Effects of Interspecific Hybridization on Cotton
(*Gossypium hirsutum* L.**Gossypium barbadense* L.)

Mehmet ÇOBAN[1], Aydın ÜNAY[2], Hakan ÇİFCİ[3], Birnur İLHAN[4]

[1]Cotton Research Institute, 09800 Nazilli, Turkey
[2]Department of Crop Science, Adnan Menderes University, 09100 Aydin, Turkey
[3]Sheep Breeding Research Institute, 10200 Bandırma, Turkey
[4]General Directorate of Agricultural Research and Policies, 06171 Ankara, Turkey

Abstract

The experimental material Claudia, Candia, Şahin 2000, BA 308, Naz 07 and Fantom (Gossypium hirsutum L.) were used as a female parents and Giza 45 and Avesto (Gossypium barbadense L.) used as a male parents. The selected cotton genotypes were crossed by line tester method. An experiment was carried out in randomized complete block design with four replications to assess hereditary and heterotic effects on yield components and fiber quality traits. The research was carried out at Cotton Research Institute Nazilli during the year 2011 and 2012. Positive heterosis percentage was obtained from all hybrids for fiber length and fiber strength. Standard heterosis values were positive and significant for fiber length, fiber strength and micronaire. The performance of all combinations for yield and fiber quality traits at F_1 generations showed that Claudia x Giza 45, Candia x Giza 45, Şahin 2000 x Giza 45, BA 308 x Avesto, Naz 07 x Giza 45 and Fantom x Avesto hybrid populations would be used for improve cotton lines having enhanced for fiber length with acceptable yield potentials.

Key Words : *Cotton,Line x Tester ,Heterosis*

1. INTRODUCTION

Upland cotton (*Gossypium hirsutum* L.) account for approximately 90% of the world cotton production. *Gossypium barbadense* L. with extra-long, strong and fine cotton is the second most cultivated species (Lacape et al., 2007; Yu et al., 2011). Interspecific crossing between *G.hirsutum* L. and *G. barbadense* L. is useful tool in increasing genetic diversity among elite germplasm for fiber traits such as fiber length and strength. Commercial potential of interspecific hybrids is greater than intraspecific hybrids and, less inbreeding depression in interspecific was determined (Baloch et al., 1993). Berger et al. (2011) revealed that although some interspecific crosses exhibited lower yield potential and lint percent than commercial cultivars, improvement in length and bundle strength were possibly the result of introgression from *G. barbadense* L. into *G. hirsutum* L.

Cotton breeders face the problem of selecting suitable parents and promising crosses to breed high yielding and high quality cotton varieties. The line x tester analysis is a useful tool to estimate general and specific combining abilities, heterosis value and gene action for yield and quality characteristics.

Heterosis gives an opportunity to cotton breeders to understand the basis on which parental lines could be better in the breeding program. The development of a new variety with high yield potential with fiber quality parameters is the specific target of the cotton breeders. The first step in a successful breeding program is to select appropriate parents. Line x tester analysis provides a systematic approach for the detection of appropriate parents and crosses superior in terms of the studied traits.

The objective of the present research was to determine heterosis values and to select those cultivars and F_1 crosses that were good combiners for seed cotton yields (SCY; g plant^{-1}), ginning out turn (GOT; %), boll weight (BW; gr), Number of bolls (NB), fiber length (FL; mm), fiber fineness (FF; micronaire) and fiber strength (FS; g tex^{-1}) in *hirsutum* x *barbadense* hybrid populations.

2. MATERIAL AND METHODS

The parental material for this study consisted of six Gossypium hirsutum L. genotypes Claudia, Candia, Sahin 2000, BA 308 Naz 07 and Fantom as female and two Gossypium barbadense L. testers such as Giza 45 and Avesto as male. Each line was crossed with each tester in a line x tester mating design (Kempthorne, 1957) during growing season 2011. The parents and their 12 F_1 hybrids were raised in a randomized block design with four replications at Cotton Research Institute, Nazilli in 2012. Each plot of parents and hybrids included one row. Rows were 6 m long and 0.7 m apart and plants were spaced 0.2 m within row. Data were collected on ten consecutively selected plants in each genotype for seed cotton yields (SCY; g plant^{-1}), ginning out turn (GOT; %), boll weight (BW; gr), Number of bolls (NB), fiber length (FL; mm), fiber fineness (FF; micronaire), and fiber strength (FS; g tex^{-1}).

The heterosis was calculated over parents means by using mean values of hybrids over replications by following formula.

$$\text{Heterosis} = \frac{F_1 - MP}{MP} \times 100$$

Where;

F_1 = Mean performance of a cross

MP = [(P1+P2)/2]= Mid Parent

3. RESULTS AND DISCUSSION

The results of analysis of variance for SCY, GOT, BW and NB are presented table 1. Considerably variability existed among the genotypes for studied all characters. The mean squares due to the line and testers were found to be highly significant for GOT. The mean squares due to the line x testers was found significant for SCY, BW and NB. Line x tester mean squares indicated that there is non-additive gene effects and significant heterosis values in inter-specific populations between *Gossypium hirsutum* L. x *Gossypium barbadense* L..

The results of analysis of variance for FF, FS, and FL are presented table 2. The mean squares due to the line x testers and line were found to be significant for FL and FS respectively. Heterosis values and mean values of the hybrids are shown at table 3a and table 3b. According to the our results only one hybrid Candia x Giza 45 exhibited a non-significant positively heterosis for SCY (Table 3). Unfortunately, negative heterosis for GOT was estimated in all hybrids. The data showed that all hybrids exhibited significant and substantial amount of heterosis for desired fiber quality traits such as FF, FS and FL.

Heterosis values is ranged between 31.17 %(Candia x Giza 45) to -32.76 % (Naz 07 x Avesto). Although, Claudia x Giza 45, Candia x Giza 45, Şahin 2000 x Giza 45, Şahin 2000 x Avesto and Fantom x Avesto cross combinations heterosis values were significant and positive, Candia x Avesto, BA 308 x Avesto and Naz 07 x Avesto were significant and negative values in terms of number of bolls. Similar heterosis values reported by Alam et al. (1991), Solangi et al. (2001), Ashwathama et al. (2003) and Abro et al. (2009).

Table – 1 Analysis of variance for SCY, GOT, BW and NB.

	df	SCY	GOT	BW	NB
Replications	3	602.21 *	2.80	0.31	27.84 *
Line	5	89.33	31.47 **	0.13	2.15
Tester	1	466.25	25.81 **	4.63	8.67
Line x Tester	5	587.35 *	2.82	0.71 *	21.32 *
Errror	57	73.85	3.61	0.16	2.89

*, **; Significant at 5% and 1% probability level, respectively.

Heterosis values for boll weight are changed between 22.70 % (Fantom x Avesto) to -18.71 % (Naz 07 x Giza 45). Heterosis values were positive and significant for Claudia x Avesto, Candia x Avesto, Şahin 2000 x Avesto, BA 308 x Avesto ve Fantom x Avesto cross combinations. All other combinations have significant and negative heterosis values. Meredith and Brown (1998) also reported similar results for boll weights.

Table – 2 Analysis of variance for FF, FS and FL.

	SD	Fiber Fineness	Fiber Strength	Fiber Length
Replications	3	0.07	6.44	3.37 **
Line	5	0.22	19.02 **	4.35
Tester	1	0.25	4.14	2.36
Line x Tester	5	0.06	2.77	3.55 **
Errror	57	0.14	4.51	1.22

*, **; Significant at 5% and 1% probability level, respectively.

Table – 3a Heterosis values and means of the measured characters of F_1 hybrids.

	Seed Cotton Yields			Ginning Out Turn			Boll Weigth			Number of Boll		
	Means	Heterosis		Means	Heterosis		Means	Heterosis		Means	Heterosis	
Claudia x Giza 45	68.65	27.90	*	35.90	-4.23	**	5.85	-15.45	**	14.10	17.75	**
Claudia x Avesto	59.75	20.22		37.30	-6.90	**	5.38	8.35	**	12.35	-2.76	
Candia x Giza 45	75.15	43.90	**	36.43	-2.93	**	6.30	-6.81	**	15.15	31.17	**
Candia x Avesto	49.50	2.59		37.18	-7.29	**	4.85	0.81	**	10.40	-15.27	**
Şahin 2000 x Giza 45	63.40	41.99	**	33.53	-4.59	**	5.63	-15.30	**	12.55	23.04	**
Şahin 2000 x Avesto	58.60	44.07	*	35.48	-5.93	**	5.08	8.09	**	11.90	8.92	**
BA 308 x Giza 45	52.00	-6.82		31.53	-13.84	**	5.65	-16.81	**	11.35	-7.35	**
BA 308 x Avesto	63.35	22.22		34.23	-12.61	**	5.16	6.48	**	13.40	3.28	
Naz 07 x Giza 45	67.15	6.21		37.35	-0.23		6.03	-18.71	**	13.55	-2.69	
Naz 07 x Avesto	42.85	-27.68	*	39.83	-0.47		4.96	-9.27	**	9.85	-32.76	**
Fantom x Giza 45	51.30	7.49		36.33	2.40	*	5.54	-17.48	**	10.45	-2.56	
Fantom x Avesto	66.20	51.31	**	35.85	-5.78	**	5.84	22.70	**	14.15	23.58	**

*, **; Significant at 5% and 1% probability level, respectively.

Our study showed that Claudia x Giza 45, Candia x Giza 45, Şahin 2000 x Giza 45, Şahin 2000 x Avesto and Fantom x Avesto cross combinations have positive and significant heterosis values for seed cotton yields. Heterosis values varied between 51.30 % (Fantom x Avesto) to -27.70 % (Naz 07 x Avesto). Similar heterosis values were repoted Meredith and Brown (1998) and Ashwathama et al. (2003).

Ginning out turn heterosis values were changed between 2.40 % (Fantom x Giza 45) to -13.80 % (BA 308 x Giza 45). All heterosis values were found negative except for Fantom x Giza 45 cross combination. All heterosis values were significant except Naz 07 x Giza 45 and Naz 07 x Avesto cross combinations. Similar results reported by Meredith and Bridge (1972), Meredith and Brown (1998) and Lakho et al. (2001) for ginning out turn heterosis values.

Table – 3b Heterosis values and means of the measured characters of F_1 hybrids.

	Fiber Fineness			Fiber Stregth			Fiber Length		
	Means	Heterosis		Means	Heterosis		Means	Heterosis	
Claudia x Giza 45	3.87	-8.66	**	39.20	1.32		37.32	8.21	**
Claudia x Avesto	3.75	-6.14	**	39.38	4.48	**	37.68	14.57	**
Candia x Giza 45	3.97	-5.51	**	42.15	12.55	**	37.31	11.05	**
Candia x Avesto	3.56	-10.23	**	40.90	12.21	**	37.40	16.91	**
Şahin 2000 x Giza 45	3.60	0.17		37.33	6.11	**	36.24	8.19	**
Şahin 2000 x Avesto	3.59	6.78	**	37.03	8.34	**	37.31	16.99	**
BA 308 x Giza 45	3.70	-7.50	**	40.90	14.33	**	37.42	11.21	**
BA 308 x Avesto	3.56	-5.29	**	38.43	10.50	**	36.96	15.34	**
Naz 07 x Giza 45	3.50	-16.19	**	37.33	0.34		37.25	9.46	**
Naz 07 x Avesto	3.58	-9.21	**	38.43	6.15	**	36.14	11.45	**
Fantom x Giza 45	4.11	1.86	**	39.20	7.18	**	34.12	2.05	**
Fantom x Avesto	3.86	1.61	**	38.28	7.59	**	36.82	15.69	**

*Significant at 5% level, ** Significant at 1% level.

Our results indicated that heterosis for fiber fineness were negative and it changed between 6.80 % (Şahin 2000 x Avesto) to -16.20 % (Naz 07 x Giza 45). All values were significant except for Şahin 2000 x Giza 45 combination. Davis (1978) also reported similar heterosis values for fiber fineness.

According to fiber strength heterosis values varied from 14.33 % (BA 308 x Giza 45) to 0.34 % (Naz 07 x Giza 45). All values were significant except for Claudia x Giza 45 and Naz 07 x Giza 45 combinations. Similar values were reported by Zheng-Sheng et al. (2003).

Heterosis values for fiber length were positive and it ranged between 0.34 % (Naz 07 x Giza 45) to 14.33 % (BA 308 x Giza 45). Similarly Gad et al. (1974), Davis (1978), Stoilova (1994), Meredith ve Brown (1998), Lakho et al. (2001) and Solangi et al. (2001) were calculated positive heterosis values.

Seed cotton yields varied from 42.85 to 75.15 g plant-1 and Naz 07 x Avesto and Candia x Giza 45 represented lowest and highest yield, respectively. Maximum ginning out turn was recorded in cross Naz 07 x Avesto (39.83%). Boll weight values varied 4.85 to 6.30 gram and Candia x Avesto and Candia x Giza 45 represented lowest and highest, respectively. For number of bolls varied from 9.85 (Naz 07 x Avesto) to 15.15 (Candia x Giza 45) represented lowest and highest, respectively.

Fiber fineness values varied from 3.50 to 4.11 micronaire and Naz 07 x Giza 45 and Fantom x Giza 45 represented lowest and highest, respectively. The strength of 37.68 g tex^{-1} was recorded by cross combination Claudia x Avesto. For fiber length varied from 34.12 mm (Fantom x Giza 45) to 37.68 mm (Claudia x Avesto) represented lowest and highest, respectively.

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