J. Agric. Sci. Mansoura Univ., 34 (3): 1581 - 1598, 2009

DOUBLE CROSSES ANALYSIS FOR YIELD COMPONENT AND FIBER TRAITS IN EGYPTIAN COTTON (*Gossypium barbadense* L.)

Yehia, W. M. B.; H. M. E. Hamoud and M. A. Abo EL-Yazid
Cotton Research Instatute, Agriculture Research Center , Egypt .

ABSTRACT

The combining ability estimates for yield , yield components and fiber traits in cotton were the ultimate aim of this investigation . In this study six cotton varieties i.e.: G. 45 , G.89 x Pima S6 , C.B.58 , TNB , Aust. 12 and G. 89 belong to Species *Gossypium barbadense* L. and their 45 double crosses were used for this purpose . In the 2008 growing season , these all genotypes (six varieties and 45 double crosses) were evaluated in a field trial experimental at Sakha Agriculture Research Station for following traits : seed cotton yield per plant (S. C.Y./P.), lint cotton yield per plant (L.C.Y./P.) , number of seeds per boll (No. S./B.) , number of bolls per plant (No. B./P.) , fiber strength (F.S.) , fiber finenesses (F.F.) , 2.5% span length (2.5% S.L.) , 50% span length (50% S.L.) and uniformity ratio (U.R.%.) .

The results showed that the mean squares of genotypes were significant and highly significant for all the studied traits . Further partition of crosses mean squares to its component showed that the mean squares due to 1- line general , 2- line specific effect , 2- line arrangement , 3- line arrangement and 4- line arrangement were either significant or highly significant for most studied traits suggesting the presence of the additive and non- additive variance in the inheritance of these traits .

For the mean performances , the results showed that the cross [(P_3 x P_6) x (P_4 x P_5)] cleared the highest mean for seed cotton yield per plant , lint cotton yield per plant , the cross [(P_3 x P_4) x (P_5 x P_6)] showed the highest mean for number of seeds per boll . Also, the crosses [(P_2 x P_6) x (P_3 x P_4)] , [(P_2 x P_3) x (P_4 x P_6)] and [(P_2 x P_3) x (P_4 x P_5)] were the best crosses for number of bolls per plant , fiber strength and fiber finenesses . In addition , the cross [(P_1 x P_6) x (P_2 x P_4)] was the superior for 2.5% span length and 50% span length , as well as , the cross [(P_2 x P_6) x (P_4 x P_5)] was the best cross for uniformity ratio .

The variety C.B.58 (P_3) was the best combiner for most of yield and yield components traits . . In the same time , the variety TNB (P_4) was the best and good combiner for most of fiber traits . The variety G.89 x Pima S6 (P_2) was the best combiner for (No. B./ P.) while the variety Aust. 12 (P_5) was the good combiner for (U.R.%) .

The results also cleared that , the two- line interaction effect (S^2_{12}) and (S^2_{26}) showed positive (desirable) effect for most of yield studied traits . Also ,(S^2_{34}) was the best combination for (F.S.) , (2.5% S.L.) and (50% S.L.) .Regarding the three – line interaction effect , the results showed that the combination (S^3_{256}) was the best combination for (S.C.Y./ P.) , (L.C.Y./ P.) and (No. B./P.) . In addition , (S^3_{345}) was the best positive desirable effect for most of fiber traits. . Also , the combinations (S^3_{126}) , (S^3_{346}) and (S^3_{146}) were the best combinations for (No. S./B.) , (F.S.) and (F.F.) , respectively .. Moreover , (S^4_{1256}) was the best combination for (2.5% S.L.) , (50% S.L.) and (U.R.%.) , as well as , (S^4_{2345}) and (S^4_{2346}) were the best combination for (No. S./B.) , (F.S.) and (F.F.) .

The specific combining ability effects (t^2 $_{(ij)(..)}$ showed that the combination $t^2{}_{(36)}$ $_{(..)}$ was the best for (S.C.Y./P.) and (L.C.Y./P.) , $t^2{}_{(15)}$ $_{(..)}$ and t^2 $_{(12)}$ $_{(..)}$ were the best for (No. B./P.) and (F.S.) , respectively . Also , the combination $t^2{}_{(16)}$ $_{(..)}$ was the best for (2.5% S.L.) , (50% S.L.) and (U.R,%) .

The specific combining ability effect $t^2(_{i.})\ (_{j.})$ cleared that the combination $t^2\ (_{1.})\ (_{2.})$, $t^2\ (_{3.})\ (_{6.})$ and t2 $(_{3.})\ (_{4.})$ were the best combinations for (No. S./B.) , (F.F.) and (U.R.%) , respectively , as well as the combination $t^2\ (_{2.})\ (_{6.})$ was the best effect for (2.5% S.L.) and (50% S.L.) .

The results revealed that the dominance genetic variance (σ^2D) was positive and larger than those of additive genetic variance (σ^2A) for most of the studied traits . Concerning epistatic variance , additive by additive (σ^2AA), additive by dominance (σ^2AD), dominance by dominance (σ^2DD) and additive by additive by additive (σ^2AAA) were positive with considerable magnitude for most of studied traits. Therefore, it could be recommended the recurrent selection breeding program for improvement these traits with respect to these genetic materials.

INTRODUCTION

Cotton improvement requires the ability to select higher performing individuals from a population. Identification of superior individuals requires variation in the population . This is usually overcome by crossing unrelated strains to create the genetic variation through recombination followed by selection . Parental selection for creating genetic variability for cotton improvement program depends on combining ability which depends on the type of gene effects and amount of potential genetic variability involved . The amount of genetic control is influential because improvement of a trait with very small genetic control relative to environmental influences will be difficult . Several genetic mating designs exist to facilitate separation of environmental and genetic effects underling quantitative traits in plants . Among the most common mating designs in crop improvement is the double crosses analysis .

The theoretical aspects of double crosses analysis has been outlined by Rawlings and Cockerham (1962-b) . A double crosses or quadriallel is the first generation progeny of the crossing between unrelated F_1 hybrids Viz., (a x b) x (c x d) where a , b, c and d are the four parents and a x b and c x d are the two F1 hybrids involving these parents . Taking " P" as the number of parents , all possible double crosses would be P (P-1) (P-2) (P-3) /8 .

Double crosses analysis provides information about components of genetic variance and combining ability effects . Various components variance i.e., additive (σ^2A), dominance (σ^2D) and interactions are worked out . The interaction components including additive x additive (σ^2AA), additive x dominance (σ^2AD) dominance x dominance (σ^2DD) and additive x additive x additive (σ^2AAA) component of variance . Both general combining ability (GCA) and specific combining ability effects (SCA) are estimated [as seven kinds in three groups for SCA] .The SCA effects are estimated as two line interaction effects (three kind)s , three line interaction effects (two kind)s and four line interaction effects (two kinds). This technique also gives information on the order in which parents should be crossed for obtaining superior recombinants (Singh and Narayanan 2000) . Many investigation studied general and specific combining abilities, among them ; Miller and Marani (1963) reported significant general and specific combining ability effects for lint yield , Eadl and Miller 1971 found significant general and specific combining abilities for lint yield and yield components , Baloch *et al*., 1995 revealed the importance of specific combining ability for yield and general combining ability for number of bolls per plant ; Wilson 1991 , Tang *et al*. 1993 and Nadeem *et al* .,1998 reported significant general and specific combining ability effects for lint yield , seed cotton yield and boll number per plant . Abd EL Maksoud *et al* (2003 a, b) , Abd EL-Hadi *et al*. (2005 a-b) , Hemida *et al*. (2006) , EL- Mansy and EL-Lawendy (2008) Abd EL-Bary (2008) and Abd EL-Bary *et al*. (2008) revealed that the magnitude of additive genetic variance was positive and larger than that of dominance genetic variance with respect to all studied yield components and fiber traits . In the same time , the results revealed that the three types of epistatic variance (σ^2AA, σ^2DD and σ^2AD) were contributed in the genetic expression of most studied traits . In addition the results illustrated that the additive x dominance genetic variance was played the major role in the inheritance of most of studied traits .

The present investigation was carried out to determine the gene action for some yield components and fiber traits using double cross system of six cotton varieties .

MATERIALS AND METHODS

The genetic materials used in the present investigation included six cotton varieties belong to *Gossypium barbadense* L., Giza 45 (P_1) , Giza 89 x Pima S_6 (P_2) is a promising variety , C.B.58 (P_3) is American variety , TNB (P_4) is Indian variety , Aust.12 (P_5) is Australian variety and Giza 89 (P_6. The inbred seeds of all varieties were obtained from Cotton Breeding Section, Cotton Research Institute, Agricultural Research Center, Giza, Egypt.

These six varieties were involved in a series of hybridization according to quadariallel crosses (double crosses) mating design as following :In the growing season of 2006, the six selected 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 seed for further investigations. In 2007 growing season, single crosses were again mated in a diallel fashion to produce double cross hybrid with the restriction that no parent should appear more than once in the same double cross combination to obtain 45 double crosses; number of double crosses = P(P-1) (P-2) (P-3)/8 where, P : is number of parental varieties.

These 51 genotypes which included the six parental varieties and their 45 double crosses were evaluated in 2008 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 cotton yield per plant in grams (L.C.Y./P.); number of seeds per boll (No. S./ B.) , number of open bolls per plant (No. B. /P.); fiber strength (F.S.), fiber fineness (F.F.) 2.5% span length (2.5% S.L.) , 50% span length (50% S.L.) as a measure of span length in mm. and uniformity ratio (U.R.%) . The fiber properties were measured in the laboratories of 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 significance of means were determined using the least significant difference value (L.S.D) at 0.05 and 0.01 levels, according to by Steel and Torrie (1980).

Considering $Y_{(ij)(kl)m}$ as the measurement recorded on a double cross $G_{(ij)(kl)m}$ the statistical model takes the following form:

$Y_{(ij)(kl)m} = \mu + r_m + G_{(ij)(kl)} + e_{(ij)(kl)m}$

Where:

$Y_{(ij)(kl)m}$: the observation on double cross (ij) (kl) grown in replication m, m = 1, …; r, i, j, k, l = 1, …; p where no two of i j, k, and l can be the same

μ : the general mean

r_m : effects of replication *m*.

$G_{(ij)(kl)}$: the genotypic effect of the double cross hybrid (ij) (kl)

$e_{(ij)(kl)}$: a random error.

Further, $G_{(ij)(kl)} = (g_i + g_j + g_k + g_l) + (s_{ij} + s_{ik} + s_{jk} + s_{il} + s_{jk} + s_{jl} + s_{kl}) + (s_{ijk} + s_{ijl} + s_{ikl} + s_{jkl}) + (s_{ijkl}) + (t_{ij} + t_{kl}) + (t_{i.k} + t_{i.l} + t_{j.k} + t_{j.l}) + (t_{ij.k} + t_{ij.l} + t_{kl.i} + t_{kl.j}) + (t_{ijkl})$

g_i : the average general effect of the line i

s_{ij} : the 2-line interaction effect of lines i and j appearing together irrespective of arrangement.

s_{ijk} : the 3-line interaction effect of lines i, j and k appearing together irrespective of arrangement.

s_{ijkl} : the 4-line interaction effect of lines i, j, k and l appearing together irrespective of arrangement.

t_{ij} : the 2-line interaction effect of lines i and j due to the particular arrangement (ij)(--).

$t_{i.j}$: the 2-line interaction effect of lines i and j due to the particular arrangement (i -)(j -).

$t_{ij.k}$: the 3-line interaction effect of lines i, j and k due to the particular arrangement (i j)(k -).

$t_{ij.k}$: the 4-line interaction effect of lines i, j, k and l due to the particular arrangement (i j)(k l).

The theoretical aspect of quadriallel analysis has been illustrated by Rawlign and Cockerham (1962b) and outlined by Singh and Chaudhary (1985). The form of the analysis of variance of the quadriallel crosses and expectation of mean squares are presented in Table 1.

Estimation of combining Ability Effects:

$g_i = [Y_{i....} / (r\ p_1\ p_2\ p_3/2)] - \mu$ Where, $\mu = Y_{....} / (p_1\ p_2\ p_3/8)$

$S^2_{ij} = [Y_{ij...}/(3r\ p_2 p_3/2)] - \mu - g_i - g_j$

$S^3_{ijk} = (Y_{ijk...} / 3r\ p_3) - \mu - g_i - g_j - g_k - S_{ij} - S_{ik} - S_{jk}$

$S^4_{(ijkl)} = [(Y_{ijkl..}/(3r)] - \mu - g_i - g_j - g_k - g_l - S_{ij} - S_{ik} - S_{il} - S_{jk} - S_{jl} - S_{kl} - S_{ijk} - S_{ijl} - S_{jkl} - S_{jkl}$

$t^2_{(ij)(..)} = [Y_{(ij)(..)}. /(r\ p_2 p_3/2)] - \mu - g_i - g_j - S_{ij}$

$t^2_{(i\,-)\,(j\,-)} = [Y_{(i\,.)(j\,.).} / r\, p_2 p_3] - \mu - g_i - g_j - S_{ij}$

$t^3_{(ij)\,(k\,-)} = [Y_{(ij)(k.).} / r\, p_3] - \mu - g_i - g_j - g_k - S_{ij} - S_{ik} - S_{jk} - S_{ijk} - t^2_{ij} - t^2_{i.k} - t^2_{j.k}$

$t^4_{(ij)\,(k\,l)} = [Y_{(ij)(kl).} / r] - \mu - g_i - g_j - g_k - g_l - S_{ij} - S_{ik} - S_{il} - S_{jk} - S_{jl} - S_{kl} - S_{ijk} - S_{ijl} - S_{ikl} - S_{jkl} - S_{ijkl} - t^2_{ij} - t^2_{kl} - t^2_{i.\,k} - t^2_{i\,.\,l} - t^2_{j.\,k} - t^2_{j.\,l} - t^3_{ij.\,k} - t^3_{ij.\,l} - t^3_{kl\,.i.} - t^3_{kl\,.j}$

Table 1: Form of the analysis of variance of the double crosses and expectation of mean squares

S.O.V.	d.f	S.S	M.S
Replications	r-1	$(8\sum Y^2 \ldots m) /(r\, p\, p_1\, p_2\, p_3) - C.$	R
Hybrids	$3^6\, C_4 - 1$	$(\sum Y^2_{(i\,j)\,(kl)} /r) - C$	H
1-line general	P_1	$(2\sum Y^2_{i\ldots.} / r\, p_2\, p_3\, p_4) - (4p_1 / p_4)\, C$	G
2- line specific	$P\, P_3 / 2$	$(2\sum Y^2\, ij\ldots /3r\, p_4\, p_5) - (6pp_2 / p_4 p_4)\, C - (3p_3 / p_5)\, G$	S_2
2-line arrangement	$P\, P_3 / 2$	$(2\sum Y^2\, (i\,j)\, (.\,.).\, /r\, p_1\, p_2) + (\sum Y_2\, (i\,.)\, (j\,.).\, /r\, p_1\, p_2) - (2\sum Y^2\, ij\ldots /3r\, p_{1\,2})$	T_2
3-line arrangement	$P\, P_2\, P_4 / 3$	$(\sum Y^2_{(i\,j)\,(k\,.)\,.} /r\, p_3) - (\sum Y^2_{ijk\,..} /3r\, p_3 - (2p_2/ p_3)\, T_2$	T_3
4-line arrangement	$P\, P_1\, P_4\, P_5 / 12$	$(\sum Y^2_{(i\,j)\,(k\,l)} /r) - (\sum Y^2_{ijkl\,.} /3r) - T_2 - T_3$	T_4
Error	$(r-1)\, (3^6\, C_4 - 1)$	M - R - H	E
Total	$3r^6\, C_4 - 1$	$\sum Y^2\, (i\,j)\, (kl)\, m - C$	

RESULTS AND DISCUSSION

Analysis of variance of 45 double crosses were made for all the studied traits ,seed cotton yield per plant (S.C.Y./P.), lint cotton yield per plant (L.C.Y./P.), number of seeds per boll (N.S./ B.), number of bolls per plant (No. B./P.), Fiber strength (F.S.), fiber fineness(F.F.), span length at 2.5% and 50% (2.5%S.L., 50%S.L.) and uniformity ratio (U.R%) and the mean squares are calculated and the results are presented in Table 2. The results indicated that the mean squares of crosses were significant and highly significant for all the studied traits.

The results also indicated that the mean squares due to 1-line general were significant for seed cotton yield per plant (S.C.Y. /P.) and lint cotton yield per plant (L.C.Y./P.). These results suggesting the presence of the additive variance in segregating generations would be efficient to improve these traits. The estimates due to 2-line specific effect was highly significant for all the studied traits with except number of bolls per plant (No. B./P.) and uniformity ratio U.R%. In addition, the results for 2-line arrangement were significant for fiber finenesses (F.F.), span length at 2.5 and 50% (2.5% S.L. and 50% S.L.), revealing the presence of non-additive variance in the inheritance of these traits. However, 3- line arrangement mean squares were highly significant for seed cotton yield per plant (S.C.Y./P.) , lint cotton yield per plant (L.C.Y./P.), span length at 2.5% and 50% (2.5% S.L. and 50% S.L.), indicating to the contribution of additive by dominance interaction including all three factors or higher order interactions except all dominance types. On the other hand, the results indicted that the mean squares due to 4-line arrangement were significant for number of bolls per plant (No. B./P.) , span length at 2.5% and 50% and uniformity ratio (U.R.%). These results illustrated that the contribution of dominance x dominance genetic variance in the genetic expression of these traits and all three factor interactions, except all additive type.

Table 2: The analysis of variance of the double crosses for yield component traits and some fiber traits

S .O .V	d f	S.C.Y/ P	L.C.Y. / P	N.S./B.	N. B./ P	F.S	F.F	S.L.2.5%	S.L.50%	U.R.%
Rep.	2	228.47	36.88	0.439	51.16	2.282	0.063	1.142	2.046	2.115*
Crosses	44	681.22**	99.23**	10.270*	103.58**	1.940*	0.210**	2.316**	2.382**	1.006*
1_line general	5	707.37*	103.60**	3.441	84.53	1.434	0.262	0.542	0.806	0.842
2_line specific	9	630.81**	91.29**	15.404**	62.58	3.170**	0.280**	2.232**	2.332**	1.220
2_line arrangement	9	372.38	51.11	9.116	47.43	1.111	0.292*	3.755**	3.488**	0.892
3_line arrangement	16	1003.94**	148.35**	8.729	173.12	2.230*	0.144	1.944**	1.916**	0.643
4_line arrangement	5	269.03	38.56	14.863	75.02**	0.800	0.100	2.847**	3.549**	2.152**
Error	88	234.35	33.14	6.658	39.58	1.157	0.113	0.807	0.879	0.647

The mean performance for 45 double –crosses for yield components and fiber traits were determined and the results are presented in Table 3. The results showed that there no specific cross was superior for all the studied traits. However , the cross (P_3 x P_6) x (P_4 x P_5) cleared the highest mean performances with the mean value 120.46 and 43.63 gm. , respectively . Also , the cross (P_3 x P_4) x (P_5 x P_6) showed the highest mean for number of seeds per boll (No. S./B.) with the mean value 20.77 . The results also cleared that the crosses (P_2 x P_6) x (P_3 x P_4) ; (P_2 x P_3) x (P_4 x P_6) and (P_2 x P_3) x (P_4 x P_5) were the best and showed the desirable mean performances for number of bolls per plant , fiber strength and fiber finenesses , respectively with the mean values 43.33 , 11.23 and 3.00, respectively . In the same time, the cross (P_1 x P_6) x (P_2 x P_4) was superior for 2.5 % and 50 % span length traits with the highest mean desirable values 35.47 and 30.97, respectively . On the other hand the highest mean performances for uniformity ratio was the cross (P_2 x P_6) x (P_4 x P_5) with value 87.67 % .

General combining ability effects for each parental variety :-

The estimates of general combining ability effects (gi) of parental varieties were obtained for yield and yield components and fiber traits which are shown in Table 4.The results indicated that no parent from six parent was good combiner or inferior for all the studied traits which the results cleared that the variety C.B.58 (P_3) was the best combiner for seed cotton yield per plant(S.C.Y./P.) , lint cotton yield per plant (L.C.Y./P.) and number of seeds per boll (No. S./B.) . In the same time , the variety TNB (P4) was good combiner for most of fiber traits , such as for fiber strength (F.S.) , 2.5% span length (2.5% S.L.) and 50% span length (50% S.L.) . On the other hand , the variety G.89 x Pima S_6 (P_2) was the best combiner for number of bolls / plant (No. B./ P.) . Also , the variety Aust. 12 (P_5) was the best combiner for fiber finenesses (F.F.) and Uniformity ratio % (U.R.%) . These results could be suggested that these parental varieties 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 generation.

Table 3: mean performances for yield component traits and some fiber traits

crosses	S.C.Y/ P	L.Y. / P	N.S./B.	N. B./ P	F.S	F.F	S.L.2.5%	S.L.50%	U.R.%
(12) (34)	107.20	41.63	15.05	37.73	10.30	4.20	32.80	28.01	85.40
(12) (35)	99.10	36.51	15.28	36.82	10.60	3.57	32.00	27.74	86.67
(12) (36)	93.32	33.73	16.98	33.40	9.07	4.20	33.50	28.94	86.40
(12) (45)	72.50	26.48	15.79	24.24	9.40	4.17	33.87	29.35	86.67
(12) (46)	57.61	20.88	18.73	18.99	10.20	3.87	34.00	29.45	86.60
(12) (56)	72.17	25.77	16.38	25.41	10.00	4.00	33.93	29.40	86.63
(13) (24)	79.43	28.35	18.98	25.23	8.87	3.97	33.17	28.56	86.10
(13) (25)	53.49	19.40	17.73	17.68	8.57	3.93	32.50	28.01	86.17
(13) (26)	75.16	26.50	19.73	24.03	9.80	4.13	32.63	28.15	86.23
(13) (45)	108.85	39.41	18.81	34.95	9.60	3.87	34.20	29.70	86.83
(13) (46)	87.40	32.56	17.95	29.89	9.13	4.10	32.37	27.87	86.10
(13) (56)	80.80	27.26	16.32	30.46	8.70	4.17	33.10	28.59	86.37
(14) (23)	84.88	29.63	18.69	29.62	10.20	4.03	34.30	29.80	86.87
(14) (25)	61.90	24.32	15.31	21.92	8.57	3.97	32.23	27.71	85.97
(14) (26)	63.90	21.57	18.06	24.58	9.20	3.93	31.47	26.74	84.97
(14) (35)	89.58	33.36	18.02	30.74	10.63	3.97	33.63	29.36	87.23
(14) (36)	89.41	31.94	18.84	30.30	9.30	4.00	32.87	28.52	86.77
(14) (56)	88.87	31.69	18.19	32.17	8.60	3.67	33.80	29.50	87.27
(15) (23)	91.39	32.52	19.20	31.80	9.03	3.57	33.30	28.78	86.43
(15) (24)	93.93	34.13	14.28	35.93	9.87	4.03	33.40	28.82	86.27
(15) (26)	103.37	38.54	15.80	37.15	10.20	3.73	33.63	29.30	87.10
(15) (34)	79.82	28.47	16.58	27.47	9.47	3.50	33.40	28.88	86.47
(15) (36)	77.75	28.68	15.34	28.16	8.17	3.90	32.37	27.82	85.97
(15) (46)	73.74	27.74	16.91	24.85	9.30	3.67	32.60	27.99	85.87
(16) (23)	104.00	38.77	18.70	35.28	8.77	3.97	34.67	30.16	87.00
(16) (24)	85.58	31.40	15.07	32.16	9.00	3.60	35.47	30.97	87.27
(16) (25)	78.90	28.56	20.13	27.61	9.07	3.97	34.80	30.29	87.03
(16) (34)	71.39	26.72	15.30	26.31	8.47	3.77	35.20	30.34	86.20
(16) (35)	59.20	21.99	17.19	18.66	9.50	3.47	33.77	29.21	86.50
(16) (45)	78.30	27.47	15.88	26.63	9.93	3.67	33.70	29.26	86.83
(23) (45)	94.14	34.13	17.30	30.81	7.87	3.00	33.47	28.98	86.60
23) (46)	87.38	32.58	18.06	29.24	11.23	4.10	32.43	27.87	85.93
(23) (56)	94.59	34.21	15.03	36.08	8.00	3.73	33.10	28.65	86.57
(24) (35)	73.65	28.16	15.34	27.26	8.70	3.87	33.50	29.19	87.17
(24) (36)	74.73	27.09	13.07	30.42	11.20	4.10	32.67	28.20	86.30
(24) (56)	98.11	36.04	18.06	34.88	9.33	3.60	32.30	27.85	86.23
(25) (34)	83.27	29.10	19.27	26.32	9.90	3.67	34.27	29.54	86.20
(25) (36)	108.81	40.75	18.80	35.59	8.20	4.40	33.57	28.70	85.50
(25) (46)	103.07	37.67	14.62	40.88	9.00	4.17	33.80	29.36	86.87
(26) (34)	105.65	39.97	13.96	43.33	9.20	3.97	33.77	29.34	86.90
(26) (35)	81.58	30.17	16.75	27.63	9.20	4.07	32.77	27.92	85.20
(26) (45)	88.15	32.28	19.39	27.55	8.27	3.93	33.57	29.43	87.67
34) (56)	72.25	25.76	20.77	22.39	10.27	3.47	33.00	28.65	86.80
(35) (46)	95.52	34.23	18.73	30.59	9.00	3.77	34.77	30.21	86.87
(36) (45)	120.46	43.63	18.84	39.71	9.63	4.23	34.73	30.38	87.43
L.S.D.0.05	24.99	9.401	4.214	10.274	1.757	0.550	1.467	1.531	1.313
L.S.D.0.01	33.25	12.503	5.604	13.664	2.336	0.731	1.951	2.037	1.747

(12) (34) means (P_1 x P_2) (P_3 x P_4) and so on

Table 4: General line effect (g_i) for yield component traits and some fiber traits

Parents	S.C.Y/ P	L.Y. / P	N.S./B.	N. B./ P	F.S	F.F	S.L.2.5%	S.L.50%	U.R.%
P_1	-3.331	-1.283	-0.009	-1.169	0.039	0.005	-0.008	-0.015	-0.026
P_2	0.270	0.211	-0.198	0.479	0.016	0.034	-0.068	-0.081	-0.068
P_3	2.044	0.757	0.171	0.422	0.008	0.008	-0.037	-0.053	-0.059
P_4	0.260	0.129	-0.054	0.062	0.110	-0.020	0.061	0.073	0.057
P_5	0.480	0.131	0.019	-0.096	-0.126	-0.057	0.005	0.030	0.081
P_6	0.277	0.055	0.070	0.303	-0.047	0.030	0.047	0.046	0.014

Specific combining ability effects :-

Two- line specific effect :-

The two line interaction effect of lines i and j appearing together irrespective of arrangement (S^2_{ij}) . It refers to the specific combining ability effect of the two lines used as the parents involved in the same single cross (first or second single cross) [(first and second) or (third and fourth) parent] or one of the two used as a parent involved in the first single cross and the second lines used as a parent involved in the second single cross [(first and third) or (second and fourth) parent] for all combinations , with respect to the studied yield and yield components and fiber traits were calculated and the results are presented in Table 5 .

The results indicated that no two line hybrids were superior or inferior for all the studied traits . However , it could be noticed that (S^2_{12}) had the desirable effect for number of seeds per bolls (No. S./ B.). Also, the combination S^2_{26} was the best combination for most of studied traits such as seed cotton yield per plant , lint cotton yield per plant and number of bolls per plant . Moreover , (S^2_{34}) was the best combination for most of studied fiber traits , such as fiber strength , 2.5 % span length and 50% span length . On the other hand , for uniformity ratio (U.R.%) the combination (S^2_{45}) was the best with desirable positive specific effect . In the same time , the combination (S^2_{35}) was the best with negative desirable specific effect for fiber finenesses (F.F.) .

Table 5: The 2-line interaction effect of lines i and j appearing together irrespective of arrangement S^2ij for yield component traits and some fiber traits

S^2_{ij}	S.C.Y/ P	L.Y. / P	N.S./B.	N. B./ P	F.S	F.F	S.L.2.5%	S.L.50%	U.R.%
S^2 12	-0.266	-0.150	0.240	-0.284	0.084	0.016	0.072	0.073	0.027
S^2 13	0.978	0.345	0.137	0.268	-0.049	0.012	-0.065	-0.052	0.014
S^2 14	-0.453	-0.121	-0.095	-0.195	-0.047	0.021	-0.013	-0.045	-0.103
S^2 15	-1.263	-0.425	-0.352	-0.096	0.142	-0.006	-0.081	-0.065	0.017
S^2 16	-2.326	-0.933	0.062	-0.862	-0.092	-0.038	0.079	0.074	0.019
S^2 23	0.688	0.282	-0.049	0.274	0.004	-0.008	-0.081	-0.090	-0.058
S^2 24	-1.788	-0.635	-0.318	-0.320	-0.009	0.003	-0.064	-0.070	-0.044
S^2 25	0.051	0.104	-0.089	0.086	-0.136	-0.003	-0.034	-0.036	-0.015
S^2 26	1.585	0.610	0.019	0.723	0.072	0.026	0.039	0.042	0.022
S^2 34	1.434	0.559	0.121	0.358	0.147	-0.004	0.131	0.136	0.069
S^2 35	-1.050	-0.497	0.144	-0.549	-0.058	-0.046	0.014	0.006	-0.022
S^2 36	-0.005	0.068	-0.182	0.070	-0.037	0.055	-0.037	-0.054	-0.063
S^2 45	1.393	0.482	0.191	0.154	-0.033	-0.015	0.072	0.096	0.100
S^2 46	-0.326	-0.156	0.048	0.064	0.051	-0.025	-0.066	-0.045	0.035
S^2 56	1.350	0.466	0.125	0.308	-0.041	0.013	0.034	0.029	0.001

Three- line specific effects :-

The three line specific effects of lines i , j and k appearing together irrespective of arrangement (S^3_{ijk}) . It meaning the specific combining ability effect of any two lines used as the parents involved in any single cross and the third line used as a parent involved in the second single cross (as male or female) for combinations . The three – line specific effect was calculated for yield and yield components as well as fiber traits and the results are presented in Table 6 .

The results cleared that no combination exhibited desirable effects for all the studied traits. Also, the results showed that the combination (S^3_{256}) was superior with desirable effect for most of studied yield and yield components traits such as , seed cotton yield per plant (S.C.Y./P.) , lint cotton yield per plant (L.C.Y./P.) and number of bolls per plant . Also , the results illustrated that the combination (S^3_{345}) was the best positive desirable effect for most of fiber traits i.e.: 2.5% span length (2.5% S.L.) , 50% span length (50% S.L.) and uniformity ratio % (U.R.%) . On the other hand the combinations (S^3_{126}) , (S^3_{346}) and (S^3_{146}) were the best which, had the best three line specific effect for number of seeds per boll , fiber strength and fiber finenesses , respectively .

Four – line specific effects :-

The four – line interaction effect of i, j, k and l appearing together irrespective of arrangement (S^4_{ijkl}). It refers to specific combining ability effect of any two lines used as the parents involved in any single cross and the other two lines as parents involved in the second single cross (as male or female) for all double combinations , with respect to the studied yield components traits and fiber traits were obtained and the results are presented in Table 7.

Table 6: The 3-line interaction effect of lines i, j and k appearing together irrespective of arrangement S^3ijk for yield component traits and some fiber traits

S^3_{ijk}	S.C.Y/ P	L.Y. / P	N.S./B.	N. B./ P	F.S	F.F	S.L.2.5%	S.L.50%	U.R.%
S^3 123	1.739	0.582	0.339	0.347	0.020	0.004	-0.036	-0.019	0.034
S^3 124	-1.573	-0.591	-0.087	-0.590	-0.026	0.034	0.001	-0.034	-0.108
S^3 125	-0.619	-0.157	-0.139	-0.032	0.114	0.013	-0.020	-0.006	0.033
S^3 126	-0.080	-0.134	0.365	-0.295	0.061	-0.020	0.199	0.205	0.094
S^3 134	2.301	0.916	0.126	0.660	-0.001	0.031	0.049	0.038	-0.010
S^3 135	-1.067	-0.445	-0.130	-0.095	0.062	-0.026	-0.118	-0.098	0.011
S^3 136	-1.017	-0.362	-0.061	-0.376	-0.178	0.014	-0.024	-0.025	-0.006
S^3 145	0.540	0.278	-0.242	0.265	0.055	0.024	-0.041	-0.043	-0.024
S^3 146	-2.174	-0.844	0.011	-0.725	-0.122	-0.047	-0.034	-0.051	-0.064
S^3 156	-1.382	-0.526	-0.192	-0.329	0.054	-0.024	0.016	0.018	0.014
S^3 234	-0.524	-0.160	-0.219	-0.008	0.098	-0.016	0.001	-0.003	-0.010
S^3 235	-1.243	-0.477	0.009	-0.457	-0.156	-0.052	-0.067	-0.085	-0.080
S^3 236	1.404	0.619	-0.227	0.666	0.047	0.049	-0.060	-0.073	-0.061
S^3 245	-0.681	-0.205	-0.138	-0.228	-0.178	0.000	-0.025	-0.017	0.017
S^3 246	-0.798	-0.313	-0.191	0.186	0.088	-0.011	-0.105	-0.086	0.012
S^3 256	2.643	1.048	0.090	0.889	-0.053	0.033	0.043	0.036	-0.001
S^3 345	0.848	0.205	0.410	-0.166	0.059	-0.043	0.208	0.222	0.121
S^3 346	0.242	0.157	-0.076	0.231	0.138	0.019	0.004	0.016	0.037
S^3 356	-0.639	-0.277	0.000	-0.380	-0.081	0.028	0.006	-0.026	-0.096
S^3 456	2.078	0.687	0.351	0.437	-0.001	-0.011	0.002	0.030	0.085

Table 7: The 4-line interaction effect of lines i, j, k and l appearing together irrespective of arrangement S^4ijkl for yield component traits and some fiber traits

S^4_{ijkl}	S.C.Y/ P	L.Y. / P	N.S./B.	N. B./ P	F.S	F.F	S.L.2.5%	S.L.50%	U.R.%
S^4 1234	3.294	1.212	0.285	0.717	0.050	0.066	0.049	0.011	-0.092
S^4 1235	-1.515	-0.652	0.127	-0.172	0.091	-0.085	-0.307	-0.254	0.033
S^4 1236	3.439	1.187	0.607	0.496	-0.082	0.033	0.151	0.184	0.161
S^4 1245	-2.337	-0.607	-0.788	-0.514	-0.072	0.126	-0.121	-0.154	-0.143
S^4 1246	-5.675	-2.379	0.243	-1.972	-0.057	-0.090	0.075	0.042	-0.088
S^4 1256	1.996	0.789	0.245	0.591	0.323	-0.002	0.370	0.390	0.210
S^4 1345	4.207	1.564	0.183	1.387	0.247	0.013	0.136	0.160	0.120
S^4 1346	-0.598	-0.029	-0.088	-0.124	-0.299	0.014	-0.039	-0.057	-0.058
S^4 1356	-5.892	-2.245	-0.701	-1.501	-0.152	-0.004	-0.184	-0.200	-0.121
S^4 1456	-0.249	-0.123	-0.121	-0.079	-0.010	-0.065	-0.137	-0.136	-0.048
S^4 2345	-3.925	-1.572	0.123	-1.721	-0.269	-0.150	0.196	0.190	0.068
S^4 2346	-0.940	-0.122	-1.065	0.978	0.513	0.035	-0.240	-0.210	-0.004
S^4 2356	1.712	0.792	-0.224	0.523	-0.290	0.078	-0.090	-0.192	-0.340
S^4 2456	4.221	1.563	0.250	1.551	-0.192	0.023	-0.149	-0.088	0.128
S^4 3456	2.263	0.622	0.925	-0.163	0.199	0.009	0.292	0.315	0.174

The results showed that no combination or cross exhibited desirable effects for all the studied traits . The best double combination for seed cotton yield per plant (S.C.Y./P.) , lint cotton yield per plant (L.C.Y./P) and number of bolls per plant (No.B./P.) was S^4_{2456} . In addition , the best four – line interaction effect for 2.5% span length , 50% span length and uniformity ratio was the combination $S4_{1256}$.

The results also indicated that , the double combinations S^4_{3456} , S^4_{2346} and S^4_{2345} were the best and exhibited desirable effects for number of seeds per boll (No. S. /B.) , fiber strength (F.S.) and fiber finenesses (F.F.) , respectively .

Two-line interaction effect of line i and j due to particular arrangement :-

The specific combining ability effects t^2 $(_{ij})$ $(_{..})$ it refers to the specific combining ability effect of the two lines (i and j) used as a parents involved together in the same single cross for all combinations, and this effect are calculated for yield , yield components and fiber traits and the results are presented in Table 8. The results cleared that no one of the combinations was the superior or desirable effect for all the studied traits and the results noticed that the combination $t^2(_{36})(_{..})$ was the best combination for seed cotton yield per plant and lint cotton yield per plant. Also , the combination $t^2(_{14})(_{..})$ was the best with (desirable) effect for number of seeds per boll (No. S./B.).

The results cleared that , the combinations t^2 $(_{15})$ $(_{..})$ and t^2 $(_{12})(_{..})$ were the best for number of bolls per plant (No.B./P.) and fiber strength (F.S.), respectively . Also, the results showed that the combination t^2 $(_{16})$ $(_{..})$ was the best combination for 2.5% span length , 50% span length and uniformity ratio , as well as , the combination between the line 2 as a parent of the first single cross and the line 3 as another parent in the same cross appeared the negative (desirable) effect for fiber finenesses (F.S.).

Table 8: The 2- line interaction effect of lines i and j due to particular arrangement t^2(ij)(..). for yield component traits and some fiber traits

$t^2_{(ij)}$ (..).	S.C.Y/ P	L.Y. / P	N.S./B.	N. B./ P	F.S	F.F	S.L.2.5%	S.L.50%	U.R.%
t^2 (12)(..).	1.549	0.905	-0.847	0.566	0.444	0.065	-0.076	-0.084	-0.037
t^2 (13)(..).	-4.266	-2.056	0.767	-2.322	-0.231	0.122	-0.326	-0.324	-0.128
t^2 (14)(..).	-2.150	-1.123	0.829	-0.318	-0.030	0.041	-0.420	-0.331	0.085
t^2 (15)(..).	5.353	2.108	-0.488	2.413	-0.061	-0.089	-0.230	-0.274	-0.220
t^2 (16)(..).	-0.487	0.166	-0.261	-0.339	-0.122	-0.139	1.052	1.012	0.300
t^2 (23)(..).	4.299	1.240	0.724	1.123	-0.189	-0.181	0.300	0.343	0.254
t^2 (24)(..).	0.067	0.006	-0.815	0.919	0.033	-0.037	0.057	0.089	0.113
t^2 (25)(..).	-4.658	-1.630	0.729	-1.976	-0.215	0.163	0.194	0.101	-0.207
t^2 (26)(..).	-1.258	-0.521	0.209	-0.633	-0.074	-0.009	-0.476	-0.450	-0.122
t^2 (34)(..).	-2.571	-0.654	-0.597	-0.093	-0.009	-0.104	0.154	0.051	-0.237
t^2 (35)(..).	-3.798	-0.803	-0.632	-1.001	0.437	-0.002	-0.007	0.031	0.107
t^2 (36)(..).	6.335	2.273	-0.263	2.293	-0.007	0.165	-0.120	-0.101	0.004
t^2 (45)(..).	6.173	2.007	0.329	0.688	-0.180	0.022	0.354	0.397	0.270
t^2 (46)(..).	-1.520	-0.236	0.254	-1.196	0.185	0.078	-0.144	-0.206	-0.231
t^2 (56)(..).	-3.070	-1.682	0.061	-0.124	0.019	-0.094	-0.311	-0.256	0.050

Two- line interaction effect of lines i and j due to particular arrangement :-

The specific combining ability effect of the two lines (i and j) where i is a parent involved in the first single cross (as a male or female) and j is a parent involved in the second single cross (as male or female) for all combinations . With respect to the studied yield components and fiber traits were obtained and the results are presented in Table 9. The results indicated that no one of combination was exhibited desirable values effect for all the studied traits , the results also indicated that the combination t^2 $(_{2.})$ $(_{5.})$ was the best for seed cotton yield per plant (S.C.Y./P.). Also, the combination (t^2 $(_{1.})$ $(_{3.})$) was the best with desirable effect for lint cotton yield per plant (L.C.Y./P.) , number of bolls per plant (No.B./P.) and fiber strength (F.S.).

The results illustrated that the combinations t^2 $(_{1.})$ $(_{2.})$, t^2 $(_{3.})$ $(_{6.})$ and t^2 $(_{3.})$ $(_{4.})$ were the best and had desirable effect for number of seeds per boll , fiber finenesses and uniformity ratio . In addition, the combination t^2 $(_{2.})$ $(_{6.})$ was the best for 2.5% span length and 50% span length , respectively .

Three- line interaction effect of lines I, j and k due to particular arrangement .

The specific combining ability effects t^3 $(_{ij})$ $(_{k.})$ refers to the specific combining ability effect of the three lines (i , j and k) where i and j are two parents involved together in the same single cross and k is a third parent involved in the another single cross for all combinations . In this respect, the studied yield and yield components as well as fiber traits were calculated and the results are presented in Table 10 . The results showed that no combination exhibited desirable values of three line effect for all the studied traits . Also, the results cleared that t^3 $(_{34})$ $(_{2.})$ was the best combination for seed cotton yield per plant (S. C. Y. /P.) and number of bolls per plant(No.B./P.) .

Table 9: The 2-line interaction effect of lines i and j due to particular arrangement t^2(i.)(j.). for yield component traits and some fiber traits

$t^2(_{i.})(_{j.})$.	S.C.Y/ P	L.Y. / P	N.S./B.	N. B./ P	F.S	F.F	S.L.2.5%	S.L.50%	U.R.%
t^2(1.)(2.).	-0.775	-0.453	0.424	-0.283	-0.222	-0.032	0.038	0.042	0.019
t^2(1.)(3.).	2.133	1.028	-0.384	1.161	0.116	-0.061	0.163	0.162	0.064
t^2(1.)(4.).	1.075	0.561	-0.414	0.159	0.015	-0.020	0.210	0.165	-0.043
t^2(1.)(5.).	-2.676	-1.054	0.244	-1.207	0.031	0.044	0.115	0.137	0.110
t^2(1.)(6.).	0.243	-0.083	0.131	0.170	0.061	0.069	-0.526	-0.506	-0.150
t^2(2.)(3.).	-2.150	-0.620	-0.362	-0.562	0.094	0.091	-0.150	-0.172	-0.127
t^2(2.)(4.).	-0.034	-0.003	0.407	-0.460	-0.017	0.019	-0.029	-0.044	-0.056
t^2(2.)(5.).	2.329	0.815	-0.364	0.988	0.107	-0.081	-0.097	-0.051	0.104
t^2(2.)(6.).	0.629	0.260	-0.105	0.317	0.037	0.005	0.238	0.225	0.061
t^2(3.)(4.).	1.285	0.327	0.299	0.046	0.005	0.052	-0.077	-0.025	0.119
t^2(3.)(5.).	1.899	0.402	0.316	0.501	-0.219	0.001	0.004	-0.015	-0.054
t^2(3.)(6.).	-3.168	-1.137	0.132	-1.146	0.004	-0.082	0.060	0.050	-0.002
t^2(4.)(5.).	-3.086	-1.004	-0.165	-0.344	0.090	-0.011	-0.177	-0.199	-0.135
t^2(4.)(6.).	0.760	0.118	-0.127	0.598	-0.093	-0.039	0.072	0.103	0.116
t^2(5.)(6.).	1.535	0.841	-0.031	0.062	-0.009	0.047	0.156	0.128	-0.025

On the other hand , the combinations t^3 $(_{56})$ $(_{4.})$, t^3 $(_{34})$ $(_{5.})$ and t^3 $(_{13})$ $(_{2.})$ were exhibited the best desirable effect (positive or negative) to number of seeds per boll (No. S./ B.) , fiber strength (F. S.) and fiber finenesses (F.F.) , respectively . For 2.5% span length , the combination among the line 1 and 5 in the first single cross and the line 2 in the second single cross t^3 $(_{15})$ $(_{2.})$ was the best effect . In addition, the combinations t^3 $(_{56})$ $(_{1.})$ and t^3 $(_{14})$ $(_{2.})$ were showed great positive (desirable) effects for 50% span length and uniformity ratio , respectively .

Four – line interaction effect of lines i, j, k and l due to particular arrangement :-

The specific combining ability effects t^4 $(_{ij})$ $(_{kl})$ refers to the specific combining ability effect of the four lines (i, j. k and l) where [i and j] are two parents involved together in the first cross and [k and l] are two parents involved together in the second single cross for all double combinations , in this respect these value were determined for studied yield , yield components and fiber traits as presented in Table 11 . The results showed no one of double crosses exhibited desirable values for all the studied traits . However , 21 , 27, 21. 21,18,21, 21, 21 and 24 out of 45 double crosses showed desirable specific combining ability effects t^4 $(_{ij})$ $(_{kl})$ values for seed cotton yield per plant (S.C.Y./P.) , lint cotton yield per plant (L.C.Y./P.) , number of seeds per boll (No .S,/B.) , number of bolls per plant (No.B./P.) , fiber strength (F.S.) , fiber finenesses (F.F.) , 2.5% span length (2.5% S.L.) , 50% span length (50% S.L.) and uniformity ratio (U.R.%.) , respectively , These double crosses involved [(poor x poor) x (poor x good)] or [(poor x poor) x (good x good)] or [(poor x good) x (good x good)] general combiners varieties , indicating to the presens of important epistatic gene action .

Table 10: Three- line interaction effect of lines i, j and k due to particular arrangement t^3(i j)(k-) for yield component traits and some fiber traits

t^3 (i j)(k-)	S.C.Y/ P	L.Y. / P	N.S./B.	N. B./ P	F.S	F.F	S.L.2.5%	S.L.50%	U.R.%
t^3 (12)(3.).	10.788	4.081	-0.452	4.640	-0.132	-0.057	-0.378	-0.360	-0.107
t^3 (12)(4.).	-2.033	-0.511	0.716	-1.100	0.013	0.041	0.039	0.077	0.125
t^3(12)(5.).	-0.694	-0.661	0.130	-0.253	-0.060	0.002	0.029	0.005	-0.069
t^3 (12)(6.).	-9.610	-3.814	0.453	-3.853	-0.265	-0.050	0.386	0.362	0.089
t^3 (13)(2.).	-11.002	-4.015	0.167	-4.695	-0.030	-0.121	-0.003	0.010	0.040
t^3 (13)(4.).	5.135	2.154	0.344	1.892	-0.140	-0.109	-0.111	-0.112	-0.044
t^3 (13)(5.).	3.871	1.664	-0.875	2.199	0.012	0.051	0.333	0.291	0.012
t^3(13)(6.).	6.261	2.253	-0.404	2.927	0.389	0.057	0.106	0.135	0.120
t^3 (14)(2.).	-5.364	-1.958	-0.967	-1.388	0.080	-0.023	-0.333	-0.408	-0.347
t^3 (14)(3.).	-1.974	-1.040	0.196	-0.919	0.402	0.035	0.386	0.415	0.247
t^3 (14)(5.).	4.972	2.628	-0.374	1.378	-0.309	-0.041	0.279	0.296	0.162
t^3 (14)(6.).	4.516	1.492	0.317	1.247	-0.143	-0.012	0.089	0.028	-0.147
t^3 (15)(2.).	8.573	3.013	0.200	3.113	0.398	0.099	0.437	0.427	0.150
t^3 (15)(3.).	-8.618	-3.379	0.435	-3.458	-0.310	0.034	-0.056	-0.052	-0.016
t^3 (15)(4.).	-3.898	-1.894	0.350	-1.579	0.016	0.020	-0.096	-0.082	-0.002
t^3 (15)(6.).	-1.410	0.152	-0.497	-0.490	-0.043	-0.065	-0.056	-0.019	0.088
t^3 (16)(2.).	8.568	3.413	0.176	3.253	-0.226	0.078	-0.139	-0.070	0.139
t^3 (16)(3.).	-2.329	-0.691	0.205	-1.424	-0.075	0.049	-0.116	-0.164	-0.188
t^3 (16)(4.).	-0.279	-0.311	-0.996	0.628	0.096	0.069	-0.042	-0.048	-0.036
t^3 (16)(5.).	-5.473	-2.577	0.875	-2.117	0.327	-0.056	-0.756	-0.730	-0.215
^{3} (23)(1.).	0.214	-0.066	0.285	0.055	0.162	0.179	0.381	0.351	0.068
t^3 (23)(4.).	-4.563	-1.745	-0.047	-1.926	0.249	-0.056	-0.169	-0.223	-0.234
t^3(23)(5.).	-1.821	-0.498	-0.688	0.285	-0.296	-0.060	-0.081	-0.086	-0.048
t^3 (23)(6.).	1.871	1.069	-0.275	0.462	0.074	0.119	-0.431	-0.384	-0.039
t^3 (24)(1.).	7.397	2.469	0.251	2.488	-0.093	-0.018	0.294	0.331	0.222
t^3 (24)(3.).	-11.082	-4.139	0.037	-3.873	-0.262	-0.006	-0.094	-0.074	0.032
t^3 (24)(5.).	3.841	1.591	0.639	1.150	0.081	0.141	-0.094	-0.135	-0.152
t^3 (24)(6.).	-0.224	0.073	-0.113	-0.684	0.241	-0.081	-0.164	-0.211	-0.216
t^3 (25)(1.).	-7.879	-2.351	-0.331	-2.860	-0.338	-0.101	-0.466	-0.432	-0.081
t^3 (25)(3.).	0.095	-0.063	0.729	-1.432	0.331	-0.010	0.233	0.224	0.066
t^3 (25)(4.).	5.109	1.632	-1.166	2.510	0.308	-0.059	-0.378	0.097	0.118
t^3 (25)(6.).	7.333	2.411	0.039	3.758	-0.087	0.007	0.039	0.008	0.105
t^3 (26)(1.).	1.043	0.401	-0.630	0.600	0.491	-0.028	0.029	-0.292	-0.228
t^3 (26)(3.).	2.349	0.740	0.048	1.227	-0.031	-0.018	0.386	0.382	0.136
t^3 (26)(4.).	1.522	0.626	0.090	0.976	-0.554	0.056	0.067	0.094	0.048
t^3 (26)(5.).	-3.655	-1.246	0.282	-2.170	0.169	-0.001	-0.029	0.266	0.166
t^3 (34)(1.).	-3.161	-1.115	-0.540	-0.973	-0.262	0.074	-0.247	-0.303	-0.203
t^3 (34)(2.).	15.645	5.883	0.010	5.799	0.013	0.061	0.388	0.298	0.202
t^3 (34)(5.).	-8.634	-3.883	1.136	-4.697	0.564	-0.045	0.092	-0.244	0.070
t^3 (34)(6.).	-1.279	-0.232	-0.009	-0.036	-0.306	0.014	0.244	0.199	0.168
t^3 (35)(1.).	4.746	1.715	0.440	1.259	0.298	-0.085	-0.275	-0.239	0.004
t^3 (35)(2.).	1.726	0.561	-0.041	1.147	-0.035	0.070	0.262	-0.138	-0.018
t^3 (35)(4.).	1.011	0.481	-0.323	0.801	-0.539	0.124	-0.310	0.346	0.154
t^3 (35)(6.).	-3.685	-1.954	0.556	-2.206	-0.161	-0.107	0.169	0.000	-0.247
t^3 (36)(1.).	-3.932	-1.562	0.199	-1.502	-0.314	-0.106	-0.278	0.029	0.068
t^3 (36)(2.).	-4.220	-1.809	0.227	-1.689	-0.043	-0.101	-0.153	0.003	-0.097
t^3 (36)(4.).	-2.868	-1.217	-0.273	-0.814	0.425	-0.011	0.343	0.015	0.006
t^3 (36)(5.).	4.685	2.316	0.110	1.713	-0.061	0.054	0.095	0.054	0.019
t^3 (45)(1.).	-1.074	-0.735	0.025	0.201	0.294	0.020	0.009	-0.214	-0.160
t^3 (45)(2.).	-8.950	-3.224	0.527	-3.659	-0.389	-0.081	0.044	0.037	0.034
t^3 (45)(3.).	7.623	3.402	-0.813	3.895	-0.025	-0.079	0.014	-0.102	-0.224
t^3 (45)(6.).	-3.773	-1.451	-0.068	-1.124	0.300	0.118	0.054	-0.118	0.080
t^3 (46)(1.).	-4.237	-1.181	0.678	-1.875	0.046	-0.056	-0.182	0.020	0.183
t^3 (46)(2.).	-1.298	-0.699	0.023	-0.292	0.313	0.025	0.028	0.118	0.168
t^3 (46)(3.).	4.147	1.449	0.281	0.850	-0.119	-0.003	-0.032	-0.213	-0.174
t^3 (46)(5.).	2.908	0.666	-1.237	2.513	-0.425	-0.044	-0.167	0.281	0.055
t^3 (56)(1.).	6.883	2.424	-0.378	2.607	-0.284	0.121	-0.047	0.748	0.127
t^3 (56)(2.).	-3.678	-1.165	-0.321	-1.589	-0.081	-0.006	0.072	-0.275	-0.270
t^3 (56)(3.).	-1.000	-0.362	-0.667	0.494	0.222	0.054	-0.183	-0.055	0.228
t^3 (56)(4.).	0.865	0.784	1.305	-1.388	0.125	-0.074	0.303	-0.163	-0.134

Table 11: The four-line interaction effect of lines i, j, k and l due to particular arrangement t^4 ($_{i\ j}$)($_{k\ l}$) for yield component traits and some fiber traits

$t^4(_{i\ j})(_{k\ l})$	S.C.Y/ P	L.Y. / P	N.S./B.	N. B./ P	F.S	F.F	S.L.2.5%	S.L.50%	U.R.%
t^4(12)(34)	-4.545	-1.133	-0.060	-2.269	0.236	0.026	-0.543	-0.569	-0.303
t^4(12)(35)	3.819	1.063	0.147	1.312	-0.100	-0.107	0.232	0.268	0.214
t^4(12)(36)	0.726	0.070	-0.087	0.957	-0.136	0.081	0.310	0.300	0.089
t^4(12)(45)	0.726	0.070	-0.087	0.957	-0.136	0.081	0.310	0.300	0.089
t^4(12)(46)	3.819	1.063	0.147	1.312	-0.100	-0.107	0.232	0.268	0.214
t^4(12)(56)	-4.545	-1.133	-0.060	-2.269	0.236	0.026	-0.543	-0.569	-0.303
t^4(13)(24)	3.237	0.912	0.705	0.602	-0.092	-0.021	-0.095	-0.159	-0.225
t^4(13)(25)	-0.294	0.099	-1.486	1.553	-0.047	0.037	-0.073	-0.028	0.094
t^4(13)(26)	-2.943	-1.011	0.781	-2.155	0.139	-0.016	0.169	0.187	0.131
t^4(13)(45)	-2.943	-1.011	0.781	-2.155	0.139	-0.016	0.169	0.187	0.131
t^4(13)(46)	-0.294	0.099	-1.486	1.553	-0.047	0.037	-0.073	-0.028	0.094
t^4(13)(56)	3.237	0.912	0.705	0.602	-0.092	-0.021	-0.095	-0.159	-0.225
t^4(14)(23)	1.308	0.222	-0.645	1.668	-0.144	-0.005	0.638	0.727	0.528
t^4(14)(25)	2.328	1.323	0.555	-0.494	-0.089	-0.088	-0.201	-0.178	0.000
t^4(14)(26)	-3.636	-1.544	0.091	-1.173	0.233	0.093	-0.437	-0.549	-0.528
t^4(14)(35)	-3.636	-1.544	0.091	-1.173	0.233	0.093	-0.437	-0.549	-0.528
t^4(14)(36)	2.328	1.323	0.555	-0.494	-0.089	-0.088	-0.201	-0.178	0.000
t^4(14)(56)	1.308	0.222	-0.645	1.668	-0.144	-0.005	0.638	0.727	0.528
t^4(15)(23)	-3.524	-1.162	1.339	-2.865	0.147	0.070	-0.159	-0.241	-0.308
t^4(15)(24)	-3.055	-1.393	-0.468	-0.463	0.225	0.006	-0.109	-0.122	-0.089
t^4(15)(26)	6.579	2.555	-0.871	3.328	-0.372	-0.077	0.269	0.362	0.397
t^4(15)(34)	6.579	2.555	-0.871	3.328	-0.372	-0.077	0.269	0.362	0.397
t^4(15)(36)	-3.055	-1.393	-0.468	-0.463	0.225	0.006	-0.109	-0.122	-0.089
t^4(15)(46)	-3.524	-1.162	1.339	-2.865	0.147	0.070	-0.159	-0.241	-0.308
t^4(16)(23)	2.216	0.940	-0.694	1.198	-0.003	-0.066	-0.479	-0.487	-0.219
t^4(16)(24)	-0.182	0.481	-0.238	-0.139	-0.133	0.015	0.205	0.281	0.314
t^4(16)(25)	-2.034	-1.421	0.931	-1.059	0.136	0.051	0.274	0.206	-0.094
t^4(16)(34)	-2.034	-1.421	0.931	-1.059	0.136	0.051	0.274	0.206	-0.094
t^4(16)(35)	-0.182	0.481	-0.238	-0.139	-0.133	0.015	0.205	0.281	0.314
t^4(16)(45)	2.216	0.940	-0.694	1.198	-0.003	-0.066	-0.479	-0.487	-0.219
t^4(23)(45)	2.216	0.940	-0.694	1.198	-0.003	-0.066	-0.479	-0.487	-0.219
t^4(23)(46)	-3.524	-1.162	1.339	-2.865	0.147	0.070	-0.159	-0.241	-0.308
t^4(23)(56)	1.308	0.222	-0.645	1.668	-0.144	-0.005	0.638	0.728	0.528
t^4(24)(35)	-0.182	0.481	-0.238	-0.139	-0.133	0.015	0.205	0.281	0.314
t^4(24)(36)	-3.055	-1.393	-0.468	-0.463	0.225	0.006	-0.109	-0.122	-0.089
t^4(24)(56)	3.237	0.912	0.705	0.602	-0.092	-0.021	-0.095	-0.159	-0.225
t^4(25)(34)	-2.034	-1.421	0.931	-1.059	0.136	0.051	0.274	0.206	-0.094
t^4(25)(36)	2.328	1.323	0.555	-0.494	-0.089	-0.088	-0.201	-0.178	0.000
t^4(25)(46)	-0.294	0.099	-1.486	1.553	-0.047	0.037	-0.073	-0.028	0.094
t^4(26)(34)	6.579	2.555	-0.871	3.328	-0.372	-0.077	0.269	0.362	0.397
t^4(26)(35)	-3.636	-1.544	0.091	-1.173	0.233	0.093	-0.437	-0.549	-0.528
t^4(26)(45)	-2.943	-1.011	0.781	-2.155	0.139	-0.016	0.169	0.187	0.131
t^4(34)(56)	-4.545	-1.133	-0.060	-2.269	0.236	0.026	-0.543	-0.569	-0.303
t^4(35)(46)	3.819	1.063	0.147	1.312	-0.100	-0.107	0.232	0.268	0.214
t^4(36)(45)	0.726	0.070	-0.087	0.957	-0.136	0.081	0.310	0.300	0.089

Thus , it is not necessary that parents having high general combination ability effect (gi) would also contribute to high specific combining ability effects $t^4_{(ij)(kl)}$.

The results also cleared that the crosses t^4 (15) (26) [(P_1 x P_5) x (P_2 x P_6)] , t^4 (15) x (34) [(P_1 x P_5) x (P_3 x P_4)] and t^4 (26) (34) [(P_2 x P_6) x (P_3 x P_4)] were the best combinations for seed cotton yield per plant (S.C.Y./P.) , lint cotton yield per plant (L.C.Y./P.) and number of bolls per plant(No. B./ P . On the other hand , The combinations t^4 (15) (23) [(P_1 x P_5) x (P_2 x P_3)] , t^4 (15) (46) [(P_1 x P_5) x (P_4 x P_6)] and t^4 (23)(46) [(P_2 x P_3) x (P_4 x P_6)] had the best specific effect for number of seeds per boll (No. S./ B.) . In addition , the combinations t^4 (12) (34) [(P_1 x P_2) x (P_3 x P_4)] , t^4 (12) (56) [(P_1 x P_2) x (P_5 x P_6)] and t^4 (34) (56) [(P_3 x P_4) x (P_5 x P_6)] were the best and desirable effects for fiber strength . (F.S.) .

The results cleared that the crosses t^4 (12) (35) [(P_1 x P_2) x (P_3 x P_5)] , t^4 (12) (46) [(P_1 x P_2) x (P_4 x P_6)] and t^4 (35) (46) [(P_3 x P_5) x (P_4 x P_6)] exhibited the desirable negative specific effect for fiber finenesses . Also , the crosses t^4 (14) (23) [(P_1 x P_4) x (P_2 x P_3)] , t^4 (14) (56) [(P_1 x P_4) x (P_5 x P_6)] and t^4 (23) (56) [(P_2 x P_3) x (P_5 x P_6)] had the highest and desirable specific combining ability effect for 2.5% span length and 50% span length , as well as , uniformity ratio (U.R.%.) .Most of these combinations involved at least one of the best general combiner for any studied traits . This indicates that predications of superior crosses based on the general combining ability effects of the parents would generally be valid and the contribution of non-allelic interaction in the inheritance of these traits . These finding may explain the superiority of the double crosses over their four parents for the studied traits .

Genetic parameters :-

The genetic parameters estimates were obtained and the results are presented in Table 12 . The results showed that the magnitudes of dominance genetic variance (σ^2D) were positive and larger than those of additive genetic variance (σ^2A) for number of seeds per boll and most of fiber studied traits . However , the epistatic variances especially, additive by additive genetic variance (σ^2AA) showed positive genetic variance for seed cotton yield per plant (S.C.Y./P.) , lint cotton yield per plant (L.C.Y./ P.) , number of bolls per plant (No. B./P.) and fiber strength (F.S.) . While , additive by dominance (σ^2AD) genetic variance were positive for most of studied traits . On the other hand , dominance by dominance (σ^2DD) and additive by additive by additive genetic variance (σ^2AAA) was positive for No S./B., No. B./ P. 2.5% S.L. , 50% S.L. and U.R.% .

It could be concluded that yield , yield components and fiber traits were mainly controlled by the epistatic variance , This finding may explain the superiority of most studied double crosses than their parents in most of yield and fiber traits . These results are partially agreement with those obtained by Abd EL Maksoud *et al*. (2003 a-b) , Abd EL Hadi *et al*. (2005 a-b) , Hemida *et al*., (2006) , EL-Mansy and EL-Lawendy (2008) and Abd EL bary (2008)

Table 12: The estimation of genetic variances for yield components and some fiber traits

Genetic Parameters	S.C.Y/ P	L.Y. / P	N.S./B.	N. B./ P	F.S	F.F	S.L.2.5 %	S.L.50 %	U.R.%
σ^2A	-1786.9	-260.1	-31.5	-179.1	-8.49	-0.656	-3.99	-3.60	-1.53
σ^2D	-4271.9	-637.1	54.2	-491.2	-10.86	-0.302	12.95	18.75	12.73
σ^2AA	6407.6	944.3	-6.5	658.3	22.81	1.374	-7.08	-13.24	-9.87
σ^2AD	11378.6	1681.7	-214.9	920.7	36.18	1.725	-50.63	-73.92	-48.97
σ^2DD	-926.6	-120.2	127.7	474.5	-15.84	-1.099	37.78	50.70	27.51
σ^2AAA	-7585.7	-1121.1	143.3	-613.8	-24.12	-1.150	33.75	49.28	32.65

REFERENCES

Abd EL-Bary , A.M.R. ; Y.A. M. Soliman, H. M. E. Hamoud and M. A. Abo EL-Yazid . (2008). Triallel analysis for yield components and fiber traits in Gossypium Barbadense L. J. Agric. Sci. Mansoura Univ., 33 (2) : 1189 – 1202 .

Abd EL-Bary , A.M.R. (2008). Quadriallel analysis for yield components and fiber traits in Gossypium Barbadense L.J. Agric. Sci. Mansoura Univ., 33 (2) : 1203-1220.

Abd EL- Hadi , A.H. ; M. A. Raafat and W.M. B. Yehia (2005-a) . Three – crosses analysis for vegetative, earliness and fiber traits of Egyptian cotton (Gossypium Barbadense . L.) . J. Agric. Sci. Mansoura Univ. , 30(1) : 231- 246 .

Abd EL- Hadi , A.H. ; M. A. Raafat and W.M. B. Yehia (2005-b) . Three – crosses analysis for yield and its components of some Egyptian cotton . Egypt . J. Genet. Cytol., 34 : 305-319 .

Abd EL-Maksoud , M.M.; A.A. Awad and Abd EL- Bary , A.M.R. (2003-a). Triallel analysis of some quantitatively inherited traits in Gossypium barbadense L.1-Yield and yield components. J.Agric. Sci. Mansoura Univ. , 28 (10) : 7307 – 7318.

Abd EL-Maksoud , M.M. ; EL- Adl, A.M. ; Hamada, M.S. and Abd EL- Bary , A. M. (2003-b) . Triallel analysis of some quantitatively inherited traits in Gossypium Barbadense L. 2- Fiber properties . J. Agric. Sci. Mansoura Univ., 28 (10) : 7319 – 7329 .

Baloch. M.J ; H.Bhutto ; R.Rind and G.H.Tunio. (1995) . Combining ability estimates in 5 x 5 diallel intra- hirsutum crosses . Pakistan Journal of Botany . 27 : 121- 126

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

EL- Adl . A. M. and P.A. Miller . (1971) . Transgressive segregation and the nature of gene action for lint yield in an intervarietal cross of upland cotton . Crop Sci. 11 : 381-384.

EL- Mansy, Y. M. and M. M. EL-Lawendy (2008). Application of three – way crosses in cotton (Gossypium Barbadense). Annals of Agric. Sc., Meshtohar, Vol. 46(1) : Ag. 11-22.

Hemida , G.M. K. ; H.H. EL-Adly and S. A. S. Mohamed (2006) . Triallel crosses analysis for some quantitative character in Gossypium Barbadense L. J. Agric. Sci. Mansoura Univ. , 31 (6) : 3451- 3461 .

Miller. P.A and A. Marani . (1963). Heterosis and combining ability in diallel crosses of upland cotton . Gossypium hirsutum L. Crop Sci. 3 : 441 – 444 .

Nadeem. A; D.K. Munir ; M.A.Khan ; A.Mushtag ; N.Austin and M. Ahmad . (1998) . Genetic studiees of cotton (Gossypium hirsutum L.) 1- combining ability and heterosois studies in yield and yield components . Pakistan Journal of Scientific and Industrial Research . 41 : 54 – 56 .

Rawling, J.O. and C. C. Cockerham (1962-b) . analysis of double cross hybrid population . Biometrics, 18: 229- 244.

Singh, P. and S.S. Narayanan (2000). Biometrical techniques in plant breeding . Klyani Publishers . New Delhi , 2 nd ed

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

Steel, R. G. D. and Torrie (1980) . Principle and procedures of statistics . McGraw Hill Book Company Inc., New York .

Tang.B.; J.N.Jenkins ; J.C.McCarty and C.E. Watson. (1993) . F2 hybrids of host plant germplasm and cotton cultivars . II. Heterosis and combining ability for lint yield and yield components . Crop Sci. 33 : 700 : 705.

Wilson . F.D. (1991). Combining ability for yield characteristics and earliness of pink bollworm resistant cotton . Crop Sci. 31: 922 – 925 .

تحليل الهجن الزوجية لمكونات المحصول وصفات التيلة في القطن المصري

وليد محمد بسيوني يحيي ، هشام مسعد السيد حمود و محمد عبد الفتاح أبو اليزيد
معهد بحوث القطن - مركز البحوث الزراعية - مصر

استخدم في هذا البحث ستة أصناف من القطن تابعة للنوع باربادنس وهي جيزة ٤٥ ، جيزة ٨٩ x بيما س٦ ، C.B.58 ، TNB ، Aust. 12 و جيزة ٨٩ . وفي الموسم الزراعي ٢٠٠٦ تم التهجين بين هذه الأصناف في نظام نصف دائري وتم الحصول علي ١٥ هجين فردي وفي الموسم الزراعي ٢٠٠٧ تم زراعة هذه الهجن وتم التهجين فيما بينها للحصول علي ٤٥ هجين زوجي بحيث لا يظهر الأب في الهجين إلا مرة واحدة وفي الموسم الزراعي ٢٠٠٨ تم تقييم هذه التراكيب الوراثية المتحصل عليها وهي ٤٥ هجين زوجي بالإضافة للآباء الستة في تجربة قطاعات كاملة العشوائية بمحطة البحوث الزراعية بسخا حيث تم قياس الصفات التالية : محصول القطن الزهر للنبات ، محصول القطن الشعر للنبات ، عدد البذور في اللوزة ، عدد اللوز للنبات ، متانة التيلة ، نعومة التيلة ، طول التيلة عند ٢,٥% ، طول التيلة عند ٥٠% بالإضافة لمعامل الانتظام .

ويمكن تلخيص النتائج المتحصل عليها فيما يلي :-

*. بالنسبة لاختبار المعنوية أظهرت النتائج أن التراكيب الوراثية الموجودة تحت الدراسة كان هناك بينها اختلافات معنوية وعالية المعنوية لكل الصفات الموجودة تحت الدراسة كما أظهرت تجزئة متوسط مجموع المربعات لمكوناتها أهمية وجود التباين المضيف والتباين الغير مضيف بكل مكوناته (التباين السيادي ، التباين المضيف x التباين السيادي ، التباين المضيف x التباين المضيف ، التباين السيادي x التباين السيادي ، التباين المضيف xالتباين المضيف x التباين المضيف)

* . كانت أفضل التراكيب الوراثية المتحصل عليها هي (C.B.58 x جـ٨٩) x (TNB x Aust.12) ، (C.B.58 x TNB) x (Aust.12 x جـ٨٩) ، ((جـ٨٩ x بيماس٦) x جـ٨٩) x (C.B.58 x TNB) ، ((جـ٨٩ x بيماس٦) x C.B.58) x (TNB x جـ٨٩) ، ، ((جـ٨٩ x بيماس٦) x C.B.58) x (TNB x Aust.12) ، (جـ٤٥ x جـ٨٩) x ((جـ٨٩ x بيماس٦) x TNB) بالإضافة إلي ((جـ٨٩ x بيماس٦) x جـ٨٩) x (TNB x Aust.12) .

*. أظهرت النتائج أن الصنف C.B.58 كان أفضل الأصناف قدرة عامة علي التآلف لمعظم صفات المحصول مثل متوسط محصول القطن الزهر للنبات ، متوسط محصول القطن الشعر للنبات بالإضافة لعدد البذور في اللوزة في حين

أن الصنف TNB كان ذو أفضل قدرة عامة علي التآلف لصفات متانة التيلة والطول عند ٢,٥% و ٥٠% . أما الصنف جـ٨٩ x بيماس٦ بالإضافة للصنف Aust.12 كانا ذو قدرة عامة علي التآلف لصفات متوسط عدد اللوز للنبات ومعامل الانتظام كل علي حدة .

*- بالنسبة للقدرة الخاصة علي التآلف توجد سبعة أنواع من القدرة الخاصة تنقسم إلي ثلاث مجاميع كالتالي :-

**- المجموعة الأولي :- قدرة خاصة بين سلالتين :-

١- في هذا النوع لا يهم ترتيب السلالتين سواء كانا معا في نفس الهجين الفردي أم كل سلالة في هجين وكانت أفضل الاتحادات عند تواجد جـ٤٥ مع جـ٨٩ x بيماس٦ أو تواجد جـ٨٩ x بيماس٦ مع جـ٨٩ لمعظم صفات المحصول . أيضا عند تواجد C.B.58 مع TNB لمعظم صفات التيلة .

٢- في هذا النوع يشترط وجود السلالتين معا في نفس الهجين الفردي وكانت أفضل اتحادات عند تواجد C.B.58 مع جـ٨٩ لصفات محصول القطن الزهر للنبات ومحصول القطن الشعر للنبات وعند تواجد جـ٤٥ مع Aust.12 أو تواجد جـ٤٥ مع جـ٨٩ x بيماس٦ لصفات عدد اللوز للنبات ومتانة التيلة وبالنسبة لصفات الطول عند ٢,٥% و ٥٠% ومعامل الانتظام كان أفضل اتحاد عند تواجد الصنف جـ٤٥ مع جـ٨٩ .

٣- في هذا النوع يشترط تواجد احدي السلالتين في هجين فردي والسلالة الاخري في هجين آخر وكانت أفضل الاتحادات عند تواجد الصنف جـ٤٥ مع C.B.58لصفات محصول القطن الشعر للنبات وعدد اللوز للنبات ومتانة التيلة وعند تواجد جـ٤٥ مع جـ٨٩ x بيماس٦ ، C.B.58 مع جـ٨٩ و C.B.58 مع TNB لصفات عدد البذور في اللوزة ونعومة التيلة ومعامل الانتظام كل علي حدة .

**- المجموعة الثانية : قدرة خاصة بين ثلاث سلالات :-

١- في هذا النوع لا يهم ترتيب السلالات أي منهم في هجين فردي والاخري في هجين فردي آخر وكانت أفضل الاتحادات عند تواجد جـ٨٩ x بيماس٦ مع Aust.12 ومع جـ٨٩ بالنسبة لمعظم صفات المحصول في حين أفضل اتحاد كان بين C.B.58 مع TNB مع Aust.12 بالنسبة لمعظم صفات التيلة .

٢- في هذا النوع يشترط تواجد السلالتين الأولي والثانية في هجين فردي والسلالة الثالثة في الهجين الفردي الأخر وكانت أفضل اتحادات عند تواجد C.B.58 مع TNB في هجين فردي مع جـ٨٩ x بيماس٦ في الهجين الأخر لمعظم صفات المحصول . وتواجد C.B.58 مع TNB معAust.12 ، جـ٤٥ مع C.B.58مع جـ٨٩ x بيماس٦ بالإضافة لتواجد جـ٤٥ مع Aust.12 مع جـ٨٩ x بيماس٦ لمعظم صفات التيلة .

**- المجموعة الثالثة : قدرة خاصة بين أربع سلالات :-

١- في هذا النوع لا يهم ترتيب السلالات أي منهم في هجين فردي والاخري في هجين آخر وكانت أفضل اتحادات عند تواجد جـ٨٩ x بيماس٦ و TNBو Aust.12و جـ٨٩ لصفات المحصول وتواجد جـ٤٥ مع جـ٨٩ x بيماس٦ مع Aust.12 مع جـ٨٩ لصفات التيلة .

٢- في هذا النوع يهم الترتيب حيث تتواجد السلالة ١ و ٢ في هجين فردي والسلالة ٣ و ٤ في الهجين الفردي الأخر وكانت أفضل اتحادات عند تواجد جـ٤٥ مع Aust.12 في الهجين الفردي الأول و جـ٨٩ x بيماس٦ مع C.B.58 في الهجين الثاني ، و تواجد جـ٤٥ مع Aust.12 في هجين وC.B.58 مع TNB في الهجين الأخر ، وتواجد جـ٨٩ x بيماس٦ مع C.B.58 في الهجين الأول مع TNB مع جـ٨٩ في الهجين الأخر لصفات المحصول ومكوناته .

*- أوضحت النتائج أن قيم التباين السيادي كانت اعلي من قيم التباين المضيف وموجبة لمعظم الصفات تحت الدراسة .

*- أظهرت النتائج أن قيم التباين التفوقي بصوره المختلفة هي المؤثرة وذات الأثر الأكبر في توارث صفات المحصول ومكوناته وصفات التيلة ومن هنا يجب عمل برنامج انتخابي للهجن المتفوقة من الهجن الزوجية في أجيالها الانعزالية للحصول عل أصناف وسلالات متفوقة للصفات تحت الدراسة .