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Genetic components determination of yield and fiber quality properties in cotton (*Gossypium barbadense* L.)

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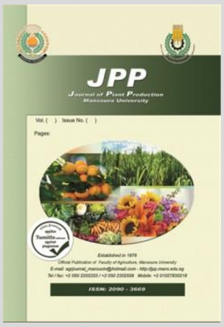

ABSTRACT

This study was conducted at Sakha Agricultural Research Station, Cotton Research Institute, Agricultural Research Center, Kafr El-Sheikh Governorate, Egypt, during two growing seasons (2021 and 2022). Six Egyptian cotton varieties were used as lines with five genotypes as testers, using line x tester analysis. Genotypes, parents, crosses and parents *vs.* crosses mean squares were extremely significant for all the studied characters, except for micronaire reading in the crosses. Giza 94 x 10229 exhibited significant useful heterosis (BP) for all the studied characters. Lines Giza 86 and Giza 76 recorded significantly and positive desirable general combining ability effects (GCA) for most traits while, Giza 96 was significant desirable general combining ability effects for fiber quality characters. In this respect, testers showed that Uzbekistan had significant and positive desirable for most yield characters while, BBB had significant desirable general combining ability effects for most studied characters. Crosses Giza 96 x Australy13, Giza 86 x 10229 and Giza 75 x C.B.58 were significant desirable specific combining ability effects (SCA) for some yield traits. Generally, Giza 86 could be used for improving high yielding cotton varieties in plant breeding programs, while Giza 96 considered as beneficial parent for breeding programs to produce new varieties characterized with best fiber quality.

Keywords: Line x tester, Heterosis, GCA, SCA, Heritability ,Cotton.

INTRODUCTION

Cotton breeding's major objectives are high yield and adequate fiber quality properties. In a breeding program, quality measures refer to suitable parents and promising cross combinations based on heritability, combining ability, and heterosis effects for yield and yield components. It was discovered that parents and cross combinations should be chosen based on their combining ability and gene action in terms of phenotypic performance efficacy. Line x tester analysis is one of the most significant statistical-genetic approaches for obtaining information about the parents (GCA) and crosses (SCA) (Usharani *et al.*, 2016).

Heterosis is utilized to measure the performance of an F_1, which is produced by crossing two varieties or pure lines, but its use in cotton has not yet reached the successive level. Heterotic effects are used in traditional breeding programs to assess dominance or/and epistatic variance, as well as promising cross combinations. Dewdar (2011) showed positive significant general combining ability (GCA) effects in the parental genotypes for the majority of the studied characteristics.

Linga swamy *et al.*, (2013) revealed that the magnitude of general and specific combining ability variations demonstrated in the importance of additive and non-additive gene action in the inheritance for the traits of seed cotton yield and yield characteristics. On the other side, the variations of genotypes, parents, and crosses were identified as significant for seed and lint cotton yield/plant, lint%, and uniformity index. Mabrouk *et al.*, (2018) indicated that mean squares for general combining ability were significant for the traits of seed index and lint%, while SCA mean squares was significant for all traits except lint%.

According to Al-Hibbiny *et al.,* (2020) found significantly positive heterosis over mid as well as better-parents in two crosses (Giza 89 x 10229) and (Giza 96 x 10229) for the majority of studied traits. Moreover, Giza 89 x 10229 and Giza 96 x 10229 were significantly and negative for micronaire reading for heterosis over mid and better parents. The sources of variation revealed significant variances for most studied traits using line x tester analysis. The proportional contribution due to line x tester was greater than the contributions for lines and testers for most studied traits. In comparison to the other parents, the lines Giza 90, Australy 12 and Uzbekistan, in addition the tester Giza 97 showed higher cotton yield and most traits. Based on mean performance, the hybrid combinations (TNB x Giza 94) followed by (Giza 90x Aus.12) x Giza 86, and (Giza 96 x Giza 94) were recognized as excellent (Yehia and El-Hashash, 2022). Besides, Kanasagra (2022) the cross combination GTHV-15/220 x G.Cot-20 recorded highest and positive standard heterosis values and it was (73.92%) for seed cotton yield/plant followed by GSHV-172 x G.Cot-38 (22.09%) and about (20.21%) for GTHV-15/220 x GJ.Cot-101. The primary goal of this research was to assess heterosis, combining ability, gene action for yield and its components and fiber quality traits in some crosses belong to *Gossypium barbadense* L.

MATERIALS AND METHODS

The mating design used for this experiment was line x tester analysis. In 2021 growing season, thirty crosses were made using eleven *G. barbadense* L. parents. The six female parents (lines) were Giza 96, Giza 94, Giza 86, Giza 76, Giza 75 and Giza 68. The five male parents (testers) were 10229 (Australian strain), Uzbekistan (Uzbekistan variety), C.B. 58 (American Egyptian cotton variety), Australy 13

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(Australian variety), and BBB (Australian variety). The eleven parents and their 30 F_1 crosses were evaluated at Sakha Agricultural Research Station in randomized complete blocks design (RCBD) with three replicates during 2022 growing season. Experimental plot consisted of one ridges of 4.0 meter in length and 60 cm in width. Seeds were planted in hills spaced 40 cm apart and one plant was left per hill at thinning time.

The studied characters were :-

-Seed cotton yield (g) / plant (SCY/P) (SCY/P.g)
-Lint cotton yield (g) / plant (LCY/P)
-Lint percentage (L %)
- Boll weight (g) (BW)
-Seed index (g) (S
-Lint index (g) (LI)
-2.5% span length (mm) (2.5% SL) (mm) (UHM)
-Micronaire reading (MR)
-Pressley index (PI)
-Uniformity index (UI)

All fiber properties were measured in the Cotton Technology Research Division's Laboratories at the Cotton Research Institute in Giza.

Statistical analysis:

Analysis of variance, partitioning of genotypes, line x tester analysis, estimation of general and specific combining ability were computed according to Singh and Chaudhary (1977). Heterosis as percentage of mid and better-parents (MP and BP) was determined according to Steel and Torrie (1980). Heritability in both broad (h^2_b%) and narrow (h^2_n%) senses were estimated from formulas presented by Allard (1960) and Mather (1949).

RESULTS AND DISCUSSION

Analysis of variance

Analysis of variance for eleven parents and their thirty F_1 crosses of all studied characters are showed in Table (1). The results indicated that genotypes, parents and crosses mean squares were extremely significant for all the studied characters , except for MR in the crosses. Mean squares of parents *vs.* crosses as indication to average heterosis over all crosses were significant for all studied characters. Also, mean squares due to lines, testers and line x tester were significant for all studied characters, except for BW in both testers and line x tester, indicating thereby that the parent lines and testers used in the present study were divergent and that significant differences were transmitted through the progenies. Similar results were reported by Samreen *et al.,* (2008), Baloch *et al.* (2014), Al-Hibbiny (2015), Shaker *et al.,* (2016), Lingaraja *et al.* (2017) and Tigga *et al.,* (2017).

The mean performance of genotypes

Mean performances related to parents as well as crosses are presented in Table (2). For parental lines, Giza 96 showed best means for SCY/P, LY/P, 2.5% SL, PI and UI, Giza 68 had the highest values for L%, and desirable MR, Giza 86 had the highest values for BW and LI. The highest values for SI were recorded for Giza 76. For tester, 10229 was the highest values for SI. Uzbekistan recorded the highest values for LCY/P, L%, LI and UI. Australy 13 recorded the highest values for BW, BBB variety had the best means for SCY/P, LCY/P, PI and MR. Concerning crosses, the results noticed best mean performances for Giza 96 x 10229 for 2.5% SL, Giza 96 x BBB for PI, Giza 86 x 10229 for BW, SI and LI, Giza 76 x Uzbekistan for SCY/P, LCY/P and L%, Giza 75 x 10229 for UI, Giza 75 x C.B.58 for MR.

Table 1. Mean square estimates for the studied characters in line x tester analysis.

S.O.V	d.f.	SCY/P(g)	LCY/P(g)	L %	BW (g)	SI (g)
Replications	2	9.54	2.70	0.20	0.001	0.01
Genotypes	40	527.30**	128.16**	8.85**	0.14**	0.60**
Parents (P)	10	153.79**	28.90**	3.19**	0.16**	0.39**
Crosses (C)	29	3404.35**	962.34**	64.33**	0.45**	8.68**
P. vs. C	1	556.89**	133.62**	8.89**	0.12**	0.40**
Lines (L)	5	2147.41**	573.57**	42.28**	0.49**	1.23**
Testers (T)	4	892.63**	149.98**	1.82**	0.04	0.37**
L X T	20	92.11**	20.37**	1.96**	0.04	0.19**
Error	80	30.06	4.90	0.13	0.02	0.03

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

Table 1. Continued.

S.O.V.	d.f.	LI (g)	2.5% SL (mm)	PI	MR	UI
Replications	2	0.03	0.63	0.01	0.06	0.70
Genotypes	40	1.05**	3.59**	0.73**	0.19**	4.26**
Parents (P)	10	0.26**	1.56**	0.68**	0.41**	3.96**
Crosses (C)	29	16.08**	24.66**	3.43**	0.08	22.00**
P. vs. C	1	0.80**	3.56**	0.66**	0.11**	3.75**
Lines (L)	5	3.36**	14.27**	2.42**	0.16**	15.33**
Testers (T)	4	0.30**	0.81**	0.99**	0.28**	3.45**
L X T	20	0.27**	1.43**	0.15**	0.07**	0.92**
Error	80	0.02	0.28	0.04	0.03	0.34

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

Table 2. Mean performances of lines, testers with thirty F_1 crosses for studied traits.

Genotypes		SCY/P(g)	LCY/P(g)	L %	BW (g)	SI (g)
Lines :						
Giza 96		109.47	40.90	37.36	3.06	10.03
Giza 94		89.07	33.47	37.59	3.13	9.33
Giza 86		90.33	34.08	37.73	3.33	9.97
Giza 76		91.70	32.68	35.56	2.98	10.10
Giza 75		81.93	29.95	36.54	2.59	9.23
Giza 68		92.73	35.69	38.48	2.76	9.40
Testers :						
10229		90.83	34.23	37.68	3.14	10.20
Uzbekistan		96.73	38.06	39.35	2.69	9.83
C.B 58		94.30	36.09	38.27	2.86	9.50
Australy 13		94.00	36.14	38.45	3.22	9.27
BBB		102.10	39.16	38.35	2.87	9.80
LSD	0.05	8.77	3.54	0.57	0.23	0.27
	0.01	11.46	4.63	0.75	0.30	0.35
F_1 crosses						
Giza 96 x 10229		109.47	43.86	40.06	2.74	10.20
Giza 96 x Uzbekistan		110.27	43.57	39.52	2.76	10.07
Giza 96 x C.B. 58		95.43	36.33	38.07	2.93	10.37
Giza 96 x Australy 13		101.93	40.99	40.22	2.77	9.50
Giza 96 x BBB		109.27	43.18	39.52	2.75	9.60
Giza 94 x 10229		106.83	41.32	38.67	3.17	10.30
Giza 94 x Uzbekistan		102.90	41.35	40.18	3.28	10.20
Giza 94 x C.B. 58		114.73	45.35	39.53	3.34	9.90
Giza 94 x Australy 13		95.77	37.75	39.43	3.16	10.03
Giza 94 x BBB		101.83	39.63	38.92	3.28	9.93
Giza 86 x 10229		97.37	39.54	40.60	3.47	11.13
Giza 86 x Uzbekistan		97.10	38.73	39.90	3.16	10.67
Giza 86 x C.B. 58		96.50	37.28	38.63	3.09	10.73
Giza 86 x Australy 13		82.00	33.19	40.48	3.17	10.60
Giza 86 x BBB		104.30	43.24	41.45	3.18	10.53
Giza 76 x 10229		128.13	53.69	41.90	3.30	10.40
Giza 76 x Uzbekistan		135.13	56.94	42.13	3.15	10.30
Giza 76 x C.B. 58		130.67	52.88	40.47	3.14	10.07
Giza 76 x Australy 13		107.70	43.86	40.73	3.20	10.10
Giza 76 x BBB		134.87	56.10	41.59	3.19	10.20
Giza 75 x 10229		99.10	35.11	35.44	3.18	10.10
Giza 75 x Uzbekistan		92.00	33.82	36.76	3.14	10.30
Giza 75 x C.B. 58		93.83	35.01	37.32	3.20	10.80
Giza 75 x Australy 13		79.13	28.88	36.50	3.13	10.50
Giza 75 x BBB		106.20	37.77	35.57	3.27	10.77
Giza 68 x 10229		106.10	41.81	39.40	2.84	10.43
Giza 68 x Uzbekistan		110.63	44.67	40.37	2.88	10.60
Giza 68 x C.B. 58		113.30	44.94	39.67	3.00	10.50
Giza 68 x Australy 13		95.47	36.79	38.53	2.87	9.77
Giza 68 x BBB		116.07	46.69	40.23	3.28	10.30
LSD	0.05	7.60	3.07	0.49	0.20	0.24
	0.01	9.92	4.01	0.65	0.26	0.31

Table 2. Continued.

Genotypes	LI (g)	2.5% SL(mm)	PI	MR	UI
		Lines			
Giza 96	5.99	34.43	11.23	3.57	88.00
Giza 94	5.62	32.53	10.37	4.40	86.23
Giza 86	6.04	32.93	10.67	4.50	84.73
Giza 76	5.58	33.03	10.20	3.87	85.57
Giza 75	5.34	32.60	9.70	3.80	85.10
Giza 68	5.88	33.30	10.43	3.40	85.70
		Testers			
10229	6.17	31.97	10.33	4.37	84.30
Uzbekistan	6.38	32.83	10.07	3.97	84.93
C.B 58	5.89	32.47	10.00	3.95	83.87
Australy 13	5.79	31.70	9.50	4.20	84.23
BBB	6.10	32.45	10.60	3.57	84.90
LSD 0.05	0.24	0.84	0.30	0.28	0.94
LSD 0.01	0.31	1.10	0.39	0.37	1.22
		F_1 crosses			
Giza 96 x 10229	6.82	35.77	11.67	4.13	87.77
Giza 96 xUzbekistan	6.58	34.77	10.83	4.37	87.87
Giza 96 x C.B. 58	6.37	35.45	11.33	4.05	87.23
Giza 96 x Australy 13	6.39	35.57	11.30	3.90	87.63
Giza 96 x BBB	6.27	35.00	11.80	3.87	86.83
Giza 94 x 10229	6.50	33.40	10.60	4.07	87.13
Giza 94 xUzbekistan	6.85	31.80	10.30	4.20	85.57
Giza 94 x C.B. 58	6.47	33.03	10.53	4.20	86.13
Giza 94 x Australy 13	6.53	32.00	9.77	4.00	86.10
Giza 94 x BBB	6.33	32.67	10.57	3.87	86.87
Giza 86 x 10229	7.61	33.37	10.70	4.57	85.93
Giza 86 xUzbekistan	7.08	35.43	10.50	4.07	87.07
Giza 86 x C.B. 58	6.76	34.53	10.93	3.90	86.10
Giza 86 x Australy 13	7.21	34.27	10.57	4.23	86.87
Giza 86 x BBB	7.46	33.80	10.87	3.87	85.90
Giza 76 x 10229	7.50	33.00	10.57	4.37	85.67
Giza 76 xUzbekistan	7.50	33.23	10.60	3.87	85.53
Giza 76 x C.B. 58	6.84	34.43	10.33	4.00	83.57
Giza 76 x Australy 13	6.94	32.27	10.37	4.10	83.97
Giza 76 x BBB	7.26	33.93	10.93	3.90	84.40
Giza 75 x 10229	5.54	34.37	10.37	3.93	88.13
Giza 75 xUzbekistan	5.99	33.07	10.07	3.83	87.13
Giza 75 x C.B. 58	6.43	32.20	10.20	3.77	86.23
Giza 75 x Australy 13	6.04	32.77	9.90	3.77	86.33
Giza 75 x BBB	5.94	32.87	10.70	3.87	86.40
Giza 68 x 10229	6.78	34.00	11.17	4.23	86.13
Giza 68 xUzbekistan	7.18	34.37	10.37	4.00	85.80
Giza 68 x C.B. 58	6.90	33.80	10.97	3.87	85.37
Giza 68 x Australy 13	6.12	33.77	10.40	3.90	85.13
Giza 68 x BBB	6.93	33.90	10.57	3.93	84.83
LSD 0.05	0.20	0.73	0.26	0.25	0.81
LSD 0.01	0.27	0.96	0.34	0.32	1.06

Heterosis:

The genetic diversity was an important source of variability, resulting in the creation of new recombinations that differed from the parent and, as a result, the finding of heterosis. Also, heterosis is expressed as a percentage divergence of F_1 mean performance from both mid and better-parents. Heterosis indicates that F_1 crosses were superiority in some traits than its parents, which leads to superiority in adaption. Data showed positive heterosis is generally regarded as favorable for all studied traits, with the exception for micronaire reading.

The magnitude of heterosis over mid as well as better parents for studied traits were presented in Tables (3) and (4). Heterosis over mid-parents are relative for SCY/P, sixteen out of thirty F_1 crosses possessed positive and highly significantly heterotic effects which varied between (8.40%) for Giza 86 x BBB to (43.43%) for Giza 76 x Uzbekistan, while twelve crosses were positively significant for heterosis over better-parent which varied between (9.10%) for Giza 75 x 10229 to (39.73%) for Giza 76 x 10229.

The results showed that heterosis over mid-parent shown that twenty five crosses out of thirty F_1 crosses were significantly and positive heterosis for LCY/P which ranged from (6.02%) for Giza 75 x C.B.58 to (60.96%) for Giza 76 x Uzbekistan, while, eighteen crosses were significant positive heterosis over better parent ranged from (4.47%) for Giza 94 x Australy 13 to (56.83%) for Giza 76 x 10229.

Table 3. Heterosis as percentage of mid parents (MP) in thirty crosses for studied traits of cotton.

Crosses	SCY/P(g)	LCY/P(g)	L%	BW(g)	SI(g)
Giza 96 x 10229	9.30*	16.74**	6.77**	-11.67**	0.82**
Giza 96 x Uzbekistan	6.95	10.36**	3.03**	-4.06**	1.34**
Giza 96 x C.B. 58	-6.33	-5.62**	0.66**	-0.96**	6.14**
Giza 96 x Australy 13	0.20	6.42**	6.09**	-11.83**	-1.55**
Giza 96 x BBB	3.29	7.88**	4.40**	-7.31**	-3.19**
Giza 94 x 10229	18.77**	22.07**	2.76**	1.22**	5.46**
Giza 94 x Uzbekistan	10.76**	15.59**	4.45**	12.73**	6.43**
Giza 94 x C.B. 58	25.14**	30.40**	4.23**	11.53**	5.13**
Giza 94 x Australy 13	4.62	8.48**	3.70**	-0.58**	7.89**
Giza 94 x BBB	6.54	9.13**	2.50**	9.57**	3.83**
Giza 86 x 10229	7.49	15.75**	7.68**	7.32**	10.41**
Giza 86 x Uzbekistan	3.81	7.37**	3.54**	5.15**	7.74**
Giza 86 x C.B. 58	4.53	6.26**	1.67**	-0.11	10.27**
Giza 86 x Australy 13	-11.03**	-5.47**	6.27**	-3.26**	10.23**
Giza 86 x BBB	8.40*	18.08**	8.97**	2.74**	6.58**
Giza 76 x 10229	40.39**	60.48**	14.41**	8.01**	2.46**
Giza 76 x Uzbekistan	43.43**	60.96**	12.49**	11.18**	3.34**
Giza 76 x C.B. 58	40.50**	53.77**	9.62**	7.48**	2.72**
Giza 76 x Australy 13	15.99**	27.47**	10.06**	3.28**	4.30**
Giza 76 x BBB	39.18**	56.18**	12.55**	9.12**	2.51**
Giza 75 x 10229	14.72**	9.40**	-4.52**	11.24**	3.95**
Giza 75 x Uzbekistan	2.99	-0.55	-3.11**	19.22**	8.04**
Giza 75 x C.B. 58	6.49	6.02**	-0.24	17.45**	15.30**
Giza 75 x Australy 13	-10.04**	-12.60**	-2.66**	7.75**	13.51**
Giza 75 x BBB	15.41**	9.30**	-5.03**	19.93**	13.13**
Giza 68 x 10229	15.60**	19.59**	3.46**	-3.79**	6.46**
Giza 68 x Uzbekistan	16.78**	21.13**	3.73**	5.88**	10.23**
Giza 68 x C.B. 58	21.15**	25.21**	3.36**	6.94**	11.11**
Giza 68 x Australy 13	2.25	2.44	0.17	-4.07**	4.64**
Giza 68 x BBB	19.14**	24.77**	4.73**	16.71**	7.29**
LSD 0.05	7.60	3.07	0.49	0.20	0.24
LSD 0.01	9.92	4.01	0.65	0.26	0.31

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

Table 3. Continued.

Crosses	LI (g)	25% SL(mm)	PI	MR	UI
Giza 96 x 10229	12.19**	7.73**	8.19**	4.20**	1.88**
Giza 96 xUzbekistan	6.38**	3.37**	1.72**	15.93**	1.62**
Giza 96 x C.B. 58	7.31**	5.98**	6.75**	7.76**	1.51**
Giza 96 x Australy 13	8.56**	7.56**	9.00**	0.43**	1.76**
Giza 96 x BBB	3.86**	4.66**	8.09**	8.41**	0.44
Giza 94 x 10229	10.18**	3.57**	2.42**	-7.22**	2.19**
Giza 94 xUzbekistan	14.16**	-2.70**	0.82**	0.40**	-0.02
Giza 94 x C.B. 58	12.45**	1.64**	3.44**	0.60**	1.27**
Giza 94 x Australy 13	14.47**	-0.36	-1.68**	-6.98**	1.02*
Giza 94 x BBB	8.02**	0.54	0.79**	-2.93**	1.52**
Giza 86 x 10229	24.68**	2.82**	1.90**	3.01**	1.68**
Giza 86 xUzbekistan	14.06**	7.75**	1.29**	-3.94**	2.63**
Giza 86 x C.B. 58	13.30**	5.61**	5.81**	-7.69**	2.14**
Giza 86 x Australy 13	21.90**	6.03**	4.79**	-2.68**	2.82**
Giza 86 x BBB	22.91**	3.39**	2.19**	-4.13**	1.28**
Giza 76 x 10229	27.63**	1.54**	2.92**	6.07**	0.86*
Giza 76 xUzbekistan	25.38**	0.91*	4.61**	-1.28**	0.33
Giza 76 x C.B. 58	19.28**	5.14**	2.31**	2.35**	-1.36**
Giza 76 x Australy 13	22.07**	-0.31	5.25**	1.65**	-1.10**
Giza 76 x BBB	24.37**	3.64**	5.13**	4.93**	-0.98*
Giza 75 x 10229	-3.65**	6.45**	3.49**	-3.67**	4.05**
Giza 75 xUzbekistan	2.20**	1.07**	1.85**	-1.29**	2.49**
Giza 75 x C.B. 58	14.53**	-1.02**	3.55**	-2.80**	2.07**
Giza 75 x Australy 13	8.49**	1.92**	3.12**	-5.83**	1.97**
Giza 75 x BBB	3.94**	1.05**	5.42**	4.98**	1.65**
Giza 68 x 10229	12.60**	4.19**	7.54**	9.01**	1.33**
Giza 68 xUzbekistan	17.06**	3.93**	1.14**	8.60**	0.57
Giza 68 x C.B. 58	17.29**	2.79**	7.34**	5.22**	0.69
Giza 68 x Australy 13	4.95**	3.90**	4.35**	2.63**	0.20
Giza 68 x BBB	15.77**	3.12**	0.48**	12.92**	-0.55
LSD 0.05	0.20	0.73	0.26	0.25	0.81
LSD 0.01	0.27	0.96	0.34	0.32	1.06

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

Table 4. Heterosis as percentage of better parents (BP) in thirty crosses for studied traits of cotton.

Crosses	SCY/P (g)	LCY/P (g)	L %	BW (g)	SI (g)
Giza 96 x 10229	0.00	7.23**	6.32**	-12.75**	0.00
Giza 96 xUzbekistan	0.73	6.54**	0.43	-9.91**	0.33*
Giza 96 x C.B. 58	-12.82**	-11.17**	-0.53	-4.25**	3.32**
Giza 96 x Australy 13	-6.88	0.23	4.59**	-14.06**	-5.32**
Giza 96 x BBB	-0.18	5.58**	3.05**	-10.24**	-4.32**
Giza 94 x 10229	17.61**	20.71**	2.63**	1.06**	0.98**
Giza 94 xUzbekistan	6.37	8.62**	2.12**	4.80**	3.73**
Giza 94 x C.B. 58	21.67**	25.67**	3.30**	6.72**	4.21**
Giza 94 x Australy 13	1.88	4.47*	2.54**	-2.07**	7.50**
Giza 94 x BBB	-0.26	1.20	1.48**	5.01**	1.36**
Giza 86 x 10229	7.19	15.49**	7.74**	4.20**	9.15**
Giza 86 xUzbekistan	0.38	1.76	1.41**	-5.01**	7.02**
Giza 86 x C.B. 58	2.33	3.31	0.95**	-7.21**	7.69**
Giza 86 x Australy 13	-12.77**	-8.16**	5.27**	-4.80**	6.35**
Giza 86 x BBB	2.15	10.42**	8.08**	-4.40**	5.69**
Giza 76 x 10229	39.73**	56.83**	11.19**	5.31**	1.96**
Giza 76 xUzbekistan	39.70**	49.58**	7.08**	0.43**	1.98**
Giza 76 x C.B. 58	38.56**	46.51**	5.74**	5.26**	-0.33*
Giza 76 x Australy 13	14.57**	21.37**	5.93**	-0.62**	0.00
Giza 76 x BBB	32.09**	43.26**	8.45**	7.05**	0.99**
Giza 75 x 10229	9.10*	2.56	-5.96**	1.49**	-0.98**
Giza 75 xUzbekistan	-4.89	-11.15**	-6.57**	17.00**	4.75**
Giza 75 x C.B. 58	-0.49	-2.99	-2.49**	11.90**	13.68**
Giza 75 x Australy 13	-15.82**	-20.08**	-5.07**	-2.90**	13.31**
Giza 75 x BBB	4.02	-3.55*	-7.27**	14.07**	9.86**
Giza 68 x 10229	14.41**	17.15**	2.39**	-9.56**	2.29**
Giza 68 xUzbekistan	14.37**	17.35**	2.59**	4.47**	7.80**
Giza 68 x C.B. 58	20.15**	24.52**	3.08**	5.13**	10.53**
Giza 68 x Australy 13	1.56	1.81	0.13	-10.96**	3.90**
Giza 68 x BBB	13.68**	19.24**	4.55**	14.53**	5.10**
LSD 0.05	8.77	3.54	0.57	0.23	0.27
0.01	11.46	4.63	0.75	0.30	0.35

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

Table 4. Continued.

Crosses	LI (g)	25% SL(mm)	PI	MR	.UI
Giza 96 x 10229	10.52**	3.87**	3.86**	15.89**	-0.27
Giza 96 *x*Uzbekistan	3.09**	0.97*	-3.56**	22.43**	-0.15
Giza 96 x C.B. 58	6.45**	2.95**	0.89**	13.55**	-0.87
Giza 96 x Australy 13	6.77**	3.29**	0.59**	9.35**	-0.42
Giza 96 x BBB	2.91**	1.65**	5.04**	8.41**	-1.33**
Giza 94 x 10229	5.30**	4.48**	2.25**	-6.87**	1.04*
Giza 94 xUzbekistan	7.39**	-3.15**	-0.64**	5.88**	-0.77
Giza 94 x C.B. 58	9.90**	1.54**	1.61**	6.33**	-0.12
Giza 94 x Australy 13	12.83**	-1.64**	-5.79**	-4.76**	-0.15
Giza 94 x BBB	3.81**	0.41	-0.31*	8.41**	0.73
Giza 86 x 10229	23.35**	1.32**	0.31*	4.58**	1.42**
Giza 86 xUzbekistan	11.01**	7.59**	-1.56**	2.52**	2.51**
Giza 86 x C.B. 58	11.91**	4.86**	2.50**	-1.27**	1.61**
Giza 86 x Australy 13	19.38**	4.05**	-0.94**	0.79**	2.52**
Giza 86 x BBB	22.31**	2.63**	1.88**	8.41**	1.18*
Giza 76 x 10229	21.58**	-0.10	-69.16**	12.93**	0.12
Giza 76 xUzbekistan	17.56**	0.61	-69.07**	0.00	-0.04
Giza 76 x C.B. 58	16.18**	4.24**	-69.84**	3.45**	-2.34**
Giza 76 x Australy 13	19.91**	-2.32**	-69.75**	6.03**	-1.87**
Giza 76 x BBB	19.13**	2.72**	-68.09**	9.35**	-1.36**
Giza 75 x 10229	-10.14**	5.42**	0.32*	3.51**	3.56**
Giza 75 xUzbekistan	-6.14**	0.71	-1.31**	0.88**	2.39**
Giza 75 x C.B. 58	9.16**	-1.23**	0.00	-0.88**	1.33**
Giza 75 x Australy 13	4.27**	0.51	-2.94**	-0.88**	1.45**
Giza 75 x BBB	-2.53**	0.82	0.94**	8.41**	1.53**
Giza 68 x 10229	9.96**	2.10**	7.03**	24.51**	0.51
Giza 68 xUzbekistan	12.48**	3.20**	-0.64**	17.65**	0.12
Giza 68 x C.B. 58	17.20**	1.50**	5.11**	13.73**	-0.39
Giza 68 x Australy 13	4.13**	1.40**	-0.32*	14.71**	-0.66
Giza 68 x BBB	13.71**	1.80**	-0.31*	15.69**	-1.01*
LSD 0.05	0.24	0.84	0.30	0.28	0.94
0.01	0.31	1.10	0.39	0.37	1.22

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

Also, results indicated that twenty four crosses out of thirty F_1 crosses for L% relative to heterosis over mid-parent had been positive and significant which ranged from (0.66%) to (14.41%) for Giza 96 x C.B.58 and Giza 76 x 10229, respectively, while, twenty two crosses seemed significant positive heterosis over better-parent which varying from (0.95%) for Giza 86 x C.B. 58 to (11.19%) for Giza 76 x 10229. Heterosis over mid-parent regarding to BW revealed that twenty crosses out of thirty F_1 crosses exhibited highly positive significant heterosis, which ranged from (1.22%) for Giza 94 x 10229 to (19.93%) for Giza 75 x BBB, while, heterosis over better-parent indicated that, sixteen crosses were positive and significantly heterosis, which ranged from (1.06%) to (17.00%) for the crosses Giza 94 x 10229 and Giza 75 x Uzbekistan, respectively.

On the other hand, heterosis over mid-parent proven that 28 out of 30 crosses were exhibited highly significant positive heterosis for SI which ranged from (0.82%) for Giza 96 x 10229 to (15.30%) for Giza 75 x C.B.58, While, Giza 96 x Uzbekistan and Giza 75 x C.B.58 recorded positive and significant heterosis over better-parent ranged from (0.33%) to (13.68%), respectively.

The results indicated that twenty nine out of thirty F_1 crosses of heterosis over mid-parents were significant with positive heterosis for LI, which ranged from (2.20%) for Giza 75 x Uzbekistan to (27.63%) for Giza 76 x 10229, while, heterosis over better parent revealed that 27 out of 30 crosses were significantly positive heterosis which ranged from (2.91%) for Giza 96 x BBB to (23.35%) for Giza 86 x 10229.

With regard to 2.5% SL, 25 out of 30 F_1 crosses had to be significant and positive heterosis over mid-parent which ranged from (0.91%) to (7.75%) for Giza 76 x Uzbekistan and Giza 86 x Uzbekistan, respectively, whereas, heterosis over better-parent displayed that 21 out of 30 F_1 crosses were found to be significant and positive heterosis which ranged from (0.97%) to (7.59%) for Giza 96 x Uzbekistan and Giza 86 x Uzbekistan , respectively.

Concerning PI, data showed that 29 out of 30 crosses were highly significant positive heterosis over mid-parent which approximately (0.48%) for Giza 68 x BBB and (9.00%) for Giza 96 x Australy13, while heterosis over better-parent showed that thirteen crosses had significant positive heterosis which about from (0.31%) for Giza 86 x 10229 to (7.03%) for Giza 68 x 10229. Heterosis over mid parent revealed that twelve of thirty crosses for micronaire reading were offered highly significant with negative direction ranged from (-1.28%) for Giza 76 x Uzbekistan to (-7.69%) for Giza 86 x C.B.58, on the other side, heterosis over better-parent recorded five crosses were negative and significant heterotic effects which ranged from (-0.88%) for Giza 75 x C.B.58 and Giza 75 x Australy13 to (–6.87%) for Giza 94 x 10229. Heterosis over mid-parent indicated that twenty out of thirty crosses were significantly positive heterosis for uniformity index and ranged from (0.86%) for Giza 76 x 10229 to (4.05%) for Giza 75 x 10229, whereas heterosis over better-parent showed that eleven crosses were positive and significant which ranged from (1.04%) to (3.56%) for Giza 94 x 10229 and Giza 75 x 10229, respectively. Generally, Giza 94 x 10229 exhibited significant useful heterosis (BP) for all the studied characters. Similar results agreed with those reported by Patel *et al.* (2014), Srinivas *et al.* (2014), Usharani *et al.* (2014), Khan *et al* .(2015), Sultan *et al.*, (2018) and Al-Hibbiny *et al.*, (2019).

Combining ability estimates

The estimates of GCA and SCA in this study are presented in Tables 5 and 6. The line Giza 94 showed significant and positive GCA desirable for BW. On the other side, the variety Giza 96 was significant and positive desirable GCA effects for 2.5% SL and PI, while, Giza 68 had significant and positive desirable GCA effects for LCY/P, L% and LI.

Table 5. Estimates of general combining ability (GCA) effects of eleven cotton parents for the studied traits.

Parents	SCY/P (g)	LCY/P (g)	L %	BW (g)	SI (g)
Lines					
Giza 96	-0.53	-0.22	0.08	-0.31**	-0.35**
Giza 94	-1.39	-0.73	-0.05	0.14**	-0.22**
Giza 86	-10.35**	-3.41**	0.82**	0.11**	0.44**
Giza 76	21.50**	10.88**	1.97**	0.10*	-0.08
Giza 75	-11.75**	-7.69**	-3.08**	0.08*	0.20**
Giza 68	2.51	1.17**	0.25**	-0.13**	0.02
LSD 0.05	2.77	1.12	0.18	0.07	0.09
0.01	3.62	1.46	0.24	0.10	0.11
Testers					
10229	2.03	0.75	-0.05	0.02	0.13**
Uzbekistan	2.20	1.37**	0.42**	-0.04	0.06
C.B 58	1.61	0.16	-0.45**	0.01	0.10*
Australy 13	-12.13**	-4.90**	-0.08	-0.05	-0.21**
BBB	6.29**	2.63**	0.16*	0.06	-0.07
LSD 0.05	2.53	1.02	0.16	0.07	0.08
0.01	3.31	1.34	0.22	0.09	0.10

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

Table 5. Continued.

Parents	LI (g)	2.5% SL (mm)	PI	MR	UI
Lines					
Giza 96	-0.22**	1.55**	0.73**	0.04	1.28
Giza 94	-0.17**	-1.18**	-0.31**	0.05	0.17
Giza 86	0.52**	0.52**	0.05	0.11*	0.19
Giza 76	0.51**	-0.39**	-0.10*	0.03	-1.56
Giza 75	-0.72**	-0.71**	-0.41**	-0.19**	0.66
Giza 68	0.08*	0.21	0.03	-0.03	-0.73
LSD 0.05	0.07	0.27	0.09	0.09	0.30
0.01	0.10	0.35	0.12	0.12	0.39
Testers					
10229	0.09*	0.22	0.19**	0.20**	0.61**
Uzbekistan	0.16**	0.02	-0.21**	0.03	0.31*
C.B 58	-0.08*	0.15	0.06	-0.06	-0.42**
Australy 13	-0.17**	-0.32**	-0.28**	-0.04	-0.18
BBB	0.001	-0.07	0.25**	-0.14**	-0.32**
LSD 0.05	0.07	0.24	0.09	0.08	0.27
0.01	0.09	0.32	0.11	0.11	0.35

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

Table 6. Estimate of specific combining ability (SCA) effects of the 30 F_1 crosses for studied traits.

Crosses	SCY/P (g)	LCY/P (g)	L %	BW (g)	SI (g)
Giza 96 x 10229	2.16	1.52	0.63**	-0.07	0.12
Giza 96 x Uzbekistan	2.79	0.62	-0.38	0.01	0.06
Giza 96 x C.B. 58	-11.45**	-5.41**	-0.96**	0.13	0.32**
Giza 96 x Australy 13	8.79**	4.30**	0.82**	0.03	-0.23*
Giza 96 x BBB	-2.29	-1.03	-0.11	-0.10	-0.27**
Giza 94 x 10229	0.39	-0.50	-0.63**	-0.09	0.10
Giza 94 x Uzbekistan	-3.72	-1.11	0.42*	0.07	0.07
Giza 94 x C.B. 58	8.71**	4.12	0.63**	0.08	-0.27**
Giza 94 x Australy 13	3.49	1.57	0.16	-0.04	0.17
Giza 94 x BBB	-8.87**	-4.08**	-0.58**	-0.02	-0.07
Giza 86 x 10229	-0.12	0.40	0.43*	0.24**	0.27**
Giza 86 x Uzbekistan	-0.56	-1.03	-0.73**	-0.01	-0.13
Giza 86 x C.B. 58	-0.56	-1.27	-1.13**	-0.14	-0.10
Giza 86 x Australy 13	-1.32	-0.31	0.34	0.01	0.08
Giza 86 x BBB	2.56	2.22	1.09**	-0.09	-0.13
Giza 76 x 10229	-1.20	0.25	0.58**	0.09	0.06
Giza 76 x Uzbekistan	5.63	2.87*	0.35	-0.01	0.03
Giza 76 x C.B. 58	1.76	0.03	-0.45*	-0.07	-0.24*
Giza 76 x Australy 13	-7.47*	-3.93**	-0.56**	0.06	0.10
Giza 76 x BBB	1.28	0.78	0.07	-0.07	0.06
Giza 75 x 10229	3.01	0.25	-0.83**	-0.02	-0.52**
Giza 75 x Uzbekistan	-4.26	-1.67	0.03	-0.003	-0.25*
Giza 75 x C.B. 58	-1.83	0.73	1.45**	-0.003	0.21*
Giza 75 x Australy 13	-2.79	-0.34	0.26	-0.004	0.22*
Giza 75 x BBB	5.86	1.02	-0.91**	0.03	0.35**
Giza 68 x 10229	-4.25	-1.92	-0.19	-0.15	-0.02
Giza 68 x Uzbekistan	0.12	0.32	0.31	-0.05	0.22*
Giza 68 x C.B. 58	3.38	1.80	0.47*	0.01	0.08
Giza 68 x Australy 13	-0.71	-1.29	-1.03**	-0.05	-0.34**
Giza 68 x BBB	1.47	1.09	0.44*	0.25**	0.05
LSD 0.05	6.20	2.51	0.40	0.16	0.19
0.01	8.10	3.27	0.53	0.21	0.25

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

Table 6. Continued.

Crosses	LI (g)	2.5% SL(mm)	PI	MR	UI
Giza 96 x 10229	0.24**	0.23	0.09	-0.13	-0.31
Giza 96 x Uzbekistan	-0.07	-0.56	-0.34**	0.27**	0.09
Giza 96 x C.B. 58	-0.04	-0.01	-0.11	0.04	0.18
Giza 96 x Australy 13	0.07	0.58	0.19	-0.13	0.35
Giza 96 x BBB	-0.21*	-0.24	0.17	-0.06	-0.32
Giza 94 x 10229	-0.13	0.60*	0.06	-0.20*	0.17
Giza 94 x Uzbekistan	0.16	-0.80**	0.16	0.10	-1.10**
Giza 94 x C.B. 58	0.01	0.31	0.12	0.19	0.19
Giza 94 x Australy 13	0.16	-0.26	-0.31**	-0.03	-0.08
Giza 94 x BBB	-0.20*	0.15	-0.03	-0.06	0.82*
Giza 86 x 10229	0.30**	-1.14	-0.20	0.24*	-1.05**
Giza 86 x Uzbekistan	-0.30**	1.14	0.001	-0.09	0.39
Giza 86 x C.B. 58	-0.39**	0.11	0.16	-0.17	0.14
Giza 86 x Australy 13	0.15	0.31	0.13	0.14	0.68*
Giza 86 x BBB	0.24**	-0.41	-0.09	-0.12	-0.16
Giza 76 x 10229	0.20*	-0.60*	-0.18	0.12	0.43
Giza 76 x Uzbekistan	0.13	-0.16	0.25*	-0.21*	0.60
Giza 76 x C.B. 58	-0.29**	0.91**	-0.28*	0.01	-0.64
Giza 76 x Australy 13	-0.10	-0.79**	0.08	0.09	-0.48
Giza 76 x BBB	0.06	0.63*	0.13	-0.01	0.09
Giza 75 x 10229	-0.53**	1.09**	-0.07	-0.10	0.68*
Giza 75 x Uzbekistan	-0.16	-0.004	0.03	-0.03	-0.02
Giza 75 x C.B. 58	0.52**	-1.00**	-0.10	-0.01	-0.20
Giza 75 x Australy 13	0.21*	0.03	-0.07	-0.03	-0.33
Giza 75 x BBB	-0.04	-0.12	0.21*	0.17	-0.13
Giza 68 x 10229	-0.09	-0.19	0.29**	0.05	0.07
Giza 68 x Uzbekistan	0.23**	0.38	-0.11	-0.02	0.04
Giza 68 x C.B. 58	0.19*	-0.31	0.22*	-0.06	0.33
Giza 68 x Australy 13	-0.49**	0.12	-0.02	-0.05	-0.14
Giza 68 x BBB	0.15	-0.001	-0.37**	0.08	-0.30
LSD 0.05	0.17	0.60	0.21	0.20	0.66
0.01	0.22	0.78	0.28	0.26	0.86

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

Furthermore, Giza 86 had significant and positive desirable GCA effects for L%, BW, SI, LI and 2.5% SL. Also, Giza 76 was significant and positive desirable GCA effects for SCY/P, LCY/P, L%, BW and LI. While, Giza 75 was significant and positive desirable GCA effects for BW and SI and negative desirable for MR. Although, the tester 10229 was significant and positive desirable GCA effects for SI, LI, PI and UI. Whereas, Uzbekistan had significant and positive desirable for LCY/P, L%,LI and UI. Besides, C.B.58 showed significant and positive desirable GCA effects for SI. BBB showed significant and positive desirable GCA effects for SCY/P, LCY/P, L% and PI as well as negative desirable for MR.

The results of SCA effects for crosses Giza 96 x Australy 13, Giza 86 x 10229 and Giza 75 x C.B.58 gave some of yield traits experienced strong positive SCA effects. The SCA affects for some fiber properties were non-significant but desirable in the other crosses. Similar results are accordance with Iqbal *et al.* (2005), Abdel-Hafez, *et al.* (2007), Preetha and Raveendran (2008), Dahiphale *et al.* (2015) and Kaleri *et al.* (2015) .

Proportional contribution

Proportional contribution of lines, testers and lines x testers interaction for the studied traits are presented in Table (7). Except PI, all the studied traits showed that lines were contributed higher than testers and lines x tester interaction. However, for most studied traits, the proportion contribution of lines x tester interaction was greater than that of testers. Similar results were reported by Swetha *et al*., (2018), Balcha *et al*., (2019) , Yehia and El-Hashash (2019) and Yehia *et al.* (2022).

Genetic parameters

Understanding gene action assists in the selection of parents for use in hybridization programs, as well as the selection of an acceptable breeding strategy for genetic enhancement of specific quantitative traits. As a result, to develop a successful breeding program, a plant breeder must understand the sort of gene action involved in the expression of distinct quantitative traits. Table (8) shows the genetic variance component and dominance degree ratio determined for all studied traits. Non-additive genetic variance was larger than additive genetic variance for all traits.

These findings revealed that additive effects played a relatively little role in the manifestation of these features, compared to non-additive effects. Results showed that the hybridization program would be effective in improving the majority of the traits studied. Average degree of dominance was greater than one, which indicates the existence of over-dominance for all the studied traits. Similar results were presented by Nassar (2013), Komal *et al.* (2014), Yehia and Hassan (2015) , Mokadem *et al.* (2016) and El-Shazly, (2018).

Table 7. Proportional contribution (%) of Lines, Testers and Lines x Testers interaction for studied traits.

Traits	Lines	Testers	Lines x Testers
SCY/P (g)	66.48	22.11	11.41
LCY/P (g)	74.01	15.48	10.51
L%	81.99	2.83	15.18
BW (g)	73.15	4.28	22.57
SI (g)	53.43	12.73	33.84
LI (g)	72.00	5.08	22.92
2.5% SL (mm)	69.17	3.13	27.69
PI	63.66	20.88	15.46
MR	23.73	34.50	41.77
UI	70.44	12.70	16.86

Table 8. The partitioning of the genetic variance for studied traits of cotton.

Genetic parameters	SCY/P (g)	LCY/P (g)	L %	BW (g)	SI (g)	LI (g)	2.5% SL(mm)	PI	MR	UI
σ^2E.	10.02	1.6333	0.0433	0.0067	0.01	0.0067	0.0933	0.0133	0.01	0.1133
H^2_b	80.4	86.1	95.5	66.1	87.5	93.8	83.4	81.8	54.5	73.2
H^2_n	39.9	42.2	31.5	15.3	12.5	18.8	16.0	27.3	9.1	28.3
$(\sigma^2D./\sigma^2A)^{½}$	1.01	1.02	1.43	1.83	2.45	2.00	2.05	1.41	2.24	1.26

High to moderate broad sense heritability estimates (Table 8) were found for all studied traits. (h^2_b%) estimate was the highest for L% which recorded 95.56% , while for BW and MR were recorded moderate values 66.1% and 54.5% , respectively. Narrow sense heritability estimates (h^2_n%) were ranged from 42.2% for LCY/P to 9.1% for MR. High differences between broad and narrow sense heritabilities may be due to the presence of non-fixable components in the inheritance of most studied traits. Similar results were observed by Khalifa (2010), Gopikrishnan *et al.* (2013), Farooq *et al.* (2014), Ahsan *et al.* (2015) , Khalifa *et al.,* (2016), El-Shazly (2018) and Al-Hibbiny (2020).

CONCLUSION

Mean squares of parents *vs.* crosses as indication to average heterosis over all crosses were significant for all studied characters. Giza 94 x 10229 exhibited significant useful heterosis (BP) for all the studied characters. The non-additive gene effects were predominant for all the studied characters. High differences between broad and narrow sense heritabilities were observed. Giza 86 and Giza 76 were the best combiner for yield and its yield components, while Giza 96 was the best combiner for fiber quality properties.

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تقدير المكونات الوراثية لصفات المحصول و خصائص جودة الألياف فى أقطان الباربادنس.

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الملخص

أجريت هذه الدراسة في محطة البحوث الزراعية بسخا – معهد بحوث القطن – مركز البحوث الزراعية – مصر خلال موسمي الزراعة 2021 و 2022 بهدف تقدير قوة الهجين والقدرة علي التآلف ودرجة التوريث لصفات محصول القطن الزهر / نبات (جم) ، محصول القطن الشعر / نبات (جم) ، نسبة الشعر (%) ، وزن اللوزة (جم) ، معامل البذرة (جم) ، معامل الشعر (جم) ، طول التيلة عند 2.5% (مم) ، معامل البريسلي ، قراءة الميكرونير و معامل الانتظام (%) بإستخدام طريقة تحليل السلالة x الكشاف تم تهجين ستة أصناف من القطن (كأمهات) وهي جيزة 96، جيزة 94، جيزة86 ، جيزة 76 ، جيزة 75، جيزة 68 مع خمسة تراكيب وراثية (كآباء) وهي 10229 وأوزباكستان وC.B. 58 واسترالي 13 وBBB. و تم تقييم الآباء الإحدي عشر والثلاثون هجين) في موسم 2022 في تجربة بتصميم القطاعات كاملة العشوائية ذات ثلاث مكررات. ويمكن تلخيص النتائج المتحصل عليها فيما يلي: أظهرت نتائج تحليل التباين لكل من التراكيب الوراثية ، الآباء ، الهجن والآباء x الهجن وجود فروق معنوية لجميع الصفات المدروسة فيما عدا صفة قراءة الميكرونير بالنسبة للهجن. أظهر الهجين جيزة 94 x 10229 معنوية مرغوبة لقوة الهجين (نسبة للأب الأفضل) لجميع الصفات المدروسة. أظهرا الصنفان جيزة 86 وجيزة 76 قدرة عامة علي التآلف لمعظم الصفات المحصولية المدروسة وعلى الجانب الأخر أظهر الصنف جيزة 96 أفضل قدرة عامة علي التآلف لمعظم صفات جودة التيلة المدروسة. أظهرت الهجن جيزة 96 x إسترالي 13 ، جيزة 86 x 10229 وجيزة 75 x C.B. 58 أعلي قدرة خاصة علي التآلف لبعض الصفات المحصولية. أظهرت نتائج المكونات الوراثية أن التباين الراجع للسيادة أعلي من التباين الإضافي لكل الصفات المدروسة. يمكن التوصية باستخدام الصنفان جيزة 86 و جيزة 76 في برامج التربية لتحسين وزيادة القدرة الإنتاجية ، بينما يمكن إستخدام الصنف جيزة 96 كأب متفوق في برامج التربية لتحسين صفات الجودة.