General combining ability effects of the first kind (h_i) and the second kind (g_i) for yield, yield components and some fiber properties.

Traits / Parents	Effects	SCY gm.	LY gm.	LP %	SI gm.	LI gm.	MIC	PI	UHM mm.	UI
G. 90 (P1)	h_1	-10.91**	-4.182**	0.142	-0.118**	-0.041	-0.80**	0.089**	-0.096	0.096
	g_1	3.363**	1.11**	-0.233	0.069	-0.016	0.030	-0.037	0.018	0.268
G. 85 (P2)	h_1	-3.753**	-1.071**	0.502**	0.096*	0.197**	-0.033	0.018	-0.471**	0.231
	g_1	3.37**	1.52**	0.225	0.017	0.071	-0.006	0.001	-0.062	-0.234
G. 83 (P3)	h_1	5.949**	2.50**	0.294	0.129**	0.161**	0.009	0.118**	0.071	-0.169
	g_1	-4.478**	-1.654**	0.165	0.050	0.075	-0.009	-0.022	0.007	0.032
P. S6 (P4)	h_1	5.589**	1.79**	-0.512**	-0.184**	-0.254**	0.013	0.004	0.244**	-0.076
	g_1	-0.007	-0.063	-0.079	-0.042	-0.049	0.009	0.087**	0.033	0.133
P. S4 (P5)	h_1	3.124**	0.97**	-0.426**	0.078*	-0.062	0.091**	0.007	0.251**	-0.082
	g_1	-2.253*	-0.910*	-0.077	-0.093*	-0.081	-0.024	-0.049	0.004	-0.199
SE	h_1	0.811	0.338	0.149	0.038	0.043	0.024	0.022	0.086	0.126
	g_1	0.993	0.414	0.183	0.046	0.053	0.029	0.027	0.106	0.154

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

The specific combining ability of first kind (d_{ij}) as shown in Table 4, refers to the two-lien specific effects of grand parents. The results revealed that (P1 x P2), (P1 x P4), (P3 x P4) and (P3 x P5) exhibited highly significant positive values for SCY and LY characters, (P2 x P3) for yield components, MIC and PI. while (P1 x P3) cross was the best for MIC, PI and UI characters. The specific combining abilities of such single crosses are the same as the specific combining ability effects of the diallel crosses. In spite of the negative general combining ability effect of the P1 and P2 for yield as grand parents (h_i). They exhibited high specific effects for these traits. These finding indicated the predominance of non-additive effects in the inheritance of yield characters. Similar results were obtained by Lasheen *et al.* (2003) nd Yehia (2005).

Table 4:Specific combining ability effects of the first kind (d_{ij}) for yield, yield components and some fiber properties.

Trait. / Crosses	SCY Gm.	LY Gm.	LP %	SI Gm.	LI Gm.	MIC.	PI	UHM mm.	UI
P1 x P2	12.75**	4.73**	-0.30	0.05	-0.04	0.100**	-0.06**	-0.09	-0.47**
P1 x P3	-15.78**	-5.40**	-0.24	0.02	-0.06	-0.07**	0.09**	-0.12	0.52**
P1 x P4	4.79**	2.35**	0.52**	0.03	0.16**	0.01	0.10**	0.24*	-0.39**
P1 x P5	0.764	0.143	-0.15	-0.05	-0.07	-0.01	-0.17**	-0.01	0.53**
P2 x P3	-2.41**	-0.65*	0.36*	0.14**	0.19**	-0.07**	-0.01	0.30**	-0.57**
P2 x P4	-3.29**	-1.09**	0.24	-0.21**	-0.08	-0.10**	0.002	-0.30**	0.58**
P2 x P5	-3.97**	-1.63**	-0.19	-0.01	-0.06	0.06*	0.05*	0.04	0.22
P3 x P4	5.62**	1.77**	-0.52**	0.04	-0.11*	0.15**	-0.09**	-0.03	00.47**
P3 x P5	9.21**	4.06**	0.52**	-0.15**	0.04	-0.02	0.01	-0.14	-0.40**
P4 x P5	-7.13**	-..08**	-0.29	0.11**	-0.001	-0.05*	0.05*	0.11	-0.5[illegible]**
SE	0.678	0.366	0.161	0.041	0.046	0.025	0.024	0.093	0.137

With respect to the specific combining ability of the second kind (s_{ij}) as presented in Table 5, in which refers to the two-line specific effects where *i* is half grand parent and k is the third parent. It could be noticed that (S12), (S21), (S24), (S24), (S42) and (S52) and (S52) showed highly significance and positive effects for yield and its components. Moreover, (S52) was good combination for MIC and PI characters, (S14) and (S24) for UHM and UI traits. These results emphasized that the P2 as a third parent would be useful for yield and its components when was crosses to P1, P4 or P5 as a grand parent. Moreover, P4 proved to be useful as a third parent for fiber strength when recombine by P1 or P2 as a grand parent, indicating the influence of the non-additive effects in controlling these traits.

Concerning specific combining ability effects of lines in three-way crosses (t_{ijk}) which are recorded in Table 6. The results showed that the hybrids (15 x 2), (34 x 2), (35 x) and (45 x 2) were positive and significant for yield and its components, (25 x 4) for MIC, PI, UHM and UI, (12 x 4) and (23 x 4) for PI, UHM and UI. It is worthwhile to mention that the specific effects of the triallel crosses (t_{ijk}) were predominately affected by the specific effects of second kind effects (s_{ij}) rather than the first kind (d_{ij}) and partially by the general effects of first and second kind. (Tables 3, 4, 5 and 6) indicating the importance of the epistatic effects on the inheritance of such characters.

Table 5: Specific combining ability effects of the second kind (s_{jk}) for yield, yield components and some fiber properties.

Trait. / Effect	SCY Gm.	LY Gm.	LP %	SI Gm.	LI Gm.	MIC.	PI	UHM mm.	UI
S12	16.41**	7.50**	1.22**	0.18**	0.43**	0.10**	-0.22**	-0.36**	-1.63**
R***	5.26**	1.24**	-0.90**	0.29**	-0.06	0.11**	-0.11**	0.04	0.11
S13	-17.90**	-6.64**	0.53**	0.14**	0.23**	-0.12**	0.05	0.21	-1.00**
R	0.694	-0.51	-0.94**	-0.10*	-0.32**	0.07*	-0.04	-0.50**	2.39**
S14	1.82	1.03*	0.27	-0.11*	0.003	-0.04	0.43**	0.22*	0.59**
R	7.94**	2.45**	-0.75**	0.08	-0.14**	0.05	-0.10**	0.21	0.81**
S15	-10.99**	-4.28**	-0.12	-0.62**	-0.44**	-0.07*	-0.09**	-0.05	-0.62**
R	14.42**	5.01**	-0.52**	0.52**	0.20**	0.06*	-0.12**	0.33**	0.75**
S23	-26.85**	-10.56**	0.35	0.08	0.14**	-0.02	0.09**	0.73**	0.87**
R	19.43**	7.99**	0.26	0.02	0.10	-0.28**	-0.001	0.22*	-1.32**
S24	4.32**	0.94*	-0.94**	-0.45**	-0.55**	0.02	0.01	0.25*	0.85**
R	3.53**	2.48**	1.38**	0.13**	0.45**	-0.08**	-0.07**	-1.19**	0.10
S25	-6.90**	-3.68**	-1.52**	-0.25**	-0.56**	0.01	-0.04	0.44**	-0.10
R	2.52*	2.09**	1.34**	0.09*	0.42**	-0.018**	0.34**	-0.45**	0.12
S34	4.56**	1.00*	-1.11**	-0.30*	-0.48**	0.16**	0.44**	0.31**	-0.32*
R	-7.39**	-2.14**	1.05**	0.54**	0.62**	-0.03	-0.22**	-0.16	-0.41*
S35	5.58**	2.13**	-0.28	-0.33**	-0.29**	-0.08*	-0.16**	-0.23*	-0.73**
R	-1.64	0.04	1.02**	0.22**	0.40**	0.06*	-0.17**	-0.54**	0.69**
S45	-14.51**	-5.55**	0.01	-0.004	-0.0001	-0.05	-0.42**	0.37**	-1.59**
R	-0.31	-0.54	-0.32	-0.10*	-0.16**	0.02	0.38**	0.16	0.67**
SE	1.020	0.426	0.188	0.047	0.054	0.030	0.028	0.109	0.159

* & ** significant at 0.05 and 0.01 levels of probability respectively.

*** R means reciprocal; the reciprocal of (S12) is (S21).

Table 6: Three-line specific effects (t_{ijk}) for yield, yield components and some fiber properties.

Trait. / Effect	SCY Gm.	LY Gm.	LP %	SI Gm.	LI Gm.	MIC.	PI	UHM mm.	UI
12 x 3	-39.73**	-15.17**	0.60**	0.12**	0.23**	-0.15**	0.01	0.78**	-0.05
12 x 4	-11.11**	-4.51**	-0.28	-0.54**	-0.43**	-0.05	0.46**	0.62**	0.69**
12 x 5	-22.25**	-8.95**	-0.55*	-0.50**	-0.48**	-0.11**	-0.17**	0.34**	-0.16
13 x 2	33.04**	14.7**	1.97**	-0.12**	0.46**	0.05	0.05	-1.05**	-1.86**
13 x 4	22.67**	8.49**	-0.66**	-0.55**	-0.53**	0.001	0.42**	0.59**	-0.02
13 x 5	11.24**	4.22*	-0.78**	-0.49**	-0.52**	0.10**	-0.33**	0.65**	-2.33**
14 x 2	8.09**	4.08**	1.02**	0.30**	0.46**	-0.01	-0.14**	-0.89**	-1.29**
14 x 3	-20.76**	-7.09**	1.68**	0.57**	0.81**	-0.02	-0.35**	-0.32**	0.37*
14 x 5	-22.78**	-9.20**	-0.66**	-0.64**	-0.59**	-0.23**	-0.46**	-0.25*	-1.66**
15 x 2	18.91**	9.70**	2.68**	0.29**	0.90**	-0.17**	0.15**	-0.48**	-1.81**
15 x 3	-21.91**	-7.39**	1.83**	0.4**	0.75**	-0.08**	0.14**	-0.27*	-0.60**
15 x 4	5.03**	1.48**	-0.64**	-0.25**	-0.33**	0.21**	0.82**	0.28*	0.16
23 x 1	18.9**	5.73**	-1.93**	0.20**	-0.39**	0.19**	-0.20**	0.07	2.62**
23 x 4	7.23**	0.97*	-2.44**	-0.65**	-1.08**	0.30**	0.64**	0.28*	1.58**
23 x 5	-7.44**	-4.25**	-2.14**	-0.83**	-1.12**	0.01	-0.16**	0.28*	-0.63**
24 x 1	8.96**	2.14**	-1.45**	0.49**	-0.06	0.15**	-0.22**	0.39**	1.37**
24 x 3	-24.29**	-9.21**	0.76**	0.59**	0.58**	0.03	-0.20**	0.23*	-0.50**
24 x 5	-9.40**	-4.49**	-1.36**	-0.05	-0.39**	0.13**	-0.42**	0.97**	-1.97**
25 x 1	7.80**	1.35**	-1.80**	0.16**	-0.36**	0.13**	-0.07**	0.08	1.14**
25 x 3	-10.40**	-3.24**	1.59**	0.53**	0.76**	-0.03	-0.16**	0.15	0.70**
25 x 4	7.00**	1.87**	-0.90**	-0.38**	-0.49**	-0.12**	0.44**	0.60**	1.06**
34 x 1	0.10	-0.96*	-1.22**	0.13**	-0.23**	0.02	-0.03	-0.18	0.35*
34 x 2	13.80**	7.65**	2.53**	0.17**	0.78**	-0.33**	-0.06*	-0.54**	-1.77**
34 x 5	-10.92**	-4.14**	-0.12	-0.37**	-0.28**	-0.19**	-0.20**	-0.16	-1.04**
35 x 1	6.38**	0.98*	-1.61**	0.34**	-0.20**	0.07*	-0.01	-0.02	2.58**
35 x 2	10.88**	4.68**	0.42*	0.38**	0.36**	0.04	0.16**	-0.53**	-0.47**
35 x 4	0.37	0.63	-.93**	-0.26**	-0.41**	0.06*	0.50**	0.27*	1.09**
45 x 1	22.63**	8.69**	0.06	0.60**	0.40**	0.12**	-0.34**	-0.20	2.53**
45 x 2	20.70**	10.25**	2.65**	0.14**	0.88**	0.02	-0.02	-1.50**	-0.29
45 x 3	-17.37**	-5.87**	1.37**	0.38**	0.60**	-0.03	-0.16**	0.08	0.35*
SE	1.014	0.423	0.186	0.047	0.054	0.030	0.028	0.108	0.158

* & ** significant at 0.05 and 0.01 levels of probability respectively.

The estimation of genetic variances for yield, yield components and some fiber properties are shown in Table 7. It could be noticed that the genetic variances were positive for all studied traits except additive x additive genetic variance which was negative. Nevertheless, the magnitudes of the dominance variances were larger than these additive variances for all studied traits except for MIC and UHM characters. Concerning the epistatic variances, the results indicated that the additive x dominance type of epistasis played the major role in controlling the inheritance of the studied characters of the triallel crosses. Punnuswamy *et al.* (1974) in their investigation in triallel crosses, which outlined by Singh and Chaudhary (1985) demonstrated that the variances and covariance components of general effects i.e., σ^2h, σ^2g and σgh are the function of additive and additive by additive type of epistasis, whereas σ^2d and σds are the functions of additive x additive type of epistasis only σ^2s and σss involved dominance component while σ^2t and σ^2tt account for epistatic components other than additive x additive. Therefore, according to the prevalence of the epistatic genetic variances, recurrent selection might be useful in improving such crosses for the studied characters in the breeding programs.

Table 7:The estimation of genetic variances for yield, yield components and some fiber properties.

Trait. / Gen. variance	SCY Gm.	LY Gm.	LP %	SI Gm.	LI Gm.	MIC.	PI	UHM mm.	UI
σ^2 A	3097.0	475.4	6.458	1.259	1.431	0.147	0.847	2.123	12.53
σ^2 D	4228.5	641.6	14.88	1.653	2.745	0.109	0.992	1.475	14.70
σ^2 AA	-2729.3	-417.8	-*10.65	-1.6230	-2.166	-0.153	-0.842	-2.741	-13.74
σ^2 and	8579.0	1337.2	38.40	6.703	8.793	0.753	3.519	14.24	54.21
σ^2 DD	1212.6	176.8	3.790	0.402	0.308	0.015	0.287	-0.558	7.054

A refers to additive and D refers to dominance.

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تحليل الهجن الثلاثية لبعض الصفات الكمية فى القطن

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أجريت هذه الدراسة فى ثلاث مواسم متتاليه هى (٢٠٠٣ ، ٢٠٠٤ ، ٢٠٠٥) حيث تم تقييم ثلاثين هجينا ثلاثيا بطريق التزاوج التبادلى لخمس أباء من القطن يتبعون النوع *G. barbadense* L. وهذه الاباء هى جيزه ٩٠ ، جيزه ٨٥ ، جيزة ٨٣ ، بيما س ٤ وبيما س ٦. وذلك لتقدير القدرة العامة والخاصة للتألف للاباء والهجن كذلك مكونات التباين الوراثى لصفات المحصول ومكوناته وبعض صفات التيلة.

وقد أظهر تحليل التباين وجود اختلافات معنوية بين التراكيب الوراثيه تعود اساسا الى اختلافات بين الاباء واختلافات بين الهجن الثلاثيه الناتجه منها لجميع الصفات محل الدراسة. وقد أظهر تحليل التباين للقدرة العامة للتألف من النوع الاول (أباء الهجن الثنائية) قيم معنوية لجميع الصفات عدا صفة معامل الانتظام ، بينما كانت القدرة العامة للتألف من النوع الثانى (الاب الثالث) معنويه لجميع الصفات عدا صفات معدل الحليج وقيمة الميكرونير وطول التيله. بينما كان التباين الراجع الى القدرة الخاصة للتألف بأنواعها معنويا لجميع الصفات مما يشير الى سيادة العوامل الغير مضيفة فى توارث هذه الصفات.

وقد أوضحت النتائج ان التأثير الموجب والمعنوى للقدرة العامة للتألف للأباء بنوعيها (النوع الاول والثانى) يظهر جليا فى وجود جيزة ٨٣ أو بيما س ٦ فى الهجن الثنائية وإدخال جيزة ٩٠ أو جيزة ٨٥ كاب ثالث هو أفضل لصفات المحصول الزهر والمحصول الشعر. كما أن نتائج القدرة الخاصة للهجن الثلاثيه أوضحت أن الهجن (١٥ × ٢) ، (٣٤ × ٢) ، (٣٥ × ٢) ، (٤٥ × ٢) كانت معنوية وموجبة لصفات المحصول ومكوناته ، والهجن (٢٥ × ٤) ، (١٢ × ٤) ، (٢٣ × ٤) كانت الافضل لصفات التيلة. وقد أظهرت النتائج أن القدرة الخاصة للتألف للهجن الثلاثيثة تأثرت بشكل ملحوظ من القدرة الخاصة من النوع الثانى أكثر من النوع االاول وبشكل جزئى بتأثير القدرة العامة للتألف بنوعيها. وقد ثبت من النتائج أن تأثير العوامل السائدة كان أكثر أهمية من العوامل المضيفة فى توارث معظم الصفات عدا صفتى قيمة الميكرونير وطول التيلة ، كما أظهرت النتائج أن الصفات محل الدراسة تتأثر بالتفاعل بين العوامل المضيفة × العوامل السائدة. وعليه فإن استخدام الانتخاب المتكرر فى برامج التربية قد يكون مفيدا فى هذه الحالة.