IJSES

International Journal of Scientific Engineering and Science
Volume 6, Issue 12, pp. 14-18, 2022. ISSN (Online): 2456-7361

Screening of Different Cotton (*Gossypium spp.*) Genotypes for Yield and Yield Parameters

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Abstract— *The experiment was conducted to determine the yield (seed cotton and seed) and yield parameters (plant height, number of sympodial branches, number of boll per plant, seed cotton weight per boll, number of seeds per boll, 100-seed weight and ginning outturn) of different two-hundred cotton (Gossypium spp.) genotypes in east Mediterranean climatic conditions using a randomized complete block design with three replications in 2018 and 2019 growing seasons. It was determined that there were statistically significant differences among the cotton genotypes for all investigated characteristics. The results showed that plant height, number of sympodial branches, number of boll per plant, seed cotton weight per boll, number of seeds per boll, 100-seed weight, ginning outturn, seed cotton yield and seed yield ranged between 53.10-110.50 cm, 4.20-12.00 no. plant^{-1}, 4.50-18.30 no. plant^{-1}, 2.00-6.40 g, 18.00-40.00 no. boll^{-1}, 7.70-13.50 g, 26.70-45.50%, 1290.0-6230.0 kg ha^{-1} and 880.0-4060.0 kg ha^{-1}, respectively. As a result, these variations of cotton genotypes can be evaluated in cotton breeding studies for specific purposes.*

Keywords— *Cotton, genotype, yield, yield parameters.*

I. Introduction

Cotton is one of the important strategic plant that provides raw material to the textile, oil and feed industry in the world. It is grown in many different geographical regions and in more than 80 countries around the world. Approximately 26 million tons of fiber cotton is produced in the world (Anonymous, 2022a). In Turkey, 832 thousand tons of fiber cotton is produced (Anonymous 2022b). Turkey's fiber cotton production cannot meet the consumption. To meet the domestic consumption of cotton in our country, it is related to the increase in productivity. Therefore, it is very important to develop high yielding and quality cotton variety and lines. Yield of cotton depends on the genetic structure of the variety, environmental factors and cultural practices. It is stated that the effect of genetic factors in cotton yield is about 40% (Liu et al., 2013). Yield in cotton is directly related to plant height, number of sympodial branches per plant, number of bolls per plant and seed cotton weight per boll (Killi, 1995; Deshmukh et al., 2019; Iqbal et al., 2019). To develop high yielding cotton varieties, the first step in breeding is to determine suitable parents. While developing new cotton cultivars, fiber yield and quality are always considered. For this purpose, the germplasm consisting of 200 genotypes and having diverse features will be screened for yield and yield components.

II. Materials and Methods

Experimental Site and Conditions

Field study was conducted in Kahramanmaras city in 2018 and 2019, which is located in the East Mediterranean region of Türkiye (between 37º 53' north parallel and 36º 91' east meridians). The climate type in this area is Mediterranean, with hot and dry summers and warm and rainy winters. The study area had monthly air temperature between 5.3 °C (January) and 30.5 °C (August). Annually total precipitation is average about 793.50 and 813.50 mm but the total precipitation of during the cotton crop season is about 254 and 127 mm in 2018 and 2019 respectively. Soil had a sandy-clay texture, 2.65% low organic matter, 20.24% high lime content and pH of 7.53 slightly alkaline.

Experimental Material, Design and Cultural Practices

Two-hundred different cotton (*Gossypium spp.)* genotypes (Table I) were planted in one row 5.0 m long with a planting density 70x20 cm in the first week of May in 2018 and 2019, in randomized complete block design with 3 replications. The experimental area received 60 kg N and 60 kg P_2O_5 ha^{-1} as a seedbed application. Additional band-dressing of 90 kg N ha^{-1} was applied at the square stage. After emergence, plants were hoed 2 times by hand and machine. Overall 7 furrow irrigations were applied. The harvest was done by hand in 4 October and 23 September in 2018 and 2019 respectively.

Data Collection and Statistical Analyses

Ten randomly tagged plants from each plot were evaluated plant height, number of sympodial branches, number of boll per plant, seed cotton weight per boll, number of seeds per boll, 100-seed weight, ginning outturn. Boll samples of each plot were ginned in experimental gin roller and separated as seed and fiber. One hundred randomly seeds with four replications were weighed and the average of 100 seeds weight was determined. Seed cotton yield was determined after hand harvesting from each plot and weighing the seed cotton. Seed yield (kg ha^{-1}) was calculated as: [seed percentage (%) X seed cotton yield (kg ha^{-1})] (Kıllı and Beycioglu, 2020a). Experimental data were subjected to analysis of variance in accordance with Randomized Complete Block Design (RCBD) joined years with the aid of MSTAT-C statistical programming. The significant of the difference between means was compared by Duncan test ($P < 0.05$).

III. Results and Discussion

It has been determined that there are significant variations among cotton genotypes in terms of the examined characteristics (Table II). It could be seen in Table II, all investigated parameters for genotypes were statistically significant (p<0.01). The distribution of 200 cotton genotypes for plant height is shown in Figure 1A. According to the two hundred cotton genotypes, plant height value was 81.8±28.7 cm, and it ranged from 53.10 cm to 110.50 cm. The highest plant height values were obtained from Marvi (110.62 cm), NIA-UFAQ (108.98 cm), TOGO (108.19 cm) and AzGR-11835 (104.93 cm) respectively. The lowest plant height were recorded in genotype TAM 04 WB - 33s (REY.NO:GP-940 PI 662041) (53.03 cm). The fact that the plant height values we obtained in the study showed a wide variation between about 53 cm and 110 cm (Figure 1A), and also the differentiation from the findings of the researchers (Usman et al., 2017) was due to the presence of genotypes from different species and the high number of genotypes.

TABLE I. Cotton genotypes used as plant material in the study.

No	Name	No	Name	No	Name	No	Name	No	Name
1	MNH-786	41	Carolina Queen	81	Viky (ES-20021)	121	Acala 1064	161	Mex 68
2	BH-118	42	AfricaES(20025)	82	Sorbon	122	Acala Cluster	162	Europa
3	Ziroatkar-68	43	Acala Tex	83	AĞDAŞ 3	123	Auborn 56	163	TX No: 1389
4	Sindh-1	44	Tx No: 1412	84	Sugdiyon-2	124	TAM 94 L 25 P1	164	Ionia
5	AGC 85	45	Karnak 55	85	CIM-240	125	Aden	165	Helius
6	CIM 401	46	Mex 106	86	Sure Grow 125	126	Acala Okra VA2-4	166	NIAB 874
7	Frego Cluster	47	Dpl 5540-85-subokra	87	AzGR-3775	127	Deltapine 905	167	Ligur
8	AzGR-11468	48	Deltapine 120	88	Ujchi 2 Uzbek	128	Acala 29	168	NIAB 777
9	CIM-506	49	Acala 1517-70	89	Ziroatkar-64	129	Giza 45	169	Tex 2167
10	Sohni	50	TAM C155 - 22 ELS	90	AGC 208	130	Earlipima	170	Fibermax 819
11	CIM-70	51	Deltapine 45 – vert	91	B557	131	Acala 1517 SR2 – vert	171	Tex 843
12	994	52	Acala 44	92	CRIS-342	132	Acala N 28-5	172	Acala 32
13	VH 260	53	Deltapine 15A	93	MNH-814	133	Deltapine 26	173	Acala 1-13-3-1
14	Stoneville 474	54	Brown Egyptian	94	KORİNA	134	AzGR-11835	174	Deltapine 61
15	Malmal-MNH-786	55	Deltapine 12	95	FH 142	135	RANTOS	175	Deltapine 15
16	AzGR-11836	56	Deltapine 25	96	TX No: 1416	136	AĞDAŞ17	176	Deltapine 14
17	Marvi	57	Acala Nunn's	97	Stoneville 213	137	NIAB-111	177	Acala Shafter Station
18	Ziroatkar-81	58	Acala 1517 D	98	ACALA SJ 3	138	Tex 1216	178	Acala 1517-91
19	AzGR-11834	59	Acala Morell	99	Mex 123	139	Mex 122	179	Acala Tex
20	AzGR-11839	60	TAM B147 – 21	100	Fibermax 832	140	Tx No: 2700	180	Deltapine 714 GN
21	Stoneville 506	61	TAM 87 G3- 27	101	Giza 75	141	Stoneville 014	181	Acala 1517 C
22	NIBGE-2	62	Acala Glandless	102	Tex 844	142	Stonville 108 SR	182	Acala 44 WR
23	MNH-990	63	Acala 4-42	103	Tx No: 2383	143	TX No: 2382	183	Deltapine 50
24	Sadori	64	Acala 442	104	Bulgar 6396	144	Hopicala – vert	184	Acala SJ1
25	Penta	65	TAM C66 - 26	105	Deltapine 20	145	Eva	185	Crumpled
26	Aboriginal79	66	Deltapine Staple	106	Agala Sindou	146	Mex 102	186	Deltapine 41
27	Nova	67	TOGO	107	Tex 1152	147	NIAB 78	187	TAM C66 - 16
28	Shazbaz	68	NIAB-KIRN	108	NIAB 111	148	Stoneville 731N	188	TAM 01 E - 22
29	Deltapine 5816	69	Sivon	109	Mehrgon	149	Taashkent	189	Acala Harper
30	Deltapine 565	70	Alba Acala 70	110	CAMPU	150	Stonville 504	190	Acala-55-5
31	Stoneville 2B	71	NIA-UFAQ	111	Stoneville 3202	151	CASCOT L7	191	Deltapine 80
32	Deltapine 50 –vert	72	Giza 7	112	Stoneville 62	152	Avesto	192	Tropical 225
33	MNH-493	73	CRIS-134	113	Giza 70	153	Darmi	193	TAM 04 WB - 33
34	Stoneville 508	74	Acala Naked	114	Deltapine 62	154	Giza 59	194	Acala Mexican
35	AzGR-7711	75	SAMOS	115	Acala Okra	155	Tadla 25	195	Acala 3080
36	Stoneville 256	76	AĞDAŞ 6	116	Acala Young's	156	New Mexican Acala	196	Acala 51
37	Stoneville 5A	77	Zeta 2	117	TAM B182	157	Giza 83	197	TAM A106- 16ELS
38	Tamcot Sphinx	78	AĞDAŞ 7	118	Deltapine SR-5	158	Stoneville 256-315	198	TAM B139 - 17 ELS
39	Bulgar 73	79	AGC 375	119	TAM C147 -42	159	Arcota-129	199	Deltapine SR4
40	Stoneville 618 BBR	80	Haridost	120	Giza 75	160	NIAB 846	200	Acala SS 2280

TABLE II. Average values of yield and yield parameters of two hundred cotton genotypes.

	Plant height (cm)	Sympodial branches (no.plant^{-1})	Boll number (no.plant^{-1})	Seed cotton weight (g boll^{-1})	Seed number (no.boll^{-1})	100-seed weight (g)	Ginning outturn (%)	Seed cotton yield (kg ha^{-1})	Seed yield (kg ha^{-1})
Two year average	81.8 ± 28.7	8.1 ± 3.9	11.4 ± 6.9	4.2 ± 2.2	28.9 ± 10.9	10.6 ± 2.9	36.1 ± 9.4	3760 ± 2468	2470 ± 1590
Analysis of variance for investigated characteristics									
Genotypes	**	**	**	**	**	**	**	**	**
CV (%)	3.28	5.24	4.06	7.20	10.14	2.82	7.35	4.12	2.45

** Significant at the 0.01 level.

The distribution of 200 cotton genotypes for sympodial branches is shown in Figure 1B. According to the two hundred cotton genotypes, sympodial branshes was 8.1 ± 3.9 (no.plant^{-1}), and it ranged from 4.2 to 12 (no.plant^{-1}). The highest sympodial branches values were obtained from Acala Young's (12.06), Haridost (11.66), BH-118 (10.70), MNH-786 (10.30), NIA-UFAQ (10.26), Marvi (10.17), NIAB 78 (10.17), NIBGE-2 (10.16) ve Acala 44 WR (10.10) respectively. The lowest sympodial branches were recorded in genotype TAM 04 WB - 33 s (REY.NO:GP-940 PI 662041) (4.17), Acala 8 (4.46), New Mexican Acala (4.73), Acala 51 (5.13) Viky (ES-20021) (5.26) and ACALA SJ 3 (5.31). The fact that the sympodial branches values we obtained in the study showed a wide variation between about 4.2 and 12, the presence of genotypes from different species, the fact that the number of genotypes was quite high, and the plant height values were different. A

International Journal of Scientific Engineering and Science
Volume 6, Issue 12, pp. 14-18, 2022. ISSN (Online): 2456-7361

significantly variation was recorded for boll number per plant among cotton cultivars (Table II, Figure 1C). According to the two hundred cotton cultivars, average boll number per plant was 11.4 ± 6.9 (no.plant^{-1}), and it ranged from 4.5 to 18.3 (no.plant^{-1}). The variety NIA-UFAQ produced highest boll number (18.29 no.plant^{-1}) followed by CRIS-134 (18.16 no.plant^{-1}) and Marvi (15.94 no.plant^{-1}). However significantly minimum boll number (4.43 no.plant^{-1}) was recorded in variety Acala 8, and it was followed by Crumpled (5.10 no.plant^{-1}). The distribution of 200 cotton genotypes for seed cotton weight is shown in Figure 1D. According to the two hundred cotton genotypes, seed cotton weight was 4.2 ± 2.2 g, and it ranged from 2.0 to 6.4 g. The highest seed cotton weight values were obtained from Acala Glandless (6.48 g) and TAM B139 - 17 ELS (REY.NO:GP-927 PI 659699) (6.13 g). The lowest seed cotton weight were recorded in genotype Acala Nunn's (1.99 g) and Tashkent (2.37 g). Average seed number values were ranged from 18.0 to 39.8 no.boll^{-1} (Table II and Figure 1D). The genotype Tex 843 (39.78 no.boll^{-1}) gave significantly the highest seed number per boll followed by Deltapine SR-5 (37.38 no.boll^{-1}). However significantly minimum seed number per boll was recorded in genotype Tx No: 1412 (18.00 no.boll^{-1}).

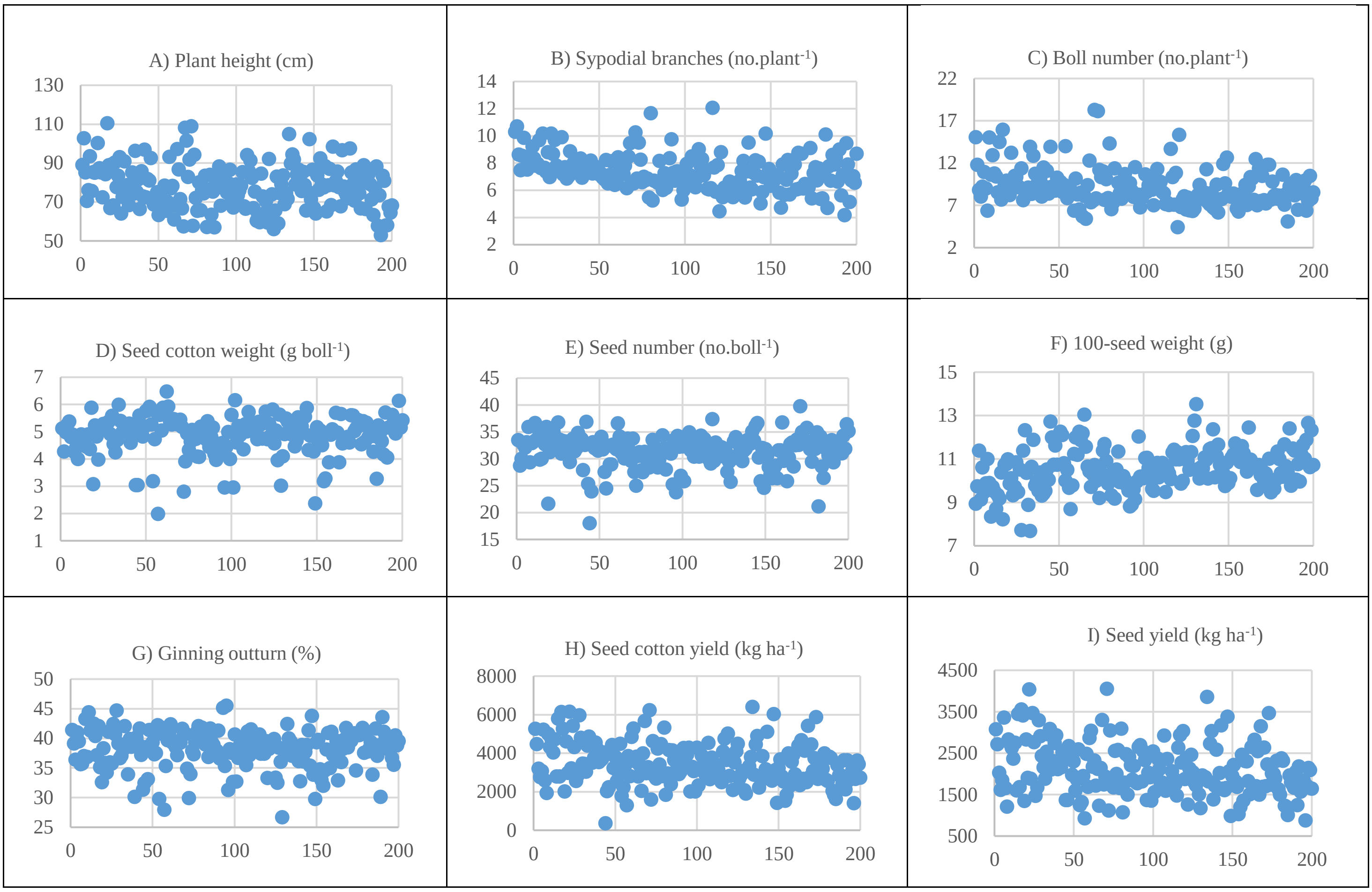

Figure 1. Distribution of 200 cotton genotypes for investigated characteristics (plant height, sympodial branches, boll number, seed cotton weight, seed number, 100-seed weight, ginning outturn, seed cotton yield and seed yield)

The distribution of 200 cotton genotypes for 100-seed weight is shown in Figure 1F. According to the two hundred cotton genotypes, 100-seed weight value was 10.6±2.9 g, and it ranged from 7.68 g (MNH-493) to 13.53 g (Acala 1517 SR2-vert). The highest 100 seed weight values were obtained from Acala 1517 SR2-vert (13.53 g), TAM C66 - 26 ELS(REY.NO:GP-899.PI 654364) (13.05 g), Karnak 55 (12.72 g) and Earlipima (12.77 g) respectively. The lowest 100 seed weights were recorded in genotype MNH-493 (7.68 g) and Shazbaz (7.72 g). Patel (2003) stated that 100 seed weight values differ according to cotton species; Efe et al. (2013), 100 seed values of some mutant cotton varieties brought from Azerbaijan in the Southeastern Anatolia region varied between 9.4 and 12.7 g; Yuka (2104) stated that the weight of 100 seeds in 13 different cotton genotypes varied between 8.13 – 10.71 g; Kıllı and Beycioglu (2020a) reported that the weight of 100 seeds in different cotton genotypes varied between 9.11 – 12.65 g. The fact that the 100 seed weight values we obtained in the study showed a wide variation between about 7.7 g and 13.5 g (Figure 1F), and also the differentiation from the findings of the researchers was due to the presence of genotypes from different species and the high number of genotypes.

Average ginning outturn values of genotypes were ranged from 26.7% to 45.5% (Table II and Figure 1G). The genotype

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Volume 6, Issue 12, pp. 14-18, 2022. ISSN (Online): 2456-7361

FH 142 (45.52%) gave significantly the highest ginning outturn followed by Shazbaz (44.69%) and CIM-70 (44.38%). However significantly minimum ginning outturn was recorded in genotype Giza 45 (26.69%) followed by Acala Nunn's (27.96%) and Taashkent (29.76%). According to the two hundred cotton genotypes, ginning outturn value was 36.1 ± 9.4%. In studies related with upland cotton, different results of ginning outturn have been reported by the researchers. Avgoulas et al. (2005), Gul et al. (2016) and Ahuja et al. (2018) reported ginning outturn of 38.9- 40.5%, 34.54-36.52%, 32.73-40.60%, respectively. Killi and Beycioglu (2020b) reported that ginning outturn values of cotton cultivars ranged from 28.57 to 42.57%.

A significantly variation was recorded for seed cotton yield among cotton genotypes (Table II, Figure 1H). Two year average seed cotton yield was 3760 ± 2468 kg ha^{-1}, and it ranged from 1292 to 6228 kg ha^{-1}. Significantly maximum seed cotton yields were recorded in NIA-UFAQ (6228 kg ha^{-1}), NIBGE-2 (6148 kg ha^{-1}) and Marvi (6134 kg ha^{-1}) while minimum seed cotton yields were recorded in Acala Nunn's (1291 kg ha^{-1}) and Acala 51 (1395 kg ha^{-1}). Jones (2001) and Iqbal and Khan (2011) reported that there are significant differences in yield between different cotton genotypes. The fact that the 15 of the genotypes used in the study produced seed cotton yields above 5000 kg ha^{-1} shows that these genotypes have high yield potential and can be used as a material in breeding studies to increase cotton yield.

Cotton genotypes showed significant differences in terms of seed yield per hectare. Average seed yield value over all genotypes was 2470 kg ha^{-1} (Table I). Seed yield values varied between 880 kg ha^{-1} and 4060 kg ha^{-1} (Figure 1I). The highest seed yield value was from NIA-UFAQ (4050 kg ha^{-1}) followed by NIBGE-2 (4042 kg ha^{-1}); the lowest seed yield value was obtained from Acala 51 (881 kg ha^{-1}). Sawan *et al.* (2007) reported the seed yields per hectare in cotton were 1828 – 2084 kg; Sawan (2016) also reported the seed yield per hectare was 1810 – 2130 kg; Tekeli (2016), in his study with 46 cotton genotypes, found that the seed yield was significantly different between genotypes and the seed yields per hectare were 596.9 kg and 2616.6 kg; Kıllı and Beycioglu (2020a) reported that the seed yield per hectare ranged from 1731.1 to 2721.4 kg. The fact that the seed yield values we obtained in the study showed a wide variation between about 880 kg and 4060 kg, and also differing from the findings of the researchers, was due to the fact that there were different genotypes, the number of genotypes was quite high, and the seed cotton yield and ginning outturn values were different.

IV. Conclusion

The study was aimed to screening of different cotton genotypes for yield and yield parameters. As a result of the study, it was determined that there were significant differences between genotypes and there were quite wide and significant variations in terms of all the examined characteristics. It may be possible to breed new cotton varieties for specific purposes by evaluating these variations determined in cotton genotypes.

Acknowledgment

The authors would like to thanks the Kahramanmaraş Sutcu Imam University (KSU). This study was supported by the Scientific Research Projects Coordination Unit of KSU with the project number of 2019/2-36M.

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