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Research Article

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Evaluation of Fiber Yield and Major Fiber Quality Characteristics of Some Cotton Genotypes

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Abstract In cotton, fiber yield, length, fineness and strength are important fiberquality parameters. This study was carried out to determine fiber yield and quality parameters (length, fineness and strength) of 46 cotton genotypes, two of which belong to barbadense and forty-four of hirsutum species, under ecological conditions of Kahramanmaras, Turkey. Based on two-year average results, cotton cultivars BA-119 (1746.30 kgha-1), ST-468 (1737.45 kgha-1), ST-488 (1696.10 kgha-1) and Furkan (1623.15 kgha-1) gave higher fiber yield per hectare than the others. Giza-45, Furkan and Baly-308 varieties yielded fiber lengths over 30 mm, while other genotypes produced shorter fiber length values. All cotton genotypes had coarse fibers ranging from 4.32-5.35micronaire. Is-1, Baly-308 and Urania cotton cultivars were distinguished with high fiber strength values.

Keywords: Cotton, fiber yield, fiber length, fiber fineness, fiber strength

Introduction

Cotton, which can be evaluated in different fields, has become a fiber plant which is traded in the world and produced a significant amount with the development of technology for processing its fibers. Its 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 one of the main raw materials of textile sector and has an important place in Turkish agriculture and economy [1]. 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. The availability of cotton fibers is directly related to the quality parameters. Length, fineness and strength are the most important quality properties of the fibers. Although it is an inherited property, these properties, which may also be affected by environmental conditions [2], directly affect yarn and fabric quality. Also, Hake *et al* [3] stated that variety is the dominant factor controlling fiber length and strength, although environmental factors such as extreme temperatures, water stress, insufficient fertilization, and unadjusted ginning can also decrease fiber length and strength. According to the average data of the last four years in Turkey, 468.000 hectares of cotton was cultivated and 838.000 tons of fiber cotton was produced [4]. The choice of cotton produced in our country by the domestic industry depends on their high fiber yields as well as their quality parameters such as length, fineness and strength at an acceptable level. For this reason, intense researches are carried out to improve fiber quality parameters in cotton [5-9]. Additionally, production and adaptation studies are performed to determine high yield and quality cotton varieties and lines suitable for production regions [10-13].

In this study, it was aimed to determine fiber yield and important fiber quality properties of 46 cotton varieties under Kahramanmaras ecological conditions.

Materials and Methods

Forty-six different cotton genotypes (Table 1), two of which belong to *barbadense* and forty-four of *hirsutum* species, were grown during the 2013 and 2014 growing seasons in Kahramanmaras, which is located in the Eastern Mediterranean region of Turkey (between 37º 36' north parallel and 46º 56' east meridians).

Table 1: Cotton genotypes used in the study

Genotip number	Genotipe name	Genotip number	Genotip name	Genotip number	Genotip name
1	ST-468	17	Beli İzvor-432	33	Cosmos
2	ST-488	18	Carmen	34	Özbek-100
3	Primera	19	Neli	35	Hersi
4	Gaia	20	ST-453	36	Samon
5	Nazilli-87	21	Baly-308	37	GSN-12
6	Taşkent-1	22	Flash	38	Dicle-2002
7	Eisa	23	Julia	39	Famosa
8	Flora	24	İs-1	40	Veret
9	Candia	25	Urania	41	Gosipolsüz-86
10	Sahel-I	26	Orgost-644	42	Tamcot-24
11	Gedera-10	27*	Giza-45	43	MaydosYerlisi
12	BA-119	28	Bulgar-33	44	BA-525
13	Cascot-2910	29	Gacot-79	45	Gloria
14	ST-373	30	Fibermax-832	46	Furkan
15	Aleppo-1	31*	Giza-70		
16	Zeta-2	32	Claudia		

*) *barbadense* cotton cultivars.

The soils where the experiment was established are alluvial soils carried by rivers and they are deposited horizontally in different layers. The slope of the land is close to flat, deep, good drainage, clayey-loam body and first class agricultural land. The pH of the experimental area soils is 7.5, slightly alkaline, lime content is high (20.24 %) and organic matter content (0.96 %) is very low [14]. Kahramanmaras province has typical Mediterranean climatic conditions with hot and dry summers and mild, rainy winters. Climatic data were obtained at the nearest climate station placed about 5 km from the experimental area. Mean temperature, total rainfall, and humidity are given in Table 2.

Average air temperature during the growing season changed from 17.2°C (April) to 28.8°C (July) in 2013, and from 12.5°C to 26.7°C in 2014, respectively. 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, and this was followed by April. There was an extended dry and hot period during July and August when only an average of 1.9 mm precipitation occurred. September was warm, with 37.9 mm and 44.6 mm of rainfall, for 2013 and 2014, respectively.

Table 2: Some climatological data of the research location during April - October in 2013 and 2014 throughout the growing season

Months	Mean temperature (°C)		Relative humidity (%)		Rainfall (mm)	
	2013	2014	2013	2014	2013	2014
April	17.2	15.6	51.9	32.7	65.9	45.4
May	22.2	16.1	51.0	41.3	76.5	52.8
June	25.6	20.4	41.5	44.9	16.3	19.8
July	28.8	26.0	35.4	34.9	0.0	1.0
August	27.0	26.7	52.0	44.4	0.0	0.9
September	24.8	19.4	40.0	46.7	37.9	44.6
October	17.5	12.5	32.8	30.7	35.1	37.6

The experimental design was a randomized complete block with four replications. Genotypes, consisting of one rows 5.0 m long with 0.70 m spacing between rows, were planted on 10 May 2013 and 2014. These genotypes

were initially over-seeded and then hand-thinned to the desired intra-row spacing of 0.20 m. Recommended insect and weed control methods were employed during each growing season as needed. Each year, 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 fiber yield and technological properties (length, fineness and strength) were investigated. 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. Fiber yield (kg ha^{-1}) was calculated as: [lint percentage (%) X seed cotton yield (kg ha^{-1})]. 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 characteristic by the MSTAT-C statistical program and where F- test indicated significant effects ($p<0.05$), means were separated using Duncan test.

Results and Discussion

From the analysis of variance (Table 3), fiber yield, fiber length, fiber fineness and fiber strength showed significant differences between genotypes. Year and genotype-year interactions were not significant for all characteristics studied, indicating that genotypes responded similarly to the years.

Table 3: Fiber yield and quality traits as affected by genotye, year and genotype x year interaction

Source of variation	Fiber yield (kgha^{-1})	Fiber length (mm)	Fiber fineness (micronaire)	Fiber strength (gtex^{-1})
G[a]	**	*	**	**
Y[b]	NS[d]	NS	NS	NS
G x Y[c]	NS	NS	NS	NS

[a]G, genotypes; [b]Y, years; [c]GxY, genotype x year interactions; [d]NS, Non-significant at the 0.05 probability level. *,**Significant at the 0.05and 0.01probability level.

The two-year average values and the Duncan groups for the investigated characteristics are given in Table 4.

Table 4: Two year average values of fiber yield, length, fineness and strength, and groups

Genotypes	Fiber yield (kgha^{-1})	Fiber length (mm)	Fiber fineness (micronaire)	Fiber strength (gtex^{-1})
ST-468	1737.45ab*	27.90 bcd*	5.05 abcd*	35.08fghi*
ST-488	1696.10b	29.53 abc	4.78 abcd	34.26ijk
Primera	420.20z	27.51 cd	5.15 abc	32.35noprs
Gaia	1475.55e	28.35abc	5.35 a	33.61klm
Nazilli-87	804.30rs	28.51 c	4.78 abcd	34.22ijk
Taşkent-I	903.55o	28.27abc	4.61 abcd	33.65klm
Eisa	843.65pr	29.57 abc	4.57 bcd	35.00fghi
Flora	1233.65h	29.50 abc	4.87 abcd	34.90 ghi
Candia	912.40no	28.22 abc	5.08 abc	34.13ijk
Sahel-I	1202.80hi	29.20 abc	5.22 ab	32.80lmnop
Gedera-10	1154.15j	29.97 abc	5.07 abcd	35.96def
BA-119	1746.30 a	28.02bcd	4.98 abcd	35.65efgh
Cascot-2910	981.20 m	28.31 abc	4.47 cd	31.82 prst
ST-373	1565.10 d	29.40 abc	4.67 abcd	32.48 nopr
Aleppo-I	720.70 tu	27.30 cd	4.73 abcd	34.31 ijk
Zeta-2	1079.90 k	28.88 abc	4.75 abcd	34.87 ghi
Beli İzvor-432	846.95 pr	28.56 abc	4.78 abcd	31.51 rst
Carmen	1170.65 ij	29.10 abc	4.82 abcd	37.53abc

Neli	664.85 vy	28.97 abc	4.98 abcd	34.67 hij
ST-453	1280.80 g	28.83 abc	5.11 abc	31.11 t
Baly-308	1301.85 g	31.20 a	4.97 abcd	38.35 ab
Flash	1053.55 kl	29.13 abc	5.13 abc	31.20 t
Julia	895.90 o	28.88 abc	4.83 abcd	35.35 efgh
Is-I	770.25 s	28.82 abc	4.95 abcd	38.53 a
Urania	1179.45ij	29.73abc	4.62 abcd	37.37bc
Orgost-644	724.00tu	27.61cd	5.11 abc	32.10oprst
Giza-45	1031.30l	30.87ab	4.32 d	33.68jklm
Bulgar-33	700.55uv	25.10d	5.17 abc	32.80lmnop
Gacot-79	686.05v	28.02bcd	4.77 abcd	32.08oprst
Fibermax-832	1144.35j	29.46abc	4.66 abcd	36.92cd
Giza-70	851.55p	28.07bcd	4.67 abcd	30.03u
Claudia	819.35pr	28.93abc	5.02 abcd	33.70jkl
Cosmos	911.00o	28.83abc	4.85 abcd	33.43klmn
Özbek-100	957.10mn	28.62abc	4.61 abcd	32.86lmno
Hersi	671.75v	29.03abc	4.87 abcd	36.13de
Samon	765.90st	27.95bcd	4.95 abcd	34.22ijk
GSN-12	1422.25f	28.77abc	5.06 abcd	31.21t
Dicle-2002	1057.25kl	27.73cd	4.92 abcd	29.63u
Famosa	1390.10f	28.53abcc	5.27 ab	35.83efg
Veret	671.20v	28.45abc	5.20 abc	34.95fghi
Gosipolsüz-86	625.00y	29.43abc	4.63 abcd	31.20t
Tamcot-24	831.50pr	28.12bc	4.96 abcd	35.01fghi
MaydosYerlisi	385.55z	27.45 cd	4.61 abcd	31.35st
BA-525	1028.10l	28.56abc	5.08 abc	32.73mnop
Gloria	1136.65j	28.82abc	4.66 abcd	35.56efgh
Furkan	1623.15cd	30.12abc	4.76 abcd	32.63mnop
Average	1023.37	28.70	4.88	31.60

*) Within a column, means with the same letter are not significantly different by Duncan's multiple test (P<0.05).

Significant differences in mean fiber yield of genotypes were observed and they varied from 385.55 to 1746.30 kgha^{-1} (Table 4). BA-119 (1746.30 kg ha^{1}), ST-468 (1737.45 kg ha^{-1}), ST-488 (1696.10 kg ha^{-1}) and Furkan (1623.15 kg ha^{-1}) gave higher fiber yield than the yield of other genotypes. These four genotypes (BA-119, ST-468, ST-488 and Furkan) showed high yield potential, while those 10 genotypes (Maydosyerlisi, Gacot-79, Neli, Aleppo-I, Bulgar-33, Is-I, Hersi, Veret and Gosipolsüz-86) showed very low yield potential. Also other genotypes had moderate yield potential. Fiber yield characteristic has been shown to differ due to genotype and growing conditions, and ginning [15].

Genotypes differed in the fiber length with values varying from 25.10 to 31.20 mm. Baly-308 cultivar showed the highest fiber length, while Bulgar-33 cultivar showed the lowest fiber length. Fiber length is primarily a genetic trait [16]. Significant differences were found among cultivars for fiber fineness. The fifteen cotton cultivars ST-468, Primera, Gaia, Candia, Sahel-I, Gedera-10, ST-453, Flash, Orgost-644, Bulgar-33, Claudia, GSN-12, Famosa, Veret and BA-525, had higher microner value than the other genotype values. These fifteen genotypes had very coarse fibers with a fiber fineness of over 5 microns. The finest fibers were in the Giza-45 varieties belonging to *barbadense.* In general, fiber fineness values above 5 micronaire are not preferred by the spinning industry. Micronaire values, which reflect cotton fiber fineness, are affected by several factors [17]. There were statistical differences between cotton cultivars for fiber strength (Table 4). Cultivars, Is-I and Baly-308 gave higher fiber strength than the other genotypes. Also ST-468, Eisa, Gedera-10, BA-119, Carmen, Julia, Urania, Fibermax-832, Hersi, Famosa, Tamcot-24 and Gloria genotypes were noted with strength values over 35.0 g tex^{-1}. Fibre strength was positively correlated with heat unit accumulation during boll development [16].

Growth environment and genotype response to environment play a part in determining fiber strength and strength variability [18].

In conclusion, genotype average for fiber yield, length, fineness and strength were 1023.37 kg ha^{-1}, 28.70 mm, 4.88 micronaire and 31.60 g tex^{-1}, respectively. Cultivars, BA-119, ST-468, ST-488, Furkan and ST-373 produced by about 70.6%, 69.8%, 65.7%, 58.6% and 52.9% higher fiber yields respectively. The Baly-308 variety, which had the longest fibers, had 8.7% longer fiber length than the general average. In general, the micronaire values of genotypes were high. Although the genotypes generally thick fibers, they produced different fiber strength results. Cultivars, Is-I and Baly-308 produced by about 21.9% and 21.4% higher fiber strength than the general average. Thus, the best choice out of forty-six genotypes for fiber yield is BA-119, ST-468, ST-488, Furkan and ST-373 for conditions of the Eastern Mediterranean region of Turkey. Also, Is-I and Baly-308 genotypes may be preferred as a genetic source for the improvement of fiber strength.

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