Effect of Cotton Cultivar and Seed Grid Adjustment on Ginning Efficiency and Fiber Properties

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ABSTRACT

This investigation was carried out at Plant Production Department, Faculty of Agriculture (Saba Basha), Alexandria University, Egypt, during 2009 season to study the effect of cotton cultivar and seed grid adjustment on ginning efficiency and fiber properties. Five seed grid adjustments; i.e., 1.50, 1.25, 1.00, 0.75 and 0.50 lineal were used. Two commercial Egyptian cotton cultivars; namely, Giza 88 as extra long staple (ELS) and Giza 86 as long staple (LS) were studied. The obtained results revealed that the extra long staple cultivar, Giza 88 surpassed the long staple cultivar, Giza 86 in gin stand capacity (kg/inch/hr), short ginning time (hr/cantar), UHML (mm), mean length (mm), uniformity index, fiber bundle strength (g/tex) and fiber elongation (%). Meanwhile, the long staple cotton cultivar, Giza 86 recorded the highest mean values concerning ginning out-turn (%), lint grade, micronaire value, maturity (%) and reflectance degree (Rd %).

Seed grid adjustment significantly affected on gin stand capacity, ginning time and lint grade. Also, the highest mean values of gin stand capacity (kg/inch/hr), short ginning time (hr/cantar) and lint grade were attained using the largest seed grid adjustment, (1.50 lineal).

The highest mean values for mean length (mm) and uniformity index (%) were recorded from seed grid adjustment, 1.25 lineal. Likewise, the highest mean values for micronaire reading, maturity (%) and weight short fiber were obtained from 0.75 lineal. While, seed grid adjustment had insignificant effect on upper half mean length (UHML), fiber strength, fiber elongation and reflectance degree (Rd %).

Key words: **Cotton cultivar; Seed grid adjustment; Fiber properties; H.V.I.**

INTRODUCTION

Egypt has traditionally been the leading source of extra long staple cotton, (ELS). Today it remains the second largest exporter of ELS cotton to the world markets. Likewise, Egypt is producing cotton in a wide range of quality and staple length from 29 up to 38 mm. Cultivated cotton cultivars in Egypt belong to either extra long staple (ELS); i.e. Giza 45, Giza 87 and Giza 88 or long staple (LS); i.e. Giza 86, Giza 80 and Giza 90. The cultivars Giza 87 and Giza 45 are among the finest types of cotton in the world.

All Egyptian cotton is handpicked and by roller gin ginned to preserve its unique fiber characteristics and maintain quality. Roller gins are considerably slower, but delicate to the fiber; therefore they are commonly used for extra long staple cotton, (ELS) and long staple cotton, (LS), also for some upland cottons in Turkey, East Africa and India.

The main objective of the ginning process is separating fibers from seeds. The perfect ginning operation should be performed without or with the slightest injury to either seeds or fiber.

In general, all cotton fiber properties are mainly affected by cultivar. Therefore, correlations of the cultivars average fiber properties with yarn tenacity. Over all environments give a good estimate of the partial influence on yarn tenacity and the associated characteristics. These results show the importance of cultivar identification for preferred fiber properties and indicate that bundle strength should have a high priority in fiber quality breeding programs (William *et al.*, 1991). Fiber length parameters; i.e., (2.5%, 50% span length and length uniformity ratio), reflectance degree (Rd %), degree of yellowness (+b), fiber maturity ratio, fiber bundle strength (g/tex), elongation (%) and toughness (g/tex) were significantly affected by cotton cultivars (Badr, 1994), El-Akhdar (1995) and Abd El-Gilel (2001). Likewise, the basic cotton fiber properties i.e., maturity, length, fineness, tenacity and color depend on the cotton cultivar as well as climatic and soil conditions, (Frydrych and Matusiak , 2002). Wali, (2003), showed that significant differences in 2.5% span length, micronaire reading and fiber bundle strength. Fiber maturity parameters, bundle strength and elongation % were highly significantly affected by the cotton cultivar (Yehia, 2003). Staple length, reflectance degree (Rd %), yellowness (+b), proportion of maturity (PM), hair weight bundle strength and elongation % were significantly affected by the cotton cultivar, (Batisha, 2005). Cotton cultivar had a highly significant effect on all studied fiber length and strength traits (Osman, 2007). Foulk *et al.*, (2008), reported that cotton quality is affected by cotton cultivar and growing conditions.

The objective of this research was to investigate the effect of cotton cultivar and seed grid adjustment on lint grade, ginning efficiency and fiber properties.

MATERIALS AND METHODS

Cotton cultivars and seed grid adjustment are among the most factors affecting on gin stand capacity, fiber properties and lint grades.

This study was carried out at Plant Production Department, Faculty of Agriculture (Saba Basha), Alexandria University, Egypt, during 2009 season using one seed-cotton level, (Good + ¼) of the two Egyptian cotton cultivars; Giza 88 as extra long staple (ELS) and Giza 86 as long staple (LS). A seed-cotton sample of 75 kilograms was taken from each cotton cultivar, representing the original stock of Al Wadi ginning Mill, Damanhour Al-Beherah Governorate. Each sample was divided into five sub-samples (15 kilograms each) also it's divided into three sub-sub samples (5 kilograms each). Seed-cotton samples were ginned at conventional roller gin stand (McCarthy) by using five seed grid adjustment; i.e., 1.50, 1.25, 1.00, 0.75 and 0.50 lineal, (1 lineal = 0.125 inch = 3.2 mm).

This experiment was conducted in a completely randomized design with three replicates and analyzed as a factorial experiment. To estimate the significant differences among studied treatments, the least significant difference (L.S.D) were calculated at 0.05 as well as the simple regression for the different characteristics (Y) on seed grid adjustment (X) according to Snedecor and Cochran (1967).

Studied characters:

1. Ginning efficiency parameters:

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

1.1. Gin stand capacity (G.S.C.): as the lint weight in kg per inch per hour, as follows:

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

1.2. Ginning time (G.T.):

$$\text{Ginning time (G.T.)} = \frac{\text{Ginning time (minute)} \times 157.5}{\text{Seed-cotton weight (Kg)} \times 60} = \text{(hr/cantar)}$$

(1 cantar = 157.5 kilograms seed-cotton)

1.3. Ginning out-turn (G.O.T.): as a percentage, as follows:

$$\text{Ginning out-turn (G.O.T.)} = \frac{\text{Lint weight (kg)}}{\text{Seed-cotton weight (kg)}} \times 100 = (\%)$$

2. Lint grade: was determined as an average grade given by a three export classers at Cotton Arbitration and Testing General Organization, (CATGO), Alexandria, Egypt. For statistical analysis, the grades were converted to code numbers, as shown in the following table (Sallouma, 1970):

Grade	Abbreviation	Code
Fully good	FG	33
Good/fully good	G/FG	29
Good	G	25
Fully good fair/good	FGF/G	21
Fully good fair	FGF	17
Good fair/fully good fair	GF/FGF	13
Good fair	GF	9
Fully fair/good fair	FF/GF	5
Fully fair	FF	1

$^{1}/_{16}$ grade is represented by one mark

3. Fiber properties by H.V.I.:

Samples were preconditioned for 24 hours, at least under the standard conditions of 65% ± 2% relative humidity and 20 ± 1 °C temperature before testing.

The High Volume Instrument (HVI) premier HFT 9000 system was used to determine the fiber properties, according to the U.S.D.A. mode at the laboratory of the Modem Nile Cotton Company, Alexandria, Egypt.

RESULTE AND DISCUSSION

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

With regard to data shown in Table (1), it could be noticed that there were significant differences among the two Egyptian cotton cultivars for this character. The highest mean value of gin stand capacity (1.27 kg/inch/hr) was recorded by the extra long staple cotton cultivar Giza 88. On the other side, the lowest mean value (1.00 kg/inch/hr) was obtained from long staple cotton cultivar Giza 86. These results could be attributed to fluffy and big size of seed-cotton locks for extra long cotton cultivar Giza 88.

As for the seed grid adjustment, significant differences due to this factor were found. It was obvious that, the gin stand capacity was increased as the seed grid adjustment increased, and vice versa. The highest gin stand capacity (1.23 kg/inch/hr) was recorded from the highest seed grid adjustment (1.50 lineal) .On the other hand, the lowest mean value of the same character (1.03 kg/inch/hr) was obtained from the seed grid adjustment (0.75 lineal). These results could be explained on the basis that the large distance of seed grid adjustment cause downfall of all trash and non-lint content and consequently the ginning zone always would be clear to increase the fiber attachment to the ginning roller and vise versa.

Highly significant interaction was found between cotton cultivar (A) and seed grid adjustment (B), Table (1). The highest mean value of the gin stand capacity (1.37 kg/inch/hr) was attained from Giza 88 when ginned with the highest seed grid adjustment, (1.50 lineal).On the contrary, the effect of seed grid adjustment was not consistent for Giza 86, Table (4).

2. <u>Ginning time (hr/cantar):</u>

Regarding data shown in Table (1), it could be concluded that the lowest ginning time per cantar (1.16 hr/cantar) was recorded for Giza 88 and the highest mean value of the same character (1.62 hr/cantar) was found for Giza 86.

The lowest mean value of ginning time per cantar (1.28 hr/cantar) was attained by using the widest seed grid adjustment (1.50 lineal). Whereas, the highest mean value for the same character (1.58 hr/cantar) was reached by ginning cottons at (0.75 lineal). These results may be due to the high speed in seed-cotton input and lint cotton output due to the clearness of ginning zone, (Table 1).

There was highly significant interaction for the same trait due to cotton cultivar (A) x seed grid adjustment (B), Table (1). The highest mean value of ginning time (1.98 hr/cantar) was noticed from cotton cultivar Giza 86 when ginned at (0.75 lineal). Meanwhile, the highest mean value for the same character (1.23 hr/cantar) was revealed when ginning Giza 88 with 0.50 seed grid adjustment, Table (4).

3. <u>Ginning out-turn (%):</u>

Data in Table (1) showed significant differences in the ginning out-turn (%) due to cotton cultivar. The highest mean value (40.91 %) was obtained from long staple cotton cultivar, Giza 86.This result might be due to the genetic structure.

Furthermore, data presented in the same table revealed that the ginning out-turn (%) was insignificantly affected by seed grid adjustment.

A significant interaction between cotton cultivar (A) and seed grid adjustment (B) was found for ginning out-turn (%), Table (1).

The highest mean value of ginning out- turn (41.54 %) was recorded when cultivar Giza 86 was ginned at the lowest seed grid adjustment, (0.50 lineal). Conversely, Giza 88 cotton cultivar produced the lowest ginning out-turn with any of the studied seed grid adjustment Table (4).

4. Lint grade:

Regarding data in Table (1), it could be noticed that, there was significant differences between the two cotton cultivars concerning the lint grade. The highest lint grade was shown from cultivar Giza 86.

Concerning, the effect of seed grid adjustment on this character, it could be concluded that, the lint grade was increased by increasing the seed grid adjustment from (0.5 to 1.5 lineal). This results could be explained on the basis that the largest seed grid gave the chance to tight locks and trash, (non-lint content) to fall down the gin stand before ginning and vice versa.

A highly significant interaction (A x B) was found for the lint grade, Table (1). The highest mean value (28.83) was attained when Giza 86 was ginned at the highest seed grid adjustment, (1.50 lineal), while, the lowest mean value for the same cultivar was 28.16 at seed grid adjustments 1, 0.75 and 0.50 lineal. On the other hand, for Giza 88 the differences between seed grid effect ranged from 28.50 at 1.50 lineal to 26.33 at 0.50 indicating that this cultivar was more affected by the seed grid distance than Giza 86 , Table (4).

The relationships between seed grid adjustment and gin stand capacity (kg/inch/hr), lint grade, ginning time (hr/kintar) and ginning out-turn (%) were illustrated in Figures 1, 2, 3 and 4. Worthy to mention that lint grade was increased as seed grid adjustment increased Fig. (2).

5. Fiber properties by H.V.I. Instrument:

Regarding Table (2), significant differences were noticed due to the cotton cultivar, concerning the upper half mean length (UHML), mean length, micronaire reading and fiber bundle strength (g/tex). However, the Egyptian cotton cultivar Giza 88 recorded the highest mean values (35.21mm, 30.29mm and 45.40 g/tex) for UHML, mean length and fiber bundle strength, respectively. This results might be due to the characters of extra long staple cottons which always recorded the highest fiber properties. Whereas, the long staple cotton cultivar Giza 86 recorded the highest mean value for micronaire, this result might be due to the genetic structure.

Also, from the same table, no significant effect due to seed grid adjustment concerning UHML and fiber bundle strength (g/tex). However, the seed grid adjustment, (1.25 lineal) recorded the highest mean values (29.85mm and 88.28 %) for the fiber mean length and uniformity index, respectively.

No significant interaction between cotton cultivar, (A) and seed grid adjustment, (B) for all H.V.I fiber properties, was found in tables 2 and 3.

It is worthy to mention that, the cotton cultivar Giza 86 gave the highest mean values (86.8%, 77.75% and 6.48) for fiber maturity, reflectance degree (Rd%) and short fiber. As well as, Giza 88 cotton cultivar recorded the highest mean value (6.58 % and 11.79) for fiber elongation (%) and degree of yellowness (+b), respectively, as shown in Table (3).

Respecting, seed grid adjustment, no significant effect for fiber elongation (%) and reflectance degree (Rd %) could be noticed. However, the highest mean values (86.1% and 5.96) were noticed when the seed-cotton was ginned at (0.75 lineal) for maturity (%) and short fiber (W) and at (1 lineal) for degree of yellowness (+b), respectively.

CONCLUSION

The extra long staple cultivar, Giza 88 surpassed the long staple cultivar, Giza 86 in gin stand capacity (kg/inch/hr), short ginning time (hr/cantar), UHML (mm), mean length (mm), uniformity index, fiber bundle strength (g/tex) and fiber elongation (%). Meanwhile, the long staple cotton cultivar, Giza 86 recorded the highest mean values concerning ginning out-turn (%), lint grade, micronaire value, maturity (%) and reflectance degree (Rd %). Also, the highest mean values of gin stand capacity (kg/inch/hr), short ginning time (hr/cantar) and lint grad were attained when ginned seed-cotton using the largest seed grid adjustment, (1.50 lineal).It is worthy to mention that, the gin stand capacity and lint grade were increased as the seed grid adjustment increased and vice versa for ginning time (hr/cantar), while ginning out-turn % was not affected.

The highest mean values for mean length (mm) and uniformity index (%) were recorded from seed grid adjustment, 1.25 lineal. Likewise, the highest mean values for micronaire reading, maturity (%) and weight short fiber were obtained from 0.75 lineal. While, seed grid adjustment had insignificant effect on upper half mean length (UHML), fiber strength, fiber elongation and reflectance degree (Rd %).

Table (1): Effect of cotton cultivar and seed grid adjustment and their interaction on gin stand capacity, ginning time, ginning out-turn and lint grade

Treatments	Gin stand capacity (kg/inch/hr)	Ginning time (hr/cantar)	Ginning out-turn (%)	Lint grade
Cotton cultivars (A)				
Giza 86	1.00 b	1.62 a	40.91 a	28.33 a
Giza 88	1.27 a	1.16 b	37.73 b	27.26 b
L.S.D. (0.05)	0.02	0.03	0.41	0.17
Seed grid adjustment (lineal) (B)				
1.50	1.23 a	1.28 c	39.22 a	28.66 a
1.25	1.16 b	1.35 b	39.23 a	28.16 b
1.00	1.13 b	1.39 b	39.20 a	27.58 c
0.75	1.03 c	1.58 a	39.52 a	27.33 cd
0.50	1.14 b	1.36 b	39.44 a	27.25 d
L.S.D. (0.05)	0.03	0.05	NS	0.26
Interaction				
A * B	**	**	*	**

* and ** significant at 0.05 and 0.01 level of probability, respectively
Mean values designated by the same letters are not significantly different.

Table (2): Effect of cotton cultivar and seed grid adjustment and their interaction on fiber properties

Treatments	UHML (mm)	Mean length (mm)	Uniformity index (%)	Micronaire value	Fiber strength (g/tex)
Cotton cultivars (A)					
Giza 86	33.04 b	28.17 b	85.27 a	4.79 a	44.10 b
Giza 88	35.21 a	30.29 a	85.88 a	3.80 b	45.40 a
L.S.D. (0.05)	0.53	0.58	NS	0.09	0.99
Seed grid adjustment (lineal) (B)					
1.50	34.12 a	29.12 ab	85.36 b	4.18 b	44.35 a
1.25	33.65 a	29.85 a	88.28 a	4.29 ab	44.80 a
1.00	34.39 a	29.00 ab	84.36 b	4.29 ab	44.41 a
0.75	34.09 a	28.80 b	84.48 b	4.40 a	45.31 a
0.50	34.39 a	29.38 ab	85.40 b	4.33 ab	44.88 a
L.S.D. (0.05)	NS	0.91	2.15	0.15	NS
Interaction					
A * B	NS	NS	NS	NS	NS

N.S. Not significant
Mean values designated by the same letters are not significantly different.

Table (3): Effect of cotton cultivar and seed grid adjustment and their interaction on fiber properties

Treatments	Fiber elongation (%)	Maturity (%)	Rd (%)	+b	Short fiber (w)
Cotton cultivars (A)					
Giza 86	6.19 b	86.8 a	77.75 a	8.56 b	6.48 a
Giza 88	6.58 a	83.8 b	67.06 b	11.79 a	4.75 b
L.S.D. (0.05)	0.20	0. 8	0.19	0.16	0.48
Seed grid adjustment (lineal) (B)					
1.50	6.25 a	85.0 ab	72.41 a	10.11 ab	5.68 ab
1.25	6.48 a	85.1 ab	72.45 a	10.16 ab	5.13 b
1.00	6.41 a	85.6 ab	72.30 a	10.33 a	5.78 ab
0.75	6.35 a	86.1 a	72.51 a	10.01 b	5.96 a
0.50	6.43 a	84.6 b	72.36 a	10.26 ab	5.51 ab
L.S.D. (0.05)	NS	1.3	NS	0.26	0.77
Interaction					
A * B	NS	NS	NS	NS	NS

N.S Not significant

Mean values designated by the same letters are not significantly different.

Table (4): Effect of interaction between cotton cultivar (A) and seed grid adjustment (B) on Gin stand capacity, Ginning time, Ginning out-turn and Lint grade

Cotton cultivars A	Seed grid adjustment (lineal) B	Gin stand capacity (kg/inch/hr)	Ginning time (hr/cantar)	Ginning out-turn (%)	Lint grade
Giza 86	1.50	1.08 d	1.47 c	40.44 b	28.83 a
	1.25	1.02 e	1.55 bc	40.46 b	28.33 b
	1.00	1.00 e	1.61 b	41.08 ab	28.16 b
	0.75	0.81 f	1.98 a	41.04 ab	28.16 b
	0.50	1.08 d	1.50 c	41.54 a	28.16 b
Giza 88	1.50	1.37 a	1.08 f	38.00 c	28.50 ab
	1.25	1.29 b	1.15 e	38.00 c	28.00 b
	1.00	1.26 b	1.16 c	37.33 c	27.00 c
	0.75	1.26 b	1.19 de	38.00 c	26.50 d
	0.50	1.19 c	1.23 d	37.33 c	26.33 d
L.S.D. (0.05)		0.05	0.07	0.93	0.38

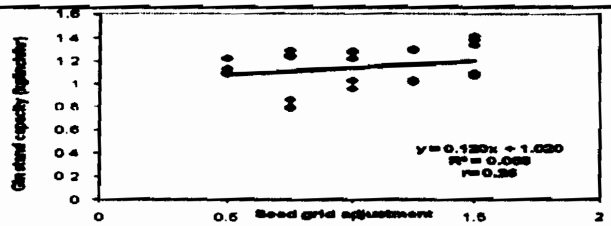

Fig. (1): Relationship between seed grid adjustment and gin stand capacity

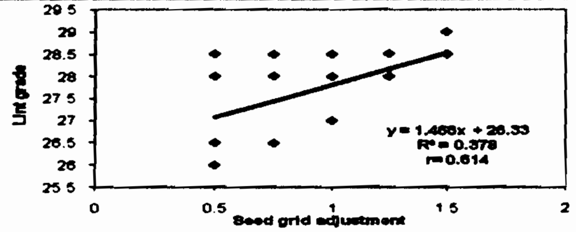

Fig. (2): Relationship between seed grid adjustment and lint grade

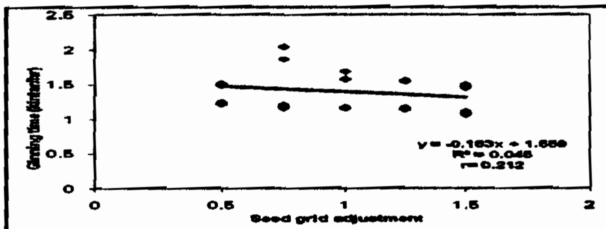

Fig. (3): Relationship between seed grid adjustment and ginning time

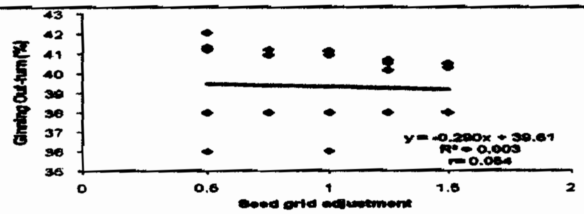

Fig. (4): Relationship between seed grid adjustment and ginning out-turn

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الملخص العربى

تأثير الصنف وفتحة الحلاجة على كفاءة الحليج وخواص الألياف

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قيمت هذة الدراسة بقسم الانتاج النباتى كلية الزراعة سابا باشا جامعه الاسكندرية فى موسم 2009 لدراسة تأثير الصنف والفتحة الإقتصادية الحلاجة الإسطوانية على كفاءة عملية الحليج والخواص التكنولوجية للألياف وكذلك رتبة القطن الشعر. أستخدمت خمس ضبطات لفتحة الحلاجة هى: 1.5 ، 1.25 ، 1 ، 0.75 ، 0.50 لينية (اللينية = 0.125 بوصة = 3.2 مم) . أستخدم صنفان من القطن هما: (جيزة 88 فائق الطول و جيزة 86 طويل). وتشير اهم النتائج المتحصل عليها إلى تفوق صنف القطن فائق الطول جيزة 88 فى صفات: القدرة الإنتاجية للحلاجة (كجم/بوصة/ساعة) وأقل زمن حليج (ساعة/قنطار) وطول النصف العلوى للشعيرات (UHML) (مم) ومتوسط الطول (مم) ومعامل الإنتظامية (%) ومتانة الشعيرات (جم/تكس) وإستطالة الألياف (%). بينما تفوق صنف القطن الطويل جيزة 86 فى الصفات: تصافى الحليج (%) و رتبة القطن الشعر وقيمة الميكرونير والنسبة المئوية لنضج الألياف ونسبة إنعكاس الضوء (Rd %) . أيضاً تم الحصول على أعلى القيم من صفات: القدرة الإنتاجية للحلاجة (كجم/بوصة/ساعة) ورتبة القطن الشعر الناتج واقل زمن حليج (ساعة/قنطار) عند حلج القطن الزهر بفتحة حلاجة (1.5 لينية).

من ناحية أخرى فقد سجلت أعلى القيم فى صفات متوسط الطول (مم) وإنتظام الطول (%)عند فتحة مشط الحلاجة Seed grid adjustment (1.25 لينية). اما أعلى قراءة ميكرونير ونسبة نضج للألياف وأعلى وزن للألياف القصيرة قد سجلت عند إستخدام فتحة مشط حلاجة (0.75 لينية). ولم يكن هناك تأثيراً معنوياً لفتحة مشط الحلاجة على كل من صفات طول النصف العلوى من الشعيرات ومتانة وإستطالة الشعيرات ونسبة إنعكاس الضوء.