Relationships Between Fiber and Yarn Technological Properties of Some Egyptian Cotton Genotypes

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ABSTRACT: The main subjective of the present study was to clarify the relationship between technological fiber and yarn traits of some Egyptian cotton varieties. Besides, developing models to predict the most important yarn quality characteristics using the cotton fiber properties attained from HVI and AFIS systems. The current study was carried out using 12 different Egyptian cotton varieties cultivated by the Cotton Research Institute, Agricultural Research Center- Giza, Egypt. The fiber testing was performed, during 2015 season, in CATGO and Eshra tex labs, Alexandria, Egypt. Different models for predicting the most important ring yarn quality traits. Yarn lea product, single yarn strength, yarn evenness CV% and yarn work of rupture was developed using HVI and AFIS data and multiple regression equations. The prediction equations attained using AFIS data showed goodness of fit statistics and high R^2 more than HVI equations. The HVI fiber (U.H.M) length parameter recorded the highest relative contribution percentage to the single yarn strength, yarn evenness CV% and yarn work of rupture (W.R.). Meanwhile, micronaire value recorded the highest relative contribution percentage to the lea product only. The mean length ($L_{(w)}$ in mm) by weight measured by AFIS instrument possessed the highest relative contribution percentage to the lea product and single yarn strength. While the upper quartile length (U.Q.L in mm) and fiber fineness recorded high convergence contribution to the yarn evenness CV%. The Mean value of length variation, by number ($L_{(n)}$ CV%) recorded the highest relative contribution to the yarn work of rupture (W.R.).

Key words: Cotton yarn, cotton fiber, HVI, AFIS, regression analysis, yarn quality, contribution percentage.

INTRODUCTION

Predicting the quality characteristics of yarns, especially tensile and evenness properties has been the main target of many studies in the last century. Generally, two approaches (Linear and Collinear multiple regression) were used for this purpose to predict yarn quality from HVI and AFIS fiber data. These models usually give us good information about interactions between different fiber properties and yarn characteristics. The AFIS (Advanced Fiber Information System) instrument is designed for individual fiber testing to provide detailed information for important fiber properties including fiber diameter, neps, trash, dust and several length parameters. AFIS instrument is one of the best choices for cotton spinning industry specialists since it provides them with both average fiber values and distributions. Although, it has a great importance, very little research can be found related to the prediction of yarn properties using AFIS test results. There is a direct relationship between certain quality characteristics of the fiber and those of the yarn. About 70 to 80 % of basic yarn quality is decided by cotton variety. Prakash (2013); Gonca and Erhan (2006) stated that direct correlation between the quality of raw materials and the end products. The lower quality of cotton fibres means the lower quality of yarn produced from such a raw material. Also, the fiber length, strength and micronaire value were the most contributors to yarn strength and evenness. Mabrouk et al. (2000); Chanselma et al. (1997) and Hequet et al. (2007), used AFIS test results to predict yarn evenness and yarn strength, using ring spun yarns over a large range of counts. In addition that, Thibodeaux et al. (2008), reported that measures of short fiber content are correlated with all the yarn properties, most strongly with yarn strength, thick, thins, and irregular CV%. Islam (2015), indicated that yarn strength, elongation, yarn evenness CV% and nep count were decreased whereas, the number of yarn imperfections were increased, as the micronaire reading increased from 4.23 to 4.27. The interaction between cotton variety (micronaire value) and yarn count was significant for yarn evenness CV%, thick places and number of neps. The aim of this investigation was to clarify the relationship between the ring spun yarn properties and the fiber traits obtained from HVI and AFIS instruments, to extract appropriate models for predicting yarn properties and to determine the relative contribution percentage of each trait to specific yarn character.

MATERIALS AND METHODS

Twelve Egyptian cotton varieties seven extra-long staple length (Giza 45, Giza 70, Giza 77, Giza 87, Giza 88, Giza 92 and Giza 96) and five long staple length(Giza 85, Giza 86, Giza 89, Giza 93 and Giza 94) were cultivated by Cotton Research Institute, Agricultural Research Center, Giza, Egypt. The fiber properties were tested by HVI (1000) flowing the procedure of A.S.T.M. (D 4605-86), ASTM (1994), in the Cotton Arbitration and Testing General Organization (CATGO) Labs at Smoha, Alexandria, Egypt and AFIS instrument in Eshra labs, Borg Elarab, Alexandria, Egypt. The main test results of fiber properties are given in Tables (1 and 2). Single yarn strength was evaluated by the Uster Tensorapid tensile testing machine, the procedure of the A.S.T.M. (D - 2256 - 80), (ASTM). (1984). Yarn evenness was tested using Uster Tester ш the designation of the A.S.T.M. (D- 1425-81), ASTM (1984). All cotton fiber samples were spun into yarns on a ring spinning machine at a yarn count of 80's for extra-long cottons and 60's for long fiber cottons at the labs of fiber and yarn testing, Cotton Research Institute, Agricultural Research Center- Giza, Egypt.

Contribution percentage of HVI fiber properties to yarn quality parameters:

The regression model which was used to calculate the relative Contribution percentage of the HVI fiber properties to the yarn quality was as follows:

$\hat{y} = B_0 + B_1 X_1 + B_2 X_2 + B_3 X_3 + B_4 X_4 + B_5 X_5 + B_6 X_6$

Where: $\hat{y}$ is the yarn quality factor (lea product, single yarn strength, yarn evenness CV% and yarn work of rupture (W.R) .

B_0, B_1, B_2, B_3 ……. B_6, are the regression coefficient or the estimates of the regression equation.

X_1 = Fiber Bundle Strength (g/tex). X_2 = Length Uniformity Percentage.
X_3 = Upper Half Mean Length (mm) X_4 = Micronaire Value.
X_5 = Short Fiber Percentage (%) X_6 = Reflectance Degree (Rd%).

Contribution percentage of AFIS fiber properties to yarn quality:

The pre-mentioned regression equation was also, used to calculate the relative contribution percentage between the AFIS fiber properties and the yarn quality parameters was as follows:

X_1 = Fiber fineness (Fin) (m.tex).
X_2 = Maturity ratio (MR).
X_3 = Upper quartile length (UQL) (mm).

X_4 = Mean length ($L_{(w)}$) by weight.
X_5 = Mean values of length variation $L_{(w)}$ CV%.
X_6 = Short fiber content ($SFC_{(w)}$ % < 12.7).
X_7 = Mean values of length variation $L_{(n)}$ CV%.

The relative contribution percentage of the i^{th} HVI and AFIS fiber (Ci%) was calculated using the following equation suggested by El-Moghazy *et al.* (1990):

$$Ci\% = 100 (Bi^* / \sum Bi^*) R^2$$

Where: Bi* is the partial regression coefficient of the i^{th} variable (i=1, 2 …K) and R^2 is the coefficient of determination. The present investigation was outlined in a completely randomized design, with three repetitions. Data attained were statistically analyzed as a factorial experiment according the procedure designated by Snedecor and Cochran, (1967).The linear multiple regression analysis with the forward stepwise method was used to clarify the interrelations between the technological fiber and yarn characters. The standard partial regression coefficient was used to calculate the relative contribution percentage of each fiber trait to yarn quality parameters, which used to develop the different predicting models.
Statistical analyses were performed using CoStat version 6.400 software.

RESULTS AND DISCUSSION

Effect of the cotton variety on studied traits:

Data presented in Tables (1,2 and 3) revealed that all studied cotton varieties significantly varied in the H.V.I. and AFIS fiber properties as well as the tested ring spun yarn characters. This could be explained on the bases that these traits are varietal characters mainly affected by the genetic structure and slightly influenced by the environmental conditions. Similar results were attained by Osman (2007), who found that cotton variety had a highly significant effect on all studied fiber length and strength traits and Yehia (2003), who found that the fiber maturity parameters, bundle strength and elongation % were highly significant affected by the cotton variety or genome.

Table (1). Average values of the studied HVI fiber properties

Properties / Varieties	U.H.M (mm)	UNF (%)	SFI (%)	Mic	MR	Str (g/tex)	Elg (%)	Rd	+b
Giza 45	35.27 a	87.60 cde	5.57 d	3.38 fg	0.85 fg	42.05 d	5.95b	72.65 ef	8.15b
Giza 70	35.13 a	88.20 bcd	5.55 d	3.72 e	0.86 def	42.10 d	4.66f	75.60 cd	8.15b
Giza 77	34.46ab	89.37 ab	5.50 d	4.58 a	0.87 abc	43.70 c	6.53 a	70.20 g	8.00b
Giza 85	31.61 de	86.50 efg	6.93 a	3.66 e	0.85 fg	36.80f	6.60 a	74.23 de	8.40b
Giza 86	32.37cd	86.10 fg	6.07bc	4.42b	0.87 ab	45.60ab	5.13de	76.33 c	7.63 b
Giza 87	35.32 a	87.93bcde	5.57 d	3.26 fg	0.86 cde	46.50ab	4.87ef	71.33 fg	9.70 a
Giza 88	35.02 a	88.73 abc	5.55 d	3.40 f	0.85 efg	45.19 b	5.07e	75.57 cd	7.87b
Giza 89	30.72 e	85.53 g	6.80 a	4.70 a	0.88 a	37.23 f	5.40cd	72.87 ef	8.03b
Giza 92	33.09bc	87.07 def	6.30 b	3.22 h	0.84 g	46.60 a	5.67c	78.53 a	7.83 b
Giza 93	34.94 a	88.03 bcd	5.57 d	2.87 i	0.84 g	40.48 e	5.14de	69.97 g	10.37a
Giza 94	34.58 a	89.70 a	5.53 d	3.99 d	0.87 abc	41.85de	4.70f	76.90 bc	8.40 b
Giza 96	34.00ab	88.60 abc	5.73cd	4.15 c	0.87 bcd	40.81de	5.63c	78.27 ab	7.60 b
L.S.D	1.40	1.47	0.47	0.136	0.011	1.40	0.281	1.62	0.808

The same latter within each column are not significantly different.
-**U.H.M:** Upper Half Mean Length (mm) -**SFI**: Short Fiber Index (%) -**UNF**: Uniformity Index (%)
-**Str**: Strength (g.tex) -**ELG**: Elongation (%) -**Mic**:Micronaire value
-**MR**:Maturity Ratio -**Rd%**: Reflectance degree -**+b**: yellowness degree

Table (2). Average values of the studied AFIS fiber properties.

properties / variety	L (w) (mm)	L (w) CV%	SFC(w)%	UQL (w) (mm)	L (n) (mm)	L (n) CV%	SFC(n)%	5.00% (mm)	MR	IFC [%]	FIN (m.tex)	Nep Size (micron)	Nep Count
Giza 45	30.08cd	32.67bcd	4.23c	36.30cd	25.08bc	44.27de	14.50de	41.55cd	0.91cd	6.57cd	131e	658bc	373ab
Giza 70	29.90d	32.47bcd	4.15cd	36.05d	24.58cde	46.65bc	16.55c	41.18d	0.92bc	6.85bcd	138d	648cd	219cde
Giza 77	31.52a	28.55f	3.10f	37.28ab	26.72a	42.50f	13.35e	42.03bc	0.96a	5.47e	162a	700a	76f
Giza 85	26.22h	35.10a	6.25a	32.05g	21.19g	49.60a	21.27a	36.6g	0.87f	8.40a	139d	681ab	94ef
Giza 86	28.28f	31.10e	4.17cd	33.47f	23.89def	43.40ef	15.00cd	38.17f	0.96a	5.57e	156b	663bc	135def
Giza 87	31.09ab	30.93e	3.25f	37.34ab	26.09ab	42.70f	13.17e	42.41b	0.94ab	6.50cd	140d	659bc	148def
Giza 88	30.42bcd	31.77cde	3.73e	36.47cd	25.23bc	45.50cd	15.30cd	41.79bcd	0.92cde	6.60cd	131e	661bc	330bc
Giza 89	27.33g	31.35de	4.35c	32.07g	22.96f	43.75ef	15.90cd	36.96g	0.95a	6.05de	159a	655cd	84f
Giza 92	28.49ef	33.07bc	4.47c	34.09f	23.61ef	45.63bcd	15.81cd	39.41e	0.89de	7.47b	129e	648cd	261bcd
Giza 93	30.85ab	33.43b	3.80de	37.67a	24.98bcd	47.13b	15.80cd	43.32a	0.88ef	6.97bc	123f	647cd	492a
Giza 94	30.64bc	31.47de	4.30c	36.79bc	25.59bc	43.80ef	16.50c	41.63cd	0.95a	6.40cd	151c	635d	92ef
Giza 96	29.06e	33.70b	5.30b	35.07e	23.83ef	49.20a	19.63b	39.79e	0.87f	8.70a	141d	648cd	153def
L.S.D.	0.668	1.353	0.401	0.681	1.12	1.53	1.26	0.744	0.025	0.801	3.14	22.73	128

The same latter within each column are not significantly different.

- $L_{(w)}$: Mean Length (mm) by weight
- $L_{(w)}$ CV%: length variation by weight.
- $SFC_{(w)}$% > 12.7: Short Fiber Content (%) by weight.
- $UQL_{(w)}$: Upper Quartile Length by weight (mm).
- $L_{(n)}$: Mean Length by number (mm).
- $L_{(n)}$: Mean Length by number (mm).
- $L_{(n)}$ CV%: length variation by number.
- $SFC_{(n)}$% > 12.7: Short Fiber Content (%) by number.
- 5.00%: Length at 5.0% (mm).
- MR: Maturity Ratio.
- IFC: Immature Fiber Content %
- FIN: Fineness (m.tex).

table (3). Average values of studied yarn properties

Properties / Varieties	Lea product	Single yarn strength (g.tex)	yarn evenness CV%	Yarn work of rupture
Giza 45	3678 a	27.13 a	10.42f	65.31c
Giza 70	3144 d	26.20 cd	10.63ef	70.04a
Giza 77	2883e	25.50 e	11.27cd	68.26b
Giza 85	2363f	23.25g	11.66bc	50.39h
Giza 86	2860 e	23.30g	11.87 b	52.43g
Giza 87	3488bc	26.57 bc	10.33f	70.61a
Giza 88	3400c	25.91 d	10.48f	70.44a
Giza 89	2410 f	22.45h	12.51a	56.12f
Giza 92	3435 bc	25.51 e	10.97de	60.32e
Giza 93	3538b	26.72 b	10.23h	71.46a
Giza 94	3063d	24.55 f	10.91de	54.01g
Giza 96	3500bc	26.10 d	11.19d	62.64d
L.S.D	133	0.367	0.416	1.62

The same latter within each column are not significantly different.

The attained multiple regression equations for the studied yarn quality parameters (lea product, single yarn strength, yarn evenness CV % and work of rupture (W.R.) on HVI and AFIS fiber technological properties were presented in Tables (4 and 6).

Table (4). Multiple regression equations for the studied yarn quality parameters on HVI fiber properties

Yarn quality factor	Regression equation	R^2
Lea Product	$= 3944.09 + 22.80\ X_1 - 13.71\ X_2 + 63.75\ X_3 - 308.18\ X_4 - 260.52 X_6$	0.76
Single yarn Strength	$= 25.18 - 0.012\ X_1 - 0.025\ X_2 + 0.357\ X_3 - 0.972\ X_4 - 0.953\ X_5$	0.79
Yarn Evenness CV%	$= 20.91 - 0.003\ X_1 - 0.025\ X_2 - 0.29\ X_3 + 0.55\ X_4$	0.51
Yarn Work of Rupture (W. R.)	$= 36.13 + 0.35\ X_1 - 0.17\ X_2 + 2.71\ X_3 - 0.88\ X_6$	0.60

X_1= Fiber strength (g/tex).
X_2 = Length Uniformity %.
X_3 =Fiber Upper Half Mean Length (mm).
X_4 = Micronaire Value.
X_5 = Short Fiber Percentage (%).
X_6 = Reflectance Degree (Rd).

Table (6). Multiple regression equations for the studied yarn quality parameters on AFIS fiber properties

Yarn quality factor	Regression equation	R^2
Lea Product	$= 1702.62 - 19.66X_1 - 417.38X_2 - 7.33X_3 + 165.90X_4$	0.76
Single yarn Strength	$= 19.83 - 0.048X_1 - 9.13X_2 + 0.043X_3 + 0.648X_4$	0.87
Yarn Evenness CV%	$= 14.09 + 0.039X_1 - 0.241X_3$	0.59
Yarn Work of Rupture (W. R.)	$=77.34 - 0.216X_1 - 20.27X_2 + 0.453X_3 + 0.37X_4 - 1.31X_5 - 7.29X_6 + 1.78X_7$	0.84

X_1= Fiber fineness (Fin)(m.tex).
X_2 = maturity ratio(MR).
X_3 = upper quartile length (UQL)(mm).
X_4 = mean length ($L_{(w)}$) (mm) by weight.
X_5= mean values of length variation L(w) CV% by weight.
X_6= short fiber content (L(w)SFC %< 12.7) by weight.
X_7 = mean value of length variation L(n) CV% by number.

Contribution percentage of HVI fiber properties to yarn quality parameters:

Table (5) and Figure (1) illustrate the relative contribution percentage of the H.V.I. fiber technological properties to the studied yarn parameters. The prementioned data indicate that the micronaire value recorded the highest relative contribution percentage (25.79%) to the lea product followed by short fiber index (21.05 %), fiber (U.H.M) length (15.45 %), fiber strength (g/tex) (10.84%) and length uniformity percentage (2.87%), respectively. Figure (2) shows the scatter plot of predicted versus estimated lea product values, regression line and correlation coefficient of our model.

Table (5). Relative contribution percentage of the HVI fiber properties to various ring spun yarn quality parameters

Yarn quality factor / Fiber properties	Lea Product	Single Yarn Strength	Yarn Evenness CV%	Yarn Work of Rupture
Fiber strength (g/tex)	10.84	1.76	0.06	8.01
Length Uniformity (LU %)	2.87	1.62	19.41	1.72
Upper Half Mean Length(U.H.M)	15.45	26.92	29.34	31.63
Micronaire Value (Mic)	25.79	25.04	2.18	-
Short Fiber Percentage (%)	21.05	23.67	-	-
Reflectance Degree (Rd)	-	-	-	18.64

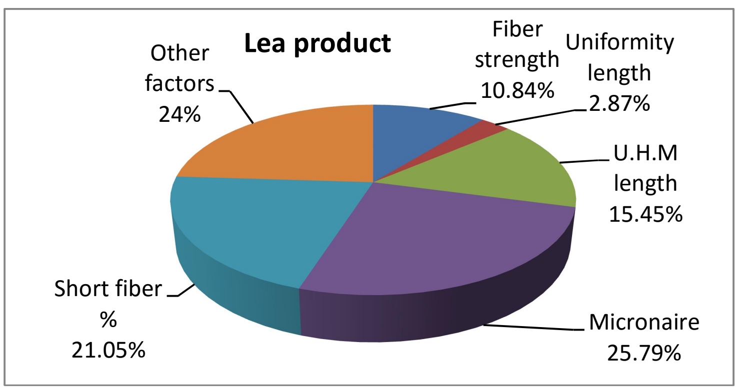

Figure (1). Relative contribution of HVI fiber properties to Lea product.

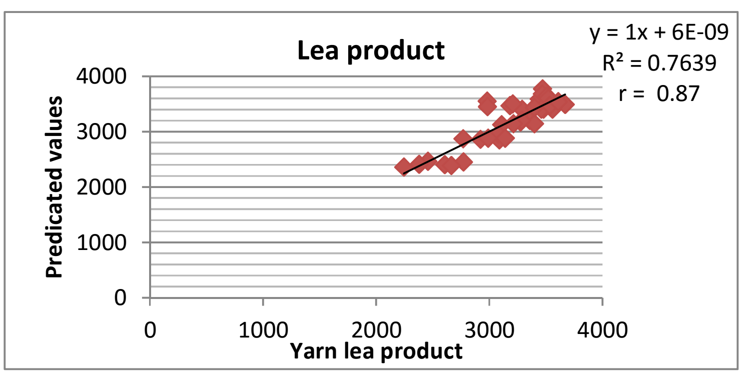

Figure (2). Predicted versus estimated yarn Lea product regression line and correlation coefficient

The fiber (U.H.M) length possessed the highest relative contribution percentage to the single yarn strength (26.92 %) followed by micronaire value (25.04 %), short fiber percentage (23.67%), fiber strength in g/tex (1.76 %) and length uniformity percentage (1.62%), as shown in Table (5) and Figure (3).Figure (4) shows the scatter plot of predicted versus estimated single yarn strength, regression line and correlation coefficient.

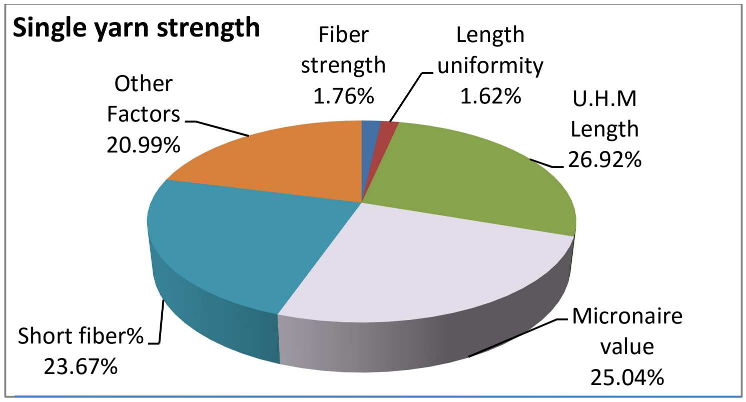

Figure (3). Relative contribution of HVI fiber properties to single yarn strength

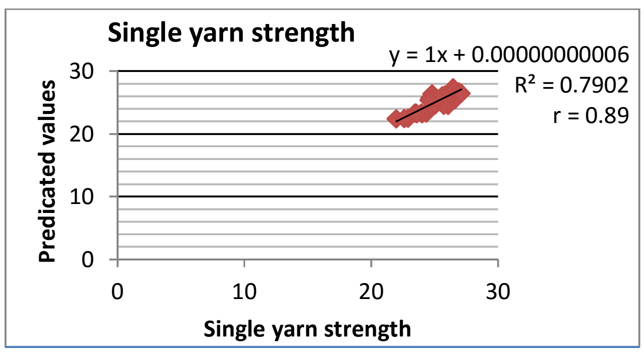

Figure (4). Predicted versus estimated single yarn strength regression line and correlation

Therefore, it is so important to establish which fiber and yarn parameters influence yarn tensile properties and if possible, to derive the functional relationship between them. So far, numerous mathematical and empirical models have been established for the estimation of single yarn tenacity and CSP (Count Strength Product) using fiber properties and some yarn parameters as Hunter (1988) and Frydrych (1992). As for yarn evenness CV %, the contribution percentages of the studied HVI fiber properties to this trait were presented in Tables 4 and 5 and illustrated in Figure 5. The fiber (U.H.M) length ranked first in order (29.34 %), while the length uniformity percentage came in the second order (19.41%) followed by the micronaire value (2.18 %) and fiber strength (g/tex) (0.06%) . Figure (6) shows the predicted versus estimated yarn evenness CV %, regression line and correlation coefficient. Mabrouk *et al*. (2000), stated that fiber length, strength and micronaire value were the most contributors to yarn evenness.

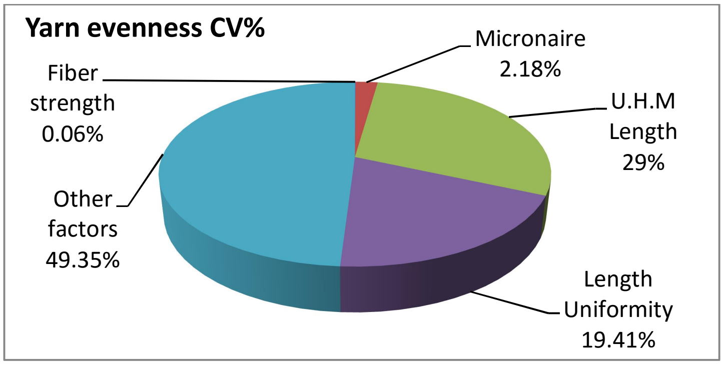

Figure (5). Relative contribution of HVI properties to evenness CV%

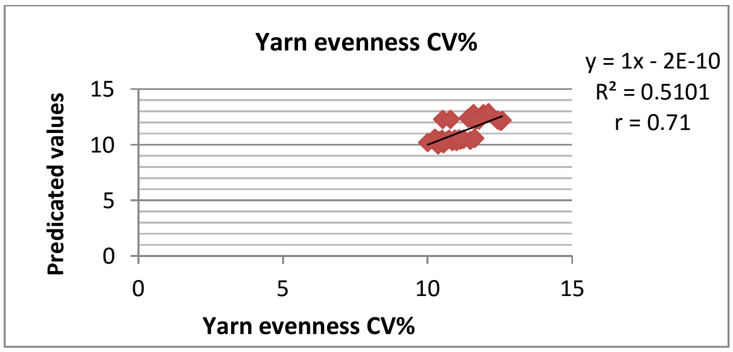

Figure (6). Predicted versus estimated yarn evenness CV% regression line and correlation coefficient.

Concerning the yarn work of rupture (W.R.), the fiber (U.H.M) length, again reached the highest relative contribution percentage (31.63 %) to the yarn work of rupture, followed by the reflectance degree (Rd%) (18.64 %), the fiber strength (8.01%) and length uniformity percentage (1.72 %), as shown in Table (5) and illustrated in Figure (7). Figure (8) shows the scatter plot of predicted values of yarn work of rupture versus experimental values, regression line and correlation coefficient. Fouda (2004), found that fiber (U.H.M) length had the highest relative contribution percentage to the yarn work of rupture (W.R.).

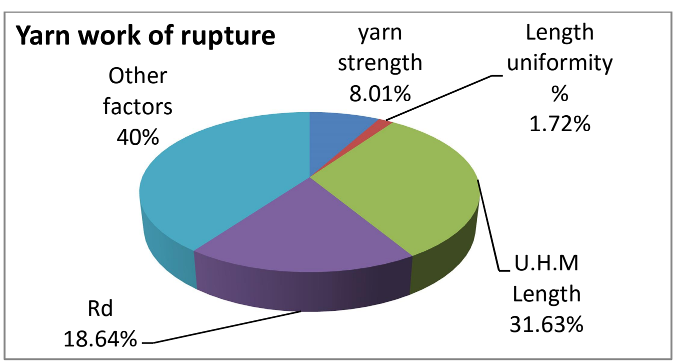

Figure (7). Relative contribution of HVI fiber properties to yarn work of rupture (W.R.)

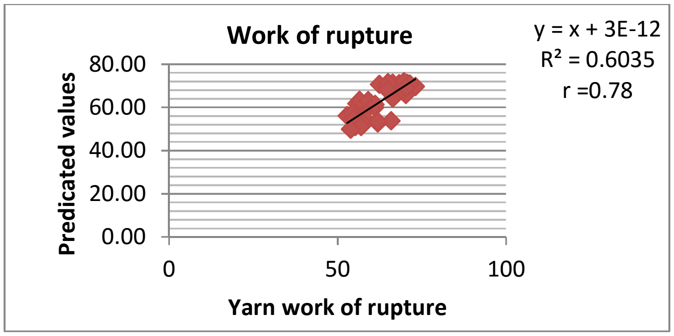

Figure (8). Predicted versus estimated yarn work of rupture regression line and correlation coefficient.

Contribution percentage of AFIS fiber properties to yarn quality parameters:

Table (7) demonstrates the relative contribution percentage of the AFIS fiber technological properties to the studied yarn parameters. The fiber diameter was the foremost property among those of AFIS, in addition we found high significant negative correlation coefficient between fiber diameter and yarn tenacity (r = - 0.64). This negative correlation means that the lower the diameter of fiber (i.e. higher number of fibers in the yarn cross-section), the higher the yarn tenacity. Our regression analysis expresses this relationship clearly.

Hequet *et al.* (2007), reported that the attained data exist to support the theory that Advanced Fiber Information System (AFIS) might be an effective tool in predicting spinning performance and yarn quality.

Table (7). Relative contribution percentage of the AFIS fiber properties to various ring spun yarn quality parameters

Yarn quality factor / Fiber properties	Lea Product	Single Yarn Strength	Yarn Evenness CV%	Yarn Work of Rupture
Fiber fineness (Fin)(m.tex).	34.13	16.60	29.55	11.15
Maturity ratio (MR).	2.09	20.31	-	6.77
Upper quartile length (UQL)(mm).	2.04	3.70	29.46	5.83
Mean length ($L_{(w)}$) (mm) by weight	37.72	46.38	-	4.02
Mean values of length variation $L_{(w)}$ CV% by weight.	-	-	-	15.35
Short fiber content ($L_{(w)}$SFC %< 12.7) by weight	-	-	-	11.51
Mean value of length variation $L_{(n)}$ CV% by number.			-	29.37

Data presented in Table (7) and illustrated in Figure (9) indicate that the mean length ($L_{(w)}$) by weight (mm) recorded the highest relative contribution percentage (37.72%) to the lea product followed by fiber fineness (34.13 %), maturity ratio (2.09%) and upper quartile length U.Q.L in mm (2.04%), respectively. The scatter plot of predicted values of lea product versus experimental values, regression line and correlation coefficient of our model were shown in Figure (10).

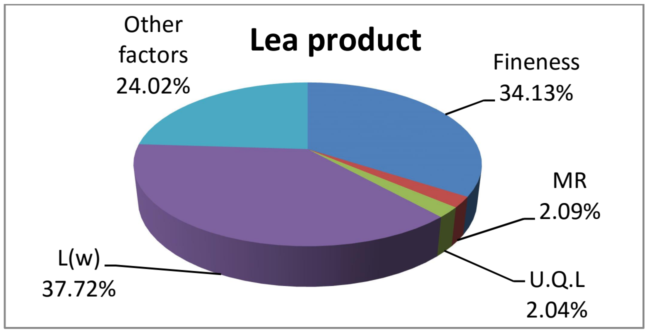

Figure (9). Relative contribution of AFIS fiber properties to the yarn lea product

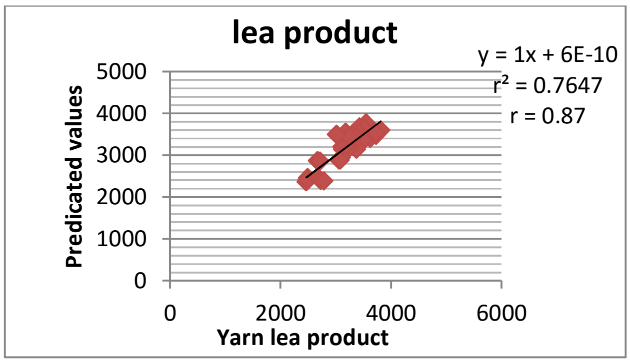

Figure (10). Predicted versus estimated yarn lea product regression line and correlation coefficient

Also, the mean length ($L_{(w)}$) by weight (mm) possessed the highest relative contribution percentage to the single yarn strength (46.38 %) followed by maturity ratio value (20.31 %), fiber fineness (16.60 %) and upper quartile length (U.Q.L) (mm) (3.70 %), as shown in Table (7) and illustrated in Figure (11). Prediction ability of our model is very high (r = 0.93) as shown in Figure 12. Similar results were also obtained by El-Habiby (2007), who found that yarn tenacity is positively and significantly correlated with mean fiber length.

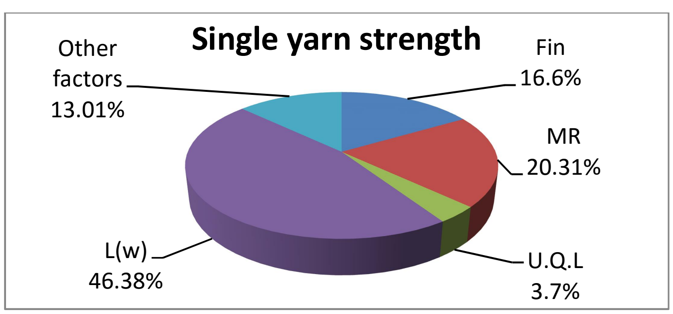

Figure (11). Relative contribution of AFIS fiber properties to the single yarn strength

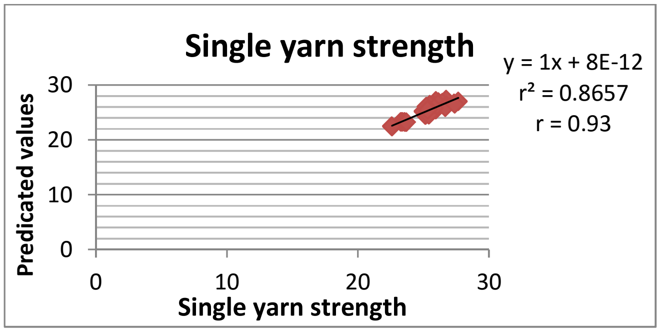

Figure (12). Predicted versus estimated single yarn strength regression line and correlation coefficient.

As for yarn evenness CV % (Table 7 and Figure 13), the fiber fineness (fin in m.tex) ranked first in order (29.55 %), while the upper quartile length (U.Q.L in mm) came in the second order (29.46 %). Figure (14) shows the predicted versus estimated yarn evenness CV %, regression line and correlation coefficient.

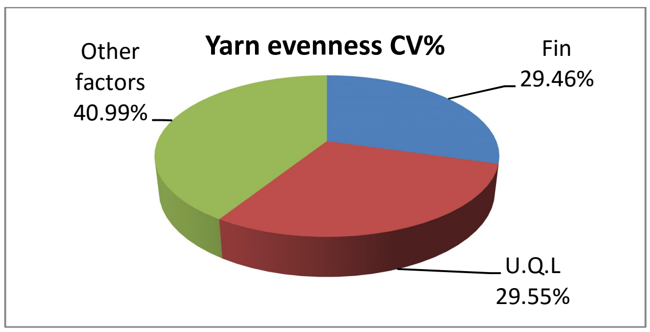

Figure (13). Relative contribution of AFIS fiber properties to the yarn evenness CV%.

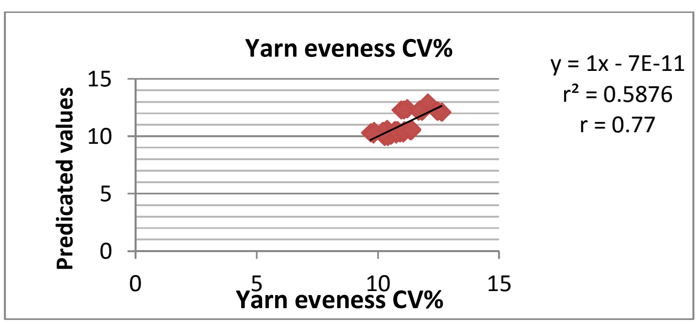

Figure (14). Predicted versus estimated yarn evenness CV% regression line and correlation coefficient

Concerning the yarn work of rupture (W.R.), the mean value of length variation $L_{(n)}$ CV% by number, possessed the highest relative contribution percentage (29.37 %) to the yarn work of rupture, followed by mean values of length variation $L_{(w)}$ CV% by weight (15.35 %), the short fiber content by weight

($SFC_{(w)}$%)(11.51 %) , fiber fineness (11.15%), maturity ratio (6.77%), upper quartile length U.Q.L in mm (5.83 %) and the mean length ($L_{(w)}$) by weight in mm (4.02 %) , as shown in Table (7) and illustrated in Figure (15). Figure (16) illustrates the scatter plot of predicted values of yarn work of rupture versus experimental values, regression line and correlation coefficient.

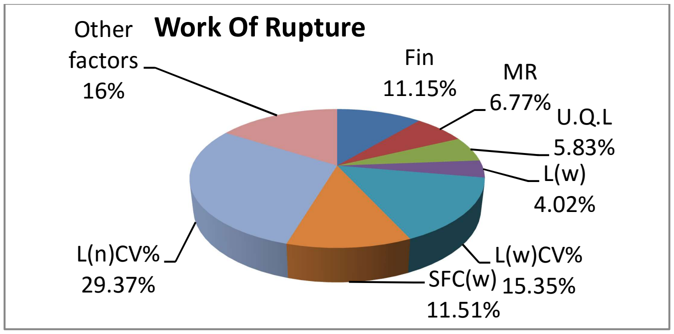

Figure (15). Relative contribution of AFIS fiber properties to the work of rupture.

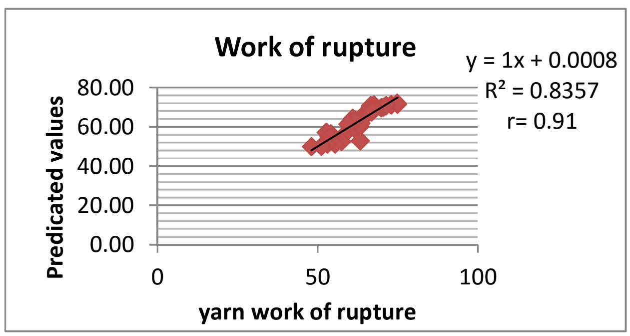

Figure (16). Predicted versus estimated yarn work of rupture regression line and correlation coefficient.

CONCLUSIONS

All studied cotton varieties significantly varied in the H.V.I. and AFIS fiber properties as well as the tested ring spun yarn characters, respectively. The multiple regression analysis method was selected to demonstrate the relationship between H.V.I. and AFIS fiber traits and yarn parameters. Then, the contribution percentage of each fiber character to each yarn parameter was determined.

The good performance of linear regression models in explaining yarn properties indicates that the relationships between fiber properties and yarn properties are nearly linear.

Our work showed that AFIS fiber properties can be more successfully used for the prediction of yarn properties more than HVI data.

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الملخص العربي

العلاقات بين الصفات التكنولوجية للشعيرات والخيط لبعض التراكيب الوراثية للقطن المصري

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استهدف هذا البحث توضيح العلاقة بين صفات الألياف وخصائص الخيط لبعض أصناف القطن المصرى. بالإضافة لتكوين معادلات للتنبؤ بخواص الخيط الهامة بإستخدام الصفات المختلفة للألياف المقدرة بأجهزة الــ HVIوالــ AFIS . استخدم فى هذه الدراسة اثناعشر صنفاً من الأقطان المصرية تم زراعتها بمعهد بحوث القطن بمركز البحوث الزراعية بالجيزة خلال موسم ٢٠١٥. وتم إختبار العينات بمعامل الهيئة العامة للتحكيم و إختبارات القطن و شركة عشرا تكس للغزل و النسيج . استخدم معامل الإرتباط لدراسة العلاقة بين الصفات الهامة للخيط الناتج من الغزل الحلقى (متانة الشلة ومتانة الخيط المفرد و مظهرية الخيط و الشغل اللازم للقطع) وصفات الألياف الناتجة من أجهزة الــ HVI والــ AFIS , كما استخدم الإنحدار المتعدد للتنبؤ بمؤشرات الطول والصفات الميكانيكية القياسية من الأجهزة المختلفة.

وقد أوضحت معادلات الإرتداد أن نتائج صفات الألياف المقدرة بجهاز الــ AFIS أعطت معاملات أفضل للارتداد و التلازم للتنبأ بصفات الخيط من النتائج المقدرة بجهاز الــ HVI. وقد سجل متوسط النصف العلوى للطول (UHM) أعلى نسبة مساهمة لصفات الألياف فى صفات متانة الخيط المفرد و مظهرية الخيط و معامل الشغل اللازم للقطع للخيط. بينما سجلت قراءة الميكرونير أعلى نسبة مساهمة فى صفة متانة الشلة فقط.

أما بالنسبة لبيانات جهاز الــ AFIS فقد سجل متوسط الطول بالوزن ($L_{(w)}$) أعلى نسبة مساهمة لصفات متانة الشلة ومتانة الخيط المفرد. وقد سجلت صفات طول الربيع الأعلى (U.Q.L in m.m) والنعومة الوزنية (Fin in m.tex) نسبة مساهمة عالية ومتقاربة في صفة مظهرية الخيط , وسجلت نسبة الاختلاف في الطول بالعدد ($L_{(n)}$ CV %) أعلى نسبة مساهمة في صفة معامل الشغل اللازم للقطع للخيط.