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# DIALLEL ANALYSIS FOR YIELD COMPONENTS AND FIBER TRAITS IN *Gossypium barbadense* L.

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## ABSTRACT

The aim of this investigation was to determine the estimates of combining ability for yield component traits and some fiber properties in cotton. The genetic materials used in the present study included six cotton varieties and their 15 $F_1$ hybrids. All six varieties belong to the species *Gossypium barbadense* L. In 2006 growing season, these genotypes were evaluated in a field trial experiment at Sakha Agricultural Research Station, Kafr El-Sheikh Governorate for the following traits: seed cotton yield/plant, lint yield/plant, boll weight, number of bolls/plant, lint percentage ,fiber fineness, fiber strength, upper half mean and uniformity ratio %.

The results showed that the performances of most the 15 $F_1$ hybrids were as good as or better than their both parents. The mean squares of genotypes were significant or highly significant for all studied traits. The results showed that Giza 86 ($P_1$) was the highest yielding parent for seed cotton yield/plant (S.C.Y./P.), lint yield/plant (L.Y./P.) and boll weight (B.W.) ,also it was the best for fiber strength (F.S.), upper half mean (UHM) and uniformity ratio % (U.R.%).The parental variety TNB1 ($P_2$) exhibited the best mean performance for fiber fineness (F.F.) and the parental variety CB-58 ($P_4$) exhibited the best mean performance for fiber fineness (F.F.), lint percentage (L.%) and number of bolls/plant (N.B. /P.). Therefore, these parental varieties could be utilized in a breeding program for improving these traits through the selection in segregating generations.

From the analysis of diallel crosses, the variety CB-58 ($P_4$) was the best combiner for seed cotton yield/plant (S.C.Y/P.), lint yield/plant (L.Y/P.), lint percentage (L. %) and number of bolls/plant (N.B/P.). Moreover, the variety Giza 86 ($P_1$) was the best combiner for boll weight (B.W.) and upper half mean (UHM).Furthermore, the results revealed that the variety TNB1 ($P_2$) was the best combiner among this group of varieties for Fiber fineness (F.F) and fiber strength (F.S) which had desirable and significant values. The results showed that the cross $P_4$ x $P_5$ gave the highest mean for lint yield/plant (L.Y/P.), lint percentage (L %) and number of bolls/plant (N.B/P.). In the same time, the results also revealed that the highest mean performances were found for the cross $P_1$ x $P_4$ for cotton yield/plant (S.C.Y/P.) and $P_2$ x $P_5$ for boll weight (B.W.). Concerning fiber properties, the results showed that the cross $P_2$ x $P_4$ gave the highest mean for fiber strength (F.S.). Meanwhile, the cross $P_2$ x $P_5$ gave the highest mean for upper half mean (UHM) and uniformity ratio % (U.R. %).

The results revealed that the magnitudes of dominance genetic variance (σ2D) were positive and larger than those of additive genetic variance ($\sigma^2A$), for all studied traits. These results indicated the predominance on dominance genetic variance ($\sigma^2D$) in the inheritance of these traits. It could be concluded that fiber properties and yield components were mainly controlled by dominance variance. The estimated heritability values in broad sense ($h^2_{b.s.}$ %) were larger than the heritability values in narrow sense ($h^2_{n.s.}$ %) for all studied traits. The results also cleared that the calculated values in broad sense ranged from 61.20 % to 97.12 % for fiber strength (F.S) and seed cotton yield/plant (S.C.Y. /P.),respectively. Narrow sense ($h^2_{n.s.}$ %) ranged from 0.00 % for seed cotton yield/plant (S.C.Y. /P.) and uniformity ratio (U.R. %) to 61.47 % for Fiber fineness (F.F).

**Keywords** : Cotton, Diallel analysis, Gene action and Combining ability

## INTRODUCTION

Cotton breeders usually seek variations, which if not present they have to create it through hybridization programs. At the same time, the production of promising hybrids depends on the choice of parental lines as well as their order in hybridization which yielded the useful heterosis when crossed together. Therefore, in this study many hybrids (using half diallel system of six cotton varieties) were evaluated to estimate the amounts of variations and further partition of the genetic variance to its components in order to understand the nature of gene action of some yield components and fiber properties and subsequently determine which breeding program is proper for improving Egyptian cotton. Many investigators studied general and specific combining abilities and gene action among them Atta *et al.* (1982), Jagtab and Kolhe (1987), May and Cynthia (1994), Khorgade *et al.* (2000), Sorour *et al.* (2000b), El-Hoseiny (2004) and Abd El-Baky (2006). Lasheen *et al.* (2003 a) indicated that the non-additive portion was larger in magnitude than the additive variance for most studied yield component traits.

In addition, Kosba *et al.* (1991), Abd El-Bary (1999), Abou El-Yazid (1999) and Abd El-Maksoud *et al.* (2000) found that the amounts of heterosis versus mid-parents were significant for most studied traits. While, heterosis versus better-parent was not of economical importance. On the other hand, Fahmy *et al.* (1994) found highly significant positive better-parent heterosis for boll weight and lint percentage.

## MATERIALS AND METHODS

The genetic materials used in the present investigation included six cotton varieties belong to *Gossypium barbadense* L., three of them are Egyptian long staple cotton varieties: Giza 86 ($P_1$) very late in maturity, high yielding characters, long staple (33.2 mm.), coarse lint (4.3 Micronaire value) and strong lint (11.0 Pressley index), Giza 85 ($P_5$) exhibited fiber strength (10.4) and Micronaire value (3.8) and Giza 89 ($P_6$) early in maturing, moderate in yield characters with high number of bolls per plant, long staple (32.0 mm.) and coarse lint (Micronaire value 4.1). The other three varieties were TNB1 Sea Island ($P_2$) an extra long staple variety, characterized by Micronaire value (3.1) and Pressley index (10.3), lint length (33.7 mm.) and boll weight (2.7g.) and Suvin ($P_3$) Indian long staple germplasm. It is characterized by earliness, high yield and its components. CB 58 ($P_4$): a medium long staple, American Egyptian variety, characterized by high lint percentage and earliness. The inbred seeds of all varieties were obtained from The Cotton Breeding Section, Cotton Research Institute, Agricultural Research Center, Giza, Egypt.

These six varieties were involved in a series of hybridization according to half diallel crosses mating design during the growing season of 2005. The six parents were planted and mated in a diallel fashion excluding reciprocals to obtain 15 single crosses. The parental varieties were also self-pollinated to obtain enough seeds for further investigations. Number of crosses is P (P-1) /2 where, P: is number of parental varieties.

The genetic materials used in the experiment consisted of 21 genotypes (the six parental varieties and 15 diallel crosses). In 2006 growing season, the experimental design used was a randomized complete blocks design with three replications. 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 the recommendations.

Data were recorded on the following traits : Seed cotton yield per plant in grams (S.C.Y. / P.); lint yield per plant in grams (L.Y./P.);boll weight in grams (B.W.) and number of open bolls per plant (N.B. /P.); lint percentage (L %), fiber fineness (F.F.) fiber strength (F.S.) upper half mean (UHM) as a measure of span length in mm. and uniformity ratio % (U.R. %).The fiber properties were measured in the laboratories of The Cotton Fiber Research Section, Cotton Research Institute according to (A.S.T.M.D-1448-59,D-1445-60T and D-1447-67).

Statistical procedures used in this study were done according to the analysis of variance for a randomized complete blocks design as outlined by Cochran and Cox (1957).

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:

$H(F_1,M.P)\% = [(F_1-M.P) / M.P ] \times 100$

$H(F_1,B.P)\% = [(F_1-B.P) / B.P ] \times 100$

The significance of means and heterosis were determined using the least significant difference value (L.S.D) at 0.05 and 0.01 levels of significance, according to Steel and Torrie (1980).

The procedures of this analysis was described by Griffing's method 2 (1956) and outlined by Singh and Chaudhary (1985). The form of the analysis of combining ability and the expectations of mean squares are presented in Table 1.

**Table 1: Form of the analysis of variance of diallel crosses mating design and expectations of mean square**

| S.O.V. | d.f | M.S | E.M.S |
|---|---|---|---|
| GCA | p-1 | Mg | $\sigma^2e + \sigma^2s + (p+2)\sigma^2g$ |
| SCA | p (p-1)/2 | Ms | $\sigma^2e + \sigma^2s$ |
| Error | (g-1)(r-1) | Mé | $\sigma^2e$ |

**p, g and r: are number of parents, genotypes and replications, respectively.**
**Mé : is the error mean square divided by number of replications**
**Ms and Mg: are the mean squares of SCA and GCA, respectively.**

In general, GCA of a line is the average value of the line in all other combinations and it is a measure of additive genetic variance. SCA is the ability of a line to do better or worse than the average value in a specific cross and it is a measure of non-additive genetic variances including dominance. These components could be obtained through the evaluation of the diallel crosses.

The mathematical model for the combining ability analysis is:

$Y_{ij} = \mu + g_i + g_j + S_{ij} + e_{ijk}$

Where:

$Y_{ij}$ : is the value of a cross between parents (i) and (j)

$\mu$ : is population mean.

$g_i, g_j$ : are the GCA effects

$S_{ij}$ : is the SCA effect

$e_{ijk}$ : is the mean error effect

Using plot means the various sums of squares are obtained as follow:

S.S. due to GCA ($S_g$) $= 1/(P+2)[\sum(Y_{i.}+Y_{ii})^2 - 4Y^2_{...}/P]$

S.S. due to SCA ($S_S$) $= \sum\sum Y^2_{ij} - 1/(P+2)\sum(Y_{i.}+Y_{ii})^2 + 2Y^2_{...}/(P+1)(P+2)$

Estimation of variance components and their genetic interpretations from ANOVA Table 1 could be explained as follows:

$\sigma^2 g = (M_g - M_s)/(P+2)$ , $\sigma^2 S = M_s - M_{\acute{e}}$ and $\sigma^2 e = M_{\acute{e}}$

The components may be translated into genetic variance components using following equations:

$\sigma^2 g = \sigma^2 A/2$ and $\sigma^2 s = \sigma^2 D$

In addition, the estimates of combining ability effects were determined using the following equations:

1. General combining ability effects (gi) for each line:

$g_i = 1/(P+2)[\sum(Y_{i.}+Y_{ii}) - 2Y_{..}/P]$

2. Specific combining ability effects ($S_{ij}$) for each cross:

$S_{ij} = Y_{ij} - 1/(P+2)[Y_{i.} + Y_{ii} + Y_{.j} + Y_{jj}] + 2Y_{..}/(P+1)(P+2)$

To test the significance of general as well as specific combining abilities effects, the critical differences were calculated as follows:

C.D. = S.E. x t

Where: S.E. : is standard error of effects and t: is "t" tabulated with the degree of freedom of error at 5% or 1% levels of probability.

Estimates of standard errors:

S.E. ($g_i$) $= [(P-1)\sigma^2 e/P(P+2)]^{1/2}$

S.E. ($S_{ij}$) $= [P(P-1)\sigma^2 e/(P+1)(P+2)]^{1/2}$

## RESULTS AND DISCUSSION

The mean performances of the six parents and their 15 $F_1$ hybrids were estimated for all studied traits and the results are presented in Table 2. The results showed that Giza 86 ($P_1$) was the highest yielding parent for seed cotton yield/plant (S.C.Y. /P.), lint yield/plant (L.Y. /P.) and boll weight (B.W.), also it was the best for fiber strength (F.S.), upper half mean (UHM) and uniformity ratio % (U.R. %).The parental variety TNB1 ($P_2$) exhibited the best mean performances for fiber fineness (F.F.) and the parental variety CB-58 ($P_4$) exhibited the best mean performances for fiber fineness, lint percentage (L.%) and number of bolls/plant (N.B. /P.). With respect to the diallel crosses, the means showed that there was no specific cross, which was superior or inferior for all studied traits. The results showed that the cross $P_4$ x $P_5$ gave the highest mean for lint yield/plant (L.Y. /P.), lint percentage (L. %) and number of bolls/plant (N.B. /P.) with means of 53.1 g., 40.4%. and 46.9, respectively. In the same time, the results also revealed that the highest mean performances were found for the cross $P_1$ x $P_4$ for seed cotton yield/plant (S.C.Y. /P.) and $P_2$ x $P_5$ for boll weight (B.W.) with means of 173.7 g and 3.3 g, respectively. Concerning fiber properties, the results revealed that the cross $P_2$ x $P_4$ gave the highest mean for fiber strength (F.S.) with means of 10.8. Meanwhile, the cross $P_2$ x $P_5$ gave the highest mean for upper half mean (UHM) and uniformity ratio (U.R. %) with means of 34.9 mm. and 86.4%, respectively.

**Table 2: The mean performances of parents and $F_1$ hybrids for yield component traits and fiber quality properties**

| Genotypes | B. W. | S.C.Y/ P | L.Y. / P | L. % | N. B./ P | F.F | F.S | UHM | U R |
|---|---|---|---|---|---|---|---|---|---|
| $P_1$ | 3.2 | 120.0 | 39.8 | 33.3 | 37.2 | 4.3 | 9.9 | 34.2 | 85.1 |
| $P_2$ | 2.6 | 100.0 | 32.3 | 32.5 | 37.8 | 3.4 | 9.7 | 33.4 | 83.5 |
| $P_3$ | 2.9 | 99.3 | 31.1 | 31.5 | 34.5 | 4.4 | 9.0 | 30.3 | 84.1 |
| $P_4$ | 2.5 | 104.4 | 37.0 | 35.4 | 41.7 | 3.4 | 8.8 | 31.9 | 84.0 |
| $P_5$ | 2.9 | 101.5 | 34.2 | 33.8 | 35.7 | 4.4 | 8.3 | 32.6 | 84.4 |
| $P_6$ | 2.8 | 110.0 | 35.7 | 32.6 | 40.1 | 4.7 | 8.6 | 32.9 | 84.7 |
| $P_1$ x $P_2$ | 2.9 | 78.0 | 25.6 | 32.9 | 27.3 | 3.7 | 8.9 | 33.4 | 84.6 |
| $P_1$ x $P_3$ | 3.1 | 76.2 | 26.3 | 34.6 | 24.9 | 4.6 | 9.7 | 34.0 | 85.2 |
| $P_1$ x $P_4$ | 3.0 | 137.3 | 49.0 | 35.7 | 45.1 | 4.4 | 9.7 | 33.1 | 84.5 |
| $P_1$ x $P_5$ | 2.8 | 111.5 | 43.7 | 39.2 | 39.3 | 4.2 | 9.4 | 33.0 | 85.3 |
| $P_1$ x $P_6$ | 3.0 | 117.7 | 43.8 | 37.2 | 39.3 | 4.7 | 9.0 | 33.5 | 84.6 |
| $P_2$ x $P_3$ | 2.6 | 96.2 | 35.4 | 36.8 | 37.2 | 3.8 | 10.0 | 32.1 | 84.0 |
| $P_2$ x $P_4$ | 2.9 | 103.6 | 33.3 | 32.2 | 36.0 | 3.7 | 10.8 | 33.6 | 83.7 |
| $P_2$ x $P_5$ | 3.3 | 131.3 | 45.0 | 34.3 | 39.9 | 4.2 | 10.4 | 34.9 | 86.4 |
| $P_2$ x $P_6$ | 2.6 | 79.3 | 27.8 | 35.0 | 30.4 | 4.2 | 9.2 | 32.3 | 85.2 |
| $P_3$ x $P_4$ | 2.8 | 121.6 | 46.4 | 38.2 | 42.9 | 4.0 | 9.1 | 34.0 | 85.9 |
| $P_3$ x $P_5$ | 2.9 | 108.2 | 42.1 | 38.9 | 37.6 | 4.5 | 10.0 | 33.8 | 85.3 |
| $P_3$ x $P_6$ | 2.9 | 125.3 | 44.5 | 35.5 | 42.6 | 4.2 | 8.4 | 32.4 | 84.0 |
| $P_4$ x $P_5$ | 2.8 | 131.6 | 53.1 | 40.4 | 46.9 | 3.3 | 9.1 | 33.4 | 84.3 |
| $P_4$ x $P_6$ | 2.7 | 116.1 | 42.8 | 36.9 | 43.4 | 4.4 | 9.4 | 32.3 | 85.8 |
| $P_5$ x $P_6$ | 2.9 | 95.0 | 33.5 | 35.3 | 33.2 | 4.5 | 9.4 | 32.5 | 84.9 |
| LSD 5% | 0.334 | 8.634 | 4.003 | 3.094 | 5.025 | 0.471 | 1.131 | 1.405 | 0.978 |
| 1% | 0.447 | 11.540 | 5.351 | 4.135 | 6.717 | 0.629 | 1.512 | 1.878 | 1.308 |

**$P_1$, $P_2$, $P_3$, $P_4$, $P_5$ and $P_6$: Giza 86, TNB1, Suvin, CB-58, Giza 85 and Giza 89.**
***, ** Significant at 0.05 and 0.01 levels of probability, respectively**

Analysis of variance of the six parents and their 15 $F_1$'s hybrids were made for all studied yield and yield component traits [seed cotton yield/plant (S.C.Y./P.), lint yield/plant (L.Y./P.), boll weight (B.W.) , lint percentage (L.%) and number of bolls/plant (N.B./P.)] and some fiber properties [ fiber fineness (F.F.), fiber strength (F.S.) , upper half mean (UHM) and uniformity ratio % (U.R.%)] and the mean squares are presented in Table 3. The mean squares of genotypes were significant or highly significant for all studied traits, while the parents vs. crosses mean squares were highly significant for (L.Y./P.), (L.%), (F.S.), (UHM) and (U.R.%). Furthermore, the results indicated that the magnitudes of the crosses mean squares of all studied traits were significant or highly significant.

**Table 3: The analysis of variance and the mean squares for yield component traits and fiber quality properties**

| S O V | d f | B. W. | S.C.Y/P | L.Y/P | L. % | N. B./P | F.F | F.S | UHM | U.R.% |
|---|---|---|---|---|---|---|---|---|---|---|
| R | 2 | 0.005 | 542.56** | 11.88 | 43.27** | 78.70** | 0.020 | 3.202** | 0.020 | 0.241 |
| G | 20 | 0.113** | 902.84** | 174.55** | 18.58** | 92.68** | 0.575** | 1.212** | 2.963** | 1.700** |
| P | 5 | 0.192** | 189.15** | 30.29** | 5.33 | 21.98 | 0.979** | 1.151* | 5.533** | 0.986* |
| C | 14 | 0.088* | 1215.39** | 220.33** | 16.38** | 124.53** | 0.468** | 1.142* | 1.835* | 1.720** |
| P. Vr C. | 1 | 0.071 | 95.59 | 254.92** | 115.68** | 0.21 | 0.049 | 2.489** | 5.916** | 4.996** |
| E | 40 | 0.041 | 27.40 | 5.89 | 3.52 | 9.28 | 0.081 | 0.470 | 0.725 | 0.352 |

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

**Table 4: The analysis of variance and mean the squares of diallel crosses for yield component traits and fiber quality properties**

| S O V | d f | B. W. | S.C.Y/P | L.Y/P | L. % | N B./P | F.F | F.S | UHM | U.R% |
|---|---|---|---|---|---|---|---|---|---|---|
| GCA | 5 | 0.065 | 251.107 | 67.709 | 6.201 | 44.319 | 0.545 | 0.482 | 1.224 | 0.299 |
| SCA | 15 | 0.029 | 317.561 | 55.008 | 6.190 | 26.417 | 0.074 | 0.378 | 0.909 | 0.656 |
| E | 40 | 0.014 | 9.134 | 1.964 | 1.173 | 3.095 | 0.027 | 0.157 | 0.242 | 0.117 |

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

The results showed that the general combining ability (GCA) and specific combining ability (SCA) mean squares were significant or highly significant for all studied traits. Meanwhile, GCA was larger in magnitude than their corresponding values of specific combining (SCA) for all studied traits except for (S.C.Y. /P.) and (U.R. %). These results indicated that the general combining ability (GCA) variances were more important in the inheritance of these traits than those of specific combining ability (SCA). In addition, the small magnitudes of mean squares of specific combining ability (SCA) with respect to their corresponding mean squares of general combining ability (GCA) may explain the absence of heterosis over the better-parent (B.P) for most of studied traits.

The amounts of heterosis versus the mid-parents (M.P) and the better-parent (B.P) for yield component traits and some fiber properties were obtained and the results are presented in Table 5.

**Table 5: The amounts of heterosis over the mid-parents (M.P) and better-parent (B.P) for yield and yield component traits and fiber quality properties**

| Entries and comparisons | B. W. | S.C.Y/P | L.Y./P. | L. % | N.B./P | F.F | F.S | UHM | U.R.% |
|---|---|---|---|---|---|---|---|---|---|
| M.P. | 2.8 | 105.9 | 35.0 | 33.2 | 37.9 | 4.1 | 9.0 | 32.5 | 84.3 |
| B.P. | 3.2 | 120.0 | 39.8 | 35.4 | 41.7 | 3.4 | 9.9 | 34.2 | 85.1 |
| F1 | 2.9 | 108.6 | 39.5 | 36.2 | 37.7 | 4.2 | 9.5 | 33.2 | 84.9 |
| H (F1, M.P)% | 2.64 | 2.58 | 12.71** | 9.03** | -0.34 | 1.51 | 4.87* | 2.09** | 0.74** |
| L.S.D 0.05 | 0.11 | 2.95 | 1.37 | 1.06 | 1.72 | 0.16 | 0.39 | 0.48 | 0.33 |
| 0.01 | 0.15 | 3.94 | 1.83 | 1.41 | 2.29 | 0.21 | 0.52 | 0.64 | 0.45 |
| H (F1, B.P)% | -10.65** | -9.51** | -0.89 | 2.22 | -9.63* | 23.98** | -4.31 | -2.96 | -0.25 |
| L.S.D 0.05 | 0.24 | 6.31 | 2.92 | 2.26 | 3.67 | 0.34 | 0.83 | 1.03 | 0.71 |
| 0.01 | 0.33 | 8.43 | 3.91 | 3.02 | 4.91 | 0.46 | 1.10 | 1.37 | 0.95 |

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

The results indicated the presence of positive heterosis over mid-parents (M.P) for (S.C.Y. /P.) and (L %) (F.S.), (UHM) and (U.R. %) traits. The amounts of positive (desirable) heterosis over mid-parents (M.P) ranged from 2.04% to 11.28% for upper half mean (UHM) and seed cotton yield/plant (S.C.Y. /P.), respectively. In addition, the estimated values of heterosis relative to better-parent indicated the absence of heterotic effect in all studied traits.

The estimates of general combining ability effects ($g_i$) of the parental varieties were obtained for yield component traits and some fiber properties and the obtained results are shown in Table 6. Positive estimates would indicate that a given variety is much better than the average of the group involved with it in the diallel crosses for all studied traits except fiber fineness. Comparison of the general combining ability effect ($g_i$) of individual parent exhibited that no parent was the best combiner for all yield and its component traits and/or fiber properties.

**Table 6: General combining ability effects ($g_i$) of parental varieties for yield component traits and fiber quality properties**

| Parents | B. W. | S.C.Y/ P. | L.Y/ P. | L. % | N. B/ P | F.F | F.S | UHM | U.R.% |
|---|---|---|---|---|---|---|---|---|---|
| G.86 | 0.151** | 0.750 | 0.075 | -0.151 | -1.747** | 0.156** | 0.115 | 0.531** | 0.165 |
| TNB1 | -0.065 | -8.287** | -4.480** | -1.410** | -2.242** | -0.325** | 0.377** | 0.231 | -0.285* |
| Suvin | 0.014 | -3.567** | -1.316** | -0.044 | -1.270* | 0.119* | -0.054 | -0.544** | -0.054 |
| CB-58 | -0.094* | 8.029** | 3.879** | 0.838* | 4.172** | -0.319** | 0.021 | -0.131 | -0.135 |
| G.85 | 0.045 | 3.238** | 2.293** | 1.042** | 0.490 | 0.069 | -0.092 | 0.194 | 0.221 |
| G.89 | -0.051 | -0.162 | -0.452 | -0.275 | 0.598 | 0.300** | -0.367** | -0.281 | 0.090 |
| SE | 0.0378 | 0.9754 | 0.4523 | 0.3495 | 0.5678 | 0.0532 | 0.1278 | 0.1587 | 0.1105 |

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

The variety CB-58 ($P_4$) was the best combiner for seed cotton yield/plant (S.C.Y. /P.), lint yield/plant (L.Y. /P.), lint percentage (L. %) and number of bolls/plant (N.B. /P.). Meanwhile, the variety Giza 85 ($P_5$) had the positive and highly significant values of general combining ability for (S.C.Y. /P.), (L.Y. /P.) and (L. %). Moreover, the variety Giza 86 ($P_1$) was the best combiner for boll weight (B.W.) and upper half mean (UHM). Furthermore, the results revealed that the variety TNB1 ($P_2$) was the best combiner among this group of varieties for Fiber fineness (F.F.) and fiber strength (F.S.) which had desirable and significant values.

The specific combining ability effects ($S_{ij}$) for all studied crosses with respect to yield and yield component traits were obtained and the results are shown in Table 7. The results cleared that no hybrid exhibited positive and significant values for all studied yield traits. However, 2, 6, 9, 6, and 7 out of 15 crosses showed positive and significant or highly significant specific combining ability effects ($S_{ij}$) values for boll weight (B.W.), seed cotton yield/plant (S.C.Y./P.), lint yield/plant (L.Y./P.), lint percentage (L. %) and number of bolls/plant (N.B./P, respectively. It is worth to notice that these crosses in cases of seed cotton yield/plant (S.C.Y./P.) and lint yield/plant (L.Y./P.) were a result of crossing poor x poor general combiner [Suvin x Giza 89 ($P_3$ x $P_6$)] and poor x good general combiners [TNB1 x Giza 85 ($P_2$ x $P_5$) and Suvin x CB-58 ($P_3$ x $P_4$)]. The same trend was observed in other yield and its component traits. Thus, it is not necessary that parents having low general combination ability effect ($g_i$) would also contribute to low specific combining ability effects ($S_{ij}$).

**Table 7: Specific combining ability effects ($S_{ij}$) of each cross for yield component traits and fiber quality properties**

| Crosses | B. W. | S.C.Y/ P | L.Y/ P | L. % | N. B./ P | F.F | F.S | UHM | U.R.% |
|---|---|---|---|---|---|---|---|---|---|
| $P_1 x P_2$ | -0.091 | -22.28** | -8.21** | -0.932 | -6.464** | -0.267* | -0.989** | -0.405 | 0.009 |
| $P_1 x P_3$ | 0.030 | -28.80** | -10.67** | -0.597 | -9.846** | 0.189 | 0.292 | 0.970* | 0.378 |
| $P_1 x P_4$ | 0.123 | 20.71** | 6.83** | -0.333 | 4.899** | 0.427** | 0.217 | -0.343 | -0.291 |
| $P_1 x P_5$ | -0.220* | -0.30 | 3.12** | 2.979** | 2.789* | -0.161 | -0.021 | -0.768* | 0.153 |
| $P_1 x P_6$ | 0.030 | 9.30** | 5.97** | 2.312** | 2.682* | 0.108 | -0.146 | 0.257 | -0.366 |
| $P_2 x P_3$ | -0.174* | 0.24 | 2.94** | 2.893** | 2.960* | -0.129 | 0.279 | -0.630 | -0.372 |
| $P_2 x P_4$ | 0.174* | -3.96 | -4.31** | -2.614** | -3.707** | 0.158 | 1.054** | 0.457 | -0.591* |
| $P_2 x P_5$ | 0.450** | 28.54** | 8.98** | -0.694 | 3.852** | 0.321* | 0.717** | 1.432** | 1.703** |
| $P_2 x P_6$ | -0.139 | -20.06** | -5.52** | 1.383 | -5.726** | 0.089 | -0.158 | -0.643 | 0.634* |
| $P_3 x P_4$ | 0.050 | 9.32** | 5.63** | 2.037* | 2.220 | 0.064 | -0.214 | 1.632** | 1.328** |
| $P_3 x P_5$ | -0.043 | 0.71 | 2.91** | 2.591** | 0.634 | 0.177 | 0.748* | 1.107** | 0.421 |
| $P_3 x P_6$ | 0.112 | 21.21** | 8.05** | 0.495 | 5.533** | -0.354** | -0.527 | 0.232 | -0.747** |
| $P_4 x P_5$ | 0.004 | 12.52** | 8.72** | 3.141** | 4.448** | -0.586** | -0.227 | 0.295 | -0.547* |
| $P_4 x P_6$ | 0.005 | 0.42 | 1.16 | 0.975 | 0.867 | 0.233 | 0.348 | -0.280 | 1.084** |
| $P_5 x P_6$ | 0.007 | -15.89** | -6.52** | -0.782 | -5.694** | -0.004 | 0.511 | -0.405 | -0.122 |
| SE | 0.0857 | 2.2121 | 1.0257 | 0.7927 | 1.2876 | 0.1205 | 0.2898 | 0.3599 | 0.2506 |

**$P_1$, $P_2$, $P_3$, $P_4$, $P_5$ and $P_6$: Giza 86, TNB1, Suvin, CB-58, Giza 85 and Giza 89, respectively**
***, ** Significant at 0.05 and 0.01 levels of probability, respectively**

Concerning fiber quality properties 3, 3, 4, and 4 out of 15 crosses showed desirable significant specific combining ability effects ($S_{ij}$) estimates in the cases of fiber fineness (F.F.), fiber strength (F.S.), upper half mean (UHM) and uniformity ratio % (U.R.%) properties, respectively. These results were in common agreement with the results obtained by many authors among them Abd El-Bary (1999 and 2003), Abd El-Maksoud *et al.* (2000) and Lasheen *et al.* (2003 a).

The Genetic parameters estimates were obtained and the results are presented in Table 8.

**Table 8: The estimates of genetic parameters, which included additive and non-additive genetic variances in addition to heritability in broad and narrow sense for yield component traits and fiber quality properties**

| Genetic parameters | B. W. | S.C.Y/ P. | L.Y/ P. | L. % | N. B./ P | F.F | F.S | UHM | U. R.% |
|---|---|---|---|---|---|---|---|---|---|
| $\sigma^2 g$ | 0.004 | -6.645 | 1.270 | 0.001 | 1.790 | 0.047 | 0.010 | 0.032 | -0.036 |
| $\sigma^2 s$ | 0.015 | 308.427 | 53.044 | 5.018 | 23.322 | 0.047 | 0.221 | 0.667 | 0.539 |
| $\sigma^2 e$ | 0.014 | 9.134 | 1.964 | 1.173 | 3.095 | 0.027 | 0.157 | 0.242 | 0.117 |
| $\sigma^2 A$ | 0.007 | -13.291 | 2.540 | 0.002 | 3.580 | 0.094 | 0.021 | 0.063 | -0.072 |
| $\sigma^2 D$ | 0.015 | 308.427 | 53.044 | 5.018 | 23.322 | 0.047 | 0.221 | 0.667 | 0.539 |
| $h^2 n$ | 23.87 | 0.00 | 5.46 | 0.04 | 14.49 | 61.47 | 6.49 | 7.98 | 0.00 |
| $h^2 b$ | 63.70 | 97.12 | 96.62 | 81.06 | 89.98 | 85.84 | 61.20 | 75.52 | 82.13 |

The results revealed that the magnitudes of dominance genetic variance ($\sigma^2 D$) were positive and larger than those of additive genetic variance ($\sigma^2 A$), for all studied yield and yield component traits [seed cotton yield/plant (S.C.Y./P.), lint yield/plant (L.Y./P.), boll weight (B.W.) , lint percentage (L.%) and number of bolls/plant (N.B./P.)] and some fiber properties [fiber strength (F.S.) , upper half mean (UHM) and uniformity ratio % (U.R.%)]. These indicated the predominance of dominance genetic variance ($\sigma^2$D) in the inheritance of these traits. It could be concluded that fiber properties and yield components were mainly controlled by dominance variance. The estimated heritability values in broad sense ($h^2$ b.s. %) were larger than their corresponding heritability values in narrow sense ($h^2$ n.s. %) for all studied traits. The results also cleared that the calculated values in broad sense ranged from 61.20 % to 97.12 % for fiber strength (F.S.) and seed cotton yield/plant (S.C.Y. /P.), respectively. Narrow sense ($h^2$ n.s. %) ranged from 0.00 % for seed cotton yield/plant (S.C.Y. /P.) and uniformity ratio % (U.R. %) to 61.47 % for fiber fineness (F.F.). These results were in common agreement with the results obtained by many authors among them May and Cynthia (1994), Abd El-Bary (1999 and 2003), Abd El-Maksoud *et al.*(2000), Khorgade *et al.* (2000) and Sorour *et al.* (2000b).

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## تحليل الهجن التبادلية لمكونات المحصول وصفات التيلة في القطن

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**معهد بحوث القطن – مركزالبحوث الزراعية – الجيزة – مصر**

اشتملت الدراسة على ستة أصناف من القطن الباربادنس هى : جيزه ٨٦ ، TNB1 ،Suvin ، CB-58 ، جيزه ٨٥ و جيزه ٨٩. طبقا لنظام التزاوج الدائرى النصف كامل أدخلت هذه الأباء فى سلسلة من التهجينات لتنتج ١٥ هجن جيل أول خلال موسم النمو ٢٠٠٥. وفى موسم النمو ٢٠٠٦ ، تم تقييم هذه التراكيب الوراثية المختلفة (الأباء الستة ، ١٥ هجين فردى) بمحطة البحوث الزراعية بسخا حيث تم قياس الصفات الآتية: محصول القطن الزهر للنبات ، محصول القطن الشعر للنبات ، وزن اللوزة ، عدد اللوز المتفتح للنبات ، تصافى الحليج ، متانة التيلة ،نعومة التيلة، طول التيلة ،معامل الأنتظام .

هذا ويمكن تلخيص النتائج المتحصل عليها من هذه الدراسة فى النقاط التالية:

- اختبار المعنوية لمتوسط المربعات الخاصة بالتراكيب الوراثية أشار إلى أن هناك اختلافا معنوى أوعالى المعنوية بين هذه التراكيب الوراثية لكل الصفات المدروسة.
- من خلال تحليل الهجن الفردية كان أفضل الأصناف قدرة عامة على التآلف الصنف جيزه ٨٦ لصفتى متوسط وزن اللوزة و طول التيلة والصنف TNB1 لمتانة ونعومة التيلة أما الصنف CB-58 فقد كان افضل الأصناف قدرة عامة على الإئتلاف لصفات محصول القطن الزهر للنبات ، محصول القطن الشعر للنبات ، عدد اللوز المتفتح للنبات.
- أظهرت الهجن التالية أفضل إمكانية لإستخدامها في برامج التربية لتحسين صفات المحصول ومكوناته وفى مقدمتها محصول القطن الزهر ومحصول القطن الشعر وعدد اللوز المتفتح الكلى للنبات وهذه الهجن هى : جيزه ٨٦ × CB-58، جيزه ٨٦× جيزه ٨٩.
- اوضح الهجينان CB-58 × جيزه ٨٥ و Suvin ×جيزة ٨٩ افضل امكانية لإستخدامها فى تحسين صفة متانة التيلة مع تحسين صفات المحصول.
- أظهرت الهجن TNB1 × جيزه ٨٥ ، CB-58× Suvin و Suvin ×جيزة ٨٥ افضل امكانية لإستخدامها فى تحسين صفات المحصول وطول التيلة معا.
- أظهرت النتائج أن قيم معامل التوريث فى المعنى الواسع تراوحت من ٦١,٢٠% الى ٩٧,١٢% لصفتى متانة التيلة و محصول القطن الزهر للنبات على الترتيب وفى المعنى الضيق تراوحت القيم من ٥٠,٠٠% لصفتى محصول القطن الزهر للنبات و معامل الأنتظام الى ٦١,٤٧% لصفة النعومه .
- بينت النتائج أن قيم التباين السيادى تلعب دورا هاما فى توارث معظم الصفات المدروسة.

نستنتج من ذلك أنه يمكن استخدام الاصناف ذات القدرة العامة العالية علي الإئتلاف والهجن المميزة في صفاتها التكنواوجية و ذات الانتاجية العالية في تحسين الاقطان المصرية من خلال برامج تربية القطن.