Yield, Yield Components and Lint Quality Traits of Some Cotton Cultivars Grown under East Mediterranean Conditions

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***Abstract*— *This study was carried out to determine yield, yield components and lint quality traits of some cotton cultivars during the cotton growing season under East Mediterranean conditions of Kahramanmaraş-Turkey. The experimental design was a randomized block design with three replications. Eighteen cotton cultivars (Delcerro, Korina, Tamcotsphinx, Aleppo-40, Kurak-2, Sealand-542, Coker-320, Dak-6, Carolina Queen, Nak-8, Siokra-133, Gürelbey, Small bract-1, NK-245, Bahar-82, Silcot-3, Acala-5 and Frego) were used as plant material. At the end of the study, it was determined that there were significant differences among the cotton cultivars for all investigated characteristics. The results showed that plant height, boll number, seed cotton weight, 100-seed weight, lint percentage, seed cotton yield, seed yield, seed oil and protein content, fiber length, fineness and strength for eighteen cotton cultivars ranged between 55.59-112.50 cm, 6.40-9.76 no. plant^{-1}, 4.40-5.83 no. boll^{-1}, 9.11-12.65 g, 35.19-43.06 %, 293.76-419.91 kg da^{-1}, 173.11-272.14 kg da-1, 17.12-22.93 %, 22.71-31.82 %, 26.00-32.80 mm, 3.50-4.60 micronaire and 25.40-40.20 g tex^{-1}, respectively. Cotton cultivar Gürelbey was distinguished with high lint percentage. Cultivar Bahar-82 gave the best results for 100-seed weight, seed cotton yield, seed yield, seed protein content and lint quality traits.*

***Keywords*— Cotton, yield, yield components, lint quality.**

I. INTRODUCTION

Cotton is an important plant used in the textile industry with natural fibers in the world. It is also used in oil and feed industry with oil and protein in seeds. According to 2017 data, 74.3 million tons of seed cotton from 32.9 million hectares of land in the world (Anonymous, 2017a). Cotton fibers can be used in many industrial areas (string, lamp roving, carpet yarn, medical cotton, plastic and gunpowder) where other cellulose is needed, especially in the textile and clothing sector. Cotton is a strategic product and plays an important role in Turkish agriculture and economy. In 2017, 501.478 hectares of cotton was cultivated and 2.4 million tons of seed cotton was produced in Turkey (Anonymous, 2017b).Although our country produces a significant amount of cotton, the country is an important cotton importer due to the higher cotton fiber demand of the cotton textile industry. For this reason, intensive agronomic and breeding studies are carried out by Turkish cotton researchers to improve the technological properties of fiber in cotton (Başal and Turgut, 2003; Mert*et al.* 2003; Karademir, 2005; Karademir *et al.* 2009; Guvercin *et al.* 2018). Additionally, production and adaptation studies are performed to determine high yield and quality cotton varieties for production areas (Killi and Aloglu, 2000; Sivaslıoglu and Gormus, 2001; Unay *et al.* 2001; Karademir *et al.* 2015).In this study, it was aimed to determine seed cotton yield, yield components and important fiber quality properties of 18 cotton varieties under Kahramanmaras ecological conditions located in East Mediterranean region.

II. MATERIALS AND METHODS

Eighteen different cotton cultivars (Delcerro, Korina, Tamcotsphinx, Aleppo-40, Kurak-2, Sealand-542, Coker-320, Dak-6, Carolina Queen, Nak-8, Siokra-133, Gurelbey, Small bract-1, NK-245, Bahar-82, Silcot-3, Acala-5 and Frego) belong to hirsutum species were grown during the 2014 growing season in Kahramanmaras, which is located in the Eastern Mediterranean region of Turkey (between 37º 36' north parallel and 46º 56' east meridians). The soils of the experimental area are alluvial soils carried by rivers and they are deposited horizontally in different layers and first class agricultural land. The pH of soils is 7.5, slightly alkaline, lime content is high (20.24%) and organic matter content (0.96%) is very low (Anonymous, 2013). Kahramanmaras province has typical Mediterranean climatic conditions with hot and dry summers and mild, rainy winters. In 2014, Average air temperature during the growing season changed from 15.6°C (April) to 26.7°C (August). The temperature at the experimental field during the growing season was convenient for cotton farming, while the temperatures of July and August were higher than the other months. There was considerable versatility in amount and distribution of precipitation from month to month. The rainfall was highest in May (52.8 mm), and this was followed by April (45.4 mm). There was an extended dry and hot period during July and August. September and October were warm, with 44.6 mm and 37.6 mm of rainfall, respectively (Anonymous, 2014).

The experimental design was a randomized complete block with four replications. Cultivars, consisting of one rows 5.0 m long with 0.70 m spacing between rows, were planted on 10 May 2014. Cotton cultivars were sown by hands, and after emergence, plants hand-thinned to the desired intra-row spacing of 0.20 m. Recommended insect and weed control methods were employed during the growing season as needed. The experimental area received 80 kg N and 80 kg P_2O_5 ha^{-1} as a seedbed application. Additional band-dressing of 80 kg N ha^{-1} was applied at the square stage. Overall 6 irrigations were applied and weeds were controlled by hoeing. In the experiment, the harvest was done twice by hand. The first harvest commenced when the cotton was approximately 70% open; the second harvest was three weeks later. In the study plant height, boll number, seed cotton weight, 100-seed weight, lint percentage, seed cotton yield, seed yield, seed oil content, seed protein content, fiber length, fiber fineness and fiber strength were investigated. Seed cotton yield was determined after hand harvesting from each plot twice and weighing the seed cotton. Harvested seed cotton was ginned with the machine of roller gin and separated as seed and lint. Seed yield (kg ha^{-1}) was calculated as: [seed percentage (%) X seed cotton yield (kg ha^{-1})]. Seed samples were collected from each plots and ground with an electric coffee mill. A small portion of ground seeds (5 g) was transferred to a disposable filter column and seed oil content was determined by the Soxhlet apparatus. Kjeldhal method was used in the determination of protein content in the samples of the cotton seed flour. After ginning, 50-g lint samples were used for determination of various quality parameters. Fiber length, fineness and strength were determined by High Volume Instrument (HVI) in Kahramanmaras Commodity Exchange fiber analysis laboratory. Analysis of variance was performed for each traits by the MSTAT-C statistical program and where F- test indicated significant effects ($p<0.05$), means were separated using Duncan test.

III. RESULTS AND DISCUSSION

A considerable variation was observed for investigated characters among cotton genotypes (Table I and II). Plant height ranged from 62.50 cm (NK-245) to 112.50 cm (Small bract-1). The variety Coker-320 (101.89 cm) ranked second in plant height closely followed by Korina (99.26 cm). The variety Silcot-3 produced highest number of bolls per plant (9.75) followed by GUrelbey (9.65), Nak-8 (9.60) and Bahar-82 (9.35). However significantly minimum number of boll per plant (6.40) was recorded in variety Carolina Queen. The differences among varieties might be due to different sympodial branches and genetic makeup. Boll number is an important yield contributing parameter. Cotton yield is a function of the number of bolls a plant produces, boll size and lint turnout (Ritchie *et al.* 2009; Sharma *et al.* 2015).

TABLE 1
AVERAGE TWO YEAR VALUES OF INVESTIGATED PROPERTIES (PH, BN, SCW, SW, LP AND SCY) OF COTTON CULTIVARS

Cultivars	PH (cm)	BN (no. plant^{-1})	SCW (g)	SW (g)	LP (%)	SCY (kg ha^{-1})
Delcerro	93.38 a-d	8.40 abc	5.42 ab	12.20 ab	36.87 b-e	4097.5 bc
Korina	99.26 abc	8.25 abc	4.87 ab	10.24 def	37.66 b-e	3615.9 fg
Tamcotsphinx	78.00 def	8.20 abc	5.10 ab	11.00 cd	37.11 b-e	3763.8 de
Aleppo-40	77.90 def	7.20 abc	4.72 ab	9.11 g	39.33 a-d	3058.5 jk
Kurak-2	89.75 b-e	7.45 abc	5.71 a	11.85 b	39.55 abc	3828.5 d
Sealand-542	83.17 b-f	7.00 abc	4.76 ab	10.55 de	39.27 a-d	2998.8 jk
Coker-320	101.89 ab	8.85 abc	4.40 b	10.66 de	34.27 e	3504.6 gh
Dak-6	94.75 a-e	6.50 bc	5.83 a	11.48 bc	38.52 b-e	3410.5 hi
Carolina Queen	79.24 c-f	6.40 c	5.10 ab	10.45 def	41.07 ab	2937.6 k
Nak-8	81.70 b-f	9.60 ab	4.50 b	10.55 de	38.85 a-d	3888.0 cd
Siokra-133	73.95 efg	8.10 abc	4.87 ab	10.78 cde	37.77 b-e	3550.2 g
Gurelbey	98.40 a-d	9.65 a	5.01 ab	11.99 ab	43.06 a	4351.2 a
Small bract-1	112.50 a	8.30 abc	4.93 ab	10.95 cd	36.16 cde	3682.7 ef
NK-245	62.50 fg	7.60 abc	5.20 ab	9.71 fg	40.94 ab	3556.8 g
Bahar-82	95.67 a-d	9.35 abc	4.99 ab	12.65 a	35.19 de	4199.1 b
Silcot-3	77.71 def	9.75 a	4.56 b	10.81 cde	35.26 de	4001.4 c
Acala-5	55.59 g	6.85 abc	5.04 ab	10.55 de	37.76 b-e	3107.2 j
Frego	82.50 b-f	8.30 abc	4.42 b	10.03 ef	36.10 cde	3301.7 i
Average	85.49	8.10	4.94	10.86	38.04	3603.0
LSD (0.05)	21.08	3.10	1.13	0.79	4.27	124.0

PH: Plant height; BN: Boll number; SCW: Seed cotton weight; SW: 100-Seed weight; LP: Lint percentage; SCY: Seed cotton yield.
Mean values the same letter in each column are not differ significantly at the 5% level.

Seed cotton weight is an important yield contributing parameter. It is evident from the data shown in Table I that seed cotton weight affected significantly by genotypes. The maximum seed cotton weight (5.83 g) was produced by Dak-6 against the minimum seed cotton weight (4.40 g) in case of Coker-320. The significant differences among the varieties for average seed cotton weight had also been reported by Ali *et al.* (2009).The diversities in 100-seed weight of cotton cultivars were statistically significant (Table I). Bahar-82 cultivar gave the highest (12.65 g) 100-seed weight while Aleppo-40 gave the lowest (9.11 g). The significant differences among varieties for 100-seed weight had also been reported by Ali *et al.* (2017). The genotype Gurelbey (43.06%) gave significantly the highest lint percentage followed by Carolina Queen (41.07%) and NK-245 (40.94%). However significantly minimum lint percentage was recorded in variety Coker-320 (34.27%). All cultivars produced lower lint percentage than 40% lint except Gurelbey, Carolina Queen and NK-245. In studies related with upland cotton, different results of lint percentage values have been reported by the researchers. Avgoulas *et al.* (2005) and Gul *et al.* (2016) reported lint percentage of 38.9-40.5%, 34.54-36.52%, respectively. Data analysis showed that Gurelbey (4351.2 kg ha^{-1}) gave the highest seed cotton yield followed by Bahar-82 (4199.1 kg ha^{-1}) and Delcerro (4097.5 kg ha^{-1}), and Carolina Queen (2937.6 kg ha^{-1}) gave the lowest seed cotton yield. In a 2-yr study in South Carolina, seed cotton yield, lint yield, and gin turnout were different among cultivars (Jones, 2001). Iqbal and Khan (2011) reported that seed cotton yield differed significantly among different genotypes. The high yielding variety Gurelbey had high boll number per plant; the low yielding variety Carolina Queen had low boll number per plant. Number of bolls per plant was significantly and positively correlated with seed cotton yield (Killi, 1995; Iqbal *et al.*2006; Salahuddin *et al.*2010).

TABLE 2
AVERAGE TWO YEAR VALUES OF INVESTIGATED PROPERTIES (SY,OC, PC, FL, FF AND FS) OF COTTON CULTIVARS

Genotypes	SY (kg ha^{-1})	OC (%)	PC (%)	FL (mm)	FF (mic.)	FS (g tex^{-1})
Delcerro	258.67ab	19.38 a-d	26.32 cd	29.15 b-e	4.55ab	35.40 b
Korina	225.41 a-e	17.74 cd	26.38 cd	29.95bc	3.85ghi	34.30bcd
Tamcotsphinx	236.70 a-d	22.93 a	24.96 hi	29.45bcd	4.35 cd	30.80 d-g
Aleppo-40	185.55 de	21.32abc	24.65i	27.30 fgh	4.00fg	28.00ghi
Kurak-2	231.43 a-d	17.23 d	25.59efg	27.61 e-h	4.35 cd	32.60 b-f
Sealand-542	182.11 de	22.26ab	25.46fgh	30.20 b	3.80 hi	32.70 b-f
Coker-320	230.35 a-d	21.17abc	26.09 de	26.00 h	3.50 j	26.40 hi
Dak-6	209.67 b-e	17.98 cd	24.67i	28.35 c-f	4.45a-d	32.30 b-f
Carolina Queen	173.11 e	19.27bcd	23.25 j	26.70gh	4.40bcd	29.50fgh
Nak-8	237.75 a-d	19.77 a-d	26.00def	28.00 d-g	3.70i	32.30 b-e
Siokra-133	220.92 a-e	20.31 a-d	26.50 cd	29.40bcd	4.10 f	33.10 b-f
Gürelbey	247.75abc	18.13 cd	26.27 cd	30.40 b	4.50abc	31.10 c-g
Small bract-1	235.10 a-d	21.30abc	24.67i	29.40bcd	4.30 de	35.25 b
NK-245	210.06 b-e	18.58 cd	27.48 b	26.75fgh	4.15ef	25.40i
Bahar-82	272.14 a	19.80 a-d	31.82 a	32.80 a	3.90gh	40.20 a
Silcot-3	259.05ab	22.28ab	26.77 c	28.35 c-f	4.40bcd	34.65bc
Acala-5	193.39cde	17.12 d	22.71 j	27.99 d-g	4.10 f	29.70 e-h
Frego	210.97 b-e	21.01abc	25.16ghi	29.20 b-e	4.60 a	30.60efg
Average	223.34	19.86	25.82	28.72	4.17	30.18
LSD (0.05)	55.77	3.59	0.62	1.62	0.17	3.69

SY: Seed yield; OC: Seed oil content; PC: Seed protein content; FL: Fiber length; FF: Fiber fineness and FS: Fiber strength

Mean values the same letters in each column are not differ significantly at the 5% level.

Seed yield was significantly affected by genotypes (Table 2). Seed yield of Bahar-82 (2721.4 kg ha^{-1}) was maximum among the cultivars by producing highest boll number per plant, 100-seed weight and seed cotton yield. The lowest seed yield was obtained from Carolina Queen (1731.1 kg ha^{-1}). Low seed cotton yield (2937.6 kg ha^{-1}) and high lint percentage (41.07%) may be the probable reason for this cultivar.

Seed oil content values of the eighteen genotypes ranged from 17.12 to 22.93%, while protein content ranged from 22.71 to 31.82%. Seed oil contents of Tamcotsphinx, Silcot-3 and Sealand-542 genotypes were 22.93%, 22.28% and 22.26%, respectively. Bahar-82 (31.82%) had the highest protein while the genotype Acala-5 (22.71%) had the lowest. Khan *et al.* (2009) showed significant variation of oil contents in cotton. Oil and protein contents of cottonseed are quantitative characteristics and both are usually negatively correlated with one another (Hanny *et al.* 1978; Wu *et al.* 2009). Significant genetic variations among cotton species and varieties in respect to cottonseed oil (17-27%) and protein (12-32%) ratios also exist (Kohel, 1980; Kohel *et al.* 1985; Wu *et al.* 2009; Dowd *et al.* 2010).

Fiber length, fineness and strength were significantly affected by genotypes (Table II). Fiber length, fineness and strength are very important characteristics regarding the fiber quality of cotton and are very useful for textile industry. Bahar-82 (31.82 mm) had the longest fiber length and this variety was followed by Gurelbey and Sealand-542. All other varieties showed a fiber length value below 30 mm. Micronaire value of cotton genotypes ranged from 3.70 to 4.60. The micronaire values of Korina, Sealand-542, Coker-320, Nak-8 and Bahar-32 genotypes were under 4.0 micronaire. These varieties had thinner fibers than others. Bahar-82 variety, which has long and fine fibers, also had the most strength fibers. Fiber strength of it was 40.20 g tex^{-1}.However, Delcerro and Small bract-1 varieties gave fiber strength values over 35 g tex^{-1}. Among genotypes, NK-245 variety (25.40 g tex^{-1}) had lower strength value compared to all other genotypes. The significant differences among varieties for fiber quality parameters had also been reported by Azhar and Naeem (2008), Foulk *et al.* (2009), Koli*et al.* (2014) and Bechere *et al.* (2016).

IV. CONCLUSION

The present study was aimed to examine different cotton genotypes under East Mediterranean climatic conditions. The results demonstrated that a considerable variation was observed for investigated characters among cotton genotypes. It is concluded from the present study that 18 cotton genotypes were identified in field conditions, and Bahar-82 were found high-efficiency and quality for seed cotton yield and fiber quality parameters such as length, fineness and strength. It was also determined that Gurelbey variety had the highest lint percentage. These genotypes (Bahar-82 and Gurelbey) could be used as genetic resources for improving seed cotton yield productivity and lint quality under East Mediterranean climatic conditions.

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