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Cytoplasmic and Combining Ability on Fiber Quality Traits in Intera and Interspesific Crosses of Tetraploid Cotton (*G. hirsutum* × G. *barbadense*)

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Abstract: The sixteen cross combinations were produced by a complete diallel-mating system with four varieties of tetraploid cottons (Sahel and Sepid of *G. hirsutum*, Barbadense5539 and Termeze14 of *G. barbadense*). The results showed that the *G. barbadense* species had high GCA for fiber length, uniformity, strength and seed index. The GCA: SCA ratios for the lint index, uniformity, strength, elasticity, fitness and seed index were higher than one indicating the presence of additive genetic effects for most of the studied characteristics except for fiber length (2.5%). Positive heterosis values were observed in intraspesific crosses for lint index and fitness. Also, negative hetrosis values obtained in interspesific crosses for lint index and fiber fitness. Hetrosis values were positive in all of combinations for fiber length and strength.

Key words: Cotton, *Hirsutum*, *Barbadense*, GCA, SCA, Cytoplasmic effect, Intra and interspesific crosses

INTRODUCTION

Cotton is the world's most-utilized natural textile fiber. This genus comprises about 50 diploid and tetraploid species [1]. Two tetraploid species, *G. hirsutum* L. and *G. barbadense* L., account for 90 and 5%, respectively, of the world's cotton production [2].

Genetic improvement has been hampered by the association of poor fiber properties with high yields and a lack of knowledge about genes that affect fiber properties. Kloth [3] observed progeny from crossing Acala 1517-75BRI and DPL SR-383 produced a broad range of values for each fiber trait measured. This trait is reflected in highly significant (p=0.01) variation between F2-derived families for each fiber trait [3].

Fiber quality has become increasingly more important to the textile industry in recent years because of technological changes in spinning. Many of the current high yielding, commercial, upland cotton cultivars do not possess the fiber quality desired by the textile industry. Cotton breeders are striving to meet the challenge to improve fiber quality. To improve the efficiency of developing a cultivar with high yield and acceptable fiber quality, it is important to have a better understanding of the genetic information for yield, its components and fiber traits [4].

A review of research concerning the genetic properties of agronomic and fiber traits was provided by Meredith [5]. Many recent agronomic and fiber trait studies focused on combining ability by using cultivars as diallel parents [6-8]. These studies provided a good understanding of the genetic behavior of fiber traits in cotton.

Generally, the female cultivar parents had higher additive effects for lint yield and lint percentage; however, these females generally had lower additive effects for fiber strength. Significant AA effects widely existed among parents and F2 population for lint percentage, boll weight and fiber strength. Studies showed that fiber strength may be significantly improved over that of the female parents, while the lint yield was slightly but not significantly predicted to be less than their female parents. Improving cotton fiber quality and lint yield remains challenging for cotton breeders. Many of the current high-yielding, commercial upland cultivars do no possess the fiber quality desired by the textile industry. In developing new cultivars, it is important to utilize variability from diverse plant genetic resources. This can limit vulnerability to pests and disease, while providing useful variation that can be used to form new favorable genetic combinations. To improve breeding efficiency when using diverse germplasm in developing high-yielding and acceptable

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fiber- quality cultivars, it is important to understand the genetic effects of these traits. One of the ways to improve fiber quality and cotton yield is to transfer genes into high yielding cultivars from *G. barbadense* [9].

Interogression of genes between upland and pima cotton has been a long-standing goal of cotton breeders. Traits that have been the target of interogression include high yield from upland sources and fiber quality from Pima germplasm. The degree of introgression is hindered by genetic breakdown in segregating interspecific breeding populations [10]. Combinations of upland and Pima chromatin already have been developed [11, 12].

In order to choose appropriate parents and crosses and to determine the combining abilities of parents in the early generation, the diallel analysis method has been widely used by plant breeders. The purpose of this study were to estimate the amount of heterosis, the GCA and SCA effect for fiber quality parameters among four different cotton genotypes of *G. hirsutum* and *G. barbadense* and to determine appropriate parents and crosses for the investigated traits.

MATERIALS AND METHODS

During the summer of 2005, four different cotton genotypes, Thermez 14 (line 2) and Barbadense 3395 (line 18) of *G. barbadense species*, Sepid (line 22) and Sahel (line 13) of *G. hirsutum* spesies, were crossed to produce F1 seeds. These genotypes display a continuous spectrum of morphological traits between the two parental species [13]. Parents and F1 seed was planted in the spring of 2006. Four parents and 12 hybrids were planted in randomized complete blocks. Plots consisted of four, 10m- long row with 80 cm apart. Seed cotton was produced with standard cultural practices for Golestan Provience of Iran.

Samples for lint percentage measurements and all measurements of fiber traits were made from hand- picked boll samples, ginned on a rolling gin, at hashemabad cotton research station. Seed index is the weight of 100 ginned, but not delinted seed and is an indicator of seed size or density. Lint percent, or lint fraction, is the ratio of lint to the total weight of unginned seed cotton expressed as a percentage. The fiber quality characters investigated in the study were analyzed via HVI. Micronaire is a measure of the fineness of the sample of fibers and is reported in standard micronaire units. Elongation is a measure of the elasticity of the fiber sample. The value is determined at the break point in the strength determination and is defined as a percent stretch of the fiber sample at the breaking point. Strength is the fiber strength of a bundle of fibers. Span length is the distance spanned by a specific percentage of the fibers in the test specimen when the initial starting point of the sanning in the test is considered 100%.

The 2.5% span length on the test specimen spanned by the longest 2.5% of the cotton fibers canned at the initial starting point. The 2.5% span length approximates the classers' staple.

The data for each measurement was tabulated and analyzed by Fisher's analysis of variance. The diallel analysis was used to evaluate traits that had significant variation among the parents. Griffing-type diallel analysis was applied to estimate the GCA and SCA effects.

RESULTS

Analysis of variance indicated the female parents were significantly different from each other for all investigated traits, except for fiber fitness. Also, significantly different was showed in the lint index, length 2.5%, strength, fitness and seed index for male parents (Table 1).

Female Parents Different: Four female parents used in this study varied significantly for all of traits, except for fitness (Table2). Sahel cultivars had the highest values in lint index (36.76). Barbadense 5539 and Termeze 14 genotypes had the lowest values in lint index (33.70 and 33.02, respectively) (Table 2). About of span length 2.5%, Barbadense 5539 and Termeze 14 (both of *G. barbadense* species) had the highest value (35.02, 35.03). The maximum uniformity was belonging to Barbadense 5539, Sepid and Termeze 14 genotypes. Barbadense 5539 (45.58), Sepid (44.50) and Teremeze 14 (44.68) had the highest value for fiber strength (Table 2). Termeze 14 (*G. barbadense*) had the best elasticity. Barbadense 5539 had the highest value for seed index (69.50) (Table 2).

Male Parents Different: Male parents were significantly different for lint index, length 2.5%, strength, fitness and seed index, while fiber elasticity and uniformity were not significantly different (Table 2). Sahel (36.32) had the highest lint index. Barbadense 5539 and Termeze 14 (both of *G. barbadense* species) had the best fiber length 2.5% (35.46 and 35.10, respectively) (Table 2). Also, Barbadense 5539 had the fiber strength. Sepid (*G. hirsutum*) had the highest value for fiber fitness. The maximum seed index was belonging to Barbadense 5539.

Table 1: Mean squares of yield components and agro morphological traits

Source	Degrees of freedom	Lint index	Length2.5%	Uniformity	Srength	Easticity	Ftness	Seed index
Replication	2	2.257^{ns}	0.401^{ns}	1.333^{ns}	6.706^{ns}	0.023^{ns}	0.243^{ns}	1.852^{ns}
Female	3	79.534*	9.618*	6.102*	64.932*	0.538*	0.184^{ns}	77.377*
Male	3	60.790*	16.466*	2.121^{ns}	94.653*	0.099^{ns}	1.386*	58.927*
Femalexmale	9	21.956*	26.102*	3.568^{ns}	30.500^{ns}	0.138^{ns}	0.388^{x}	21.536*
Error	30	0.767	1.877	1.350	14.103	0.097	0.140	0.851

*: significant at 0.01 level, x: significant at 0.05 level and ns: non significant

Table 2: Means of yield components and agro morphological traits for female and male parents

	Lint index	Length2.5%	Uniformity	Strength	Elasticity	Fitness	Seed index
Female							
Sahel	36.76a	33.28b	86.38b	41.28b	6.85b	3.97a	63.33c
Barbadense5539	30.50c	35.02a	87.56a	45.58a	6.76b	3.83a	69.50a
Sepid	33.7b	33.76b	87.76a	44.50a	6.79b	4.13a	66.32b
Termeze 14	33.02b	35.03a	87.98a	44.68a	7.22a	4.01a	66.98b
Male							
Sahel	36.32a	33.23b	86.98a	42.77bc	6.88a	3.82bc	63.77c
Barbadense5539	30.81c	35.46a	87.31a	48.00a	6.92a	3.63c	69.19a
Sepid	33.39b	33.30b	87.40a	41.78c	6.80a	4.42a	66.61b
Termeze 14	33.44b	35.10a	87.99a	45.49ab	7.02a	4.08b	66.56b

x Means within columns followed by the same letter(s) are not different at 0.05 probability level

Table 3: Means of yield components and agro morphological traits for hybrid combinations

	Lint index	Length2.5%	uniformity	strength	elasticity	fitness	Seed index
SahelxSahel	41.567a	29.500e	84.933d	35.800e	6.600bc	4.167abcde	58.767j
Sahelx Barbadense5539	31.373fgh	36.900a	87.233bc	46.233abc	6.800abc	3.167f	68.727cde
Sahelx Sepid	38.783b	30.400de	85.633cd	39.733cde	7.000ab	4.733a	61.217i
Sahelx Termeze14	35.303c	36.300a	87.733abc	43.367abcd	7.000ab	3.800cdef	64.697h
Barbadense5539x Sahel	30.307h	36.533a	88.300ab	43.967abcd	6.700abc	3.467ef	69.693bc
Barbadense5539x Barbadense5539	30.873gh	33.633bc	86.733bcd	50.267a	6.900abc	3.600def	69.127cd
Barbadense5539x Sepid	28.153i	35.333ab	87.800abc	41.400bcde	6.567bc	4.067abcde	71.847a
Barbadense5539x Termeze14	32.653ef	34.600abc	87.400abc	46.667abc	6.867abc	4.200abcd	67.347ef
Sepidx Sahel	38.767b	30.933de	87.900ab	42.833bcd	6.900abc	4.167abcde	61.233i
Sepidx Barbadense5539	28.787i	36.767a	88.100ab	47.733ab	6.867abc	3.800cdef	71.213ab
Sepidx Sepid	34.840cd	30.600de	86.667bcd	38.700de	6.333c	4.633ab	65.160gh
Sepidx Termeze14	32.320efg	36.733a	88.367ab	48.733ab	7.067ab	3.933bcde	67.680def
Termeze14x Sahel	34.623cd	35.967ab	86.800bcd	48.467ab	7.300a	3.467ef	65.377gh
Termeze14x Barbadense5539	32.193efg	34.533abc	87.167bc	47.767ab	7.133ab	3.967bcde	67.807def
Termeze14x Sepid	31.790fgh	36.867a	89.500a	47.267ab	7.300a	4.233abcd	68.210cdef
Termeze14x Termeze14	33.490de	32.767cd	88.467ab	43.200abcd	7.133ab	4.367abc	66.510fg

* Means within columns followed by the same letter(s) are not different at 0.05 probability level

Female x Male Crosses: Genotypes were classified for seed index. SahelxSahel had the highest value for lint index (41.57) and Sepid x Barbadense 5539 cross had the lowest lint index (28.8) (Table 3). Fiber length (2.5%) were significantly different among the crosses, where Sahel x Barbadense 5539, Sahel x Termeze 14, Barbadense 5539 x Sahel, Sepid x Barbadense 5539 and Sepid x Termeze 14 had the best length (2.5%), while Sahel x Sahel cross had the lowest length (2.5%). According to uniformity, Termeze 14 x Sepid cross had the highest uniformity (89.5) and Sahel x Sahel cross had the lowest uniformity (84.9)(Table 3). Fiber strength was

Table 4: Mean squares for yield and agro morphological GCA, SCA and GCA: SCA ratio for cotton genotypes

Source	d.f.	Lint index	Length2.5%	uniformity	strength	elasticity	fitness	Seed index
Rep	2	2.257^{ns}	0.419^{ns}	1.333^{ns}	6.706^{ns}	0.023^{ns}	0.243^{ns}	1.852^{ns}
genotypes	15	41.239*	20.845*	3.785*	50.217*	0.210^{x}	0.547*	40.182*
GCA	3	139.231*	25.273*	7.122*	125.771*	0.500*	1.275*	135.210*
SCA	6	32.857*	38.822*	3.758^{x}	41.600^{x}	0.194^{ns}	0.545*	32.227*
Recip	6	0.624^{ns}	0.654^{ns}	2.144^{ns}	21.058^{ns}	0.081^{ns}	0.184^{ns}	0.624^{ns}
Error	30	0.767	1.877	14.103	14.103	0.097	0.140	0.851
GCA: SCA		4.2	0.6	1.9	3.02	2.6	2.3	4.2

GCA= General combining ability, SCA= Specific combining ability, df= degree of freedom

Table 5: Mean mid-parent hetrosis for yield and agro morphological traits

Female	Male	Lint index	Length2.5%	Uniformity	Strength	Elasticity	Fitness	Seed index
Sahel	Barbadense5539	-5.38	5.15	1.93	2.07	-8.88178419700e-016	-0.57	5.21
Sahel	Sepid	0.57	0.62	0.97	4.03	0.48	0.5	-0.74
Sahel	Termeze14	-2.56	5.00	0.57	6.42	0.28	-0.63	2.40
Barbadense5539	Sepid	-4.39	3.93	1.25	0.08	0.10	-0.18	4.39
Barbadense5539	Termeze14	0.24	1.37	-0.32	0.48	-0.02	0.10	-0.24
Sepid	Termeze14	-2.11	5.10	1.37	7.05	0.45	-0.42	2.11

Table 6: General combining ability (GCA) effects of yield and agro morphological traits

Genotypes	Lint index	Length2.5%	Uniformity	Strength	Elasticity	Fitness	Seed index
Sahel	3.05	-1.02	-0.74	-2.48	-0.04	-0.09	-2.98
Barbadense5539	-2.84	0.97	0.01	2.28	-0.06	-0.25	2.82
Sepid	0.05	-0.74	0.16	-1.37	-0.11	0.29	-0.07
Termeze 14	-0.26	0.79	0.57	1.58	0.21	0.06	0.24

varied in female x male interactions. Sahel x Sahel hybrid was the lowest strength and Barbadense5539xBarbadense 5539 had the highest strength. Among the crosses, Termeze 14 x Sahel and Termeze 14 x Sepid had the best elasticity (both 7.3) and Sepid x Sepid had the minimum fiber elasticity. The analysis of variance for fitness indicated that difference among genotypes were highly significant ($p<0.01$). The maximum fitness was in Sahel x Sepid and the minimum fiber fitness was for Sahel x Barbadense5539 hybrid. Sahel x Sahel had the lowest value for seed index (58.8) and Barbadense 5539 x Sepid had the highest value (71.8)(Table 3).

Fiber Characters GCA and SCA: Combining ability mean squares for the characteristics are presented in Table 4. Significant GCA mean squares for lint index, length, uniformity, strength, elasticity, fitness and seed index indicated that additive genes controlled most of the fiber characteristics. For lint index, length (2.5%), uniformity, strength, fitness and seed index, significant SCA mean squares were observed, while fiber elasticity were not showed. GCA mean square values were higher compared to the SCA mean square, except for length 2.5%.

General Combining Ability Effects: Results for GCA effects are given in Tble 6. Sahel cultivar (*G. hirsutum*) had negative GCA effects for all fiber characteristics except for lint index, inverse Termeze 14 (*G. barbadense*) had the positive GCA effects for all fiber traits except for lint index. Barbadense 5539 known to have best fiber traits, had positive GCA effects for length, uniformity, strength and seed index. Negative GCA effects for Barbadense 5539 was recorded on lint index, elasticity and fitness. Sepid cultivar showed positive combiner for lint index, uniformity and fitness. Sepid had the negative GCA effects for length, strength, elasticity and seed index (Table 6).

Specific Combining Ability: SCA effect estimates for lint index, length 2.5%, uniformity strength, elasticity, fitness and seed index are presented in Table 7. SCA effects for fiber quality indicated variation among F1 hybrids. For lint index, six combinations had positive SCA effects. Sahel x Barbadense 5539, SahelxTermeze14, Barbadense 5539 x Sepid and Sepid x Temeze 14 had negative SCA effects. At all, intraspecific crosses (*G. hirsutum* x *G. hirsutum* and *G. barbadense* x *G. barbadense*) had the positive SCA effects and interspesific cross

Table 7: Specific combining ability (SCA) effects for yield and agro morphological traits

Female	Male	Lint index	Length2.5%	Uniformity	Strength	Elasticity	Fitness	Seed index
Sahel	Sahel	1.98	-2.74	1.07	-3.74	-0.22	0.37	-1.80
Sahel	Barbadense5539	-2.86	2.49	0.79	0.80	-0.05	0.29	2.80
Sahel	Sepid	2.19	-1.84	0.36	0.63	0.20	0.27	-2.26
Sahel	Termeze 14	-1.32	2.09	0.02	2.32	0.08	0.27	1.25
Barbadense5539	Barbadense5539	3.06	-2.58	-0.08	1.20	0.12	0.12	-3.04
Barbadense5539	Sepid	-2.23	1.55	-0.09	-0.85	-0.02	0.07	2.25
Barbadense5539	Termeze 14	2.03	-1.47	-0.71	-1.15	-0.05	-0.09	-2.01
Sepid	Sepid	1.26	-2.18	-0.72	-3.07	-0.35	-0.25	-1.24
Sepid	Termeze 14	-1.22	2.47	-1.01	3.29	0.18	-0.31	1.24
Termeze 14	Termeze 14	0.51	-3.09	-1.07	-4.46	-0.20	-0.32	-0.49

Table 8: Reciprocal effects for yield and agro morphological traits

Female	Nale	Lint index	Length2.5%	Uniformity	Strength	Elasticity	Fitness	Seed index
Sahel	Barbadense5539	0.53	0.18	-0.53	1.13	0.05	-0.15	-0.53
Sahel	Sepid	0.01	-0.27	-1.13	-1.55	0.05	0.28	-0.01
Sahel	Termeze 14	0.34	0.17	0.47	-2.55	-0.15	0.17	-0.34
Barbadense5539	Sepid	-0.32	-0.72	-0.15	-3.17	-0.15	0.13	0.32
Barbadense5539	Termeze 14	0.23	0.03	0.12	-0.55	-0.13	0.12	-0.23
Sepid	Termeze 14	0.26	-0.08	-0.57	0.73	-0.12	-0.15	-0.26

(*G. hirsutum* x *G.barbadense*) had the negative SCA effects for lint index. Combinations having positive SCA effects were showed for length in four combinations. *G. hirsutum* x *G. hirsutum* and *G.barbadense* x *G.barbadense* had the negative SCA effects. *G.hirsutum* x *G. barbadense* had the positive SCA effects for fiber length (2.5%). For uniformity, crosses with Sahel cultivar created the positive SCA effects and the other crosses had the negative SCA effects. Sahel x Termeze 14 and Sepid x Termeze 14 had the best combination with high SCA effects for fiber strength. Sahel x Sahel, Sepid x Sepid and Termeze 14 x Termeze 14 had the lowest negative SCA effects (-3.74, -3.07 and -4.46, respectively). Sahel x Sepid combination had the highest positive SCA effects and Sepid x Sepid combination had the lowest SCA effects for fiber elasticity. SCA effects estimates for fiber fitness indicated six combinations had the positive SCA effects. For seed index, intraspecific crosses (*G. hirsutum* x *G. hirsutum* and *G.barbadense* x *G.barbadense*) had the negative SCA effects and inverse, interspesific cross (*G.hirsutum* x *G.barbadense*) had the positive SCA effects (Table 7).

Hetrosies: Hetrosis values for the different combinations varied from negative to positive (Table 5). Lint index hetrosis was negative for *G.hirsutum* x *G.barbadense*, (Sahel x Barbadense 5539, Sahel x Termeze 14, Barbadense 5539 x Sepid and Sepid x Termeze 14 crosses). Intraspesific crosses (*G. hirsutum* x *G. hirsutum* and *G. barbadense* x *G. barbadense*) had the positive hetrosis. High hetrosis estimstes were observed for fiber length (2.5%) in Sahel x Barbadense 5539, Sahel x Termeze 14 and Sepid x Termeze 14 (5.15, 5.00 and 5.10 respectively). For fiber uniformity, Barbadense 5539 x Termeze 14 had the negative hetrosis (-0.32). Sahel x Sepid (4.03), Sahel x Termeze 14 (6.42) and Sepid x Termeze 14 (7.05) had the highest hetrosis value, while Barbadense 5539 x Sepid had the lowest hetrosis value for fiber strength. The highest hetrosis value recorded for elasticity in Sahel x Sepid and Sepid x Termeze 14 hybrids. Hetrosis for fiber fitness behaved different and negative except for Sahel x Sepid and Barbadense 5539 x Termeze 14 (intraspecific crosses, *G. hirsutum* x *G. hirsutum* and *G.barbadense* x *G.barbadense*). For seed index hetrosis, interspesific crosses (*G. hirsutum*x*G. barbadense*) had the positive effects and intraspecific cross (G. *hirsutum*x *G. hirsutum* and *G. barbadense*x*G. barbadense*) had the negative hetrosis (Table 5).

Cytoplasmic Maternal Effects: Referring to Table 8, it was observed that the cross combination of Sahel x Barbadense 5539 had the highest values (0.53) for lint index parameter. The lowest values of -0.32 for reciprocal effects was showed in Barbadense 5539xSepid. The reciprocal crosses Sahel x Barbadense 5539 and Sahel x Termeze 14 had the highest values for fiber span length (2.5%) (0.18 and 0.17, respectively). The lowest cytoplasmic effect was estimated in

Barbadense 5539 x Sepid (Table 8). For fiber fitness, the highest value (0.47) was exhibited by the hybrid Sahel x Termeze 14, the lowest values (-0.53 and -0.57, respectively) was showed in Sahel x Barbadense 5539 and Sepid x Termeze14. Sahel x Barbadense 5539 had the maximum maternal effects and Barbadense 5539 x Sepid had the minimum maternal effects. For elasticity, all of combination had the positive cytoplasmic effects except for Sahel x Barbadense 5539 and Sahel x Sepid. The highest value for fitness was estimated in Sahel x Sepid cross and the lowest value was in Sahel x Barbadense 5539 and Sepid x Termeze 14. For seed index, all of combinations had the negative cytoplasmic effects but barbadense5539xSepid had the positive cytoplasmic effects (Table 8).

DISCUSSION

There was a high level of variation for fiber quality characteristics studied among parents and F1 combinations. This suggests that selection could be done for lint index, fiber length, uniformity, strength, elasticity, fitness and seed index. Parents varied for GCA estimates. Values obtained from *G. barbadense* (Termeze 14 and Barbadense 5539) indicated the possibility a good combining ability from these parents for the some traits. Barbadense 5539 and Termeze 14 had high GCA for fiber length, uniformity, strength and seed index. High GCA effects on lint yield were reported by Echekwu and Alaba [14]. These results indicated strong additive genetic variance.

Positive SCA effects were observed for lint index, fiber length, uniformity, strength, elasticity, fitness and seed index for some of combination. The performance of these combinations indicated the possibility of improvement of these traits in the cotton breeding. Allam *et al*. [15] reported that significant mean squares for both GCA and SCA for fiber quality indicated that both additive and dominant gene effects were responsible for these characteristics. Singh [16] suggested that SCA effects do not significantly contribute to the improvement of self- pollinated crops, except where high hetrosis is feasible. However, in self-pollinated crops like cotton, the additive x additive type of component is fixable in later stages.

According to Griffing [17], GCA estimate close to zero indicates that genotype does not differ from the general mean of all crosses. Positive or negative values indicate that the respective parent is better or worse than the mean of the crosses. Barbadense 5539 and Termeze 14 were good combiner for fiber length, strength and seed index. Meredith and Brown [18] reported that Delcot 344 was a good combiner for fiber strength.

The GCA: SCA ratios for the lint index, uniformity, strength, elasticity, fitness and seed index were higher than one indicating the presence of additive genetic effects for most of the characteristics studied except for length 2.5%. El-Dahan *et al.* [19] reported similar results in their research work. Positive hetrosis values were observed in intraspecific crosses for lint index and fitness. Also, negative hetrosis values obtained in interspesific crosses for lint index and fitness. Hetrosis values were positive in all of combination for fiber length and strength. Low hetrosis values for fitness were reported by Subrahmanyam *et al.* [20]. These findings are in agreement with those obtained by Xian *et al.* [21] and Zhang and Zhang [22].

Breeding for high cotton lint yield is still the primary goal of cotton breeding programmes, but improving fiber quality has become increasingly important. *Gossypium hirsutum* is characterized by its high lint yield while *G. barbadense* has good fiber quality. Introgression of useful alleles for fiber quality from *G. barbadense* to *G. hirsutum* will be an effective way in improving fiber quality of *G. hirsutum* cultivars. In this study, we were estimated the amount of hetrosis, the GCA and SCA effect for fiber quality traits in intra and interspesific crosses. We determined the best parents to improve some traits. Also, the best hybrids were funded for the investigated traits.

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