Effect of some Egyptian Cotton Varieties and Grades on Fibers and Yarn Mechanical Properties

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ABSTRACT: This investigation was carried out at Plant Production Department, Faculty of Agriculture (Saba-Basha), Alexandria University, Egypt and at Cotton Research Institute, ARC, Giza, Egypt, to study the effect of cotton variety and lint grade on fiber and yarn mechanical properties during 2018 season. Two commercial Egyptian cotton varieties, *G. barbadense* namely: Giza 87 and Giza 96 as Extra-long staple (ELS) were used. Three lint cotton grades i.e., Good to Fully Good (G/FG), Good (G) and Fully Good Fair to Good (FGF/G) were used for each variety. Fibers were processed to combed yarns Ne 80. The H.V.I. classing 1000, Pressely, Stelometer and Cotton Classifying System (CCS) instruments were used to determine the physical and mechanical fiber properties. The grading system in Egypt depends upon the experience of the classer to determine grade and quality of the raw cotton according to the official grade standard of each cotton variety. The results indicated that classer's was highly significant correlated with all instrumentally measured traits (positively or negatively). The Extra-long cotton varieties had a highly significant effect for fiber properties The highest mean value of micronaire reading (3.51), maturity index (87%) , fiber length (UHML) (35.80 mm) , fiber strength (44.1 g/tex), fiber elongation(5.4 %), spinning constant index (222), reflectance degree (75.7) and trash count (112) were recorded for the Egyptian cotton variety Giza 96 .As for the lint cotton grades effect , it could be concluded that the highest lint cotton grade Good to Fully Good (G/FG) recorded the best of all fiber properties which as high value of micronaire reading , maturity index , fiber length(UHML), uniformity index, fiber strength, spinning constant index and less of short fiber index , yellowness degree and trash count vice versa. Cotton varieties (V) had highly significant differed for mechanical cotton properties measured by three instruments(HVI , Stelometer and Pressley) i.e. fiber strength and fiber elongation the highest mean values of the fiber strength (44.4 g / tex) , was attained by the cotton variety Giza 96. Whereas the lowest mean values (43.2 g/tex) and (4.8 %) of the fiber elongation. The conventional methods are biased toward the long, strong fibers in cotton, whereas the high speed instruments use less accurate, indirect methods to measure bundle mass and produce a force measurement that is confounded by differences in fiber crimp. When we compared single instrument testing (Pressley and Stelometer) with the HVI technology for evaluation of fiber properties is faster and coast less per measurement. The disadvantage of HVI for genetic modification for fiber properties may be reduced accuracy and ability to separate small differences. The HVI instrument had a highly significant effect on all studied fiber properties i.e. the micronaire reading , maturity index , fiber length , uniformity index , fiber strength , short fiber index, reflectance degree and yellowness degree .The highest mean value were (3.18), (85%) , (35.7mm), (86.4 %) , (47.6g/tex) , (5.7 %) , (76.0) and (9.4),respectively. of the maturity index, while the CCS instrument possessed the lowest mean of these traits. HVI measurements were calibrated across instruments using USDA cotton calibration standards making it possible to compare results from different instruments over a long period of time. In addition, cotton testing laboratories use cottons of known values throughout the day to check for a possible drift in measurements over time.

Key words: Egyptian cotton, lint cotton grade, fiber properties, HVI, Pressley , Stelometer, CCS.

INTRODUCTION

Egyptian cotton (*Gossypium barbadense* L.) popularly known as (White Gold) is a premier cash crop playing a key role in economic and social status of the world , is the principal crop of Egyptian agriculture. Cotton has value

because it can be spun into yarn and woven to produce clothing. High quality lint cotton will produce high quality yarn, fabric, and high quality consumer products. Cotton fiber quality is mainly influenced by genotype of the cultivars but agronomic practices and environmental conditions are the secondary factors influencing fiber quality. The cotton classing is a system of standardized procedures for determining the spinning cotton value of cotton which in turn determines its technological value (Tesema and Hussein , 2015) .

There are three major instruments for measuring tensile properties of fiber bundles, namely Pressley, Stelometer and High volume Instrument(HVI),(Farzad, 2012) . The Cotton Classification System (CCS), a new generation of cotton testing instruments is designed as a so-called MVI (Medium Volume Instrument), realizing a capacity of 20 tests per hour. The system provides fiber strength properties (g/tex) i.e., relative bundle strength (HVI) HVI-STR and absolute bundle strength (stelometer-STR) and elongation (%), (Negm *et al*., 2016).

The importance of the relationship between the fiber properties and yarn structure had increased due to the need of yarn with best possible quality at optimum cost. The spinner cost could be reduced by trying different new promising which have the same cotton qualities until matching the one that still allows for the required yarn properties is found. The tenacity of the ring yarns expresses greater value than rotor spun yarn and the elongation% of the ring yarns had a significantly lower value than that of rotor yarn. Compact yarns are claimed to be stronger and less hairy due to the improved fiber binding, and have better yarn elongation and yarn irregularity values compared with conventional ring yarn (Iqbal , 2018).

The aim of this study was to: Investigate the effect of cotton variety and lint grade on fiber properties measured by different instruments, as well as investigate the effect of cotton variety and lint grade on fiber strength and fiber elongation measured by different instruments. Evaluate the relationship between the fiber properties before and after processing and relate them to the yarn tensile properties.

MATERIALS AND METHODS

This study was carried out at Plant Production Department Laboratories, Faculty of Agriculture (Saba-Basha), Alexandria University, Cotton Research Institute , ARC , Giza and Cotton Arbitration and Testing General Organization (CATGO), Egypt, on two Egyptian cotton varieties, lint grades and some instruments, during 2018 season.

Two commercial Egyptian cotton varieties represented the extra-long staple ,extra fine(ELS) category there are Giza 87 and Giza 96 (over 1 3/8 inch fiber length = > 35 mm) were processed to combed yarns Ne 80. Each variety including three lint grades as follows; Good to Fully Good (G/FG), Good (G) and Fully Good Fair to Good (FGF/G) .

Table (1). The pedigree and origin of cotton genotypes

Cotton genotypes	Pedigree	Color	Category	Original	Year
Giza 87	G. 77 x G. 45 A	White	Extra long	Egypt	2002
Giza 96	(G.84x G.70 x 51B) x S62	White	Extra long	Egypt	2017

Fiber properties were performed at the laboratories Fiber and Spinning Testing Sector of cotton tests at the Cotton Arbitration and Testing General Organization (CATGO), Alexandria, Egypt.

A: Fiber properties:

Lint cotton samples were pre conditioned for 24 hours, under the standard conditions of (65 ± 2 %) relative humidity and (20 ± 1 C°) temperature before testing. The treatments were arranged in a completely randomized design with three replications. The cotton samples contained approximately 50 kg of ginned lint, in order to perform both fiber and spinning tests.

A.1. High Volume Instrument (HVI) classing 1000: was used to determine the fiber physical properties according to the standard method of the ASTM (D 4605-86).

A.2. The Pressely instrument: was used to determine the fiber strength**.**

- Fiber strength (Pressley index) PI= (bundle strength (lb) x 10.816) - 0.12
- Fiber strength (g /tex) **=** PI (Pressley index) x 5.36

A.3. The Stelometer instrument: was used to determine the mechanical fiber properties (fiber strength and fiber elongation) .

- Fiber strength (g/tex) = (breaking load (kg) x15) / bundle weight (mg) .
- Fiber elongation (%)**.**

A.4. Cotton Classifying System (CCS), a new generation of cotton testing instruments: was tested at the Cotton Technology Research Laboratories, Cotton Research Institute, Agricultural Research Center (ARC) , Giza, Egypt.

B: Yarn properties: were tested at the Cotton Technology Research Laboratories, Cotton Research Institute, Agricultural Research Center (ARC), Giza, Egypt.

B.1. Statimat ME Tester: was used to determine the yarn strength and yarn elongation.

B.2. Uster Evennes Tester: was used to measure yarn uniformity and imperfections .

Studied characteristics:

1- Fiber properties:

Table (2) . Mechanical fiber properties measured by different instruments

Fiber Properties	Instruments		
	HVI classing 1000	Stelometer	Pressely
Fiber strength (g/tex)	Yes	Yes	Yes
Fiber elongation (%)	Yes	Yes	No

Table (3) . Fiber cotton properties measured by different instruments

Fiber Properties	Instruments	
	High Volume Instrument HVI	Cotton Classifying System CCS
Micronaire reading	Yes	Yes
Maturity index (%)	Yes	Yes
Upper Half Mean Length (mm)	Yes	Yes
Uniformity index (%)	Yes	Yes
Fiber strength (g/tex)	Yes	Yes
Fiber elongation (%)	Yes	Yes
Short Fiber index (%)	Yes	Yes
Spinning Consistency Index (SCI)	Yes	No
Reflectance degree (Rd)	Yes	Yes
Yellowness degree of (+b)	Yes	Yes
Trash Count (Tr Cnt)	Yes	Yes
Trash Area (Tr Area)	Yes	No

2- <u>Yarn Properties:</u>

Tested under standard atmospheric condition of (21° ± 1 °C) temperature and (65 ± 2%) relative humidity at Cotton Research Institute, Agricultural Research Center laps

The two Egyptian commercial cotton varieties studied were spun at ring spinning systems , at the Cotton Technology Research Laboratories, Cotton Research Institute, Agricultural Research Center, Giza, Egypt, and the following yarn properties were determined under standard conditions :

1- Yarn strength (cN/tex) 2- Yarn elongation (%) 3- Lea Product (LCSP)

4- Thin places (1400 m) 5- Thick places (1400 m) 6- Neps (1400 m)

7- Yarn evenness (CV %)

Statistical procedures:

This investigation was conducted as a factorial experiment in a Completely Randomized Design (CRD) with three replicates and analyzed according to (Gomez and Gomez, 1984).The data was computed using the Co Stat program version 6.400, to test differences among studied mean of treatments, the least significant difference (L.S.D.) was used at 0.05 level of probability.

RESULTS AND DISCUSSION

3.1. HVI fiber properties as affected by Extra-long Egyptian cotton varieties (V), cotton grades (G) and their interactions.

Regarding to HVI fiber data in Tables (4 and 5), it is obvious that the Extra-long cotton varieties had highly significant effects on micronaire reading , maturity index , fiber length (UHML) ,uniformity index , fiber strength , reflectance degree , yellowness degree and trash count . As well as fiber

elongation, short fiber index and spinning constant index differed significantly due to genetic varietal effects.

The Extra-long cotton variety (Giza 96) recorded higher values for fiber properties i.e., micronaire reading (3.51) , maturity index (87 %) , fiber length (35.80 mm) , fiber strength (44.1 g/tex) , fiber elongation(5.4%), spinning constant index (222) , reflectance degree (75.7) and trash count(112) than the cotton variety (Giza 87) .On the other hand, the Extra-long cotton variety (Giza 87) recorded the highest values for uniformity index (88.0 %) , short fiber index (5.8 %) and yellowness degree (9.5).

Regarding the previous results, it is worth to mention that cotton varieties differed from variety to another and that due to gene poll of each variety. These results could be attributed to the best genetically structure of the Extra-long cotton variety (Giza 96). These results were in harmony with those obtained by Beheary (2005), who stated that fiber properties were significantly affected by the cotton variety.

Presented data in the Tables (4 and 5), also showed that cotton grades (G) had highly significant effects on all the studied fiber properties .

The highest lint cotton grade Good to Fully Good (G/FG) recorded the highest values of fiber properties and vice versa the lower cotton grade Fully Good Fair /Good (FGF/G) . The cotton grade Good / Fully Good possessed the highest mean value of micronaire reading (3.59), maturity index (86 %) ,fiber length (U.H.M.L.)(35.50 mm),uniformity index (88.5 %), fiber strength(46.1 g/tex), fiber elongation (5.4 %), spinning constant index(226), reflectance degree(77.8) .While, the highest mean values of short fiber index (6.1%), yellowness degree (9.6), trash count (91) and trash area (1.80 %) were obtained from the cotton grade Fully Good Fair / Good (FGF/G) .

These results could be explained on the basis of the highest lint cotton grade contains high percentage of mature fibers which properties as (high values of fiber length, uniformity index, fiber strength, maturity index and low short fiber index %). Cotton grades differed from each grade to another that due to the factors of grades, i.e., the change of color, trash content and cotton preparation of each grade.

The best mean values of the highest fiber properties i.e., micronaire reading (3.90), fiber length (35.80 mm), uniformity index (88.5 %) fiber strength (46.4 g/tex), fiber elongation (5.4%)

Table (4). Mean squares of fiber properties as influenced by the Extra-long Egyptian cotton varieties (V), cotton grades (G) and their interactions measured by HVI

S.O.V	d.f.	Micronaire reading	Maturity index (%)	Fiber length		Mechanical properties		Short fiber index (%)	Spinning Constant Index (SCI)	Color		Trash	
				Length (U.H.M.L) (mm)	Uniformity index (%)	Fiber strength (g/tex)	Fiber elongation (%)			Reflectance degree (Rd)	Yellowness degree (+b)	Trash Count (TC)	Trash Area (TA)
Cotton Variety (V)	1	0.96**	6.72**	0.26**	5.12**	13.17**	0.05*	0.14*	213.5*	1.68**	0.12**	997.5 **	0.16n.s
Cotton Grade (G)	2	0.90**	0.001**	3.53**	22.6**	28.4**	0.37**	0.74**	2072**	37.64**	0.26**	7326.8**	3.68**
Interaction (V x G)	2	0.03**	2.22 ns	0.34**	1.71 **	0.85 *	0.04*	0.02 ns	0.41 ns	4.11**	0.01 ns	486.8 *	0.47 ns
Error	12	0.003	2.22	0.02	0.21	0.13	0.01	0.02	28.11	0.13	0.01	84.16	0.22
Total	17	---	---	---	---	---	---	---	---	---	---	---	---

n.s : Not significant difference at 0.05 level of probability.
* , * *. Significant and highly significant difference at 0.05 and 0.01 levels of probability , respectively.

Table (5). Mean performance of fiber properties as affected by the Extra-long Egyptian cotton varieties(V) , cotton grades (G) and their interactions measured by HVI 1000 instrument

Traits Entries	Micronaire reading	Maturity index (%)	Fiber length		Mechanical properties		Short fiber index (%)	Spinning Constant Index (SCI)	Color		Trash	
			Length (U.H.M.L) (mm)	Uniformity index (%)	Fiber strength (g/tex)	Fiber elongation (%)			Reflectance degree (Rd)	Yellowness degree (+b)	Trash Count (TC)	Trash Area (TA)
Cotton Variety (V)												
Giza 87	3.16 b	86 b	35.50 b	88.0 a	42.4 b	5.1 b	5.8 a	210 b	73.6 b	9.5 a	88 b	0.84 a
Giza 96	3.51 a	87 a	35.80 a	86.9 b	44.1 a	5.4 a	5.6 b	222 a	75.7 a	9.1 b	112 a	1.03 a
L.S.D 0.05	0.07	0.1	0.1	0.4	0.5	0.1	0.1	5	0.3	0.1	9	--
Cotton Grade (G)												
Good /Fully Good	3.59 a	86 a	35.50 a	88.5 a	46.1 a	5.4 a	5.4 c	226 a	77.8 a	9.2 c	22 c	0.27 c
Good	3.12 b	84 b	34.92 b	86.2 b	42.8 b	5.0 b	5.7 b	212 b	75.7 b	9.4 b	62 b	0.93 b
Fully Good Fair/ Good	2.92 c	83 c	34.10 c	84.6 c	41.2 c	4.8 c	6.1 a	186 c	72.8 c	9.6 a	91 a	1.80 a
L.S.D 0.05	0.08	0.1	0.21	0.6	0.6	0.1	0.2	6	0.5	0.1	11	0.6
Interaction												
(V x G)	**	ns	**	**	**	*	ns	ns	**	ns	*	ns

Means within each column followed by the same letter are not significant difference at 0.05 level of probability
* ,* *Significant and highly significant difference at 0.05 and 0.01 levels of probability , respectively
ns : Not significant difference at 0.05 level of probability

and reflectance degree(78.4) and lowest trash count (21) were obtained from the highest lint cotton grade, Good to Fully Good (G/FG) with the Extra-long cotton variety (Giza 96) , however the lowest trash content (23) , also resulted from the cotton grade (G/FG) with the cotton variety (Giza 87) , as shown in Table (6).

Table (6).The interaction between the Extra-long Egyptian cotton varieties (V) and cotton grades (G) for fiber properties measured by HVI 1000 instrument

Cotton Variety (V)	Cotton Grade (G)	Fiber Properties						
		Micronaire reading	Fiber length (UHML) (mm)	Uniformity index (%)	Fiber strength (g / tex)	Fiber elongation (%)	Reflectance degree (Rd)	Trash Count (TC)
Giza 87	Good /Fully Good	3.28 b	35.10 b	86.4 b	45.8 b	5.2 b	77.2 b	**23 d**
	Good	2.88 d	34.60 c	85.2 c	44.1 c	5.0 c	74.8 c	45 c
	Fully Good Fair/ Good	**2.67 e**	**34.00 e**	**86.9 d**	**42.2 e**	**4.6 e**	**72.1 e**	75 b
Giza 96	Good /Fully Good	**3.90 a**	**35.80 a**	**88.5 a**	**46.4 a**	**5.4 a**	**78.4 a**	**21 d**
	Good	3.35 b	34.60 c	86.7 b	44.3 c	5.1 bc	76.7 b	59 bc
	Fully Good Fair/ Good	2.98 c	34.20 d	85.1 c	43.2 d	4.7 d	73.4 d	**108 a**
L.S.D 0.05		**0.09**	**0.21**	**0.8**	**0.2**	**0.1**	**0.6**	**16**

Means within each column followed by the same letter are not significant difference at 0.05 level of probability

The significant were noticed of interaction between Extra-long Egyptian cotton varieties and lint cotton grades (Vx G) due to the two variables mannered in depended behavior in effect of HVI fiber properties under this study. Varieties and grades interaction effect for HVI fiber properties had highly significant influenced .These results had similar trend of Hunter (1980) , Beheary (2005), Rogers (2005) , Constable *et al.* (2015) and Tesema and Subramanian (2018).

3.2. Mechanical fiber properties as affected by Extra-long Egyptian cotton varieties (V), cotton grades (G) , instruments and their interaction.

Looking forward to the data in Tables (7), it could be noticed that the studied cotton varieties differed highly significant for mechanical cotton properties, i.e., fiber strength and fiber elongation .The highest values (44.4 g/ tex and 4.8%) of fiber strength and fiber elongation, respectively, were recorded for cotton variety Giza 96. Whereas, the lowest mean values of the same traits (43.2 g/tex and 4.7%) were attained by the cotton variety (Giza 87).Table (8).

From the above mentioned results, it is worthy to mention that cotton varieties differed from each variety to another that due to the number of wall thickness layers and cellulose formation of each variety. The strength of cotton is related to the fiber structure. The tensile and fatigue tests are an excellent tool for assessing the microstructure of cotton fibers. With regard to Table (8), it is clear that for fiber strength the highest mean value (45.9 g /tex), was attained by the cotton grade Good / Fully Good (G/FG) and the lowest mean value (42.5 g /tex) was attained by the cotton grade Fully Good Fair / Good (FGF/G).

Table (7) . Mean squares of mechanical fiber properties (fiber strength and fiber elongation) as influenced by the Extra-long Egyptian cotton variety (V) , cotton grades (G), instruments (I) and their interactions

S.O.V	Mechanical properties			
	d.f.	Fiber strength	d.f.	Fiber elongation
Cotton Variety (V)	1	1.01 **	1	0.17 **
Cotton Grade (G)	2	51.86 **	2	0.82 **
Instruments (I)	2	27.47 **	1	3.18 **
Interaction (V x G)	2	0.08 ns	2	0.01 ns
(V x I)	2	0.41 *	1	2.77 ns
(G x I)	4	1.39 **	2	0.001 ns
(V x G x I)	4	0.54 **	2	0.08 **
Error	36	0.08	24	0.006
Total	53	---	35	---

ns : Not significant difference at 0.05 level of probability.
*,** Significant and highly significant difference at 0.05 and 0.01 levels of probability , respectively.

Table (8). Mean performance of mechanical fiber properties (fiber strength and fiber elongation) as affected by the Extra-long Egyptian cotton variety (V) , cotton grade (G) , instruments (I) and their interactions

Traits / Entries	Fiber strength (g / tex)	Fiber elongation (%)
Cotton variety (V)		
Giza 87	43.2 b	4.7 b
Giza 96	44.4 a	4.8 a
L.S.D 0.05	0.1	0.07
Cotton grade (G)		
Good / Fully Good	45.9a	5.1 a
Good	44.2 b	4.8 b
Fully Good Fair / Good	42.5 c	4.5 c
L.S.D 0.05	0.2	0.08
Instruments (I)		
HVI	44.4 b	5.1 a
Stelometer	42.9 c	4.5 b
Pressly	45.4 a	…
L.S.D 0.05	0.3	0.05
Interaction		
V x G	ns	ns
V x I	**	ns
G x I	**	ns
V x G x I	**	**

Means within each column followed by the same letter are not significant difference at 0.05 level of probability
** Highly significant difference at 0.01 level of probability .
ns : Not significant difference at 0.05 level of probability.

The cotton grade Good / Fully Good (G/FG) recorded the highest mean value (5.1 %) of the fiber elongation percentage , while the cotton grade Fully Good Fair / Good (FGF/G) possessed the lowest mean value (4.5 %).

Concerning the fiber strength (g/tex) , the highest mean value (45.4 g /tex) resulted from the Pressley instrument .On the other side, the lowest mean

value (42.9 g /tex), was possessed by the Stelometer instrument, as shown in Table (8). The Pressley instrument recorded unreal results due to the motion of breaking load which moved inclined horizontal plain which affected by the earth gravity .So, there is different mechanism of fiber bundle breakage in the Pressley and Stelometer measuring methods. HVI instrument recorded the highest mean value (5.1 %) of the fiber elongation percentage, than Stelometer instrument (4.5 %).On the other side , Pressley instrument did not measure the fiber elongation. These results were in harmony with those obtained by May and Jividen (1999) , El-Messiry and Abd-Ellatif (2013) and Koli *et al*. (2014). It is cleared that both Extra-long cotton varieties (Giza 96 and Giza 87) under cotton grade Good/ Fully Good with the Pressley instrument recorded the desirable highest values for fiber strength. These values were (47.3 and 47.2 g /tex) , respectively .On the other hand , the cotton grade Fully Good Fair / Good of the cotton variety (Giza 87) tested with the Stelometer instrument recorded the lowest values for fiber strength (41.3 g/tex) , as shown in Table (9).

Table (9). The interaction between the Extra- long Egyptian cotton varieties (V) , cotton grades (G) and Instrument (I) for fiber strength and fiber elongation

Cotton Variety (V)	Cotton Grade (G)	Instruments (I)	Fiber strength (g/tex)	Fiber elongation (%)
Giza 87	Good / Fully Good	HVI	45.8 c	5.2 b
		Stelometer	44.0 e	4.7 d
		Pressly	47.2 a	--
	Good	HVI	44.1 e	5.0 c
		Stelometer	42.6 hi	4.4 f
		Pressly	45.8 c	--
	Fully Good Fair / Good	HVI	43.2 fg	4.8 d
		Stelometer	41.3 k	4.1 g
		Pressly	42.7 hi	--
Giza 96	Good / Fully Good	HVI	46.4 b	5.5 a
		Stelometer	44.7 d	4.7 d
		Pressly	47.3 a	--
	Good	HVI	44.3 de	5.1 b
		Stelometer	42.9 gh	4.6 e
		Pressly	45.8 c	--
	Fully Good Fair / Good	HVI	42.4 ig	4.8 d
		Stelometer	42.1 j	4.3 f
		Pressly	43.5 f	--
L.S.D 0.05			0.5	0.01

Means within each column followed by the same letter are not significant difference at 0.05 level of probability

**: Highly significant difference at 0.01 level of probability .

Tabulated data in Table (9) showed that the Extra-long variety (Giza 96) under cotton grade Good/ Fully Good tested with the HVI instrument recorded the desirable and highest value for fiber elongation (5.5 %). On the other hand, the cotton variety (Giza 87) under cotton grade Fully Good Fair / Good tested with the Stelometer instrument recorded the lowest values for fiber elongation, where it was (4.1%). Pressley instrument recorded unreal results due to the motion of breaking load which moved inclined horizontal plain which affected by the gravity earth , the different mechanism of fiber bundle breakage in the Pressley and Stelometer measuring methods. The Stelometer instrument is the

traditional fiber tenacity reference method and might still be an option as a rapid screening tool because of its low cost and portable attributes.

Similar results were found by many workers such as May and Jividen (1999) , Beheary (2005) , Jane (2012), El-Messiry and Abd-Ellatif (2013) , Koli *et al*. (2014) , Hequet *et al.* (2015) and Shouren and Gordon (2016).

3.3. Fiber cotton properties as affected by Extra-long Egyptian cotton varieties (V), cotton grades (G), instruments (HVI and CCS) and their interactions.

With regard to Table (10), it is obvious that the Extra-long cotton varieties had a highly significant effect on micronaire reading , maturity index and trash count. The Extra-long cotton variety Giza 96 recorded the highest mean values of micronaire reading (3.51) , maturity index (87%) , reflectance degree (75.7) and trash count (128). Data tabulated in Table (11) indicated that lint cotton grades (G) had a highly significant effect on all studied fiber properties .

The cotton grade Good / Fully Good (G/FG) recorded the highest mean values of micronaire reading (3.32) , maturity index (87%) , fiber length(UHML) (35.70 mm) , uniformity index(87.4%) , fiber strength (47.3 g/tex) , fiber elongation (6.9%) and reflectance degree (77.0).While, the same grade showed the lowest mean value of short fiber index (4.1 %) yellowness degree(9.0) and trash count (87) .

The HVI instrument recorded the highest mean values of fiber properties i.e., micronaire reading (3.18) , maturity index (85 %) , fiber length(UHML)(35.7 mm) ,uniformity index (86.4%) , fiber strength(47.6 g/tex) , short fiber index (5.7 %) , reflectance degree (76.0) and yellowness degree(9.4), as presented in Table (11).

On the other hand, the CCS instrument recorded the highest mean value (7.9%) of fiber elongation and (194) of trash count. HVI instrument possessed the lowest mean value (5.1 %) of fiber elongation and (55) for trash count .

Tabulated data in Table (12) showed that , micronaire reading the Extra-long variety (Giza 96) under cotton grade Good/ Fully Good tested with the HVI instrument recorded the highest value for micronaire reading. This value was (3.90). On the other hand, the Extra-long cotton variety (Giza 87) under cotton grade Fully Good Fair / Good (FGF/G) with the CCS instrument recorded the lowest values for micronaire reading (1.56). Concerning the maturity index, the highest mean value (89 %) was given by the Extra-long variety (Giza 87) under cotton grade Good/ Fully Good (G/FG) with the CCS instrument. On the other side, the highest mean value (87%) was possessed by the Extra-long variety (Giza 96) under cotton grade Good/ Fully Good (G/FG) with the HVI instrument, as shown in Table (12). These results for measure micronaire reading and maturity index may be due to the nature of each instrument and its mode of action (Theory of working). Also, may be due to the calibration of each instruments .The Extra-long varieties (Giza 96 and Giza 87) under cotton grade Good/ Fully Good(G/FG) with the HVI instrument recorded the lowest value for trash count. These values were (21 and 23) ,respectively.

Table (10). Mean squares of fiber properties as influenced by the Extra-long Egyptian cotton varieties (V) , cotton grades (G), instruments(I) (HVI and CCS)and their interactions

S.O.V	d.f.	Micronaire reading	Maturity index (%)	Fiber length		Mechanical properties		Short fiber index (%)	Color		Trash
				Length (U.H.M.L) (mm)	Uniformity index (%)	Fiber strength (g/tex)	Fiber elongation (%)		Reflectance degree (Rd)	Yellowness degree (+b)	Trash Count (TC)
Cotton Variety (V)	1	0.97**	0.01**	0.24 ns	3.37n.s	0.69 ns	0.11 ns	0.46 ns	0.34 **	0.01 **	529 **
Cotton Grade (G)	2	3.34**	0.06**	14.5**	27.21**	21.0**	1.49 **	13.17 **	66.95 **	0.56*	14943.2 **
Instruments (I)	1	4.57**	0.06**	0.82*	10.02**	96.7 **	73.38 **	14.86 **	42.03 **	0.58*	172778.7 **
Interaction (V x G)	2	0.28**	0.004**	0.16n.s	0.1 ns	5.42 *	0.20 ns	0.28 ns	0.32 ns	0.03 ns	235.1 *
(V x I)	1	0.14**	0.02**	0.05 ns	1.6 ns	0.53 ns	0.44 ns	1.48 ns	1.56 ns	0.16 ns	469.4 **
(G x I)	2	0.36**	0.03**	1.4 **	2.78 ns	1.34 ns	1.03 *	6.2 **	8.34 ns	0.04 ns	459.7 **
(V x G x I)	2	0.07*	0.003**	0.33 ns	2.42 ns	2.27 ns	0.02 ns	0.199 ns	5.7 ns	0.002 ns	287.2 **
Error	24	0.01	2.5	0.122	1.2	1.54	0.20	0.42	3.94	0.11	46.6
Total	35	----	----	----	----	----	----	----	----	----	----

ns : Not significant difference at 0.05 level of probability.
*,** Significant and highly significant difference at 0.05 and 0.01 levels of probability , respectively.

Table (11) . Mean performance of fiber properties as affected by the Extra-long Egyptian cotton varieties (V), cotton grades (G) and Instruments (I)(HVI and CCS) and their interactions

Traits / Entries	Micronaire reading	Maturity index (%)	Fiber length		Mechanical properties		Short fiber index (%)	Color		Trash
			Length (U.H.M.L) (mm)	Uniformity index (%)	Fiber strength (g/tex)	Fiber elongation (%)		Reflectance degree (Rd)	Yellowness degree (+b)	Trash Count (TC)
Cotton Variety (V)										
Giza 87	3.16 b	86 b	35.5 a	88.0 a	42.4 a	5.1 a	5.8 a	73.6 b	9.5 a	121 b
Giza 96	3.51 a	87 a	35.8 a	86.9 a	44.1 a	5.4 a	5.6 a	75.7 a	9.1 b	128 a
L.S.D 0.05	0.07	0.1	--	--	--	--	--	0.3	0.1	5
Cotton Grade (G)										
Good /Fully Good	3.32 a	87 a	35.7 a	87.4 a	47.3 a	6.9 a	4.1 c	77.0 a	9.0 c	87 c
Good	2.88 b	82 b	35.0 b	85.9 b	45.9 b	6.4 b	4.7 b	73.7 b	9.3 b	128 b
Fully Good Fair/ Good	2.27 c	73 c	34.7 c	84.4 c	44.7 c	6.2 b	6.3 a	72.0 c	9.6 a	158 a
L.S.D 0.05	0.10	0.1	0.2	0.9	1	0.3	0.5	1.6	0.2	6
Instruments (I)										
HVI.	3.18 a	85 a	35.7 a	86.4 a	47.6 a	5.1 b	5.7 a	76.0 a	9.4 a	55 b
C.C.S	2.16 b	76 b	35.0 b	85.3 b	44.4 b	7.9 a	4.5 b	73.2 b	9.1 b	194 a
L.S.D 0.05	0.08	0.1	0.2	0.7	0.8	0.3	0.4	1.3	0.2	5
Interaction										
(V x G)	**	**	ns	ns	*	ns	ns	ns	ns	*
(V x I)	**	**	ns	ns	ns	ns	ns	ns	ns	**
(G x I)	**	**	**	ns	ns	*	**	ns	ns	**
(V x G x I)	*	**	ns	ns	ns	ns	ns	ns	ns	**

Means within each column followed by the same letter are not significant difference at 0.05 level of probability
, * Significant and highly significant difference at 0.05 and 0.01 levels of probability, respectively
ns : Not significant difference at 0.05 level of probability.

On the other hand, cotton grade Fully Good Fair / Good (FGF/G) of both cotton varieties (Giza 96 and Giza 87) tested with the CCS instrument recorded the highest values for trash count (225 and 223), respectively, Table (12).

Table (12). The interaction between the Extra-long Egyptian cotton varieties (V) , cotton grades (G) and Instrument (I)) (HVI and CCS) for fiber properties

Cotton Variety (V)	Cotton Grade (G)	Instruments (I)	Micronaire reading	Maturity Index (%)	Trash Count
Giza 87	Good / Fully Good	HVI	3.28 b	86 ab	23 h
		CCS	2.75 e	89 a	150 c
	Good	HVI	2.9 cd	84 ab	45 g
		CCS	2.47 f	83 ab	207 b
	Fully Good Fair / Good	HVI	2.67 ef	83 ab	75 e
		CCS	1.56 h	71 c	223 a
Giza 96	Good / Fully Good	HVI	3.9 a	87 a	21 h
		CCS	3.33 b	85 ab	155 c
	Good	HVI	3.34 b	86 ab	59 f
		CCS	2.81 cde	77 bc	202 b
	Fully Good Fair / Good	HVI	2.97 c	84 ab	108 d
		CCS	1.86 g	61 d	225 a
L.S.D 0.05			0.20	0.9	11

Means within each column followed by the same letter are not significant difference at 0.05 level of probability .
HVI.: High Volume Instrument
CCS : Cotton Classifying System

These results due to the HVI measurements are calibrated across instruments using USDA cotton calibration standards making it possible to compare results from different instruments over a long period of time. In addition, cotton testing laboratories use cottons of known values throughout the day to check for a possible drift in measurements over time. While calibration cottons are available for most HVI fiber properties, none are available for HVI elongation. This prevents the comparison of elongation measurements between separate HVI instruments and over time. These results were in the same line with Hequet *et al.* (2015) , Negm *et al.*(2016) and Tesema and Subramanian (2018).

3.4. Yarn properties as affected by the Extra-long Egyptian cotton varieties (V) (Giza 87 and Giza 96) , cotton grades (G) and their interactions.

Results presented in Tables (13) indicated that the effect of the Extra-long Egyptian cotton varieties (V) had highly significant effect on some yarn properties studied such as yarn strength (cN/tex), yarn elongation (%), lea product , thick places and neps / 1400 m.

Table (13). Mean squares of yarn properties as influenced by the Extra-long Egyptian cotton varieties (V), cotton grades (G) and their interactions

S.O.V	d.f.	Yarn strength	Yarn elongation	Lea product	Thin places	Thick places	Neps	Yarn evenness
Cotton Variety (V)	1	1.58**	0.14**	41568.06 **	174.22n.s	296.1**	213.6*	0.02n.s
Cotton Grade(G)	2	4.97**	0.27**	147012.5 **	5517.55**	2795.4**	5378.7**	5.3**
Interaction (V x G)	2	0.18n.s	0.03n.s	17918.1**	256.2*	91.7*	89.05n.s	0.27n.s
Error	12	0.11	0.01	1715.27	58.22	17.33	36.77	0.15
Total	17	----	----	----	----	----	----	----

ns : Not significant difference at 0.05 level of probability.
*,** Significant and highly significant difference at 0.05 and 0.01 levels of probability , respectively.

The highest mean values for yarn strength (24.28 cN/ tex), yarn elongation (4.9 %) , lea product (3172) and thick places (104/1400 m.)were recorded with the Extra-long Egyptian cotton variety (Giza 96). Whereas, the lowest mean value of yarn strength (23.69 cN / tex) lea product (3076) and were attained by cotton variety (Giza 87) , as shown in Table (14). The Extra-long Egyptian cotton variety (Giza 96) recorded higher mean values of thick places than the cotton variety (Giza 87). Generally, it could be concluded that the single yarn strength correspondingly increased by increasing number of fibers in yarn cross-section for the two studied spinning systems. These results are in agreement with Tesema and Hussein (2015) , Jacquirine (2016), Liu *et al.* (2016) and Fouda and Elhosseny (2018) .

Table (14) .Mean performance of yarn properties as affected by the Extra-long Egyptian cotton varieties (V), cotton grades (G) and their interactions

Traits Entries	Yarn Properties						
	Yarn Strength	Yarn elongation	Lea product	Thin places	Thick places	Neps	Yarn evenness
	(cN /tex)	(%)	(LCSP)	(1400 m)	(1400 m)	(1400 m)	(CV%)
Cotton variety (V)							
Giza 87	23.69 b	4.7 b	3076 b	87 a	96 b	115 a	13.65 a
Giza 96	24.28 a	4.9 a	3172 a	94 a	104 a	108 b	13.71 a
L.S.D 0.05	0.34	0.1	43	--	4	6	--
Cotton grade (G)							
Good /Fully Good	24.92a	5.1a	3286 a	66 c	78 c	81 c	12.71 c
Good	23.96b	4.9b	3113 b	83 b	100 b	113 b	13.76 b
Fully Good Fair / Good	23.10c	4.6c	2973 c	125a	121a	141 a	14.59 a
L.S.D 0.05	0.42	0.1	53	10	5	8	0.48
Interaction							
(V x G)	ns	ns	**	*	*	ns	ns

Means within each column followed by the same letter are not significant difference at 0.05 level of probability .
* , ** Significant and highly significant difference at 0.05 and 0.01 levels of probability , respectively.
ns : Not significant difference at 0.05 level of probability.

Data tabulated in Table (14) indicated that lint cotton grades (G) had a highly significant effect on all studied yarn properties .The cotton grade Good / Fully Good (G/FG) recorded the highest mean values of yarn strength (24.92 cN/tex), yarn elongation (5.1%) and lea product (3286) . Whereas, the lowest mean values of thin places (66/1400 m.), thick places (78 /1400 m.) , neps (81 / 1400 m.) and yarn evenness (CV) (12.71%) were recorded with the same lint grade .

Presented data in Table (15), showed that highly significant interaction between the two Egyptian cotton varieties studied and cotton grades (V x G) during 2018 season for lea product. It is cleared that Extra-long variety (Giza 96) under cotton grade Good / Fully Good recorded the desirable and highest values for lea product, it was (3393).

On the other hand, the interaction of (V x G) between cotton varieties (V) and cotton grades (G) during 2018 season differed significantly for lea product , thin places /1400 meters and thick places/1400 meters. The cotton grade Good/ Fully Good (G/FG) for both cotton varieties (Giza 87 and Giza 96) recorded the desirable lowest values for thin places and thick places/1400 meters. These values were (66 and 56) for thin places and (78 and 79) for thick places for the cotton varieties (Giza 87 and Giza 96) , respectively, as shown in Table (15).

These results were in the same trend with Constable *et al.* (2015) , Farooq *et al.* (2015), Tesema and Hussein (2015), Jacquirine (2016), Liu *et al.* (2016) and Fouda and Elhosseny (2018) .

Table (15).The interaction between the Extra-long Egyptian cotton varieties (V) and cotton grades (G) for Yarn properties

Cotton Varieties (V)	Cotton Grade (G)	Yarn Properties		
		Thick Places (1400 m)	Thin Places (1400 m)	Lea product
Giza 87	**Good /Fully Good**	**79 e**	56 c	3178 b
	Good	95 d	81 b	3077 c
	Fully Good Fair / Good	115 b	**128 a**	**2975 d**
Giza 96	**Good /Fully Good**	78 e	66 c	**3393 a**
	Good	106 c	86 b	3150 b
	Fully Good Fair / Good	**129 a**	**122 a**	2973 c
L.S.D 0.05		73	13	7

Means within each column followed by the same letter are not significant difference at 0.05 level of probability.

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الملخص العربي

تأثير بعض أصناف ورتب القطن المصري علي الخواص الميكانيكية للألياف والخيوط

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٣- الهيئة العامة للتحكيم واختبارات القطن-الإسكندرية

أجري هذا البحث في قسم الانتاج النباتي بكلية الزراعة- سابا باشا جامعة الاسكندرية ومعامل كلا من معهد بحوث القطن بالجيزة وهيئة التحكيم واختبارات القطن بالاسكندرية , لدراسة تأثير أصناف القطن ورتبه علي صفات الألياف والغزل والصفات الميكانيكية خلال موسم ٢٠١٨ تم استخدام صنفي القطن جيزة ٨٧ و جيزة ٩٦ اللذان يمثلان طبقة الأقطان فائقة الطول و ينتميان الي مجموعة الأقطان *(Gossypium barbadense* L.*)* , كما استخدمت ثلاث رتب هي جود/ فولي جود , جود , فولي جود فير/جود لكل صنف . تم غزل الألياف علي نمرة خيط انجليزي ٨٠ ممشط , كما استخدمت اجهزة Pressley , Stelometer , HVI 1000 بالإضافة الي جهاز CCS لتقييم الخواص الطبيعية و التكنولوجية للألياف.

ويمكن تلخيص أهم النتائج المتحصل عليها فيما يلي :

- اختلفت الأصناف فائقة الطول اختلافا عالي المعنوية لصفات الألياف حيث سجل الصنف جيزة ٩٦ أعلي القيم ٣,٥١(قراءة الميكرونير) , ٨٧ % (نسبة النضج) , ٣٥,٨ مم (لطول الربيع الأعلي) , ٤٤,١ جم/تكس (متانة الخصلة) ,٢٢٢ (معامل ثابت الغزل) , ٥,٤ % (استطالة الألياف) , ٧٥,٧ (معامل الانعكاس) , ١١٢ (عدد الشوائب) .
- سجلت رتبة جود/ فولي جود أعلي و أفضل القيم للصفات المذكورة سابقا .
- كما اختلفت الأصناف معنويا في الصفات الميكانيكية المقاسة بالأجهزة الثلاثة , حيث سجلت صفة المتانة ٤٤,٤ جم/تكس لصنف القطن فائق الطول جيزة ٩٦ .
- سجل جهاز HVI اختلافا عال المعنوية لكل صفات الألياف المدروسة حيث كانت ٣,١٨(قراءة الميكرونير) , ٨٥ % (نسبة النضج) , ٣٥,٧مم (لطول الربيع الأعلي) ,٨٦,٤% (نسبة انتظام الألياف), ٤٧,٦جم/ تكس (متانة الخصلة) , ٥,٧ % (استطالة الألياف), ٧٦ (معامل الانعكاس) , ٩,٤ (درجة الاصفرار) .
- سجل الصنف فائق الطول جيزة ٩٦ أفضل القيم في استطالة الغزل وعدد العقد/١٤٠٠ متر بينما سجل صنف جيزة ٨٧ أفضل القيم في متانة الغزل و متانة الشلة و عدد المناطق الرفيعة/١٤٠٠ متر.
- وجود تفاعل معنوي بين الأصناف و الرتب في صفات متانة الشلة, عدد المناطق الرفيعة والسميكة /١٤٠٠ متر