Evaluation of Egyptian cotton variety (Giza 90) and promising cotton cross for yarn characters

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ABSTRACT

This investigation was carried out at Plant Production Department, Faculty of Agriculture (Saba Basha), Alexandria University, Egypt to evaluate the Egyptian cotton variety (Giza 90) and promising cotton hybrid namely: (G.83(G.75x5844) G80) as long staple (LS) for yarn properties. The two twist multiplier i.e. (3.6 and 4 T.M.) and the four yarn counts (24, 30, 36 and 40 Ne) on the same spinning system (ring spinning) were used. The obtained results indicated that the long staple cotton new hybrid namely: (G.83(G.75x5844) G80) and twist multiplier (4) recorded the highest mean values of the most importance of yarn properties. The strongest, longest and finest cottons produced the best yarn quality and were capable of acceptable spinning performance, in addition to the priorities. Yarn manufacturers are asking for higher fiber strength.

***Key words*:** Egyptian cotton variety, Cotton properties, Giza; LS, Twist multiplier, Yarn count, Yarn properties

Introduction

Utilization of Egyptian cotton in producing fine yarns with high quality to be exported would provide great economical advantages allowing Egypt to dominate world market since there would be no strong competition in this respect from countries producing yarns. The improvement of cotton relies mainly upon the Cotton Research Institute, who, through a long process of breeding, maintenance, evaluation of fiber and yarn quality and spinning test arrives at new varieties of superior quality to replace the old ageing ones. Consequently, strenuous efforts have been always directed towards improving its quality to maintain the worldwide reputation it has gained.

In recent years, it is expected that Egyptian companies that produce yarn compatible with the worldwide standard price will survive. This means that the race for economical compatibility will continue and perhaps at a more forceful level. The future impact of this race on yarn quality remains to be seen.

The spinning test carried out in Cotton Research Institute (CRI), lies not only on the practical opinions expressed as to the quality of the varieties examined, but also on the fact that it provides a useful link between the breeders and industry; by this means new varieties can be launched in the market to the notice of spinners much earlier than would otherwise happen, and the breeders on their side are able to gain some idea of the trade reaction to the new cotton varieties. Spinning process is one of

the most costly processes in textile industry though, cotton breeders, technologists and spinners are primarily interested in translating the qualities of raw cotton into the qualities of yarn.

Cotton fibers properties and spinning variables such as yarn count and spinning system are well known to play an important role in the efficiency and performance of spinning process besides the yarn quality. A wide range of yarn count and twist within the same spinning system will require different fiber properties. Perhaps, the best way to emphasize this point is to briefly review the principle of different spinning systems from the fiber point of view, **El-Banna et al (2013**). Fiber processing and spinning can be affected by fiber properties, **Price et al (2009)**.

. Ring spinning: In Egypt, much breeding efforts have been directed towards enhancing cotton fiber length, strength and fineness to promote ring spinning performance. Ring spinning is the oldest type of spinning techniques available today. Thus, it has been continuously perfected since its initial development in the 19^{th} century. Furthermore, the introduction of other types of spinning in the 20^{th} century has resulted in additional developments and innovative designs in ring spinning to keep pace with the high productivity of the new systems.

EI Mogahzy (1998) reported that the true market power of ring spinning lies in its unsurpassed yarn quality and in its diversity. It is true that new spinning techniques can produce yarn at more than 6 times the linear production rate of ring spinning. However, ring spinning is the only system that can produce yarn at virtually any count from 4's to 240's and of both soft and hard twist. This point may be the primary reason for the survival of ring spinning particularly in an era in which product-range flexibility has become a significant economical plus. We must point out, however, that such diversity is not a result of the spinning design only but also (and often of more importance) a result of the art of fiber selection.

The objective of this research was to evaluate the Egyptian cotton cultivar (Giza 90) and new hybrid namely : (G.83(G.75x5844) G80) as cotton genotypes, using two twist multiplier and four yarn counts under the same ring spinning system for some yarn properties.

Materials And Methods

This study was carried out at Plant Production Department, Faculty of Agriculture (Saba Basha), Alexandria University, Egypt. Two cotton genotypes representing the same category of Egyptian cotton were used, namely: Giza 90 and new hybrid namely: (G.83(G.75x5844) G80), as long staple (1 1/4 -1 3/8 inch fiber length), were cultivated in season 2014. The fiber properties of the two involved cotton genotypes were determined and shown in Table (1) .

Studied characteristics:

A. . H.V.I. Fiber properties

Table (1): The fiber properties for the two Egyptian cotton genotypes Giza 90 and new hybrid**:** (G.83(G.75x5844) G80)

Characters / Cotton genotypes	Fiber length		Str. (g/tex	Elo. (%)	Mic.	Mat.	Values of color attributes	
	U.H.M.L. (mm)	Uni. (%)					Rd%	+ b
Giza 90	28.5	83.3	34.2	7.42	4.3	85	65	11.9
Hybrid	30.1	85.1	36.4	8.3	4.4	90	66.8	11.8

Hybrid : **(**G.83(G.75x5844) G80**)**
U.H.M.L. (mm): Upper half mean length
Uniformity index (%)
Strength (g\tex)
Elongation(%)
Micronaire value
Maturity percentage (%).
Rd % : Reflectance degree.
+b : Yellowness degree.

B. Yarn characteristics:

B.1. Single yarn strength (cN/tex)
B.2. Yarn elongation %
B.3. Yarn evenness (CV %)
B.4. Thin places / 400 m
B.5. Thick places / 400 m
B.6. No. of Neps / 400 m
B.7. Hairiness

Spain lab 900B HVI instrument system was used to determine fiber length at Upper half means length UHML, length uniformity index, fiber bundle strength (g/tex), fiber elongation (%), micronaire value , fiber maturity (%) , fiber brightness or reflectance degree (Rd %), Chroma or degree of yellowness (+b) according to (A.S.T.M., D:4605-1986.).

Cotton samples of approximately 100 Kg of ginned lint, were used in order to perform both fiber and spinning tests. The spinning tests were done in "The Pilot Spinning Mill", Cotton Research Institute. The tabulated fiber properties showed that the desired characteristics from each of cotton variety and promising cross grown in each region were, in fact, obtained. The Egyptian commercial cotton variety and a promising cross were spun into the two different twist multiplier i.e. (3.6 and 4 T.M.) and the four yarn counts (24, 30, 36 and 40 Ne) on the same spinning system (ring spinning). Studied samples were spun at ring spinning, at the Cotton Technology Research Laboratories, Cotton Research Institute, Agriculture Research Center, Giza, Egypt, and yarn properties were determined under standard conditions

Single yarn strength and elongation: The breaking load and elongation percentage of the single yarn were measured using Statimat M Tester according to the ASTM (D-2256-84). Yarn English count: The broken skein was weighed and the yarn English count was calculated according to the standard method, Yarn evenness (C.V. %): The coefficient of variance of the linear density over which unevenness is measured expressed as percentage of the linear density for the total length measured and yarn imperfections: The average number of thin places, thick places and neps were determined in 400 meter of the yarn as well as the yarn evenness CV% by the Uster Evenness Tester as recommended by Uster standards following the practice of ASTM (D-1425-84).The sensitivity settings at the imperfection indicator were according to the following: for thin places - 50 %, thick places + 50 % and neps + 200 %. The number of imperfections : thin places, thick places and neps were counted as an average per 400 meter.

Cotton fiber samples of both cotton genotypes were attained from Cotton Research Institute –Agricultural Research Center, Giza, Egypt. Fiber and yarn properties were tested under standard atmospheric condition of (20 C°± 2 C°) temperature and (65% ± 2%) relative humidity at Cotton Research Institute, Agricultural Research Center labs.

Statistical procedures:

This investigation was conducted in a completely randomized design with three replicates and analyzed as a factorial experiment according the procedure of **Snedecor and Cochran (1967)**. The data was computed using the CoStat program. To test differences among studied means of treatments, the least significant difference (L.S.D.) was used at 0.05 level of probability.

Result And Discussion

Yarn characteristics:

Data presented in Table (2) showed the mean values of the yarn properties , i.e. single yarn strength, yarn elongation (%), yarn evenness (C.V. %), yarn imperfections (thin places, thick places and neps / 400 m) and hairiness for the long staple commercial verity (Giza90) and a new hybrid (G.83(G.75x5844)G80) under the four yarn counts of 24'S, 30'S, 36'S and 40'S carded yarns.

The attained results of the yarn properties for the cotton cultivar and the new hybrid (G.83(G.75x5844)G80) used in this investigation will be presented and discussed herein during four sub-categories as follows:

B1. Effect of twist multiplier on yarn properties:

Results attained indicated that the effect of the twist multiplier treatments had a highly significant on single yarn strength and number of neps / 400 m, as given in Table (2) .

Furthermore, data presented in the same Table (2) revealed that the highest single yarn strength (18.63 cN/tex) and number of neps /400 m (67.42) were gained from the second twist multiplier (4). While, the lowest mean values (18.29 cN/tex and 63.29/400 m) for the same traits, respectively, were reached from the first twist multiplier (3.6), as shown in Table (2).

Generally, it could be concluded that the single yarn strength of the second twist multiplier (4) was positively associated with the studied yarn counts. Single yarn strength was correspondingly increased with increasing twist multiplier for the two studied cotton genotypes.

Similar results were found by **Nasir et al. (2003), Wali (2003)** and **Ibrahim (2006)**, they summarized that the single yarn tenacity and yarn elongation were increased by increasing yarn twist multiplier.

Table (2): Mean values of the single yarn properties as affected by the twist multiplier, cotton genotypes, yarn counts and their interaction during the treatments of 24'S, 30'S, 36'S and 40'S carded yarns.

Properties / Treatments	Single Yarn						
	Strength (cN/tex)	Elongation (%)	Evenness (C.V%)	Thin Places /400m	Thick Places /400m	No. of Neps /400m	Hairiness
Twist multiplier (T)							
3.6 TM	18.29 b	6.10 a	13.54 a	12.83 a	54.71 a	63.29 b	5.60 a
4 TM	18.63 a	6.23 a	13.40 a	10.21 a	56.46 a	67.42 a	5.51 a
Cotton genotypes (G)							
Giza 90	18.26 b	6.14 a	13.44 a	6.33 b	53.96 a	60.38 b	5.54 a
Hybrid	18.67 a	6.19 a	13.51 a	16.71 a	57.21 a	70.33 a	5.58 a
Yarn counts (C)							
24'S	19.18 a	6.70 a	12.28 d	2.75 b	11.50 c	50.75 c	5.73 a
30'S	18.16 c	6.43 a	13.89 b	5.58 b	70.42 ab	60.42 b	5.83 a
36'S	18.41 b	6.00 b	13.45 c	12.00 b	64.50 b	74.75 a	5.54 a
40'S	18.11 c	5.53 c	14.28 a	25.75 a	75.92 a	75.50 a	5.13 b
Interaction							
(T * G)	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.
(T * C)	*	**	**	N.S.	N.S.	N.S.	N.S.
(G * C)	N.S.	N.S.	N.S.	N.S.	*	**	N.S.
(T * G *C)	N.S.	N.S.	*	N.S.	N.S.	N.S.	N.S.

Means designated by the same letter within each column are not significantly different
*** : Significant at 0.05 level of probability.**
****: Significant at 0.01 level of probability.**
N.S.: Not significant.
Hybrid: G.83(G.75x5844) G80

B2. Effect of varietal differences on yarn properties:

Considering data in Table (2), it is obvious that the highly significant differences among cotton genotypes were noticed, these may be due to genetic background of the cotton genotypes.

The highest values of single yarn strength (18.67 cN/tex), and number of yarn imperfections (thin places (16.71) and number of neps /400 m (70.33 / 400 m) were recorded from the new hybrid (G.83(G.75x5844)G80), whereas the lowest mean values (18.26 cN/tex, 6.33 and 60.38 /400 m) for the same traits, respectively, were reached from the long staple cotton variety (Giza 90), as shown in Table (2).

These results could be explained on the basis that the long staple cotton always contain the healthy fiber properties (i.e., high values of fiber length (mm), uniformity index (%), Strength (g/tex), elongation(%), maturity percentage and less of micronaire value which reflected and produce the high yarn properties.

It could be concluded that the single yarn strength (cN/ tex) of cotton variety followed the same trend of cotton fibers and gradually increased by increasing the fiber length (mm) and strength (g / tex).

B3. Effect of yarn counts on yarn properties:

With regard to Table (2), it is obvious that the yarn counts had a highly significant effect on all yarn properties under this study.

The highest mean values of single yarn strength (19.18 cN/tex), and yarn elongation (6.70 %) and the lowest ones yarn evenness (C.V%)(12.28 %) and number of yarn imperfections (thin places (2.75) and thick places (11.50)/ 400 m and number of neps /400 m (50.75) were attained from yarn spun at 24'S. On the contrary, the highest one hairiness (5.83) was recorded from yarn spun at 30'S (English count).

Generally, the yarn imperfections were negatively associated with the studied yarn counts. The yarn imperfections (thin and thick places / 400 m and number of neps /400 m and yarn evenness (C.V. %) increased as the yarn count increased among all studied cotton genotypes.

These results could be attributed to decreasing number of the fibers in the yarn cross-section with fine yarn counts, **Ibrahim (2006) and El-Banna (2013**).

B4. Interactions

From Table (2), it could noticed that the first order interactions (T * G), (T * C) and (G * C) and the second order interactions (T * G * C) of the three studied factors, twist multiplier (T), Cotton genotypes (G) and yarn count (C) for were significant for most cases of 6 out of 28 cases, it means that each factor behaved in

different way by changing the other factors. Meanwhile, the remain interactions (22 cases) were not significant, especially, for the yarn imperfections (thin / 400 m), indicating that each factor may be acted as an independent factor.

The highest mean values of the single yarn strength, yarn elongation (%) and yarn evenness (C.V. %) (19.38 cN\tex, 6.85 % and 14.51%) were reached by the twist multiplier (4) of the 24'S yarn count, the twist multiplier (4) of the 30'S yarn count and the twist multiplier (4) of the 40'S yarn count, respectively. However, the lowest ones (17.83cN/ tex, 5.50 % and 12.27%) were attained by twist multiplier (3.6) of the 30'S yarn count, twist multiplier (3.6) of the 40'S yarn count and twist multiplier (3.6) of the 24'S yarn count , respectively, as shown in Table (3) .

Generally, the single yarn strength (cN/ tex) were gradually decreased and yarn evenness(C.V. %) increased gradually or yarn more irregular with increasing yarn count , in addition to the single yarn strength increased and yarn evenness decreased by increasing yarn twist multiplier among all studied cotton genotypes.

As for yarn imperfections (thick places /400 m) and neps /400 m, the highest mean values (78 and 78.5) were reached from the cotton new hybrid (G.83(G.75x5844) G80) spun at 30'S and cotton new hybrid (G.83(G.75x5844) G80) spun at 36'S, respectively . While,, the lowest mean values of the same traits (11and 46) were gained from the cotton variety Giza 90 spun at 24'S and cotton variety Giza 90 spun at 30'S, respectively, as shown in Table (4).

Table (3):The interaction between twist multiplier and yarn counts (T x C) for single yarn strength (cN/tex), yarn elongation (%) and yarn evenness (C.V%) during the treatments of 24'S, 30'S, 36'S and 40'S carded yarns.

Parameters		Strength (cN/tex)	Elongation (%)	Evenness (C.V%)
Twist multiplier (T)	Yarn counts (C)			
3.6 T.M.	**24'S**	18.98	6.65	12.27
	30'S	17.83	6.02	14.47
	36'S	18.22	6.25	13.39
	40'S	18.16	5.50	14.04
4 T.M.	**24'S**	19.38	6.75	12.28
	30'S	18.49	6.85	13.31
	36'S	18.61	5.75	13.50
	40'S	18.06	5.55	14.51
L.S.D$_{0.05}$		**0.336**	**0.494**	**0.294**

Table (4): The interaction between cotton genotypes (G) and yarn counts (C) for thick places /400 m and neps /400 m during the treatments of 24'S, 30'S, 36'S and 40'S carded yarns.

Parameters		Thick Places /400m	No. of Neps /400m
Cotton genotypes (G)	Yarn counts (C)		
Giza 90	**24'S**	11	47.5
	30'S	62.83	46
	36'S	65	71
	40'S	77	77
Hybrid	**24'S**	12	54
	30'S	78	74.83
	36'S	64	78.5
	40'S	74.83	74
L.S.D$_{0.05}$		**8.887**	**8.174**

Hybrid: G.83(G.75x5844) G80

As for yarn evenness (C.V%), the highest mean value (14.73 %) was reached from the twist multiplier (4) of the cotton new hybrid (G.83(G.75x5844) G80) for the 40'S. On the other hand, the lowest mean value of the same trait (12.21 %) was gained from The twist multiplier (3.6) of the cotton variety Giza 90 for the 24'S, as shown in Tables (5).

Table (5): The interaction between twist multiplier (T), cotton genotypes (G) and yarn counts (C) for evenness (C.V%) during the treatments of 24'S, 30'S, 36'S and 40'S carded yarns.

Parameters			Evenness (C.V%)
Cotton genotypes(G)	Yarn counts (C)	Twist multiplier(T)	
Giza 90	**24'S**	**3.6 T.M.**	12.21
		4 T.M.	12.34
	30'S	**3.6 T.M.**	14.59
		4 T.M.	13.22
	36'S	**3.6 T.M.**	13.23
		4 T.M.	13.33
	40'S	**3.6 T.M.**	14.29
		4 T.M.	14.29
Hybrid	**24'S**	**3.6 T.M.**	12.33
		4 T.M.	12.22
	30'S	**3.6 T.M.**	14.34
		4 T.M.	13.41
	36'S	**3.6 T.M.**	13.56
		4 T.M.	13.67
	40'S	**3.6 T.M.**	13.79
		4 T.M.	14.73
L.S.D$_{0.05}$			**0.416**

Hybrid: G.83(G.75x5844) G80

Conclusion:

Generally, it could be concluded that the yarn quality of the four studied yarn counts i.e. 24'S, 30'S, 36'S and 40'S, were found to be more affected with twist multiplier as well as the cotton variety during the treatments. Fiber strength, length, fineness (micronaire value) and uniformity index were the most contributors to yarn strength. Micronaire value, length, uniformity index were the most contributors to yarn evenness. However, the relative importance and contribution of fiber properties to yarn quality differed due to cotton categories, yarn counts and twist multiplier.

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