# Genetic Behavior of Yield and Yield Component Traits in Some Interaspecific Cotton Crosses.

**Abd EL-Hadi, A.H.*; Z.M.EL-Diasty*; M.S.Hamada*; M.A.Raaft** and W.M.B.Yehia****

** Dept. of Genetics, Faculty of Agric., Mansoura Univ., Egypt.*

*** Cotton Research Institute, Agricultural Research Center, Egypt.*

## ABSTRACT

**In this study six Egyptian cotton varieties were used. These varieties are 6022($P_1$), Suvin ($P_2$), Pima $S_7$ ($P_3$), G. 85 ($P_4$), G.88 ($P_5$) and G.70 ($P_6$). The parental varieties and all possible combinations among them were evaluated at two different locations (Sakha Agric. Station, Kafr El-Sheikh and Cotton Research Experimental at Abo-Kebir, El-Sharkia Governorate). Heterosis, gene action, general and specific combining abilities and heritability in broad and narrow senses were estimated yield and yield component traits were evaluated. These traits were - seed cotton yield per plant (S.C.Y./P), lint cotton yield per plant (L.C.Y./P.), lint percentage (L.%), Boll weight (B.W.), Number of bolls per plant (N.B. / P.), seed index (S.I.) and lint index (L.I.).**

**The results showed highly significant mean squares among these genotypes for all studied traits in single location and over all the two locations. Also the mean performances of genotypes indicated that the highest yielding variety was G.88, while G.70 was the lowest parent for most studied traits.**

**Heterosis versus the mid- parents showed highly significance and positive for most studied crosses at the all studied traits. In the same time heterosis over better – parent showed highly significant and positive for most studied crosses. The mean squares specific combining abilities (S.C.A).) were highly significant and larger than those general combining ability(G.C.A). for all studied traits. Similarly, the mean squares of specific combining ability by location (S.C.A. × L) were larger than those general combining ability by location(G.C.A. × L) and significant for most studied traits. The variety G.88 ($P_5$) was the best combiner for most studied traits and the results cleared that no-parent was the best combiner for all studied traits, and Most studied traits that exhibited different levels of heritability values.**

## INTRODUCTION

The breeding program of Egyptian cotton "*G. barbadense*, L." was confined within the local genetical make-up of the Egyptian cotton varieties. Further yield improvement of Egyptian cotton requires the study of the possible improvement outside this limited germplasm. The most suitable source could be the high yielding *G. barbadense* L. variety from outside and, since it is genetically and cytologically very close to the Egyptian varieties. Effective breeding program's for the incorporation of desirable characters from the two sources requires basic genetical information on yield characters.

El- Harony (1988), Okash (1989), Dawwam *et al.* (1991), Gomaa (1997), Bharad *et al.* (2000) and EL–Disouqi *et al* (2000) and indicated the presence of significant heterosis for yield of seed cotton, number of bolls, boll weight, lint percentage and seed index.

EL–Okkia *et al.* (1989), Dawwam and Hendawy (1989), EL-Adl *et al.* (2001) and Zeina *et al* (2001) regarded that dominance genetic variances were larger than those of additive genetic variances.

The main objective of the present study was to determine: (a) the additive and dominance component of variation, (b) heritability in broad and narrow senses and heterosis, and (c) general and specific combining ability effects.

## MATERIALS AND METHODS

Six cotton varieties genotypes belong to (*Gossypium barbadense* L.) representing a range of yield and yield components were devoted to establish the experimental materials for this investigation, two of them were extra long staple varieties, i.e. G.88 ($P_5$) and G70 ($P_6$), one of them was long staple variety G.85 ($P_4$). In addition, three new germplasm materials, 6022 ($P_1$) Russian cotton variety, Suvin ($P_2$) Indian cotton variety and Pima $S_7$ ($P_3$) American cotton variety were used. The pure seeds of these parental genotypes were obtained from cotton Breeding Section, Cotton Research Institute, Agricultural Research Center at Giza, Egypt.

In the growing season of 2002, the six parents were planted and mated in half diallel fashion to obtained 15 $F_1$ single crosses. The parental varieties were also self-pollinated to obtain enough seeds for further investigations. In the growing season of 2003, the genetic materials obtained from hybridization and their parental varieties were evaluated in two field trial experiments at Sakha Agricultural Research Station and Cotton Research Experimental at Abo-Kebir, El-Sharkia Governorate. The experimental design used was a randomized complete blocks design with three replications in both locations. Each plot was one row 4.0 m long and 0.6 m, wide. Hills were 0.4 m apart and were thinned to keep a constant stand of one plant per hill at seedling stage.

Data were recorded on the following traits Seed cotton yield per plant (S.C.Y./P.), lint cotton yield per plant (L.C.Y./P.) lint percentage (L%), Boll weight (B.W.), number of bolls per plant (N.B./P.) seed index (S.I.) and lint index (L.I.).

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

The amounts of heterosis were estimated as the percentage deviation of the overall means of the $F_1$ hybrids over the average overall parents' ($H_{M.P.}$%) are above the better parent ($H_{B.P.}$ %).

$$H_{F1,\,M.P}\% = \frac{\overline{F}_1 - \overline{M}.P}{\overline{M}.P} \times 100$$

$$H_{F1,\,B.P}\% = \frac{\overline{F}_1 - \overline{B}.P}{\overline{B}.P} \times 100$$

The significance of heterosis was determined using the least significant difference value (L.S.D.) at 0.05 and 0.01 levels, which wa calculated as suggested by Steel and Torrie (1980).

$$L.S.D._{(5\%)} = t_{0.05}\, E_{d.f} \times S^{-}_{d}$$

$$L.S.D._{(1\%)} = t_{0.01}\, E_{d.f} \times S^{-}_{d}$$

To estimate the different genotypic parameters in terms of additive and dominance genetic variances, the procedures of this analysis were described by Griffing's method 2 (1956) and outlined by Singh and Chaudhary (1985).

The components may be translated into genetic components as follow equations.

| | | | |
|---|---|---|---|
| $\sigma^2 g$ | $= ½\, \sigma^2 A$ | $\sigma^2 s$ | $= ½\, \sigma^2 D$ |
| $\sigma^2 gL$ | $= ½\, \sigma^2 AL$ | $\sigma^2 sL$ | $= ½\, \sigma^2 DL$ |

Estimates of heritability values were determined according to the following equations:

From single location

$$h^2_{b.s}\% = \frac{2\sigma^2 g + \sigma^2 s}{2\sigma^2 g + \sigma^2 s + \sigma^2 e/r} \times 100$$

$$h^2_{n.s}\% = \frac{2\sigma^2 g}{\quad} \times 100$$

$$\overline{2\sigma^2 g + \sigma^2 s + \sigma^2 e/r}$$

From combined data

$$h^2_{b.s}\% = \frac{2\sigma^2 g + \sigma^2 s}{2\sigma^2 g + \sigma^2 s + \frac{2\sigma^2 gL}{L} + \frac{2\sigma^2 sL}{L} + \sigma^2 e/Lr} \times 100$$

$$h^2_{n.s}\% = \frac{2\sigma^2 g}{2\sigma^2 g + \sigma^2 s + \frac{2\sigma^2 gL}{L} + \frac{2\sigma^2 sL}{L} + \sigma^2 e/Lr} \times 100$$

# RESULTS AND DISCUSSION

The analysis of variances of each location and from the combined data were made and the results are presented in Table 1.The results revealed that the mean squares of genotypes were significant for all studied traits in first, second locations and combined data over two locations, with the expiation of lint percentage, Boll weight and seed index in locations 2. Similarly the mean squares of G × L were significant for all studied traits with the except of lint percentage, boll weight and seed index. It could be concluded that the choice of suitable genotypes for suitable location was very important.

The means of all-parental varieties and $F_1$ hybrids were obtained from the two locations and combined data over two locations and the results are presented in Table 2. The results cleared that the $P_5$ was the highest yielding for $L_1$ and combined lint percentage (L%) in $L_2$, and number of bolls/p in $L_1$ and combined with the mean values88.54, 74.90, 30.66, 25.92, 34.61 and 31.18, respectively .The $P_3$ was the highest yielding for seed cotton yield per plant (S.C.Y./P). lint cotton yield per plant (L.C.Y./P) in the $L_2$, and lint percentage (L%) in $L_1$ and combined as well as LI in the two locations and combined with the mean values 62.96, 21.59, 35.23, 34.78, 5.93, 5.77 and 5.85, respectively. While, the lowest variety for most of studied traits was the parent P6. The F1 hybrid ($P_4 \times P_6$) was the highest value for seed cotton yield per plant (S.C.Y./P) and lint cotton yield per plant (L.C.Y./P). in location 2 and combined with value 83.33, 88.13, 31.63 and 36.92, respectively, the $F_1$ hybrid ($P_4 \times P_5$) was the highest value for boll weight (B.W). in combined with value 2.98.

For number of bolls per plant (N.B./P) the $F_1$ hybrid ($P_1 \times P_4$) was the highest value in $L_1$ with value 33.10 and the $F_1$ hybrid $P_4 \times P6$ was the highest value in $L_2$ and combined with value 31.28 and 31.27, respectively.

For seed index (S.I.) The $F_1$ hybrid ($P_2 \times P_5$) exhibited the highest value for $L_1$, $L_2$ and combined with the mean values 10.85, 10.13 and 10.49, respectively. For $L_I$ the $F_1$ hybrid ($P_4 \times P_5$) exhibited the highest value for $L_1$, with the mean value 6.54, ($P_5 \times P_6$) in $L_2$ with the mean value 5.92,but the $F_1$ hybrid ($P_2 \times P_5$) exhibited the highest value for L.I in combined with the mean value 6.05.

The results of diallel analysis for all studied traits are shown in Table 3. The results illustrated that the mean squares of specific combining abilities (S.C.A). were significant for all studied traits in each location and combined data except lint percentage (L%), boll weight (B.W). in $L_2$, as well as mean squares of general combining ability (G.C.A). were significant for most studied traits in the two locations and combined data. It could be noticed that the relative magnitudes of the mean squares of specific combining abilities (S.C.A). were larger than those of general combining ability (G.C.A). for all studied traits with few exceptions.

The interactions of G.C.A. × L and S.C.A. × L were significant for lint cotton yield per plant (L.C.Y./P), number of bolls per plant (N.B./P) and seed index (S.I.) for S.C.A. × L. On the other hand, seed cotton yield per plant (S.C.Y./P) and lint cotton yield per plant (L.C.Y./P) were significant for G.C.A. × L. These results indicated that the non-additive genetic effects were predominated and played the major role in the expression of these traits. These results were in agreement with Gomaa and Shaheen (1995), Kumareson *et al.* (2000), Bertini *et al.* (2001), El-Adle *et al.* (2001), Zeina *et al.* (2001) and Singh and Yadavendra (2002) and disagree with El-Okkia *et al.* (1989), Awad (1991), Kosba *et al.* (1999), Banumathy and Shantil (2000).

The amounts of heterosis over mid-parents ($H_{M.P.}$ %) for all studied traits from the $L_1$, $L_2$ and combined data over the two locations were calculated and the results are presented in Table 4. The results indicated that the $F_1$ cross $P_4$ x $P_6$ was the highest positive heterosis value for seed cotton yield per plant (S.C.Y./P) and lint cotton yield per plant (L.C.Y./P) in $L_1$, $L_2$ and combined data with values 56.17, 72.03, 63.31, 77.30, 78.00 and 77.60 % for the two traits in two locations and combined data, respectively. The same cross showed the highest positive heterosis value for L.% in L1 with value 13.92% , boll weight (B.W). in

L2 with value 19.04% and number of bolls per plant (N.B./P). in $L_2$ and combined with values 61.11 and 44.43% , respectively .

For L.% in $L_2$ and combined, boll weight (B.W). in $L_2$ and combined, seed index (S.I.) in $L_1$ , $L_2$ and combined the $F_1$ cross $P_1$ x $P_6$ had the highest positive heterosis with value 4.70, 8.77, 15.96, 13.66, 7.39, 26.21 , 17.55 and 21.89 %, respectively . The $F_1$ cross $P_1$ x $P_5$ had the highest value for S.I in $L_1$ and $F_1$ cross $P_5$ x $P_6$ had the highest value for $L_2$ with values 7.64 and 9.61% for two crosses respectively.

The amount of heterosis over better- parent ($H_{B.P.}$ %) for yield and yield component traits was determined from the data in first $L_1$, second L2 and combined data over two locations and the obtained results are presented in Table 5 . The results showed that the F1 cross $P_4$ x $P_6$ had the highest value and positive heterosis for seed cotton yield per plant (S.C.Y./P). and lint cotton yield per plant (L.C.Y./P). in $L_1$, L2 and combined, as well as lint percentage (L%) in $L_1$, boll weight (B.W). in $L_1$ and combined and number of bolls per plant (N.B./P) in $L_2$ and combined with the value of heterosis 47.59, 69.47, 57.23, 62.13, 70.41, 65.78, 10.11, 17.86, 13.15, 22.79 and 39.63%, respectively. But The $F_1$ cross $P_1$ x $P_6$ had the highest positive heterosis for lint percentage (L%) in $L_2$ and combined, boll weight (B.W) in $L_2$, seed index (S.I.)in $L_2$ and combined and lint index (L.I.).in $L_1$, $L_2$ and combined with the value 4.21, 7.45, 14.80, 9.34, 6.81, 22.36, 16.81 and 20.37. These results were generally in agreement with the results obtained by Aher *et al.* (1986), Abo-Arab *et al.* (1997), Raafat *et al.* (1998), Kosba *et al.* (2000), El-Akhadar (2001), and Abd El-Bary (2003).

The estimates of general combining ability effects (gi) for all studied traits for the parental varieties from single location and combined data were obtained and the results are presented in Table 6. These results showed that no parent was the best combiner for all studied traits. It could be noticed that the parent $P_5$ was the highest combiner for most of studied traits in $L_1$ and combined while P2 was the best for seed cotton yield per plant (S.C.Y./P), lint cotton yield per plant (L.C.Y./P) and boll weight (B.W). in $L_2$. For number of bolls/plant $P_1$ was the best combiner in single location and combined.

The estimates of specific combining ability effects ($S_{iJ}$) for all possible combinations with respect to the studied yield and yield component traits were obtained from the single and combined data and the results are shown in table 7. In the first location, the results revealed that nine out of 15 $F_1$ hybrids exhibited positive significant values for seed cotton yield per plant (S.C.Y./P) and lint cotton yield per plant (L.C.Y./P), In this respect, the results also cleared that seven, five, seven, three and six hybrids out of 15 $F_1$ hybrids exhibited positive and in the same time , significant values of $S_{ij}$ for lint percentage (L%), boll weight (B.W), number of bolls per plant (N.B./P), seed index (S.I) and lint index (L.I.) I respectively, in the second location six , eight , zero, three, three, four and five out of 15 $F_1$ hybrids were positive and significant values of $S_{ij}$ for seed cotton yield per plant (S.C.Y./P), lint cotton yield per plant (L.C.Y./P), L. %, boll weight (B.W)., number of bolls per plant (N.B./P), seed index (S.I.) and lint index (L.I.), respectively.

The obtained results from in the combined data over two locations, indicated that seven, seven , three, two , five, three and five out of 15 $F_1$ hybrids exhibited positive significant values of $S_{ij}$ for seed cotton yield per plant (S.C.Y./P), lint cotton yield per plant (L.C.Y./P), lint percentage (L%), boll weight (B.W)., number of bolls per plant (N.B./P), seed index (S.I.) and L.I, respectively.

The estimated values of genetic parameters and heritability in broad and narrow senses from single location and combined data overall two locations for all studied traits are shown in Table 8. The results revealed that the non-additive genetic variance including dominance ($\sigma^2D$) were larger than those additive genetic variance ($\sigma^2A$) for all studied traits with the exception of lint percentage (L%) and boll weight (B.W) in $L_2$. These results indicated that the non-additive genetic variances including dominance ($\sigma^2D$) larger than those additive genetic variance ($\sigma^2A$). Similarly the interaction $\sigma^2DL$ was larger than those of $\sigma^2AL$ were.

Concerning heritability, the results indicated that the calculated values of ($h^2_b$%) ranged from 82.01% ($L_1$) and 64.88% ($L_2$) to 97.48% ($L_1$) and 96.85% ($L_2$) for lint index (L.I.) and L.% and L.% and seed cotton yield per plant (S.C.Y./P), respectively. In the same time, the values of heritability in broad sense from the combined data ranged from 66.81% to 90.95% for L.% and seed index (S.I.), respectively. On the other hand, the highest value of $h^2_n$% was 52.07% for L.% at $L_2$. These results obtained in this investigation were in agreement with many investigators among them Carvalho *et al.* (1995), Gomaa and Shaheen (1995), Soomaro *et al.* (1995), Bertini *et al.* (2001), El-Adl *et al.* (2001), Zenia *et al.* (2001) singh and Yadavendra (2002) and Kumaresan *et al.* (2002).

## REFERENCES

**Abd El-Bary, A.M.R. (2003).** Triallel analysis of some quantitative inherited traits in *Gossypium burbadanse* L. Ph. D. Thesis, Fac. of Agric. Mansoura Univ., Egypt.

**Abo-Arab, A.R.A.; A.F. Lasheen and Z.F. Abo-Sen (1997).** Genetical analysis of yield and its components in Egyptian cotton. J. Agric. Sçi., Mansoura Univ., 22 (1): 3675-3681.

**Aher, R.P.; R.S. Hapase and R.Y. Thete (1986).** Heterosis in Deshi cotton (*G. arboreum* L.) Mahatma phule, Agric. Univ. 2 (1): 45-48.

**Awad, A.A.M. (1991).** Inheritance of earliness and economical traits in cotton Ph.D. Thesis, Fac. of Agric., Mansoura Univ., Egypt.

**Banumathy, S. and Shanti Patil (2000).** Diallel analysis for seed cotton yield and its components in cotton. Annals of Plant Physiology, 2001, Vol. 17, No. 1, pp. 7-12.

**Bertini, C.H.C., dem; Silvi, F.P.Da; Nunes, R. DeP.; Santos, J.H.R. dos (2001).** Generation, heterosis and inbreeding depression of yield characters in mutant lines of upland cotton. Pesquis Agropecuaria Brasileir, 2001, Vol: 36, No. 7, PP. 941-948.

**Carvalho, L.P.D.E.; D.C. Cosme and C.F. DE Moraes (1995).** Diallel analysis of yield and other traits in cotton. Revista-Brasileriade. Genetica. 18 (1): 93-97.

**Cochran, W.C. and G.M. Cox (1957).** Experimental design. 2nd ed., Jon Willey and sons. New York. U.S.A.

**El-Adl, A.M.; Z.M. El-Diasty; A.A. Awad and A.M.R. Abd El-Bary (2001).** Inheritance of quantitative traits of Egyptian cotton ( *G.barbadense* L.) A- Yield and yield components. Egypt. Agric. res., 79 (2): 625-646.

**El-Harony, H.A. (1988):** Inheritance of some characters in cotton Ph.D. Thesis, Fac. Agric., Kafr El-Sheikh, Tanta Univ., Egypt.

**El-Akhadar, A.A. (2001).** Evaluation of some cotton crosses for earliness and economical traits. Ph.D. thesis, Fac. of Agric. Kafr El-Sheikh, Tanta Univ. Egypt.

**El-Okkia, A.F.H.; H.B. Abo-Tour and M.M. El-Shishtawy (1989).** Genetic analysis of yield and other important characters in

Egyptian cotton (*Gossypium barbadanse* L.). J. Agric. Res. Vol. 14 No. 2: 855-874.

**Gomaa, M.A.M. and A.M.A. Sheheen (1995).** Heterosis, inbreeding depression, heritability and type of gene action in two intra. Barbadense cotton crosses. Annals, Agric. Sci., Ain-Shams Univ., Cairo, 40 (2): 629-637.

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

**Okasha, A.A. (1989):** Estimates of genetic variances of the major yield components in cotton. Ph.D. Thesis Fac. of Agric., Tanta Univ., Egypt.

**Griffing, J.G. (1956).** Concept of general and specific combining ability in relation to diallel crossing systems. Australine J. of Biol. Sci., 9: 463-493.

**Kosba, Z.A., A.H. Abd El-Hadi; A.M. Zena and H.M. Hamoud.(2000) .** Inheritance of some yield and its components and fiber traits in Egyptian cotton. J. Agric. Sci. Mansoura Univ., 25 (7): 4009-4108.

**Kosba, Z.A.; M.M. Abd El-Maksoud; A.A. Okasha and M.A. El-Ameer (1999 ).** Genetical studies on types of gene effects for economical traits in some crosses of Egyptian cotton. J. Agric. Sci., Mansoura Univ., 24 (2): 545-554.

**Kumaresan, D.; J. Ganesan and S.Ashok (2000).** Genetic analyses of quantitative characters in cotton (*Gossypium hirsutum* L.). Crop research Hisar, 19 (3): 481-484.

**Raafat, M.A.; P. Dugger and D. Richter (1998).** Studies on induced variability in Egyptian cotton. Beltwide cotton conferences, San Diego, California, USA, (1): 552-556.

**Singh, D. and Yadavendra, S.P. (2002).** Genetic analysis of three quantitative characters in cotton. Indian Journal of Genetic an plant Breeding, 2002. Vol. 62 No. 1, pp. 85-86.

**Soomro, Z.A.; M.S. Kalwar; M.I. Memon and M.D. kerrio (1995).** Genetic analysis of yield and yield components in intrspecific crosses of *Gossypium hirsutum* L. Pakistan. Journal of Botany. 27 (2): 431-434.

**Zeina, A.M.A.; A.A.M. Awad; F.I. Salama; M.A. Abd El-Gelil; E. El-Helw and A.R.A., Rizk (2001).** Evaluation of the effect of soil salinity on yield, yield components and fiber quality in Egyptian cotton varieties. Adv. Agric. Res. Vol. 6 (1): 71-86.

**Steel R.G.D. and J.H.Torrie (1980).** Principles and procedures of statistics. Mc Graw Hill Book Company Inc., New York.

**Singh, R.K. and B.D.Chaudhary (1985).** Biometrical method in quantitative genetic analysis. Kalyani Publishers, New Delhi.

**Dawwam,H.H. and F. A. Hendawy (1989).** Diallel analysis of some agronomic traits of Egyptian cotton. 1.Combining ability as influenced by nitrogen fertilizer levels. Minufiya. J.Agic. Res. Vol.14No.(1) : 57-70 .

**Bharad,S.F.;L.D.Meshram;P.W.Khorgadoand H.V.Kalpande (2000).** Heterosis for yield components and fiber characters in naturally coloured cotton. J.of Maharashtra Agric. Univ.25 (2): 171-173.

**Dawwam, H.A.;F.A.Hendawy and E.K.Hassoub(1991).** Breeding cotton for some quantitative characters. 1-Yield and its components. Minofiya J.Asric.Res.16 (2): 1261-1292.

**El-Disouqi, A.E.; A.R. Abo-Arab and Z.F. Abo-Sen (2000).** Genetic behavior of yield and its components in Egyptian cotton. J. Agric. Sci. Mansoura Univ., 25(7): 3831-3840.

**Table 1: The result of the analysis of variance for yield and yield component traits for all genotypes obtained from the data in first location ($L_1$), second location (L2) and combined data over both two locations.**

| S.V. | d.f. Sin | d.f. Comb. | Mean of squares (M.S.) S.C.Y./P. | | | L.C.Y./P. | | | L. % | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | $L_1$ | $L_2$ | Comb. | $L_1$ | $L_2$ | Comb. | $L_1$ | $L_2$ | Comb. |
| Replicate | 2 | - | 34.27 | 42.88 | - | 14.01 | 4.06 | - | 3.70 | 4.05 | - |
| Location | - | 1 | - | - | 6263.93** | - | - | 988.79** | - | - | 26.57 |
| Genotypes | 20 | 20 | 405.14** | 244.31** | 538.17** | 67.28** | 30.77** | 80.53** | 6.46** | 4.11 | 7.44** |
| Rep./Location | - | 4 | - | - | 30.57 | - | - | 8.87 | - | - | 3.88 |
| G.x L. | - | 20 | - | - | 114.29** | - | - | 17.53** | - | - | 3.14 |
| Error | 40 | 80 | 38.00 | 26.16 | 32.08 | 6.40 | 5.04 | 5.72 | 1.52 | 2.55 | 2.03 |

| S.V. | B.W. | | | No. B./P. | | | S.I. | | | L.I. | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $L_1$ | $L_2$ | Comb. | $L_1$ | $L_2$ | Comb. | $L_1$ | $L_2$ | Comb. | $L_1$ | $L_2$ | Comb. |
| Replicate | .128* | 0.000 | - | 25.71* | 4.46 | - | 0.140 | 0.777* | - | 0.119 | 0.388* | - |
| Location | - | - | 0.202 | - | - | 590.85* | - | - | 1.177* | - | - | 3.058* |
| Genotypes | 0.001** | 0.001 | 0.121** | 43.65** | 26.06** | 53.03** | 0.826** | 0.164 | 1.332** | 0.618** | 0.617** | 0.992** |
| Rep./Location | - | - | 0.065 | - | - | 14.89 | - | - | 0.151 | - | - | 0.254 |
| G.x L. | - | - | 0.049 | - | - | 16.83* | - | - | 0.290 | - | - | 0.243* |
| Error | 0.037 | 0.047 | 0.042 | 7.47 | 8.53 | 8.00 | 0.301 | 0.190 | 0.240 | 0.139 | 0.113 | 0.126 |

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

S.C.Y./P.: Seed cotton yield per plant    L.C.Y./P.: Lint cotton yield per plant.    L.%.: Lint percentage.    B.W.: Boll weight.

N.B./P.: Number of bolls per plant.    S.I.: Seed index.    L.I.: Lint index.

Table 2: The mean performances of parents and $F_1$ hybrids for yield and yield component traits in the two locations and their combined analysis.

| Genotypes | S.C.Y/P. | | | L.C.Y/P. | | | | L % | | | | B.W. | | | | No. B./P. | | | S.I. | | L.I. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | L1 | L2 | Comb. | L1 | L2 | Comb. | L1 | L2 | Comb. | L1 | L2 | Comb. | L1 | L2 | Comb. | L1 | L2 | Comb. | L1 | L2 | Comb. |
| $P_1$ | 70.00 | 58.75 | 64.38 | 23.24 | 19.00 | 21.12 | 33.19 | 32.27 | 32.73 | 2.62 | 2.50 | 2.56 | 26.87 | 23.59 | 25.23 | 9.89 | 9.86 | 9.88 | 4.92 | 4.70 | 4.81 |
| $P_2$ | 60.00 | 59.17 | 59.59 | 19.45 | 20.09 | 19.77 | 32.43 | 34.01 | 33.22 | 3.01 | 2.98 | 3.00 | 20.01 | 19.95 | 19.98 | 11.64 | 10.87 | 11.26 | 5.59 | 5.61 | 5.60 |
| $P_3$ | 71.67 | 62.92 | 67.30 | 25.29 | 21.59 | 23.44 | 35.23 | 34.32 | 34.78 | 3.00 | 2.88 | 2.94 | 23.88 | 22.01 | 22.95 | 10.88 | 11.03 | 10.96 | 5.93 | 5.77 | 5.85 |
| $P_4$ | 62.92 | 49.17 | 56.05 | 21.15 | 17.00 | 19.08 | 33.53 | 34.52 | 34.04 | 2.47 | 2.55 | 2.51 | 25.45 | 19.33 | 22,39 | 10.54 | 10.32 | 10.43 | 5.32 | 5.44 | 5.38 |
| $P_5$ | 88.54 | 61.25 | 74.90 | 30.66 | 21.19 | 25.92 | 34.62 | 34.61 | 34.62 | 2.84 | 2.79 | 2.82 | 31.18 | 22.05 | 26.62 | 10.27 | 10.14 | 10.21 | 5.44 | 5.36 | 5.40 |
| P6 | 56.04 | 47.71 | 51.88 | 17.52 | 15.55 | 16.54 | 31.29 | 32.58 | 31.94 | 2.52 | 2.45 | 2.49 | 22.26 | 19.50 | 20.88 | 10.14 | 9.84 | 9.99 | 4.62 | 4.76 | 4.69 |
| $P_1$ x $P_2$ | 89.17 | 78.96 | 84.07 | 31.95 | 26.44 | 29.15 | 35.65 | 33.49 | 34.57 | 2.99 | 2.70 | 2.85 | 29.92 | 29.33 | 29.63 | 9.99 | 9.79 | 9.89 | 5.53 | 4.93 | 5.23 |
| $P_1$ x $P_3$ | 85.83 | 65.00 | 75.42 | 30.27 | 22.01 | 26.14 | 35.22 | 33.86 | 34.54 | 2.85 | 2.74 | 2.80 | 30.24 | 23.83 | 27.04 | 10.61 | 9.98 | 10.30 | 5.76 | 5.11 | 5.44 |
| $P_1$ x $P_4$ | 94.58 | 68.75 | 81.67 | 34.44 | 22.81 | 28.63 | 36.38 | 33.12 | 34.75 | 2.86 | 2.76 | 2.81 | 33.10 | 25.18 | 29.14 | 9.92 | 10.06 | 9.99 | 5.67 | 4.98 | 5.33 |
| $P_1$ x $P_5$ | 86.25 | 61.04 | 73.65 | 31.25 | 20.98 | 26.12 | 36.22 | 34.47 | 35.35 | 3.17 | 2.63 | 2.90 | 27.50 | 23.27 | 25.39 | 10.85 | 10.13 | 10.49 | 6.16 | 5.33 | 5.75 |
| $P_1$ x $P_6$ | 83.75 | 68.96 | 76.36 | 30.50 | 23.51 | 27.01 | 36.38 | 33.95 | 35.17 | 2.87 | 2.87 | 2.87 | 29.21 | 24.05 | 26.63 | 10.54 | 10.79 | 10.67 | 6.02 | 5.56 | 5.79 |
| $P_2$ x $P_3$ | 85.21 | 77.50 | 81.36 | 29.40 | 24.93 | 27.17 | 34.34 | 32.17 | 33.36 | 2.71 | 3.13 | 2.92 | 30.49 | 24.81 | 27.65 | 9.59 | 9.40 | 9.50 | 6.08 | 4.47 | 4.78 |
| $P_2$x $P_4$ | 85.42 | 78.33 | 81.88 | 29.36 | 27.06 | 28.21 | 34.42 | 34.54 | 34.48 | 2.78 | 2.92 | 2.85 | 30.82 | 26.87 | 28.85 | 9.77 | 9.55 | 9.66 | 5.13 | 5.04 | 5.09 |
| $P_2$ x $P_5$ | 84.46 | 68.33 | 76.40 | 30.09 | 23.81 | 26.95 | 35.60 | 34.87 | 35.24 | 2.89 | 2.74 | 2.82 | 29.27 | 25.17 | 27.22 | 11.22 | 10.99 | 11.11 | 6.20 | 5.89 | 6.05 |
| $P_2$ x $P_6$ | 81.04 | 64.58 | 72.81 | 27.94 | 20.05 | 24.00 | 34.51 | 31.06 | 32.78 | 2.71 | 2.83 | 2.77 | 29.87 | 22.96 | 26.42 | 10.93 | 10.51 | 10.72 | 5.77 | 4.73 | 5.25 |
| $P_3$ x $P_4$ | 74.88 | 63.13 | 68.86 | 26.46 | 22.04 | 24.25 | 35.47 | 34.92 | 35.20 | 2.99 | 2.82 | 2.91 | 25.09 | 22.43 | 23.76 | 10.50 | 10.99 | 10.75 | 5.77 | 5.90 | 5.84 |
| $P_3$ x $P_5$ | 89.59 | 64.17 | 76.88 | 31.86 | 22.08 | 26.97 | 35.57 | 34.36 | 34.97 | 2.86 | 2.96 | 2.91 | 31.28 | 21.95 | 26.62 | 10.72 | 9.95 | 10.34 | 5.92 | 5.20 | 5.56 |
| $P_3$ x $P_6$ | 77.92 | 57.92 | 67.92 | 26.50 | 20.03 | 23.27 | 33.92 | 34.54 | 34.23 | 2.91 | 2.74 | 2.83 | 27.20 | 21.13 | 24.17 | 10.77 | 10.60 | 10.69 | 5.53 | 5.59 | 5.56 |
| $P_4$ x $P_5$ | 61.25 | 67.92 | 64.59 | 22.80 | 24.50 | 23.65 | 37.18 | 36.09 | 36.64 | 3.09 | 2.86 | 2.98 | 19.99 | 23.78 | 21.89 | 11.04 | 9.99 | 10.52 | 6.54 | 5.64 | 5.09 |
| $P_4$ x $P_6$ | 92.92 | 83.33 | 88.13 | 34.29 | 28.97 | 31.63 | 36.92 | 34.71 | 35.82 | 2.97 | 2.70 | 2.84 | 31.25 | 31.28 | 31.27 | 10.11 | 10.62 | 10.37 | 5.92 | 5.66 | 5.79 |
| $P_5$ x $P_6$ | 89.58 | 67.71 | 78.65 | 31.06 | 23.77 | 27.42 | 34.60 | 35.11 | 34.86 | 2.90 | 2.94 | 2.92 | 31.06 | 23.17 | 27.12 | 10.63 | 10.95 | 10.79 | 5.62 | 5.92 | 5.77 |
| L.S.D $_{0.05}$ | 3.427 | 2.844 | 2.214 | 1.704 | 1.248 | 0.934 | 0.686 | 0.888 | 0.557 | 0.107 | 0.118 | 0.079 | 1.515 | 1.624 | 1.101 | 0.305 | 0.236 | 0.191 | 0.207 | 0.187 | 0.139 |
| L.S.D $_{0.01}$ | 9.295 | 7.016 | 5.428 | 3.470 | 3.079 | 2.290 | 1.691 | 2.190 | 1.366 | 0.264 | 0.291 | 0.194 | 3.737 | 4.006 | 2.701 | 0.753 | 0.582 | 0.470 | 0.511 | 0.461 | 0.340 |

Pr: P2, P3, P4, P5 and $P_6$: 6022, suvin, Pima $s_7$, G.85, G.88 and G.70

**Table 3: The Analysis of variance and the mean squares of diallel crosses for yield and its components in the two locations and combined.**

| S.O.V. | d.f. s | d.f. comb. | Mean of squares (M S) | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | S.C.Y./P. | | | L.C.Y./P. | | | L. % | | | B.W. | | | N. B./P. | | | S.I. | | | L. I. | | |
| | | | $L_1$ | $L_2$ | Comb. | $L_1$ | $L_2$ | Comb. | $L_1$ | $L_2$ | Comb. | $L_1$ | $L_2$ | Comb. | $L_1$ | $L_2$ | Comb. | $L_1$ | $L_2$ | Comb. | $L_1$ | $L_2$ | Comb. |
| G.C.A. | 5 | 5 | 188.4** | 94.31 | 132.5* | 33.98** | 10.33 | 23.78* | 6.21** | 7.89** | 12.14* | 0.077 | 0.139* | 0.192* | 13.99 | 11.94 | 16.41 | 0.644 | 0.348 | 0.782* | 0.469* | 0.654** | 0.957* |
| S.C.A. | 15 | 15 | 477.4** | 294.3** | 699.4** | 78.38** | 37.59** | 99.45** | 6.54** | 2.86 | 5.87** | 0.096** | 0.060 | 0.098** | 53.54** | 30.77** | 65.24** | 0.886** | 0.920** | 1.516** | 0.668** | 0.605** | 1.004** |
| G.C.A.xL | - | 5 | - | - | 150.2* | - | - | 20.53* | - | - | 1.96 | - | - | 0.024 | - | - | 9.52 | - | - | 0.210 | - | - | 0.166 |
| S.C.A.xL | - | 15 | - | - | 102.32 | - | - | 16.52 * | - | - | 3.53 | - | - | 0.057 | - | - | 19.07* | - | - | 0.290 | - | - | 0.269* |
| Error | 40 | 80 | 38.00 | 26.16 | 32.08 | 6.40 | 5.04 | 5.72 | 1.52 | 2.55 | 2.03 | 0.037 | 0.047 | 0.042 | 7.47 | 8.53 | 8.00 | 0.301 | 0.180 | 0.240 | 0.139 | 0.113 | 0.126 |

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

Table 4: The amounts of heterosis over the mid- parents and $F_1$ crosses for yield and its component traits in the first location ($L_1$), second location ($L_2$) and the combined data over the two locations.

| Crosses | S.C.Y/P. | | | L.C.Y/P. | | | L % | | | B.W. | | | No. B. /P. | | | S.I. | | | L.I. | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $H_{F1.M-P}$% | | | $H_{F1.M-P}$% | | | $H_{F1.M-P}$% | | | $H_{F1.M-P}$% | | | $H_{F1.M-P}$% | | | $H_{F1.M-P}$% | | | $H_{F1.M-P}$% | | |
| | $L_1$ | $L_2$ | Comb. | $L_1$ | $L_2$ | Comb. | $L_1$ | $L_2$ | Comb. | $L_1$ | $L_2$ | Comb. | $L_1$ | $L_2$ | Comb. | $L_1$ | $L_2$ | Comb. | $L_1$ | $L_2$ | Comb. |
| $P_1$ x $P_2$ | 37.19** | 32.92** | 35.62** | 49.21** | 35.28** | 42.58** | 8.66** | 1.06 | 4.84** | 6.22* | -1.46 | 2.52* | 27.65** | 34.73** | 31.08** | -7.20** | -5.55** | -6.43** | 5.23* | -4.36* | 0.48 |
| $P_1$ x $P_3$ | 21.16** | 6.85* | 14.55** | 24.75** | 8.45* | 17.33** | 2.95* | 1.70 | 2.33* | 1.42 | 1.86 | 1.82 | 19.17** | 4.52 | 12.45** | 2.17 | -4.45* | -1.15 | 6.18* | -2.39 | 2.06 |
| $P_1$ x $P_4$ | 42.31** | 27.41** | 35.63** | 55.17** | 26.72** | 42.44** | 9.05** | -0.85 | 4.09** | 12.38** | 9.31* | 10.85** | 26.53** | 17.33** | 22.39** | -2.89* | -0.30 | -1.62 | 10.74** | -1.78 | 4.61* |
| $P_1$ x $P_5$ | 8.81* | 1.73 | 5.76* | 15.96* | 4.40 | 11.03** | 6.83** | 3.08* | 4.97** | 16.12** | -0.57 | 7.81** | -5.25* | 1.97 | -2.06 | 7.64** | 1.30 | 4.43** | 18.92** | 5.96* | 12.63** |
| $P_1$ x $P_6$ | 32.89** | 29.55** | 31.36* | 49.66** | 30.09** | 43.44** | 12.84** | 4.70* | 8.77** | 11.67** | 15.96** | 13.66** | 18.91** | 11.63* | 15.51** | 5.21* | 9.54** | 7.39** | 26.21** | 17.55** | 21.89** |
| $P_2$ x $P_3$ | 49.42** | 26.96** | 28.24** | 31.16** | 19.63** | 25.76** | 2.10* | -5.84** | -1.88* | -9.82** | 6.83* | -1.68 | 38.94** | 18.26** | 28.81** | -14.83** | -14.16** | -14.49** | -11.81** | -21.44** | -16.51** |
| $P_2$x $P_4$ | 38.98** | 44.60** | 41.61** | 44.31** | 45.92** | 45.23** | 4.37 | 0.77 | 2.53* | 1.46 | 5.61* | 3.45* | 35.59** | 36.81** | 36.18** | -11.90** | -9.86** | -10.93** | -5.96* | -8.78** | -7.29** |
| $P_2$ x $P_5$ | 13.72** | 13.49** | 13.61** | 19.88** | 15.36** | 17.94** | 6.19** | 1.63 | 3.89* | -1.20 | -5.03* | -3.10* | 14.36** | 19.86** | 16.82** | 2.42* | 4.62* | 3.49* | 12.42** | 7.38** | 10.00** |
| $P_2$ x $P_6$ | 39.68** | 20.85** | 30.64** | 50.78** | 12.51** | 32.20** | 8.32** | -6.71** | 0.61 | -1.99 | 4.24* | 0.91 | 41.33** | 16.40* | 29.32** | 0.37 | 1.50 | 0.89 | 13.03** | -8.78** | 2.04 |
| $P_3$ x $P_4$ | 10.82* | 12.64** | 11.65** | 13.95** | 14.23** | 14.06** | 3.17* | 1.42 | 2.30* | 9.32** | 3.87* | 6.79** | 1.72 | 8.51* | 4.81* | -1.96 | 2.95* | 0.51 | 2.58 | 5.26* | 4.01* |
| $P_3$ x $P_6$ | 11.84** | 3.36 | 8.13** | 13.88** | 3.23 | 9.26** | 1.85* | -0.30 | 0.78 | -2.05 | 4.41* | 1.04 | 13.62** | -0.36 | 7.40* | 1.37 | -6.00* | -2.31* | 4.13* | -6.56* | -1.16 |
| $P_3$ x $P_6$ | 22.02** | 4.71* | 13.98** | 23.80** | 7.86* | 16.41** | 1.93* | 3.26* | 2.61* | 5.43* | 2.81 | 4.24* | 17.90** | 1.81 | 10.29* | 2.47 | 1.58 | 2.05* | 4.83* | 6.17* | 5.50* |
| $P_4$ x $P_5$ | -19.12** | 23.02** | -1.35 | -11.99** | 28.31** | 5.09 | 9.11** | 4.38* | 6.73** | 16.38** | 7.12* | 11.82** | -29.40** | 14.93* | -10.67* | 6.10* | -2.35* | 1.94* | 21.58** | 4.44* | -5.57** |
| $P_4$ x $P_6$ | 56.17** | 72.03** | 63.31** | 77.30** | 78.00** | 77.60** | 13.92** | 3.43* | 8.58** | 19.04** | 8.00* | 13.60** | 30.97** | 61.11** | 44.43** | -2.22 | 5.36** | 1.57 | 19.11** | 10.98** | 15.00** |
| $P_5$ x $P_6$ | 23.92** | 24.28** | 24.07* | 28.93** | 29.36** | 29.13** | 4.99** | 4.51* | 4.75** | 8.21* | 12.21** | 9.98** | 16.24** | 11.53* | 14.19** | 4.16* | 9.61** | 6.83** | 11.73** | 17.00** | 14.37** |
| L.S.D $_{0.05}$ | 2.968 | 2.463 | 1.917 | 1.219 | 1.081 | 0.809 | 0.594 | 0.769 | 0.482 | 0.093 | 0.102 | 0.068 | 1.312 | 1.406 | 0.954 | 0.264 | 0.204 | 0.166 | 0.180 | 0.162 | 0.120 |
| L.S.D $_{0.01}$ | 7.321 | 6.077 | 4.705 | 3.005 | 2.666 | 1.984 | 1.622 | 1.897 | 1.182 | 0.228 | 0.252 | 0.168 | 3.236 | 3.469 | 2.339 | 0.652 | 0.504 | 0.407 | 0.444 | 0.400 | 0.294 |

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

$P_1$, $P_2$, $P_3$, $P_4$, $P_5$ and $P_6$: 6022, suvin, Pima57, G.85, G.88 and G.70

**Table 5: The amounts of heterosis over the better- parent and $F_1$ crosses for yield and its component traits in the first location ($L_1$), second location ($L_2$) and the combined data over two locations.**

| Crosses | S.C.Y/P. H.F1.B.P. % | | | L.C.Y/P. H.F1.B.P. % | | | L % H.F1.B.P. % | | | B.W. H.F1.B.P. % | | | No. B. /P. H.F1.B.P. % | | | S.I. H.F1.B.P. % | | | L.I. H.F1.B.P. % | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $L_1$ | $L_2$ | Comb. | $L_1$ | $L_2$ | Comb. | $L_1$ | $L_2$ | Comb. | $L_1$ | $L_2$ | Comb. | $L_1$ | $L_2$ | Comb. | $L_1$ | $L_2$ | Comb. | $L_1$ | $L_2$ | Comb. |
| $P_1$ x $P_2$ | 27.39** | 33.45** | 30.58** | 37.05** | 31.61** | 38.02** | 7.41** | -1.53 | 4.06* | -0.66 | -9.40* | -5.00* | 11.35* | 24.33** | 17.44** | -14.18** | -9.94** | -12.17** | -01.07 | -12.12** | -6.61** |
| $P_1$ x $P_3$ | 19.76** | 3.31 | 12 07** | 19.69** | 1.95 | 11.52** | -0.03 | -1 34 | -0.69* | -5 00* | -4.86 | -4.76* | 12.54* | 1.02 | 7.17* | -2.48 | -9.52** | -6.02** | -2 87 | -11.44** | -7.09** |
| $P_1$ x $P_4$ | 35.11** | 17.02** | 26.85** | 48.19** | 20.05** | 35.56** | 8.50** | -4.11** | 2.09* | 9.16* | 8.24* | 9.77** | 23.19** | 6.74 | 15.50** | -5.88** | -2 52 | -4.22* | 6.58* | -8.46** | -0.93 |
| $P_1$ x $P_5$ | -2.59 | -0.34 | -1 67 | 1.92 | -0.99 | 0.73 | 4.62* | -0.40 | 2.11* | 11.62** | -5.73* | 3.84* | -11.80 | -1.36 | -4.62* | 5.65* | -0.10 | 2.74* | 13.24** | -0.56 | 6.48** |
| $P_1$ x $P_6$ | 19.64** | 17.38** | 18.61** | 31.24** | 23.74** | 27.89** | 9.61** | 4.21* | 7.45** | 9.54* | 14.80** | 12.11** | 8.71* | 1.95 | 5.55* | 3.94* | 9.43** | 6.81** | 22.36** | 16.81** | 20.37** |
| $P_2$ x $P_3$ | 18.89** | 23.17** | 20.90** | 16.25** | 15.47** | 15.91** | -1.96 | -6.26* | -4.08** | -9.97** | 5.03* | -2.67 | 27.68** | 12.72* | 20.48** | -17.61** | -14.78** | -15.63** | -14.33** | -22.53** | -18.29** |
| $P_2$x $P_4$ | 35.76** | 32.38** | 37.41 | 38.82** | 34.69** | 42.69** | 2.65* | 0.00 | 1.29 | -7.64* | -2.01 | -5.00* | 26.05 | 34.69** | 28.85** | -16.07** | -12.14** | -14.21** | -8.23* | -10.16** | -9.11** |
| $P_2$ x $P_5$ | -4.61 | 11.56* | 2.00 | -1.86 | 12.36* | 3.93 | 2.83* | 0.75 | 1.79* | -3.99 | -8.05* | -6.00* | -6.13* | 14.15* | 2.25 | -3.61* | 1.10 | -1.33 | 10.91** | 4.99* | 8.04** |
| $P_2$ x $P_6$ | 35.07** | 9.14* | 22.18 | 42.99** | -0.20 | 21.40** | 6.41** | -8.67** | -1.32 | -9.97** | -5.03* | -7.67** | 34.19** | 15.09* | 26.58** | -6.10* | -3.31* | -4.80** | 3.22 | -15.69** | -6.25** |
| $P_3$ x $P_4$ | 4.06 | 0.33 | 2.32 | 4.63 | 2.08 | 3.46 | 0.68 | 1.10 | 1.21 | -0.33 | -2.08 | -1.02 | -1.41 | 1.91 | 3.53 | -3.49* | -0.36 | -1.92* | -2.70 | 2.25 | -0.17 |
| $P_3$ x $P_5$ | 1.19 | 1.99 | 2.64 | 3.91 | 2.27 | 4.01 | 0.97 | -0.72 | 0 55 | -4.67* | 2.78 | -1.02 | 0.32 | -0.45 | 0:00 | -1.47 | -9.79** | -5.66** | -0.17 | -9.88** | -4.96* |
| $P_3$ x $P_6$ | 8.72* | -7.95* | 0.92 | 4.78 | -7.23** | -0.73 | -3.72* | [illegible] | -1.58 | -3.00 | -4.86 | -3.74* | 13.90* | -4.00 | 5.32* | -1.01 | -3.90* | -2.46* | -6.75* | -3.12 | -4.96* |
| $P_4$ x $P_5$ | -30.82 | 10.89* | -13.77 | -25.64** | 15.62** | -8.79* | 7.39** | 4.28* | 5.83** | 8.80* | 2.51 | 56.7* | -35.89** | 7.85* | -17.77** | 4.74* | -3.20* | 0.86 | 20.22** | 3.68* | -5.39** |
| $P_4$ x $P_6$ | 47.59** | 69.47** | 57.23** | 62.13** | 70.41** | 65.78** | 10.11** | 0.49 | 5.21** | 17.86** | 5.88* | 13.15** | 22.79 | 60.41** | 39.63** | -4.08* | 2.91* | -0.58 | 11.28** | 4.04* | 7.62** |
| $P_5$ x $P_6$ | 1.17 | 10.55* | 5.01* | 1.30 | 12.18** | 5.75* | -0.06 | 1.44 | 0.69 | 2.11 | 5.38* | 3.55* | -0.38 | 5.08 | 1.87 | 3.51* | 7.99** | 5.68** | 3.31 | 10.45** | 6.85** |
| L.S.D $_{0.05}$ | 3.427 | 2.844 | 2.214 | 1.407 | 1.248 | 1.340 | 0.726 | 0.880 | 0.557 | 0.135 | 0.149 | 0.079 | 1.515 | 1.624 | 1.101 | 0.305 | 0.581 | 0.192 | 0.207 | 0.187 | 0.139 |
| L.S.D $_{0.01}$ | 8.455 | 7.016 | 5.428 | 3.471 | 3.079 | 2.289 | 1.791 | 2.191 | 1.366 | 0.264 | 0.291 | 0.194 | 3.736 | 4.007 | 2.701 | 0.753 | 0.236 | 0.470 | 0.511 | 0.460 | 0.340 |

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

$P_1$, $P_2$, $P_3$, $P_4$, $P_5$ and $P_6$: 6022, suvin, Pima57, G.85, G.88 and G.70

**Table 6: General combining ability effects of parental genotypes for yield and yield component traits in the two locations and their combined analysis.**

| Parents | S.C.Y/P. | | | L.C.Y/P. | | | L % | | | B.W. | | | No. B./P. | | | S.I. | | | L.I. | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $L_1$ | $L_2$ | Comb. | $L_1$ | $L_2$ | Comb. | $L_1$ | $L_2$ | Comb. | $L_1$ | $L_2$ | Comb. | $L_1$ | $L_2$ | Comb. | $L_1$ | $L_2$ | Comb. | $L_1$ | $L_2$ | Comb. |
| $P_1$ | 2.834* | 0.252 | 1.543* | 1.208** | -0.257 | 0.478 | 0.243 | -0.553* | -0.155 | -0.007 | -0.092* | -0.050* | 1.109* | 0.955* | 1.032* | -0.237* | -0.206* | -0.223* | -0.065 | -0.246* | -0.156* |
| $P_2$ | -1.451* | 3.481** | 1.015 | -0.949* | 0.826* | -0.062 | -0.589* | -0.465* | -0.527* | 0.019 | 0.105* | 0.062* | -0.637* | 0.479 | -0.079 | 0.151* | -0.017 | 0.067 | -0.073 | -0.126* | -0.100* |
| $P_3$ | -0.055 | -0.582 | -0.318 | -0.007 | -0.198 | -0.103 | 0.111 | 0.078 | 0.094 | 0.047* | 0.085* | 0.053* | -0.443 | -0.879* | -0.661* | 0.056 | 0.107* | 0.082 | 0.056 | 0.128* | 0.092 |
| $P_4$ | -2.790* | 0.199 | -1.295* | -0.685* | 0.439 | -0.123 | 0.394* | 0.575* | 0.485* | -0.050* | -0.036 | -0.043* | -0.545 | 0.376 | -0.085 | -0.130* | -0.033 | -0.082 | 0.024 | 0.103 | 0.064 |
| $P_5$ | 3.913** | -0.816* | 1.549* | 1.685** | 0.245 | 0.952* | 0.516* | 0.782* | 0.649* | 0.069* | 0.027 | 0.048* | 0.828* | -0.469 | 0.180 | 0.186* | 0.020 | 0.103 | 0.232** | 0.178* | 0.205** |
| $P_6$ | -2.452* | -2.534* | -2.493* | -1.225* | -1.054* | -1.140* | -0.674** | -0.416* | -0.545* | -0.078* | -0.062* | -0.070* | -0.312 | -0.461 | -0.387 | -0.026 | 0.129* | 0.052 | -0.175* | -0.037 | -0.106* |
| S.E. | 1.9893 | 1.6507 | 1.8280 | 0.8165 | 0.7246 | 0.7712 | 0.3979 | 0.5154 | 0.4598 | 0.0621 | 0.0670 | 0.0654 | 0.8792 | 0.9426 | 0.9094 | 0.1771 | 0.1369 | 0.1581 | 0.1203 | 0.1085 | 0.1146 |

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

**Table 7: Specific combining ability affects ($S_{ij}$) of each cross for yield and yield component traits in the two locations and their combined analysis.**

| Crosses | S.C.Y/P. | | | L.C.Y/P. | | | L % | | | B.W. | | | N. B./P. | | | S.I. | | | L.I. | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $L_1$ | $L_2$ | Comb. | $L_1$ | $L_2$ | Comb. | $L_1$ | $L_2$ | Comb. | $L_1$ | $L_2$ | Comb. | $L_1$ | $L_2$ | Comb. | $L_1$ | $L_2$ | Comb. | $L_1$ | $L_2$ | Comb. |
| $P_1$ x $P_2$ | 8.225* | 9.770** | 8.998** | 3.713* | 3.602** | 3.658** | 1.097* | 0.524 | 0.811 | 0.119* | -0.093 | 0.013 | 1.523 | 4.298* | 2.907* | -0.341* | -0.289* | -0.415* | 0.033 | -0.025 | 0.004 |
| $P_1$ x $P_3$ | 3.496 | -0.127 | 1.685 | 1.193 | 0.196 | 0.695 | -0.036 | 0.351 | 0.158 | -0.052 | -0.006 | -0.029 | 1.643 | 0.156 | 0.900 | 0.294 | -0.227 | 0.034 | 0.127 | -0.095 | 0.016 |
| $P_1$ x $P_4$ | 14.981** | 2.842 | 8.912** | 6.042** | 0.359 | 3.201* | 0.847* | -0.879 | -0.016 | 0.055 | 0.112 | 0.084 | 4.604* | 0.252 | 2.428* | -0.206 | -0.004 | -0.105 | 0.076 | -0.203 | -0.064 |
| $P_1$ x $P_5$ | -0.056 | -3.849* | -1.953 | 0.509 | -1.210 | -0.351 | 0.562 | 0.264 | 0.413 | 0.243* | -0.081 | 0.081 | -1.699* | -0.813 | -1.256 | 0.410* | 0.013 | 0.212 | 0.358* | 0.063 | 0.211* |
| $P_1$ x $P_6$ | 3.809* | 5.786* | 4.789* | 2.639* | 2.255* | 2.597* | 1.915** | 0.942 | 1.429* | 0.097 | 0.252* | 0.175* | 0.482 | -0.045 | 0.219 | 0.309 | 0.568* | 0.439* | 0.591** | 0.516* | 0.554** |
| $P_2$ x $P_3$ | 7.157* | 9.147** | 8.152* | 2.481* | 2.039* | 2.260* | 0.120 | -1.427* | -0.654 | -0.129* | 0.190* | 0.031 | 3.643* | 1.612 | 2.628* | -1.107* | -0.989** | -1.048** | -0.544* | -0.858** | -0.701** |
| $P_2$x $P_4$ | 10.099** | 9.196** | 9.648** | 3.120* | 3.525** | 3.323* | -0.280 | 0.450 | 0.085 | -0.055 | 0.077 | 0.011 | 4.078** | 2.411* | 3.245* | -0.744* | -0.703** | -0.724** | -0.462* | -0.263* | -0.363* |
| $P_2$ x $P_5$ | 2.349 | 0.211 | 1.325 | 1.504 | 0.470 | 0.987 | 0.774* | 0.576 | 0.675 | -0.064 | -0.172* | -0.118 | 1.148 | 1.559 | 1.354 | 0.309* | 0.684** | 0.537* | 0.400* | 0.508* | 0.454* |
| $P_2$ x $P_6$ | 5.387* | -1.820 | 1.784 | 2.240* | -1.985* | 0.128 | 0.871* | -2.036* | -0.583 | -0.090 | 0.011 | -0.040 | 2.888* | -0.663 | 1.113 | 0.312 | 0.092 | 0.202 | 0.376* | -0.431* | -0.028 |
| $P_3$ x $P_4$ | -2.130 | -1.948 | -2.039 | -0.723 | -0.464 | -0.594 | 0.070 | 0.289 | 0.180 | 0.134* | 0.018 | 0.076 | -1.853* | -0.664 | -1.259 | 0.081 | 0.610* | 0.346* | 0.048 | 0.340* | 0.194 |
| $P_3$ x $P_5$ | 6.170* | 0.107 | 3.139 | 2.334* | -0.229 | 1.053 | 0.044 | -0.481 | -0.219 | -0.118* | 0.095 | -0.010 | 2.963* | -0.303 | 1.330 | -0.072 | -0.483* | -0.278 | -0.003 | -0.429* | -0.216* |
| $P_3$ x $P_6$ | 0.865 | -4.424* | -1.780 | -0.143 | -0.984 | -0.564 | -0.416 | 0.897 | 0.241 | 0.079 | -0.032 | 0.024 | -0.072 | -1.128 | -0.600 | 0.247 | 0.061 | 0.154 | 0.007 | 0.172 | 0.090 |
| $P_4$ x $P_5$ | -19.433** | 3.076 | -8.178* | -6.044** | 1.553** | -2.246* | 1.374* | 0.752 | 1.063* | 0.212* | 0.092 | 0.152* | -8.222** | 0.273 | -3.975* | 0.491* | -0.297* | 0.097 | 0.649** | 0.036 | 0.343* |
| $P_4$ x $P_6$ | 18.600** | 20.211** | 19.406** | 8.322** | 7.322** | 7.822** | 2.297** | 0.567 | 1.432* | 0.239* | 0.018 | 1.129* | 4.176** | 7.767** | 5.972** | -0.230 | 0.224 | -0.003 | 0.429* | 0.267* | 0.348* |
| $P_5$ x $P_6$ | 8.563* | 5.604* | 7.084* | 2.756* | 2.313* | 2.535* | -0.138 | 0.760 | 0.311 | 0.047 | 0.155* | 0.101 | 2.613* | 0.502 | 1.558 | -0.027 | 0.498* | 0.236 | -0.072 | 0.455* | 0.192 |
| S.E | 5.4634 | 4.5337 | 5.0205 | 2.2424 | 1.9899 | 2.1181 | 1.0928 | 1.4154 | 1.2629 | 0.1705 | 0.1922 | 0.1795 | 2.4145 | 2.5888 | 2.4977 | 0.4863 | 0.3761 | 0.4342 | 0.3304 | 0.3305 | 0.3146 |

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

Table 8: The estimates of genetic parameters in addition to heritability in broad and narrow senses as well as dominance degree for yield and its components from two locations and their combined data.

| Genetic parameters | S.C.Y./P. | | | L.C.Y./P. | | | L. % | | | B.W. | | | N. B./P. | | | S.I. | | | E.I. | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $L_1$ | $L_2$ | Comb. | $L_1$ | $L_2$ | Comb. | $L_1$ | $L_2$ | Comb. | $L_1$ | $L_2$ | Comb. | $L_1$ | $L_2$ | Comb. | $L_1$ | $L_2$ | Comb. | $L_1$ | $L_2$ | Comb. |
| [redacted]$\sigma^2_A$ | -74.24 | -50.0 | -76.02 | -11.01 | -6.82 | -10.04 | 0.08 | 1.26 | 1..02 | -0.005 | 0.020 | 0.017 | -9.89 | -4.71 | -5.11 | -0.06 | -0.14 | -0.085 | -0.05 | 0.012 | 0.007 |
| [redacted]$\sigma^2_D$ | 439.40 | 268.16 | 259.59 | 71.98 | 32.55 | 39.46 | 5.02 | 0.31 | 1.17 | 0.058 | 0.013 | 0.021 | 46.12 | 22.24 | 23.09 | 0.585 | 0.740 | 0.653 | 0.530 | 0.492 | 0.419 |
| [redacted]$\sigma^2_{AL}$ | - | - | 11.98 | - | - | 1.00 | - | - | -0.40 | - | - | 0.008 | - | - | -2.39 | - | - | -0.02 | - | - | -0.026 |
| [redacted]$\sigma^2_{DL}$ | - | - | 70.24 | - | - | 10.81 | - | - | 1.50 | - | - | 0.015 | - | - | 11.07 | - | - | 0.05 | - | - | 0.14 |
| [redacted]$\sigma^2_e$ | 38.00 | 26.16 | 32.08 | 6.40 | 5.04 | 5.72 | 1.52 | 2.55 | 2.03 | 0.37 | 0.047 | 0.042 | 7.47 | 8.53 | 8.00 | 0.301 | 0.180 | 0.240 | 0.139 | 0.113 | 0.126 |
| [redacted]D.d | > 1.0 | >1.0 | > 1.0 | >1.0 | > 1.0 | >1.0 | 7.92 | 0.50 | 1.07 | > 1.0 | 0.81 | 1.11 | > 1.0 | >1.0 | > 1.0 | >1.0 | > 1.0 | >1.0 | >1.0 | 6.40 | 7.74 |
| [redacted]$h^2_{b.s}$ % | 97.20 | 96.85 | 84.82 | 97.13 | 95.09 | 85.19 | 97.48 | 64.88 | 66.81 | 82.50 | 67.35 | 67.26 | 94.88 | 88.67 | 80.30 | 85.40 | 92.50 | 90.95 | 82.01 | 92.98 | 82.24 |
| [redacted]$h^2_{n.s}$ % | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 1.43 | 52.07 | 31.12 | 0.00 | 40.81 | 30.09 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 2.21 | 1.35 |

## الملخص العربي

# السلوك الوراثي لصفات المحصول ومكوناته فى بعض الهجن الصنفية للقطن

اشرف حسين عبد الهادي*-زكريا محمد الديسطي*-محمد سعد حمادة*-محمد احمد رأفت** -وليد محمد بسيوني يحيي**

* قسم الوراثة - كلية الزراعة - جامعة المنصورة - مصر.

** معهد بحوث القطن - مركز البحوث الزراعية - مصر.

فـي هـذه الدراسة تم استخدام ست أصناف من القطن المصري ثلاثة منها مصرية والـثلاثة الأخـرى مصـرية أجنبية وهى الصنف الروسي 6022 والصنف الهندي سيوفين والصـنف الأمريكي بيما س7، جيزة 85، جيزه 88 وجيزه 70 . هذه الأصناف بالإضافة لكـل الهجن الممكنة بينها بنظام التزاوج النصف دائري تم تقييمها في منطقتين وهما محطة البحوث الزراعية بسخا وتجارب معهد بحوث القطن بمركز أبو كبير - محافظة الشرقية.

قـوة الهجيـن، وأثـر الجين، القدرة العامة والخاصة على التآلف إلي جانب درجة التوريـث بـالمدى الواسـع والضـيق تم دراستها على صفات المحصول ومكوناته وهى: محصـول القطن الزهر للنبات، محصول القطن الشعر للنبات، تصافى الحليج، متوسط وزن اللوزة، عدد اللوز على للنبات، معامل البذرة، معامل الشعر وكانت النتائج كالتالي :

* فـي دراسـة تحلـيل التباين أظهرت كل الصفات اختلافات عالية المعنوية وذلك بالنسبة لكل موقع علي حدة وأيضا بالنسبة لتحليل التباين المشترك لكلا الموقعين .

*بالنسـبة لدراسة المتوسطات أظهرت الدراسة أن الصنف جيزة 88 كان هو الأعلى بالنسبة لمتوسط كل الصفات تحت الدراسة أما الصنف جيزة 70 (كأب) كان ذا قيم منخفضة لمعظم الصفات المدروسة.

•أظهـــرت النتائج أن القدرة الخاصة علي التالف كانت اكبر من قيم القدرة العامة علـــي التالف إلى جانب ان النتائج أظهرت أيضا أن التباين الغير إضافي كان اكبر من قيم التبايـــن الغـــير إضافي وكان له الدور الأكبر ويلعب دورا أساسيا في توارث الصفات تحت الدراسة . كما ان التفاعل بين القدرة الخاصة علي التالف والمواقع كان اكبر من قيم التفاعل بين القدرة العامة علي التالف والمواقع . وفي دراسة قوة الهجين بالنسبة لمتوسط الأبوين أو بالنسبة للأب الأعلى أظهرت النتائج وجود قيم عالية المعنوية وموجبة لمعظم الهجن .

• بالنســـبة لدراســـة قيمة المكافئ الوراثي في المدى الواسع والمدي الضيق أظهرت النـــتائج أن قيمة المكافئ الوراثي في المدى الواسع كانت اكبر من قيمة المكافئ الوراثي في المدى الضيق .