Effect of Cotton Variety and Seed Cotton Grade on Ginning Efficiency and Fiber Properties

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ABSTRACT: The present investigation was conducted in the Plant Production Department, Faculty of Agriculture (Saba Basha), Alexandria University during 2016, to investigate the effect of Egyptian cotton variety (*Gossypium barbadense*), seed cotton grade and their interaction on ginning efficiency and fiber properties. Four commercial Egyptian cotton varieties namely: Giza 87 and Giza 92 (belong to extra-long staple length, 1.3/8 inch), Giza 86 and Giza 94 (belong to long staple length. 1.1/8 inches) were used. Four seed cotton grades namely: Good/ Fully Good (G/FG); Good (G); Fully Good Fair/Good (FGF/G) and Fully Good Fair (FGF) were used. The obtained results clarified that the ginning efficiency parameters were significantly affected by the cotton variety, meanwhile, the lint cotton grade was insignificantly affected. All studied the High Volume Instrument (H.V.I.) fiber properties were significantly affected by cotton variety, except, the upper half mean length, short fiber content and reflectance degree were insignificantly affected. The seed cotton grade significantly influenced the ginning efficiency parameters and lint cotton grade. All studied fiber technological properties were significantly affected by the seed cotton grade, while, the upper half mean length and fiber elongation were insignificantly affected. The interaction between the two studied factors was significant for ginning time, gin stand capacity, lint cotton percentage, micronaire, fiber maturity, reflectance degree, yellowness degree, trash count and trash area.

Key words: Ginning, Efficiency, Seed cotton grade, Fiber properties, Egyptian Cotton

INTRODUCTION

Cotton is one of the most important crops for both local industry and export. Cotton fiber represents about 50 percent of the cost of yarn and there is a direct correlation between specific quality characteristics of the fiber and those of the yarn. Traditionally, the price of cotton was largely determined by factors such as staple length, grade, color and micronaire.

Ewida (1992) concluded that the highest seed cotton grade gave the highest gin stand capacity, ginning out-turn and micronaire reading, while the lowest seed cotton grade gave the highest floating fiber index and mote count. Beheary and Badr (1995) stated that both cotton genotype and location had significant effects on fiber length and maturity parameters. The ability of the cotton variety to react with the environmental conditions of the growing location reflects positively or negatively on fiber quality. The cotton genotype had a highly significant effect on all studied characters, only the length uniformity was significantly affected by this factor. El-Akhedar (1995) demonstrated that all the studied cotton fiber properties were significantly affected by cotton variety, except, 50% span length. Abd El-Gelil (2001) found that there were significant differences among the studied varieties for the fiber length, fiber elongation percentage, micronaire value as well as color and trash grades and their attributes in both seasons. Fouda (2004) recorded highly

significant difference in the upper half mean length and insignificant difference for the length uniformity index among the studied varieties. Highly significant differences were found among studied cotton varieties in fiber strength, elongation (%), fiber reflectance degree (Rd %) and yellowness degree (+b). Batisha (2005) found that the staple length, the color attributes: reflectance degree (Rd %), yellowness (+b), proportion of maturity (PM), hair weight, bundle strength and elongation (%) were significantly affected by the cotton variety. Ibrahim (2010) clearified that the highest mean values of gin stand capacity, ginning out-turn, lint grade, micronaire value, fiber elongation (%) and reflectance degree (Rd %) were obtained from the highest seed-cotton level, (G/FG). Ibrahim (2013) indicated that the extralong staple cotton variety Giza 45 and high lint cotton grade (G/FG) recorded the highest mean values of the most importance of fiber and yarn properties and the lowest value of short fiber content (%) and yarn evenness CV (%) and vice versa for the long staple cotton variety Giza 80 and low lint cotton grade Fully Good Fair to Good (FGF/G). Elbanna (2019) found that the McCarthy roller gin stand with using the seed cotton level; namely, (G + ¼); recorded the highest mean values of the most important ginning efficiency properties; i.e., gin stand capacity (kg lint/inch/hr.), lint percentage (%) and lint grade. The highest seed cotton level (G +¼), produced the best fiber quality characteristics.

MATERIALS AND METHODS

Four commercial Egyptian cotton varieties namely: Giza 87 and Giza 92 (belong to extra-long staple length), Giza 86 and Giza 94 (belong to long staple length) were used in this study through 2016 season. Four seed cotton grades namely: Good/ Fully Good (G/FG); Good (G); Fully Good Fair/Good (FGF/G) and Fully Good Fair (FGF) were used for each cotton variety. A sample of seed-cotton representing each grade was drown from each cotton variety. The seed cotton sample of each grade (9 kilograms each) was divided into three replicates (3 kilograms each). Seed-cotton grade samples were ginned at Al Delta ginning Mill, Desouk, Kafr El-Sheikh, Governorate using conventional roller gin stand (McCarthy). The seed grid adjustment; i.e., 1.25, 1.00, 1.00 and 0.75 lineal were used when ginning the seed cotton grades i.e., (G/FG), (G), (FGF/G) and (FGF), respectively of Giza 87 and Giza 92. While, the seed grid adjustment; i.e., 1.50, 1.25, 1.25 and 1.00 lineal were used when ginning the seed cotton grades, respectively of Giza 86 and Giza 94.

The studied characters:

These parameters were calculated, according to the following equations, proposed by Chapman and Stedronsky (1959):

1. Ginning time (hr/kentar):

$$\text{Ginning time (G.T.)} = \frac{\text{Ginning time (minute)} * 157.5}{\text{Seed-cotton weight (kg)} * 60} = \text{(hr/kantar)}$$

2. Gin stand capacity (kg/inch/hr):

$$\text{Gin stand capacity (G.S.C)} = \frac{60 * \text{weight of ginned lint (kg)}}{\text{Time (min)} * \text{Length of roller (inch)}} = \text{(kg/inch/hr)}$$

3. Lint cotton (%):

$$\text{Lint cotton (\%)} = \frac{\text{Lint weight (kg)}}{\text{Seed-cotton weight (kg)}} * 100 = \text{(\%)}$$

4. Lint cotton grade:

The lint grade was determined by a committee of three expert classers from Cotton Arbitration and Testing General Organization (CATGO), Alexandria.

For statistical analysis, the lint grades were converted to code numbers according to (Sallouma, 1970).

5. H.V.I. Fiber Properties:

Technological fiber properties of all studied samples were determined by High Volume Instrument (H.V.I.) at the laboratory of the Cotton Arbitration and Testing General Organization (CATGO), (Smouha), Alexandria, Egypt.

Samples were preconditioned for 24 hours, at least under the standard conditions of (65% ± 2%) relative humidity and (21 ± 1 $^{\circ}$C) temperature before testing.

Statistical analysis:

This experiment was conducted in a completely randomized design with three replicates and computed as a factorial experiment (Two factors) to estimate the significant differences among studied treatments. The least significant difference (L.S.D) were calculated at 0.05 level of probability to compare between treatments averages according to Snedecor and Cochran (1967).

RESULTS AND DISCUSSION

The attained results will be presented and discussed herein in three categories as follows:

1. Cotton variety effect (A):

Obtained results indicated that the ginning time (hr/kantar), gin stand capacity (kg/inch/hr), lint cotton percentage (%) were significantly affected by the Egyptian cotton variety, whereas, the lint cotton grade was insignificantly affected by the cotton variety, as shown in Table (1).

Table (1). Mean values of ginning time, gin stand capacity, lint percentage and lint grade as affected by Egyptian cotton variety (A), seed cotton grade (B) and their interaction (A * B) during 2016 season

Characters / Treatments	Ginning time (hr/kentar		Gin stand capacity (kg/inch/hr)		Lint cotton (%)		Lint cotton grade	
Cotton variety (A)								
Giza 87	1.61	b	0.83	c	33.66	d	21.42	a
Giza 92	1.44	c	1.02	a	36.4	c	23.38	a
Giza 86	1.60	b	0.93	b	37.14	b	24.28	a
Giza 94	1.89	a	0.82	c	37.93	a	23.96	a
L.S.D. (0.05)	0.08		0.04		0.61		N.S.	
Seed cotton grade (B)								
G/FG	1.39	c	1.07	a	37.77	a	26.98	a
Good	1.60	b	0.90	b	36.29	b	26.04	a
FGF/G	1.75	a	0.87	b	36.16	b	21.80	b
FGF	1.80	a	0.77	c	34.91	c	18.17	c
L.S.D. (0.05)	0.08		0.04		0.61		3.26	
Interaction								
A * B	**		**		**		N.S.	

Mean values designated by the same letter in within each column are not significantly different according to L.S.D. value.
** Highly significant at 0.01 level of probability.
N.S.: Not significant.
FG: Fully Good   G: Good   FGF: Fully Good Fair

Furthermore, the highest mean values of ginning time (1.89 hr/kantar), gin stand capacity (1.02 kg/inch/hr) and lint percentage (37.93 %) were recorded by Giza 94, Giza 92 and Giza 94, respectively. Conversely, the lowest mean values (1.44, 0.82 and 33.66 %) of the respective properties were obtained for Giza 92, Giza 94 and Giza 87, respectively.

Data shown in Table (2) cleared that the uniformity index, fiber bundle strength, fiber elongation, spinning consistency index, micronaire reading and fiber maturity were significantly affected by Egyptian cotton variety, while, the upper half mean length and short fiber content were insignificantly affected.

The highest mean values of uniformity index (86.05%), fiber bundle strength (45.72 g/tex), fiber elongation (6.44 %), spinning consistency index (200.92), micronaire reading (3.69) and fiber maturity (85 %) were attained from the Egyptian cotton varieties, Giza 92, Giza 92, Giza 86, Giza 92, Giza 92 and Giza 92, respectively. On the other hand, the lowest mean values of the same traits (84.38 %), (39.38 g/tex), (5.75   %), (182.58), (2.92) and (84 %) were recorded using Giza 94, Giza 87, Giza 87, Giza 94, Giza 87 and Giza 87, respectively.

Table (2). Mean values of upper half mean length, uniformity index, short fiber content, fiber bundle strength, fiber elongation and spinning consistency index, micronaire reading and fiber maturity as affected by Egyptian cotton variety (A), seed cotton grade (B) and their interaction (A * B) during 2016 season

Characters / Treatments	Upper half mean length (mm)	Uniformity index (%)	Short fiber content (%)	Fiber bundle strength (g/tex)	Fiber elongation (%)	Spinning consistency index	Micronaire reading	Fiber maturity (%)
Cotton variety (A)								
Giza 87	38.03a	85.47a	6.37a	39.38c	5.75b	189.42ab	2.92c	84b
Giza 92	32.65a	86.05a	6.29a	45.72a	6.33a	200.92a	3.69a	85a
Giza 86	31.69a	84.47b	7.14a	42.25b	6.44a	187.92b	3.42b	85a
Giza 94	32.14a	84.38b	7.18a	39.51c	6.42a	182.58b	3.04c	84b
L.S.D. (0.05)	N.S.	0.93	N.S.	2.17	0.46	11.69	0.21	0.01
Seed cotton grade (B)								
G/FG	33.81a	87.01a	5.93c	44.48a	6.23a	211.17a	3.64a	85a
Good	37.42a	85.73b	6.04c	42.94ab	6.33a	200.75a	3.21b	84b
FGF/G	31.89a	84.28c	7.06b	41.71b	6.21a	184.67b	3.09b	84b
FGF	31.41a	83.33d	7.95a	37.73c	6.17a	164.25c	3.14b	84b
L.S.D. (0.05)	N.S.	0.93	0.78	2.17	N.S.	11.69	0.21	0.01
Interaction								
A * B	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	**	**

Mean values designated by the same letter in within each column are not significantly different according to L.S.D. value.
** Highly significant at 0.01 level of probability.
N.S.: Not significant.
FG: Fully Good   G: Good   FGF: Fully Good Fair

Data of the reflectance degree, yellowness degree, trash count and trash area presented in Table (3) revealed that these fiber properties were significantly affected by Egyptian cotton variety except reflectance degree, which was insignificantly affected. The highest mean values of yellowness degree (9.61%), trash count (170.50) and trash area (1.75%) were gained from Giza 86, Giza 92 and Giza 92, respectively. On the other hand, the lowest mean values of the same characters (9.21%), (110.00) and (1.09%) were recorded by Giza 94 cotton variety only. These results were agreement with those obtained by Batisha (2005) who found that the staple length, the color attributes: reflectance degree (Rd %), yellowness (+b), proportion of maturity (PM), hair weight, bundle strength and elongation (%) were significantly affected by the cotton variety.

2. Seed cotton grade effect (B):

Results attained cleared that of seed cotton grade significantly influenced the ginning time (hr/kantar), gin stand capacity (kg/inch/hr), lint cotton (%) and lint cotton grade, as shown in Table (1). It is worthy to mention that, the highest mean values of ginning time (1.80 hr./kantar), gin stand capacity (1.07 kg/inch/hr) and lint cotton (37.77 %) and lint cotton grade (26.98) were recorded by the seed cotton grades (FGF), (G/FG), (G/FG) and (G/FG), respectively. On the other side, the

lowest mean values (1.39, 0.77, 34.91 % and 18.17) of the respective properties were gained from the seed cotton grade G/FG, FGF, FGF and FGF, respectively.

It is obvious that the uniformity index, short fiber content, fiber bundle strength, spinning consistency index, micronaire reading and fiber maturity shown in Table (2) were significantly affected by seed cotton grade. Meanwhile, the upper half mean length and fiber elongation percentage were insignificantly affected.The highest mean values of uniformity index (87.01%), short fiber content (7.95), fiber bundle strength (44.48 g/tex), spinning consistency index (211.17), micronaire reading (3.64) and fiber maturity (0.85 %) were recorded by the seed cotton grade (G/FG), (FGF), (G/FG) , (G/FG) , (G/FG) and (G/FG), respectively. Contrary, the lowest mean values of the same traits (84.28 %), (5.93), (37.73 g/tex), (164.25) and (3.09) were attained from the (FGF/G), (G/FG), (FGF), (FGF), (FGF) and (G), respectively. Concerning the reflectance degree, yellowness degree, trash count and trash area presented data in Table (3) showed that these fiber properties were significantly affected by the seed cotton grade. The highest mean values of reflectance degree (75.50%), yellowness degree (9.67%), trash count (214.17) and trash area (2.40%) were ginned from the seed cotton grade (G/FG), (FGF), (FGF) and (FGF), respectively. On the other hand, the lowest mean values of the same traits (63.55%), (9.04%), (61.00) and (0.51) were reached by the seed cotton grade (FGF), Good, (G/FG) and (G/FG),, respectively. These results were agreement with those obtained by Ibrahim (2010) who found that The gin stand capacity, ginning out-turn, lint grade, micronaire value, fiber elongation (%) and reflectance degree (Rd %) were obtained from the highest seed-cotton level (G/FG).

Table (3). Mean values of reflectance degree, yellowness degree trash content and trash area as affected by cotton variety (A), seed cotton grade (B) and their interaction (A * B).

Characters Treatments	Reflectance degree (Rd%)	Yellowness degree (+b%)	Trash count	Trash area (%)
Cotton variety (A)				
Giza 87	67.72 a	9.36 ab	146.33 a	1.72 a
Giza 92	69.42 a	9.23 b	170.50 a	1.75 a
Giza 86	69.27 a	9.61 a	112.75 b	1.29 b
Giza 94	70.08 a	9.21 b	110.00 b	1.09 b
L.S.D. (0.05)	N.S.	0.26	28.73	0.38
Seed cotton grade (B)				
G/FG	75.50 a	9.48 a	61.00 d	0.51 d
Good	70.98 b	9.04 b	99.33 c	1.14 c
FGF/G	66.46 c	9.21 b	165.08 b	1.79 b
FGF	63.55 d	9.67 a	214.17 a	2.40 a
L.S.D. (0.05)	2.38	0.26	28.73	0.38
Interaction				
A * B	*	**	**	**

Mean values designated by the same letter within each column are not significantly different according to L.S.D. value. * and **   Significant at 0.05 and 0.01 levels of probability, respectively.
FG: Fully Good   G: Good   FGF: Fully Good Fair

3. The interactions between Egyptian cotton variety and seed cotton grade (A x B):

Data in Tables (1, 2 and 3), indicated that the interaction between the two studied factors, i.e. Egyptian cotton variety and seed cotton grade (A * B) was highly significant for ginning time, gin stand capacity, lint cotton percentage, micronaire reading, fiber maturity, yellowness degree trash content and trash area, except reflectance degree was significant difference.

Concerning data in Table (4) it is worthy to mention that the highest mean values of ginning time (2.25 hr/kantar), gin stand capacity (1.27 and 1.18 kg/inch/hr), lint cotton percentage (41.53%), micronaire reading (4.32) and fiber maturity (0.86 %) were recorded for the grade (FGF/G) of Giza 94, grade (FGF/G) of (Giza 92, grade G/FG of Giza 94, grade G/FG of Giza 86 and grade G/FG of Giza 86, respectively. The lowest mean values of the same fiber properties (1.17 hr./kantar), (0.65 kg/inch/hr.), (32.96 %), (2.54) and (0.82 %) were gained from the grade FGF/G of Giza 92, grade FGF/G of Giza 94 , grade G of Giza 87, grade FGF of Giza 94, grade FGF of Giza 94 and grade FGF/G of Giza 87, respectively.

Table (4). The interaction between Egyptian cotton variety and seed cotton grade (A*B) for Ginning time, Gin stand capacity and lint cotton during 2016 season

Treatments		Ginning time (hr/kentar)	Gin stand capacity (kg/inch/hr)	Lint cotton (%)	Micronaire reading	Fiber maturity (%)
Cotton variety (A)	Seed cotton grade (B)					
Giza 87	G/FG	1.41	0.94	34.01	3.16	84
	Good	1.48	0.87	32.96	2.97	83
	FGF/G	1.75	0.75	33.76	2.77	82
	FGF	1.78	0.74	33.89	2.79	83
Giza 92	G/FG	1.37	1.00	35.14	3.54	85
	Good	1.56	0.91	36.13	3.48	85
	FGF/G	1.17	1.27	37.92	3.62	85
	FGF	1.64	0.87	36.4	4.12	86
Giza 86	G/FG	1.34	1.18	40.37	4.32	86
	Good	1.50	0.99	37.94	3.37	84
	FGF/G	1.79	0.77	35.56	2.91	83
	FGF	1.77	0.77	34.69	3.10	84
Giza 94	G/FG	1.45	1.13	41.53	3.55	85
	Good	1.84	0.82	38.13	3.04	83
	FGF/G	2.25	0.65	37.41	3.05	83
	FGF	2.00	0.68	34.64	2.54	82
L.S.D. $_{0.05}$		**0.15**	**0.08**	**1.21**	**0.42**	**0.01**

FG: Fully good   G: Good   FGF: Fully good fair

Regarding data of color and trash attributes interactions were shown in Table (5) it could be noticed that the highest mean values of reflectance degree (78.26%), yellowness degree (10.10 %), trash count (289.00) and trash area (3.84 %) were possessed by the grade G/FG of Giza 94, grade FGF/G of Giza 86, grade FGF of Giza 87 and grade FGF of Giza 87, respectively. On the contrary, the lowest mean values of the same fiber traits (64.50), (8.70), (27.00) and (0.30%) were attained from the grade FGF of Giza 92, grade FGF/G of Giza 92, grade G/FG of Giza 87, grade G/FG of Giza 94 and grade G/FG of Giza 87, respectively.

Table (5). The interaction between Egyptian cotton variety and seed cotton grade (A * B) for reflectance degree and yellowness degree during 2016 season

Treatments		Reflectance degree (Rd %)	Yellowness degree (+b %)	Trash count	Trash area (%)
cotton variety (A)	seed cotton grade (B)				
Giza 87	G/FG	76.10	9.60	27.00	0.30
	Good	69.70	8.83	115.00	1.26
	FGF/G	67.76	9.13	154.33	1.45
	FGF	57.30	9.86	289.00	3.84
Giza 92	G/FG	72.93	9.33	117.66	0.80
	Good	73.50	9.10	87.00	0.83
	FGF/G	66.73	8.70	219.33	2.73
	FGF	64.50	9.76	258.00	2.62
Giza 86	G/FG	74.70	9.36	67.00	0.63
	Good	70.46	9.13	93.33	1.37
	FGF/G	65.76	10.10	165.66	1.83
	FGF	66.15	9.85	125.00	1.32
Giza 94	G/FG	78.26	9.63	32.33	0.30
	Good	70.26	9.10	102.00	1.10
	FGF/G	65.56	8.90	121.00	1.14
	FGF	66.23	9.20	184.66	1.80
L.S.D. $_{0.05}$		4.76	0.522	57.45	0.75

FG: Fully Good   G: Good   FGF: Fully Good Fair

CONCLUSION

The obtained results could be concluded that the ginning efficiency parameters were significantly affected by the cotton variety and seed cotton grade. All studied H.V.I. fiber properties were significantly affected by cotton variety, except, the upper half mean length, short fiber content and reflectance degree were insignificantly affected. All studied fiber technological properties were significantly affected by the seed cotton grade, while, the upper half mean length and fiber elongation were insignificantly affected. `

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الملخص العربي

تأثير الصنف ورتبة القطن الزهر علي كفاءة الحليج وخواص الألياف

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**الهيئة العامة للتحكيم واختبارات القطن – الأسكندرية – مصر

أُجرى هذا البحث بقسم الإنتاج النباتي– كلية الزراعة (سابا باشا) – جامعة الإسكندرية موسم ٢٠١٦ لدراسة تأثير الصنف ورتبة القطن الزهر والتداخل بينهما علي كفاءة الحليج وخواص الألياف.

أُستخدِم أربعة أصناف من القطن المصري هم: جيزة ٨٧ ، جيزة ٩٢، جيزة ٨٦،، وجيزة ٩٤. مع أربعة رتب من القطن الزهر هم: (جود/فولى جود، جود، فولى جود فير/جود و فولى جود فير) لكل صنف.

وأوضحت النتائج المتحصل عليها أن مؤشرات كفاءة الحليج تأثرت معنويا، بينما لم تتأثر رتبة القطن الشعر بصنف القطن. جميع صفات الألياف التي درست بجهاز الـ H.V.I. قد تأثرت معنويا بصنف القطن ما عدا متوسط طول الشعيرات ، محتوى الشعيرات القصيرة ودرجة انعكاس اللون.

أثرت رتبة القطن الزهر معنويا على جميع مؤشرات كفاءة الحليج ورتبة القطن الشعر. جميع الصفات التكنولوجية التي درست للألياف تأثرت معنويا برتبة القطن الزهر عدا متوسط طول الشعيرات و إستطالة الألياف. وكان التفاعل Interactionبين عاملي الدراسة (الصنف*رتبة القطن الزهر) معنوياً للصفات: وقت الحليج، إنتاجية الحلاجة، النسبة المئوية للقطن الشعر، قراءة الميكرونير، نضج الشعيرات، درجة انعكاس اللون، درجة اصفرار اللون، عدد الشوائب و نسبة الشوائب.