J. Plant Production, Mansoura Univ., Vol. 9 (6): 573 - 578, 2018

Line × Tester Analysis for Yield and Fiber Quality Traits in Egyptian Cotton under Heat Conditions

Mahrous, H.
Cotton Research Institute, Agricultural Research Center, Giza, Egypt

ABSTRACT

This research was carried out to evaluate the performance of eight Egyptian cotton genotypes and their F_1 hybrids under Upper Egypt heat conditions using Line x Tester analysis, during 2016 and 2017 seasons. In addition, to determine the combining ability, heterosis and gene action which control yielding ability and fiber traits. Eight Egyptian cotton genotypes and 15 crosses were evaluated at Shandaweel Agricultural Research Station, Sohag governorate. Analysis of variance indicated that genotypes, parents, crosses and parents vs. crosses were significant or highly significant for all the studied traits, except lint percentage in parents and parents vs. crosses, which were insignificant. The mean squares due to lines or tester (G.C.A.) were significant or highly significant for most of the studied traits. Line x Tester (S.C.A.) main squares was highly significant for most yield traits, while insignificant Line x Tester (S.C.A.) mean squares were found for all fiber quality traits. Regarding mean performance and heterosis, the varieties Giza 90, Giza 95 and Giza 86 were the best parents in yielding ability and gave high yielding crosses under heat conditions, while Giza 45 and Giza 92 were the good parents to produce the best fiber quality crosses. The results of heterosis also showed that seven crosses had positive and highly significant heterosis based on mid-parents in seed and lint cotton yield /plant and number of bolls/plant i.e., (Giza 80 x Giza 90), (Giza 86 x Giza 90), (Giza 86 x Giza 95), (Giza 87 x Giza 90), (Giza 45 x (Giza 90 x Australian)), and (Giza 92 x Giza 90), while the cross (Giza 92 x Giza 95) had better yield and fiber traits. The line Giza 86 was the best combiner for seed and lint cotton yield/plant, number of bolls/plant and seed index, while lines Giza 45 and Giza 92 were the best combiners for fiber fineness, fiber strength and fiber length. The tester Giza 90 was the best combiner for seed cotton yield/plant and lint cotton yield/plant. Four crosses exhibited positive and significant values of specific combining ability (S.C.A.) effects for seed cotton yield/plant, lint cotton yield/plant, lint percentage and number of bolls/plant. 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 variance for all fiber quality traits. Broad sense heritability (H_b%) was higher than narrow sense heritability (H_n%) for all traits and high heritability estimates in narrow sense were found for all fiber traits.

Keywords: Gossypium barbadense, Combining ability, Heterosis, Heritability.

INTRODUCTION

Improvement of yield and fiber properties in Egyptian cotton is one of the focal endeavors of cotton (*Gossypium barbadense* L.) breeding programs. It is important to assess adaptation and yielding ability of promising genotypes across heat conditions to select the superior and adaptable genotypes. Heat is one of the most important abiotic stresses influencing productivity of cotton worldwide. Cotton is sensitive to heat stress, especially at flowering and boll formation stages and the heat usually cause heavy fruit shedding in the forms of squares, flowers and small bolls. Upper Egypt, one of the measure cotton production areas, is exposed to extreme heat stress usually from June to August, during the peak time of flowering and boll loading, which caused decreasing in lint cotton yield and fiber quality. After global worming now a days, Upper Egypt temperature during summer months approaches about 45 – 50^{o} C and this beyond limit temperature stress severely affect the yielding ability and fiber properties of Egyptian cotton and cause decrease in yield and fiber traits. Therefore, breeding for high yielding ability and fiber properties in Egyptian cotton under heat condition would be beneficial in both current and future climate.

The primary objective of a plant breeding program is to develop new varieties high in yield and fiber quality. The first step in successful breeding program is to select appropriate parents. Line x Tester analysis is carried out to help breeders to design plant breeding strategy for improving many traits in future varieties and hybrids. This systematic approach is used to detect appropriate parents and crosses in terms of investigated traits. This method was applied to improve self and cross-pollinated plants (Kempthorne 1957). There have been many studies pointing out that variation in seed cotton yield and its components is governed by additive and non-additive gene action Abd El-Bary *et al.* (2008), El-Fesheikawy *et al.* (2012) and Al-Hibbiny (2015). General combining ability (G.C.A.) is defined as the performance of a line in series of cross combinations and it is useful for hybridization and selection program. On the other hand, specific combining ability (S.C.A.) is defined as the performance of hybrids in particular combination and it is important for hybrid development (Baloch *et al.* (2010).

The objectives of this study were evaluate 23 genotypes of Egyptian cotton (8 parents and 15 hybrids) under heat conditions of Upper Egypt and determine G.C.A. for parents, S.C.A. for hybrids and gene action before selecting the superior hybrids that can be utilized in breeding programs for yielding ability and fiber quality under heat conditions of Upper Egypt.

MATERIALS AND METHODS

This study was carried out during the two summer seasons of 2016 and 2017 to evaluate 8 cultivated genotypes of Egyptian cotton (*G. barbadense L.*) and their 15 F_1 crosses for yield components and fiber quality traits under heat conditions of Upper Egypt, Shandaweel Research Station, Sohag governorate. Eight genotypes of Egyptian cotton were selected as parents based on their yield and fiber traits. Three cotton genotypes Giza 90, Giza 95 and (Giza 90 ×Australian) were used as testers which selected for their well adaptation and high yielding ability under heat condition. The five cotton varieties Giza 80, Giza 86, Giza 87, Giza 45 and Giza 92 were used as lines which selected for their high yield or fiber quality and crossed in a Line x Tester mating design at Shandaweel Agricultural Research Experimental Station, A.R.C., during 2016 cotton growing seasons. Eight genotypes and their 15 F_1 hybrids were planted in a randomized complete block design (R.C.B.D.) with three replications in 2017 season. Each plot included one row 4 meters long and 0.7 meter wide. Seeds were sown in hills spaced 25 cm within a row. After full emergence, seedlings were thinned on two plants/hill. Recommended cultural practices were applied for cotton production during the two seasons.

Data were recorded on the following traits: seed cotton yield/plant in grams (S.C.Y./P.), lint yield/plant in grams (L.Y./P.), lint percentage (L.P.%), number of bolls/plant (N.B./P.), seed index in grams (S.I.), lint index in grams (L.I.), fiber fineness in Micronaire reading (M.R.), fiber strength in Pressely index (P.I.), fiber length in 2.5% span length mm (F.L.) and uniformity ratio % (U.R.%). The fiber properties were measured in the laboratories of Cotton Fiber Research Section, Cotton Research Institute according to [A.S.T.M. (1976) D-1448-59, D-1445-60T and D-1447-67].

Data were analyzed and differences were scrutinized for significance using L.S.D. 0.05 and 0.01 levels. The G.C.A. variance effects of the parents and the S.C.A. variance effects of the hybrids were calculated by the using of the Line x Tester analysis method, according to Kempthorne (1957) and Singh and Chaudhary (1979).

Heterosis was calculated as the percentage increase of the overall means of the F_1 hybrids over the mid-parent (M.P.) according to the following equations: Heterosis % = [(F_1-M.P.) / M.P.] x 100

The significance of means differences and heterosis were estimated using L.S.D. at 0.05 and 0.01 probability, described by Steel and Torrie (1980).

RESULTS AND DISCUSSION

The analysis of variance for all the studied traits of the eight parents and their 15 F_1's crosses are presented in Table 1. The data pointed out the mean squares of the genotypes, parents, crosses and parents vs. crosses were highly significant for all the studied traits, except lint percentage, which was significant in genotypes and crosses and insignificant in parents and parents vs. crosses, indicating the presence of variability among hybrids and their parents. As a consequence, the analysis of combining ability was possible. The mean squares due to lines (G.C.A.) were highly significant for all the studied traits, except number of bolls/plant, which was significant, while lint percentage and lint index were insignificant. Testers' (G.C.A.) mean squares were significant and highly significant in most studied traits revealing important role of additive type gene effects. Line x Tester (S.C.A.) mean squares was highly significant for seed cotton yield, lint yield, lint percentage and Number of bolls/plant and was significant for seed index and lint index, revealing non-additive gene effects role as dominant or epistasis. While, insignificant Line x Tester (S.C.A.) mean squares were found for all fiber quality traits, it could be due to that only additive genes were controlling the fiber traits. El-Fesheikawy *et al.* (2012), Baloch *et al.* (2014) and Al-Hibbiny (2015) found that mean squares of G.C.A. of lines and testers and S.C.A. of lines and testers and specific combining ability (S.C.A.) of Lines x Tester interactions were significant and the significance of G.C.A. and S.C.A. variances suggested that both additive and dominant genes were controlling the studied traits.

Eight genotypes of Egyptian cotton and their 15 F_1's hybrids were evaluated for their yielding ability and fiber quality traits under heat conditions of Upper Egypt, Shandaweel Research Station, Sohag governorate. The mean performances of the eight parents and their 15 F_1's hybrids for all the studied traits are presented in Table 2. The results showed that Giza 90 (T_1) was the highest yielding parent for seed cotton yield/plant (89.03), also it was the best mean performance for fiber strength (P.I.) (11.03) and uniformity ratio (U.R.%) 90 %. However, the parent (Giza 90 × Australian) (T_3) showed the highest values for lint yield, lint percentage, number of bolls/plant and lint index. Generally, the three testers were better than the five lines in yielding traits and uniformity ratio%. It could be due to, the testers (Giza90, Giza95 and Giza 90 x Australian) which were adapted to Middle and Upper Egypt conditions and show the optimum performance under heat condition. (L_1) Giza 80 (adapted for Middle Egypt) and (L_2) Giza 86 (the highest Egyptian cultivar in yielding ability) were the best lines in yield traits and uniformity ratio %, while (L4) Giza 45 and (L5) Giza 92 (Extra-long varieties) were the best lines in fiber fineness (M.R.), strength (P.I.) and fiber length (F.L.).

Respect to crosses, The results revealed that the cross L_2 x T_2 (Giza 86 x Giza 95) gave the highest means for seed cotton yield/plant (100.33) , lint yield/plant (40.20), lint percentage (40.10 %), and seed index (10.37). In the same time, the results also revealed that the highest mean performances were found for the cross L_3 x T_1 (Giza 87 x Giza90) for number of bolls/plant (35.80) and the cross L_2 x T_1 (Giza 86 x Giza90) was better or comparable with the two parents in all the yield and fiber traits. Moreover, the cross L_1 x T_1 (Giza80 x Giza90) recorded the high value of uniformity ratio % (87.30%). The cross L_4 xT_3 (Giza45 x Giza90 x Australian) recorded the high result in fiber length (34.67). The cross L_5 xT_1 (Giza92 x Giza90) showed the best performance in fiber strength (10.93) and the cross L_5 x T_2 (Giza92 x Giza95) gave the best value in fiber fineness (2.87). Generally, Giza 90 and Giza 86 were the best parents in yield and could be used in breeding programs for improving varieties possessing high yielding potential, while Giza 45 and Giza 92 could be considered as excellent parents to produce new hybrids with high fiber quality under heat conditions. It could be due to Giza-90 cultivar which has been known as the earliest and the most heat tolerant Egyptian cotton cultivar and planting in Upper Egypt and Giza-86 which has the highest yielding ability and planted in North Egypt (Delta), while Giza 45 and Giza 92 are from the best fiber properties cultivars and adapted for North Egypt (Delta).

Table 1. Mean squares of all genotypes for all yielding ability and fiber quality studied traits, evaluated under heat conditions of Upper Egypt at shandaweel research station, season 2017.

S.O.V	D.f	Traits									
		SCY/P	LY/P	LP%	NB/P	SI	LI	MR	PI	FL	UR %
Rep.	2	4.30	0.29	0.54	2.73	0.08	0.11	0.24	0.18	0.54	0.41
Genotypes	22	257.04**	60.89**	10.38*	41.20**	0.58**	0.84**	0.96**	0.41**	8.45**	9.32**
Parents (P)	7	247.82**	66.27**	9.73	31.89**	1.11**	0.10*	1.24**	0.54**	15.14**	10.64**
Crosses (C)	14	210.79**	48.73**	10.78*	34.78**	0.30**	0.66*	0.86**	0.31**	4.40**	5.55**
P *vs* C	1	969.18**	193.33**	9.35	196.18**	0.79**	1.59**	0.40*	0.91**	18.19**	52.93**
Line (L)	4	168.51**	41.09**	6.76	25.35*	0.33**	0.15	2.82**	0.81**	12.24**	16.19**
Tester (T)	2	337.49**	42.89**	8.50	33.89*	0.59**	1.45**	0.08	0.18*	3.62*	2.42
L X T	8	200.25**	54.01**	13.36**	47.96**	0.21*	0.71*	0.07	0.09	0.68	1.01
Error	44	10.69	2.38	4.80	4.99	0.08	0.32	0.06	0.05	0.73	1.94

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

Table 2. Mean performance of parents and their crosses for yielding ability and fiber properties traits, evaluated under heat conditions of Upper Egypt at shandaweel research station, season 2017.

Genotypes	Traits									
	SCY/P	LY/P	LP%	NB/P	SI	LI	MR	PI	FL	UR %
L1(Giza 80)	81.67	31.00	37.97	26.42	10.80	5.67	4.17	9.80	29.33	87.00
L2(Giza 86)	78.33	29.13	37.19	22.87	10.87	5.46	3.80	10.07	31.00	87.33
L3(Giza 87)	66.33	22.80	34.32	25.20	9.87	5.30	3.07	10.27	34.00	85.67
L4(Giza 45)	69.67	24.33	35.01	26.88	9.40	5.77	2.97	10.83	34.67	85.00
L5(Giza 92)	70.00	25.50	36.51	21.97	10.27	5.67	2.97	10.59	34.67	84.67
T1(Giza 90)	89.03	34.17	38.38	29.75	9.87	6.32	4.33	11.03	31.00	90.00
T2(Giza 95)	87.83	34.00	38.71	29.13	9.50	6.65	4.27	10.13	29.67	88.33
T3 (G.90 x Aust.)	87.00	34.27	39.41	31.15	9.30	7.00	4.40	10.10	30.33	88.67
L1 x T1	92.27	35.33	38.33	33.94	9.67	6.44	4.33	10.17	31.00	87.30
L1 x T2	80.93	30.00	37.16	27.02	10.17	5.82	4.17	10.13	30.67	87.28
L1 x T3	85.17	32.23	37.88	28.45	9.30	6.58	4.20	10.17	32.33	87.31
L2 x T1	95.17	35.67	37.49	30.78	9.70	6.19	3.97	10.03	32.00	85.67
L2 x T2	100.33	40.20	40.10	35.42	10.30	6.50	4.10	10.77	30.33	86.00
L2 x T3	84.07	31.75	37.86	30.90	9.80	6.26	4.27	10.67	32.30	85.67
L3 x T1	98.33	37.00	37.65	35.80	9.83	6.14	3.57	10.43	33.33	85.33
L3 x T2	78.70	30.77	39.09	24.63	9.90	6.51	3.43	10.70	32.30	83.67
L3 x T3	79.40	31.00	39.04	28.82	9.43	6.80	3.37	10.60	33.33	83.67
L4 x T1	83.33	32.00	38.41	30.18	9.50	6.57	3.07	10.77	34.30	85.33
L4 x T2	70.00	22.33	31.91	25.11	9.53	4.92	3.07	10.87	33.67	84.33
L4 x T3	90.10	35.33	39.23	33.19	9.40	6.87	3.03	10.87	34.67	84.67
L5 x T1	91.23	34.10	37.38	31.62	9.57	6.26	3.40	10.93	33.00	84.67
L5 x T2	91.00	34.67	38.08	29.45	10.03	6.13	2.87	10.87	33.67	84.67
L5 x T3	79.00	31.33	39.80	27.88	10.23	6.48	2.97	10.93	34.67	83.00
L.S.D $_{0.05}$	5.39	2.55	3.61	3.69	0.45	0.92	0.40	0.37	1.40	2.29
L.S.D $_{0.01}$	7.18	3.39	4.81	4.90	0.60	1.24	0.54	0.49	1.86	3.06

Heterosis based on the mid-parent (M.P.) for yield, yield components and fiber properties are presented in Table 3.

In general, positive heterosis is considered as desirable for all studied traits, except fiber fineness. Respect to yield traits, the results revealed that 7 promising crosses from the fifteen F_1 crosses showed highly significant and positive heterotic values relative to mid-parent in seed cotton yield /plant, lint cotton yield /plant and number of bolls/plant. These promising crosses were L_1xT_1 (Giza 80 x Giza 90) which gave 8.11, 8.42 and 20.84%, L_2xT_1 (Giza 86 x Giza 90) recorded 13.73, 12.70 and 16.99 %, L_2xT_2 (Giza 86 x Giza 95) showed 20.67, 27.36 and 36.23 %, L_3xT_1 (Giza 87 x Giza 90) recorded 26.58, 29.89 and 30.30 %, L_4xT_3 (Giza 45 x (Giza 90 x Australian)) showed 15.02, 20.58 and 14.39 % , L_5xT_1 (Giza 92 x Giza 90) recorded 14.73, 14.30 and 22.27 % and L_5xT_2 (Giza 92 x Giza 95) gave 15.31, 16.54 and 15.26% heterosis relative to the mid-parent (M.P) in seed and lint cotton yield /plant and number of bolls/plant, respectively.

The observed heterosis values for fiber quality traits were highly significant in the crosses produced from L_4 (Giza 45) with the three testers. Also L_5 (Giza 92) with T_2 (Giza 95) and T_3 (Giza 90 x Australian) recorded highly significant heterosis relative to the mid-parent (M.P.) for fiber fineness (M.R.) (-20.72 and -19.40 %), fiber strength (P.I.) (4.92 and 5.65 %) and fiber length (F.L.) (4.66 and 6.68 %), respectively. Moreover, L_2 (Giza 86) and L_3 (Giza 87) showed positive and significant or highly significant heterosis in fiber strength (P.I.) with the two testers (Giza 95) and (Giza 90 x Australian). Finally, only two crosses L_2xT_2(Giza 86 x Giza 95) and L_3xT_1 (Giza 87 x Giza 90) surpassed the better parent and showed significant or highly significant increases over the better parent, which recorded 14.23 and 10.45% in seed cotton yield /plant, 18.24 and 8.28% in lint yield /plant and 21.59 and 20.34% in number of bolls/plant, respectively. The same trend was obtained by El-Fesheikawy *et al.* (2012) and AL-Hibbiny (2015).

Generally, T_1 (Giza 90), T_2 (Giza 95) and L_2 (Giza 86) were the best parents in yielding ability and gave high yielding crosses under heat conditions, while Giza 45 and Giza 92 could be considered as a good parents to produce the best fiber properties crosses. These results indicated the possibility of developing hybrids with high yielding ability and fiber quality traits of Egyptian cotton using line x tester analysis and heterosis results under heat conditions of Upper Egypt.

Table 3. Heterosis relative to the mid-parent (M.P) of the 15 F_1 crosses for yielding ability and fiber properties traits evaluated under heat conditions of Upper Egypt at shandaweel research station, season 2017.

Crosses	Traits									
	SCY/P	LY/P	LP%	NB/P	SI	LI	MR	PI	FL	UR %
L1 x T1	8.11**	8.42**	0.41	20.84**	-6.43**	7.42	1.88	-2.35	2.77	-1.32
L1 x T2	-4.51	-7.69*	-3.08	-2.72	0.20	-5.52	-1.18	1.66	3.97	-0.38
L1 x T3	0.99	-1.24	-2.09	-1.16	-7.46**	3.87	-1.98	2.21	8.38**	-0.57
L2 x T1	13.73**	12.70**	-0.78	16.99*	-6.46**	5.09	-2.34	-4.93**	3.23	-3.38**
L2 x T2	20.76**	27.36**	5.67	36.23**	1.13	7.35	1.61	6.63**	0.00	-2.08
L2 x T3	1.70	0.16	-1.15	14.40*	-2.83	0.48	4.15	5.80**	5.43**	-2.65*
L3 x T1	26.58**	29.89**	3.58	30.30**	-0.41	5.68	-3.51	-2.07	2.55	-2.85*
L3 x T2	2.10	8.35*	7.05	-9.33	2.22	8.95	-6.54	4.90**	1.55	-3.83**
L3 x T3	3.57	8.64*	5.90	2.29	-1.62	10.57	-9.77	4.07*	3.62	-4.02**
L4 x T1	5.02	9.40*	4.67	6.59	-1.40	8.68	-15.89**	-1.46	4.55*	-2.48
L4 x T2	-11.11**	-23.44**	-13.43**	-10.34	0.85	-20.77**	-15.19**	3.72*	4.66*	-2.69*
L4 x T3	15.02**	20.58**	5.43	14.39*	0.53	7.60	-17.77**	3.87*	6.68**	-2.49
L5 x T1	14.73**	14.30**	-0.17	22.27**	-4.97	4.42*	-6.85	1.11	0.50	-3.05*
L5 x T2	15.31**	16.54**	1.25	15.26**	1.47	-0.49	-20.72**	4.92**	4.66*	-2.12
L5 x T3	0.64	4.84	4.85	4.97	4.55*	2.29	-19.40**	5.65**	6.68**	-4.23**
L.S.D $_{0.05}$	5.03	2.18	2.94	3.71	0.38	0.74	0.41	0.35	1.21	2.19
L.S.D $_{0.01}$	7.04	2.93	3.95	5.00	0.52	1.00	0.55	0.48	1.63	2.95

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

The general combining ability effects (G.C.A.) of the parental genotypes are shown in Table 4. Positive estimates would indicate that given parent variety is much better than the average of its group involved with it in the top crosses for all studied traits. The results indicated that the line Giza 86 had positive and highly significant or significant (G.C.A.) for seed cotton yield/plant, lint cotton yield/plant, number of bolls/plant and seed index, while significant and positive (undesirable) (G.C.A.) was detected for fiber fineness. Giza 45 had negative (undesirable) and significant or highly significant (G.C.A.) effects for all yield traits. While, Giza 45 and Giza92 had highly significant and negative (desirable) G.C.A. effects for fiber fineness (M.R.) and positive and highly significant (G.C.A.) for fiber strength (P.I.) and fiber length (F.L.). The results of testers showed that, Giza 90 had highly significant and positive G.C.A. effects for seed cotton yield/plant and lint cotton yield/plant. While, Giza 95 had highly significant and positive (G.C.A.) for seed index. (Giza 90 x Australian) showed highly significant and positive G.C.A. effects for number of bolls/plant and fiber length (F.L.), it could be due to, the three testers adapted for Middle and Upper Egypt conditions and gave the optimum performance under heat conditions of Upper Egypt (Sohag Governorate) .

Table 4. General combining ability (GCA) effects of the 5 lines and the 3 testers for yielding ability and fiber quality traits evaluated under heat conditions of Upper Egypt at shandaweel research station, season 2017.

Parents	Traits									
	SCY/P	LY/P	LP%	NB/P	SI	LI	MR	PI	FL	UR %
					Lines (Females)					
L1(G. 80)	-0.48	-0.39	-0.17	-0.81	-0.05	-0.02	0.65**	-0.44**	-1.58**	2.09**
L2(G. 86)	6.59**	2.96**	0.52	2.66**	0.18*	0.02	0.52**	-0.10	-0.69*	0.53
L3(G. 87)	-1.12	0.01	0.63	-0.04	-0.04	0.18	-0.13	-0.02	0.09	-1.02*
L4(G. 45)	-5.45**	-3.03**	-1.44*	-1.89*	-0.28**	-0.18	-0.53**	0.24**	1.31**	-0.47
L5(G. 92)	0.48	0.45	0.46	0.07	0.19*	-0.01	-0.51**	0.32**	0.87**	-1.14*
SE ±	1.20	0.50	0.67	0.85	0.09	0.17	0.09	0.08	0.28	0.50
					Testers (Males)					
T1(G. 90)	5.46**	1.91**	-0.11	-1.11	-0.11	0.02	0.08	-0.13*	-0.18	0.42
T2(G. 95)	-2.40**	-1.31**	-0.69	-0.60	0.23**	-0.32*	-0.06	0.07	-0.38	-0.04
T3 (G. 90 x Aust)	-3.06**	-0.58	0.80	1.71**	-0.12	0.30*	-0.02	0.06	0.56**	-0.38
SE ±	0.93	0.39	0.52	0.66	0.07	0.13	0.07	0.06	0.22	0.39

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

The results of specific combining ability effects (S. C. A.) for all the studied traits are presented in Table 5. The results cleared that four crosses exhibited positive and significant values of specific combining ability (S.C.A.) effects. The cross L_2 xT_2 had positive and significant or highly significant values of (S.C.A.) effects for seed cotton yield/plant, lint cotton yield/plant, lint percentage and number of bolls/plant, also showed insignificant but desirable S.C.A. effects for all the other traits. The cross L_3xT_1 showed positive and significant or highly significant values of (S.C.A.) effects for seed cotton yield/plant, lint yield/plant and number of bolls/plant. In addition, L_4xT_3 showed positive and highly significant values of (S.C.A.) effects for seed cotton yield/plant, lint yield/plant and number of bolls/plant. L_5xT_2 showed positive and highly significant values of (S.C.A.) effects for seed cotton yield/plant and lint cotton yield/plant and showed insignificant but desirable S.C.A. effects for fiber fineness (M.R.), fiber length (F.L.) and uniformity ratio (U.R.%). These results are in agreement with many studies especially with those reported by Abd El-Bary *et al.* (2008), Karademir *et al. (*2009) and AL-Hibbiny (2015).

Table 5. Specific combining ability (SCA) effects of the 15 F_1 hybrid for yielding ability and fiber quality traits, evaluated under heat conditions of Upper Egypt at shandaweel research station, season 2017.

Crosses	Traits									
	SCY/P	LY/P	LP%	NB/P	SI	LI	MR	PI	FL	UR %
L1 x T1	0.68	0.91	0.65	1.73	0.06	0.14	0.02	0.14	-0.16	-0.42
L1 x T2	-2.78	-1.20	0.06	-1.24	0.23	-0.14	-0.01	-0.10	-0.29	0.04
L1 x T3	2.1	0.30	-0.71	-0.48	-0.29*	-0.001	-0.01	-0.04	0.44	0.38
L2 x T1	-3.49	-2.11*	-0.88	-4.85**	-0.13	-0.15	-0.22	-0.33*	-0.04	-0.53
L2 x T2	9.55**	5.65**	2.31*	5.23**	0.14	0.51	0.05	0.20	0.49	0.27
L2 x T3	-6.07**	-3.54**	-1.43	-0.38	-0.01	-0.36	0.18	0.12	-0.44	0.27
L3 x T1	7.39**	2.17*	-0.84	3.66*	0.22	-0.36	0.03	-0.02	0.51	0.69
L3 x T2	-4.37*	-0.83	1.19	-2.59	-0.05	0.35	0.04	0.05	-0.29	-0.51
L3 x T3	-3.02	-1.34	-0.35	-1.07	-0.16	0.01	-0.07	-0.03	-0.22	-0.18
L4 x T1	-3.28	0.21	2.00	-1.57	0.13	0.43	-0.07	0.06	0.29	0.13
L4 x T2	-8.74**	-6.23**	-3.91**	-3.32*	-0.17	-0.88**	0.07	-0.04	-0.18	-0.40
L4 x T3	12.01**	6.03**	1.91	4.89**	0.05	0.45	-0.002	-0.02	-0.11	0.27
L5 x T1	-1.31	-1.17	-0.93	1.04	-0.27	-0.06	0.24	0.15	-0.60	0.13
L5 x T2	6.33**	2.62**	0.35	1.92	-0.14	0.16	-0.15	-0.12	0.27	0.60
L5 x T3	-5.02*	-1.45	0.58	-2.96*	0.41**	-0.11	-0.09	-0.03	0.33	-0.73
SE ±	2.08	0.87	1.17	1.48	0.15	0.29	0.16	0.14	0.48	0.87

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

The relative contribution of lines (females), testers (males) and Lines x Testers interaction by the magnitude of sum of squares of lines, testers and their interaction relative to the sum of square of crosses are shown in Table 6. The results revealed that, Lines x Testers interactions were high in magnitude than lines or testers contributions for all yield traits which ranged from 78.80 for number of bolls/plant (N.B./P.) to 40.00% for seed index (S.I.). While, the contributions of lines were higher than those of testers and Line x Tester for all fiber quality traits. The contributions of tester were slightly higher than those of line for seed cotton yield/plant and higher for lint index.

Knowledge of the nature of gene action involved in the expression of various quantitative characters is essential to plant breeders for starting breeding programs. The genetic variance components and heritability in broad and narrow senses for all the studied traits are presented in Table 6. The results indicated that the non-additive of genetic variance (dominance) was larger than additive genetic variance with respect to all yielding ability traits. These results indicated that non-additive effect play a major role in the expression of these traits, and additive effect had a minor role and the hybridization program would be effective in improvement of the yielding studied traits. While, the additive genetic variance was higher than dominance variance for all fiber quality traits revealing, an additive type of gene action controlled fiber quality traits. Basal *et al. (*2009) showed that the additive and dominance gene effects were negative or positive and significant for all yielding ability investigated traits, except seed index in populations I and III and lint percentage in pop. III.

After determined the phenotypic, genotypic and additive variances, calculated of heritability in broad and narrow senses showed that broad sense heritability (H_b%) estimates were higher than the corresponding values of narrow sense heritability (H_n%) for all studied traits. The highest broad sense heritability values were observed in lint cotton yield/plant with values of 96.09 % and the lowest was for lint percentage with value of 53.76%. Narrow sense heritability was 11.33% for lint cotton yield/plant and 22.13% for seed cotton yield/plant indicated that the values of dominance variances were more than additive in these traits. High heritability estimates in narrow sense were found for all fiber traits. It could be due to, the high contributions of additive variance in the genotypic variance (more than 60.09%) for all fiber traits, and additive variance (σ^2A) was controlling the inheritance of these traits. El-Fesheikawy *et al.* (2012) noticed that heritability value in broad sense was more than 95% for all the studied traits.

Table 6. Proportional Contribution of lines, testers and their interactions to total variance, variances and heritability in broad and narrow sense for yielding ability and fiber quality traits, evaluated under heat conditions of Upper Egypt at shandaweel research station, season 2017.

Parameters	Traits									
	SCY/P	LY/P	LP%	NB/P	SI	LI	MR	PI	FL	UR%
Lines	22.84	24.09	17.92	20.82	31.43	6.49	93.69	74.65	79.48	83.35
Testers	22.87	12.57	11.26	13.92	28.10	31.39	1.33	8.29	11.75	6.23
L x T	54.29	63.33	70.82	78.80	40.00	61.47	4.65	16.59	8.83	10.40
σ^2A	18.97	2.30	-1.00	-2.26	0.13	0.04	0.29	0.11	2.50	2.15
σ^2D	63.18	17.20	2.85	14.33	0.04	0.13	0.003	0.01	-0.03	-0.31
σ^2G	82.15	19.50	1.86	12.07	0.17	0.17	0.29	0.12	2.57	2.46
σ^2P	85.68	20.30	3.46	13.73	0.19	0.28	0.32	0.14	2.82	3.11
H_b%	95.84	96.09	53.76	87.89	86.21	61.90	90.63	87.80	91.36	79.18
H_n%	22.13	11.33	-	-	68.40	46.43	60.63	78.58	87.72	69.13

All negative values equal zero.

CONCLUSION

The results of parents and crosses performance indicated that, the Middle and Upper Egypt varieties adapted for heat conditions and gave the optimum performance in most yielding ability traits . While the North Egypt varieties were adapted for low heat conditions and showed lowest values in the same traits except Giza 86 but all these varieties were high in fiber quality properties. These results also reflect the important role of choosing the good parent before hybridization and selection for isolate high yielding crosses with good fiber quality characters from Egyptian cotton adapted to Upper Egypt heat conditions. This study isolated some superior crosses in yielding ability and fiber quality which performed well under heat conditions of Upper Egypt and these crosses could be used in breeding for high yielding ability with good fiber quality characters under heat conditions in Egyptian cotton.

REFERENCES

Abd El-Bary, A.M.R.; A.M. Soliman and H.H. El-Adly (2008) Diallel analysis for yield components and fiber traits in *Gossypium barbadense L*. J. Agric. Sci. Mansoura Univ., 33(2): 1163-1172.

AL-Hibbiny, Y.I.M. (2015) Estimation of heterosis, combining ability and gene action by using Line x Tester analysis in cotton (Gossypium barbadense L.). Egypt. J. Plant Breed. 19(2):385 – 405.

A.S.T.M. (1976) American Society for Testing and Materials. Designation, D-1445-67, D-1447-63 and D-1448-59, Philadelphia, Pa.

Baloch, A.W. ; M. J. Baloch; W. A. Jatoi and N. F. Veesar. (2010) Production of Superior F1 hybrids: genetic analysis for estimating combining ability in upland cotton (*Gossypium hirsutum L.*). J. Agric. Res. 48(4):419-428.

Baloch M. J. ; J. A. Solangi; W. A. Jatoi; I. H. Rind and F. M. Halo (2014) Heterosis and specific combining ability estimates for assessing potential crosses to develop F_1 hybrids in upland cotton. Pak. J. Agri., Agril. Engg., Vet. Sci., 30 (1): 8-18.

Basal H., A. Unay; O. Canavar and I. Yavas (2009) Combining ability for fiber quality parameters and within-boll yield components in intraspecific and interspecific cotton populations Spanish J. of Agric. Res. 7(2), 364-374.

El-Fesheikawy, A.B.A.; Mahrous, H. and Baker, KH.M.A. (2012) Line x Tester analysis for yield components and fiber properties in some of intra-specific cotton crosses of *Gossypium barbadense L*. Minia J.of Agric. Res. & Devolp. 32(6): 123-138.

Karademir C.; E. Karademir; R. Ekinci and O. Gencer (2009) Combining ability estimates and heterosis for yield and fiber quality of cotton in Line x Tester design. Not. Bot. Hort. Agrobot. Cluj 37(2): 228-233.

Kempthorne, O. (1957) An introduction to genetic statistics. Iowa State Univ., John Wiley and Sons, Inc., New York. pp. 453-471.

Singh, R.K. and B.D. Chaudhary (1979) Line x Tester analysis biometrical methods in quantitative genetic analysis. 2nd Kalyani Publishers, Daryagnai, New Delhi, India.

Steel, R.G.D. and J.H. Torrie (1980) Principles and procedures of statistics. A biometrical Approach 2nd Ed., McGraw Hill Book Company Inc., New York, U.S.A. pp 450 – 625.

تحليل السلالة x الكشاف لصفات المحصول وجودة الالياف فى القطن المصرى تحت ظروف الحرارة العالية

حمدى محروس

معهد بحوث القطن - مركزالبحوث الزراعية - الجيزة - مصر

أُجريت هذه الدراسة بمحطة بحوث جزيرة شندويل بسوهاج موسمي ٢٠١٦ و٢٠١٧ لتقييم أداء بعض أصناف القطن المصري والهُجن الناتجة منها محصوليا وتكنولوجيا تحت ظروف الحرارة لصعيد مصر (سوهاج). وقد اشتملت الدراسة على ثمانية أصناف من القطن المصرى منها خمسة أصناف استُخدمت كأمهات (سُلالات) فى التهجين هى: جيزه ٨٠، جيزه ٨٦، جيزه ٨٧، جيزه ٤٥ وجيزة ٩٢ بينما استُخدمت الاصناف جيزة ٩٠ و جيزة٠ ٩٥ و (جيزة ٩٠× استرالى) كآباء (كشاف) لتُنتج ١٥ هجين جيل أول (بنظام تزاوج السلالـة × الكشاف) خلال موسم النمو ٢٠١٦، قُيمت هذه التراكيب الوراثية المختلفة (٨ أباء و١٥ هجين فردى) فى تجربة قطاعات كاملة العشوائية بثلاث مكررات فى موسم النمو ٢٠١٧ بمحطة البحوث الزراعية بشندويل (محافظة سوهاج) لتقييم أداء الاصناف والهُجن المدروسة محصوليا وتكنولوجيا وذلك عن طريق دراسة القدرة العامة والخاصة على التآلف وكذلك دراسة قوة الهجين والفعل الجينى ومعامل التوريث تحت ظروف الحرارة لصعيد مصر (سوهاج). وكانت أهم النتائج كما يلي:كان هناك اختلافاً معنوى وعالى المعنوية بين التراكيب الوراثية للصفات المحصولية والتكنولوجية المدروسة. كما كانت قيم التباين الوراثى للقدرة العامة والخاصة على التآلف عالية المعنوية لجميع الصفات المحصولية وهذا يُبين أهمية كل من الفعل الجيني المُضيف وغير المُضيف في وراثة هذه الصفات.كانت قيم التباين الوراثى للقدرة الخاصة على التآلف غيرمعنوية لجميع الصفات التكنولوجية المدروسة وهذا يُبين ان التباين المُضيف فقط هو المؤثر فى وراثة الصفات التكنولوجية للشعر في القطن المصري.أظهرت النتائج أن أفضل الأصناف قدرة عامة على التآلف هو الصنف جيزة ٨٦ لصفات محصول القطن الزهر والشعر للنبات، عدد اللوز المُتفتح للنبات بالإضافة لمُعامل البذرة. أما الصنفان جيزة ٤٥ وجيزة ٩٢ فقد كانا أفضل الأصناف قُدرة عامة على الإئتلاف للصفات التكنولوجية لشعر القطن كالنعومة والمتانة وطول التيلة. كما كان جيزة ٩٠ أفضل كشاف لصفة محصول القطن الزهر والشعر للنبات بينما كان جيزة ٩٠ × استرالى الأفضل فى صفات عدد اللوز على النبات ومُعامل الشعر وطول التيلة.اظهرت نتائج القُدرة الخاصة للتآلف عدداً من الهُجن المُبشرة والتى يمكن استخدامها في برامج التربية لتحسين صفات المحصول (محصول القطن الزهروالشعر للنبات وعدد اللوز المُتفتح للنبات) وهذه الهُجن هى: جيزة٨٦ × جيزه ٩٥، جيزة ٨٧ × جيزه ٩٠ وكذلك الهجين جيزة ٤٥ × (جيزة ٩٠ × استرالى) و جيزة ٩٢× جيزه ٩٥ لتحسين المحصول وجودة الالياف. أظهرت النتائج أيضا أن نسبة مُساهمة تفاعل السلالة × الكشاف كانت أعلى من مُساهمة كلاً من السُلالات والكشافات لكل الصفات المحصولية المدروسة. بينما كانت نسبة مُساهمة تفاعل السلالة أعلى من مُساهمة كلاً من الكشاف والتفاعل بينهم فى الصفات التكنولوجية.كانت درجة التوريث العامة في المدى الواسع أعلى من درجة التوريث الخاصة في المدى الضيق في كل الصفات المدروسة. وكانت درجة التوريث الخاصة في المدى الضيق منخفضة فى الصفات المحصولية دليلا على انها تتاثر بفعل الجين السيادى. بينما كانت درجة التوريث الخاصة في المدى الضيق عالية جدا فى الصفات التكنولوجية للالياف دليلا على انها تتاثر بفعل الجين الاضافى. نستنتج من ذلك أنه يُمكن استخدام الأصناف ذات القدرة العامة العالية علي الإئتلاف والهُجن المُميزة الناتجة منها ذات الانتاجية العالية محصوليا وجيدة الصفات التكنولوجية في تحسين الأقطان المصرية كماً ونوعاً من خلال برامج التربية تحت ظروف الحرارة لصعيد مصر.