Egypt. J. Plant Breed. 24(1):41– 53(2020)

COMBINING ABILITY, HETEROSIS AND HERITABILITY FOR FIBER QUALITY PROPERTIES IN EGYPTIAN COTTON CROSSES

SH.A. Mokadem[1], M.A. Salem[1], H.S. Khalifa[2] and T.M.E. Salem[2,*]

1. Agronomy Dept., Fac. of Agric., Minia Univ., Egypt.

2. Cotton Breeding Dept., Cotton Res. Inst., Agric. Res. Center, Giza, Egypt.

*Corresponding author E-mail address: mr.taher.2009@gmail.com

ABSTRACT

The present investigation was carried out to study heterosis, general and specific combining ability and heritability in broad and narrow sense for cotton fiber quality properties using line × tester design. The study enjoyed eight parents (five lines and three testers) of cotton and their 15 F_1 hybrids. Mean squares due to genotypes (parents and their F_1 hybrids) were highly significant for fiber finances (F.F.), fiber strength (F.S.), fiber length (F.L.) and uniformity index (U.I.) in F_1 hybrids. Line × tester mean squares were highly significant for (F.F.), (F.S.), (F.L.) and (U.I.). The percentage of heterosis relative to mid-parent and better parent of the cross Giza 90 × BBB had recorded the best heterosis (desirable) relative to mid-parent and better parent for (F.S.), (F.L.) and (U.I.) with values (3.71 and 2.09), (4.57 and 2.75) and (1.64 and 0.94%), respectively. In addition, the crosses Giza 90 × BBB and [((G.83 × G.80) × G.89) × Australy] × 10229 had recorded positive and highly significant heterosis for (F.L.) and (U.I.) in F_1 hybrids. Results showed that the estimates of broad sense heritability in F_1 hybrids for (F.F.), (F.S.), (F.L.) and (U.I.) were high with values 84.024, 89.903, 96.116 and 95.441%, respectively. It be concluded that the previous crosses could be used to produce promising hybrids and expansion the genetic base.

Key words: ***Gossypium barbadense, line × tester analysis, Heterosis, Combining ability, Heritability.***

INTRODUCTION

Cotton is the world's first fiber crop and an important economic crop in Egypt. Cotton contributes significantly to reducing unemployment through the agricultural operations that take place from the preparation of land to harvest. Operations of the textile industry and its biproducts can be used to improve livestock and some additional industries such as oils, soap and other industries.

Honorable effort have been devoted to increase the yield capacity and fiber quality through breeding programs, which depends on the knowledge concerning multiple factors such as the nature of the inheritance of genes controlling different characters and heterosis.

El-Said (2016) found that the estimates of $h^2_{b.s.}$% were larger those $h^2_{n.s.}$%, which were 63.08, 92.42, 94.01 and 95.25 % for fiber fineness, fiber strength, fiber length and uniformity ratio, respectively. Moreover, estimates of $h^2_{n.s.}$% were 37.43, 59.12, 60.27 and 30.96% for the same traits, respectively. Khalifa *et al* (2016) indicated that low heritability in narrow sense (≤30) was obtained for fiber fineness and fiber strength. They indicated that the low values of $h^2_{n.s.}$ % could be due to great influence of environmental conditions.

Hussein (2017) estimated heterosis relative to mid parents for fiber fineness. the results recorded that two crosses (Giza 90 x Giza 92) and (Giza 87 x Giza 92) had significant positive heterotic effect with values of 18.10 % and 17.84 %, and two crosses (Giza 80 x Giza 92) and (Giza 80 x Giza 93) had significant negative heterotic effect with values of -14.82 % and -18.87 %, respectively. Monicashree *et al* (2017) displayed that the heterosis analysis revealed that the hybrid TCH 1705-101 x COD 5-1-2 topped the list for standard heterosis with significant values for fibre fineness (-13.33) and elongation per cent (17.78). Further, the hybrids TCH 1705-101 x BS-1 and TCH 1705-152 x CD-98955 also registered significant standard heterosis for uniformity ratio and elongation per cent traits each. The above hybrids were followed by African I-2 x TCH 1705-250, ARBC-1301 x TCH 1705-250, C 10-3 x Surabhi, G.cot 100 x TCH 1705-250, TCH 1705-101 x TCH 1705-250, TCH 1705-152 x BS-1, TCH 1705-152 x KC3, TCH 1705-152 x Surabhi and VS-9-S11-1 x TCH 1608 which showed significant standard heterosis for uniformity ratio trait each. Therefore, these hybrids selected based on standard heterosis for improvement in the fibre quality traits.

Swetha *et al* (2018) revealed that significant GCA and SCA mean squares for, fibre uniformity ratio (%), micronaire value (g/inch) and fibre strength (g/tex). However GCA variance showed significant mean squares for all the traits except uniformity ratio, and SCA showed significant mean squares for all the traits except micronaire and fibre strength. Among the parents: Parent TCB 37 and GSB 21 are good combiners for fibre quality traits. Variances for GCA and SCA appeared significant and important in determining the genetic control of most of the traits investigated. The GCA variances were lower than SCA variances for uniformity ratio as indicated by their lower ratios indicating predominance of non-additive gene action (dominant or epistasis) in inheritance of these traits.

Isong *et al* (2019) cleared that significant variation existed among the genotypes, crosses, parents and their interactions. Hybrid TCH1819 x TCB37 was outstanding in yield followed by COD-5-1-2 x DB3 and KC2 x TCB37. TCH1705-101 x CCB36 performed best in fibre fineness, while TCH1819 x TCB209 out performed in uniformity ratio and elongation per cent. The combining ability analysis showed an equal importance of additive and non-additive genetic components in fibre quality parameters.

The lines TCH1819, COD-5-1-2, VS-9-S11-1 and MCU7 and testers DB3 and TCB37 were distinguished as best combiners. Surabhi x TCB209, TSH0250 x CCB36, VS-9-S11-1 x DB3 and TCH1705-101 x DB3 were identified as best specific combiners and may be recommended for further breeding program.

Shahzad *et al* (2019) Results showed that fiber quality traits were determined by main genetic effects. Moreover, additive and dominance-environment interaction effects were found to be predominant for fiber traits. Results showed that broad-sense heritability and its interaction heritability were significant for most of fiber quality traits.

Yehia and El-Hashash (2019) reported that the two crosses G.90 × C.B.58 and G.95 × G.86 exhibited the best heterosis versus mid-parents and better parent for fiber traits. Results showed that the variances due to genotypes, parents, crosses and parent vs cross exhibited significant differences ($p<0.01$) for fiber traits. The variances due to GCA of lines and testers, and SCA of line x tester interactions were highly significant for the studied traits, indicating the importance of both additive and non-additive gene action in controlling these traits. The estimates of GCA and SCA effects revealed that the parents and some crosses were having desirable and significantly GCA and SCA effects, respectively. High mean performances and desirable GCA effects values were observed of lines Pima S6, Suvin, G.90, Aust. 12 and tester C.B.58 for investigated traits. The best values of mean performances, SCA effects and heterosis were found in the combinations G.90 x C.B.58 and G.95 x G.86 for fiber traits. These crosses are considered the promising crossed to be used in breeding programs for produce hybrid cotton and improvement for these traits in Egypt.

MATERIALS AND METHODS

The present investigation used eight divergent cotton genotypes as parents. These genotypes are (Giza 90, [(G.83 × G.80) × G.89] × Australy, (G.91 × G.90) × G.80, [(G.83 × G.80) × G.89] × (G.83 × Daltabain 703), Giza 95, TNB I, BBB and 10229.The first five genotypes were used as lines while the late three genotypes were used as testers and all genotypes belong to (G. *barbadense*, L.).

The variety Giza 90 characterized by earliness, high no. of bolls/plant, high yielding ability, high lint percentage, micronaire value is (4.0), pressley index (9.8) and lint length (30.0mm.). The new Promising hybrids [(G.83 × G.80) × G.89] × Australy, (G.91 × G.90) × G.80 and [(G.83 × G.80) × G.89] × (G.83 × Daltabain 703) characterized by high yielding ability, high lint percentage, early maturity and heat tolerance. The cultivar Giza 95 a new long staple cotton characterized by high yielding ability, high lint percentage, early maturity, heat tolerance, micronaire value is (4.2) and lint length (31.2mm.). TNB I an extra-long staple, it characterized by boll weight (2.8g), micronaire value is (3.8), pressley index (11.6) and lint length (33.7 mm.). BBB characterized by big bolland black, boll weight (2.7g), micronair value is (3.1), pressley index (10.4) and length (33.2mm). 10229 characterized by earliness, high lint percentage and low strength.

The present investigation was conducted during two seasons 2018 and 2019 at Sids Agricultural Research Experimental Station, Beni-Suef Governorate, Agricultural Research Center, Egypt.The eight cotton genotypes were involved in a series of hybridization according to line × tester mating design Kempthorne (1957) and detailed by Singh and Chaudhary (1985).

- First season (2018): Eight parental genotypes were sown on the 5th of April, each plot consist of six rows for each line and nine rows for each tester. Each row was four meter long, 0.65 m apart. Seed was sown at 80 cm, the five parental lines were top crossed to each of the three testers to produce 15 F_1 hybrid seeds. Moreover, all parental lines and testers were self-pollinated to obtain additional seeds for each one.

- Second season (2019): The eight parental genotypes with 15 F_1 hybrids were grown at Sids Experimental Station. The experiment was set in a Randomized Complete Blocks Design (R.C.B.D.) with three replications. The plot size was two rows for parents and three rows for F_1 hybrids. Rows were 4.0 m long with row wide of 0.65 m and hills were spaced of 0.40 m apart to give 10 hills /row, and thinned at one plant per hil. The experiment was planted on the 29th of March. All cultural practices were followed throughout the growing season as usually done with ordinary cotton culture.

The following fiber quality and properties were measured by use High Volume Instrument (H.V.I.) according to A.S.T.M.-D-4605-98. The traits were fiber fineness (F.F.) (Mic.), Fiber strength (F.S.) (P.I.), Fiber length (F.L.) (mm) and Uniformity index (U.I.).

RESULITS AND DISCUSSION

Analysis of variance for fiber quality and properties are presented in Table (1). Mean squares due to genotypes (parents and their F_1 hybrids) were highly significant for fiber finances (F.F.), fiber strength (F.S.), fiber length (F.L.) and uniformity index (U.I.). Mean squares due to parents were highly significant for (F.F.), (F.S.), (F.L.) and (U.I.). In addition, mean squares due to crosses were highly significant for (F.F.), (F.S.), (F.L.) and (U.I.) in F_1 hybrids. Mean squares due to parents versus crosses for (F.F.), (F.S.), (F.L.) and (U.I.) were highly significant in F_1 hybrids.

Table 1. Line × tester mean squares of fiber quality and properties.

SOV	df	F.F. (Mic.)	F.S. (P.I.)	F.L. (mm)	U.I.
Replication	**2**	**0.03***	**0.00**	**0.04***	**0.01**
Genotypes	**22**	**0.17****	**0.16****	**2.11****	**1.66****
Parents	**7**	**0.07****	**0.17****	**2.22****	**1.16****
Crosses	**14**	**0.22****	**0.17****	**1.47****	**1.59****
Parents Vs. Crosses	**1**	**0.17****	**0.018****	**10.24****	**6.14****
Lines (L)	**4**	**0.23****	**0.22***	**1.13****	**2.22****
Testers (T)	**2**	**0.74****	**0.32****	**6.27****	**3.08****
Lines × Testers	**8**	**0.08****	**0.11****	**0.45****	**0.90****
Error	**44**	**0.01**	**0.00**	**0.01**	**0.02**

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

Sum squares of crosses using line × tester analysis was further partitioned to lines (females), testers (males) and lines × testers interaction. The results indicated that the mean squares among lines were highly significant for (F.F.), (F.L.) and (U.I.) and for (F.S.) was only significant in F_1 hybrids. Concerning mean squares among testers for (F.F.), (F.S.), (F.L.) and (U.I.) in F_1 hybrids were highly significant. Regarding to lines × testers, mean squares of these interactions were highly significant for (F.F.), (F.S.), (F.L.) and (U.I.) in F_1 hybrids were highly significant.

Mean performance due to parental lines, testers and F_1 hybrids for fiber quality and properties are presented in Table (2) and (3), respectively. Results indicated that the mean performance of the line (L_1) was the best in comparison with the other lines for (F.L.) with the mean value of 31.50 (mm) and the line (L_2) was the best in comparison with the other lines for (F.F.), (F.S.) and (U.I.) with the mean values of 4.23(Mic.), 9.77 (P.I.) and 84.03, respectively. The tester (T_2) was the best tester for (F.L.) with the mean value of 32.63 (mm) and the tester (T_3) was the best tester for (F.F.), (F.S.) and (U.I.) with the mean values of 4.03 (Mic.), 9.90 (P.I.) and 84.93, respectively. On the other hand, the mean performance of the line (L_1) was the lowest line for (F.F.), (F.S.) and (U.I.) with the mean values of 4.50 (Mic.), 9.50 (P.I.) and 83.13, respectively and the line (L_5) was the lowest line for (F.L.) with the mean value of 31.27 (mm). The tester (T_1) was the latest tester for (F.F.), (F.S.), (F.L.) and (U.I.) with the mean values 4.37 (Mic.), 9.23 (P.I.), 31.07 (mm) and 83.43, respectively.

Table 2. Mean performance of the three testers and parental lines for fiber quality and properties.

Genotypes	F.F. (Mic.)	F.S. (P.I.)	F.L. (mm)	U.I.
Giza 90	4.30	9.57	31.50	83.37
[(G.83 × G.80) × G.89] × Australy	4.23	9.77	30.43	84.03
(G.91 × G.90) × G.80	4.50	9.50	30.63	83.13
[(G.83 × G.80) × G.89] × (G.83 × Daltabain 703)	4.43	9.67	30.43	83.60
Giza 95	4.43	9.77	31.27	83.60
TNB I	4.37	9.23	31.07	83.43
BBB	4.20	9.27	32.63	84.53
10229	4.03	9.90	32.47	84.93
L.S.D. 0.05	0.12	0.11	0.22	0.27
L.S.D. 0.01	0.16	0.15	0.31	0.38

(F.F.), (F.S.), (F.L.) and (U.I.) are fiber finances, fiber strength, fiber length and uniformity index, respectively.

Table 3. Mean performance of crosses F_1 for fiber quality and properties.

	Crosses	F.F. (Mic.)	F.S. (P.I.)	F.L. (mm)	U.I.
1	Giza 90 × TNB I	4.17	9.47	31.70	83.77
2	Giza 90 × BBB	3.80	9.77	33.53	85.33
3	Giza 90 × 10229	4.13	9.90	32.70	83.83
4	[(G.83 × G.80) × G.89] × Australy × TNB I	4.47	9.27	30.90	83.70
5	[(G.83 × G.80) × G.89] × Australy × BBB	4.13	9.73	31.90	83.73
6	[(G.83 × G.80) × G.89] × Australy × 10229	4.17	9.03	32.53	85.23
7	(G.91 × G.90) × G.80 × TNB I	4.40	9.50	31.07	84.47
8	(G.91 × G.90) × G.80 × BBB	3.80	9.73	32.03	85.10
9	(G.91 × G.90) × G.80 × 10229	4.37	9.83	32.53	85.20
10	[(G.83 × G.80) × G.89] × (G.83 × Daltabain 703) × TNB I	4.53	9.33	31.47	84.57
11	[(G.83 × G.80) × G.89] × (G.83 × Daltabain 703) × BBB	3.70	9.67	32.67	85.20
12	[(G.83 × G.80) × G.89] × (G.83 × Daltabain 703) × 10229	4.07	9.70	32.77	85.23
13	Giza 95 × TNB I	4.47	9.43	31.70	83.17
14	Giza 95 × BBB	4.40	9.57	32.30	84.40
15	Giza 95 × 10229	4.50	9.30	31.90	83.90
L.S.D. 0.05		0.16	0.12	0.29	0.19
L.S.D. 0.01		0.21	0.16	0.39	0.26

(F.F.), (F.S.), (F.L.) and (U.I.) are fiber finances, fiber strength, fiber length and uniformity index, respectively.

As for crosses, the cross (No. 2) was the highest mean performance in F_1 hybrids for (F.L.) and (U.I.) with values 33.53 (mm) and 85.33, respectively. The cross (No. 3) was the highest mean performance for (F.S.) with value 9.90 (P.I.). The cross (No. 11) in F_1 hybrids was the best mean performance for (F.F.) with value 3.70 (Mic.). On the other hand, the cross (No. 4) was the lowest mean performance for (F.L.) with value 30.90 (mm). While, the cross (No. 6) was the lowest mean performance for (F.S.) with value 9.03(P.I.). The cross (No. 10) was the lowest mean performance for (F.F.) with value 4.53 (Mic.). While, the cross (No. 13) was the lowest mean performance for (U.I.) with value 83.17.

Estimates of heterosis relative to the mid-parents and better parent for fiber quality and properties are presented in Table (4). The percentage of heterosis relative to mid-parent and better parent of the cross (No. 2) recorded the best heterosis (desirable) relative to mid-parent and better parent for (F.S.), (F.L.) and (U.I.)with values (3.71 and 2.09), (4.57 and 2.75) and (1.64 and 0.94%), respectively. The crosses (No. 2 and 11) had recorded the best heterosis (desirable) relative to mid-parent and better parent for (F.F.) with values (-10.59 and -9.52) and (-14.29 and -11.90%), respectively.

Table 4. Estimates of heterosis (H.%) relative to the mid-parent (M.P.) and better parent (B.P.) for fiber quality and properties.

Crosses		F.F. (Mic.)		F.S. (P.I.)		F.L. (mm)		U.I.	
		M.P.	B.P.	M.P.	B.P.	M.P.	B.P.	M.P.	B.P.
1	Giza 90 × TNB I	-3.85**	-3.10	0.71	-1.05	1.33**	0.63*	0.43**	0.39**
2	Giza 90 × BBB	-10.59**	-9.52**	3.71**	2.09**	4.57**	2.75**	1.64**	0.94**
3	Giza 90 × 10229	-0.80	2.48	1.71**	0.00	2.24**	0.71**	-0.38**	-1.30**
4	[(G.83 × G.80) × G.89] × Australy × TNB I	3.87**	5.51**	-2.46	-5.12	0.48*	-0.54*	-0.04	-0.40**
5	[(G.83 × G.80) × G.89] × Australy × BBB	-1.98	-1.59	2.27**	-0.34	1.16**	-2.25**	-0.65**	-0.95**
6	[(G.83 × G.80) × G.89] × Australy × 10229	0.81	3.31	-8.14	-8.75	3.44**	0.21	0.88**	0.35**
7	(G.91 × G.90) × G.80 × TNB I	-0.75	0.76	1.42**	0.00	0.70**	0.00	1.42**	1.23**
8	(G.91 × G.90) × G.80 × BBB	-12.64**	-9.52**	3.73**	2.45**	1.26**	-1.84**	1.51**	0.67**
9	(G.91 × G.90) × G.80 × 10229	2.34	8.26**	1.37**	-0.67	3.11**	0.21	1.38**	0.31*
10	[(G.83 × G.80) × G.89] × (G.83 × Daltabain 703) × TNB I	3.03*	3.81*	-1.23	-3.45	2.33**	1.28**	1.25**	1.15**
11	[(G.83 × G.80) × G.89] × (G.83 × Daltabain 703) × BBB	-14.29**	-11.90**	2.11**	0.00	3.59**	0.10	1.34**	0.78**
12	[(G.83 × G.80) × G.89] × (G.83 × Daltabain 703) × 10229	-3.94**	0.83	-0.85	-2.02	4.18**	0.92**	1.14**	0.35**
13	Giza 95 × TNB I	1.52	2.29	-0.70	-3.41	1.71**	1.38**	-0.42**	-0.52**
14	Giza 95 × BBB	1.93	4.76**	0.53	-2.05	1.09**	-1.02**	0.39**	-0.16
15	Giza 95 × 10229	6.29**	11.57**	-5.42	-6.06	0.10	-1.75**	-0.44**	-1.22**
L.S.D. 0.05		0.12	0.14	0.10	0.11	0.13	0.16	0.18	0.21
L.S.D. 0.01		0.16	0.18	0.13	0.15	0.18	0.21	0.25	0.28

(F.F.), (F.S.), (F.L.) and (U.I.) are fiber finances, fiber strength, fiber length and uniformity index, respectively.

The results emphasize that the best cross was (No. 2) for all studied fiber quality and properties. Therefore, this cross combination is considered the desirable materials in breeding programs for improvement these traits. These results are in common agreement with the results mentioned by Hussein (2017) and Monicashree *et al* (2017).

General combining ability effects (g_i) of the parents in F_1 hybrids for fiber quality traits are shown in Table (5). Results noted that the estimates of (G.C.A.) for (F.F.) were negative and highly significant and for traits (F.S.) and (F.L.) were positive and highly significant in line (L_1) in F_1 hybrids. In addition, the estimates of (G.C.A.) for (U.I.) were positive and highly significant in line (L_4). Estimates of (G.C.A.) for (F.F.) were negative and highly significant and for (F.L.), (F.S.) and (U.I.) were positive and highly significant in tester (T_2) in F_1 hybrids.

Table 5. General combining ability effects (gi) of four parental lines and three testers in F1 for fiber quality and properties.

Genotypes	F.F. (Mic.)	F.S. (P.I.)	F.L. (mm)	U.I.
Giza 90	-0.17**	0.16**	0.53**	-0.14**
[(G.83 × G.80) × G.89] × Australy	0.05	-0.20**	-0.33**	-0.23**
(G.91 × G.90) × G.80	-0.02	0.14**	-0.23**	0.46**
[(G.83 × G.80) × G.89] × (G.83 × Daltabain 703)	-0.11**	0.02	0.18**	0.54**
Giza 95	0.24**	-0.12**	-0.14**	-0.63**
C.D. 0.05	0.06	0.05	0.06	0.09
C.D. 0.01	0.08	0.06	0.09	0.12
TNB I	0.20**	-0.15**	-0.74**	-0.52**
BBB	-0.24**	0.14**	0.37**	0.29**
10229	0.04	0.01	0.37**	0.22**
C.D. 0.05	0.04	0.04	0.05	0.07
C.D. 0.01	0.06	0.05	0.07	0.09

(F.F.), (F.S.), (F.L.) and (U.I.) are fiber finances, fiber strength, fiber length and uniformity index, respectively.

C.D. is critical difference at 0.05 and 0.01 levels of probability, respectively.

It could be concluded from the previous data that the line (L_1) and tester (T_2) were the best combiner for (F.F.), (F.S.), (F.L.) and (U.I.).

Specific combining ability effects (s_{ij}) of the parents in F_1 hybrids for fiber quality and properties are presented in Table (6). Results showed that the estimates of specific combining ability (S.C.A.) effects for (F.F.) the cross (No. 11) had displayed negative and highly significant. For (F.S.) in F_1 hybrids the crosses (No. 3 and 5) had displayed positive and highly significant. In addition, for (F.L.) and (U.I.) the crosses (No. 2 and 6) had recorded positive and highly significant in F_1 hybrids. Results concluded that the cross (No. 13) had displayed negative and highly significant for (F.F.) and for the traits (F.S.) and (F.L.) had showed positive and highly significant.

Table 6. Estimates of specific combining ability effects (Sij) of each cross for fiber quality traits.

	Crosses	F.F. (Mic.)	F.S. (P.I.)	F.L. (mm)	U.I.
1	Giza 90 × TNB I	-0.07	-0.10*	-0.20**	-0.02
2	Giza 90 × BBB	0.01	-0.09*	0.51**	0.72**
3	Giza 90 × 10229	0.06	0.18**	-0.32**	-0.70**
4	[(G.83 × G.80) × G.89] × Australy × TNB I	0.01	0.07	-0.13*	-1.42**
5	[(G.83 × G.80) × G.89] × Australy × BBB	0.11*	0.24**	-0.25**	-0.78**
6	[(G.83 × G.80) × G.89] × Australy × 10229	-0.13*	-0.32**	0.38**	0.78**
7	(G.91 × G.90) × G.80 × TNB I	0.01	-0.04	-0.06	0.06
8	(G.91 × G.90) × G.80 × BBB	-0.15**	-0.10*	-0.22**	-0.12
9	(G.91 × G.90) × G.80 × 10229	0.13**	0.13**	0.28**	0.05
10	[(G.83 × G.80) × G.89] × (G.83 × Daltabain 703) × TNB I	0.23**	-0.08*	-0.09	0.08
11	[(G.83 × G.80) × G.89] × (G.83 × Daltabain 703) × BBB	-0.16**	-0.04	-0.01	-0.09
12	[(G.83 × G.80) × G.89] × (G.83 × Daltabain 703) × 10229	-0.07	0.12**	0.09	0.01
13	Giza 95 × TNB I	-0.19**	0.14**	0.48**	-0.13
14	Giza 95 × BBB	0.18**	-0.01	-0.04	0.27**
15	Giza 95 × 10229	0.00	-0.14**	-0.44**	-0.14
C.D. 0.05		0.10	0.08	0.11	0.15
C.D. 0.01		0.13	0.11	0.15	0.20

(F.F.), (F.S.), (F.L.) and (U.I.) are fiber finances, fiber strength, fiber length and uniformity index, respectively.
C.D. is critical difference at 0.05 and 0.01 levels of probability, respectively.

From the previous results it could be concluded that the previse crosses had the best (S.C.A.) effects for (F.F.), (F.S.), (F.L.) and (U.I.) These results are in common agreement with the results mentioned by Swetha *et al* (2018), Isong *et al* (2019), Shahzad *et al* (2019) and Yehia and El-Hashash (2019).

Estimates of heritability in broad ($h^2_{b.s.}$ %) and narrow sense ($h^2_{n.s.}$ %) and genetic components for fiber quality and properties are presented in Table (7). The results clarified that the mean square of general combining ability were lower than those of specific combining ability for Fiber quality and properties. The results cleared that the ratio of (G. C.A. / S.C.A.) was noticed to be low for Fiber quality and properties, indicated that specific combining ability was more important than general combining ability.Thus, the non-additive (σ^2D) genetic variance of these traits were larger than those the additive (σ^2A) genetic variance.

Table 7. Combining ability and genetic components as well as estimates of heritability in broad (h2b.s.%) and narrow sense (h2n.s.%) for fiber quality traits.

Estimates	F.F. (Mic.)	F.S. (P.I.)	F.L. (mm)	U.I.
σ2 G.C.A.	0.005	0.002	0.036	0.024
σ2 S.C.A.	0.027	0.038	0.148	0.296
σ2 G.C.A. / σ2 S.C.A.	0.179	0.057	0.246	0.082
σ2 A	0.010	0.004	0.073	0.049
σ2 D	0.027	0.038	0.148	0.296
$h^2_{b.s.}$%	84.024	89.903	96.116	95.441
$h^2_{n.s.}$%	22.112	9.230	31.699	13.503

(F.F.), (F.S.), (F.L.) and (U.I.) are fiber finances, fiber strength, fiber length and uniformity index, respectively.

Results claimed that the estimates of broad sense in F_1 hybrids for (F.F.), (F.S.), (F.L.) and (U.I.) were high with values 84.024, 89.903, 96.116 and 95.441%, respectively. Results noticed that the estimates of narrow sense in F_1 hybrids for (F.F.), (F.S.), (F.L.) and (U.I.) were low to moderate with values 22.112, 9.230, 31.699 and 13.503%, respectively.

These results are in common agreement with the results mentioned by El-Said (2016) and Khalifa *et al* (2016).

CONCLUSIONS

Variance due to the genotypes, parents, crosses, parent vs cross, lines, testers and line × tester exhibited highly significance for most fiber quality and properties. Line × tester interaction contributed to combination variances was higher than those of lines and testers for most studied traits. Based on S.C.A. effects and heterosis and mean performance values, the superior crosses were the two crosses Giza 90 × TNB I and Giza 95 × TNB I for most fiber quality and properties. These hybrids are considered the promising crosses to be used in breeding programs for produce hybrids cotton and improvement for fiber quality and properties.

REFERENCES

A.S.T.M. (1998). American Society for Testing and Materials. Designation, D-4605-98 and D-3818-98 Philadelphia., Pa, USA.

El-Said, E.Y.E. (2016). Genetical analysis for some agronomical and technological characters of cotton (*Gossypium barbadense* L.).M.Sc. Thesis, Fac. Agric., Sohag Univ., Egypt.

Khalifa, H.S, S.R.N. Said and A.E.M. Eissa (2016). Diallel analysis on some Egyptian cotton genotypes for earliness, yield components and some fiber traits. Egypt. J. Plant Breed. 20(1):11-25.

Hussein, H.K. (2017). Genetic studies on yield, yield components and fiber quality in Egyptian cotton (*Gossypium barbadense*, L).M.Sc. Thesis, Fac. Agric., Minia Univ., Egypt.

Isong, A., A. Balu, C. Isong and E. Bamishaiye (2019). Estimation of heterosis and combining ability in interspecific cotton hybrids. Electronic Journal of Plant Breeding, 10 (2): 827-837.

Kempthorne, O. (1957). An Introduction to Genetic Statistics. Iowa state Univ. John Wiley and Sons Inc. New York, USA.

Monicashree, C., P. A. Balu and M. Gunasekaran (2017). Combining Ability and Heterosis Studies on Yield and Fibre Quality Traits in Upland Cotton (*Gossypium hirsutum* L.). Int.J.Curr.Microbiol.App.Sci. 6(8): 912-927.

Shahzad M.T., F. Ijaz, O. Khan, B. Saleem and U. Hassan (2015). Correlation, Path Analysis and Heritability Among Some Yield and Fibre Related Traits of (*Gossypium hirsutum,* L.). Cotton Genomics and Genetics. 6(4):1-7.

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

Steel, R.G.D. and J.H. Torrie (1980). Principles and Procedures of Statistics. Second Edition, McGraw Hill Book Company Inc., New York.

Swetha, S., J.M. Nidagundi, J.R. Diwan, R. Lokesha, A.C. Hosmani and A. Hadimani (2018). Combining ability studies in cotton (*Gossypium barbadense*, L). J. of Pharmacognosy and Phytochemistry. 7(1): 638-642.

Yehia, W.M.B. and E.F. El-Hashash (2019). Combining ability effects and heterosis estimates through line x tester analysis for yield, yield components and fiber traits in Egyptian cotton. Journal of Agronomy, Technology and Engineering Management. 2(2): 248-262.

القدرة على التآلف وقوة الهجين ودرجة التوريث لخصائص جودة الألياف لهجن القطن المصرى

شكرى عبدالسلام مقدم[١]، منصور عبدالمجيد سالم[١]، حسين صلاح خليفة[٢]

و طاهر محمد السيد سالم[٢]

١. قسم المحاصيل – كلية الزراعة – جامعة المنيا – مصر.

٢. قسم تربية القطن – معهد بحوث القطن – مركز البحوث الزراعية – الجيزة – مصر.

أجريت هذه الدراسة بمحطة البحوث الزاعية بسدس والتابعة لمركز البحوث الزراعية والتى تقع بمحافظة بنى سويف بجمهورية مصر العربية فى موسمى ٢٠١٨ و ٢٠١٩ و استخدم فيها ثمانية تراكيب وراثية مختلفة من القطن تتبع النوع الباربادنس، وقد استخدم تحليل السلالة × الكشاف لدراسة القدرة على التالف فيما بينها ، وكذلك قوة الهجين ودرجة التوريث وكانت اهم النتائج كما يلى: أوضحت النتائج أن تباينات الآباء وهجن الجيل الأول كانت عالية المعنوية لصفات نعومة ومتانة وطول التيلة ومعامل الانتظام. أظهرت النتائج أن تباين السلالات × الكشافات كانت عالية المعنوية لجميع الصفات المدروسة. أشارت النتائج إلى أن الهجين جيزة ٩٠ × BBB أفضل الهجن لصفات طول التيلة ومعامل الانتظام . علاوة على ذلك كان الهجين رقم جيزة ٩٠ × ١٠٢٢٩ أعلى متوسط أداء بالنسبة لصفة متانة التيلة أما الهجين [(جيزة ٨٣ × جيزة ٨٠) × جيزة ٨٩] × (جيزة ٨٣ × دلتابابن ٧٠٣) × BBB الأفضل لصفة نعومة التيلة. خلُصت النتائج الى أن الهجينين جيزة ٩٠ × TNB I و جيزة ٩٥ × TNB I أفضل الهجن بالنسبة لمعظم صفات جودة التيلة. ومن خلال هذة الدراسة يمكن استخدام السلالات والكشافات التى أظهرت قدرة عالية على التالف فيما بينها فى برامج التربية لإنتاج هجن جديدة ذات صفات جودة افضل للتيلة وايضا لتوسيع القاعدة الوراثية.