

Research Article

Environmental Impacts Having Different Altitude on Day-Degree Units with Yield and Fiber Quality of Cotton (*Gossypium hirsutum* L.) F₁ Hybrids Obtained By Line x Tester Design

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Abstract

Temperature is an important factor that affecting growth and development in cotton (*Gossypium hirsutum* L.). This research was carried out at Kahramanmaraş and Elbistan conditions having different altitude and temperature in 2012, after the hybridization which made in 2011. For this purpose, eight parents and their fifteen F₁ hybrids which are obtained by Line x Tester used as a plant material in a randomized complete block design with four replications. In this study, the effects of Kahramanmaraş and Elbistan conditions were examined on the number of day and degree-day units required for squaring, flowering, bolls opening and harvesting times as well as seed cotton yield, gin outturn, fiber fineness and fiber length. Results indicated that investigated properties, except fiber length were affected by Kahramanmaraş and Elbistan conditions. While genotypes were using less degree-day unit for the first squaring in Elbistan, have been used more degree-day unit in Kahramanmaraş for the first flower, boll opening and harvest times. But, genotypes have been used more day number for collect to degree-day units in Elbistan. For this reason, although genotypes which have 207.41 kg da⁻¹ seed cotton yield in 195 days using 1593.5 °C degree-day unit in Elbistan, had been got 426.25 kg da⁻¹ seed cotton yield in 157 days using 2480.1 °C degree-day in Kahramanmaraş. As a result, 1x4 F₁ hybrids and Fantom for Elbistan, 1x5 F₁ hybrids and Stoneville 468 for Kahramanmaraş are found very important.

Key words: Cotton, environmental effect, line x tester mating, degree-day units, yield and fiber properties.

Farklı Yüksekliğe Sahip Çevrelerin Line x Tester Yöntemiyle Geliştirilmiş Pamuk (*Gossypium hirsutum* L.) Melezlerinde Gün-Derece Üniteleri ile Verim ve Lif Kalitesine Etkisi

Özet

Sıcaklık, pamukta (*Gossypium hirsutum* L.) büyüme ve gelişmeyi etkileyen en önemli bir faktördür. Bu çalışma, 2011 yılında yapılan melezlemeyi takiben, 2012 yılında, yükselteleri farklı Kahramanmaraş ve Elbistan koşullarında yürütülmüştür. Çalışmada, Çoklu dizi (Line x Tester) yöntemine uygun melezlemeyle geliştirilmiş onbeş F₁ kombinasyonu ile bu melezlerin sekiz ebeveyni, tesadüf blokları deneme desenine göre dört tekerrürlü yetiştirilmiş ve genotiplerin taraklanma, çiçeklenme, koza açma ve hasat dönemlerine ait gün sayıları ve gün-derece ünitelerinin yanı sıra kütlü pamuk verimi, çırçır randımanı, lif inceliği ve lif uzunluğu incelenmiştir. Lokasyonlar arasındaki fark lif uzunluğu hariç diğer özelliklerde değişime neden olmuştur. Genotipler, taraklanma için Elbistan koşullarında daha çok, ilk çiçek, ilk koza açma ve hasat zamanları için daha az gün-derece ünitesi kullanırken, bu ünitelerin temini için Kahramanmaraş'tan daha fazla gün sayısına ihtiyaç duyulmuştur. Bu durum, Elbistan'da 195 günde temin edilen 1593.5 °C gün-derece ünitesiyle 207.41 kg da⁻¹ ortalama kütlü üretimini oluştururken, Kahramanmaraş'ta 157 günde temin edilen 2480.1 °C gün-derece ünitesiyle 426.25 kg da⁻¹ kütlü üretimi oluşmuştur. Sonuç olarak ise Elbistan için 1x4 F₁ melezi ile Fantom çeşidinin, Kahramanmaraş için ise 1x5 F₁ melezi ile Stoneville 468 çeşidinin önemli olduğu saptanmıştır.

Anhtar kelimeler: Pamuk, çevre etkisi, çoklu dizi analizi, gün-derece ünitesi, verim ve lif özellikleri.

Introduction

Cotton is a very important plant for Turkey in terms of economic and social life. Because of having different development periods after seeding such as germination, seedling emergence, squaring, flowering, boll opening and harvesting time, as in other living things, the yield and fiber quality of cotton can be effected by environmental conditions, genetic potential and genotype x environmental. Moreover, the most important environmental factor affecting these periods is temperature. While cotton need at least between 15-21 °C and 27-32 °C daily temperatures for seedling with vegetative and boll growing periods respectively, today's commercial varieties request a 150 day, which has minimum temperature of 15 °C. Because, the low night temperatures at the growing period can be regressed the boll development of cotton an important way.

While the degree-day units required for the developmental periods of cotton are classified as low, ideal and high, these classes have correlate with both cultivars and some properties of cotton-growing zone such as altitude, number of cloudy day, wind speed with way as well as sowing time. Cotton, which is significantly affected by periods when the average temperature falls below 12 °C or exceeds 35 °C, does not complete the developmental period and can't be pass to other new cycle without adequate degree-day units. This effect could be made a change on the yield and quality of cotton in final, if the required degree-day unit provides in any longer periods or shorter periods (Gou, 1985; Lakkineni et al., 1994). For example, when temperatures are 40 °C and above, while the numbers and weights of bolls in cotton decreases and/or the duration of cotton boll opening could extends if the temperatures decreased from 26 °C to 19 °C (Reddy and Hodges, 1992). Furthermore, the times provided by degree-day units and degree-day units react to sowing time due to their influence (Süllü, 2001; Akışcan, 2004). Although earlier genotypes able to reduce degree-day stress (Bauer and Bradow, 1996) and all genotypes haven't got equal and adequat qualitative properties for reduce the effects of degree-day in all areas.

The increasing of earliness which is defined as maturation in a short time in cotton and determined by much number of methods (Calhaun and Bowman, 1999), leads to change in yield and quality properties because increase of environmental sensitivity (Niles and Feaster, 1984).

Whereas, while researchers were suggesting some criteria for determine of earliness in cotton such as boll maturation (İncekara and Turan, 1977),

first blossoming period (Başbağ, 1999) and squaring period with flowering periods (Richmond and Radwan, 1962). Kempthorne (1957) used Line x Tester analysis for selection of appropriate parent and hybrid combinations for breeding programs.

Because of special requests if it's as hot and humid conditions, Cotton can be grown in particular regions, in other words, between the 47th northern (N) and the 32^d (S) latitude in the world. While cotton cultivation carried out in the districts of Merkez, Pazarcık, Narlı and Türkoğlu of Kahramanmaraş where they are under Mediterranean climate effect (462 m altitude, 37° 32' 131" N-36° 55' 54" E) in Turkey, has never been cultivated in the Elbistan Plain (1138 m altitude, 38° 16' 675" N-37° 05' 24" E). Elbistan plain has been effected by the Mediterranean and terrestrial climates (Anonymous, 2017).

However, longtime average of temperature and vegetation duration with soil and topography conditions of the region can be suitable for some cotton varieties which earlier.

This study was conducted to the determine the impact of altitude and environmental conditions on degree-day units for some development stages of cotton like squaring time, flowering time, boll opening time, harvesting time with seed cotton yield, gin outturn, fiber fineness and length.

Materials and Methods

This study was carried out under the conditions of Kahramanmaraş-center and Elbistan (Karahöyük village) in 2012, following of hybridization in 2011 which made in Kahramanmaraş and 23 cotton genotypes (8 parents and 15 F₁ combinations) were used as plant materials.

While the central district of Kahramanmaraş was located 462 meter altitude from sea level and influenced from Mediterranean climate condition, Karahöyük village is at the intersection of the Mediterranean and terrestrial climate conditions with 1138 meter altitude. The F₁ combinations were obtained by crossing in accordance with Line x Tester method from the three lines which are intermediate and/or late varieties (Stoneville 468, Adana 98 and Furkan) and five testers which are very early varieties (Beli Izvor 432, Berke, Nazilli 663, Primera and Fantom).

All genotypes were planted on 28th April 2012 and 13th May 2012 in the Kahramanmaraş and Elbistan, respectively.

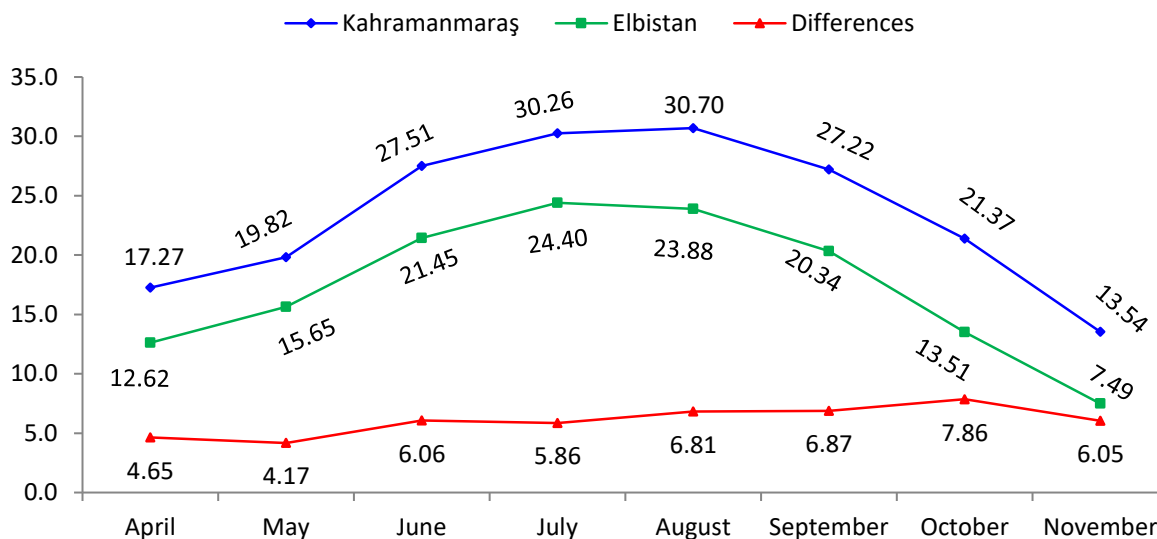


Figure 1. Averages temperature in Kahramanmaraş and Elbistan locations (°C).

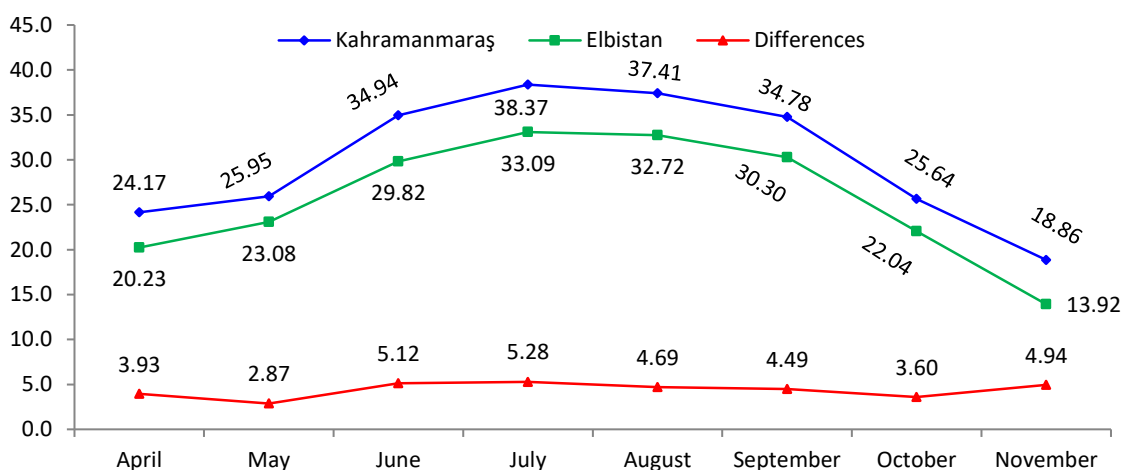


Figure 2. Maximum temperatures in Kahramanmaraş and Elbistan locations (°C).

Experiments were conducted in randomized complete block design with four replications, plots were 6 m long with 4 rows in central district and 2 rows in Elbistan. Row spacing was 0.70 m and intrarow spacing was 0.30 m together with sowing, 60 kg ha⁻¹ nitrogen and phosphorus (P₂O₅) were applied and 100 kg ha⁻¹ nitrogen (N) was applied as top dressing before the second irrigation in Central district and before the first irrigation in Elbistan. The harvest was performed by hand on 4 September 2012 and 5 October 2012 in Kahramanmaraş and on 4th October 2012, 5th November 2012 and 28th November 2012 in Elbistan.

The first squaring, flowering and boll opening dates were determined over 10 plants randomly selected from each plot. With these dates, number of day elapsed until the relevant growth period and total heat units (*degree-day*)

required for each growth period were determined in accordance with the equation of (Quinn and Kelly, 2011). Degree-day units for the day with a temperature of 12 °C and above (*the minimum threshold temperature in cotton which is cease the growth*) was calculated by degree-day = (daily maximum temperature-15+daily minimum temperature-15)/2; the value for the day with temperatures below 15 °C was calculated by degree-day = (daily maximum temperature-15)/2. After the determination of degree-day required for each growth period, initially region-based, then combined line x tester analysis was performed.

While the average temperatures in Kahramanmaraş were varying from 13.54 °C (November) to 30.70 °C (August), it varied between 7.49 °C (November) and 24.40 °C (August) in Elbistan. Moreover, the differences in average

temperatures between locations varied from 4.17 °C (May) to 7.86 °C (October) (Figure 1). Maximum temperatures varied between 18.86 °C (November) and 38.37 °C (July) in Kahramanmaraş and between 12.92 °C (November) and 33.09 °C (July) in Elbistan. Furthermore, the differences in maximum temperatures of the locations varied between 2.87 °C (May) and 4.94 °C (November) (Figure 2).

The minimum temperatures of the cotton growth season varied between 9.71 °C (November)

and 24.04 °C (August) in Kahramanmaraş and between 2.82 °C (November) and 14.54 °C (July) in Elbistan. Moreover, the differences in maximum temperatures between locations varied from 6.05 °C (May) to 11.31 °C (September) (Figure 3).

After the variance analysis was performed on the obtained data, line x tester analysis was performed on the genotypes which were found to be important and variational sources were determined.

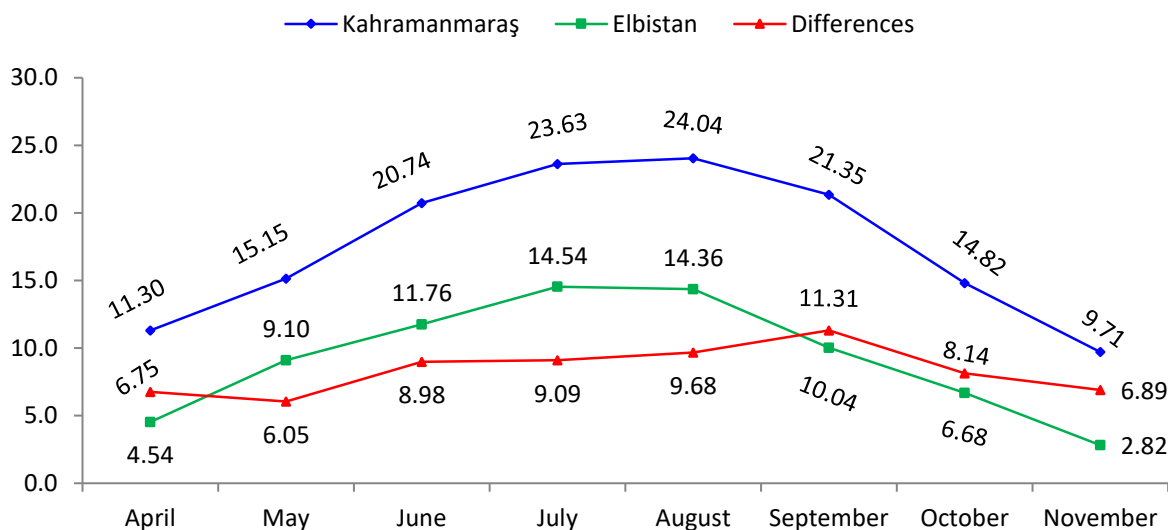


Figure 3. Minimum temperatures in Kahramanmaraş and Elbistan locations (°C).

Results and Discussion

Sowing-First squaring time (day)

A flower bud on cotton, called a square, begins as private format on the sympodial and monopodial branches. The duration of squaring period is managed mostly by the genetic structure (Özbek et al., 2004), which is affected by temperature changes and the ideal temperatures for squaring must be 27-30 °C during at the day and 22-25 °C at night (Reddy et al., 1995; Akışcan and Mert, 2005).

While the genotypes were affecting from the differences of altitude for squaring time, first squares which show up in Kahramanmaraş at the first week of June, were observed in Elbistan at the first weeks of July (Table 1 and 4). Moreover, the hybrids begun to sowing-squaring period more earlier than the parents (~ 3.61 day).

Because of effects of variation either Kahramanmaraş or Elbistan, except tester effect in Kahramanmaraş, the degree-day units needs of hybrids for sowing-squaring periods were ranged from 306.2 °C (2x4) to 408.7 °C (3x6) in Kahramanmaraş, despite of changed from 410.0 oC (2x4 and 2x6) to 457.8 oC (3x6) in Elbistan. On the other hand, while the parents have been used more

degree-day units and day number than hybrids in Kahramanmaraş and Elbistan (Table 1 and 5), the researchers reported that the Çukurova 1518 variety had been used 372.0 °C Süllü (2001) and 295.7 °C Çelik et al., (2009) degree-day unit for squaring time in Adana and Antalya, respectively.

Consequently, while the degree-day units used by the hybrids changed between 35.00 (2x4) and 42.5 day (3x6) in Kahramanmaraş and between 50.3 (2x4) and 57.0 day (3x6) in Elbistan, the degree-day units used by parents were changed between 36.8 (Furkan) and 47.5 day (Beli Izvor 432) in Kahramanmaraş, and between 53.8 (Fantom) and 61.0 day (Furkan) in Elbistan (Table 4). Researchers were reported that the squaring time of cotton was being decreased in late sowing (Akışcan, 2004; Akışcan and Mert, 2005) and have changed with years as well as genotypes (Kaya, 2006). The obtained results is showed that the 3x6 F₁ combination with the Furkan variety which is the mother parent of this hybrid had used maximum degree-day unit and day number for squaring period, while the 2x4 F₁ combination with Fantom cultivar have been used minimum degree-day unit and day number for squaring period (Table 7 and 4).

Table 1. The mean squares and significances degree in line x tester analysis of genotypes in terms of number of day numbers for squaring, flowering and first boll opening in Kahramanmaraş and Elbistan locations.

Variation sources	df	Number of day for the beginning of											
		Squaring		Flowering		First boll opening							
		K.Maraş	Elbistan	K.Maraş	Elbistan	K.Maraş	Elbistan						
Replications	3	40.3	31.1	36.9	21.4	0.8	63.1						
Genotypes	22	37.9	**	26.4	**	48.4	**	32.3	**	58.8	**	194.6	**
Parents (P)	7	48.7	**	21.8	**	78.3	**	32.85	**	87.4	**	62.2	**
Hybrids (H)	14	15.7	**	13.4	**	25.0	**	14.4	**	47.5	**	271.9	**
P Vs H	1	273.0	**	239.8	**	167.3	**	280.9	**	17.9	**	38.4	**
Lines (L)	2	52.9	**	56.3	**	75.8	**	66.6	**	125.6	**	430.9	**
Testers (T)	4	12.5	**	10.1	**	17.0	**	9.6	**	39.5	**	227.1	**
L x T	8	8.0	**	4.4	**	16.3	**	3.7	**	32.0	**	254.6	**
Error	66	3.4		2.0		3.3		2.6		0.3		5.5	

*: $P \leq 0.05$, **: $P \leq 0.01$, df: Degrees of freedom.

Sowing-First flowering time (day)

Following seed sowing, while degree-day units which used by hybrids are changes from 673.5 °C (1x4) to 843.6 °C (3x5) in Kahramanmaraş and from 660.7 °C (1x4 and 1x8) to 769.2 °C (3x5) in Elbistan, the degree-day units that used by parents were changed from 645.2 °C (Beli Izvor 432) to 879.1 °C (Furkan) in Kahramanmaraş and from 708.0 °C (Beli Izvor 432 and Fantom) to 818.6 °C (Furkan) in Elbistan (Table 7). For this reason, the units used by the hybrids were collected between 58.0 and 68.8 days in Kahramanmaraş and between 72.3 and 79.3 days in Elbistan, while the units used by parents were collected between 55.8 (Beli izvor 432) and 70.5 day (Furkan) in Kahramanmaraş and between 75.5 (Beli izvor 432) and 83.8 day in Elbistan (Furkan) (Table 5). This differences were supported by sources of variation in Elbistan and Kahramanmaraş, except tester in Kahramanmaraş and hybrids were found more suitable and important than parents. Furthermore, it was determined that sources of variation responded to different environmental conditions (G x Lc, P x Lc, and T x Lc in Table 3) like altitude and the line x tester interaction was important.

After the seed sowing, the hybrids which to blooming in june at Kahramanmaraş and in july at Elbistan had been used less degree-day units than parents. Researchers reported that the Çukurova 1518 variety used 590 °C and 565.9 °C degree-day unit in Adana and Antalya Süllü (2001); Çelik et al., (2009), respectively, and reaction to both years and sowing times (Akışcan and Mert, 2005; Kaya, 2006). In the study, in spite of fact that the minumum degree-day unit was being used by the 1x4 F₁ hybrid (Kahramanmaraş: 58.0 day and 673.5 °C; Elbistan: 72.3 day and 660.7 °C) and Beli Izvor 432 variety (Kahramanmaraş: 55.8 day and 645.2 °C; Elbistan; 75.5 day and 708.0 °C), 3x5 F₁ hybrid (Kahramanmaraş: 68.8 day and 843.6 °C; Elbistan:

79.3 day and 769.2 °C) and Furkan had been used maximum degree-day unit (Kahramanmaraş:70.5 day and 879.1 °C; Elbistan: 83.8 day and 818.6 °C) (Table 5 and 7), and Fantom cultivar had been attracted attention because of degree-day units which its nearest in both Kahramanmaraş and Elbistan condition.

Furthermore, some of the hybrids such as 1x4, 1x7, 1x8, 2x4, 2x5, 2x6, 2x4, 2x5, 2x6, 2x7, 2x8, 3x5 and Beli Izvor 432 were used less day numbers and degree-day units for the squaring in Kahramanmaraş and less day numbers and degree-day units for flowering time in Elbistan instead of the Kahramanmaraş (Table 5 and 7). This situation can be coming from the earliness potential of the genotypes, and 1x4 F₁ (Stoneville 468 x Beli Izvor 432) hybrids had combined seed cotton yield, gin outturn and fiber length with earliness.

Sowing-First boll opening time (day)

While genotypes used less temperature units (~129.1 °C) in Elbistan for the first boll opening time (Table 7), they needed to require more day (42.6 day) for total degree-day units than Kahramanmaraş (Table 6).

Table 2. The mean squares and significances degree in line x tester analysis of genotypes in terms of seed cotton yield, gin outturn, fiber fineness and length at Kahramanmaraş and Elbistan locations.

Sources	df	Seed cotton yield (kg da ⁻¹)		Gin outturn (%)		Fiber								
						Fineness (micronaire)		Length (mm)						
		K.Maraş	Elbistan	K.Maraş	Elbistan	K.Maraş	Elbistan	K.Maraş	Elbistan					
Replications	3	4856.20	515.30	3.35	3.63	0.02	0.04	0.54	1.29					
Genotypes	22	4695.69	**	6062.86	**	12.63	**	15.33	**	0.11	0.42	**	1.39	0.71
Parents (P)	7	4597.62	**	10629.25	**	16.31	**	17.73	**	0.19	0.24	**	1.78	1.04
Hybrids (H)	14	1193.98		4179.42	**	10.93	**	15.19	**	0.06	0.29	**	1.21	0.49
P Vs H	1	54406.21	**	466.26		10.52	**	0.38		0.17	3.35	**	1.24	1.46
Lines (L)	2	4551.87	**	9310.97	**	16.19	**	27.57	**	0.09	0.27		0.98	0.01
Testers (T)	4	881.32		7143.70	**	29.34	**	22.07	**	0.04	0.60	**	1.31	0.57
L x T	8	510.84		1414.39	**	0.41		8.66	**	0.06	0.15		1.22	0.57
Error	66	2006.69		515.30		0.95		0.78		0.12	0.09		1.21	0.62

Table 3. The mean squares and significances degrees in combined line x tester analysis of genotypes after sowing time in terms of squaring, flowering, first boll opening with seed cotton yield, gin outturn, fiber fineness and length in Kahramanmaraş and Elbistan locations.

Sources	df	Number of day			Seed cotton yield (kg da ⁻¹)	Gin outturn (%)	Fiber							
		Squaring (day)	Flowering day)	First boll opening (day)			Fineness (micronaire)	Length (mm)						
Replications (R)	6	17.8	14.6	25.8	1342.87	1.74	0.01	0.46						
Genotypes (G)	22	62	**	74.7	**	170.5	**	4736.12	**	18.22	**	0.27	**	0.95
Locations (Lc)	1	10774.3	**	10200.5	**	83215.1	**	2203033.9	**	1839.76	**	73.91	**	0.62
Parents (P)	7	65.8	**	102.9	**	140.2	**	5273.53	**	14.59	**	0.3	**	1.61
Hybrids (H)	14	27.9	**	34.5	**	192.8	**	2486.23	*	20.81	**	0.19	*	0.69
P Vs H	1	512.2	**	440.9	**	71.3	**	32472.84	**	7.44	**	1.02	**	0.00
Lines (L)	2	108.8	**	141.7	**	494.4	**	9415.15	**	38.03	**	0.04		0.40
Testers (T)	4	21.3		24.6		153.7		2778.96	*	45.7	**	0.4		0.74
L x T	8	11	**	12.6	**	136.9	**	607.63		4.07	**	0.13		0.75
G x Lc	22	2.3	*	6	*	79.4	**	6022.43	**	9.73	**	0.26	**	1.15
P x Lc	7	4.9	*	8.1	*	2.1		9953.34	**	19.46	**	0.13		1.22
H x Lc	14	1.2	*	4.9		123.4	**	2887.17	**	5.31	**	0.16		1.01
L x Lc	2	0.5		2.4		0.8		901.29		6.48	**	0.1		2.46
T x Lc	4	5.5	*	10.8	*	0.2		7124.65	**	17.9	**	0.07		0.91
L x T x Lc	8	1.5		2		2.3		7721.48	**	6.89	**	0.37	**	0.34
Error	132	3.5		3.6		2.5		1322.03		0.95		0.1		0.94

*: P ≤ 0.05, **: P ≤ 0.01, df: Degrees of freedom.

While genotypes were started the boll opening time in the third week of August in Kahramanmaraş and second week of September in Elbistan with the 1591.5 °C and 1462.4 °C respectively, Kaya (2006) was reported that some genotypes used less degree-day unit than our finding (between 1174 °C and 1255 °C) in Kahramanmaraş. Moreover, while the hybrids entering to boll opening time used less degree-day units than their parents and the degree-day units in Kahramanmaraş changed from 1485.8 °C (1x8 and 3x8) to 1674.6 (2x8 and 3x5) °C. In addition, the degree-day units in Elbistan changed from 1227.3 (1x4) °C to 1493.2 °C (2x6).

The degree-day units used by hybrids, while obtain in between 101.75 day (1x8) and 112.0 day (3x5) in Kahramanmaraş, contrarily were obtain in between 121.00 day (1x4) and 155.25 day (2x6) in Elbistan. On the other hand, the day degree units used by parents that are changing between 1525.5 °C (Primera, Nazilli 663 and Fantom) and 1749.4 °C (Adana 98) in Kahramanmaraş and in Elbistan from 1458.3 °C (Primera, Nazilli 663 and Fantom) to 1506.40 °C (Adana 98), whereas, the supply of these

units was obtained between 104.0 and 116.0 day in Kahramanmaraş although obtained between 151.3 and 157.3 day in Elbistan (Table 6). When compared to other genotypes, while the 1x4 F₁ hybrid combination using minimum number of day (121.0 day) and degree-day units (1227.3 °C) for the first boll open times, 3x7 F₁ hybrid (147.5 day and 1458.3 °C) and Fantom (147.5 day and 1458.3 °C) cultivars followed them (Table 6 and 7). This is due to the fact that the genotypes affected by altitude are caused by the rapid transition to generative development.

Sowing-harvesting times (day)

As in other features, the sowing-harvesting periods of the locations and the degree-day units of this periods also showed differences (Figure 4). Although harvests in Kahramanmaraş were completed in 4 September and 5 October 2012 using 2013.7 °C and 2480.1 °C day-degree units, in Elbistan were completed using 1448.2 °C, 1580.5 °C and 1593.5 °C degree-day units in 4th October 2012, 5th November 2012 and 28th November 2012, respectively.

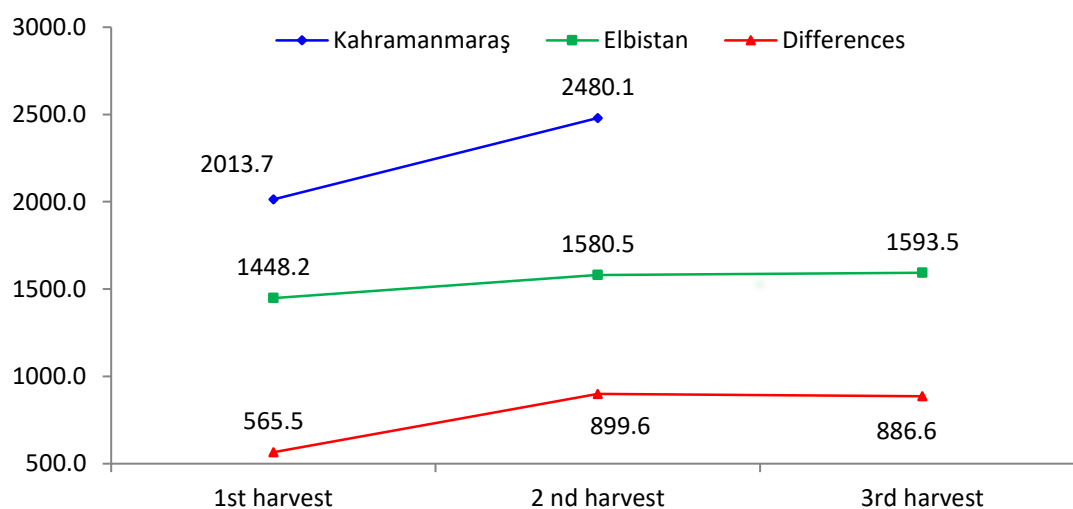


Figure 4. The degree-day units (°C) for harvest dates at Kahramanmaraş and Elbistan.

This differences had been produce about 30 day gap with 565.5 °C and 899.6 °C degree-day units between two location for first harvesting time and second harvesting time, respectively. Moreover, this situation can be said for the harvesting times of the locations too. For example, while the day number and degree-day unit between first and second harvest in Kahramanmaraş were forming from 30 day and 466.4 °C, in Elbistan were found as 31 day with 132.3 °C degree-day unit (Daily 4.27 °C), respectively.

While this differences emphasizes the importance of locations and genotypes in terms of

seed cotton yield, gin outturn and fiber fineness, fiber length wasn't affected from this differences.

Seed cotton yield (kg da⁻¹)

The average yields of parents and hybrids in Kahramanmaraş more than Elbistan and changed from 392.95 kg da⁻¹ to 444.01 kg da⁻¹ in Kahramanmaraş, against from 204.33 kg da⁻¹ to 209.50 kg da⁻¹ in Elbistan (Table 9).

It was determined that the variation between two location contributed by differences among lines, while the differences in Elbistan were supported by differences among testers and L x T interactions (Table 2 and 3). On the other hand, our

findings about that hybrids were more important than parents in Kahramanmaraş and differences of locations was found more effective on parents,

hybrids and testers (G x Lc, P x Lc, H x Lc, T x Lc and L x T x Lc in Table 3). Our finding is in agreement with Güvercin and Oğlakçı (2016).

Table 4. The days number first squaring time of parents and hybrids (F₁) after sowing in Kahramanmaraş and Elbistan conditions.

Genotypes (hybrids and parents)			Locations		Average (days)			
			Kahramanmaraş	Elbistan				
1x4			38.5	q-u	53.5	f-ı	46.0	f-ı
1x5			37.3	t-w	54.3	e-h	45.8	f-ı
1x6			38.8	q-t	54.3	e-h	46.5	fgh
1x7			37.3	t-w	52.3	h-k	44.8	ıjk
1x8			36.0	vw	51.5	ıjk	43.8	jkl
2x4			35.0	w	50.3	k	42.6	l
2x5			37.3	t-w	53.0	g-j	45.1	h-k
2x6			36.3	uvw	51.0	jk	43.6	kl
2x7			37.8	r-v	52.3	h-k	45.0	h-k
2x8			36.0	vw	51.8	ıjk	43.9	jkl
3x4			40.0	o-r	54.5	d-h	47.3	ef
3x5			40.8	n-q	55.8	b-f	48.3	de
3x6			42.5	mn	57.0	bc	49.8	bcd
3x7			37.8	r-v	54.5	d-h	46.3	f-ı
3x8			37.3	t-w	53.3	g-j	45.3	hij
Average of hybrids			37.9	b	53.3	a	45.6	
Lines	Stoneville 468	(1)	42.3	mno	56.8	bcd	49.5	bcd
	Adana 98	(2)	43.8	m	58.0	b	50.9	b
	Furkan	(3)	47.5	l	61.0	a	54.3	a
Testers	Beli İzvor 432	(4)	36.8	t-w	55.3	c-g	46.0	f-ı
	Primera	(5)	43.0	mn	57.8	b	50.4	bc
	Berke	(6)	41.5	m-p	56.5	b-e	49.0	cd
	Nazilli 663	(7)	39.8	p-s	54.3	e-h	47.0	ef
	Fantom	(8)	37.5	s-v	53.8	f-ı	45.6	ghı
Averages of parents			41.5	b	56.7	a	49.1	
Averages of genotypes			39.7	b	55.0	a	47.3	
Coefficient of Variation (%)							3.5	
Least Significant Differences (0.05)								
Hybrids			1.42		LSD Average of Locations–Genotypes		0.48	
LSD Parents			1.74		LSD Hybrids x Locations		2.01	
LSD Genotypes			1.62		LSD Parents x Locations		2.41	
LSD Average of Locations–Hybrids			0.52		LSD Genotypes x Locations		2.30	
LSD Average of Locations–Parents			0.85					

The difference in harvesting time between locations (38 day) hadn't been preventing the difference in day degree units. This situation, resulting in less seed cotton yield with ginning outturn and fiber fineness from the same genotype under Elbistan conditions. The difference between first and second harvest in Elbistan is 31 days and 132.3 °C, while difference between second and third harvest is 23 day and 13 °C degree-day. Whereas, difference between first and second harvest in Kahramanmaraş was 31 days and 466.4 °C degree-day.

For this reason, the 1x4 F₁ hybrid has been distinguished from other genotypes in term of harvesting time and yield in Elbistan. Or else, in the

Kahramanmaraş where same genotypes are located, the first harvests were made with 2013.7 °C degree-day units which collected in 123 day after planting.

Moreover, while the last harvest in Kahramanmaraş was completed in 157 days with 2480.1 °C degree-day units, it had completed in Elbistan within 195 days and 1593.5 °C degree-day units. Then, 426.25 kg da⁻¹ (Kahramanmaraş) and 207.41 kg da⁻¹ (Elbistan) seed cotton yield had been obtained (Table 9 and Figure 4).

This finding which consistent with Haliloğlu (2015), indicated that for a kilogram of seed cotton yield production what you needed 5.82 °C degree-day units in Kahramanmaraş and 7.68 °C degree-day

units in Elbistan (total temperature/yield averages for the final crop). As a result, it can be said, it is determined that the 1x5 F₁ hybrid (484.80 kg da⁻¹) and Stoneville 468 (428.68 kg da⁻¹) cultivar were

found very important for Kahramanmaraş, while 1x4 F₁ hybrid (293.90 kg da⁻¹) with Fantom cultivar (281.88 kg da⁻¹) had been determined very important for Elbistan.

Table 5. The days number first flowering time of parents and hybrids (F₁) after sowing in Kahramanmaraş and Elbistan conditions.

Genotypes (hybrids and parents)			Locations		Average (days)
			Kahramanmaraş	Elbistan	
1x4			58.0 qr	72.3 hi	65.1 i
1x5			59.8 opq	76.0 efg	67.9 fg
1x6			59.5 opq	76.0 efg	67.9 fg
1x7			60.0 opq	74.5 gh	67.3 fgh
1x8			60.0 opq	73.0 h	66.5 ghi
2x4			59.8 opq	74.5 gh	67.3 fgh
2x5			60.0 opq	74.5 gh	67.3 fgh
2x6			61.3 nop	74.5 gh	67.9 fg
2x7			61.0 nop	75.5 fg	68.3 ef
2x8			59.3 pq	74.3 gh	66.8 f-i
3x4			62.8 lmn	77.3 def	70.0 d
3x5			68.8 j	79.3 bcd	74.0 b
3x6			61.8 mno	78.0 cde	69.9 de
3x7			62.5 lmn	77.3 def	69.9 de
3x8			60.0 opq	76.5 efg	68.3 ef
Average of hybrids			61.0 b	75.6 a	68.3
Lines	Stoneville 468	(1)	64.8 kl	79.8 bc	72.3 c
	Adana 98	(2)	66.0 k	81.3 b	73.6 bc
	Furkan	(3)	70.5 ij	83.8 a	77.1 a
Testers	Beli İzvor 432	(4)	55.8 r	75.5 fg	65.6 hi
	Primera	(5)	65.3 k	80.8 b	73.0 bc
	Berke	(6)	64.8 kl	79.8 bc	72.3 c
	Nazilli 663	(7)	63.8 klm	77.3 def	70.5 d
	Fantom	(8)	59.5 opq	75.8 efg	67.9 fg
Averages of parents			63.8 b	79.2 a	71.5
Averages of genotypes			61.9 b	76.8 a	69.4
CV (%)					2.5
LSD Hybrids			1.47	LSD Average of Locations–Genotypes	0.50
LSD Parents			1.90	LSD Hybrids x Locations	2.08
LSD Genotypes			1.71	LSD Parents x Locations	2.69
LSD Average of Locations–Hybrids			0.54	LSD Genotypes x Locations	2.41
LSD Average of Locations–Parents			0.95		

Gin outturn (%)

The means of gin outturn of genotypes were effected from locations having different altitude, showed higher values in Kahramanmaraş condition (~6.32 %) and was found very significant both Kahramanmaraş and Elbistan.

The average gin outturn of hybrids and parents found 41.94 % and 41.23 % in Kahramanmaraş and 35.41 % and 35.28 % in Elbistan (Table 10), were supported by the differences between lines, testers, hybrids, parents such as GxLc, PxLc, H x Lc, LxLc, TxLc and LxTxLc interactions (Table 3).

Nazilli 663 (43.74 %) variety and 1x5 F₁ hybrid (44.50 %) were found very important for Kahramanmaraş. Then, 1x4 F₁ hybrid (38.54 %) and Beli İzvor variety (38.53 %) are found very important for Elbistan as well as Beli İzvor 432 variety which is least affected by the locations (Kahramanmaraş: 39.55 %, Elbistan: 38.53 %). Although some researchers reported that sowing time (Oad et al., 2002) and difference of years (Efe et al., 2013) did not affect gin outturn, the difference in altitude effect on gin outturn had determined very important in this study.

Table 6. The days number boll opening time of parents and hybrids (F₁) after sowing in Kahramanmaraş and Elbistan conditions

Genotypes (hybrids and parents)		Locations		Average (days)
		Kahramanmaraş	Elbistan	
1x4		106.5 qr	121.0 k	113.8 k
1x5		104.0 st	150.0 hı	127.0 hı
1x6		106.8 q	151.5 e-h	129.1 fg
1x7		105.0 rs	151.0 gh	128.0 gh
1x8		101.8 u	148.0 j	124.9 j
2x4		109.0 op	153.0 cde	131.0 cd
2x5		109.0 op	152.5 d-g	130.8 de
2x6		111.0 mn	155.3 b	133.1 b
2x7		108.0 pq	153.0 cde	130.5 de
2x8		112.0 m	152.3 efg	132.1 bc
3x4		108.0 pq	151.5 e-h	129.8 ef
3x5		112.0 m	154.5 bc	133.3 b
3x6		110.0 no	152.8 def	131.4 cd
3x7		103.0 tu	147.5 j	125.3 j
3x8		102.0 u	148.3 j	125.1 j
Average of hybrids		107.2 b	149.5 a	128.3
Lines	Stoneville 468 (1)	112.0 m	154.5 bc	133.3 b
	Adana 98 (2)	112.0 m	157.3 a	136.6 a
	Furkan (3)	116.0 l	154.0 bcd	133.0 b
Testers	Beli İzvor 432 (4)	108.0 pq	151.3 fgh	129.6 ef
	Primera (5)	104.0 st	147.8 j	125.9 ij
	Berke (6)	105.0 rs	149.0 ij	127.0 hı
	Nazilli 663 (7)	104.0 st	148.0 j	126.0 ij
	Fantom (8)	104.0 st	147.5 j	125.8 j
Averages of parents		108.1 b	151.2 a	129.6
Averages of genotypes		107.5 b	150.1 a	128.8
CV (%)				0.90
LSD Hybrids		1.23	LSD Average of Locations–Genotypes	0.34
LSD Parents		1.07	LSD Hybrids x Locations	1.73
LSD Genotypes		1.15	LSD Parents x Locations	1.52
LSD Average of Locations–Hybrids		0.45	LSD Genotypes x Locations	1.63
LSD Average of Locations–Parents		0.54		

Fiber fineness (micronaire)

Fiber fineness is very important a property which is effected by temperature variation (Liakatas et al., 1998; Reddy et al., 1999) It is observed from Table 7 that the difference among all variations souch except lines and L x T interactions in Elbistan for this property is significant, though not significant in Kahramanmaraş.

While the differences among the testers gave the highest contribution to the variation of fiber fineness in Elbistan, the average of the hybrid and parents varied between 3.37 and 3.77 micronaire in Elbistan and between 4.72 and 4.81 micronaire in Kahramanmaraş.

As seen Table 11, while the Beli Izvor 432 (4.14 micronaire) and 2x6 F₁ hybrid (3.04 micronaire) in Elbistan having been got very thickest and thinnest fibers, 3x7 F₁ hybrids (5.01 micronaire)

with Fantom variety (4.26 micronaire) in Kahramanmaraş have been got very thickest and thinnest fibers, respectively.

In the study, though Beli Izvor 432, Berke, Nazilli 663 varieties and 1x7 F₁ hybrids were having mature (> 3.80 micronaire) fiber in Elbistan, others have got immature fiber (<3.80 micronaire) which were affected negatively to strength fiber and dye performance (Bange et al., 2010).

As some researchers is determine non-significant importance in terms of varieties and variety x year interaction (Efe et al., 2013), this study determined that the fiber fineness was affected by different environmental where having different altitude.

Table 7. Total heat units (degree-day) required of hybrids in terms of beginning of squaring, flowering and first boll opening under Kahramanmaraş (KM) and Elbistan (E) locations and the differences (D) in degree-day units between two locations.

Genotypes (hybrids and parents)	Total heat units (degree-days) for									
	Squaring (°C)			Flowering (°C)			first boll opening (°C)			
	KM	E	D	KM	E	D	KM	E	D	
1x4	357.6	429.4	-71.8	673.5	660.7	12.8	1581.6	1227.3	354.3	
1x5	344.6	438.0	-93.4	704.0	708.0	-4.0	1525.5	1465.7	59.9	
1x6	357.6	438.0	-80.4	704.0	708.0	-4.0	1581.6	1473.1	108.5	
1x7	344.6	422.1	-77.5	704.0	691.0	13.0	1544.7	1469.3	75.4	
1x8	317.5	415.6	-98.2	704.0	660.7	43.3	1485.8	1458.3	27.5	
2x4	306.2	410.0	-103.9	704.0	691.0	13.0	1617.3	1477.1	140.2	
2x5	344.6	422.1	-77.5	704.0	691.0	13.0	1617.3	1477.1	140.2	
2x6	330.9	410.0	-79.1	739.2	691.0	48.2	1656.0	1493.2	162.8	
2x7	344.6	422.1	-77.5	721.9	708.0	14.0	1599.8	1477.1	122.7	
2x8	317.5	415.6	-98.2	704.0	691.0	13.0	1674.6	1477.1	197.5	
3x4	369.8	438.0	-68.2	739.2	741.4	-2.2	1599.8	1473.1	126.7	
3x5	381.3	446.9	-65.6	843.6	769.2	74.4	1674.6	1486.9	187.7	
3x6	408.7	457.8	-49.1	739.2	741.4	-2.2	1637.7	1477.1	160.6	
3x7	344.6	438.0	-93.4	739.2	741.4	-2.2	1504.0	1458.3	45.7	
3x8	344.6	429.4	-84.8	704.0	724.3	-20.3	1485.8	1461.1	24.7	
Averages of hybrids	347.6	428.8	-81.2	721.9	707.9	14.0	1585.7	1456.8	128.9	
Lines	Stoneville 468 (1)	408.7	457.8	-49.1	787.2	769.2	18.0	1674.6	1486.9	187.7
	Adana 98 (2)	424.8	467.5	-42.7	800.9	792.0	8.9	1749.4	1506.4	243.0
	Furkan (3)	495.2	498.0	-2.9	879.1	818.6	60.6	1674.6	1481.4	193.2
Testers	Beli İzvor 432 (4)	330.9	446.9	-116.0	645.2	708.0	-62.8	1599.8	1473.1	126.7
	Primera (5)	408.7	467.5	-58.8	800.9	780.5	20.4	1525.5	1458.3	67.2
	Berke (6)	394.4	457.8	-63.4	787.2	769.2	18.0	1544.7	1461.1	83.6
	Nazilli 663 (7)	369.8	438.0	-68.2	771.6	741.4	30.2	1525.5	1458.3	67.2
	Fantom (8)	344.6	429.4	-84.8	704.0	708.0	-4.0	1525.5	1458.3	67.2
Averages of parents	397.1	457.8	-60.7	772.0	760.8	11.2	1602.4	1473.0	129.5	
General averages	364.9	438.9	-74.1	739.3	726.3	13.0	1591.5	1462.4	129.1	

Table 8. Harvest dates and degree-day units of genotypes in Kahramanmaraş and Elbistan.

Harvest dates	Degree-day units		Implementation
	Kahramanmaraş (°C)	Elbistan (°C)	
04.09.2012	2013.7		1 st hand harvest
05.10.2012		1448.2	1 st hand harvest
04.10.2012	2480.1		2 nd hand harvest
05.11.2012		1580.5	2 nd hand harvest
28.11.2012		1593.5	3 rd hand harvest

Fiber length (mm)

Whereas there were no differences among the variation sources, the fiber length averages of the hybrids and the parents were found 28.94 mm and 28.18 mm in Kahramanmaraş and 29.23 mm

and 28.97 mm in Elbistan, respectively (Table 2, 3 and 12).

While 1x8 F₁ hybrid (30.03 mm) and Nazilli 663 cultivar (29.37) have got longest fibers in Elbistan, the 2x7 F₁ (28.81 mm) hybrid and the Beli İzvor 432 (27.75 mm) variety have shortest fiber.

Table 9. The means seed cotton yield of parents and hybrids (F₁) after sowing in Kahramanmaraş and Elbistan conditions.

Genotypes (hybrids and parent)			Locations		Average (days)			
			Kahramanmaraş	Elbistan				
1x4			438.37	a-e	293.90	ij	366.13	a
1x5			484.80	a	218.45	l-o	351.62	ab
1x6			462.96	abc	232.74	k-n	347.85	abc
1x7			467.20	ab	177.32	o-s	322.26	b-f
1x8			448.26	a-d	207.80	l-q	328.03	bcd
2x4			433.17	b-f	234.88	k-n	334.02	a-d
2x5			427.27	b-f	199.02	m-r	313.14	c-h
2x6			436.05	a-f	215.98	l-p	326.01	bcd
2x7			424.95	b-f	218.48	l-o	321.72	b-g
2x8			431.33	b-f	213.30	l-p	322.32	b-f
3x4			427.71	b-f	219.79	l-o	323.75	b-e
3x5			444.95	a-e	180.12	o-s	312.53	d-h
3x6			458.80	abc	189.82	n-s	324.31	b-e
3x7			438.55	a-e	166.43	p-s	302.49	d-i
3x8			435.77	a-f	167.71	p-s	301.74	d-i
Averages of hybrids			444.01	a	209.50	b	326.53	
Lines	Stoneville 468	(1)	428.68	b-f	158.66	qrs	287.42	f-i
	Adana 98	(2)	418.32	b-f	147.26	s	282.79	hi
	Furkan	(3)	387.50	fg	158.07	rs	272.78	i
Testers	Beli izvor 432	(4)	364.95	gh	243.69	klm	304.32	d-i
	Primera	(5)	405.00	d-g	213.93	l-p	309.46	d-h
	Berke	(6)	325.10	hi	255.63	jkl	290.36	e-i
	Nazilli 663	(7)	397.88	efg	175.48	o-s	286.68	ghi
	Fantom	(8)	416.18	c-f	281.88	ijk	355.28	ab
Averages of parents			392.95	a	204.33	b	298.64	
Averages of genotypes			426.25	a	207.41	b	316.83	
CV (%)							11.21	
LSD Hybrids			34.25		LSD Average of Locations-Genotypes		10.36	
LSD Parents			38.25		LSD Hybrids x Locations		48.44	
LSD Genotypes			35.12		LSD Parents x Locations		54.09	
LSD Average of Locations-Hybrids			12.51		LSD Genotypes x Locations		49.67	
LSD Average of Locations-Parents			19.12					

While the 2x7 F₁ hybrid (29.81 mm) and Furkan (29.91 mm) variety have been got longest fibers in Kahramanmaraş in contrast the 1x6 F₁ hybrid (27.87 mm) and Stoneville 468 (28.02 mm) variety had had been least fiber length.

It can be said that the fiber length is managed by the genetic structure when the degree-day units of last harvest dates (Kahramanmaraş: 2480.1 °C; Elbistan: 1593.5 °C; Difference: 886.6 °C) in locations taken into consideration.

Conclusion

As a result of the study, it was determined that cotton cultivation in Elbistan could be done with appropriate genotypes. The degree-day units and day number being necessary for squaring, flowering, boll opening and harvesting times of the genotypes after sown showed to be different

according to locations and genotypes. While this situation have effected seed cotton yield, gin outturn and fiber fineness of cotton, fiber length didn't effected.

Moreover, it was found differences in terms of average of 218.84 kg of seed cotton yield, 6.32 % of gin outturn and 1.27 micronaire fiber fineness between Kahramanmaraş and Elbistan locations. Furthermore, while Kahramanmaraş determined as very important location in terms of seed cotton yield and gin outturn, Elbistan had been found very important in term of fiber fineness.

Genotypes in Elbistan except 1x7 F₁ hybrids with Beli Izvor 432, Berke and Nazilli 663 cultivars that weren't able to produce mature fiber which negatively affected fiber fineness, gin outturn and seed cotton yield. The genotypes which being use total 2480.1 °C day degree units in 157 day for

426.25 kg da⁻¹ seed cotton yield in Kahramanmaraş, used 1593.5 °C degree-day units in 195 day for 207.41 kg da⁻¹ seed cotton yield in Elbistan.

Table 10. The gin outturn of parents and hybrids (F₁) after sowing in Kahramanmaraş and Elbistan conditions.

Genotypes (hybrids and parents)			Locations		Average (days)			
			Kahramanmaraş	Elbistan				
	1x4		41.00	lj	38.54	lmn	39.77	bcd
	1x5		44.50	a	36.96	opq	40.73	a
	1x6		41.17	hij	33.82	v-y	37.49	hij
	1x7		44.13	ab	37.18	op	40.66	ab
	1x8		43.59	a-d	37.13	op	40.36	abc
	2x4		39.01	lm	33.46	wxy	36.23	l
	2x5		42.93	b-f	37.44	nop	40.19	abc
	2x6		39.65	kl	32.84	yz	36.24	l
	2x7		42.33	d-h	33.80	v-y	39.63	cde
	2x8		41.50	g-j	37.76	mno	38.07	ghi
	3x4		40.49	jk	33.11	xy	36.80	jkl
	3x5		43.33	a-e	35.10	s-v	39.21	de
	3x6		40.32	jk	33.35	wxy	36.83	jkl
	3x7		42.40	d-h	35.48	rst	38.94	d-g
	3x8		42.75	c-g	35.27	r-u	39.01	def
Average of hybrids			41.94	a	35.41	b	38.68	
Lines	Stoneville 468	(1)	43.24	a-e	34.45	s-w	38.85	efg
	Adana 98	(2)	40.40	jk	34.14	u-y	37.27	ijk
	Furkan	(3)	41.44	hij	31.69	z	36.57	kl
Testers	Beli izvor 432	(4)	39.55	kl	38.53	lmn	39.04	def
	Primera	(5)	37.55	nop	35.69	qrs	36.62	jkl
	Berke	(6)	42.12	e-i	34.28	t-x	38.20	fgh
	Nazilli 663	(7)	43.74	abc	37.02	op	40.38	abc
	Fantom	(8)	41.80	f-i	36.45	pqr	39.13	de
Average of parents			41.23	a	35.28	b	38.26	
Average of genotypes			41.69	a	35.37	b	38.53	
CV (%)							2.4	
LSD	Hybrids		0.95		LSD	Average of Locations-Genotypes		0.27
LSD	Parents		0.94		LSD	Hybrids x Locations		1.34
LSD	Genotypes		0.92		LSD	Parents x Locations		1.33
LSD	Average of Locations-Hybrids		0.35		LSD	Genotypes x Locations		1.30
LSD	Average of Locations-Parents		0.47					

This result had been indicated that a temperature unit of approximately 1.86 °C less than Elbistan (7.68 °C) was required in Kahramanmaraş (5.82 °C) for one kilogram of seed cotton yield production.

As a result, both 1x4 F₁ hybrids which is having high seed cotton yield and gin outturn and Fantom cultivar which having high seed cotton yield are being found very important for Elbistan, in contrast 1x5 F₁ hybrids and Stoneville 468 having been found very important in Kahramanmaraş in terms of investigated properties.

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Table 11. The fiber fineness means of parents and hybrids (F₁) after sowing in Kahramanmaraş and Elbistan conditions.

Genotypes (hybrids and parents)		Locations		Average (days)
		Kahramanmaraş	Elbistan	
1x4		4.70	3.27 j-n	3.98 fgh
1x5		4.52	3.51 ı-m	4.01 d-h
1x6		4.81	3.15 k-n	3.98 fgh
1x7		4.82	3.85 e-ı	4.34 abc
1x8		4.84	3.77 f-ı	4.30 a-e
2x4		4.68	3.10 mn	3.89 h
2x5		4.97	3.68 g-j	4.32 a-d
2x6		4.71	3.04 n	3.88 h
2x7		4.88	3.19 k-n	4.03 c-h
2x8		4.86	3.51 ı-m	4.18 a-h
3x4		4.82	3.16 k-n	3.99 e-h
3x5		4.90	3.14 lmn	4.02 c-h
3x6		4.90	3.15 k-n	4.02 c-h
3x7		5.01	3.45 ı-n	4.19 a-h
3x8		4.73	3.65 g-j	4.23 a-g
Average of hybrids		4.81 a	3.37 b	4.09
Lines	Stoneville 468 (1)	4.99	3.60 h-k	4.30 a-f
	Adana 98 (2)	4.76	3.59 h-k	4.18 a-h
	Furkan (3)	4.61	3.66 g-j	4.13 b-h
Testers	Beli İzvor 432 (4)	4.84	4.14 def	4.49 a
	Primera (5)	4.70	3.58 h-l	4.14 b-h
	Berke (6)	4.89	4.07 d-g	4.48 a
	Nazilli 663 (7)	4.73	3.99 e-h	4.36 ab
	Fantom (8)	4.26	3.58 h-l	3.92 gh
Average of parents		4.72 a	3.77 b	4.25
Average of genotypes		4.78 a	3.51 b	4.15
CV (%)				0.07
LSD Hybrids	0.30	LSD Average of Locations–Genotypes		0.09
LSD Parents	0.35	LSD Hybrids x Locations		0.43
LSD Genotypes	0.32	LSD Parents x Locations		0.50
LSD Average of Locations–Hybrids	0.11	LSD Genotypes x Locations		0.45
LSD Average of Locations–Parents	0.18			

Table 12. The means fiber length means of parents and hybrids (F₁) after sowing in Kahramanmaraş and Elbistan conditions.

Genotypes (hybrids and parents)			Locations		Average (days)
			Kahramanmaraş	Elbistan	
1x4			29.63	28.88	29.25
1x5			29.25	29.02	29.14
1x6			27.87	29.11	28.49
1x7			28.47	29.17	28.82
1x8			29.04	30.03	29.53
2x4			29.22	29.39	29.30
2x5			29.04	29.41	29.23
2x6			29.07	29.10	29.08
2x7			29.81	28.81	29.31
2x8			28.80	29.31	29.06
3x4			29.38	28.90	29.14
3x5			28.35	28.87	28.61
3x6			28.59	29.85	29.22
3x7			28.18	29.28	28.73
3x8			29.35	29.33	29.34
Average of hybrids			28.94	29.23	29.08
Lines	Stoneville 468	(1)	28.02	29.10	28.56
	Adana 98	(2)	29.80	28.99	29.40
	Furkan	(3)	29.91	29.04	29.47
Testers	Beli İzvor 432	(4)	28.89	27.75	28.32
	Primera	(5)	29.70	29.33	29.52
	Berke	(6)	28.82	29.00	28.91
	Nazilli 663	(7)	28.73	29.37	29.05
	Fantom	(8)	29.58	29.14	29.36
Average of parents			28.18	28.97	29.07
Average of genotypes			29.02	29.14	29.08
CV (%)			3.79	2.71	3.33
LSD Hybrids			0.98	LSD Average of Locations–Genotypes	0.28
LSD Parents			0.85	LSD Hybrids x Locations	1.38
LSD Genotypes			0.95	LSD Parents x Locations	1.20
LSD Average of Locations–Hybrids			0.36	LSD Genotypes x Locations	1.34
LSD Average of Locations–Parents			0.42		

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