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ESTIMATION OF GENETIC PARAMETERS FOR SOME AGRONMIC AND TECHNOLOGICAL QUANTITATIVE TRAITS IN COTTON USING LINE X TESTER ANALYSIS

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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 (2022 and 2023). Four Egyptian cotton varieties were used as lines with four genotypes as testers, using line x tester analysis. Results indicated that the genotypes, parents, crosses, parents *vs.* crosses, lines, testers and line x tester were significant for all studied traits except uniformity index for lines. Most crosses exhibited significantly mid-parent heterosis for most studied traits, while, the crosses Giza95 x Australy13, Giza92 x Australy13, Giza93 x PimaS_6 and Giza97 x Australy13 were significant useful heterosis (better-parent) for most yield traits and fiber properties. The line Giza95 was significant and positive desirable GCA effects for most yield traits except for boll weight, while the lines Giza92 and Giza93 were significant desirable GCA effects for most fiber properties studied. As well as, the tester Australy13 was significant and positive desirable GCA effects for most yield traits studied.

The crosses Giza92 x Australy13 and Giza95x TNB1 were significant and positive desirable SCA effects for most yield studied traits. However proportion contribution of lines was higher than of lines x testers interaction and testers for most studied traits. The non-additive genetic variance was larger than additive genetic variance for most studied traits, except for seed cotton yield/plant and lint cotton yield/plant.

Heritability narrow sense (h^2_b%) estimate was obtained for lint cotton yield/plant which recorded 61.67%, while for lint percentage was recorded moderate values 7.35%. Broad sense heritability estimates (h^2_n%) were ranged from 60.85% to 91.25% for uniformity index and micronaire reading, respectively.

Generally, Giza95 and Australy13 could be used for improving high yielding cotton varieties in plant breeding programs, while Giza92 and Giza93 considered as beneficial parents for breeding programs to produce new varieties characterized with best the fiber quality.

Key words: Line x tester, Heterosis, GCA, SCA, Heritability, Cotton.

INTRODUCTION

Line x Tester mating design is an extension (modified version) of top cross method in which several testers are used. The line × tester analysis is a common approach for assessing the expression of genetic aspects of traits 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 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 traits in cotton by Arif *et al.*, (2022), Farooq *et al.*, (2023), Sukrutha *et al.*, (2023), Hottigodar *et al.*, (2023) and Balci *et al.*, (2023).

General objective of this study is to determine the magnitude of general and specific combining abilities (GCA and SCA) and provide information about the genetic variance for some traits in some cotton hybrids belonging to Gossypium barbadense. *L.*

MATERIALS AND METHODS

The mating design used for this experiment was line x tester analysis. In 2022 growing season at sakha experimental station, sixteen crosses were made using nine *G. barbadense L.* parents. The four female parents (lines) were

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Giza 92, Giza93, Giza95 and Giza97. The four male parents (testers) were TNB1, PimaS$_4$, PimaS$_6$ and Australy13. The eight parents and their sixteen F$_1$ crosses were evaluated at Sakha Agricultural Research Station in randomized complete blocks design (RCBD) with three replicates during 2023 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 (gm) / plant (SCY/P)	Lint index (g) (LI)
Lint cotton yield (g) / plant (LCY/P)	Fiber length (FL)
Lint percentage (L %)	Micronaire reading (MR)
Boll weight (g) (BW)	Fiber strength (FS)
Seed index (g) (SI)	Uniformity index (UI)

Fiber properties were estimated as fiber length at upper half means (U.H.M) mm, length uniformity index (U.I), fiber strength in grams/tex, and micronaire reading (MR). The previous fiber tests were determined using high volume Instrument (HVI) according to (A.S.T.M: D 46050 – 1998). All fiber tests were carried out at the laboratories of the Cotton Research Institute, Agricultural Research Center, under constant conditions of temperature (70^o F ± 2) and relative humidity (65 % ± 2).

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 (1979). 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

The analysis of variance for eight parents and their sixteen F$_1$ crosses of all studied characters are presented in Table (1). The results showed that genotypes, parents, crosses, parents *vs.* crosses, lines, testers and line x tester recorded highly significant for all studied traits except for uniformity index of lines. Similar results were reported by Lingaraja *et al.* (2017), Tigga *et al.*, (2017), Al-Hibbiny *et al.*, (2020), Yehia and El-Hashash (2022), Samak *et al.*, (2022) and Farooq *et al*., (2023).

Table 1. Mean squares of line x tester analysis for yield, yield components and fiber properties.

SOV	df	Seed cotton yield/plant	Lint cotton yield/plant	Lint percentage	Boll weight	Seed index
Replications	2	23.14	7.04	0.26	0.01	0.07
Genotypes	23	2232.35**	488.34**	11.59**	0.16**	1.12**
Parents	7	2963.03**	611.39**	17.47**	0.20**	0.68**
Crosses	15	1428.15**	328.68**	7.22**	0.09**	0.80**
P. *vs*. C	1	9180.62**	2021.92**	35.94**	0.95**	9.01**
Lines	3	2673.91**	606.43**	7.58**	0.12**	2.64**
Tester	3	4116.07**	954.31**	13.30**	0.14**	0.23**
Line x Tester	9	116.92**	27.55**	5.08**	0.06**	0.38**
Error	46	35.54	5.72	0.28	0.01	0.04

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

Table 1. Cont.

SOV	df	Lint index	Fiber length	Fiber strength	Micronaire reading	Uniformity index
Replications	2	0.004	0.13	0.12	0.003	0.06
Genotypes	23	2.14**	7.02**	1.07**	0.62**	4.88**
Parents	7	1.88**	7.11**	1.16**	0.86**	3.57**
Crosses	15	1.57**	4.36**	0.79**	0.51**	2.65**
P. *vs*. C	1	12.49**	46.30**	4.73**	0.67**	47.53**
Lines	3	3.59**	10.71**	1.50**	0.97**	0.50
Tester	3	1.84**	4.42**	1.27**	0.49**	8.54**
Line x Tester	9	0.80**	2.22**	0.40**	0.36**	1.40**
Error	46	0.05	0.17	0.05	0.01	0.29

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

Heterosis

The magnitude of heterosis over mid as well as better parents for traits studied are presented in Tables (2) and (3). For yield, yield components and fiber quality traits of 16 crosses. Mid- parent heterosis was positive significant and highly significant for all studied traits except for traits lint percentage of the crosses Giza97 x TNB1, fiber strength of the crosses Giza92 x TNB1 and Micronaire reading for the crosses Giza92 x TNB1, Giza93 x PimaS4, Giza93 x PimaS6, Giza93 x Australy, Giza95 x pimaS6, Giza95 x Australy, Giza97 x TNB1, Giza97 x PimaS4 and Giza97 x PimaS4 which showed negatively significant or highly significant Mid-parent heterotic effects. With respect to heterosis better (Table 3) The results indicated that, 8 crosses showed significant or highly significant positively better-parent heterosis effect for seed cotton yield/plant and lint yield i.e. crosses Giza92 x TNB1, Giza92 x PimaS6, Giza92 x Australy13, Giza93 x TNB1, Giza93 x PimaS4, Giza93 x PimaS6, Giza93 x Australy13, Giza95 x Australy13 and Giza97 x Australy13. lint percentage traits was positively significant of the crosses Giza93 x PimaS4 and Giza97 x PimaS6. With regarding to boll weight five crosses recorded positively significant better parents of the crosses Giza92 x Australy13, Giza93 x Australy13, Giza95 x TNB1 and Giza95 x Australy13. On the other hand seed index for all crosses under studied were significant or highly significant relative to better parents except of the crosses Giza92 x TNB1, Giza92 x PimaS6, Giza93 x PimaS4, and Giza97 x TNB1. For lint index 11 crosses showed significant better parents heterosis effects for lint index trait except the crosses Giza92 x TNB1, Giza92 x PimaS6, Giza92 x TNB1, Giza93 x Australy13, Giza95 x PimaS4, and Giza97 x PimaS6 which showed insignificant better parents heterosis effects. According to fiber trait Table (3), all crosses showed derived positive or negative better parents heterosis effects except for Micronaire reading which was negatively significant better parents heterosis effects for most crosses except for the crosses Giza92 x PimaS4, Giza92 x PimaS6, Giza92 x Australy13 and Giza93 x TNB1 which recorded insignificant better parents heterosis effects. Similar results agreed with those reported by Arif *et al.* , (2022) , Abdel-Aty *et al.,* (2023), Hottigodar *et al.,* (2023) and Parmar *et al.,* (2023) .

Table 2. Heterosis relative to the mid-parent (MP) for yield, yield components and fiber properties.

Crosses	Seed cotton yield/plant	Lint cotton yield/plant	Lint percentage	Boll weight	Seed index
Giza92 x TNB1	24.30**	11.39**	1.53**	0.45**	0.36*
Giza92 x PimaS4	14.12**	7.72**	1.82**	0.36**	0.71**
Giza92 x PimaS6	20.97**	9.77**	1.48**	0.02	0.44**
Giza92 x Australy13	37.28**	19.61**	3.20**	0.34**	1.22**
Giza93 x TNB1	16.33**	8.68**	2.04**	0.19**	0.88**
Giza93 x PimaS4	25.85**	13.31**	2.91**	0.16*	0.13
Giza93 x PimaS6	24.00**	11.78**	2.33**	0.29**	0.47**
Giza93 x Australy13	30.75**	16.27**	3.21**	0.34**	0.50**
Giza95 x TNB1	28.93**	14.03**	1.62**	0.44**	1.69**
Giza95 x PimaS4	26.38**	7.85**	-1.12**	0.14*	1.08**
Giza95 x PimaS6	27.43**	13.61**	2.20**	0.20**	1.21**
Giza95 x Australy13	24.18**	11.52**	0.88*	0.23**	0.66**
Giza97 x TNB1	21.20**	5.07**	-1.99**	0.07	0.87**
Giza97 x PimaS4	8.65*	6.07**	2.23**	0.23**	0.72**
Giza97 x PimaS6	23.63**	9.90**	0.78**	0.27**	0.45**
Giza97 x Australy13	29.25**	13.28**	0.87*	0.17*	0.63**
LSD 0.05	8.52	3.42	0.75	0.13	0.30
LSD 0.01	11.40	4.57	1.01	0.17	0.40

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

Table 2. Cont.

Crosses	Lint index	Fiber length	Fiber strength	Micronaire reading	Uniformity index
Giza92 x TNB1	0.59**	1.36**	-0.68**	-0.18*	1.70**
Giza92 x PimaS4	0.88**	1.42**	1.20**	0.06	0.13
Giza92 x PimaS6	0.62**	2.31**	0.72**	0.08	2.18**
Giza92 x Australy13	1.67**	2.24**	0.55**	0.32**	3.10**
Giza93 x TNB1	1.07**	1.75**	0.11	0.01	0.37
Giza93 x PimaS4	0.83**	0.17	0.86**	-0.34**	2.04**
Giza93 x PimaS6	0.87**	2.37**	0.51**	-0.31**	1.79**
Giza93 x Australy13	1.18**	2.04**	1.01**	-0.57**	2.14**
Giza95 x TNB1	1.63**	0.96**	0.04	0.00	2.01**
Giza95 x PimaS4	0.33*	2.21**	0.73**	0.14	1.24**
Giza95 x PimaS6	1.46**	4.74**	0.01	-0.30**	2.52**
Giza95 x Australy13	0.73**	1.76**	1.34**	-1.03**	3.37**
Giza97 x TNB1	0.00	1.36**	-0.08	-0.38**	0.68*
Giza97 x PimaS4	1.11**	-0.13	1.30**	-0.43**	-0.18
Giza97 x PimaS6	0.49**	1.18**	0.12	-0.25**	2.30**
Giza97 x Australy13	0.68**	1.48**	0.98**	-0.08	2.18**
LSD 0.05	0.31	0.59	0.32	0.16	0.77
LSD 0.01	0.42	0.79	0.43	0.21	1.04

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

Table 3. Heterosis relative to the better-parents (BP) for yield, yield components and fiber properties.

Crosses	Seed cotton yield/plant	Lint cotton yield/plant	Lint percentage	Boll weight	Seed index
Giza92 x TNB1	16.07**	10.59**	-0.26	0.11	0.22
Giza92 x PimaS4	-7.63	1.35	0.44	0.07	0.44*
Giza92 x PimaS6	4.40	4.97*	0.48	-0.31**	0.10
Giza92 x Australy13	27.20**	11.86**	0.43	0.19*	0.83**
Giza93 x TNB1	15.33**	6.33**	-0.27	0.00	0.37*
Giza93 x PimaS4	11.33*	10.08**	1.01*	0.02	0.03
Giza93 x PimaS6	14.67**	10.12**	0.80	0.11	0.43*
Giza93 x Australy13	13.43**	5.38**	-0.08	0.34**	0.48**
Giza95 x TNB1	-4.13	-0.64	0.58	0.16*	0.95**
Giza95 x PimaS4	-20.20**	-12.40**	-2.57**	-0.08	0.75**
Giza95 x PimaS6	-13.97**	-5.07*	0.37	-0.07	0.95**
Giza95 x Australy13	9.43*	5.40**	0.81	0.15*	0.45*
Giza97 x TNB1	0.80	-3.07	-2.16**	-0.16*	0.33
Giza97 x PimaS4	-25.27**	-7.64**	1.65**	0.05	0.60**
Giza97 x PimaS6	-5.10	-2.24	-0.18	0.05	0.40*
Giza97 x Australy13	27.17**	12.87**	0.06	0.14	0.63**
LSD 0.05	9.84	3.95	0.87	0.15	0.34
LSD 0.01	13.16	5.28	1.16	0.19	0.46

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

Table 3. Cont.

Crosses	Lint index	Fiber length	Fiber strength	Micronaire reading	Uniformity index
Giza92 x TNB1	0.25	-0.02	-0.90**	-0.37**	1.60**
Giza92 x PimaS4	0.39*	0.46	0.57**	-0.13	-0.30
Giza92 x PimaS6	0.18	0.92*	0.47*	-0.13	1.50**
Giza92 x Australy13	0.71**	0.72*	-0.20	-0.16	2.60**
Giza93 x TNB1	0.80**	0.70*	-0.02	-0.06	0.08
Giza93 x PimaS4	0.41*	-0.46	0.31	-0.65**	1.80**
Giza93 x PimaS6	0.51**	1.30**	0.34	-0.63**	1.30**
Giza93 x Australy13	0.30	0.84*	0.34	-1.17**	1.44**
Giza95 x TNB1	0.85**	-0.17	-0.50*	-0.73**	1.27**
Giza95 x PimaS4	-0.29	0.67	0.60**	-0.21*	-0.03
Giza95 x PimaS6	0.78**	3.63	-0.50*	-0.63**	1.00*
Giza95 x Australy13	0.57**	0.78*	1.33**	-1.10**	3.03**
Giza97 x TNB1	-0.39*	0.95**	-0.17	-0.90**	-0.10
Giza97 x PimaS4	0.88**	-0.13	0.80**	-0.57**	-0.43
Giza97 x PimaS6	0.20	0.75*	0.00	-0.37**	2.30**
Giza97 x Australy13	0.45*	0.92*	0.37*	-0.23*	1.00*
LSD 0.05	0.36	0.68	0.37	0.18	0.89
LSD 0.01	0.48	0.92	0.50	0.24	1.20

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

The GCA and SCA effects of parents and their crosses for different yield contributing traits are presented in Table 4 and Table 5, respectively.

The estimates of GCA effects revealed that among lines significant and positive GCA effect for Giza95 for some yield and fiber traits, while Giza92 as well as Giza93 showed significant and positive GCA effect for some fiber quality traits. One tester Australy13 identified as good general combiner in desirable direction. In case of SCA effects, the cross combinations Giza92 x Australy13 and Giza95 x TNB1 showed positive and significant SCA effects for most yield components lint cotton yield/plant, lint percentage, boll weight, seed index and lint index. On the other side, the crosses Giza95 x Australy13 and Giza97 x TNB1 showed significant and positive GCA effects for some fiber quality traits. Similar results are accordance with Yehia *et al.,* (2022), Raiz *et al.,* (2023), Reddy *et al*., (2023), Bourgou *et al*., (2023) and Balci *et al.,* (2023).

Table 4. Estimates of general combining ability effects of the parental genotypes for yield, yield components and fiber traits.

Parents	Seed cotton yield/plant	Lint cotton yield/plant	Lint percentage	Boll weight	Seed index
Lines :					
Giza92	-7.23**	-3.64**	-0.56**	0.13**	-0.41**
Giza93	-14.40**	-6.39**	-0.47**	-0.07*	-0.22**
Giza95	20.17**	9.87**	1.16**	0.03	0.67**
Giza97	1.45	0.16	-0.14	-0.09**	-0.03
LSD 0.05	3.48	1.40	0.31	0.05	0.12
LSD 0.01	4.65	1.87	0.41	0.07	0.16
Testers :					
TNB1	-0.38	-1.19*	-0.64**	-0.02	-0.16*
PimaS4	-17.84**	-7.82**	-0.39*	-0.03	-0.03
PimaS6	-7.40**	-3.72**	-0.53**	-0.10**	0.02
Australy13	25.61**	12.73**	1.57**	0.16**	0.18**
LSD 0.05	3.48	1.40	0.31	0.05	0.12
LSD 0.01	4.65	1.87	0.41	0.07	0.16

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

Table 4. Cont.

Parents	Lint index	Fiber length	Fiber strength	Micronaire reading	Uniformity index
Lines :					
Giza92	-0.42**	1.08**	0.15*	0.09*	0.05
Giza93	-0.30**	0.50**	0.23**	-0.40**	0.05
Giza95	0.79**	-0.84**	-0.53**	0.26**	-0.29
Giza97	-0.07	-0.75**	0.15*	0.06*	0.20
LSD 0.05	0.13	0.24	0.13	0.06	0.32
LSD 0.01	0.17	0.32	0.18	0.09	0.42
Testers :					
TNB1	-0.28**	-0.41**	-0.45**	-0.30**	-0.76**
PimaS4	-0.16*	-0.43**	0.31**	0.08*	-0.61**
PimaS6	-0.14*	0.87**	0.01	0.05	1.03**
Australy13	0.58**	-0.04	0.14*	0.17**	0.35*
LSD 0.05	0.13	0.24	0.13	0.06	0.32
LSD 0.01	0.17	0.32	0.18	0.09	0.42

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

Table 5. Estimates of specific combining ability effects of the 18 F_1 crosses for yield, yield components and fiber traits.

Crosses	Seed cotton yield/plant	Lint cotton yield/plant	Lint percentage	Boll weight	Seed index
Giza92 x TNB1	1.40	0.72	0.22	0.11*	-0.52**
Giza92 x PimaS4	-4.85	-1.90	-0.15	0.09	0.12
Giza92 x PimaS6	-3.25	-2.37	-0.72*	-0.22**	-0.13
Giza92 x Australy13	6.70	3.56*	0.65*	0.02	0.54**
Giza93 x TNB1	-6.64	-2.38	0.12	-0.10*	0.19
Giza93 x PimaS4	6.82	3.30*	0.33	-0.06	-0.27*
Giza93 x PimaS6	-0.29	-0.76	-0.49	0.09	0.08
Giza93 x Australy13	0.10	-0.16	0.05	0.07	0.00
Giza95 x TNB1	3.46	3.73*	1.42**	0.14*	0.33**
Giza95 x PimaS4	4.85	-1.40	-1.97**	-0.09	0.01
Giza95 x PimaS6	0.65	1.83	1.11**	-0.01	0.16
Giza95 x Australy13	-8.96*	-4.16**	-0.56	-0.05	-0.50**
Giza97 x TNB1	1.78	-2.06	-1.76**	-0.16**	0.00
Giza97 x PimaS4	-6.83	0.00	1.80**	0.06	0.14
Giza97 x PimaS6	2.90	1.30	0.11	0.14*	-0.11
Giza97 x Australy13	2.15	0.77	-0.14	-0.04	-0.04
LSD 0.05	6.96	2.79	0.61	0.10	0.24
LSD 0.01	9.31	3.73	0.82	0.14	0.32

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

Table 5. Cont.

Crosses	Lint index	Fiber length	Fiber strength	Micronaire reading	Uniformity index
Giza92 x TNB1	-0.28*	-0.13	-0.43**	-0.31**	0.45
Giza92 x PimaS4	0.04	0.37	0.28*	-0.07	-0.73*
Giza92 x PimaS6	-0.30*	-0.47	0.48**	0.00	-0.07
Giza92 x Australy13	0.55**	0.23	-0.32*	0.38**	0.35
Giza93 x TNB1	0.14	0.51*	0.19	0.24**	-0.68*
Giza93 x PimaS4	-0.06	-0.63*	-0.24	-0.10	1.37**
Giza93 x PimaS6	-0.09	-0.16	0.09	-0.01	-0.27
Giza93 x Australy13	0.01	0.28	-0.04	-0.13*	-0.42
Giza95 x TNB1	0.65**	-1.11**	0.21	0.23**	0.25
Giza95 x PimaS4	-0.61	0.57*	-0.28*	0.38**	-0.13
Giza95 x PimaS6	0.45**	1.38**	-0.31*	-0.01	-0.24
Giza95 x Australy13	-0.48**	-0.84**	0.39**	-0.60**	0.11
Giza97 x TNB1	-0.51**	0.73**	0.04	-0.16*	-0.03
Giza97 x PimaS4	0.64**	-0.31	0.24	-0.21**	-0.51
Giza97 x PimaS6	-0.06	-0.74**	-0.26*	0.03	0.58
Giza97 x Australy13	-0.07	0.33	-0.02	0.34**	-0.04
LSD 0.05	0.25	0.48	0.26	0.13	0.63
LSD 0.01	0.34	0.65	0.35	0.17	0.85

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

Proportional contribution

Proportional contribution of lines, testers and lines x testers interaction for the studied traits are presented in Table (6). Most studied traits showed that lines were contributed higher than testers and lines x tester interaction. for most studied traits, However the proportion contribution of testers was greater than that of lines x tester interaction. Similar results were reported by Swetha *et al.*, (2018), Balcha *et al.*, (2019) , Yehia and El-Hashash (2022) and Yehia *et al.*, (2022).

Table 6. Proportional contributions of lines, testers and their interaction for yield, yield components and fiber traits.

Traits	Lines	Testers	Lines x Testers
Seed cotton yield/plant	37.45	57.64	4.91
Lint cotton yield/plant	36.90	58.07	5.03
Lint percentage	20.99	36.83	42.18
Boll weight	27.08	32.95	39.97
Seed index	65.89	5.82	28.29
Lint index	45.76	23.53	30.71
Fiber length	49.16	20.28	30.56
Fiber strength	37.83	32.05	30.12
Micronaire reading	38.14	19.51	42.35
Uniformity index	3.78	64.48	31.74

Genetical parameters

The genetic variance component and dominance degree ratio were calculated for all studied traits are presented in Table (7). The results indicated that the non-additive genetic variance was larger than additive genetic variance for all traits studied except for seed cotton yield/plant and lint cotton yield/plant, 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 for some traits, which indicates the existence of over-dominance for some traits. Similar results were presented by Mokadem *et al.*, (2016), El-Shazly, (2018) and Vaghela *et al.*, (2019).

Table 7. The partitioning of the genetic variance for yield, yield components and fiber traits.

Genetical parameters and heritability	Seed cotton yield/plant	Lint cotton yield/plant	Lint percentage	Boll weight	Seed index
σ^2e	11.85	1.91	0.09	0.00	0.02
σ^2A	91.06	20.91	0.15	0.002	0.03
σ^2D	27.13	7.28	1.60	0.02	0.11
$(\sigma^2D/ \sigma A)^{½}$	0.55	0.59	3.28	2.88	1.95
σ^2G	118.18	28.19	1.75	0.02	0.14
σ^2Ph	130.03	30.10	1.84	0.02	0.16
H^2_b	76.88	83.13	86.32	70.84	76.75
H^2_n	59.23	61.67	7.35	7.62	16.00

Table 7. Cont.

Genetical parameters and heritability	Lint index	Fiber length	Fiber strength	Micronaire reading	Uniformity index
σ^2e	0.02	0.06	0.02	0.00	0.09
σ^2A	0.05	0.15	0.03	0.01	0.09
σ^2D	0.25	0.68	0.12	0.12	0.37
$(\sigma^2D/\ \sigma A)^{½}$	2.18	2.14	2.05	3.34	2.06
σ^2G	0.30	0.83	0.14	0.13	0.46
σ^2Ph	0.32	0.89	0.16	0.13	0.55
H^2_b	86.45	82.86	73.56	91.25	60.85
H^2_n	15.08	14.81	14.11	7.52	11.56

Heritability

High to moderate broad sense heritability estimates (Table 7) were found for all traits studied. (h^2_b%) estimate was the highest for all studied traits. Narrow sense heritability estimates (h^2_n%) were ranged from 7.35 % for lint percentage to 61.67% for lint cotton yield/plant. High differences between broad and narrow sense heritabilities may be due to the presence of non-fixable components in the inheritance of most traits studied. Similar results were observed by Vadodariya *et al.*, (2017), El-Shazly (2018), Al-Hibbiny (2020), Farooq *et al*., (2023), Yehia *et al*., (2023) and Sukrutha *et al*., (2023).

CONCLUSIONS

Mean squares of parents *vs.* crosses as indication to average heterosis over all crosses were significant for all studied characters. Giza95 x Australy13 exhibited significant useful heterosis (BP) for most studied characters. Non-additive gene effects were predominant for all the studied characters. High differences between broad and narrow sense heritabilities were observed. Giza95 and Australy13 were the best combiner for yield and its yield components, while Giza92 and Giza93 were the best combiner for fiber quality properties.

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تقدير المكونات الوراثية لبعض الصفات المحصولية والتكنولوجية الكمية في القطن باستخدام تحليل السلالة × الكشاف

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الملخص العربى

أجريت هذه الدراسة في محطة البحوث الزراعية بسخا – معهد بحوث القطن – مركز البحوث الزراعية – مصر خلال موسمي الزراعة ٢٠٢٢ و ٢٠٢٣ بهدف تقدير قوة الهجين والقدرة علي التآلف ودرجة التوريث لصفات محصول القطن الزهر / نبات (جم) ، محصول القطن الشعر / نبات (جم) ، معدل الحليج (%) ، وزن اللوزة (جم) ، معامل البذرة (جم) ، معامل الشعر (جم) ، طول التيلة (مم) ، متانة التيلة ، قراءة الميكرونير ونسبة الانتظام (%) باستخدام طريقة تحليل السلالة × الكشاف.

تم تهجين أربعة أصناف من القطن (كأمهات) وهي جيزة ٩٢، جيزة ٩٣ ، جيزة ٩٥ ، جيزة ٩٧ مع أربع تراكيب وراثية (كآباء) وهي TNB1 ، بيما س٤ ، بيما س٦ واسترالي ١٣. و تم تقييم الثمانية آباء و الست عشر هجينا في موسم ٢٠٢٣ في تجربة مصممه بطريقة قطاعات كاملة العشوائية ذات ثلاث مكررات.

ويمكن تلخيص النتائج المتحصل عليها فيما يلي:

- أظهرت نتائج تحليل التباين لكل من التراكيب الوراثية ، الآباء ، الهجن ، الآباء x الهجن ، السلالات ، الكشافات و السلالات x الكشافات وجود فروق معنوية لجميع الصفات المدروسة فيما عدا صفة نسبة الانتظام بالنسبة للسلالات.
- أظهرت معظم الهجن وجود قوة هجين مفيدة محسوبة بالنسبة لمتوسطات الابوين لمعظم الصفات المدروسة. بينما أظهرت الهجن جيزة ٩٥ × إسترالى ١٣ ، جيزة ٩٢ × استرالي ١٣ ، جيزة ٩٣ × بيما س٦ و جيزة ٩٧ × إسترالى ١٣ أعلي قيم لقوة الهجين بالنسبة لأفضل الأباء لمعظم الصفات المحصولية و التكنولوجية المدروسة.
- أظهرا الصنف جيزة ٩٥ (كسلالة) قدرة عامة علي التآلف لكل الصفات المحصولية المدروسة ماعدا صفة وزن اللوزة، بينما أظهرا الصنفان جيزة ٩٢ وجيزة ٩٣ (كسلالات) أفضل قدرة عامة علي التآلف لمعظم صفات جودة التيلة المدروسة، علي الجانب الاخر أظهر الصنف استرالي ١٣ قدرة عامة علي التآلف لمعظم الصفات المحصولية المدروسة، أيضا أظهرت الهجن جيزة ٩٢ × إسترالي ١٣ ، جيزة ٩٥ × TNB1 أعلي قدرة خاصة علي التآلف لبعض الصفات المحصولية.
- أظهر تقدير نسبة المساهمة الي أن مساهمة السلالات أعلي من مساهمة كل من تفاعل السلالة × الكشاف والكشافات لمعظم الصفات المدروسة.
- كانت قيم المكونات الوراثية تدل علي أن التباين الراجع للسيادة كان أعلي من التباين الإضافى لغالبية الصفات المدروسة فيما عدا صفتى محصول الزهر والشعر/النبات.
- كانت أعلي قيمة لدرجة التوريث بالمعني الضيق لصفة محصول القطن الشعر/نبات (٦١.٦٧%) بينما كانت أقل قيمة لصفة معدل الحليج (٧.٣٥%). كانت درجة التوريث بالمعني الواسع تتراوح بين (٦٠.٨٥%) لصفة معامل الإنتظام و ٩١.٢٥ % لصفة قراءة الميكرونير.

الخلاصة

يوصى باستخدام الصنفان جيزة ٩٥ و استرالي ١٣ في برامج التربية لتحسين وزيادة القدرة الإنتاجية ، بينما يمكن إستخدام الصنفان جيزة ٩٢ وجيزة ٩٣ كأباء متفوقة في برامج التربية لتحسين صفات الجودة.