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YIELD AND FIBER QUALITY POTENTIAL FOR TRIALLEL CROSSES IN COTTON:
2- SUPERIORITY

Yehia, W.M.B.; H.M.E. Hamoud; A.A.A. El-Akheder and M.A. Abd El-Gelil
Cotton Research Institute, Agriculture Research Center. Egypt

ABSTRACT

In this study five varieties were used. These varieties were Suvin (P_1), TNB (P_2), Pima S_6 (P_3), G. 88 (P_4) and G. 89 (P_5). The all possible crosses among the three parental varieties to form 30 three way crosses. All genetic materials (five parental varieties, 30 three-way crosses, 10 F_1 single crosses and two check varieties) were evaluated at Sakha Agriculture Research Station. Heterosis (Superiority) at Mid-parents, better parent, mid-F_1 single crosses, better F_1 single crosses, mid-checks and better check were evaluated for yield, yield components and fiber traits.

The results of the analysis of variances of all genotypes showed highly significant differences for all the studied traits.

For superiority (heterosis) over the mid-parents the results indicated that the three-way cross (G. 88 x G. 89) x Pima S_6 cleaned the highest positive heterosis for boll weight (B.W) and number of seeds per boll (No.S./B.). The cross (Pima S_6 x G. 88) x Suvin for seed cotton yield per plant (S.C.Y./P.) and number of bolls per plant No.B./P. In the same time the cross (G. 88 x G. 89) x TNB was the superior and had the highest heterosis for lint cotton yield per plant (L.C.Y./P.). On the other hand, the superior cross for lint percentage (L. %), lint index (L.I) and fiber strength (F.S.) was (Suvin x G. 89) x Pima S_6. However, for 2.5% span length (2.5% S.L.), 50% span length (50% S.L.) and uniformity ratio % (U.R.%) the three way cross (TNB x Pima S_6) x G. 89 was the superior and had the highest positive heterosis values (desirable).

Concerning heterosis over the better parent, the results cleared that the crosses (G. 88 x G. 89) x TNB, (Suvin x G. 89) x Pima S_6 and (G. 88 x G. 89) x Pima S_6 were the superior and had the highest positive heterosis values (superiority) for lint cotton yield per plant (L.C.Y./P.), lint percentage (L. %) and number of seeds per boll (No. S./B.). In the same time, the three way cross (TNB x Pima S_6) x G. 89 was the highest for 2.5% span length (2.5% S.L.), 50% span length (50% S.L.) and uniformity ratio % (U.R.%). On the other hand, for seed index (S.I.) and boll weight (B.W.) the results cleared that the superior cross was (Pima S_6 x G. 89) x TNB and the cross (Pima S_6 x G. 88) x Suvin was the superior for seed cotton yield per plant S.C.Y./P. and number of bolls per plant (No.B./P.). However, the cross (Suvin x TNB) x G. 89 was the superior and had the highest positive heterosis values for lint index (L.I.).

The estimates of heterosis (Superiority) over the mid-F_1 single cross. The results revealed that, the three way crosses (Pima S_6 x G. 89) x TNB, (TNB x Pima S_6) x Suvin, (G. 88 x G. 89) x Pima S_6 and (TNB x Pima S_6) x G. 88 were the superior and had the highest positive significant heterosis (superiority) for boll weight (B.W.), seed index (S.I.), number of seeds per boll (No.S/B.) and fiber strength (F.S.). While, the cross (Suvin x TNB) x Pima S_6 was the superior and had the lowest negative heterosis value (desirable) for fiber fineness. On the other hand, the cross (TNB x Pima S_6) x G. 89 was the superior three-way cross for 2.5% span length (2.5% S.L.), 50% span length (50% S.L.) and uniformity ratio % (U.R.%). In the same time, the cross (Pima S_6 x G. 88) x Suvin was the superior for seed cotton yield per plant and number of bolls per plant. While, the cross (G. 88 x G. 89) x TNB was the superior for lint cotton yield per plant (L.C.Y./P.) and lint percentage (L.%). Although, for lint index

(L.I) the cross (Suvin x TNB) x G. 89 was the superior and had the highest mean of superiority.

For heterosis over the better F_1 single crosses, the results cleared that the cross (Pima S_6 x G. 88) x Suvin was the superior for seed cotton yield per plant (S.C.Y./P.) and number of bolls per plant (No.B./P.). In the same time, the cross (TNB x Pima S_6) x G. 89 was the highest for 2.5% and 50% span length, while, for lint cotton yield per plant and seed index the crosses (G. 88 x G. 89) x TNP and (TNB x Pima S_6) x Suvin had the highest positive heterosis (superiority), respectively.

For heterosis over mid-checks, the results cleared that the three way crosses [(Pima S_6 x G. 89) x TNB, (Pima S_6 x G. 88) x Suvin, (G. 88 x G. 89) x TNB, (TNB x Pima S_6) x Suvin, (TNB x G. 89) x G. 88, (G. 88 x G. 89) x Pima S_6 and (TNB x Pima S_6) x G. 88] were the superior crosses and had the highest positive heterosis values for boll weight (B.W), seed cotton yield per plant (S.C.Y./P), lint percentage (L.%), seed index (S.I.), lint index (L.I.), number of seeds per boll No.S./B. and fiber strength (F.S.), respectively. While, the cross (TNB x Pima S_6) x G. 89 was the superior for 2.5% and 50% span length, as well as uniformity ratio %.

For heterosis (superiority) over the better check the results cleared that, the crosses (Pima S_6 x G. 89) x TNB, (Pima S_6 x G. 88) x Suvin, (TNB x Pima S_6) x Suvin and (G. 88 x G. 89) x Pima S_6 were the highest crosses and had the highest positive heterosis for boll weight (B.W.), seed cotton yield per plant (S.C.Y/P.), seed index (S.I.) and number of seeds per boll (No.S./B.), respectively. While, the cross (Suvin x TNB) x G. 89 was the superior for lint index (L.I.) as well as, for 2.5% and 50% span length the cross (TNB x Pima S_6) x G. 89 was the superior and had the highest positive heterosis values (superiority).

INTRODUCTION

Inbreeding depression is usually defined as the lowered fitness or vigour of inbred individuals compared with their non-inbred counter parts, observed in many (but by no means all) organisms its converse is heterosis the hybrid vigour manifested in increased size, growth rate or other parameters resulting from the increase in heterozygosity in F_1 generation crosses between inbred lines.

Problems arise in defining fitness and vigour, so long as we are discussing population of wild plants, we have the concept of Darwinian fitness if individuals of one genotype survive to breed more than other, then that genotype confers greater fitness. Fitness is an observed quantity that integrates the effect of all characters that influence the ability of the plants to line and reproduce. As natural selection can only act to increase the frequency of an allele in proportion to the extent to which that allele increases fitness it was predicted (Falcaner, 1960) that the amount of heritable variance for a trait would be inversely proportional to its effect on the plants fitness. In other words, there would be more inheritable variance in relatively "neutral" characters than in ones that increased the plant viability or fecundity.

Vigour is another vegue concept but to most growers it is synonymous with rate of growth or biomass accumulation. In an annual, this is well correlated with production of grain, flowers or fruit since these plants maximize their investment in seed production. But a perennial may increase its growth rate only to reinvest these resource in further vegetative production.

Vigour has sometimes been used as a measure (or even a near-synonym) of fitness in discussions of heterosis. But a plant can be too vigorous for its own good: it can become structurally unstable and vulnerable to destruction by on chemical stress or dependent on a higher and more reliable supply of water nutrients than the environment can guarantee. On the other hand, heterosis is one method to increase cotton yields that have a stagnated in recent years. We are using heterosis to increase yield of cotton haws long been an objective of breeders. The yield increase of hybrids over the better parent or best commercial cultivar (useful heterosis) has been documented in numerous reviews (Loden and Richmond, 1951; Davis, 1978; Meredith, 1984; Basu, 1995 and Chaudhary 1997). A review using more recent data (Meredith, 1998) showed an average useful heterosis of 21.4% for F_1 hybrids and 10.7% for F_2s generations.

Udayakumar *et al.* (1984) claimed that raw cotton yield showed highly significant heterosis with the mean of 222% over mid-parents. Abd El-Bary (2003) found that the amounts of heterosis versus mid-parents were significant for most studied traits. While, heterosis versus better-parents was not of economical importance.

Concerning heterosis versus better-parent, Al-Zanati (1993) found that the useful heterosis values ranged from 8.64 to 51.03% in comparison with their respective better-parent for yield and fiber traits. In this respect Hamoud (2000) reported that heterosis versus mid-parents and better parent exhibited undesirable values for all studied fiber traits. Abou El-Yazied (2004) obtained significant heterosis values results better-parent for seed cotton yield per plant, lint cotton yield per plant, boll weight and lint percentage. Anther seems results obtained by Abd El-Bary (2003), Abd El-Hadi *et al.* (2005), Yehia (2005), Hemaida *et al.* (2006), Abd El-Bary *et al.* (2008) and El-Mansy and El-Lawendy (2008).

MATERIALS AND METHODS

The genetic materials used in the present investigation included five cotton varieties belong to *Gossypium barbadense*, L., three of these varieties new germplasm materials, Suvin (P_1) and TNB (P_2) are Indian cotton varieties and Pima S_6 (P_3) is American cotton variety. In addition Giza 88 (P_4) was belonging to extra long staple and as well as G. 89 (P_5) was belonging to long staple varieties, respectively.

In the growing season 2006, the five parent (all varieties) were planted and mated in a half diallel crosses to obtained ten F_1 single crosses. The parental varieties were also self-pollinated to obtain enough seeds for further investigation.

In 2007 growing season, the five parents and their ten single crosses were planted and mated in three-way crosses to obtain 30 combinations. In the same time the five parents were planted and mated in a half diallel cross to obtained ten F_1 crosses gain.

In the growing season of 2008, all genetic materials obtained form hybridization and their parents as well as to G. 86 and G. 89 x G. 86 used as checks (five parents, ten single crosses, 30 three way crosses and two checks) were evaluated in experimental at Sakha Agriculture Research Station. The experimental design used was a randomized complete blocks design with three replications as outlined by Cochran and Cox (1957). Each plot was one row of 4.0 m long and 60 cm in width. Hills were 40 cm apart and were thinned to keep constant stand of one plant per hill at seedling stage ordinary practices were followed as usual for the cotton field.

The data were taken for eight plants from plot and data were recorded on the following traits:

A. Yield and yield component traits:

1. Boll weight (B.W).
2. Seed cotton yield per plant (S.C.Y./P).
3. Lint cotton yield per plant (L.C.Y./P).
4. Lint percentage (L.%).
5. Number of bolls per plant (No.B./P).
6. Seed index (S.I.).
7. Lint index (L.I).
8. Number of seeds per boll (No.S./B.)

B. Fiber traits:

1. Fiber strength (F.S.).
2. Fiber firmness (F.F.).
3. 2.5% span length (2.5% S.L.).
4. 50% span length (50% S.L.).
5. Uniformity ratio % (U.R.%).

The heterosis (superiority) were determined for 30 three way crosses by comparing their average overall mean as all by the average mean of the two parents (mid-parents) as well as the mean of the best one (better parent). In addition the comparison between F_1 hybrids and by the mid-checks and better check. The values of superiority (heterosis) could be estimated from the following equations.

$$H(T.\ MP)\ \% = \frac{T' - MP'}{M.P'.} \times 100$$

$$H(T.\ B.P)\ \% = \frac{T' - BP'}{B.P'.} \times 100$$

$$H(T.\ MF_1)\ \% = \frac{T' - M.F.'_1}{M.F'} \times 100$$

$$H(T.\ B.F_1)\ \% = \frac{T' - B.F.'_1}{B.F'_1} \times 100$$

$$H(T.\ M.ch.)\ \% = \frac{T' - M.ch'}{M.ch'} \times 100$$

$$H(T.\ B.ch.)\ \% = \frac{T' - B.ch.'}{B.ch'} \times 100$$

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

The procedures of diallel analysis was described by Griffing's methods (1956). The theoretical aspect of triallel analysis has been illustrated by Rawling and Cockerhan (1962) and out lined by Singh and Chaudhary (1985).

RESULTS AND DISCUSSION

The analysis of variance for all genotypes for yield, yield components and fiber traits were made and the results are presented in Table 1. The results revealed that the mean squares of genotypes were highly significant for all the studied traits. The mean square of replications were non significant for most of studied traits with except lint percentage, seed index and number of seeds per boll. This result could be concluded that the choice of suitable genotypes was very important to introduce high yielding crosses.

The amounts of heterosis over mid-parents in 30 three way crosses for yield, yield components and fiber traits ($H_{T.M.P\%}$) were calculated and the results are presented in Table 2. The results indicated that the cross (G. 88 x G. 89) x Pima S_6 was the highest positive heterosis value for boll weight (B.W.) with the mean heterosis value of 31.83%.

The same crosses showed the highest positive heterosis value for number of seeds per boll (No.S./B.) with the heterosis value of 53.75%.

For 2.5% span length, 50% span length and uniformity ratio (2.5% S.L., 50% S.L. and U.R.%). The three way cross (TNB x Pima S_6) x G. 89 had the highest positive heterosis values with the mean of 13.50, 17.15 and 3.28%, respectively.

The amount of heterosis over the mid-parents for seed cotton yield per plant (S.C.Y./P), lint cotton yield per plant (L.C.Y./P), seed index (S.I) and number of bolls per plant (No. B./P.) were calculated and the results cleared that, the crosses (Pima S_6 x G. 88) x Suvin, (G. 88 x G. 89) X TNB, (Pima S_6 x G. 89) x TNB and (Pima S_6 x G. 88) Suvin and had the amount of heterosis values 65.68, 40.73, 31.39 and 47.89%, respectively.

For lint percentage (L. %) and fiber strength (F.S.) the three way crosses (Suvin x G 89) x Pima S_6 had the highest positive heterosis with the mean values of 8.82 and 60.25%, respectively. On the other hand, the cross (Suvin x G. 89) x TNB had the highest heterosis for lint index (L.I.) with the mean value of heterosis 38.12.

These results were generally in agreement with the result obtained by Udayakumar *et al.* (1984), Basu (1995), Meredith (1998), Abd El-Bary (2003), Abou El-Yazied (2004) and Abd El-Hadi *et al.* (2005).

The amounts of heterosis for all studied traits over the better-parent ($H_{T.B.P\%}$) were calculated and the results are presented in Table 3. The amount of heterosis versus better parent for boll weight (B.W.) showed 11 three-way crosses exhibited significant positive values of heterosis.

Table 1: The result of the analysis of variance for yield, yield components and fiber traits for all genotypes.

S.V.	d.f.	B.W	S.C.Y./P.	L.C.Y./P.	L. %	S.I	L.I.	No.B./P.	No.S./B.	F.F.	F.S.	2.5% S.L.	50% S.L.	U.R. %
Replications	2	0.072	72.29	19.47	3.135*	2.293**	0.2123	12.93	25.275**	0.057	0.234	1.086	1.664	0.368
Genotypes	46	0.192**	467.30**	64.66**	4.605**	1.597**	0.544**	57.072**	17.95**	0.213**	0.646**	3.622**	2.954**	3.851**
Error	92	0.037	87.91	12.27	0.98	0.21	0.293	12.85	2.557	0.126	0.279	1.052	1.507	1.437

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

Table 2: The amount of heterosis over the mid-parents for yield, yield components and fiber traits in 30 three-way crosses.

Three-way crosses		B.W	S.C.Y./P.	L.C.Y./P.	L. %	S.I	L.I.	No.B./P.	No.S./B.	F.F.	F.S.	2.5% S.L.	50% S.L.	U.R. %
(Suvin x TNB)	x Pima S_6	21.72**	9.98	16.78	6.65**	10.95**	23.23**	9.13	27.79**	9.67	4.35	5.85**	5.09	-0.66
	x G. 88	24.69**	36.44**	29.84**	-4.43*	1.81	-5.11	7.92	32.61**	23.89**	3.96	6.75**	6.78*	0.00
	x G. 89	-1.29	-17.24	-52.40**	7.68**	13.28**	27.81**	-20.62	8.94	11.73	0.40	9.99**	13.21**	2.82**
(Suvin x Pima S_6)	x TNB	18.14**	10.67	11.20	1.18	19.63**	22.21**	-6.27	36.46**	16.05*	-0.67	8.18**	8.92**	0.60
	x G. 88	25.93**	14.65	16.47	1.52	19.25**	21.98**	-9.70	46.09**	27.59**	-7.21*	9.78**	11.36**	1.52
	x G. 89	12.82**	0.27	0.28	0.13	19.69**	20.25**	-15.76	37.75**	12.93	-2.32	2.65	2.22	-0.46
(Suvin x G. 88)	x TNB	1.99	12.15	13.24	1.30	14.51**	16.90*	10.25	18.34**	18.09*	-0.67	1.57	1.81	0.16
	x Pima S_6	8.60	-3.20	-4.96	-1.59	1.64	-0.59	-11.26	13.96	16.53*	0.54	2.91	1.45	-1.42
	x G. 89	12.83**	-20.01	-13.80	7.81**	4.98	18.56**	-33.11**	14.99*	19.83**	4.66	5.61**	6.00*	0.48
(Suvin x G. 89)	x TNB	1.17	2.99	2.47	-0.26	10.32**	9.90	-3.57	14.12*	17.32*	34.41**	6.54**	8.02**	1.37
	x Pima S_6	20.44**	11.42	21.29	8.82**	20.16**	38.12**	-12.26	33.67**	17.82*	60.25**	1.10	3.58	2.30*
	x G. 88	10.94*	34.77**	35.27**	0.17	14.94**	15.23*	14.36	29.62**	16.95*	-3.33	7.98**	8.67**	1.02
(TNB x Pima S_6)	x Suvin	15.63**	32.33**	35.58**	2.81	29.00**	34.88**	14.04	35.07**	180*	2.63	1.45	1.49	0.05
	x G. 88	17.03**	-18.69	-15.67	3.86*	23.13**	30.37**	-30.94**	41.93**	17.17*	12.37**	5.73**	5.95*	0.24
	x G. 89	2.75	8.87	10.05	1.35	27.86**	30.64**	1.12	30.05**	12.27	-0.20	13.50**	17.15**	3.28**
(TNB x G. 88)	x Suvin	6.82	11.97	12.25	0.60	5.44	6.43	3.58	14.23*	24.76**	-4.76	6.04**	6.67*	0.67
	x Pima S_6	17.41**	4.18	7.26	3.22	22.30**	28.17**	-11.71	41.64**	212.80**	0.64	10.72**	11.15**	0.42
	x G. 89	4.98	-4.86	-12.07	-9.11**	15.43**	-0.75	-13.74	28.05**	7.80	9.81**	7.56**	7.25*	-0.30
(TNB x G. 89)	x Suvin	17.68**	-0.15	2.14	2.48	11.09**	15.43*	-19.49	18.80**	19.27**	-3.87	2.87	2.82	-0.06
	x Pima S_6	10.66*	6.21	7.99	1.77	23.71**	27.02**	-8.43	35.92**	13.85*	-3.24	5.32*	5.91	0.58
	x G. 88	18.09**	53.91**	13.71	1.79	21.14**	24.30**	23.86	21.55**	17.53**	11.63**	7.03**	7.72**	0.64
(Pima S_6 x G. 88)	x Suvin	10.91*	65.68**	15.24	-1.89	23.82**	20.20**	47.89**	35.14**	33.57**	3.19	2.51	1.70	-0.75
	x TNB	12.07*	7.14	7.53	0.61	23.25**	23.77**	-4.42	38.61**	11.72	-1.78	4.71*	3.76	-0.86
	x G. 89	24.78**	9.57	7.72	-1.66	7.81*	4.67	-16.48	22.42**	15.69*	10.11**	3.53	3.14	-0.46
(Pima S_6 x G. 89)	x Suvin	7.38	1.77	7.31	5.49**	19.46**	30.34**	-10.15	26.88**	31.32**	0.87	10.21**	12.15**	1.66
	x TNB	27.90**	-2.06	-2.94	-0.062	31.39**	30.00**	-27.20**	41.10**	11.22	-1.72	9.09**	10.23**	1.05
	x G. 88	10.57*	-2.26	0.32	2.53	22.05**	26.63**	-15.50	33.75**	20.70**	-3.45	3.80	3.48	-0.27
(G. 88 x G. 89)	x Suvin	12.83**	23.22*	25.10*	1.53	12.99**	15.78*	4.01	28.83**	30.17**	2.08	6.35**	7.70*	1.30
	x TNB	20.67**	31.84**	40.73**	6.89**	7.70*	19.81**	3.61	24.56**	15.69*	-3.04	2.60	1.54	-0.88
	x Pima S_6	31.83**	-22.04*	-23.79*	-2.43	19.64**	14.69	-43.50**	53.75**	13.41*	5.21	8.73**	9.39**	0.58
L.S.D. 0.05		0.254	12.42	4.640	1.309	0.608	0.717	4.7747	2.118	0.471	0.699	1.359	1.625	1.588
L.S.D. 0.01		0.337	16.45	6.146	1.734	0.805	0.950	6.288	2.806	0.624	0.926	1.800	2.153	2.103

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

Table 3: The amount of heterosis over the better parent for yield, yield components and fiber traits in 30 three-way crosses.

Three-way crosses		B.W	S.C.Y./P.	L.C.Y./P.	L. %	S.I	L.I.	No.B./P.	No.S./B.	F.F.	F.S.	2.5% S.L.	50% S.L.	U.R. %
(Suvin x TNB)	x Pima S_6	16.84**	0.73	8.68	3.51	-3.13	9.64	-5.03	13.00	30.34**	3.69	4.21	3.74	-1.60
	x G. 88	15.12**	27.03*	20.11	-7.79**	-3.64	-9.31	-8.22	20.78**	47.24*	3.30	3.52	1.95	-1.51
	x G. 89	-3.44	-25.87*	-57.15**	5.45*	4.55	22.00**	-35.33**	3.45	37.93**	-0.70	8.67**	11.44**	2.19
(Suvin x Pima S_6)	x TNB	13.40*	1.37	3.49	-1.80	4.44	8.73	-20.59	20.67**	37.93**	-1.30	6.51*	7.52*	-0.35
	x G. 88	15.55**	3.45	7.87	-3.58	5.35	6.21	-19.21	20.32**	47.24*	-7.98	7.22**	7.32*	0.20
	x G. 89	9.89	-8.64	-9.80	1.445	2.93	4.00	-27.90*	18.79*	35.52**	-3.59	2.17	1.57	-1.49
(Suvin x G. 88)	x TNB	-5.84	4.41	4.76	-2.26	8.38*	11.72	-6.23	7.79	40.34**	-1.30	-1.50	-2.79	-1.35
	x Pima S_6	-0.35	-12.66	-11.98	-6.54**	-10.20**	-1.45	-20.60	-6.15	34.48**	-0.30	0.51	-2.23	-2.70*
	x G. 89	5.65	-29.41*	-22.91	3.30	-2.02	10.52	-41.98**	2.22	43.79**	3.92	3.61	2.30	-1.11
(Suvin x G. 89)	x TNB	-1.03	-7.75	-7.78	-2.33	1.82	4.91	-21.43	8.37	44.83**	1.70	5.26*	6.32	0.74
	x Pima S_6	17.31**	1.52	9.10	7.10**	3.33	19.45	-24.91*	15.28*	41.38**	-7.28	0.2	2.92	1.25
	x G. 88	3.89	18.93	20.97	-4.02	7.27	7.41	-0.81	15.22*	40.37**	-3.72	9.22**	4.88	-0.58
(TNB x Pima S_6)	x Suvin	11.00*	21.21	26.18*	-0.21	12.63**	20.00*	-0.78	19.44*	40.34**	1.00	-0.12	0.18	-0.90
	x G. 88	5.50	-22.41	-16.23	0.03	12.10**	12.24	-35.69**	20.00*	20.45*	11.67**	2.11	1.50	-0.53
	x G. 89	-1.72	4.67	6.16	-0.94	17.0**	15.20*	-10.01	15.23	19.61*	-0.60	11.67**	15.71**	2.77*
(TNB x G. 88)	x Suvin	-1.37	4.24	3.84	-2.93	-0.20	1.72	-11.91	4.04	48.28**	-5.30	2.83	1.85	-0.85
	x Pima S_6	5.84	-0.58	6.54	-0.60	1.34**	10.34	-17.78	19.76*	25.21**	-0.30	6.92**	6.49	-0.35
	x G. 89	-3.44	-11.26	-15.63	-11.71**	11.23**	-8.45	-22.25*	17.00*	14.85*	9.70*	4.33	2.90	-1.35
(TNB x G. 89)	x Suvin	15.12**	-10.57	-8.06	0.35	2.53	10.18	-34.41**	12.852	47.2**	-4.70	1.64	1.21	-0.67
	x Pima S_6	5.84	2.11	4.18	-0.54	13.30**	12.01	-18.51	20.43*	21.29*	-4.59	3.62	4.60	0.08
	x G. 88	8.59	43.56**	9.10	-1.12	16.74**	14.66	11.64	6.3	25.21**	11.00*	3.852	3.35	-0.42
(Pima S_6 x G. 88)	x Suvin	1.77	49.49**	6.73	-6.83**	9.39*	4.66	32.31**	16.27*	54.14**	1.99	0.12	-1.99	-2.04
	x TNB	1.03	2.25	6.81	-3.11	12.20**	6.55	-11.00	17.19*	14.85	-2.59	1.11	-0.59	-1.62
	x G. 89	14.78**	2.20	3.35	-4.46*	3.89	-3.45	-24.72*	7.08	23.25**	10.00*	0.42	-1.05	-1.51
(Pima S_6 x G. 89)	x Suvin	4.59	-7.27	-3.47	3.81	2.7	12.73	-23.10*	14.31	57.59**	-0.30	9.69**	11.44**	0.62
	x TNB	22.34**	-5.84	-6.37	-0.79	20.34**	14.63	-35.22**	34.21**	18.49*	-2.99	7.37**	8.88*	0.55
	x G. 88	2.14	-7.33	-3.80	-1.95	9.40*	6.03	-20.36	5.33	25.21**	-4.29	1.741	0.21	-1.11
(G. 88 x G. 89)	x Suvin	5.65	8.74	11.87	-2.73	5.45	7.93	-9.79	19.63*	56.21**	1.91	4.33	3.94	-0.30
	x TNB	11.00*	22.97*	35.0**	3.84	3.78	10.52	-6.61	22.19*	23.25**	-4.30	-0.48	-2.58	-1.93
	x Pima S_6	21.79**	-26.08*	-26.92**	-6.70**	7.27	-3.97	-46.75**	35.78**	17.65*	3.99	6.23*	5.93	-0.27
L.S.D. 0.05		0.312	15.21	5.683	1.604	0.745	0.878	5.816	2.595	0.576	0.856	1.663	1.991	1.945
L.S.D. 0.01		0.413	20.15	7.528	2.124	0.987	1.163	7.704	3.437	0.763	1.134	2.203	2.637	2.577

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

In the same time, the cross (Pima S_6 x G. 89) x TNB gave the highest positive heterotic (superiority) value of 22.34%. On the other hand, heterosis value for seed index (S.I) was the highest value for the same cross with positive heterosis value of 20.34%.

For seed cotton yield per plant (S.C.Y./P), and number of bolls per plant (No.B./P.). The results indicated that four and one out of the 30 three way crosses showed significant positive heterosis values from the better parent and the cross (Pima S_6 x G. 88) x Suvin showed the high hest positive significant heterosis of 49.49 and 32.31% for the two traits, respectively.

With regard to lint cotton yield per plant (L.C.Y./P.). and number of seeds per ball (No.S./B.) two and 17 crosses had disables positive heterosis values versus better parent and the highest mean values for the two traits were the crosses (G. 88 x G. 89) x TNB and (G. 88 x G. 89) x Pima S_6 with the mean values 35.0 and 35.78% for the same traits of the two crosses, respectively.

Concerning lint percentage (L.%), the results of heterosis versus better-parent revealed that two out of 30 the three way crosses gave significant and positive heterosis and the cross (Suvin x G. 89) x Pima S_6 showed the highest positive heterosis of 7.10%.

For lint index (L.I.) the results showed that the cross (Suvin x TNB) x G. 89 showed the highest positive significant heterosis values versus better parent with mean value of 22.00%.

The amount of heterosis (superiority) versus better parent for fiber strength (F.S) showed four out of the 30 three-way crosses exhibited significant positive values of heterosis, and the cross (TNB x Pima S_6) x G. 88 gave the highest value of 11.67%.

For 2.5 % span length (2.5% S.L.), 50% span length (50% S.L.) and uniformity ratio (U.R.%) the results indicated that 10, 6 and 1 out of the 30 three way-crosses showed highly significant positive heterosis over the better parent and the cross (TNB x Pima S_6) x G. 89 showed the highest positive significant positive heterosis for the three traits with the mean values of 11.67, 15.71 and 2.77%, respectively. These results were in agreement with the results obtained by Uajakumar *et al.* (1984); Al-Zanati (1993), Hamoud (2000); Abd El-Bary (2003); Yehia (2005) and El-Mansy and El-Lawendy (2008).

The amounts of heterosis for yield, yield components and fiber traits over the mid-F_1 single crosses in three-way crosses ($H_{T.M.F.}$ %) were estimated and the results are presented in Table 4.

The amount of heterosis versus mid-F_1 single crosses for boll weight (B.W.), seed cotton yield per plant (S.C.Y./P.) seed index (S.I.) and number of seeds per boll (No.S./B.) showed 13, 20, 18 and 17 out of the 30 three way-crosses exhibited significant positive values of heterosis. In the same time the crosses (Pima S_6 x G. 89) x TNB; (Pima S_6 x G. 88) x Suvin; (TNB x Pima S_6) x Suvin and (G. 88 x G. 89) x Pima S_6 gave the highest positive heterosis for the above four traits, respectively with the mean heterosis values of 24.48, 93.56, 16.02 and 20.79%, respectively.

Table 4: The amount of heterosis over the mid-F_1 single crosses for yield, yield components and fiber traits in 30 three way-crosses.

Three-ways crosses		B.W	S.C.Y./P.	L.C.Y./P.	L. %	S.I	L.I.	No.B./P.	No.S./B.	F.F.	F.S.	2.5% S.L.	50% S.L.	U.R. %
(Suvin x TNB)	x Pima S_6	18.83**	30.43**	32.57**	1.77	-0.21	2.55	31.43*	12.73*	-12.09*	3.59	1.39	0.11	-1.15
	x G. 88	17.13**	56.57**	46.51**	-6.28**	-0.73	-10.54	31.89*	20.50**	-0.70	2.89	3.71	3.51	-0.21
	x G. 89	-1.75	-0.57	-44.86**	3.67*	7.70**	14.12*	-0.17	3.21	-6.98	-1.10	5.82*	8.00**	2.02*
(Suvin x Pima S_6)	x TNB	15.38**	31.25**	26.24*	-3.46*	7.60*	1.70	12.89	20.39**	-6.98	-1.39	3.62	3.75	0.11
	x G. 88	14.34**	33.94**	31.35**	-2.00	8.53**	4.76	16.09	20.04**	-0.70	-8.07*	7.42**	8.96**	1.52
	x G. 89	8.74*	22.55	16.07	-5.14**	6.04*	-2.72	11.29	18.52**	-8.60	-3.69	-0.51	-1.56	-1.03
(Suvin x G. 88)	x TNB	-4.20	28.69*	27.78*	-0.66	11.65**	10.20	34.74**	7.54	-5.35	-1.69	-1.33	-1.31	-0.05
	x Pima S_6	-1.40	13.08	7.18	-5.01**	-7.49*	-14.63*	14.09	-6.37	-9.30	-0.40	0.69	0.74	-1.42
	x G. 89	4.55	-5.31	-0.80	4.99**	0.94	9.01	-10.44	1.99	-3.02	2.89	3.80*	3.86	0.19
(Suvin x G. 89)	x TNB	0.70	23.74	18.68	-3.98**	4.89	-1.87	21.28	8.12	-2.33	1.29	2.50	3.05	0.58
	x Pima S_6	16.08**	36.18**	40.39**	3.09	6.45*	11.73*	15.92	15.81**	-4.65	-7.37*	-2.02	-0.25	1.72*
	x G. 88	2.80	59.54**	55.67**	-2.45	10.51**	5.95	53.11**	14.95**	-5.35	-4.68	6.12**	6.48*	0.73
(TNB x Pima S_6)	x Suvin	12.94**	56.94**	53.91**	-1.90	16.02**	12.24*	37.31**	19.16**	-5.35	0.90	-2.83	-3.33	-0.45
	x G. 88	7.34	0.46	2.18	1.66	8.01**	10.71	-7.59	14.60*	0.00	11.55**	2.29	3.04	0.78
	x G. 89	0.00	40.40**	36.62**	-2.61	9.05**	4.42	38.90**	10.05	-0.70	-0.70	8.74**	12.15**	3.24**
(TNB x G. 88)	x Suvin	0.35	28.49*	26.66*	-1.35	2.81	0.34	26.58	3.0	0.00	-5.68	3.01	3.40	0.46
	x Pima S_6	7.69	28.73*	29.96**	1.03	7.28*	8.84	18.14	14.37*	3.95	-0.40	7.11**	8.11**	0.96
	x G. 89	-1.75	19.04	8.57	-10.26**	7.18*	-9.69	20.02	11.74*	-4.65	9.26**	4.52*	4.46	-0.05
(TNB x G. 89)	x Suvin	17.13**	19.97	18.31	-1.35	5.62	3.06	1.25	12.56*	-0.70	-5.08	-1.03	-1.91	-0.83
	x Pima S_6	7.69	36.97**	34.06**	-2.22	5.52	1.53	25.78	15.01**	0.70	-4.68	0.90	1.38	0.54
	x G. 88	10.49*	92.57**	40.39**	0.50	12.49**	13.10*	72.33**	6.07	3.95	10.56**	4.01*	4.92	0.89
(Pima S_6 x G. 88)	x Suvin	0.70	93.56**	29.96**	-5.30**	12.70**	3.23	90.13**	11.04	3.95	1.89	0.30	-0.50	-0.75
	x TNB	2.80	32.38**	30.28**	-1.53	8.12**	5.10	27.90	11.92*	-4.65	-2.69	1.30	0.92	-0.33
	x G. 89	16.78**	37.09**	33.00**	-2.90	0.10	-4.76	16.20	6.83	2.33	9.56**	0.60	0.46	-0.21
(Pima S_6 x G. 89)	x Suvin	3.50	24.39*	24.22*	-0.08	5.83*	5.44	1871	9.17	6.28	-0.40	6.81**	8.00**	1.08
	x TNB	24.48**	26.31*	20.49	-4.51**	12.07**	3.91	0.00	19.39**	-1.63	-3.09	4.52*	5.52*	1.01
	x G. 88	0.00	24.31	23.79*	-0.34	5.41	4.59	22.93	5.08	3.95	-4.38	1.60	1.74	0.19
(G. 88 x G. 89)	x Suvin	4.55	45.87**	43.96**	-1.13	8.64**	6.46	39.25**	14.25*	5.35	0.90	4.52*	5.52*	1.01
	x TNB	12.94**	64.95**	73.76**	5.54**	0.00	9.01	44.15**	8.70	2.33	-4.68	-0.30	-1.10	-0.63
	x Pima S_6	19.23**	-0.85	-5.96	-5.17**	3.33	-5.27	-17.80	20.79**	-2.33	3.88	6.42**	7.54**	1.05
L.S.D. 0.05		0.230	11.28	4.214	1.190	0.552	0.652	4.314	1.923	0.427	0.636	1.234	1.476	1.443
L.S.D. 0.01		0.305	14.94	5.582	1.577	0.732	0.863	5.714	2.548	0.566	0.842	1.634	1.956	1.911

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

For lint cotton yield pier plant (L.C.Y./P) and lint percentage (L. %). The results indicated that 20 and 4 out of the 30 three way crosses showed positive heterosis values from the mid-F_1 single crosses and the cross (G. 88 x G. 89) x TNB showed the highest positive significant heterosis for the two traits with the mean values of 73.76 and 5.54%, respectively.

With regard to lint index (L.I.) 4 three-way crosses had desirable heterosis versus mid F_1 single crosses and the cross (Suvin x TNB) x G. 89 had the highest value with the mean of 14.12% for the same trait. On the other hand, the crosses (Pima S_6 x G. 88) x Suvin and (TNB x Pima S_6) x G. 88 had the highest positive heterosis values for number of bolls per plant (No.B./P.) and fiber strength (F.S.) with the mean values of 90.13 and 11.55%, respectively.

Concerning 2.5% span length (2.5% S.L.); 50% span length (50% S.L) and uniformity ratio (U.R.%) the results revealed that 12, 9 and 3 out of the 30 three-way crosses gave significant and positive heterosis values (desirable) and the cross (TNB x Pima S_6) x G. 89 showed the highest means for all above traits with the mean of heterosis values of 8.74, 12.15 and 3.24%, respectively. On the other hand, the cross (Suvin x TNB) x Pima S_6 had the lowest negative heterosis (desirable) value for fiber firmness with the mean value -12.09%. These results were in common agreement with the results obtained by many authors among them, Abd El-Bary (2003); Yehia (2005), Hemida *et al.* (2006), Abd El-Bary *et al.* (2008) and El-Mansy and El-Lawendy (2008).

The amount of heterosis values over the better F_1 single crosses ($H_{T.B..F}$%) for yield, yield components and fiber traits were determined and the obtained results are presented in Table 5. The results showed that the cross (Pima S_6 x G. 88) x Suvin had the highest positive heterosis values (desirable) for seed cotton yield per plant (S.C.Y./P.) and number of bolls per plant (No.B./P.) with the values of heterosis 46.14 and 49.19%, respectively. On the other hand, the cross (G. 88 x G. 89) x TNB had the highest positive heterosis (desirable) and significant for lint cotton yield per plant (L.C.Y./P.) with the mean value of 31.55%. While, for 2.5% span length (2.5% S.L.) and 50% span length (50% span length) the results cleared that the cross (TNB x Pima S_6) x G. 89 had the highest heterosis and desirable with the mean values of 5.87 and 9.28%, respectively. In the same time, the cross (TNB x Pima S_6) x Suvin had the highest heterosis value and significant for seed index (S.I.) with the mean value of 12.17%. These results were generally in agreement with the results obtained by Davis (1978); Al-Zanati (1993) and Abd El-Bary (2003).

The amounts of heterosis (superiority) for all studied traits over the mid-checks ($H_{T.M.ch.}$ %) were calculated and the results are presented in Table 6. The amount of heterosis versus mid-checks for boll weight (B.W.), seed cotton yield per plant (S.C.Y./P.). Lint percentage (L.%), seed index (S.I.), number of seeds per boll (No.S./B.) and fiber strength (F.S.) showed 12, 2, 2, 27, 29 and 4 out of the 30 three way-crosses, showed positive and significant heterosis values (desirable) and the crosses (Pima S_6 x G. 89) x TNB, (Pima S_6 x G. 88) x Suvin, (G. 88 x G. 89) x TNB; (TNB x Pima S_6) x

Suvin; (G. 88 x G. 89) x Pima S_6 and (TNB x Pima S_6) x G. 88 had the highest heterosis values for the above traits, respectively with the mean values of 24.04, 28.53, 4.41, 24.58, 37.50 and 9.80%, respectively.

Concerning lint index (L.I.) the results of heterosis versus mid-checks revealed that 9 out of the 30 three way crosses gave significant and positive heterosis and the cross (Suvin x TNB) x G. 89 showed the highest positive of heterosis with the mean value of 19.82. On the other hand, the cross (TNB x pima S_6) x G. 89 showed the highest positive heterosis for 2.5% span length (2.5% S.L.), 50% span length (50% S.L.) and uniformity ratio (U.R. %) with the mean values of heterosis 11.16, 13.55 and 2.23%, respectively.

These results were in agreement with the results obtained by Abd El-Hadi *et al.* (2005); Yehia (2005), Hemid *et al.* (2006), Abd El-Bary *et al.* (2008), and El-Mansy and El-Lawendy (2008).

The amount of heterosis over the better check in 30 three way-crosses for yield, yield components and fiber traits were calculated and the results are presented in Table 7.

For boll weight (B.W.), the results showed that the cross (Pima S_6 x G. 89) x TNB showed the highest significant heterosis versus better check with the mean value of heterosis 23.61%. On the other hand, the cross (Pima S_6 x G. 88) x Suvin had the highest positive heterosis (desirable) for seed cotton yield per plant (S.C.Y./P.) with the mean of 26.13%. In the same time, the cross (TNB x Pima S_6) x Suvin had the highest and significant positive heterosis with the mean of 19.76% for seed index (S.I.).

With regard to number of seeds per boll 22 crosses had desirable heterosis versus the better check and the cross (G. 88 x G. 89) x Pima S_6 was the highest cross and had the highest positive desirable heterosis with the value of 30.80%. On the other hand, the cross (Suvin x TNB) x G. 89 had the highest heterosis value (desirable) and significant for lint index (L.I) with the mean of 19.40% for the above trait. In the same time for 2.5% span length (2.5% S.L.) and 50% span length (50% S.L) the cross (TNB x Pima S_6) x G. 89 was the highest cross and had the highest positive desirable heterosis with the mean values of 10.41 and 12.70%, respectively.

These results were in agreement with the results obtained by Abd El-Hadi *et al.* (2005), Yehia (2005), Hemida *et al.* (2006), Abd El-Bary *et al.* (2008) and El-Mansy and El-Lawendy (2008).

Table 5: The amount of heterosis over the better F_1 single crosses for yield, yield components and fiber traits in 30 three-way crosses.

Three-way crosses		B.W	S.C.Y./P.	L.C.Y./P.	L. %	S.I	L.I.	No.B./P.	No.S./B.	F.F.	F.S.	2.5% S.L.	50% S.L.	U.R. %
(Suvin x TNB)	x Pima S_6	2.72	-1.52	0.36	-1.08	-3.52	-5.19	3.13	-4.74	-5.50	-2.80	-1.29	-2.45	-2.44*
	x G. 88	1.21	18.22	10.92	-8.90**	-4.02	-17.30*	3.49	1.83	6.75	-3.46	0.97	0.86	-1.51
	x G. 89	-15.11**	-24.92*	-58.26**	0.77	4.12	5.50	-21.67	-12.78*	0.00	-7.20	3.02	5.24	0.70
(Suvin x Pima S_6)	x TNB	-0.30	-0.9	-4.43	-6.15**	4.02	-5.97	-11.41	1.73	0.00	-7.48	0.88	1.10	-1.19
	x G. 88	-1.21	1.13	-0.56	-4.74*	4.93	-3.14	-8.91	1.43	6.75	-13.74**	4.58	6.18	0.20
	x G. 89	-6.04	-7.47	-12.13	-7.79**	2.52	-10.06	-12.67	0.15	-1.75	-9.63*	-3.14	-4.07	-2.32*
(Suvin x G. 88)	x TNB	-17.22**	-2.84	-3.26	-3.44	7.95*	1.89	5.73	-9.13	1.75	-7.76	-3.93	-3.83	-1.35
	x Pima S_6	-14.80**	-14.62	-18.86	-7.67**	-10.56**	-21.07**	-10.47	-20.88**	-2.50	-6.54	-1.97	-3.28	-2.70*
	x G. 89	-9.67*	-28.51*	-24.90*	2.05	-2.41	0.79	-29.72*	-13.82*	4.25	-..46	1.06	1.21	-1.11
(Suvin x G. 89)	x TNB	-12.89**	-6.57	-10.15	-6.67**	1.41	-9.28	-4.83	-8.64	5.00	-4.95	-0.21	0.41	-0.73
	x Pima S_6	0.30	2.82	6.29	0.21	2.92	3.32	-9.04	-2.81	2.50	-13.08**	-4.61	-2.80	0.39
	x G. 88	-11.18*	20.46	17.85	-5.18*	6.84	-2.04	20.14	-2.86	1.75	-10.56*	3.32	3.76	-0.58
(TNB x Pima S_6)	x Suvin	-2.42	18.49	16.52	-4.64*	12.17**	3.77	7.74	0.69	1.75	-5.33	-5.40*	-5.80	-1.74
	x G. 88	-7.25	-24.15*	-22.64	-1.18	4.43	2.36	-27.48*	-3.16	7.50	4.67	-0.41	0.44	-0.53
	x G. 89	-13.60**	6.01	3.42	-5.33*	5.43	-3.46	9.00	-7.01	6.75	-6.82	5.87*	9.28**	1.90
(TNB x G. 88)	x Suvin	-13.29**	-2.99	-4.11	-4.10	-0.60	-7.23	-0.67	-12.29	7.50	-11.50**	0.29	0.76	-0.85
	x Pima S_6	-6.95	-2.80	-1.61	-1.79	3.72	0.63	-7.30	-3.36	11.75	-6.54	4.29	5.35	-0.35
	x G. 89	-15.11**	-10.12	-17.81	-12.77**	3.62	-16.51*	-5.82	-5.58	2.50	2.52	1.76	1.79	-1.35
(TNB x G. 89)	x Suvin	1.21	-9.4	-10.44	-4.10	2.11	-4.72	-20.55	-4.89	6.75	-10.93**	-3.64	-4.42	-2.12
	x Pima S_6	-6.95	3.41	1.49	-4.95*	2.01	-6.13	-1.30	-2.81	8.25	-10.56**	-1.76	-1.21	-0.77
	x G. 88	-4.53	45.40**	6.29	-2.31	8.75*	4.56	35.23**	-10.37	11.75	3.74	1.26	2.24	-0.42
(Pima S_6 x G. 88)	x Suvin	-12.99**	46.14**	-1.61	-7.95*	8.95*	-4.56	49.19**	-6.17	11.75	-4.39	-2.35	-3.04	-2.04
	x TNB	-11.18*	-0.05	-1.37	-4.28*	4.53	-2.83	0.36	-5.43	2.50	-8.69*	-1.38	-1.66	-1.62
	x G. 89	0.91	3.51	0.68	-5.62**	-3.22	-11.95	-8.82	-9.72	10.00	2.80	-2.05	-2.10	-1.51
(Pima S_6 x G. 89)	x Suvin	-10.57*	-6.08	-5.96	-2.87	2.31	-2.52	-6.85	-7.75	14.25*	-6.54	3.99	5.24	-0.23
	x TNB	7.55	-4.63	-8.78	-7.18**	8.35*	-3.93	-21.53	0.89	5.75*	-9.07*	1.76	2.83	-0.30
	x G. 88	-13.60**	-6.14	-6.29	-3.13	1.91	-3.30	-3.54	-11.20	11.75	-10.28**	-1.09	-0.86	-1.11
(G. 88 x G. 89)	x Suvin	-9.67*	10.14	8.98	-3.90	5.03	-1.57	9.27	-3.46	13.25	-5.33	1.76	2.83	-0.30
	x TNB	-2.42	24.54*	31.55*	2.59	-3.32	0.79	13.12	-8.14	10.00	-10.56**	-2.94	-3.62	-1.93
	x Pima S_6	3.02	-25.14*	-28.81*	-7.82**	-0.10	-12.42	-35.50**	2.07	5.00	-2.52	3.61	4.80	-0.27
L.S.D. 0.05		0.312	15.21	5.683	1.604	0.745	0.878	5.816	2.595	0.576	0.856	1.663	1.991	1.945
L.S.D. 0.01		0.413	20.15	7.528	2.124	0.987	1.163	7.704	3.437	0.763	1.134	2.203	2.637	2.577

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

Table 6: The amount of heterosis over the mid-checks for yield, yield components and fiber traits in 30 three-way crosses.

Three-way crosses		B.W	S.C.Y./P.	L.C.Y./P.	L. %	S.I	L.I.	No.B./P.	No.S./B.	F.F.	F.S.	2.5% S.L.	50% S.L.	U.R. %
(Suvin x TNB)	x Pima S_6	18.47**	-13.39	-12.87	0.68	7.15	7.68	-21.20*	28.32**	-2.83	1.96	3.64	1.36	-12.12*
	x G. 88	16.72**	3.97	-3.71	-7.28**	6.59	-6.07	-20.93*	37.17**	9.77	1.27	6.0**	4.80	-1.19
	x G. 89	-2.09	-33.97**	-63.76**	2.56	15.64**	19.82**	-40.15**	17.49*	2.83	-2.65	8.17**	9.36**	1.02
(Suvin x Pima S_6)	x TNB	14.98**	-12.84	-17.03	-4.49*	15.53**	6.79	-32.32**	37.03**	2.83	-2.94	5.92**	5.06	-0.87
	x G. 88	13.94**	-11.06	-13.68	-3.05	16.54**	10.00	-30.40**	36.64**	9.77	-9.51*	9.80**	10.33**	0.52
	x G. 89	8.36	-18.62*	-23.71**	-6.16**	13.85**	2.14	-33.28**	34.91**	1.03	-5.20	1.69	-0.32	-2.00*
(Suvin x G. 88)	x TNB	-4.53	-14.55	-16.02	-1.72	19.89**	15.71*	-19.22**	22.41**	4.63	-3.24	0.86	-0.07	-1.02
	x Pima S_6	-1.74	-24.91**	-29.56**	-6.03**	-0.67	-10.36	-31.60**	6.58	0.26	-1.96	2.93	0.50	-2.39*
	x G. 89	4.18	-37.12**	-34.80**	3.86*	8.38*	14.46*	-46.31**	16.09*	7.22	1.27	6.10**	5.16	-0.79
(Suvin x G. 89)	x TNB	0.35	-17.83*	-22.00*	-5.01**	12.63**	3.04	-27.29**	23.07**	7.97	-0.29	4.78*	4.34	-0.41
	x Pima S_6	15.68**	-9.57	-7.73	1.98	14.30**	17.32*	-30.51**	30.92**	5.40	-8.82	0.15	1.00	0.72
	x G. 88	2.44	5.94	2.31	-3.50	18.66**	11.25	-8.21	3085**	4.63	-6.18	8.47**	7.82*	-0.26
(TNB x Pima S_6)	x Suvin	12.54**	4.21	1.15	-2.95	24.58**	17.86*	-17.68*	35.64**	4.63	-0.69	-0.68	-2.12	-1.42
	x G. 88	6.97	-33.29**	-32.84**	0.57	15.98**	16.25*	-44.60**	30.45**	10.54	9.80**	4.56*	4.34	-0.21
	x G. 89	-0.35	-6.77	-10.21	-3.65*	17.09**	9.64	-16.72	25.27**	9.77	2.25	11.16**	13.55**	2.23*
(TNB x G. 88)	x Suvin	0.00	-14.68	-16.75	-2.40	10.39**	5.36	-24.11**	18.15*	10.54	-7.16	5.30*	4.70	-0.52
	x Pima S_6	7.32	-14.52	-14.59	-0.05	15.20**	14.29*	-29.17**	30.19**	14.91*	-1.96	9.49**	9.47**	-0.02
	x G. 89	-2.09	-20.95*	-28.65**	-11.22**	15.08**	-5.18	28.04**	27.19**	5.40	7.55*	6.84**	5.77	-1.02
(TNB x G. 89)	x Suvin	16.72**	-20.34*	-22.25*	-2.40	13.41**	8.21	-39.30**	28.13**	9.77	-6.57	1.17	-0.68	-1.80
	x Pima S_6	7.32	-9.05	-11.89	-3.26	13.30**	6.61	-24.59**	30.92**	11.31	-6.18	3.14	2.65	-0.44
	x G. 88	10.10*	27.87**	-7.73	-0.57	20.78**	18.75**	3.32	20.74**	14.91*	8.82*	6.32**	6.24*	-0.09
(Pima S_6 x G. 88)	x Suvin	0.35	28.53**	-14.59	-6.32**	21.01**	8.39	13.99	26.40**	14.91*	0.29	2.53	0.75	-1.72
	x TNB	2.44	-12.09	-14.38	-2.58	16.09**	10.36	-23.32**	27.39**	5.40	-4.22	3.54	2.19	-1.30
	x G. 89	16.38**	-8.97	-12.59	3.94*	7.49*	0.00	-30.34**	21.61**	13.11*	7.84*	2.84	1.72	-1.19
(Pima S_6 x G. 89)	x Suvin	3.14	-17.40	-18.36*	-1.15	13.63**	10.71	-28.83**	24.27**	17.48**	-1.96	9.18**	9.36**	0.09
	x TNB	24.04**	-16.13	-20.81*	-5.53**	20.34**	9.11	-40.05**	35.90**	8.74	-4.61	6.84**	6.85*	0.02
	x G. 88	-0.5	-17.46	-18.64*	-1.4	13.18**	9.82	-26.30**	19.61*	14.91*	-5.88	3.85	3.01	-0.79
(G. 88 x G. 89)	x Suvin	4.18	-3.14	-5.39	-2.19	16.65**	11.79	-16.52	30.05**	16.65*	-0.69	6.84**	6.85*	0.02
	x TNB	12.54**	9.53	14.20	4.41*	7.37*	14.46*	-13.58	23.74**	13.11*	-6.18	1.91	0.14	-1.61
	x Pima S_6	18.82**	-34.16**	-38.20**	-6.18**	10.95**	-0.54	-50.72**	37.50**	7.97	2.25	8.78**	8.89**	0.06
L.S.D. 0.05		0.270	13.17	4.922	1.389	0.646	0.61	5.037	2.247	0.499	0.741	1.441	1.725	1.685
L.S.D. 0.01		0.312	17.45	6.519	1.840	0.855	1.008	6.672	2.977	0.661	0.982	1.980	2.285	2.232

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

Table 7: The amount of heterosis over the better check for yield, yield components and fiber traits in 30 three way-crosses.

Three-way crosses		B.W	S.C.Y./P.	L.C.Y./P.	L. %	S.I	L.I.	No.B./P.	No.S./B.	F.F.	F.S.	2.5% S.L.	50% S.L.	U.R. %
(Suvin x TNB)	x Pima S_6	18.06**	-15.01	-16.88	-2.48	3.01	7.30	-23.56*	22.07**	-0.53	-1.61	2.94	0.60	-2.21
	x G. 88	16.32**	2.03	-8.14	-10.19**	2.47	-6.41	-23.29*	30.49**	12.37	-2.27	5.30*	4.02	-1.28
	x G. 89	-4.43	-35.21**	-65.43**	0.66	11.17**	19.40*	-41.94**	11.76	5.26	-6.05	7.44**	8.54*	0.93
(Suvin x Pima S_6)	x TNB	14.58**	-14.47	-20.85*	-7.48**	11.06**	6.41	-34.34**	30.36**	5.26	-6.34	5.20*	4.27	-0.96
	x G. 88	13.54*	-12.72	17.65	-6.09**	12.03**	9.61	-32.48**	29.98**	12.37	-12.68**	9.06**	9.580**	0.43
	x G. 89	7.99	-20.14*	-27.23**	-9.10**	9.45*	1.78	-35.27*	28.34**	3.42	-8.51	1.01	-1.07	-2.09
(Suvin x G. 88)	x TNB	-4.86	-16.14	-19.89*	-4.80*	15.25**	15.30	-21.63*	16.45*	7.1	-6.62	0.18	-0.82	-1.12
	x Pima S_6	-2.08	-26.31**	-32.80**	-8.97**	-4.51	-10.68	-33.64**	1.39	2.63	-5.39	2.23	-0.25	-2.48*
	x G. 89	3.82	-38.30**	-37.80**	0.612	4.19	14.06	-47.91**	10.44	9.74	-2.27	5.39*	4.38	-0.88
(Suvin x G. 89)	x TNB	0.00	-19.37	-25.59**	-7.99**	8.27*	2.67	-29.46**	17.08	10.53	-3.78	4.07	3.56	-0.50
	x Pima S_6	12.53**	-11.26	-11.98	-1.21	9.88*	16.90*	-32.58**	24.54**	7.89	-12.02**	-0.52	0.25	0.63
	x G. 88	2.08	3.96	-2.40	-6.52**	14.07**	10.85	-10.95	24.48**	7.11	-9.46*	7.74**	7.01	-0.35
(TNB x Pima S_6)	x Suvin	12.15*	2.26	-3.50	-5.99**	19.76**	17.44*	-20.14*	29.03**	7.11	-4.16	-1.35	-2.85	-1.51
	x G. 88	6.60	-34.53**	-35.94**	-2.58	11.49**	15.84*	-46.25**	24.10**	13.16	5.96	3.86	3.56	-0.30
	x G. 89	-0.69	8.51	-14.35	-6.67**	12.57**	9.25	-19.21	19.17*	12.37	-5.68	10.41**	12.70**	2.14
(TNB x G. 88)	x Suvin	-0.35	-16.27	-20.59*	-5.46**	6.12	4.98	-26.38**	12.40	13.16	-10.41*	4.59	3.91	-0.62
	x Pima S_6	6.94	-16.12	-18.52	-3.19	10.74**	13.88	-31.29**	23.85**	17.63	-5.39	8.75**	8.65*	-0.12
	x G. 89	-2.43	-22.43*	-31.93**	-14.00**	10.63**	-5.52	-30.19**	21.00*	7.89	3.78	6.12*	4.98	-1.12
(TNB x G. 89)	x Suvin	16.232**	-21.83*	-25.83**	-5.46**	9.02*	7.83	-41.11**	21.88**	12.37	-9.84*	0.49	-1.42	-1.89
	x Pima S_6	6.94	-10.75	-15.95	-6.29**	8.92*	6.23	-26.84**	24.54**	13.95	-9.46*	2.45	1.89	-0.53
	x G. 88	9.72	25.48*	-11.98	-3.69	16.11**	18.33*	0.23	1.86	17.63	5.01	5.60	5.44	-0.19
(Pima S_6 x G. 88)	x Suvin	0.00	26.13*	-18.52	-9.25**	16.33**	8.01	10.58	20.24*	17.63	-3.22	1.84	0.00	-1.81
	x TNB	2.08	-13.74	-18.32	-5.64**	11.60**	9.96	-25.61**	21.19*	7.89	-7.57	2.85	1.42	-1.39
	x G. 89	15.97**	-10.67	-16.62	-6.95**	3.33	-0.36	-32.42**	15.69	15.79*	4.07	2.14	0.96	-1.28
(Pima S_6 x G. 89)	x Suvin	2.78	-18.94	-2212*	-4.25*	9.24*	10.32	-30.96**	18.22*	20.26**	-5.39	8.45**	8.54*	0.00
	x TNB	23.61**	-17.70	-24.46*	-8.49**	15.68**	8.72	-41.84**	29.29**	11.32	-7.95	6.12*	6.05	-0.07
	x G. 88	-0.69	-19.00	-22.39*	-4.50	8.81*	9.43	-28.50**	13.79	17.63*	-9.18*	3.15	2.24	-0.88
(G. 88 x G. 89)	x Suvin	3.82	-4.95	-9.74	-5.26*	12.14**	11.39	-19.01	23.72**	19.21*	-4.16	6.12*	6.05	-0.07
	x TNB	12.15*	7.49	8.94	1.14	3.22	14.06	-16.16	17.71*	15.79*	-9.46*	1.22	-0.60	-1.70
	x Pima S_6	18.40**	-35.39**	41.04**	-9.13	6.66	-0.89	-5.19**	30.80**	10.53	-1.32	8.05**	8.08*	-0.03
L.S.D. 0.05		0.312	15.21	5.683	1.604	0.745	0.878	5.816	2.595	0.576	0.856	1.663	1.991	1.945
L.S.D. 0.01		0.413	20.15	7.528	2.124	0.987	1.163	7.704	3.437	0.763	1.134	2.203	2.637	2.577

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

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تقدير المحصول وصفات التيلة فى القطن باستخدام الهجن الثلاثية:
٢- التفوق

وليد محمد بسيونى يحيى ، هشام مسعد السيد حمود ، عادل عبدالعظيم أبواليزيد الأخضر ومحمد عبدالباقى عبدالجليل

معهد بحوث القطن – مركز البحوث الزراعية – مصر

تم استخدام خمسة أصناف من القطن المصرى فى هذه الدراسة. تلك الأصناف هى: سيوفين ، TNB ، بيما س٦ ، جيزه ٨٨ ، بالإضافة للصنف جيزه ٨٩ وهذه الأصناف الخمسة جيمعها تابعة للنوع باربادنس .*Gossypium barbadense* L فى موسم ٢٠٠٦ تم التهجين بينها فى نظام نصف دائرى للحصول على ١٠ هجن فردية وفى موسم ٢٠٠٧ تم إجراء التهجين بين الهجن الفردية والأباء الأخرى للحصول على ٣٠ هجين ثلاثى بحيث لا يتكرر الأب فى الهجين إلا مرة واحدة إلى جانب إجراء الهجن نصف الدائرية مرة أخرى للحصول على بذرة كافية. وفى الموسم الزراعى ٢٠٠٨ تم زراعة جميع التراكيب الوراثية المتحصل عليها وهى: (٣٠ هجين ثلاثى + ١٠ هجن فردية والأباء الخمسة اضافة الى صنفان تجاريان استخدما ككشاف) فى تجربة قطاعات كاملة العشوائية من ٣ مكررات فى محطة البحوث الزراعية بسخا ، وتم أخذ القياسات على صفات المحصول مكوناته وكذلك صفات التيلة فى القطن.

وتم تقدير التفوق (قوة الهجين) على أساس متوسط الأباء ، أفضل الأباء ، متوسط الهجن الفردية ، أفضل الهجن الفردية ، متوسط الصنفان التجاريان
وأفضل الأصناف التجارية النتائج المتحصل عليها أظهرت التالى:

- أشارت نتائج اختبارات تحليل التباين إلى وجود اختلافات عالية المعنوية بين كل التراكيب الوراثية المستخدمة لكل الصفات الموجودة تحت الدراسة.
- بالنسبه لقوة الهجين على أساس متوسط الأباء أظهرت النتائج أن الهجين (جيزه ٨٨ × جيزه ٨٩) × بيما س٦ كان أفضل الهجن لصفة متوسط وزن اللوزة وصفة متوسط عدد البذور فى اللوزة فى حين أن الهجين (بيما س٦ × جيزه ٨٨) × سيوفين كان الأفضل لصفة متوسط محصول القطن الزهر للنبات وعدد اللوز المتفتح للنبات. بينما الهجين (جيزه ٨٨ × جيزه ٨٩) × TNB كان الأفضل لصفة متوسط محصول القطن الشعر للنبات. فى نفس الوقت كان الهجين (سيوفين × جيزه ٨٩) × بيما س٦ الأكثر تفوقا لصفة تصافى الحليج ومتانة التيلة ومعامل الشعر أما لصفة الطول عند ٢,٥% والطول عند ٥٠% بالإضافة لمعامل الانتظام فكان التفوق للهجين الثلاثى (TNB × بيما س٦) × جيزه ٨٩.
- أما بالنسبه لقوة الهجين (التفوق) على أساس أفضل الأباء أظهرت النتائج أن الهجن (جيزه ٨٨ × جيزه ٨٩) × TNB ، (سيوفين × جيزه ٨٩) بيما س٦ والهجين (جيزه ٨٨ × جيزه ٨٩) × بيما س٦ كانوا

الأعلى قيما ولهم السبق لصفات متوسط محصول القطن الشعر للنبات ، تصافى الحليج بالإضافة لعدد البذور فى اللوزة. بينما لصفات متوسط الطول عند ٢,٥% ، متوسط الطول عند ٥٠% بالإضافة لمعامل الانتظام فكان أفضل الهجن لهذه الصفات السابقة هو الهجين (TNB × بيما س٦) × جيزه ٨٩. فى نفس الوقت كان الهجين (بيما س٦ × جيزه ٨٩) × TNB هو الأكثر تفوقا لصفات معامل البذرة ومتوسط وزن اللوزة ، بينما أظهرت النتائج أيضا أن الهجين (بيما س٦ × جيزه ٨٨) × سيوفين كان أفضل الهجن بالنسبه لمتوسط محصول القطن الزهر للنبات وصفة عدد اللوز المتفتح على النبات. أما لصفة معامل الشعر فكان السبق للهجين (سيوفين × TNB) × جيزه ٨٩.

- أظهرت النتائج أن قوة الهجين على أساس متوسط الهجن الفردية أن الهجن (بيما س٦ × جيزه ٨٩) × TNB ، (TNB × بيما س٦) × سيفوين ، (جيزه ٨٨ × جيزه ٨٩) × بيما س٦ ، والهجين (TNB × بيما س٦) × جيزه ٨٨ كان الأكثر تفوقا لصفات متوسط وزن اللوزة ، معامل البذرة ، عدد البذور فى اللوزة بالإضافة لمتانة التيلة. فى حين أن الهجين (سيوفين × TNB) × بيما س٦ كان الأفضل لصفة النعومة. بينما الهجين (TNB × بيما س٦) × جيزه ٨٩ كان له السبق لصفات متوسط الطول عند ٢,٥% وعند ٥٠% بالإضافة لمعامل الانتظام. وفى نفس الوقت كان الهجين (بيما س٦ × جيزه ٨٨) × سيوفين هو الأكثر تفوقا لصفات متوسط محصول القطن الزهر للنبات بالإضافة لعدد اللوز المتفتح على النبات. أما لصفة تصافى الحليج ومحصول القطن الشعر للنبات كان الهجين (جيزه ٨٨ × جيزه ٨٩) × TNB هو الأكثر تفوقا فى حين أن الهجين (سيوفين × TNB) × جيزه ٨٩ كان له التفوق لصفة معامل الشعر.
- بالنسبه لتقدير قوة الهجين (التفوق) على أساس أفضل الهجن الفردية أظهرت النتائج أن الهجين (بيما س٦ × جيزه ٨٨) × سيوفين كان الأكثر تفوقا بالنسبه لصفات محصول القطن الزهر للنبات بالإضافة لعدد اللوز المتفتح على النبات. بينما الهجين (TNB × بيما س٦) × جيزه ٨٩ كان الأفضل أداء وتفوقا لصفات متوسط الطول عند ٢,٥% وعند ٥٠% فى نفس الوقت كان الأكثر تفوقا لصفات محصول القطن الشعر هو الهجين (جيزه ٨٨ × جيزه ٨٩) × TNP أما الهجين (TNB × بيما س٦) × سيوفين كان الأكثر أداء وتفوقا بالنسبه لصفة معامل البذرة.
- أظهرت قياسات قوة الهجين (التفوق) على أساس متوسط الأصناف التجارية أن الهجن التالية: (بيما س٦ × جيزه ٨٩) × TNB ، (بيما س٦ × جيزه ٨٨) × سيوفين ، (جيزه ٨٨ × جيزه ٨٩) × TNB ، (TNB × بيما س٦) × سيوفين ، (سيوفين × TNB) × جيزه ٨٩ ، (جيزه ٨٨ × جيزه ٨٩) × بيما س٦ بالإضافة للهجن (TNB × بيما س٦) × جيزه ٨٨ كانت الأفضل والأكثر تفوقا لصفات متوسط وزن اللوزة ، متوسط محصول القطن الزهر للنبات ، تصافى الحليج ، معامل البذرة ، معامل الشعر ، عدد البذور فى اللوزة ، بالإضافة لصفة متانة التيلة على الترتيب. بينما الهجين (TNB × بيما س٦) × جيزه ٨٩ كان الأكثر تفوقا لصفات متوسط الطول عند ٢,٥% وعند ٥٠% بالإضافة لمعامل الانتظام.
- بالنسبه لتقدير التفوق (قوة الهجين) على أساس أفضل الصنفان التجاريان أظهرت النتائج أن الهجن (بيما س٦ × جيزه ٨٩) × TNB ، (بيما س٦ × جيزه ٨٨) × سيفوين ، (TNB × بيما س٦) × سيوفين بالإضافة للهجن (جيزه ٨٨ × جيزه ٨٩) × بيما س٦ كانت الأكثر أداء وتفوقا لصفات متوسط وزن اللوزة ، محصول القطن الزهر النبات ، معامل البذرة ، ومتوسط عدد البذور فى اللوزة على الترتيب. بينما الهجين (سيوفين × TNB) × جيزه ٨٩ كان الأكثر تفوقا لصفات معامل الشعر علاوة على أن الهجين (TNB × بيما س٦) × جيزه ٨٩ كان أيضا الأكثر تفوقا لصفات متوسط الطول عند ٢,٥% وعند ٥٠%.
- من خلال النتائج السابقة يتضح ان هناك مجموعة ممتازة من الهجن الثلاثية الناتجة تتفوق على ابائها وكذلك على الهجن الفردية بالاضافة لتفوقها على الصنفان التجاريان وبالتالى يمكن استخدامها تجاريا او عن طريق الانتخاب فى اجيالها الانعزالية للحصول على اصناف متفوقة محصوليا.