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Evaluation of some Intraspecific Cotton Crosses for some Quantitative Characters at Three Locations

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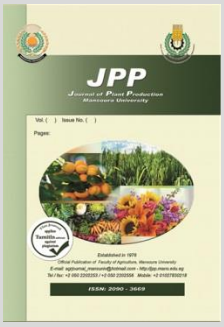

ABSTRACT

The objectives of this study were to determine the heterosis, combining abilities, proportional contributions, genetic components and heritability measurements of some yield, its components and fiber quality characters for six genotypes belong to *Gossypium barbadense*, L *viz.*, Giza 95 (L_1), Giza87 (L_2), and Giza93 (L_3), which used as a parental lines (L) as well as, Suvin (T_1), Karshenky (T_2), and 10229 (T_3) which used as a testers (T), by using line x tester analysis (LxT) across three locations i.e. Sakha, Sids and Shandweel during 2017 and 2018 seasons. The variances due to the genotypes, locations (Loc.), parents (P), crosses (C), (P vs. C), L, T, (parents x loc.) and (P vs. C x loc.) were significant for most traits under study. Among the parents, Giza 95 (L_1) and Karshenky (T_2) were highest yielding parents for most studied yield traits, Giza 87 (L_2) and Suvin (T_1) for most studied fiber traits. According to useful heterosis and desirable specific combining ability effects estimations, the promising recombination's i.e., (L_1xT_1), (L_2xT_2), (L_3xT_1), (L_3xT_2) and (L_3xT_3) were the highest values for most studied traits. Proportion contribution of testers were the high values for No. of bolls/plant, seed cotton yield per plant, boll weight and fiber strength traits. Meanwhile, lines contributions were the highest for other traits. The non-additive genetic effect was larger than additive ones for NB/P, SCY/P, LY/P and length uniformity index. Meanwhile, heritability in broad sense (h^2_b %) were higher than the values of narrow sense (h^2_n %) for all characters under study.

Keywords: Barbadense cotton, Combining ability, Heterosis, Gene action and Heritability.

INTRODUCTION

The main goal in cotton breeding is looking and selecting the genotypes with high yield and quality traits, substantial work has been carried out to increase the yield and fiber quality of Egyptian cotton. However, selection of parents based on *per se,* adaptation and genetic diversity does not lead necessarily to desirable results. This is due to the differential ability of the parents, which depended on complex interactions among the genes and its difficult judged by their mean performance alone, Allard (1960). Also, parents, who perform well in the new recombination, are very important in the breeding program of Egyptian cotton. The information about relative magnitude of genetic variance and combining ability with respect to traits of economic importance is essential for exploitation of the existing gene action in the population. Thus, Egyptian cotton breeders seek the most appropriate materials for breeding and the way to present clearly the results of experimental scientific studies.

Estimation of combining ability can be used to determine the usefulness of the parents in hybrid combinations and to develop best hybrid adaptable to the different environments, Sprague and Tatum (1942). Both general (GCA) and specific (SCA) combining ability have a significant impact on evaluation of genotypes and population improvement.

Maximizing of heterosis magnitude can be done if the parents which used in hybridization are genetically varied .Exploiting heterosis is one of the methods to improvement yield and fiber quality traits in cotton. Kumar (2008) stated that to maximize heterosis, there is a need for utilizing breeding programs aimed at constantly creating variability and increasing genetic diversity between populations that can further be exploited through selection for combining ability between such diverse populations. Also heterosis can be enhanced by increasing dominant gene action. It is difficult to precisely detect and manipulate the degree of dominant gene action while selecting, based on phenotypic measurements, for high heterosis. However, it is possible to create and improve heterotic populations against a tester or reciprocally develop diverse populations which differ for the alleles at a large number of yield influencing loci (showing dominance).

Different methods have been applied to improve the selection of genes controlling the useful agronomic traits. The most used breeding designs are diallel, line × tester, test crosses, bi-parental and multiple crosses designs Nduwumuremyi *et al*. (2013). The major purpose of these designs is to estimate the combining abilities of experimental crosses and parental lines as well as understanding the heredity of the studied characters Sharma (2006).

Line × tester analysis is a common approach for assessing the expression of genetic aspects of traits, especially when is an extension (modified version) of top cross method in which several testers are used. Kempthorne (1957), which provides information about GCA and SCA of parents and at the same time it is helpful in identifying best heterotic crosses. Also, line × tester analysis provides information about regarding genetic mechanism controlling yield and yield components. The

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most important merit of this approach is that it enables evaluation with less experimental materials compared to other mating designs. The line x tester design has been used in studies about yield and its components as well as fiber quality properties in cotton. The most important merit of this approach is that it enables evaluation with less experimental materials compared to other mating designs. The line x tester design has been used in studies about yield, its components and fiber quality properties in cotton. However, many researchers were reported that such as Karademir *et al.* (2016), Usharani *et al.* (2016), Chinchane *et al.* (2018), Khokhar *et al.* (2018), Patel and Patel (2018), Prakash *et al.* (2018) and Rajeev and Patil (2018).

In this respect, AL-Hibbiny (2011) cleared that the significantly positive heterotic values over mid-parents were observed for fiber strength and fiber length. While, significantly negative heterosis (useful) values versus mid-parents were detected for fiber fineness. The following crosses were developed the significant values i.e., the cross; Giza 90 x Australian for fiber length and fiber strength, the following crosses; Giza 86 x Australian, Giza 86 x Pima S_7 and Giza 45 x Pima S_7 were exhibit useful heterosis over better-parents for most fiber traits. Also, highest and significant values were possessed by the cross; (Giza 90 x Australian) for upper half mean and pressely index and both (Giza 86 x Australian) and (Giza 86 x Pima S_7) crosses for micronaire reading over the three studied locations and its combined data. EL-Fesheikawy *et al.* (2012) stated that heterosis over both mid- (MP) and better (BP) parents were significant or highly significant for all studied traits. They added that values of heterosis for fiber quality characters were usually lower than yield and yield components traits, but it’s important for the textile industry. AL-Ameer (2015) study heterosis in cotton and indicate that the F_1 cross in one or more traits over its parents, and conduct to distinction in acclimation, generally positive heterosis is considered as coveted to all studied characters unless fiber fineness. Heterosis over both better and mid-parents for most cases were detected. Mabrouk *et al.* (2018) results revealed that the variances of the genotypes, parents and crosses were significant for Bolls / plant, seed and lint cotton yield/plant, lint % and uniformity index characters. The mean squares due to GCA were significant for Bolls/plant, seed and lint cotton yield / plant and lint %, as well as mean squares of SCA were significant for all previous traits except lint % . Recently, Balcha *et al.* (2019) estimate of variance analysis and showed that, presence of significant differences among genotypes for all studied traits except uniformity index, GCA(lines) was significant for all traits, while SCA was significant for number of bolls/plant, seed and lint cotton yield and fiber strength. Performing lines for lint yield and related traits followed by crossing with testers is possible to obtain commercial cotton hybrids. Also, Yehia and EL-Hashash (2019) reported that genotypes, parents (P), crosses(C) and (P *vs.* C) variances exhibited significantly differences ($P<0.01$) for most studied characters. The variances due to GCA of parents, and SCA crosses were significant for most traits under study, indicating the importance of both additive and non-additive gene actions in controlling these traits. Line × tester proportional contribution was greater than individual contribution of both lines and testers for most traits under study.

The objective of this study was evaluate 15 genotypes (6 parents and 9 hybrids) at three locations i.e., Sakha, Sids and Shandweel in two successive seasons 2017 and 2018 and determine combining ability, gene action ,heterosis, and heritability for yield and its components as well as fiber quality properties.

MATERIALS AND METHODS

In 2017 (first season), nine single crosses between six parental varieties were made by using the three Egyptian cotton cultivars as lines (Females), Giza 95 (L_1), Giza 87 (L_2) and Giza 93 (L_3). While, the three remaining genotypes were used as testers (males) i.e., Suvin (T_1) (Indian variety), Karshenky (T_2) (Russian variety) and 10229 (T_3) (Australian strain) to produce nine F_1's seeds .The parental genotypes were also selfed to obtain more seeds. 15 genotypes (nine single hybrids and six parents) were evaluated in the second season (2018) at three locations i.e., Sakha, Sids and Shandweel which located at Kafr El-Sheikh, Beni-suef and Sohag governorates, respectively. Each experiment was randomized complete block design with three replications to evaluate the 15 genotypes. Each block therefore, contained 15 plots. Experimental plots were two ridges /plot; 4 m long and 0.60 m wide. Hills were spaced 0.40 m apart and one plant/hill was kept after thinning at seedlings stage. Ordinary cultural practices and pests control were followed as the recommendations.

Data involved in this study were as follows:

A-Yield components characters are:

- Number of bolls/plant (NB/P)
- Seed cotton yield/plant (SCY/P.g.)
- Lint cotton yield/plant (LCY/P.g.)
- Lint percentage (L %)
- Boll weight (BW.g.)
- Seed index (SI g.)
- Lint index (LI.g.)

B-Fiber properties characters are:

- Micronaire reading (fiber fineness) (FF).
- Fiber strength (pressely index) (FS).
- Uniformity index (UI).
- Fiber length(FL) (upper half mean mm)

The fiber properties tests were analyzed in the laboratories of the Cotton Technology Research Division at Giza, Cotton Research Institute to determine fiber quality, under controlled conditions of 65 ± 2% of relative humidity and 70 ± 2°F temperatures for all samples. Fiber properties were measured by using High Volume Instrument (HVI) according to A.S.T.M. D-4605(1986).

Statistical analysis:

Line x tester analysis first step is to perform variance analysis and test differences significance among 15 genotypes including crosses and parents. If these differences are found significant, line x tester analysis was performed Singh and Chaudhary (1979). Kempthorne (1957) reported that, using broad base genotypes as a tester; the general combining of lines is tested as in the top cross method. In addition, line x tester analysis is an extension of this method in which several testers are used. In order to evaluate the materials used in this study, both of genotypes means (per se) and variances for studied characters were computed. Statistical procedures were done according to Cochran and Cox (1957). Differences among means were compared by using the Least Significant Differences (L.S.D.) test as given by Steel and Torrie (1980). Heritability in both broad (h^2_b %) and narrow (h^2_n %) senses was computed from two formulas outlined by Allard (1960) and Mather (1949).

RESULTS AND DISCUSSION

Analysis of variance:

Mean squares and variance analysis of yield and its components as well as fiber quality traits under study for combined analysis at three locations for all genotypes are showed in Table (1). Results revealed significant differences between genotypes, crosses, parents *vs.* crosses, lines and parents vs. crosses x locations for all studied traits, except for Bolls/plant, seed index and fiber length in the crosses and lines, fiber fineness in the parents vs. crosses and uniformity index in the parents vs. crosses x locations. Mean squares due to locations, parents, testers and parents x locations were significant for most traits under study. Genotypes x locations mean square were significant for seed and lint cotton yield / plant, boll weight and fiber length .On the other hand, Line x Tester had significant for lint %. Also, mean square for crosses x locations were significant for lint %, lint index, fiber length, fiber strength and fiber fineness, while the mean squares for lines x locations were significant for lint %, seed and lint indices, fiber strength and fiber fineness. However, significant mean squares due to testers x locations for all fiber quality traits except uniformity index, while the mean squares for Line x Tester x locations interaction were non-significant for all traits under study. Usharani *et al*. (2016) reported that, both GCA variances due to lines and testers and SCA variances due to lines x testers interaction were significant for all studied characters.

Table 1. Analysis of variance of line x tester for all genotypes of yield, its components and fiber properties over combined analysis at three locations.

SOV	df	NB/P	SCY/P	LCY/P	L.%	BW	SI.
Replicate	2	101.03	1369.41	177.57	0.63	0.07	0.28
Locations (Loc.)	2	292.61**	2728.60**	398.27**	0.77	0.12*	0.07
Genotypes (G.)	14	285.93**	6408.21**	1275.06**	15.08**	0.43**	20.00**
Parents (P.)	5	48.82	683.83	164.27	0.99	0.10*	2.70**
Crosses (C.)	8	59.58	1146.73*	249.80**	33.90**	0.07	2.81**
P. v. C.	1	613.55**	17312.01**	3130.49**	23.64**	0.91**	57.36**
Lines (L.)	2	63.02	1598.03*	458.07**	33.92**	0.09	7.10**
Testers (T.)	2	88.16	1936.21*	333.66*	15.95**	0.08	3.22**
L. × T.	4	43.58	526.34	103.74	55.33**	0.06	0.46
G. × LOC.	28	61.69	838.28*	130.85*	0.79	0.08**	1.25
P. × LOC.	10	34.11	203.81	2.48	3.45**	0.03	5.72**
C. × LOC.	16	6.78	232.29	75.12	1.60**	0.02	1.40
P. v. C × LOC.	2	320.94**	14583.42**	2732.21**	6.44**	0.78**	57.29**
L. × LOC.	4	114.79	565.28	29.90	5.50**	0.02	3.51**
T. × LOC.	4	102.23	396.19	32.31	0.12	0.02	1.57
L. × T. × LOC.	8	51.36	418.98	47.70	0.13	0.00	0.21
Error	88	51.15	515.57	76.76	0.76	0.04	0.14
		LI	FL	FS	FF	UI	
Replicate	2	0.02	0.07	0.01	0.04	0.27	
Locations (Loc.)	2	0.05	0.12*	0.31**	0.05	1.13	
Genotypes (G.)	14	3.64**	0.43**	2.04**	1.95**	8.48**	
Parents (P.)	5	0.56**	0.10*	0.99**	0.85**	4.49**	
Crosses (C.)	8	0.84**	0.07	0.37**	0.60**	1.51*	
P. v. C.	1	7.41**	0.91**	1.59**	0.001	5.03**	
Lines (L.)	2	2.70**	0.09	0.59**	1.44**	2.96*	
Testers (T.)	2	0.48*	0.08	0.75**	0.87**	1.34	
L. × T.	4	0.10	0.06	0.07	0.05	0.87	
G. × LOC.	28	0.11	0.08**	0.10	0.03	0.55	
P. × LOC.	10	0.27*	3.59**	0.43**	0.41**	2.02**	
C. × LOC.	16	0.42**	1.74**	0.15**	0.30**	0.61	
P. vs. C. × LOC.	2	7.36**	6.98**	1.28**	0.10*	1.39	
L. × LOC.	4	1.32**	4.28	0.14*	0.70**	0.92	
T. × LOC.	4	0.22	2.05**	0.22**	0.41**	0.10	
L. × T. × LOC.	8	0.04	0.02	0.05	0.01	0.15	
Error	88	0.14	0.04	0.05	0.03	0.71	

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

Genotypes mean performance (*Per se*):

The mean performances of the six parents and their 9 F1's hybrids for all studied characters across data at three locations are presented in Table (2). Giza 95 (L_1) possessed the highest means for all yield and its components traits except seed index. Giza 87 (L_2) had the best values for all fiber traits except fiber fineness. Meanwhile, Giza 93 (L_3) gave the best *per se* for seed index and micronaire reading (FF). For testers, Suvin (T_1) recorded best means for all fiber traits, Karshenky (T_2) achieved the best values for all yield traits except lint percentage and 10229 (T_3) gave the highest means for lint%. With respect to the crosses, best means were found as follow; the cross (G. 95 x Karshenky) for all yield traits, (G. 87 x Suvin) for upper half mean

(FL), (G. 87 x 10229) for uniformity index, (G. 93 x Suvin) for fiber strength and fiber fineness.

In general, Giza 95 and Karshenky cultivars can be used for improve yield characteristics in breeding programs. In the same time, Giza 87 and Suvin cultivars can be used for improvement of fiber quality. These results generally correspond with the findings of AL-Hibbiny (2011) and EL-Fesheikawy *et al*. (2012)

Table 2. Mean performances of all genotypes of yield, its components and fiber properties for combined analysis at three locations.

		NB/P	SCY/P	LCY/P	L. %	BW	SI.
Lines :							
Giza 95		44.84	150.12	61.62	41.01	3.36	9.80
Giza 87		42.66	127.38	47.70	37.50	3.00	9.63
Giza 93		35.30	113.63	42.41	37.33	3.22	10.37
Testers :							
Suvin		42.81	124.52	46.96	37.80	2.90	9.63
Karshenky		47.29	151.64	58.82	38.90	3.20	10.43
10229		43.73	128.39	51.57	40.30	2.93	9.73
LSD	0.05	6.84	22.12	8.30	0.77	0.21	0.37
	0.01	9.21	29.78	11.18	1.04	0.28	0.49
F_1 hybrids							
Giza 95 x Suvin		51.09	181.28	74.34	40.99	3.55	10.87
Giza 95 x Karshenky		57.93	206.34	84.74	41.07	3.56	11.48
Giza 95x 10229		48.41	163.63	66.18	40.48	3.38	10.88
Giza 87 x Suvin		46.74	151.50	57.39	37.90	3.24	10.23
Giza 87 x Karshenky		48.99	171.77	66.87	38.97	3.52	10.74
Giza 87 x 10229		46.35	150.36	58.56	38.89	3.25	10.32
Giza 93 x Suvin		44.54	153.69	60.14	39.14	3.45	10.86
Giza 93 x Karshenky		54.05	190.12	74.73	39.30	3.53	11.05
Giza 93 x 10229		54.69	185.18	73.89	39.86	3.39	11.01
LSD	0.05	5.92	19.16	7.19	0.67	0.18	0.32
	0.01	7.97	25.79	9.68	0.90	0.24	0.43

Table 2. Cont.

		LI	FL	FS	FF	UI
Lines :						
Giza 95		6.82	30.54	9.14	4.73	83.09
Giza 87		5.78	35.12	10.64	3.66	85.31
Giza 93		6.18	33.98	10.49	3.51	85.16
Testers :						
Suvin		5.86	32.72	10.20	3.52	86.40
Karshenky		6.64	32.47	9.52	4.52	85.88
10229		6.57	32.16	10.00	3.83	86.32
LSD	0.05	0.37	0.60	0.25	0.17	0.80
	0.01	0.49	0.81	0.33	0.22	1.07
F_1 hybrids						
Giza 95 x Suvin		7.55	33.44	10.39	4.09	86.40
Giza 95 x Karshenky		8.01	31.82	9.64	4.58	84.63
Giza 95x 10229		7.40	32.29	10.24	4.52	85.11
Giza 87 x Suvin		6.25	35.14	10.66	3.57	86.20
Giza 87 x Karshenky		6.86	33.30	10.34	4.36	86.33
Giza 87 x 10229		6.58	33.82	10.44	3.84	86.72
Giza 93 x Suvin		6.99	34.79	10.80	3.36	86.70
Giza 93 x Karshenky		7.29	33.96	10.19	3.94	86.02
Giza 93 x 10229		7.31	34.49	10.74	3.50	86.26
LSD	0.05	0.32	0.52	0.21	0.14	0.69
	0.01	0.43	0.70	0.29	0.19	0.93

Heterosis:

Heterosis estimates of hybrid combinations over both mid-parents (MP) and better-parents (BP) for yield, its components and fiber quality characters for combined analysis at three locations are shown in Tables (3) and (4), respectively. All hybrid combinations for yield and its components were significantly positive useful heterotic values over MP except crosses; (Giza 95 x 10229 and Giza 87 x 10229 for seed cotton yield/plant and lint %) and (Giza 87 x Suvin for lint %), while relative to BP the crosses 5, 4, 8, 1 and 8 out of the 9 F_1 crosses possessed significantly and positively desirable heterosis for NB/P, SCY/P, LY/P, L. % and LI, respectively. Meanwhile, boll weight and seed index were significantly positive useful heterotic values for all crosses. For fiber properties heterosis versus MP; the 8, 9 and 4 crosses out of the 9 F_1 hybrid combinations was significantly positive useful heterosis for FL, FS and UI, respectively, while six crosses were negative and significant (useful) heterosis for FF, also relative to heterosis versus better-parents the 3 and 5 crosses out of the 9 F_1 crosses was positive and significant useful heterosis for FL and FS, respectively, while two crosses were negative and significant useful heterosis for FF. However, EL-Fesheikawy *et al*. (2012) indicated that the promising crosses showed the highest values of Heterosis relative to MP were (T_2xL_5) for SCY/P (79.7%), LY/P (13.0%), B/P(62.3%) and for LI(11.4%), (T_2xL_3) for BW (84.5%), (T_1xL_5) for L. % (3.6), UHM (8.9%) and for UI (2.6%), (T_2xL_4) for SI (13.8%), (T_1xL_2) for FS (7.0%) and (T_1xL_4) for FF which showed negative significant Heterosis value (-4.7%) indicating greater the micronaire value, lower is the fineness. As regards the promising crosses which exhibited the highest values of B.P Heterosis were as follow, (T_2xL_5) for SCY/P (56.2%), LY/P (13.3%), B/P (57.4%) and for FF(-8.0%),(T_2xL_3) for BW (65.9%) , (T_2xL_4) for seed (11.3%) and for lint (8.3%)indices, (T_1xL_2) for FS (5.7%) and the cross (T_1xL_3) for FL (3.4%), indicating that hybridization would improve cotton production and fiber quality. Sorour *et al*. (2013) found that positive heterotic effects for mid-parents were found for most of the traits in the crosses (10229 x G.86) x G.45, G.45 x Suven, G.45 x G.70, TNB x G.70 and C.B 58 x G.93. Also, positive heterotic effects relative to the better parent were found for most of the traits in the crosses (10229 x G.86) x TNB, G.45 x Suven and G.45 x G.70 over two planting dates and their combined. AL-Ameer (2015) showed that the following crosses were evidenced the best values of heterosis relative to better and mid-parents i.e., crosses; TNB x Giza 85 and CB-58 x Giza 85 for most studied characters. Mahrous (2018) the results of heterosis noticed that 7 crosses had positive and highly significant heterosis in seed and lint cotton yield /plant and number of bolls/plant i.e., (Giza 80 x Giza 90), (G.86 x G.90), (G.86 x G.95), (G.87 x G.90), (G.45 x (G.90 x Australian)), and (G. 92 x G.90).

Table 3. Heterosis relative to the mid-parents (MP) for yield, yield components and fiber quality for combined analysis at three locations.

Crosses	NB/P	SCY/P	LY/P	L.%	BW	SI.
Giza 95 x Suvin	16.58**	32.01**	36.94**	4.03**	13.45**	11.84**
Giza 95 x Karshenky	25.76**	36.76**	40.72**	2.80**	8.64**	13.45**
Giza 95 x 10229	9.31**	17.51	16.93**	-0.44	7.52**	11.38**
Giza 87 x Suvin	9.38**	20.29*	21.26**	0.66	9.95**	6.23**
Giza 87 x Karshenky	8.93**	23.12*	25.55**	2.01*	13.59**	7.09**
Giza 87 x 10229	7.30*	17.57	17.98**	-0.03	9.52**	6.60**
Giza 93 x Suvin	14.04*	29.07**	34.60**	4.20**	12.59**	8.56**
Giza 93 x Karshenky	30.88**	43.34**	47.65**	3.12**	9.82**	6.21**
Giza 93 x 10229	38.38**	53.03**	57.25**	2.71**	10.21**	9.56**
LSD at 0.05	5.92	19.16	7.19	0.67	0.18	0.32
LSD at 0.01	7.97	25.79	9.68	0.90	0.24	0.43
	LI	FL	FS	FF	UI	
Giza 95 x Suvin	19.17**	5.73**	7.41**	-0.94**	1.95*	
Giza 95 x Karshenky	19.00**	1.01**	3.33**	-1.08**	0.18	
Giza 95x 10229	10.53**	2.99**	7.02**	5.58**	0.48	
Giza 87 x Suvin	7.35**	3.60**	2.24**	-0.62**	0.40	
Giza 87 x Karshenky	10.42**	-1.46*	2.59**	6.52**	0.86*	
Giza 87 x 10229	6.50**	0.55*	1.18**	2.67**	1.06**	
Giza 93 x Suvin	16.08**	4.31**	4.40**	-4.58**	1.08**	
Giza 93 x Karshenky	13.76**	2.21**	1.83**	-1.80**	0.59	
Giza 93 x 10229	14.63**	4.30**	4.88**	-4.69**	0.60	
LSD at 0.05	0.32	0.52	0.21	0.14	0.69	
LSD at 0.01	0.43	0.70	0.29	0.19	0.93	

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

Table 4. Heterosis relative to the better-parents (BP) for yield, yield components and fiber quality for combined analysis at three locations.

Crosses	NB/P	SCY/P	LY/P	L.%	BW	SI.
Giza 95 x Suvin	13.93**	20.75	20.65**	-0.04	5.76**	10.88**
Giza 95 x Karshenky	22.51**	36.07**	37.52**	0.15	6.12**	10.01**
Giza 95x 10229	7.96	9.00	7.39	-1.31**	0.73**	11.00**
Giza 87 x Suvin	9.19*	18.94	20.31**	0.26	8.23**	6.23**
Giza 87 x Karshenky	3.60	13.27	13.68**	0.18	9.92**	2.98**
Giza 87 x 10229	5.98	17.11	13.55**	-3.50	8.38**	6.05**
Giza 93 x Suvin	4.05	23.42**	28.09**	3.54**	6.96**	4.72**
Giza 93 x Karshenky	14.30**	25.37**	27.05**	1.04*	9.44**	5.87**
Giza 93 x 10229	25.04**	44.23**	43.29**	-1.08*	5.24**	6.22**
LSD at 0.05	6.84	22.12	8.30	0.77	0.21	0.37
LSD at 0.01	9.21	29.78	11.18	1.04	0.28	0.49
	LI	FL	FS	FF	UI	
Giza 95 x Suvin	10.79**	2.21**	1.85**	16.09**	0.01	
Giza 95 x Karshenky	17.49**	-1.98**	1.28**	1.23**	-1.45*	
Giza 95x 10229	8.53**	0.41	2.44**	17.97**	-1.40	
Giza 87 x Suvin	6.66**	0.06	0.10	1.26**	-0.23	
Giza 87 x Karshenky	3.26**	-5.19**	-2.82**	19.15**	0.53	
Giza 87 x 10229	0.12	-3.70**	-1.88**	5.17**	0.46	
Giza 93 x Suvin	13.08**	2.39**	2.97**	-4.43**	0.35	
Giza 93 x Karshenky	9.77**	-0.07	-2.86**	12.34**	0.17	
Giza 93 x 10229	11.20**	1.50**	2.44**	-0.32**	-0.08	
LSD at 0.05	0.37	0.60	0.25	0.17	0.80	
LSD at 0.01	0.49	0.81	0.33	0.22	1.07	

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

Combining ability Effects:

Values of general combining ability (GCA) for the parents (lines and testers) and specific combining ability (SCA) F_1 crosses over combined analysis at three locations are shown in Table (5). Data cleared that Giza 95 (L_1) was positive and significant useful GCA effects (gi) for SCY/P, LY/P, L. %, seed and lint indices. Giza 87 (L_2) was positive and significant desirable for FL, FS and UI. Also, Giza 93 (L_3) had positive and significant GCA effects for FL and FS, while it was negative and significant desirable for micronaire reading (FF). Regarding testers, results revealed that Suvin (T_1) was significant and positive useful GCA effects (gi) for upper half mean (FL), fiber strength and uniformity index, while, significant and negative desirable GCA effects (gi) were shown for micronaire reading (FF) Karshenky (T_2) was positive and significant desirable for NB/P, SCY/P, LY/P, BW, seed and lint indices. Contrarily, 10229 (T_3) was insignificant desirable for all studied traits.

Table 5. General(g_i) and specific($\hat{S}_{ij}$)combining ability effects Estimates of the parental varieties and nine F_1 hybrids for yield, its components and fiber quality for combined analysis at three locations.

Parents		NB/P	SCY/P	LCY/P	L. %	BW	SI.
Lines :							
Giza 95		2.17	11.10*	6.55**	1.22**	0.07	0.25**
Giza 87		-2.95*	-14.78**	-7.60**	-1.04**	-0.09*	-0.39**
Giza 93		0.78	3.68	1.05	-0.19	0.03	0.14
LSD	0.05	2.79	9.03	3.39	0.32	0.09	0.15
	0.01	3.76	12.16	4.56	0.42	0.11	0.20
Testers :							
Suvin		-2.85*	-10.50*	-4.58**	-0.28	-0.02	-0.17*
Karshenky		3.35**	16.76**	6.91**	0.16	0.11*	0.26**
10229		-0.49	-6.26	-2.33	0.12	-0.09*	-0.09
LSD	0.05	2.79	9.03	3.39	0.32	0.09	0.15
	0.01	3.76	12.16	4.56	0.42	0.11	0.20
F_1 hybrids							
Giza 95 x Suvin		1.47	8.02	3.83	0.42	0.07	-0.03
Giza 95 x Karshenky		2.11	5.83	2.75	0.07	-0.04	0.14
Giza 95x 10229		-3.57	-13.86	-6.58	-0.49	-0.03	-0.11
Giza 87 x Suvin		2.23	4.12	1.03	-0.41	-0.08	-0.03
Giza 87 x Karshenky		-1.72	-2.87	-0.98	0.22	0.08	0.05
Giza 87 x 10229		-0.52	-1.26	-0.05	0.18	0.00	-0.02
Giza 93 x Suvin		-3.70	-12.14	-4.87	-0.02	0.01	0.06
Giza 93 x Karshenky		-0.39	-2.97	-1.77	-0.29	-0.03	-0.19
Giza 93 x 10229		4.09	15.11	6.63*	0.31	0.03	0.13
LSD	0.05	4.84	15.64	5.87	0.55	0.15	0.26
	0.01	6.51	21.06	7.90	0.73	0.20	0.35

Table 5. Cont.

Parents		LI	FL	FS	FF	UI
Lines :						
Giza 95		0.52**	-1.15**	-0.29**	0.42**	-0.66**
Giza 87		-0.57**	0.42**	0.10*	-0.05	0.38*
Giza 93		0.06	0.74**	0.19**	-0.37**	0.28
LSD	0.05	0.15	0.25	0.10	0.07	0.33
	0.01	0.20	0.33	0.14	0.09	0.44
Testers :						
Suvin		-0.21**	0.79**	0.23**	-0.30**	0.39*
Karshenky		0.25**	-0.65**	-0.32**	0.32**	-0.38*
10229		-0.04	-0.14	0.09	-0.02	-0.01
LSD	0.05	0.15	0.25	0.10	0.07	0.33
	0.01	0.20	0.33	0.14	0.09	0.44
F_1 hybrids						
Giza 95 x Suvin		0.11	0.14	0.07	0.00	0.63*
Giza 95 x Karshenky		0.10	-0.05	-0.12	-0.14*	-0.37
Giza 95x 10229		-0.21	-0.09	0.06	0.14*	-0.26
Giza 87 x Suvin		-0.11	0.27	-0.06	-0.05	-0.61*
Giza 87 x Karshenky		0.05	-0.14	0.19*	0.11	0.29
Giza 87 x 10229		0.06	-0.13	-0.13	-0.06	0.32
Giza 93 x Suvin		0.00	-0.41	-0.01	0.06	-0.02
Giza 93 x Karshenky		-0.15	0.19	-0.06	0.02	0.08
Giza 93 x 10229		0.15	0.22	0.07	-0.08	-0.06
LSD	0.05	0.26	0.42	0.17	0.12	0.56
	0.01	0.35	0.57	0.23	0.16	0.76

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

The data of specific combining ability effects ($\hat{S}_{ij}$) for all yield studied traits showed insignificant SCA ($\hat{S}_{ij}$) effects for all crosses except LY/P was significant desirable SCA effects ($\hat{S}_{ij}$) for cross Giza 93 x 10229, while, fiber strength and uniformity index showed significant and desirable SCA effects for crosses Giza 87 x Karshenky and Giza 95 x Suvin respectively, also, micronaire reading (FF) was negative and significant desirable specific combining ability effects ($\hat{S}_{ij}$) for Giza 95 x Karshenky. In this respect, EL-Fesheikawy *et al.* (2012) stated that no hybrid combination exhibited positive and significant values for all studied yield traits. However, 5,3,5,5,2, 2, and 2 out of 10 crosses under study showed positive and significant or highly significant specific combining ability effects ($\hat{S}_{ij}$) values for SCY/P, BW, LY/P, NB/P, L.%, SI and LI , respectively. Concerning fiber quality properties only the cross Karshenky x (Giza 90* Australian) out of the 10 studied crosses showed desirable significant specific combining ability effect ($\hat{S}_{ij}$) estimate in the case of UI. Other fiber quality characters had no significant values for specific combining ability effects ($\hat{S}_{ij}$) for all studied crosses. Also, Sorour *et al.* (2013) found that the two crosses; CB.58 x G.93 and G.45 x G.70 showed highly significant desirable specific combining ability effect ($\hat{S}_{ij}$) estimate for seed cotton and lint yield, BW and NB/P at two sowing dates and their combined. Recently, Mahrous (2018) found that the line Giza 86 was the best combiner for SCY/P,LY/P, NB/P and SI, while lines Giza 45 and Giza 92 were the best combiners for FF, FS and FL. Giza 90 was the best combiner for SCY/P and LY/P. Four crosses exhibited significantly positive values of specific combining ability effects ($\hat{S}_{ij}$) for SCY/P, LY/P, L. % and NB/P.

Proportional contribution:

As shown in Table (6), relative percentages of contribution of lines, testers and their interactions for combined analysis over three locations.

Table 6. Proportional contributions of lines, testers and their interaction for yield, its components and fiber quality for combined analysis at three locations.

characters	Lines	Testers	Lines x Testers
No. of bolls/plant	26.44	36.99	36.57
Seed cotton yield/plant	34.84	42.21	22.95
Lint cotton yield/plant	45.84	33.39	20.76
Lint percentage	86.70	3.83	9.46
Boll weight	34.72	48.12	17.16
Seed index	63.16	28.70	8.14
Lint index	79.83	14.34	5.83
Upper half mean(FL)	63.35	32.64	4.01
Fiber strength	40.14	50.95	8.92
Micronaire reading(FF)	59.62	36.05	4.33
Uniformity index	49.03	22.10	28.87

Results cleared that, lines were larger than testers and lines x testers interaction in their relative contributions for all traits under study, except for NB/P, SCY/P, BW and FS which recorded high values with testers contributions .AL-Hibbiny (2011) showed that the proportion contribution revealed that, the contribution due to lines was higher than that of the testers for fiber fineness, while the testers contribution were higher than that of the lines for fiber strength. However, lines x testes contribution were larger than those of testers and lines for all studied characters at three locations and their combined data. EL-Fesheikawy *et al.* (2012) reported that, lines x testers interaction were high in magnitude than lines or testers contributions for all studied characters which ranged from 57.174 for NB/P to 53.83 for BW. Also, the contributions of lines were slightly higher than those of testers for studied characters.

Genetic parameters:

Gene action offers the behavior or mode of expression of genes in a genetic population. Knowledge of gene action helps in the parent's choice in hybridization programs and also in the choice appropriate breeding method for the genetic improvement of various quantitative characters. Therefore, the nature of gene action involved in the expression of various a quantitative character is essential to plant breeder for starting a suitable breeding program. Partitioning of the genetic parameters for all traits in combined analysis at three environments are presented in Table (7). The results indicated that the non-additive of genetic variance (σ^2D) were higher than additive genetic ones (σ^2A) for NB/P, SCY/P, LY/P and UI. These results indicated that non-additive effects play a major role in the expression of these characters, while additive effects had a minor role and indicating the hybridization program would be effective in improvement of some studied traits. The importance of non-additive genetic variances was verified by the average degree of dominance which is more than one for some traits. This indicated that the over-dominance played an important role of the dominance component. El-Fesheikawy *et al*.(2012) revealed that the magnitudes of dominance genetic variance (σ^2D) were positive and larger than those of additive genetic variance (σ^2A), for all studied yield and yield component traits as well as fiber quality characters These indicated the predominance of dominance genetic variance (σ^2D) in the inheritance of these traits. It could be concluded that fiber properties and yield components were mainly controlled by dominance variance. Sorour *et al.* (2013) found that dominance effects were important in the inheritance of BW, SCY/P and NB/P traits. The additive gene effects contribute the major portion of gene pool for LY/P, L. % and SI traits. Mahrous (2018) found that the non-additive of genetic variance was larger than additive genetic variance in all yielding ability traits and additive genetic variance was higher than dominance ones for all fiber quality traits.

Heritability:

Heritability in both broad and narrow senses for combined analysis at three locations are presented in Table (7). Results showed that broad sense heritability (h^2_b %) estimates were higher than the corresponding values of narrow sense heritability (h^2_n %) for all traits under study. The highest broad sense heritability was observed in case of fiber fineness with values of 92.31% and the lowest was for boll weight with value of 19.77%, while for narrow sense heritability, it ranged from 3.27% to 51.77% for No. of bolls/plant and Fiber length, respectively. AL-Hibbiny (2011) found that heritability value in broad sense was the highest (97.47%) for fiber length (UHM) at the combined data, while the lowest one (76.38%) was calculated for fiber fineness at Loc.3. For narrow sense heritability estimates, the lowest value zero was detected for fiber length (UHM) and micronaire reading at all locations and their combined data, while the highest one (5.38%) was found for fiber strength at Loc.1. EL-Fesheikawy *et al*. (2012) observed that heritability values in broad sense (h^2 b.s. %) were larger than their corresponding heritability values in narrow sense (h^2 n.s. %) for all studied traits. The results also cleared that the calculated values in broad sense ranged from 99. 71 % to 99. 99 % for boll weight and uniformity index, respectively. Narrow sense (h^2 n.s. %) ranged from 31.78 % for number of bolls/plant to 35.12% for boll weight.

Table 7. Partitioning of the genetic variance and heritability estimates for yield, its components and fiber quality properties for combined analysis at three locations.

Genetic parameters and heritability	NB/P	SCY/P	LY/P	L. %	BW	SI.	LI	FL	FS	FL	UI
σ^2GCA	0.89	34.47	8.11	0.15	0.0017	0.02	0.04	0.19	0.02	0.03	0.04
σ^2SCA	8.96	117.23	26.38	0.14	0.0001	0.01	0.02	0.05	0.01	0.01	0.22
σ^2A	1.78	68.93	16.23	0.31	0.0034	0.04	0.08	0.37	0.03	0.06	0.07
σ^2D	8.96	117.23	26.38	0.14	0.0001	0.01	0.02	0.05	0.01	0.01	0.22
$(\sigma^2D./\sigma A)^{½}$	4.49	2.61	2.55	1.37	0.37	0.50	0.90	0.77	1.32	0.96	3.48
σ^2G.	10.74	186.16	42.61	0.45	0.003	0.05	0.10	0.42	0.04	0.07	0.29
σ^2E.	17.05	171.86	25.59	0.25	0.01	0.07	0.05	0.01	0.02	0.01	0.24
σ^2Ph	27.79	358.02	68.20	0.70	0.01	0.12	0.15	0.43	0.06	0.08	0.53
H^2_b	69.28	75.49	83.20	80.51	19.77	58.22	75.95	82.10	81.14	92.31	80.40
H^2_n	3.27	9.67	11.09	28.02	17.43	34.17	41.81	51.77	29.49	48.00	6.12

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تقييم بعض هُجن القُطن الصنفية لبعض الصفات الكمية في ثلاث مناطق

يُسرى إبراهيم مُحمد الحبينى ، بدير مُصطفى رمضان وعرفة بدري عبد الكريم الفشيقاوي
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تهدف هذه الدراسة إلى تقدير القُدرة علي التآلف ونسبة المُساهمة ومكونات التبايُن الوراثي و قوة الهجين ودرجة التوريث لبعض الصفات لثلاثة أصناف مصرية من القُطن كسُلالات وهي جيزة ٩٥، جيزة ٨٧، جيزة ٩٣ وثلاثة تراكيب وراثية ككشافات وهي سيوفين وكارشنكى و١٠٢٢٩ باستخدام طريقة تحليل السُلالة x الكشاف وذلك في ثلاث مناطق وهي سخا (مُحافظة كفر الشيخ) وسدس (مُحافظة بني سويف) وشندويل (مُحافظة سوهاج) خلال موسمي الزراعة ٢٠١٧ و٢٠١٨. وكانت أهم النتائج المُتحصل عليها هي: أظهر تحليل التبايُن لكُل من التراكيب الوراثية والمواقع والآباء والهُجن و(الآباء x الهُجن) والسُلالات والكشافات و(الآباء x المواقع) و(الآباء x الهُجن x المواقع) إلي وجود فروق معنوية لمُعظم الصفات المدروسة. أظهرت الدراسة وجود قوة هجين مُفيدة محسوبة بالنسبة لمُتوسطات الأبوين وأحسن الآباء وذلك لمُعظم الصفات المدروسة، وقد أظهر الهجينين (جيزة ٩٥xسيوفين) و (جيزة ٩٣xسيوفين) أعلي قيم لقوة الهجين بالنسبة لمُتوسط الأبوين لكُل الصفات المدروسة. بينما أعطي الهجين (جيزة ٩٣ x كاراشنكي) أعلي قيم لقوة الهجين بالنسبة لأفضل الأبوين لمُعظم الصفات المحصولية المدروسة. بينما أظهرا الهجينين (جيزة ٩٣ xسيوفين) و (جيزة ٩٣x١٠٢٢٩) أعلي قيم لقوة الهجين بالنسبة لأفضل الأبوين لمُعظم صفات التيلة المدروسة. أظهر الصنف جيزة ٩٥ (كسُلالة) أفضل قُدرة عامة علي التآلف لمُعظم الصفات المحصولية المدروسة بينما أظهرا الصنفين جيزة ٨٧ وجيزة ٩٣ (كسُلالات) أفضل قُدرة عامة علي التآلف لمُعظم صفات الشعر المدروسة كذلك أظهر الصنف سيوفين (ككشاف) أفضل قُدرة عامة علي التآلف لكُل صفات الألياف المدروسة بينما أظهر الصنف كارشنكي أفضل قُدرة عامة للتآلف لمُعظم الصفات المحصولية المدروسة. كما أظهر التركيب (جيزة ٩٣x ١٠٢٢٩) أعلي قُدرة ائتلافية خاصة لصفة محصول الشعر علي النبات بينما أظهر الهجينين (جيزة ٨٧xكارشنكي) و(جيزة ٩٥xسيوفين) أعلي قُدرة خاصة علي التآلف لصفتي متانة التيلة ونسبة الإنتظام علي التوالي. أشارت النتائج لتقدير نسب المُساهمة أن مُساهمة السُلالات أعلي من مُساهمة كُل من الكشافات وتفاعل السُلالهx الكشاف لمُعظم الصفات المدروسة، فى حين كانت قيم نسبة مُساهمة الكشافات أعلي من مُساهمة كل من السُلالات وتفاعل السُلالهx الكشاف لباقى الصفات.دلت قيم المُكونات الوراثية علي أن التبايُن غير الإضافي أكثر أهمية من التبايُن المُضيف في كُل من الصفات عدد اللوز/النبات ، محصول الزهر والشعر/النبات ومُعامل الإنتظام. كانت قيم درجة التوريث بالمعني الواسع أكبر من قيم درجة التوريث بالمعني الضيق لكُل الصفات المدروسة وكانت أكبر قيمة لدرجة التوريث بالمعني الواسع لصفة قراءة الميكرونير (٩٢,٣١%) بينما سجلت صفة وزن اللوزة أقل قيمة (١٩,٧٧%)، فى حين أن درجة التوريث بالمعني الضيق تراوحت بين ٣,٢٧% لصفة عدد اللوز علي النبات و٥١,٧٧% لصفة طول التيلة. عموماً فإنه يُمكن إستخدام الصنف كارشنكي والصنف جيزة ٩٥ في برامج التربية لتعظيم القُدرة الإنتاجية للأصناف الجديدة بينما يمُكننا إعتبار الصنفين جيزة ٨٧ وسيوفين كآباء مُتفوقة في برامج التربية لإنتاج تراكيب جديدة تتميز بجودة الألياف.