American-Eurasian J. Agric. & Environ. Sci., 15 (5): 754-763, 2015
ISSN 1818-6769

DOI: 10.5829/idosi.aejaes.2015.15.5.12623

Effect of Delaying Planting Date on Yield, Fiber and Yarn Quality Properties in Some Cultivars and Promising Crosses of Egyptian Cotton

[1]E.D. Elayan, Sohair, [1]A.M.A. Abdalla, [2]Abdel-Gawad, S.D. Nadia and [2]A.E. Faramawy Wageda

[1]Department of Agronomy, Faculty of Agriculture, Cairo University, Giza, Egypt
[2]Cotton Research Institute, Agricultural Research Center, Giza, Egypt

Abstract: Two field experiments were conducted in Sakha Agric. Res. Station, Cotton Research Institute, Agricultural Research Center, during 2012 and 2013 seasons, to study the effect of delaying planting date on yield, yield components, fiber and yarn properties of some cotton genotypes. The experiments were laid out in a split plot design in a randomized complete block design arrangement with three replications. Three sowing dates (15 April, 30 April and 15 May) were allocated in the main plots and four cotton genotypes (cultivars G86, G88 and promising crosses from the crosses 10299 X G86, {G84 × (G70×51B)} × P62) were assigned in the sub-plots. Delaying planting pushed cotton plants for an early flowering and maturity expressed in fewer number of days to first open flower and first open boll and the seed cotton yields per plant and per feddan were consistently decrease with each 15-days delay in planting due to a significant decrease in each of the number of open bolls/plant and boll weight. The response to delay of planting was negative with quadratic and linear functions in the first and second seasons, respectively. The reduction of seed cotton yield due to delay of planting was associated with a significant deterioration in fiber length and strength and hence lea count strength product and yarn elongation in both seasons. Genotype 10229 X G.86 was superior in No. of open bolls/ plant, boll weight, seed cotton yield / plant and per fed and lea count strength product in both seasons, seed index, lint percentage, fiber uniformity index and fiber strength in the first season and yarn elongation in the second one. Giza 86 cotton cultivar gave the highest average of plant height and fiber elongation in both seasons and seed index and lint percentage in the second season. Giza 88 cotton cultivar and {G84 × (G70×51B)} × P62 genotype recorded the earliest reading regarding days to first flower, days to first open boll and was also, superior in fiber length and micronaire value in both seasons, yarn elongation in the first season and fiber strength and single yarn strength in the second one.

Key words: Cotton genotypes · Planting dates · Seed cotton yield · Fiber properties · *Gossypium barbadense* L.

INTRODUCTION

In Egypt, cotton growers got used to delay cotton planting beyond end of March in order to have one extra cut from berseem, which precedes cotton from October to March. This delay was always, accompanied by a significant decrease in seed cotton yield and quality, with different magnitudes which vary according to cotton genotypes. Ebaid *et al.* [1] found that the number of open bolls per plant, boll weight, lint percentage and seed index were not significantly affected by sowing date, however, early sowing date increased seed cotton yield by 13 to 14% as compared with the late sowing date. Ali and El-Sayed [2] revealed that early sowing (25 March) significantly increased number of open bolls per plant, boll weight, seed index, lint percentage, number of days to 1st flower, days to the first open boll and seed cotton yield per plant and per feddan. However, plant height was not significantly affected by sowing date. Gadallah [3] concluded that delaying cotton planting from 20 March to 25 April was accompanied by a gradual decrease in plant height, seed cotton yield per plant or feddan. Seed cotton yield was decreased by 38.91 and 63.16% due to delaying cotton planting to 10 April and 25 April, in respective

Corresponding Author: E.D. Elayan, Department of Agronomy, Faculty of Agriculture, Cairo University, Giza, Egypt

order as compared with first planting date at 20 March in both seasons. The respective averages were 33.91 and 55.57 % regarding fiber length at 2.5% SL and uniformity ratio, as well as, micronaire reading. Pressley index was decreased with delaying sowing cotton. On the other hand, lint percentage and seed index responses were distinctive, where both characters were increased when cotton was sown late. Hayatullah *et al.* [4] found that, planting cotton on 25 April had significantly increased fiber quality (bundle strength, span length, micronaire reading), as compared with late sowing on 15 May. Emara [5] indicated that sowing date gave significant effects on all growth parameters; No. of open bolls/plant, boll weight, seed index and seed cotton yield/fed, while sowing date did not exhibit any significant effect on lint percentage. Elayan *et al.* [6] evaluated three sowing dates (25 March, 25 April, 25 May) and cleared that sowing date had significant effect on growth characters, yield and yield components. They indicated that, delaying sowing tended to increase significantly plant height, No. of days to first flower and first boll, while planting cotton on 25 March was superior in seed index and seed cotton yield/ feddan. Ali and El-Sayed [2] reported that, the Egyptian cotton cultivar Giza 88 gave a significant increase in each of number of open bolls per plant, boll weight, seed index, lint percentage, number of days to 1st flower, days to the first open boll and seed cotton yield per plant and per feddan in the early sowing. El-Sayed and El-Menshawi [7] found that, Giza 88 cultivar recorded a significant decrease in seed cotton yield due to late sowing at the last week of April. El-Zeky *et al.* [8] stated that, the Egyptian cotton cultivar Giza 86 gave a significant decrease in number of open bolls per plant, boll weight, lint percentage and cotton yield per plant and feddan due to late sowing. Emara [5] also, reported that Giza 86 cotton cultivar gave a significant increase in all growth parameters; No. of open bolls/plant, boll weight, seed index and seed cotton yield/fed, due to early planting (30 March) but did not exhibit any significant effect on lint percentage compared with late planting date on 30 April. His results also indicated significant positive effects on upper half mean length, micronaire reading, reflected and yellowness in favor of early planting. However, planting date did not exhibit any significant effect on uniformity index, fiber strength or fiber elongation %.

The objective of the present investigation was to study the effect of delaying planting date on yield, fiber and yarn properties of some Egyptian cotton genotypes.

MATERIAS AND METHODS

The field experiments were carried out in Sakha Agric. Res. Experimental Station, Cotton Research Institute of ARC, Egypt, to study the effect of delaying planting date (15 April, 30 April and 15 May) on four Egyptian cotton genotypes (cultivars G86, G88 and promising lines from the crosses 10299 X G86, {G84 × (G70×51B)} × P62) in 2012 and 2013 seasons. A split plot design with three replications was used where planting dates in the main plots and genotypes in the sub plots were allocated. Sub plot included 6 ridges of 5 meters long and 60 cm apart with a total area of 10.8 m^2. Hill spacing was 20 cm, where two plants were left per hill after thinning. The soil texture was clay loam in both seasons.

Soil chemical and mechanical analysis according to Jackson [9] were made for both seasons and are given in Table (1).

All cultural practices were done as recommended for the region. Nitrogen (60 kg N/fed) as ammonium nitrate (33.5%N) and potassium (48 kg K_2O/fed) as potassium sulphate (48% K_2O) were side dressed in two equal parts at the first and second irrigations. Phosphorus (30 kg P_2O_5) as ordinary superphosphate (15.5% P_2O_5) was broadcasted at planting.

Recorded Data

Yield and Yield Attributes: At harvest, ten plants were randomly taken from the inner ridges of each sub-plot to measure the following yield and yield attributes:

Plant height, measured from cotyledonary node to the top of the plant (cm). Number of days from planting date to first flower. Number of days from planting date to first open boll. Number of open bolls per plant.

Plant boll weight (g) calculated by dividing seed cotton yield per plant by number of open bolls per plant. Seed cotton yield per plant (g). Seed cotton yield per feddan (kentar) was determined by picking all open bolls per plants of the three inner ridges (7.2 m^2) in kilogram and then calculated in kentar/feddan (kentar = 157.5 kg) (feddan = 4200 m^2). Lint percentage= Weight of lint cotton (g)/ Seed cotton weight (g) x100. Seed index, as weight of 100 seeds in grams.

Fiber Properties: A sample of 30 g of lint was taken where the following fiber properties were recorded: Upper half mean length (U.H.M.L.) (mm). Fiber uniformity index. Fiber strength (g/tex). Fiber elongation(%). Micronair value. HVI instrument system was used to determine fiber according to ASTM: D- 4604 – 05 [10].

Table 1: Chemical and mechanical analysis of the soil during the two growing seasons (2012 and 2013)

	Chemical analysis					
	Available N (ppm)	Available P (ppm)	Available K (ppm)	Available Fe (ppm)	Available Mn (ppm)	Available Zn (ppm)
2012	94.40	0.01	154.84	1.95	0.70	0.13
2013	91.56	2.12	37.28	4.10	0.88	0.04
	Available Cu (ppm)	p H	EC	SP	---	---
2012	5.07	8.00	3.50	70.00	---	---
2013	0.08	7.79	4.22	70.00	---	---
	Mechanical analysis 2012			Mechanical analysis 2013		
	Clay %	Silt %	Sand %	Clay %	Silt %	Sand %
	45.26	31.36	23.38	37.50	39.60	15.70

Table 2: Mean monthly air and soil temperatures, relative humidity and rain fall during the two cotton growing seasons, 2012 and 2013

	2012 season					2013 season				
	Temp. 0C					Temp. 0C				
Month	Mix	Min	RH %	Rain fall (mm)	Soil temp °C	Mix	Min	RH %	Rain fall (mm)	Soil temp°C
April	26.70	13.80	63.90	2.30	24.00	25.62	12.92	68.47	0.82	25.00
May	25.10	13.50	70.40	1.70	23.00	31.08	18.15	69.28	0.09	27.00
June	27.20	15.40	69.40	1.80	25.20	31.06	20.57	71.26	0.02	29.30
Jule	32.70	21.80	74.20	0.80	31.10	33.18	22.13	73.98	0.11	31.60
Aug.	34.00	22.70	73.70	0.10	31.10	33.25	22.29	73.84	0.04	31.30
Sep.	31.80	20.60	70.90	0.00	27.80	31.99	20.53	71.78	0.02	28.80
Oct.	29.60	19.00	74.40	0.20	27.40	28.79	18.13	69.74	0.10	30.20

Yarn Properties: Lea count strength product. The spun yarns were tested for Lea skein strength by Good-brand Lea tester according to ASTM D1578-93R00-05 [11]. Single yarn strength (cN/tex). Yarn elongation (%). Measured by the statimate ME Automatic Tensile tester according to ASTM: D2256-91 [12].

LSD test at the 0.05 level of significance was used to test the significance of differences among treatment means and response equations were calculated according to the methods described by Snedecor and Cochran [13] using M-STAT computer pakage [14]. All fiber tests were performed at the laboratories of the Cotton Research Institute, Agricultural Research Center, under controlled conditions of temperature 21 ° c ± 2 and relative humidity of 65% ±2.

Table (2) shows monthly meteorological data according to Sakha Meteorological Station during the two growing seasons.

RESULTS AND DISCUSSION

Yield and Yield Attributes

Plant Height: Data in Tables (3 and 4) indicated that planting dates and genotypes had significant effects on plant height in 2012 and 2013 seasons. The latest planting date (May 15) gave the tallest plants (145.83 and 134.75 cm in 2012 and 2013 seasons, respectively), while the shortest plants (133.50 and 120.00 cm) were obtained from earliest date (April 15) in 2012 and 2013 seasons, respectively. Giza 86 cotton cultivar gave the tallest plants (148.33 and 140.67 cm in both seasons respectively). The shortest plants (118.00 and 92.67 cm) were obtained from Giza 88 cotton cultivar in both seasons, respectively. Similar results were reported by El-Hindi *et al*. [15]. These results explained that, Egyptian cotton genotypes are influenced more or less by environmental conditions. As to the interaction between the planting dates and genotypes, the third planting date and cultivar ½Giza 86½ resulted in the highest averages of plant height (155 and 148 cm) in the two seasons, respectively. The significant increase of cotton plant height, caused by late planting could be attributed to the increase of air and soil temperatures at time of planting and during the early growth stages. Table (2) clearly indicates a clear increase in air temperature particularly during night, where more photosynthesis, built during day time, might have been partitioned towards plant elongation. Similar results were reported by El-Hindi *et al*. [15] who reported significant increase in cotton plant height due to delaying cotton planting. The significant differences among the four cotton genotypes in plant height could be attributed to differences in their genetic make up as reported by others.

Table 3: Effect of planting dates and genotypes on plant height, No. of days to first flower and to first open boll, No. of open bolls/plant and boll weight in 2012 and 2013 seasons

	Plant height(cm)		No. of days to first flower		No. of days to first open boll		No. of open bolls/plant		Boll weight (g)	
Main effects	2012	2013	2012	2013	2012	2013	2012	2013	2012	2013
Planting dates										
15 April	133.50	120.00	75.75	74.83	126.67	124.92	17.69	17.08	2.76	3.04
30 April	139.00	126.75	72.33	71.33	122.00	121.42	15.90	14.50	2.53	2.78
15 May	145.83	134.75	69.67	69.17	117.92	119.50	12.63	12.00	2.30	2.54
LSD 0.5	1.83	3.62	0.73	1.08	0.55	0.94	0.59	1.49	0.28	0.17
Genotypes										
Giza 86	148.33	140.67	75.11	74.11	124.56	124.22	15.88	15.00	2.44	2.69
10229×G86	144.67	135.67	72.00	71.33	122.22	121.56	17.00	16.11	2.82	3.12
Giza 88	118.00	92.67	71.67	70.78	121.33	121.00	13.71	12.11	2.30	2.52
[G84×(G70×51B)]×P62	146.78	139.67	71.56	70.89	120.67	121.00	15.04	14.89	2.56	2.82
LSD 0.5	1.04	2.59	0.87	0.88	1.01	0.98	0.58	1.60	0.18	0.20

Table 4: Effect of interaction between planting dates and genotypes on plant height, No. of days to first flower and to first open boll, No. of open bolls/plant and boll weight in 2012 and 2013 seasons

	Plant height (cm)			No. of days to first flower			No. of days to first open boll			No. of open bolls/plant			Boll weight (g)		
	Planting Dates			Planting Dates			Planting Dates			Planting Dates			Planting Dates		
Treatments	D 1	D 2	D 3	D 1	D 2	D 3	D 1	D 2	D 3	D 1	D 2	D 3	D 1	D 2	D 3
Genotypes	2012														
Giza 86	143.00	147.00	155.00	78.33	75.00	72.00	128.33	125.00	120.33	18.00	16.13	13.50	2.73	2.40	2.20
10229×G86	140.00	144.00	150.00	76.00	71.00	69.00	127.00	121.67	118.00	18.60	17.07	15.33	3.00	2.87	2.60
Giza 88	110.00	118.00	126.00	75.00	71.33	68.67	126.67	121.00	116.33	16.53	14.60	10.00	2.50	2.30	2.10
[G84×(G70×51B)]×P62	141.00	147.00	152.33	73.67	72.00	69.00	124.67	120.33	117.00	17.63	15.80	11.70	2.80	2.57	2.30
LSD 0.5	1.81			N.S			N.S			1.00			N.S		
Genotypes	2013														
Giza 86	135.00	139.00	148.00	77.33	74.00	71.00	127.33	124.00	121.33	17.67	14.33	13.00	3.03	2.60	2.43
10229×G86	131.00	135.00	141.00	75.00	70.00	69.00	125.00	120.33	119.33	18.67	15.67	14.00	3.30	3.17	2.90
Giza 88	81.00	94.00	103.00	74.33	70.33	67.67	124.67	120.33	118.00	14.33	13.00	9.00	2.73	2.53	2.30
[G84×(G70×51B)]×P62	133.00	139.00	147.00	72.67	71.00	69.00	122.67	121.00	119.33	14.67	15.00	12.00	3.10	2.83	2.53
LSD 0.5	4.48			1.53			N.S			N.S			N.S		

The significant interaction between planting dates and cotton genotypes clearly indicated that plant elongation was mainly governed by environmental × genetic interaction. However, Giza 86 which had the tallest plants was more reactive to delay of planting and hence the tallest plants were observed at the latest date of planting, i.e. in May 15th.

Number of Days to First Flower: Results pertaining to number of days to first flower are presented in Tables (3 and 4). It is obvious that the effects of planting dates and genotypes on number of days to first flower were significant in both seasons. Sowing on 15 May gave the lowest averages (69.67 and 69.17 days) in 2012 and 2013 seasons, respectively. Giza 88 cotton cultivar and genotype {G84 × (G70×51B)} × P62) gave the earliest reading of days number to first flower in the first (71.67 and 71.56) and second (70.78 and 70.89) seasons, respectively. Concerning the effect of sowing date × genotypes interaction, the shortest duration to first flower was recorded by Giza 88 when was planted on May 15th. This interaction was significant in only the second season (Table 4). These data are quite interesting as they clearly indicate a photoperiodic thermoperiodic interaction effect on the duration to first flower. With each 15-days delay in planting, the number of long days was decreased where plants were able to perform more vegetative rather than reproductive growth. In Egypt, the longest day is on June 21st, therefore, late sown plants in May 15th had only about three weeks of long days compared with seven weeks afforded to early sown ones on April 15th. Cotton as a facultative short – day plant according to Chang [16] was pushed for an early reproductive growth as long days were decreased and days became shorter beyond 21st of June when plants were only 45- days old. These late sown plants were pushed to commit early flowering and hence set their first flower earlier than early sown ones. High temperature during May and June might have had magnified the effect of photoperiod, where a termoperiod × photoperiod interaction effect played an enhancing role on the duration to first flower and hence the number of days was decreased. These results are in agreement with those reported by Elayan *et al.* [17] and Elayan *et al.* [6].

Number of Days to First Open Boll: Data in Tables (3 and 4) indicated that the effect of planting dates and genotypes on number of days to first open boll was significant in both seasons. Sowing on 15 May gave the shortest period (117.92 and 119.50 day) in 2012 and 2013 seasons, respectively. Giza 88 cotton cultivar gave the earliest reading regarding number of days to first open boll (120.67 and 121.00 day) in the two seasons, respectively. The interaction between sowing dates and genotypes was not significant in both seasons, which agrees with results reported by Elayan *et al.* [17] and Elayan *et al.* [6]. Similar effects were aforementioned in the number of days to first flower and could account for the results observed herein.

Number of Open Bolls /Plant: Data in Tables (3 and 4) showed that planting date had significant effect on number of open bolls /plant. The highest average of number of open bolls /plant was obtained from sowing on 15 April in both seasons indicating that early sowing significantly increased No. of open bolls / plant. This result is in agreement with those obtained by Gadallah [3] and Elayan *et al.* [17]. Genotype 10229 X G.86 gave the highest number of open bolls /plant in 2012 and 2013 seasons (17.00 and 16.11 bolls/plant respectively). The interaction between sowing dates and genotypes had a significant effect in the first season only. Genotype 10229 X G.86 and sowing on 15 April gave the highest number of open bolls /plant (18.60 bolls). These results agree with the results obtained by El-Hindi *et al.* [15] and El-Sayed and El-Menshawi [18].

Boll Weight: Data in Tables (3 and 4) show that the effects of the studied main factors were significant on boll weight in both seasons. However, the interactions were not significant in both seasons. Concerning the effect of sowing date, planting on15 April resulted in the heaviest boll weight (2.76 and 3.04 g in 2012 and 2013 seasons, respectively). These results agree with those obtained by El-Sayed and El-Menshawi [18]. Genotype 10299 X G.86 produced the heaviest boll weight (2.82 and 3.12 g in the two seasons, respectively). In contrast, Giza 88 cotton cultivar gave the lightest boll weight (2.30 and 2.52 g in the two seasons, respectively).

Seed Index: Data in Tables (5 and 6) show the effect of planting dates and genotypes on seed index. It is clear that the effects of these main factors were significant in both seasons. While the interactions were not significant in both seasons. Concerning the effect of the planting date, the first date (15 April) achieved the highest average (10.19 g). While the lowest average (9.17 g) was obtained from the third date (15 May) in 2012 season. Regarding the effect of the genotypes, (10299 X G86) exhibited the highest mean of seed index (10.34 g) in the first season and Giza 86 (10.06 g) in the second season. In contrast the lowest averages (9.02 and 9.09 g) were obtained from Giza 88 cotton cultivar in the two seasons, respectively.

Lint Percentage: Data in Tables (5 and 6) revealed that planting dates varied significantly in lint percentage in the first season. Earliest planting date (15 April) produced the highest average lint percentage (38.28%). Delaying sowing date decreased lint %. Genotypes significantly affected lint %. Genotype 10229 X G86 gave the highest average in the first season (38.58 %) and Giza 86 cotton cultivar gave the highest average (40.01 %) in the second season. These results are in agreement with those reported by Ali and El-Sayed [2] and Elayan *et al.* [17]. The interaction between planting dates and genotypes had no significant effect on lint % in both seasons.

Seed Cotton Yield: Data in Tables (5 and 6) indicated that planting date and genotypes had significant effects on seed cotton yield per plant and per feddan in both seasons. The highest averages of seed cotton yield per plant were obtained from the earliest planting date on 15 April (41.76 and 44.76 g) in 2012 and 2013 seasons, respectively. This may be attributed to the increased number of bolls per plant and boll weight in early sowing date. The same trend was recorded for cotton yield per fed where, the highest average was recorded from planting date of 15 April (12.44 and 12.41 ken/fed). Delaying sowing date decreased seed cotton yield / plant and per feddan. This result agrees with those obtained by Gadallah [3] and Elayan *et al.* [17]. Genotype 10229 X G.86

Table 5: Effect of planting dates and genotypes on seed index, lint percentage, seed cotton yield/plant and seed cotton yield/fed in 2012 and 2013 seasons

	Seed index (g)		Lint percentage %		Seed cotton yield/Plant (g)		Seed cotton yield/fed (kentar)	
Main effects	2012	2013	2012	2013	2012	2013	2012	2013
Planting dates								
15 April	10.19	9.32	38.28	39.27	41.76	44.74	12.44	12.41
30 April	9.68	9.52	37.81	39.75	35.38	36.60	10.69	10.60
15 May	9.17	10.28	35.92	39.63	26.23	28.13	7.92	8.49
LSD 0.5	1.81	0.23	0.55	N.S	2.35	4.15	0.69	1.11
Genotypes								
Giza 86	9.59	10.06	36.94	40.01	34.79	37.24	10.48	10.81
10229×G86	10.34	9.84	38.58	39.89	40.71	43.10	11.96	12.34
Giza 88	9.02	9.09	36.16	38.32	28.74	27.80	8.76	8.13
[G84×(G70×51B)]×P62	9.59	9.82	37.67	39.98	33.59	37.82	10.21	10.71
LSD 0.5	1.42	0.20	0.83	0.77	1.96	4.32	0.59	1.03

Table 6: Effect of interaction between planting dates and genotypes on seed index, lint percentage, seed cotton yield/plant and seed cotton yield/fed in 2012 and 2013 seasons

	Seed index (g)			Lint percentage %			Seed cotton yield/Plant (g)			Seed cotton yield/fed (kentar)		
	Planting Dates			Planting Dates			Planting Dates			Planting Dates		
Treatments	D 1	D 2	D 3	D 1	D 2	D 3	D 1	D 2	D 3	D 1	D 2	D 3
Genotypes	2012											
Giza 86	10.13	9.63	9.00	38.00	37.50	35.33	42.90	34.80	26.67	12.73	10.60	8.10
10229×G86	10.80	10.37	9.87	39.57	38.77	37.40	45.87	41.03	35.23	13.23	12.13	10.50
Giza 88	9.47	8.97	8.63	37.07	36.67	34.73	37.13	30.23	18.87	11.30	9.23	5.73
[G84×(G70×51B)]×P62	10.34	9.73	9.17	38.50	38.30	36.20	41.13	35.47	24.17	12.50	10.80	7.33
LSD 0.5	N.S			N.S			N.S			1.02		
Genotypes	2013											
Giza 86	9.60	10.17	10.40	39.37	40.47	40.20	47.40	33.53	30.80	12.83	9.80	9.80
10229×G86	9.40	9.70	10.43	40.30	40.03	39.33	48.87	44.73	35.70	13.60	12.73	10.70
Giza 88	8.57	8.63	10.07	37.23	39.27	38.47	35.10	29.70	18.60	10.27	8.67	5.47
[G84×(G70×51B)]×P62	9.70	9.57	10.20	40.17	39.23	36.20	47.60	28.43	27.43	12.83	11.20	8.00
LSD 0.5	N.S			N.S			N.S			N.S		

gave the highest averages of seed cotton yield per plant (40.71 and 43.10g.) and per feddan (11.90 and 12.34 ken) in 2012 and 2013 seasons, respectively. The interaction between planting dates and genotypes had a significant effect in the first season only, where genotype 10229 X G86 with the earliest sowing date gave the best results in seed cotton yield per plant and per feddan in both seasons.

The planting date × genotype interaction did not significantly affect the seed cotton yield / plant in both seasons (Table 6), indicating that the main effects of the two factors under study acted independently. Therefore, the response of the four cotton genotypes to delay of planting was almost the same, where their seed cotton yield/ plant were consistently decreased with each 15-days delay in planting. However, it is interesting to answer the question whether the second 15-days delay of planting)from 30 April to 15 May) had a similar negative effect on seed cotton yield / plant as the first 15- days (from 15 April to 30 April). Therefore the response equations of seed cotton yield / plant to delay of planting were calculated and are presented herein as follows:-

1. $Y^{1st} = 41.76 - 4.995\times - 1.385\times^2$ (1)

2. $Y^{2nd} = 44.74 - 7.975\times - 0.165\times^2$ (2)

Where Y [1st] and Y [2nd] are the seed cotton yields/plant in the two seasons, respectively. These equations clearly indicate that the negative effect of delaying planting on seed cotton yield/ planting was quadratic in the first season, while it was linear in the second one. It is quite clear from equation (1) that delay of planting in the first season from 30 April to 15 May had a more adverse effect on seed cotton yield/plant than the delay of planting from 15 to 30 April. This effect was, however, equal in the second season, i.e. was proportional to the two delaying periods. In other words, 6.38 and 9.15 g were lost in the seed cotton yield/plant in the first season compared with 8.14 and 8.47 g in the second one due to the first and second 15-days delay of planting, respectively. The data of night temperature in the two seasons Table (2), indicated 7°C increase from June to August (the most active reproduction) in the first season compared to only 2°C increase in the second season. This could account for more adverse effect of delaying planting in the first than in the second season particularly the second delay of planting.

Fiber Properties

Fiber Length: Data pertaining to fiber length (mm) of the four genotypes under the adopted treatments in the two seasons are given in Tables (7 and 8). The results show that the effects of the planting dates and genotypes were significant in both seasons but their interaction was not significant. Concerning the effect of planting date, the first date (15April) produced the highest fiber length averages (34.31 and 34.40 mm in the two seasons, respectively. In contrast, the lowest averages (32.73 and 32.34mm were obtained by the latest planting date treatment (15 May). In conclusion fiber length was decreased as the planting date was delayed. These results are in line with those obtained by Emara [5]. This may be due to that early cotton planting afforded cotton plants more vegetative growth, resulting in greater accumulation of dry matter, which enhances cotton fiber length. Regarding the effect of the genotypes on fiber length, the cultivar ?Giza 88? surpassed the rest of genotypes (33.83 and 34.34mm in the two seasons, respectively). This could be due to that this cultivar belongs to the extra long group.

Fiber Uniformity Index: Data presented in Tables (7 and 8) clarified that, uniformity index values were significantly affected by the two factors under the study in the two seasons. Concerning the main factor (planting date), the first planting date treatment (15 April) gave the highest uniformity index (88.06 and 87.38%) for the two seasons, respectively. These results are in harmony with those reported by Elayen *et al.* [17]. However, Emara [5] indicated that the fiber uniformity index was not significantly affected by sowing date. Genotype (10299 X G86) surpassed the other three genotypes in uniformity index value (87.07%) in the first season. This superiority in the second season, (86.82 %) was observed by {G84 × (G70×51B) × P62} genotype.

Fiber Strength (g/ Tex): Data presented in Tables (7 and 8) showed that fiber strength (g/tex) was significantly affected by the two factors under study while the interaction was not significant in both seasons. The first planting date (15 April) gave the strongest fibers (46.53 and 46.00 g/tex) for 2012 and 2013 seasons, respectively. These results are in harmony with Wenqing *et al.* [19]. However Emara [5] indicated that the fiber strength was not affected by sowing date. Genotype 10229 X G.86 recorded the highest fiber strength average (47.34 g/tex) in the first season, but Giza 88 cotton cultivar recorded the highest one in the second season (44.19 g/tex).

Fiber Elongation (%): Data in Tables (7 and 8) indicated that, the highest averages of fiber elongation (7.21 and 6.99%) were obtained from planting date on 15 April in both seasons. As planting date was delayed the elongation percent value was decreased. This may be attributed to increase in fiber convolution number in early sowing dates. This result is in harmony with those obtained by Elayan *et al.* [17] and Wenqing *et al.* [19]. On the contrary, Emara [5] found that delayed planting date increased fiber elongation percent. Giza 86 cotton cultivar gave the highest value of fiber elongation percent (7.43 and 6.71%) in the two seasons, respectively. The interaction between planting date and genotypes did not cause a significant variation in fiber elongation percentage in both seasons.

Fiber Fineness (Micronaire Value): Data in Tables (7 and 8) indicated that, planting dates and genotypes had significant effects on micronaire value in both seasons, where it tended to decrease as sowing date was delayed. Planting date on 15 May gave the best reading (3.58 and 3.53) in the two seasons, respectively. This result agrees with those obtained by Gadallah [3] and Elayan *et al.* [17] but contrary with Emara [5]. Giza 88 cotton cultivar was the finest one (3.77 and 3.46) followed by genotype {G84 × (G70×51B) × P62} (4.10 and 3.74) in the two seasons, respectively. The interaction between planting dates and genotypes had no significant effect on micronaire value.

Table 7: Effect of planting dates and genotypes on fiber length, fiber uniformity index, fiber strength, fiber elongation and Micronaire value in 2012 and 2013 seasons

	Fiber length (mm)		Fiber uniformity index (%)		Fiber strength (g / tex)		Fiber elongation (%)		Micronaire value	
Main effects	2012	2013	2012	2013	2012	2013	2012	2013	2012	2013
Planting dates										
15 April	34.31	34.40	88.06	87.38	46.53	46.00	7.21	6.99	4.39	4.11
30 April	33.59	33.47	86.80	85.53	45.76	42.51	6.85	6.48	4.03	3.78
15 May	32.73	32.34	85.30	84.28	42.54	40.48	6.48	5.92	3.58	3.53
LSD 0.5	0.93	0.75	0.58	0.71	1.64	0.85	0.60	0.20	0.13	0.25
Genotypes										
Giza 86	33.50	32.23	86.79	85.26	42.26	41.51	7.43	6.71	4.00	4.18
10229×G86	33.53	32.93	87.07	84.91	47.34	42.90	7.28	6.57	4.12	3.84
Giza 88	33.83	34.34	86.87	85.94	44.26	44.19	6.44	6.00	3.77	3.46
[G84×(G70×51B)]×P62	33.31	34.10	86.14	86.82	45.92	43.39	6.22	6.57	4.10	3.74
LSD 0.5	0.49	0.59	0.94	0.67	1.18	0.99	0.10	0.18	0.26	0.30

Table 8: Effect of interaction between planting date and genotypes on fiber length, fiber uniformity index, fiber strength, fiber elongation and Micronaire value in 2012 and 2013 seasons

	Fiber length (mm)			Fiber uniformity index (%)			Fiber strength (g / tex)			Fiber elongation (%)			Micronaire value		
	Planting Dates			Planting Dates			Planting Dates			Planting Dates			Planting Dates		
Treatments	D 1	D 2	D 3	D 1	D 2	D 3	D 1	D 2	D 3	D 1	D 2	D 3	D 1	D 2	D 3
Genotypes	2012														
Giza 86	33.80	33.70	33.00	87.90	87.00	85.47	43.27	42.93	40.57	7.67	7.50	7.13	4.57	4.00	3.43
10229×G86	34.43	33.24	32.90	88.40	87.43	85.37	48.93	48.07	45.03	7.63	7.23	6.97	4.43	4.13	3.80
Giza 88	34.60	34.00	32.13	87.87	87.00	85.77	46.17	45.07	41.53	6.97	6.37	6.00	4.23	3.80	3.27
[G84×(G70×51B)]×P62	34.40	33.40	33.00	88.07	85.77	84.60	47.77	46.97	43.03	6.57	6.30	5.80	4.33	4.17	3.80
LSD 0.5	N.S			N.S			N.S			0.18			N.S		
Genotypes	2013														
Giza 86	32.57	32.07	32.07	86.70	85.20	83.87	43.27	41.90	39.37	7.37	6.63	6.13	4.40	4.17	3.97
10229×G86	34.03	33.73	31.03	86.33	84.77	83.63	46.07	41.90	40.73	7.10	6.43	6.17	4.27	3.83	3.43
Giza 88	36.27	33.93	32.83	87.60	85.73	84.50	48.17	43.10	41.30	6.60	6.10	5.30	3.77	3.37	3.23
[G84×(G70×51B)]×P62	34.73	34.13	33.43	88.90	86.43	85.13	46.50	43.13	40.53	6.90	6.73	6.07	4.00	3.73	3.50
LSD 0.5	N.S			N.S			N.S			N.S			N.S		

Table 9: Effect of planting dates and genotypes on Lea count strength, single yarn strength and yarn elongation in 2012 and 2013 seasons

	Lea count strength product (LCSP)		Single yarn strength (c.N/tex)		Yarn elongation (%)	
Main effects	2012	2013	2012	2013	2012	2013
Planting dates						
15 April	3092.50	3106.25	20.83	23.61	4.53	4.65
30 April	3005.00	2945.00	20.94	23.33	3.94	4.30
15 May	2715.00	2680.00	20.45	22.74	3.94	3.82
LSD 0.5	268.08	151.83	0.28	N.S	0.23	0.31
Genotypes						
Giza 86	2736.67	2725.00	16.65	18.27	3.56	3.39
10229×G86	3193.33	3108.33	21.86	20.32	4.02	5.25
Giza 88	2853.33	2805.00	22.18	28.21	4.80	3.92
[G84×(G70×51B)]×P62	2966.67	3003.00	22.27	26.10	4.15	4.45
LSD 0.5	186.81	104.53	0.29	0.51	0.15	0.52

Table 10: Effect of interaction between planting dates and genotypes on Lea count strength, single yarn strength and yarn elongation in 2012 and 2013 seasons

	Lea count strength product (LCSP)			Single yarn strength (c.N/tex)			Yarn elongation (%)		
	Planting Dates			Planting Dates			Planting Dates		
Treatments	D 1	D 2	D 3	D 1	D 2	D 3	D 1	D 2	D 3
Genotypes	2012								
Giza 86	2900	2820	2490	16.80	16.74	16.40	4.25	3.31	3.12
10229×G86	3300	3350	2930	21.73	22.46	21.39	4.01	4.02	4.03
Giza 88	3070	2850	2640	22.36	22.24	21.93	5.51	4.39	4.51
[G84×(G70×51B)]×P62	3100	3000	2800	22.43	22.30	22.08	4.34	4.03	4.09
LSD 0.5	N.S			N.S			0.27		
Genotypes	2013								
Giza 86	2840	2780	2555	18.67	18.15	18.00	3.92	3.14	3.12
10229×G86	3380	3155	2790	20.73	20.20	20.02	5.81	5.67	4.28
Giza 88	3005	2795	2615	28.59	28.21	27.83	3.96	3.92	3.88
[G84×(G70×51B)]×P62	3200	3050	2760	26.44	26.77	25.09	4.91	4.45	3.99
LSD 0.5	N.S			N.S			N.S		

Yarn Properties

Lea Count Strength: Data in Tables (9 and 10) clarified that, planting dates, genotypes and interaction between them had significant effects on Lea count strength product in both seasons. Planting date on 15 April gave the highest Lea count strength product (3092.50 and 3106.25 for the two seasons, respectively). In contrast, the lowest averages (2715 and 2680) were obtained from the third planting date treatment (15 May) in the two seasons, respectively. This result is similar to that obtained by Elayan *et al.* [17]. Genotype (10299 X 86) surpassed other genotypes in Lea count strength product (3190.33 and 3108.33) in the two seasons, respectively. In contrast, the lowest value (2736.67 and 2725.00) was obtained from Giza 86 cotton cultivar in the two seasons, respectively.

Single Yarn Strength: Data presented in Tables (9 and 10) showed that, single yarn strength was affected by the two factors under the study significantly in both seasons but their interaction was not significant. The first planting date (15 April) gave the highest single yarn strength (20.83cN/tex) in the first season. In contrast, the lowest value (20.45cN/tex) was obtained from the third planting date (15 May) in the first season. Genotype {G84 × (G70×51B)} × P62 surpassed others in single yarn strength (22.27cN/tex) in the first season. This superiorly (28.21 cN/tex) was obtained from Giza 88 in the second season. In contrast, the lowest value (16.65 and 18.27 cN/tex) was obtained from Giza 86 cotton cultivar in the two seasons, respectively.

Yarn Elongation: Data presented in Tables (9 and 10) clarified that, yarn elongation was affected significantly by the two factors under study in both seasons, but interactions was not significant. The first planting date (15 April) gave the highest yarn elongation (4.53 and 4.65%) in 2012 and 2013 seasons, respectively. In contrast, the lowest value (3.94 and 3.82%) was obtained from the third planting date (15 May) in both seasons, respectively. Genotype (10299 X 86) showed the highest yarn elongation (5.25%) in the second season. This was obtained from Giza 88 cotton cultivar in the first season (4.80%). In contrast the lowest value (3.56 and 3.39%) was obtained from Giza 86 in both seasons, respectively.

To summarize the effect of date of planting on fiber and yarn properties, it could be concluded that early planting on April 15th which afforded cotton plants better and proper durations to first flower and hence first open boll (Table 3) played a great role in building up more available photosynthates for setting larger number of bolls/ plant and as well heavier boll weight than late sown ones on either April 30th or May 15th. This improved plant growth was finally reflected in seed index and lint percentage (Table 5) where more long fibers were produced and gained more strength, fineness and uniformity (Table 7) than those produced by late sown plants. This favorable effect was almost the same on the four cotton genotypes under study as was expressed in insignificant planting date × genotypes interaction on fiber and yarn properties in both seasons (Tables 8 and 10).Finally it could be safely concluded that early sown healthy cotton plants, produce as well high quality fibers with high yarn properties.

REFERENCES

1. Ebaid, M.A.A., A.A. Ali and M.M. El-Sayed, 1988. Effect of planting dates and cultivars on yield components of cotton plants. Minufiya J.Agric. Res., 13(2): 875-888.
2. Ali, S.A. and A.F. El Sayed, 2001. Effect of sowing dates and nitrogen levels on growth, earliness and yield of Egyptian cotton cultivar Giza 88. Egypt. J. Agric Res., 79(1): 221-232.
3. Gadallah, R.A., 2002. Growing cotton after Faba Bean. Ph.D Thesis Fac. of Agric., Cairo Univ., Giza, Egypt.
4. Hayatullah, A., A. Inayatullah, M. Muhammed, A.K. Ejaz and A.K. Muhammed, 2011. Effect of sowing time and plant spacing on fiber quality and seed cotton. Sarhad J. Agric., (27): 411-413.
5. Emara, M.A.A., 2012. Response of cotton growth and productivity to application of potassium and zinc under normal and late sowing dates. J. Plant production, Mansoura Univ., 3(3): 509-524.
6. Elayan, Sohair, E.D., M. Abdallah, Amany, M.A. Elsayed and M. Abdel-Twab, Rania, 2013. Effect of some growth regulators under different planting dates on growth and yield of cotton. Bull. Fac. Agric. Cairo Univ., (64): 116-128.
7. El-Sayed, E.A. and M. El-Menshawi, 2001. Response of late sowing cotton cultivar (Giza 88) to time of potassium application under different levels of nitrogen. J. Agric. Sci. Mansoura Univ., 26(9): 5177-5188.
8. El-Zeky, M.M., S.G. Metwally, Sh. Z. Saleh and I.M.M. Banna, 2007. Influence of sowing date, nitrogen and potassium fertilization on cotton yield under saite affected soils in north of Delta. J. Agric. Sci. Mansoura Univ., 32(7): 5943-5950.
9. Jackson, M.I., 1967. Soil chemical analysis. Prentice-Hall of India ltd., New Delhi, pp: 388-415.
10. ASTM D4604-05, 2005. “Test Methods for Measurement of Cotton Fibers by High Volume Instruments (HVI) (Motion Control Fiber Information System)”. Vol. 7. 02 Section 7.
11. ASTM D1578-93R00., 2005. Standard Test Method for Breaking Strength of Yarn in Skein Form. Annual Book of ASTM Standards. Vol. 7. 02 Section 7.
12. ASTM D2256-91., 1991. “Practice for Conditioning and Testing Textiles.” Annual Book of ASTM Standards. Vol. 7. 01 Section 7.
13. Snedecor, G.W. and W.G. Cochran, 1982. Statistical Method, lowa state., Univ. Press., USA.
14. M-STAT., 1986. A microcomputer program of the design management and analysis of agronomic research experiments. Michigan Stat Unvi. USA.
15. El-Hindi, M.H., E.M. Said, M.H. Ghonema and A.F. Khalifa, 2006. Studies on the effect of some cultural practices on the growth and the yield of Egyptian cotton. J. Agric. Sci. Mansoura Univ., 31(7): 4087-4095.
16. Chang, J.H., 1974. Photoperiodism: 70-86, Climate and Agriculture, 3rd Ed. Aldine Publishing Company, Chicago, Illinois, USA.
17. Elayan, Sohair, E.D., M. Abdalah, Amany and A. El-Ssadi, Sawsan, 2008. Effect of three sowing dates on different characteristics of four Egyptian cotton cultivars. Agric. Sci. Mansoura Univ., 33(3): 1721-1736.
18. El-Sayed, E.A. and M. El-Menshawi, 2005. Responses of the promising hybrid cotton Giza 89 × 86 to hill spacing and nitrogen fertilizer levels. J. Agric. Res. Tanta Univ., 31(3): 436-456.
19. Wenqing, Z., Y. Wang, H.J. Shu and Z. Zhou, 2012. Sowing date and boll position affected boll weight, fiber quality and fiber physiological parameters in two cotton *(Gossypium hirsutum* L.*)* Cultivars. African J. of Agric., Res., 7(45): 6073-6081.