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EFFECT OF SOWING TIME IN COTTON (*Gossypium hirsutum* L.) ON BOLL DISTRIBUTION, CELLULOSE RATIO AND FIBER QUALITY

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ABSTRACT

The growth, flowering, square, and boll formation of the cotton plant are significantly affected by sowing time and fruiting distributions. This study was carried out in order to determine the effect of sowing time, varieties and boll distribution on fiber yield and fiber quality of cotton, under the GAP region ecological conditions of Türkiye during 2017 and 2018 cotton growing seasons. In this study, Candia and Lima cotton varieties were used as plant material. Cotton seeds were sown on 5 May (normal sowing) and 10 June (late sowing) using a pneumatic seeder in both years. In the study, the number of bolls (per plant^{-1}), yield per plant (g plant^{-1}), boll weight (g), ginning outturn (%), holocellulose, cellulose, scan viscosity, and polymerization degree were studied. According to the research, the number of bolls, boll weight, and fiber yield were higher in normal planting than in late planting. The low positional sympodial branch (1-5 fruit branches) boll position was better in the number of bolls, and the middle positional sympodial branch (6-10 fruit branches) was better in boll weight compared to other positions. The fiber yield obtained in a low positional sympodial branch (1-5 fruit branches) and middle positional sympodial branch (6-10 fruit branches) positions was higher than the upper positional sympodial branch position (11 and higher fruit branches). The effects of sowing times and cultivars on cellulose and holocellulose rations were statistically insignificant. The cellulose ratio (94.40) obtained in the upper positional sympodial branch position (11 and higher fruit branches) in the first year was higher than the other sympodial positions, while the effect of the boll position was statistically insignificant in the second year of the experiment. In conclusion, the planting time had a significant effect on boll positions and fiber quality of cotton. Late sowing had negative impact on boll maturation, cellulose synthesis, yield and fiber quality. Hence, the delay in cotton planting caused a decrease in yield; so, cotton should be sown as early as possible in the region.

Keywords: Cotton, sowing date, boll position, boll weight, fiber quality

INTRODUCTION

Cotton (*Gossypium hirsutum* L.) has a perennial and indeterminate growth feature and continues to grow vegetatively under suitable environmental conditions, in which the maturation may be delayed (Bondada and Oosterhuis, 2001). Cotton varieties differ in fiber properties (Baloch, 2001) and can be affected by environmental conditions (Killi *et al*., 2005). The sowing date is the main factor affecting the vegetative and generative development of the cotton plant. Therefore, very early or very late sowing causes a serious decrease in seed cotton yield (Bange and Milroy, 2004). Cotton is very sensitive to temperature fluctuations and is planted in a wide variety of agroecological regions. Therefore, the optimum sowing date of varieties in a region is very important as the sowing date is the most important controllable factor for cotton plants (Bachubhai *et al*., 2018).

The cotton plant has a distinctive main stem and irregular growth design (Jenkins *et al*., 1990 b). Previous studies have revealed that different yield and fiber properties can be obtained from bolls located at different positions (Davidonis *et al*., 2004; Ma *et al*., 2014). Some studies indicated that the bolls in the first node on the same fruiting branch contribute more to the yield than those in the later nodes. In addition, the results revealed that 60% of the total yield was obtained from the bolls in the 1st node and 30% from the 2nd node (Davidonis *et al*., 2004). Özkan and Kaynak, 2009 reported that seed cotton yield, boll seed cotton weight, fiber length, and fiber strength were higher until the 7th fruiting branch, and the gin yield and fiber fineness were higher in the 6th and 10th fruiting branches. Fiber length, strength, and fineness are significantly affected by the fruiting positions, and the fibers properties of the third fruiting position are lower than the fibers obtained from the first fruiting position (Ma *et al*., 2014). Bradow *et al*. (1997) reported that the fiber length varies between fruiting positions, and Snowden *et al*., (2013) indicated that boll distribution characteristics are associated with cotton maturity, which can determine yield and fiber quality. Cotton is a natural fiber mainly composed of cellulose which is the major component of wood (Abbas and Ahmad, 2018). The cellulose content of cotton fiber is almost 96% (Turkoglu *et al*., 2020). The cotton has a hairy seed, and a single hyper-extended cell rises from the protodermal cells of the external integument layer of the seed coat. Similar to all living plant cells, environmental conditions significantly affect the fiber development of cotton (Tariq *et al*., 2018). Cellulose, a linear chain polysaccharide, is composed of glucose molecules connected to each other by beta-1,4 glycosidic bonds. The ideal temperature range for cellulose synthesis is between 25 and 30 °C, and cellulose synthesis decreases in temperatures above or below this range (Nakashima *et al*., 2004). This research was carried out to determine the effects of sowing times, varieties and boll positions on yield, yield components and some fiber characters of cotton.

MATERIALS and METHODS

Plant material and experimental design: The field experiment was conducted in Sultantepe village (altitude 465 m; 37° 08' North and 38° 46' East), located in Şanlıurfa City, close to the Turkey-Syria border in 2017 and 2018 cotton growing seasons. Sanliurfa City is located GAP Region in the southeast of Türkiye and under semi-arid climatic conditions. The layout of the experiment was split-split plot, according to randomized blocks design, with 3 replications. The sowing times were placed in the main plots and the cultivars were placed in the subplots, and boll position were placed sub-sub plots. Candia and Lima cotton varieties were used as the plant materials in the study. Each plot consisted of 12 m long 6 rows, and interrow and intra-row distances were 70 and 15 cm, respectively. The seeds were sown on 5 May (normal sowing) and 10 June (late sowing) with a pneumatic seeder in both years.

Climatic and soil parameters: Some physical and chemical properties of soil samples (0-30 cm) taken from the experimental site are given in Table 1, and some climate data of Şanlıurfa province are given in Table 2. Soils in the experimental field had low organic matter content (1.12%), slightly alkaline, very calcareous, slightly saline, clay loamy texture, low phosphorus content, and moderate potassium content (Ramazanoglu, 2019).

Table 1. Some physical and chemical properties of soils in the experimental site

Depth (cm)	pH	Organic Matter (%)	Lime (%)	Plant Nutrients (mg kg^{-1})						
				P	K	Mg	Fe	Zn	Cu	Mn
0.30	7.92	1.12	29.6	4,70	180	303	3,46	0,72	4,64	0,44

Harran University, Agricultural Faculty, Soil Department Laboratory, 2017.

Table 2. Some climate data of Sanliurfa province for 2017 and 2018 growing seasons.

	2017			2018			1929-2018
Months	**Mean Temp. (°C)**	**Precipitation (kg/m^2)**	**Mean Relative Humidity (%)**	**Mean Temp. (°C)**	**Precipitation (kg/m^2)**	**Mean Relative Humidity (%)**	**Long term Temp. (°C)**
April	16.6	79.2	50.2	19.4	38.2	45.4	16.2
May	22.9	7.2	39.0	23.9	112.8	52.6	22.1
June	29.7	0.0	27.0	28.3	6.8	41.4	28.0
July	34.2	0.0	22.9	31.3	0.0	38.7	31.9
August	32.2	0.0	35.7	31.1	0.0	40.9	31.5
September	29.6	0.0	28.8	27.4	0.0	41.6	27.1
October	20.5	17.1	36.9	20.6	28.8	54.3	20.5
November	13.4	17.4	56.0	14.3	30.5	55.5	13.1

Source; Turkish State Meteorojical Service

The pH of the soil of the trial area is 7.92 and it is suitable for cotton farming. The organic matter content is 1.12% and it is extremely low. The nitrogen and phosphorus content is extremely low. Potassium content is 180 kg/ha, which may be sufficient for cotton cultivation, but it can be said that some of the potassium is bound in the soil and cannot be utilized sufficiently by the plant (Table. 1). As can be seen from Table 2, spring precipitation is quite low in the experimental area. There is no precipitation in summer. For this reason, cotton farming can only be done by irrigation. In conclusion As seen table 1 and 2 soil properties and climatic conditions are suitable for cultivation cotton growing at trial area.

Cultural practices: All treatments received the same amount of fertilizer based on the nutrient demand of cotton plants and soil analysis. Plant nutrients were applied in the seedbeds at rates of 16 kg/da pure N and 7 kg/da P_2O_5. All of the phosphorus and 7 kg/da of nitrogen were applied as 20.20.0 compound fertilizer with planting, and the remaining 9 kg N/da was applied with a lister just before the first irrigation. Considering the water demand of cotton plants, 11 furrow irrigation was carried out throughout the growing seasons. Furrow irrigation was applied to the experiment 10 times in total. . All cultural practices were performed traditionally during the growing seasons. After the cotton plants emerged, hand hoeing was applied once, and tractor hoeing was applied 2 times. Auxiliary chemicals were applied 15 days before harvest to shed the leaves and open the bolls. The defoliant that the trade name Finish Pro765 (active ingredient ethephon+cyclanide) was applied as a harvest aid. The harvest was carried out at a time when all the bolls were opened. Harvest in normal planting time was made October 15 in the first year, October 18 in the second year. The late sown crop was harvested November, 05 and 9 during 1^{st} and 2^{nd} year of study.

Measurement of parameters: The boll positions of 10 randomly selected plants from each plot were divided into 3 parts as lower boll positions (1-5 fruit branches), middle boll positions (6-10 fruit branches), and upper boll positions (11 and above fruit branches). The measurements were carried out on the bolls obtained in each position (Beyyavaş and Haliloğlu, 2019). The bolls obtained from each position were counted and weighted, and fiber yields were calculated by ginning. The chemical quality of fibers was determined in Harran University, Central Laboratory. The holocellulose, cellulose, hemicellulose, scan viscosity and degree of polymerization of the fibers were investigated. Dry fibers were digested in an acetic-nitric reagent, and the cellulose content was determined with anthrone using the method described by Updegraff, (1969). Cellulose must be dissolved in a soluble solvent to determine the polymerization degree of cotton samples (Nelson and Irvine, 1992). Then, after the paste was dissolved in 0.5 M Copper ethylene diamine (CED) solution according to the SCAN cm 15 (Tappi, 1992) standard, the relative viscosity value was determined using a pipette type viscometer. This value was converted to the actual viscosity value in cm^3 g^{-1} using the Table prepared according to the equation of Martin *et al*., 2006. The number of glucose units that make up the cellulose molecule is defined as the degree of polymerization (DP). The DP is determined by dividing the molecular weight of cellulose by the weight of one anhydrous glucose unit (Clark, 1978). The tensile strength of the fibers, and especially the tensile ability, largely depends on the DP of the fibers. The following relationship (Eq.1) was determined between the viscosity value calculated and the DP of the dough.

DP0.905 = 0.75 x Viscosity

(Eq.1)

In the equation, “viscosity” is SCAN cm 15:88 viscosity determined in cm3 g-1 (Pulp, S., and Paper Board Testing Committee, 1988; Turkoglu *et al*., 2020). The chloride method of Wise and Karl was used to produce holocellulose (Wise and Karl, 1962).

Statistical analysis: The experiment was established according to the split-split plots in the randomized complete block design, The data collected were analyzed using JMP 13.2 statistical program. Analysis of variance (ANOVA) was performed to evaluate the differences in properties investigated between the treatments. Tukey-HSD multiple range test at $p \leq 0.05$ was used as post-hoc, where ANOVA indicated significant differences among the treatments.

RESULTS AND DISCUSSION

Number of Bolls (per plant^{-1}): As can be seen from Table 3; source of variation The number of bolls in normal planting time (23.47 and 23.02 per/plant) in both years of the experiment was higher than that in the late planting time (16.17 and 16.27 per/plant). The number of bolls (20.95 and 20.61 per/plant) obtained from cultivars Candia was higher than that of Lima (18.17 and 18.69 per/plant). Similarly, Hussain *et al.* (2020) and Haliloğlu *et al.* (2020) stated that the number of bolls in normal sowing time was higher than the number of bolls in late sowing time. Cotton has an indeterminate growth habit, which provides a higher number of bolls per plant if the plants remain longer period in the field or planted earlier (Qamar *et al.* 2016). The results can be attributed to the higher photosynthesis and dry matter in normal sowing time. The difference between the cultivars may be due to the genotypic differences of the cultivars used as material. The varieties differ in their genetic structure and respond differently to various biotic and abiotic stresses and climatic conditions. Therefore, cultivar selection and appropriate planting time are important to increase seed cotton yield under different agroecological regions (Farid *et al.* 2017). The boll position of the low positional sympodial branch (1-5 fruit branches) produced more boll numbers than the other two positions (Table 3). The findings reported in previous studies are in accordance with our findings. Anjum *et al.* (2002) reported that the first fruit branch position contributed between 22.74 and 42.11% to the total number of bolls. In addition, the middle position fruit branch position contributes between 17.81 and 28.15% to the total number of bolls. The effect of sowing date* boll position interaction on the number of bolls was insignificant in 2017, while other interactions were significant (P<0.01). In 2018, all interactions had a statistically significant (P<0.01) effect on the number of bolls.

Table 3. Average number of bolls-1 and boll weight (g) per plant obtained for different sowing times, varieties, and fruiting positions,

Factors of Experiment	Number of bolls per plant^{-1}		Boll weight (g)	
Sowing date	**2017**	**2018**	**2017**	**2018**
Normal date	23.47a	23.02a	6.56a	6.52a
Late date	16.17b	16.27b	6.06b	5.91b
Cultivars				
Candia	20.95a	20.61a	6.45a	6.36a
Lima	18.17b	18.69b	6.17b	5.98b
Boll positions				
Low Positional Sympodial Branch	8.24a	8.11a	5.93b	6.02b
Middle Positional Sympodial Branch	6.40b	6.66b	6.83a	6.77a
Upper Positional Sympodial Branch	5.23c	5.07c	6.23b	6.04b
CV%	11.48	10.43	6.54	5.01
Factors	F value		F value	
Years				
Sowing date	111.2080**	562.9902**	25.5772**	39.1739**
Cultivars	10.7244**	18.3071**	15.7236**	25.1111**
Boll positions	46.9544**	56.9208**	14.8157**	22.0028**
Interaction				
Sowing Date*Cultivars	8.1917**	17.3636**	18.8226**	11.0329**
Sowing Date* Boll Position	ns	4.8089**	3.7343**	5.3776**
Cultivars * Boll Position	8.6593**	8.9240**	ns	ns
Sowing Date*Cultivars* Boll Position	7.9739**	4.7406**	ns	ns

Means with same letters, within a column or row, are statistically similar to each other at p≤0.05
Here, *= p<0.05, **= p<0.01, ns= non-significant

Boll weight (g): As seen in Table 3; The boll weight (6.56 and 6.52 g) obtained for normal sowing in both years of the experiment was higher than the late sowing (6.06 and 5.91 g). The boll weight (6.45 and 6.36 g) of the Candia cultivar was higher than that of the Lima cultivar (6.17 and 5.98 g). The prolongation of the vegetation period had a positive contribution to the boll weight. Boll weight is the most important factor that directly contributes to cotton yield (Table 3). Similar to our findings, Qamar *et al*., (2016) and Haliloğlu *et al.* (2020) indicated that the delay in sowing time causes a decrease in boll weight. Killi *et al.* (2005) reported that boll seed weight decreased by 14% in late sowing. The boll weight (6.83 and 6.77 g) in the Middle Positional Sympodial Branch position (6-10 fruit branches) was higher than the other two positions. The results on boll weight and boll positions reported in previous studies are in accordance with our findings. Kerby and Ruppenicker (1989) and Jenkins *et al.* (1990 a) stated that the bolls in fruiting branches at the middle parts of the plant were heavier. Zhao *et al.* (2012) stated that the highest boll weight was recorded in the low positional sympodial branch (1-5 fruit branches) position, while Haliloğlu (1999) found that the boll weight per plant was higher in the uppermost part of the fruiting branches (11th-15th fruit branch). In contrast, Beyyavaş and Haliloğlu (2019) indicated that the position does not have a significant effect on boll weight.

Fiber yield per plant (g): The fiber yield per plant obtained in normal sowing (128.44 and 126.51 g) was higher in both years of the experiment than the late sowing (73.33 and 83.35 g) (Table 4). The findings on higher fiber yield per plant in normal sowing compared to late sowing are in accordance with the findings of Qamar *et al.* (2016), Hussain *et al.* (2020), Haliloğlu *et al.* (2020), Dhir *et al.* (2021) and Tariq *et al.* (2021). The fiber yield per plant (109.68 and 114.68 g) of the Candia variety was higher in 2017 and 2018 compared to the Lima variety (92.09 and 97.17 g) (Table 5). The difference in fiber yield per plant between cultivars can be attributed to the differences in the genotypes of the cultivars. Fiber yield per plant (47.11 and 49.25 g/plant) obtained in the low positional sympodial branch (1-5 fruit branches) positions was higher than the other two parts. Özkan and Kaynak (2009) obtained the highest yields between 1-6 fruiting branches, which is compatible with our findings. In contrast to our study, the highest fiber yield per plant was reported between 4-9 fruiting branches by Jenkins *et al.* (1990a), between 3-7 fruiting branches by Hake *et al.* (1996), between 6-10 fruiting branches by Beyyavaş and Haliloğlu (2019). The effect of Sowing Date*Cultivars and Sowing Date* Boll Position interactions on fiber yield per plant was not significant, while other interactions were significant (P<0.01).

Ginning outturn (%): The effect of sowing time and boll positions on ginning outturn in both years of the experiment and varieties in the second year was not statistically significant. The only significant difference (P<0.01) in ginning out turn between the treatments was recorded for variety. The ginning outturn of the Candia variety was higher than that of the Lima variety (Table 4). The physiological responses of genotypes may vary under different environmental conditions (Hund *et al.* 2008; Zhao *et al.* 2012). The effects of interactions on the out turn were statistically not important. The ginning-out turn in normal sowing time was slightly higher than the late sowing, which is in line with the findings of previous studies. Arshad *et al.* (2007) reported that the gin out turn was 13% higher in normal sowing time than in late sowing. Similarly, Dhir *et al.* (2021) stated that the ginning outturn was high in the early sowing period.

Table 4. Average fiber yield per plant and ginning outturn (%) obtained for different sowing times, varieties and fruiting positions.

Factors of Experiment	**Fiber Yield per plant (g)**		**Ginning outturn (%)**	
Sowing date	**2017**	**2018**	**2017**	**2018**
Normal date	128.44a	126.51a	42.57ns	41.97ns
Late date	73.33b	83.35b	42.16ns	41.80ns
Cultivars				
Candia	109.68ns	114.68a	42.78a	42.13ns
Lima	92.09ns	97.17b	41.95b	41.65ns
Boll positions				
Low Positional Sympodial Branch	39.77a	41.27a	42.10ns	42.05ns
Middle Positional Sympodial Branch	35.24a	37.65a	41.95ns	42.15ns
Upper Positional Sympodial Branch	25.64b	26.98b	42.00ns	41.95ns
CV%	17.9	16.62	0.44	0.83
Interaction	F value		F value	
Sowing date	204.6218**	3279.705**	ns	ns
Cultivars	ns	13.7863**	57.0920**	ns
Boll positions	17.2325**	19.1861**	ns	ns
Sowing Date*Cultivars	ns	Ns	ns	ns
Sowing Date* Boll Position	ns	Ns	ns	ns
Cultivars * Boll Position	5.4952**	7.2228**	ns	ns
Sowing Date*Cultivars* Boll Position	5.0461**	3.9725**	ns	ns

Means with same letters, within a column or row, are statistically similar to each other at p≤0.05
Here, *= p<0.05, **= p<0.01, ns= non-significant

Holocellulose: The effect of sowing times and cultivar types on holocellulose was statistically insignificant in both years of the experiment. The effect of fruiting positions on holocellulose was significant (P<0.01) in the first year, while it was insignificant in the second year. The ball position of, Upper Positional Sympodial Branch (11 and above fruit branches) had higher gin efficiency (95.06) than other positions (Table 5). Holocellulose is the sum of hemicellulose and cellulose components (Mert, 2017). The cellulose and hemicellulose were statistically insignificant, which had a direct impact on the holocellulose.

Cellulose: The effects of sowing times and cultivars on cellulose were not statistically significant. The effect of late harvest on cellulose was not statistically significant, while it caused a decrease in the cellulose ratio (Table. 5). Slightly more cellulose was formed in normal sowing compared to late sowing. Similar to our findings on cellulose formation, Zhao *et al.* (2012) stated that the fiber of normally planted cotton had higher cellulose content than late-planted cotton in the same ball position. Chen *et al.* (2014) reported that the average daily minimum temperature in late plantings is the primary environmental factor affecting cotton and reported that late plantings reduced the cellulose content between 6.7 to 20.9%. The cellulikose ratio in the first year of the study was higher in the 3rd position (94.40) compared to other positions, while the difference was statistically insignificant in the second year. The effect of variety x position interaction on cellulose ratio was significant (P<0.01), while other interactions were insignificant. The cellulose ratio in cotton varieties depends on genetic and environmental factors (Hund *et al*., 2008) and varies between 82 and 96% (Mert, 2017) (Table 6). In addition, the chemical and physical quality properties of the fiber have strong correlations. Similar to the correlation found in our study, Wang *et al*. (2009) reported a negative (P<0.05) relationship between cellulose content and fiber strength in cotton, and a significant (P<0.01) positive relationship with cellulose content.

Table 5. Average holocellulose and cellulose obtained for different sowing times, varieties and fruiting positions.

Factors of Experiment	**Holocellulose**		**Cellulose**	
Sowing date	**2017**	**2018**	**2017**	**2018**
Normal date	94.78ns	95.03ns	94.20ns	94.94ns
Late date	94.51ns	94.92ns	93.89ns	94.17ns
Cultivars				
Candia	94.71ns	95.01ns	94.18ns	94.42ns
Lima	94.57ns	94.94ns	93.92ns	94.20ns
Boll positions				
Low Positional Sympodial Branch	94.42b	95.19ns	93.79b	94.51ns
Middle Positional Sympodial Branch	94.45b	94.75ns	93.95ab	94.09ns
Upper Positional Sympodial Branch	95.06a	94.99ns	94.40a	94.31ns
CV%	0.51	0.47	0.59	0.53
Interaction	F value		F value	
Sowing date	ns	Ns	ns	ns
Cultivars	ns	Ns	ns	ns
Boll positions	6.4006**	Ns	3.9014**	ns
Sowing Date*Cultivars	ns	12.3051**	ns	ns
Sowing Date* Boll Position	ns	Ns	ns	ns
Cultivars * Boll Position	11.8741**	17.5911**	19.3221**	17.5479**
Sowing Date*Cultivars* Boll Position	ns	Ns	ns	ns

Means with same letters, within a column or row, are statistically similar to each other at p≤0.05
Here, *= p<0.05, **= p<0.01, ns= non-significant

Table 6. Average scan viscosity obtained for different planting times, cultivars and fruiting positions.

Factors of Experiment	**Scan viscosity**		**Degree of polymerization**	
Sowing date	**2017**	**2018**	**2017**	**2018**
Normal sowing	465.29a	466.94a	645.71a	646.01a
Late sowing	439.79b	440.57b	607.39b	606.98b
Cultivars				
Candia	482.15a	482.52a	671.41a	670.53a
Lima	422.94b	424.98b	581.69b	582.47b
Boll positions				
Low Positional Sympodial Branch	453.18b	453.80b	627.12b	627.32b
Middle Positional Sympodial Branch	456.27a	458.16a	632.38a	633.53a
Upper Positional Sympodial Branch	448.18c	449.31c	620.15c	621.14c
CV%	0.22	0.68	0.17	0.15
Interaction	**F value**		**F value**	
Sowing date	9841.021**	460.9226**	12088.76**	10510.39**
Cultivars	75332.96**	4289.425**	19288.65**	29838.28**
Boll positions	195.4846**	24.4204**	389.2504**	430.6854**
Sowing Date*Cultivars	5940.161**	292.9070**	7564.310**	7320.109**
Sowing Date* Boll Position	581.9782**	60.3610**	1342.689**	1739.321**
Cultivars * Boll Position	816.0086**	85.6928**	1812.944**	2318.390**
Sowing Date*Cultivars* Boll Position	75.0941**	Ns	178.7350**	152.6753**

Means with same letters, within a column or row, are statistically similar to each other at p≤0.05
Here, *= p<0.05, **= p<0.01, ns= non-significant

Scan viscosities: The effects of sowing times, cultivars and boll positions on scan viscosity were significant ($P<0.01$) in both years of the study. The scan viscosity values in both years of the study (465.29 and 466.94) recorded in normal sowing were higher than that in the late sowing (439.79 and 440.57). The scan viscosity values (482.15 and 482.52) obtained in Candia variety were higher than those of Lima (422.94 and 424.98). The scan viscosity values (456.27 and 458.16) obtained in Middle Positional Sympodial Branch (6-10. fruit branches) boll position were higher than the other boll positions in both years. The effect of the Sowing Date*Cultivars* Boll Position interaction on the scan viscosity value was insignificant in the second year, while all other interactions were significant ($P<0.01$) (Table 6).

Degree of Polymerization: The effects of sowing times, cultivars, and boll positions on the degree of polymerization were significant ($P<0.01$) in both years of the study. The degree of polymerization in both years of the study (645.71 and 646.01) obtained in normal sowing were higher than that in late sowing (607.39 and 606.98). The degree of polymerization (671.41 and 670.53) obtained in the Candia variety was higher than those of Lima (581.69 and 582.47). The degree of polymerization (632.38 and 633.53) obtained in the Middle Positional Sympodial Branch (6-10. fruit branches) boll position was higher than the other boll positions in both years. All other interactions had a significant ($P<0.01$) effect on the degree of polarization (Table 6).

Conclusion: The number of bolls, boll weight, boll seed weight and fiber yield obtained in normal sowing were higher in both years of the experiment than the late sowing. The Candia cultivar performed better than the Lima cultivar. The Low Positional Sympodial Branch (1-5 fruit branches) position was better in the number of bolls and Middle Positional Sympodial Branch (6-10 fruit branches) was better in boll weight. The fiber yield of Low Positional Sympodial Branch (1-5 fruit branches) and Middle Positional Sympodial Branch (6-10 fruit branches) positions was better than that recorded in Upper Positional Sympodial Branch (11 and higher fruiting branches) positions. The cellulose ratio was higher in the Upper Positional Sympodial Branch (11 and above fruit branches) (94.40) position in the first year, while the effect of the boll position on the cellulose ratio was not statistically significant in the second year. The results concluded that planting time had a significant effect on boll positions and fiber quality. Late sowing had negative impact boll maturation, cellulose synthesis, yield and fiber quality due to adverse environmental conditions. It was determined that the delay in cotton planting caused a decrease in yield; so, cotton should be sown as early as possible in the region.

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