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TRIALLEL ANALYSIS OF SOME QUANTITATIVELY INHERITED TRAITS IN *Gossypium barbadense* L.: II-FIBER PROPERTIES

Abd El-Maksoud, M.M.[1]; A.M. El-Adl[1] ; M.S. Hamada[1] and A.M. Abd El-Bary[2]
1- Dept. of Genetics, Faculty of Agric., Mansoura Univ., EGYPT
2- Cotton Research Institute, Agric. Res. Center, Giza, EGYPT

ABSTRACT

This investigation aimed to evaluate some three-way crosses of Egyptian cotton for combining ability and further partition of genotypic variance to its components for fiber properties. The genetic materials used in the present study included six cotton varieties and their 60 three-way crosses. These genotypes were evaluated during two successive growing seasons at Sakha Agricultural Research Station, Kafr El-Sheikh Governorate for the following traits: fiber fineness , fiber strength, 50% span length , 2.5% span length and uniformity ratio.

The results revealed that partition of the three-way crosses mean squares to its components predicted the significant contribution of additive, dominance and epistatic variances in the genetic expression of fiber properties. These parameters were stable at different years for the studied fiber properties except for 2.5% span length. Giza 87 variety was the best general combiners as a parent and/or grand parent in the three-way crosses for yield and yield components. Therefore, this variety could be utilized in a breeding program for improving these traits to pass favorable genes for improving hybrid and subsequently producing improved genotypes through the selection in segregating generations. The best three-way combination for fiber properties resulted from the crossing the single cross (Giza 76 x Giza 87) by Giza 85 as parent. In addition, the results showed that fiber properties were mainly controlled by additive variance as well as additive x dominance variances, while the other components play the minor role in the inheritance of these traits. Thus, the selection within the advanced generations of the previous three-way cross may be effective for improving fiber properties.

INTRODUCTION

Combining ability analysis and the genetic components of any breeding materials supply the breeders useful information regarding choice of parents for development superior hybrids and/or determine the most effective breeding methods. Two types of general combining ability effects and three kinds of specific combining ability effects according to the parent's order in the three-way cross are valid (Ponnuswamy *et al.*, 1974). In addition, triallel cross analysis provides additional information about the components of epistatic variance, viz., additive x additive, additive x dominance and dominance x dominance, besides additive and dominance components of genetic variance. This technique also gives information on the order in which parents should be crossed for obtaining superior recombinants (Singh and Narayanan, 2000).

General (GCA) and specific (SCA) combining ability effects have been studied for fiber properties in cotton by several investigators, among them, Gomaa (1997), Abd El-Bary (1999), Shaheen *et al.*, (2000), Abdel-Hamid and Esmail (2001) and Christopher *et al.*, (2003). They mentioned that both GCA and SCA were important in the genetic expression of most studied fiber properties.

The present investigation was carried out to estimate combining ability and gene action for fiber properties using triallel system of six Egyptian cotton varieties.

MATERIALS AND METHODS

Genetic materials:

The genetic material used in the present investigation included six Egyptian cotton varieties belong to *Gossypium barbadense* L.). Three of them are long staple, Giza-85 (P_1), Giza-86 (P_2) and Giza-89 (P_3), while the other are extra-long staple, Giza-76 (P_4), Giza-77 (P_5) and Giza-87 (P_6). The inbred seeds of all varieties were obtained from Cotton Breeding Section, Cotton Research Institute, Agricultural Research Center, Giza, Egypt. In the growing season of 1999, the six parents were planted and mated in a diallel fashion excluding reciprocals to obtain 15 single crosses. In 2000 growing season, the crossing of these single crosses with parents was done in such a way that no parent should appear more than once in the same three way cross to obtain 60 three-way crosses; number of three-way crosses = p (p-1)(p-2)/2 where, p: is equal to number of parental varieties. In addition, the parental varieties were also self-pollinated to obtain enough seeds for further investigations.

Experimental procedure:

In the two growing seasons of 2001 and 2002, the genetic materials were evaluated in a field trial experiment at Sakha Agricultural Research Station, Kafr El-Sheikh Governorate. The genetic material used in these experiments consisted of 66 genotypes (six parental varieties and 60 three way crosses). The experimental design used was a randomized complete blocks design with three replications in both years. Each plot was one row 4.0 m long and 0.6 m. wide. Hills were 0.4 m apart to insure 10 hills per row. Hills were thinned to keep a constant stand of one plant per hill at seedlings stage. Ordinary cultural practices were followed as usual for the cotton field in the two years.

Data were recorded on the following traits: fiber fineness (F.F.), fiber strength (F.S), 50% span length (50% S.L.), 2.5% span length (2.5% S.L) and uniformity ratio (U.R.%).

Biometrical analysis:

The combined analysis for combining ability over two years was carried out for all studied traits according to the procedure outlined by Singh (1973) with modification for triallel-crosses analysis (Singh and Chaudhary, 1985). Considering Y_{ijkl} as the measurement recorded on a triallel cross, the mathematical model takes the following form:

$Y_{ijkl} = m + b_1 + h_i + h_j + d_{ij} + g_k + s_{ik} + s_{jk} + t_{ijk} + e_{ijkl}$

Where:

Y_{ijkl} : phenotypic value in the l^{th} replication on ij^{th} cross (grand parents) mated to k^{th} parent.

m : general mean

b_l : effects of l^{th} replication.

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

h_j : general line effect of j^{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}, s_{jk}: two-line specific effect where i and j are half parents and K is the parent. Hence specific effects of second kind.

t_{ijk} : three-line specific effect.

e_{ijkl} : error effect.

Where the estimation of these effects were as follows:

$$h_i = \frac{P-1}{rP(P-2)(P-3)} [Y_{i...} + [(P-4)/(P-1)]\, Y_{..i.} - [(P-4)/(P-1)]\, Y_{....}]$$

$$g_k = \frac{P-4}{rP(P-3)} [Y_{..i.} + [1/(P-2)]\, Y_{i...} - [1/(P-2)]\, Y_{....}]$$

$$d_{ij} = \frac{P-3}{r(P-1)(P-4)} \left[Y_{ij} + \frac{1}{P-3}(Y_{i.j.} + Y_{j.i.}) - \frac{2}{P(P-3)} Y_{....} - \left(\frac{r(P^2-4+P+2)}{P-3} \right)(h_i + h_j) - \frac{r}{P-3}(g_i + g_j) \right]$$

$$S_{ik} = \frac{D}{D_2} \left[Y_{i.k.} + \frac{1}{D} Y_{k.i.} + \left(\frac{V-3}{D} \right) Y_{ik..} - \left(\frac{2(P-3)}{PD} \right) Y_{....} - r(P-2)h_i - \left(\frac{P-2}{D} \right) rhi - \frac{rg_i}{D} - \frac{D_1}{D} rg_j \right]$$

Where:

$D = P^2 - 5P + 5$

$D_1 = P^3 - 7P^2 + 14P - 7$

$D_2 = r(P-1)(P-3)(P-4)$.

$$t_{ijk} = \overline{y}_{ijk} - \overline{y} - h_i - h_j - g_k - d_{ij} - S_{ik} - S_{jk}$$

The variance components; $\sigma^2 e$, $\sigma^2 t$, $\sigma^2 tt$, $\sigma^2 d$, $\sigma^2 ds$, $\sigma^2 s$, $\sigma^2 ss$, $\sigma^2 gh$, $\sigma^2 h$ and $\sigma^2 g$ were estimated according to the formulae cited in Singh and Chaudhary (1985). Where, Ponnuswamy *et al.* (1974) demonstrated that the variances and co-variances components of general effects i.e., $\sigma^2 h$, $\sigma^2 g$, $\sigma^2 gh$ are the function of additive and additive x additive type of epistasis, whereas $\sigma^2 d$ and $\sigma^2 ds$ are the functions of additive x additive type of epistasis only. $\sigma^2 s$ and $\sigma^2 ss$ involve dominance components, while $\sigma^2 t$ and $\sigma^2 tt$ account for epistatic components other than additive x additive. Therefore, the genetic variance components could be calculated from the previous variances using the following manner and the breeding coefficient assumed to be one (F = 1).

$$\sigma^2 A = \frac{1}{227F} \left[448\ \sigma^2 h + 40\, \sigma^2 g + 604 \sigma gh - 292 \sigma^2 d - 584\, \sigma ds \right]$$

$$\sigma^2 D = \frac{1}{127F^2}\left[416\sigma^2 h - 352\sigma^2 g + 496\sigma gh - 336\sigma^2 d - 672\sigma ds - \frac{1816}{3}\sigma^2 s + \frac{4540}{3}\sigma ss - 254\sigma^2 t - \frac{3556}{3}\sigma tt\right]$$

$$\sigma^2 AA = \frac{1}{227F^2}\left[-832\,\sigma^2 h + 704\sigma^2 g - 992\,\sigma gh + 672\,\sigma^2 d + 13446\,ds\right]$$

$$\sigma^2 AD = \frac{32}{3F^3}\left[\sigma^2 s - \sigma ss + 4\,\sigma tt\right]$$

$$\sigma^2 DD = \frac{1}{3F^4}\left[-16\sigma^2 s + 16\,\sigma ss + 24\,\sigma^2 t - 32\,\sigma tt\right]$$

Subsequently, the estimate of heritability and dominance degree ratio were recorded for all studied traits.

RESULTS AND DISCUSSION

Analysis of variance of 60 three-way crosses were made for all studied fiber properties and the mean squares from the combined data over two years are presented in Table 1. The results showed that the magnitudes of the crosses mean squares were highly significant for all studied fiber quality properties except for uniformity ratio. However, the partition of crosses mean squares to its components revealed the mean square due to *g* eliminating *h* were highly significant and larger in magnitudes than the corresponding other components for all studied fiber properties except uniformity ratio, while the mean squares due to *h* eliminating *g* were significant in the cases of fiber fineness and fiber strength. These results suggested that these traits are mainly controlled by additive gene actions. Therefore, the selection within advanced segregating generations would be highly effective for improvement these traits.

Table 1: Combined analysis of variance and mean squares of triallel crosses for fiber quality properties

S.O.V.	d.f	F.F.	F.S.	F.L.		
				50% S.L.	2.5% S.L	U.R. %
Years	1	1.48	0.59	6.18	90.80*	53.09
Reps.	4	0.59	3.65	6.80	5.14	24.92
Crosses	59	0.37**	1.20**	1.10**	3.77**	1.88
Due to *h* eliminating *g*	5	0.77**	2.66**	0.79	7.54	2.82
Due to *g* eliminating *h*	5	2.23**	3.35**	5.22**	26.27**	2.23
Due to *s* eliminating *d*	19	0.15	0.78	0.83	1.59	1.71
Due to *d* eliminating *s*	9	0.13	1.08*	0.84	1.20	2.38
Due to *t*	21	0.25*	1.33**	0.64	1.76	1.79
Crosses x Y	59	0.15	0.63	0.53	1.62*	1.53
Due to *h* eliminating *g* x Y	5	0.09	0.66	0.48	0.59	1.46
Due to *g* eliminating *h* x Y	5	0.28	0.73	0.49	0.45	0.83
Due to *s* eliminating *d* x Y	19	0.16	0.55	0.34	0.81	2.22
Due to *d* eliminating *s* x Y	9	0.15	0.79	0.76	2.62*	1.28
Due to *t* x Y	21	0.12	0.54	0.71	2.29**	1.01
Error	236	0.14	0.49	0.58	1.19	2.15

***, ** significant at 0.05 and .01 levels of probability, respectively.**

Significant interaction effects between crosses and years were detected only in the case of fiber length at 2.5% span length and subsequently mean square due to t_{ijk} by years and *d* eliminating *s* by years interactions were significant for the same trait. These findings indicated that the genetic performances of the three-way crosses for fiber properties except 2.5% span length. were stable with different years.

Combining ability effects:

Due to the variable magnitudes and signs of general and specific combining ability effects were different from year to another with respect to most of studied fiber quality traits. Therefore, the general and specific combining ability effects from the combined data would be more precise to present information concerning the behavior of these varieties.

Two types of general combining ability effects are worked out through triallel crosses. viz., general line effect of first kind (hi) and general line effect of second kind (g_k). The first refers to the general combining ability effect of a line used as one of the grand parents. Whereas the latter one refers to the general combining ability effect of a line used as parent, which was crossed to the single cross in order to produce three-way cross.

The estimates of general combining ability effects of first kind (hi) of the parental varieties were obtained for all studied fiber quality properties and the results are shown in Table 2. Comparison of general combining ability effects (hi) of individual parent exhibited that the variety Giza 87 (P_6) was the best general combiner among this group of varieties as a grand parent for most of studied fiber quality properties. In addition, . comparison of the general combining ability effects of the second kind (g_k) of individual parent (Table 3) exhibited again that the variety Giza 87 was the best general combiner among this group of varieties as parents in the three-way crosses for fiber fineness (F.F.), fiber strength (F.S.), fiber length at 50% span length (50% S.L.) and fiber length at 2.5% span length (2.5% S.L.). Thus, it can be suggested that this parental variety could be utilized in a breeding program for improving these traits to pass favorable genes for improving hybrids and subsequently inserted in selection program in order to produce varieties with good fiber quality properties.

Table 2: General line effect (h_i) of first kind (grand parent) for fiber quality properties

Parents	F.F.	F.S.	F.L.		
			50% S.L.	2.5% S.L.	U.R.%
Giza 85	-0.050	-0.288**	-0.115	-0.415**	0.243
Giza 86	0.020	0.043	0.012	0.083	-0.140
Giza 89	0.163**	0.013	-0.064	-0.121	-0.021
Giza 76	-0.009	-0.009	0.070	0.103	0.103
Giza 77	-0.001	-0.022	-0.050	-0.113	0.036
Giza 87	-0.123**	0.263**	0.148*	0.463**	-0.220
S.E.	0.037	0.069	0.075	0.107	0.144

***, ** Significant at 0.05 and 0.01 levels of probability, respectively.**

Table 3: General line effect of second kind (g_k) for fiber quality properties

Parents	F.F.	F.S.	F.L.		
			50% S.L.	2.5% S.L.	U.R.%
Giza 85	0.012	-0.431**	-0.453**	-1.106**	0.268
Giza 86	0.137**	0.115	0.055	0.026	0.121
Giza 89	0.307**	-0.127	-0.256**	-0.472**	-0.021
Giza 76	-0.088	0.224**	0.238*	0.481**	-0.031
Giza 77	-0.092*	0.006	0.023	0.241	-0.302
Giza 87	-0.277**	0.213*	0.393**	0.831**	-0.034
S.E.	0.046	0.087	0.095	0.135	0.182

*, ** Significant at 0.05 and 0.01 levels of probability, respectively.

Regarding specific combining ability, triallel crosses included three kinds of specific combining ability effects according to the parent's order in the three-way cross. These kinds are: two-line specific effects of first kind (d_{ij}), which refers to the specific combining ability effect of a line used as one of the grand parents (parents involved in single cross) for three-way cross; two-line specific effect of second kind (S_{ik}), which refers to the specific combining ability of a line when crossed as a parent to the single cross; the third kind is three-line specific effect (t_{ijk}), which refers to specific combining ability effect of lines in three-way cross. These three kinds of specific combining ability effects were determined for all studied traits. The specific combining ability effects of the first kind (d_{ij}) for all studied crosses with respect to the studied fiber quality properties were obtained from the combined data over both years and the results are shown in Table 4. The results cleared that no cross exhibited desirable and significant values for all studied fiber quality properties. However, 1, 1, 3, 3 and 2 out of 15 crosses showed positive significant specific combining ability effects (d_{ij}) estimates in the cases of fiber fineness (F.F.), fiber strength (F.S.), fiber length at 50% span length (50% S.L.), fiber length at 2.5% span length (2.5% S.L.) and uniformity ratio (U.R.%) properties, respectively. This finding may insure the minor role of dominance genetic variance in the genetic expression of fiber quality properties.

Table 4: Specific combining ability effects of the first kined (d_{ij}) for fiber quality properties

Crosses	F.F.	F.S.	F.L.		
			50% S.L.	2.5% S.L.	U.R.%
$P_1 \times P_2$	0.05	0.26	0.45*	0.77**	0.27
$P_1 \times P_3$	0.08	-0.23	0.05	0.05	0.57
$P_1 \times P_4$	-0.11	0.28	-0.04	-0.32	0.34
$P_1 \times P_5$	-0.13	-0.43*	0.07	-0.15	0.33
$P_1 \times P_6$	0.05	-0.004	-0.27	-0.05	-0.82*
$P_2 \times P_3$	-0.001	0.17	-0.14	0.12	-0.56
$P_2 \times P_4$	-0.01	-0.24	0.21	0.07	0.63
$P_2 \times P_5$	-0.05	0.32	0.10	0.07	0.32
$P_2 \times P_6$	-0.08	-0.04	0.66**	1.22**	0.26
$P_3 \times P_4$	-0.02	0.29	0.50**	0.85**	0.18
$P_3 \times P_5$	0.17	0.07	0.14	0.17	0.05
$P_3 \times P_6$	-0.21*	0.41*	-0.69**	-0.56*	-1.48**
$P_4 \times P_5$	0.10	-0.31	0.12	0.17	0.10*
$P_4 \times P_6$	-0.001	0.20	0.03	-0.47	0.81*
$P_5 \times P_6$	-0.12	-0.03	0.22	-0.15	0.92
S.E.	0.09	0.20	0.19	0.28	0.37

P_1, P_2, P_3, P_4, P_5 and P_6 are Giza 85, Giza 86, Giza 89, Giza 76, Giza 77 and Giza 87, respectively.

*, ** Significant at 0.05 and 0.01 levels of probability, respectively.

The specific combining ability effects of the second kind (S_{ik}) [where i is a grand parent and k as a parent] for all possible combinations were obtained from the combined and the results are presented in Table 5. The results revealed that no combination exhibited negative or positive significant values for all fiber properties. However, from these values it was cleared that combination with line 2 (Giza 86) used as one of the grand parents and line 1 (Giza 85) as parent (S_{21}) gave high performance as compared to any other combinations for fiber length at 50% span length (50% S.L.) and 2.5% span length (2.5%). Regarding fiber strength, the combinations with line 5 (Giza 77) used as one of the grand parents and line 2 as parent (S_{52}), line 4 (Giza 76) used as one of the grand parents and line 6 (Giza 87) as parent (S_{46}) or line 6 (Giza 87) used as one of the grand parents and line 1 (Giza 85) as parent gave high specific combining ability effects compared to any other combinations. On the contrary, the combination with line 5 used as one of the grand parents and line 1 (Giza 85) as parent (S_{51}) gave undesirable significant values for fiber strength (F.S), fiber length at 50% span length (50% S.L.) and uniformity ratio (U.R.%).

Table 5:Two-line specific effect of second kind (S_{ik}) for fiber quality properties

Combinations	F.F.	F.S.	F.L.		
			50% S.L.	2.5% S.L.	U.R. %
S_{12}	0.115	0.035	-0.186	-0.435*	0.124
r	0.054	0.077	0.343*	0.423*	0.450
S_{13}	-0.003	0.216	0.213	0.209	0.318
r	-0.082	0.120	-0.115	-0.371	0.252
S_{14}	-0.038	-0.143	-0.248	-0.287	-0.287
r	-0.072	-0.108	0.215	0.227	0.278
S_{15}	-0.050	-0.136	0.051	0.105	-0.060
r	-0.020	-0.375**	-0.311*	-0.156	-0.721*
S_{16}	-0.024	0.029	0.170	0.408	-0.095
r	0.121	0.286*	-0.132	-0.123	-0.258
S_{23}	-0.052	-0.242	-0.231	-0.423*	-0.072
r	-0.015	-0.059	0.189	0.373	-0.009
S_{24}	0.005	0.259	0.210	0.325	0.142
r	0.044	-0.182	-0.257	-0.173	-0.508
S_{25}	-0.050	0.109	-0.178	-0.221	-0.310
r	-0.015	0.361**	0.085	0.027	0.225
S_{26}	0.044	-0.202	-0.144	-0.104	-0.211
r	-0.129	-0.154	0.169	0.207	0.167
S_{34}	0.091	0.042	-0.053	-0.098	-0.103
r	0.071	0.107	-0.118	-0.081	-0.172
S_{35}	-0.066	0.083	0.088	0.302	-0.179
r	0.121	0.085	0.087	0.088	0.071
S_{36}	0.072	-0.186	-0.110	-0.207	0.039
r	-0.137	-0.166	0.050	0.207	-0.146
S_{45}	-0.022	-0.114	0.005	-0.030	0.132
r	-0.015	-0.133	0.212	0.195	0.428
S_{46}	-0.021	0.298*	0.155	0.056	0.269
r	-0.043	-0.024	-0.120	-0.135	-0.181
S_{56}	-0.071	0.062	-0.072	-0.153	-0.003
r	0.188*	0.052	0.034	-0.157	0.418
S.E.	0.073	0.137	0.149	0.214	0.288

***, ** Significant at 0.05 and 0.01 levels of probability, respectively**

The specific combining ability effects (t_{ijk}) for all possible combinations, with respect to the studied fiber quality proprieties from the combined data were obtained and the results are presented in Tables 6. The results revealed that no three-way cross exhibited negative or positive significant values for all fiber properties.

Table 6: Three-line specific effect (t_{ijk}) for fiber quality properties

Crosses	F.F.	F.S.	F.L.		
			50% S.L.	2.5% S.L.	U.R. %
$P_1 \times P_2 \times P_3$	-0.032	0.362*	0.242	0.359	0.301
$P_1 \times P_2 \times P_4$	0.142	-0.030	-0.331	-0.245	-0.632
$P_1 \times P_2 \times P_5$	0.046	-0.336*	0.206	0.115	0.299
$P_1 \times P_2 \times P_6$	-0.156	0.003	-0.117	-0.229	0.033
$P_1 \times P_3 \times P_2$	-0.212*	-0.060	-0.313	-0.429	-0.390
$P_1 \times P_3 \times P_4$	-0.073	-0.192	0.108	-0.027	0.401
$P_1 \times P_3 \times P_5$	0.099	0.544**	-0.019	0.121	-0.113
$P_1 \times P_3 \times P_6$	0.187*	-0.292	0.224	0.336	0.103
$P_1 \times P_4 \times P_2$	0.018	0.006	0.309	0.462	0.264
$P_1 \times P_4 \times P_3$	0.104	-0.123	-0.219	-0.143	-0.490
$P_1 \times P_4 \times P_5$	0.077	-0.016	0.008	-0.236	0.399
$P_1 \times P_4 \times P_6$	-0.199*	0.133	-0.098	-0.083	-0.172
$P_1 \times P_5 \times P_2$	-0.074	-0.351*	-0.272	-0.456	-0.199
$P_1 \times P_5 \times P_3$	-0.063	-0.249	0.137	0.238	0.070
$P_1 \times P_5 \times P_4$	-0.030	0.444	0.146	0.242	0.094
$P_1 \times P_5 \times P_6$	0.168	0.156	-0.010	-0.024	0.036
$P_1 \times P_6 \times P_2$	0.269**	0.406*	0.277	0.424	0.326
$P_1 \times P_6 \times P_3$	-0.009	0.010	-0.160	-0.455	0.121
$P_1 \times P_6 \times P_4$	-0.039	-0.222	0.078	0.031	0.137
$P_1 \times P_6 \times P_5$	-0.221*	-0.193	-0.194	0.001	-0.584
$P_2 \times P_3 \times P_1$	-0.028	0.153	-0.073	-0.072	-0.57
$P_2 \times P_3 \times P_4$	0.181*	-0.204	0.241	0.233	0.337
$P_2 \times P_3 \times P_5$	-0.103	-0.344	-0.098	-0.215	0.070
$P_2 \times P_3 \times P_6$	-0.050	0.396	-0.070	0.054	-0.349
$P_2 \times P_4 \times P_1$	0.040	-0.092	0.233	0.242	0.348
$P_2 \times P_4 \times P_3$	-0.126	-0.091	0.043	-0.038	0.142
$P_2 \times P_4 \times P_5$	-0.102	0.179	-0.411*	-0.305	-0.776*
$P_2 \times P_4 \times P_6$	0.188*	0.004	0.134	0.102	0.286
$P_2 \times P_5 \times P_1$	0.034	0.498**	0.283	0.588*	0.054
$P_2 \times P_5 \times P_3$	0.070	-0.013	-0.338	-0.644	-0.095
$P_2 \times P_5 \times P_4$	-0.122	-0.081	0.002	-0.018	0.011
$P_2 \times P_5 \times P_6$	0.018	-0.403*	0.052	0.074	0.031
$P_2 \times P_6 \times P_1$	-0.047	-0.559**	-0.443*	-0.758**	-0.345
$P_2 \times P_6 \times P_3$	0.088	-0.258	0.052	0.323	-0.347
$P_2 \times P_6 \times P_4$	-0.201*	0.316	0.088	0.031	0.284
$P_2 \times P_6 \times P_5$	0.160	0.501*	0.303	0.405	0.408
$P_3 \times P_4 \times P_1$	-0.120	0.066	-0.217	-0.583*	0.176
$P_3 \times P_4 \times P_2$	0.106	0.207	-0.023	0.242	-0.398
$P_3 \times P_4 \times P_5$	-0.016	-0.028	0.314	0.521*	0.123
$P_3 \times P_4 \times P_6$	0.030	-0.244	-0.074	-0.179	0.100
$P_3 \times P_5 \times P_1$	-0.019	-0.051	-0.057	0.127	-0.481
$P_3 \times P_5 \times P_2$	0.283**	-0.153	0.302	0.267	0.545
$P_3 \times P_5 \times P_4$	-0.098	0.063	-0.166	-0.184	-0.210
$P_3 \times P_5 \times P_6$	-0.167	0.141	-0.080	-0.210	0.147
$P_3 \times P_6 \times P_1$	0.167	-0.168	0.347*	0.527*	0.363
$P_3 \times P_6 \times P_2$	-0.177*	0.007	0.034	-0.079	0.244
$P_3 \times P_6 \times P_4$	-0.010	0.333*	-0.183	-0.022	-0.527
$P_3 \times P_6 \times P_5$	0.020	-0.172	-0.198	-0.426	-0.079
$P_4 \times P_5 \times P_1$	0.092	-0.573**	-0.170	-0.303	-0.039
$P_4 \times P_5 \times P_2$	-0.120	0.352*	-0.002	-0.085	0.180
$P_4 \times P_5 \times P_3$	0.047	0.114	0.134	0.227	0.074
$P_4 \times P_5 \times P_6$	-0.019	0.107	0.038	0.161	-0.214
$P_4 \times P_6 \times P_1$	-0.012	0.600**	0.153	0.644*	-0.485
$P_4 \times P_6 \times P_2$	-0.003	-0.564**	-0.283	-0.618*	-0.045
$P_4 \times P_6 \times P_3$	-0.026	0.100	0.041	-0.046	0.275
$P_4 \times P_6 \times P_5$	0.041	-0.136	0.089	0.021	0.255
$P_5 \times P_6 \times P_1$	-0.108	0.127	-0.057	-0.413	0.467
$P_5 \times P_6 \times P_2$	-0.089	0.152	-0.028	0.274	-0.525
$P_5 \times P_6 \times P_3$	-0.053	0.148	0.067	0.178	-0.048
$P_5 \times P_6 \times P_4$	0.250**	-2.427*	0.018	-0.039	0.106
S.E.	0.090	0.168	0.184	0.263	0.288

P_1, P_2, P_3, P_4, P_5 and P_6: are Giza 85, Giza 86, Giza 89, Giza 76, Giza 77 and Giza 87, respectively.

***, ** Significant at 0.05 and 0.01 levels of probability, respectively**

However, 5, 8, 1 and 4 out of 60 three-way crosses showed desirable significant values of specific combining ability effects (t_{ijk}) for fiber fineness (F.F.), fiber strength (F.S.) and fiber length at 50% span length (50% S.L.) and 2.5% span length (2.5% S.L.), respectively. In general, the results showed that the best three-way combination for most fiber properties was (Giza 76 x Giza 87) x Giza 85.

Genetic parameters:

The estimates of the different genetic variance components and heritability as well as dominance degree ratio (D.d) were calculated for fiber quality properties and the results are shown in Table 7. The results revealed that the magnitudes of additive genetic variance (σ^2A) were positive and larger than those of dominance genetic variance (σ^2D), with respect to all fiber properties. These findings indicated the predominate of additive genetic variance in the inheritance of these properties. These could be verified by the dominance degree ratio (D.d), which were less than one, revealing the importance of partial dominance in the inheritance of these traits.

Additive by additive genetic variance (σ^2AA), showed a negative magnitudes for all studied fiber properties. While, additive by dominance (σ^2AD) genetic variance showed positive and considerable magnitudes for all studied fiber properties. However, dominance by dominance genetic variance (σ^2DD) exhibited positive magnitude in the cases of fiber fineness and fiber strength. These results suggested again that fiber properties were mainly controlled by additive and additive x dominance genetic variance, while dominance by dominance epistatic variance play the minor role in the inheritance of fiber fineness and fiber strength. The estimated values of heritability in broad and narrow sense were ranged from (42.34% and 26.74%) to (90.69% and 46.69%) for uniformity ratio and fiber fineness, respectively. These results were in common agreement with other results obtained by El-Okkia *et al.* (1989), Kosba *et al.* (1991), Gomaa (1997), El-Adl *et al.*, (2000) and Shaheen *et al.* (2000).

Genetic parameters	F.F	F.S	Fiber length		
			50% S.L	2.5% S.L	U.R %
σ^2A	3.07	3.20	3.15	3.80	3.20
σ^2D	2.90	2.37	2.60	1.68	1.87
σ^2AA	-3.42	-3.56	-3.40	-3.42	-3.69
σ^2AD	0.52	2.41	1.70	4.91	6.54
σ^2DD	0.06	0.53	-0.15	-4.62	-1.64
σ^2e	0.14	0.49	0.58	1.19	2.15
D.d	0.97	0.86	0.91	0.65	0.76
H_b%	90.7	64.8	76.15	52.00	42.34
H_n%	46.7	37.2	41.75	36.53	26.74

Note: Negative values were considered equal to zero during the calculation of heritabilities and dominance degree ratio.

REFERENCES

Abd El-Bary, A.M.R. (1999). Inheritance of quantitative traits of Egyptian cotton (*G. barbadense* L.). M.Sc. Thesis, Fac. of Agric. Mansoura, Univ., Egypt.

Abdel-Hamid, A.M. and R.M. Esmail (2001). Breeding cotton for water stress conditions. 2- Fiber properties. Annals Agric. Sci., Ain Shams Univ., Cairo, 46(1): 165-188.

Christopher, L.C.; J.N. Jenkins; J.C. McCarty; J.C.E. Watson and J. Wu (2003). Genetic variances and combining ability of crosses of American cultivars, Australian cultivars and wild cottons. The Journal of Cotton Science, 7: 16 – 22.

El-Adl, A.M.; Z.M. El-Diasty; A.A. Awad and A.M.R. Abd El-Bary (2000). Inheritance of quantitative traits of Egyptian cotton (*G. barbadense* L.). b- Earliness and fiber traits. J. Agric. Sci. Mansoura Univ., 25(10): 6153-6165.

El-Okkia, A.F.H.; H.A. El-Harony and M.O. Ismail (1989). Heterosis, inbreeding depression, gene action and heritability estimates in an Egyptian cotton cross (*Gossypium barbadense* L.). Communications in Sci. and Dev. Res., Vol. 28: 213-231.

Gomaa, M.A.M. (1997). Genetic studies on yield, yield components and fiber properties in three Egyptian cotton crosses. Annals Agric. Sci., Ain-Shams Univ., Cairo, 42(1): 195-206.

Kosba, Z.A.; Kawther S. Kash and A.M. Zeina (1991). Heterosis, type of gene action and heritability of earliness and fiber traits in cotton. J. Agric. Sci. Mansoura, Univ., 16(4): 790-798.

Ponnuswamy, K.N.; M.N. Das and M.I. Handoo (1974). Combining ability type analysis for triallel crosses in Maize (*Zea mays* L.). Theo. Applied Genetics, 45: 170-175.

Shaheen, A.MA.; M.A.M. Gomaa and R.M. Esmail (2000). Response to selection for yield, yield components and fiber properties in three Egyptian cotton crosses. Annals Agric. Sci. Ain Shams Univ., Cairo, 45(2): 491-506.

Singh, D. (1973). Diallel analysis for combining ability over several environments. II. Indian J. of Genetics and Plant Breeding. Vol. 33 No. 3: 468-483.

Singh, P. and S.S. Narayanan (2000). Biometrical Techniques in Plant Breeding. Klyani Publishers, New Delhi, 2nd ed.

Singh, R.K. and B.D. Chaudhary (1985). Biometrical Method in Quantitative Genetic Analysis. Kalyani Publishers, New Delhi.

تحليل الهجن الثلاثية لبعض الصفات الموروثة كميا فى القطن:
٢ - مواصفات التيلة

ممدوح محمد عبد المقصود[١]، على ماهر محمد العدل[١]، محمد سعد حماده[٢]و عبد الناصر محمد عبد البارى[٢]
١- قسم الوراثة – كلية الزراعة – جامعة المنصورة.
٢- معهد بحوث القطن – مركز البحوث الزراعية – الجيزة.

تهدف هذه الدراسة إلى تقييم بعض الهجن الثلاثية من القطن المصرى من حيث قدرتها على التآلف ، علاوة على تقسيم التباين الوراثى إلى مكوناته لصفات التيلة. وفى هذه الدراسة تم تقييم ستة أصناف من القطن المصرى والهجن الثلاثية الناتجة بينها (٦٠ هجين ثلاثى) وذلك فى موسمين زراعيين متتاليين بمحطة البحوث الزراعية بسخا – محافظة كفر الشيخ للصفات التالية :- نعومة التيلة، متانة التيلة وطول التيلة عند ٥٠% ، ٢,٥% بالإضافة الى نسبة الإنتظام.

أشارت النتائج المتحصل عليها أنه بتقسيم متوسط مربعات الهجن الثلاثية إلى مكوناته ، إتضح أن كل من الفعل الجينى المضيف والسيادى والتفوقى يساهم معنويا فى التعبير الوراثى لصفات التيلة. وهذه المقاييس كانت تتصف بالثبات الوراثى لصفات التيلة مع المواسم المختلفة فيما عدا صفة طول التيلة عند ٢,٥%.

الصنف جيزة ٨٧ كان أحسن الأباء قدرة عامة على التآلف عند إستخدامه كأحد الأبــاء للهجن الفردية أو كأب ثالث فى الهجن الثلاثية فى صفات التيلة. ولذلك يمكن إستخدام هذا الصنف فى برامج التربية بغرض تحسين هذه الصفات من خلال إنتاج هجن ثلاثية بتجميع الجينات المرغوبة فيها ثم يتبعها الإنتخاب فى الأجيال الإنعزالية المتقدمة للحصول على تراكيب وراثية مميزة فى مواصفات التيلة.

إتضح أن أفضل الهجن الثلاثية لقدرتها الخاصة على التآلف ينتج من الهجين الفردى جيزه ٧٦ ×جيزه ٨٧ مع الصنف جيزه ٨٥. بالإضافة إلى ذلك أشارت النتائج إلى أن صفات التيلة محكومة رئيسيا" بالفعل الجينى المضيف والتفاعل التفوقى بين الفعل الجينى المضيف والسيادى بينما المكونات الأخرى التى تشمل الفعل الجينى السيادى ،المضيف x المضيف والسيادى x السيادى تلعب الدور الثانوى فى توريث مثل هذه الصفات. ولذلك فإن الإنتخاب فى الأجيال الإنعزالية المتقدمة للهجين الثلاثي السابق الأشارة إليه يكون هو الطريقة الفعالة لتحسين مواصفات التيلة فى القطن المصرى.