The technological value determination of some long staple Egyptian cotton varieties by using some mathematical analysis models

A. F. Younes [1], M. S. Salem [2,*], E. A. Mesbah [2], I. A. Ebaido [2], and A. A. Hassan [3]

[1] *Grading Section. Cotton Research Institute, Agriculture Research Center, Giza, Egypt.*

[2] *Agronomy Department, Faculty of Agriculture, Al-Azhar University, Cairo, Egypt.*

[3] *Spinning Department Cotton Research. Institute, Agriculture Research Center, Giza, Egypt.*

*Corresponding author E-mail: mohamedsherien 205@azhar.edu.eg (A. Younes)

ABSTRACT:

This study was carried out in the Laboratories of Cotton Grade Section, Cotton Research Institute, Agricultural Research center, Giza, Egypt and spinning unit of Industrial Menia EL- Kameh, EL-Sharkia Governorate, Egypt in 2016 and 2017 seasons, to investigate the relationships between fiber properties and lea product, single yarn strengths and unevenness at 40's and 60's yarn count at 3.6 twisting index for Giza 86,Giza90 and Giza95 cotton varieties, with using FQI, SCI, PDI and MI_{AHP} as mathematical models. The technological values were estimated by four models correlated positively with high significant and each of lea product and single yarn strengths, in both seasons. On the contrary, this correlation was negative with the regular percentage for Giza 86 and Giza 95 varieties, SFC, UHML, FS and the Mic value had the highest contribution toward yarn quality properties at 40's and 60's Y.C for the studied varieties.

Keywords: Cotton, Long staple Egyptian cotton var., Technological value - Statistical Models analysis.

INTRODUCTION

Cotton is a natural fiber that have great diversity in its properties. Most of these properties play an important role in predicting and determining the spinning characteristics. Spinning cotton fiber is considered one of the most important operations to produce the yarns. Its stage depends on multiple steps that require time-consuming, the efficiency of spinning machines that differed from one factory to another and modern or old fashion for the techniques as well as the used machines. Therefore, several researches are directed to eliminate these obstacles and make the best use of statistical approaches and mathematical prediction equations to short cut the long period for spinning cotton fibers and make the decision for the superiority of multiple model equations under the study that differed between cotton species and production location through creating relationship between fiber properties and yarn quality that are represented by regression and correlation equations which are angle stone for these prediction models. El-Mogazhy et al. (1990). suggested a Premium-Discount index (PDI) through developing statistical approach that depends on model relating fiber to yarn properties. Majumdar. et al. (2005). compared three traditional methods to determine technological value of cotton fiber. These methods were Fiber Quality index (FQI), the Spinning Consistency index (SCI) the Premium-Discount index (PDI) and the new method that has been proposed based on Multiple-Criteria Decision-Making (MCDM) technique. They found that the decision-maker plays a key role in determining the criteria weights in the proposed multiplicative AHP method. They indicated that the Premium-Discount Index method shows maximum rank correlation between the technological value of cotton and yarn tenacity. Also, Ureyen and Kadoglu (2007), indicated that the relationship between yarn properties as dependent variables and fiber traits as indecent variable are nearly linear for each yarn property. Therefore, we choose multiple linear regression. Hager et al. (2011), found that the Fiber strength and Fineness were the most effective fiber properties to predict yarn properties for the category of Extra-long staple under ring spinning system, while, the Upper half mean length, Fiber strength and Maturity had the greatest influence on the studied yarn properties for the long staple cotton category. Fares and Hassan (2015) found that all the supposed models of regression were significant and they reflected large part of variation of the studied yarn properties. Mesbah and Hassan (2016), published that there were positive highly significant correlation between Single yarn strength and each of Upper half mean, Fiber strength and Fiber elongation %. On the same trend, between yarn evenness and most studied fiber traits, at 80's, 100's, 120's and 140's yarn count for Extra-long staple Egyptian cotton varieties, on the same line, Abdel Daim et al. (2020) indicated that Fiber strength, Upper half mean length, Uniformity index and short fiber index plays an important role in determining technological value of cotton, while, the fiber fineness and fiber elongation had low influence under a Multi Criteria Decision Making (MCDM). Consequently, this study aimed to determine the technological value or to illustrate the relation between fiber properties and yarn quality properties of some long staple Egyptian cotton varieties by using some models of analysis.

MATERIAL AND METHODS

This investigation was conducted during 2016 and 2017 seasons at cotton Grade Section, cotton Research Institute, Giza, Egypt to study the relationship between fiber properties and yarn quality traits (Lea product, Single yarn strength “cN/tex” and Unevenness “cV%”) at 40’s and 60’s yarn count for three long Egyptian Cotton varieties (Giza 86, Giza 90 and 95), in the presence of 3.6 twisting index through the ring spinning system. These treatments were arranged in completely randomized design with factorial analysis in the presence of three repetitions samples for each grade (FG, G, FGF and GF), also variety under the study to analyze the effects of spinning variables as well as their interactions on yarn quality properties. The obtained data were subjected to statistical analysis according to the procedure outlined by *Snedecore and Chocran (1981).* The different data means of each variety were analyzed separately. Least significant difference at **5**% probability level was used for comparing the different means. Eventually, it could be compared between the resulted cotton yarn properties from traditional spinning method and the value estimated by prediction equations as well as the correlation or approaches between them.

The studied traits:

These traits were determined by weighting 10 g from each sample, grade and variety.

Fiber quality properties:

Upper Half Mean Length (UHML) mm (X_1)

Length uniformity percentage (U%) (X_2)

Short fiber content (SFC) (X_3)

Micronaire value (Mic.). (X_4)

Maturity ratio (MR%) (X_5)

Fiber strength (F.S. g/tex) (X_6)

Fiber elongation (FE%) (X_7)

were determined by using Cotton Classification System (CCS) and High-Volume Instrument (HVI) as obtained Ebaido et al. (2017).

All fiber tests were carried out at the Grading Section. at cotton Res. Inst., Agric. Res. Center, under controlled conditions of 65% ± 2° relative humidity and temperature of 20 ± 2°, where cotton spinning process as ring system (5 kg for each sample) on two yarn counts (40’s and 60’s) was detected in spinning unit of Industrial Menia El-Kameh El-Sharkia Governorate, Egypt.

Yarn quality properties:

To study the yarn quality traits, carded yarns of 20 texliner density at twist factor (3.6) were spun from long staple Egyptian cotton varieties (Giza 86, Giza 90 and Giza 95) to determine the following yarn properties:

Lea product, (Y_1). It was measured by using Good Brand Lea tests according to ASTM (D-1598-93Roo).

Single yarn strength, (Y_2). It was estimated by using Uster Automatic, where 120 breaks were taken from the tested samples, according to ASTM (D-2256-67).

Yarn Unevenness (cV%), (Y_3). It was calculated by using Uster tester III, according to ASTM (D-2256-67).

Determination of yarn quality by using the prediction equations for different varieties under study: This investigation concluded four models as follow:-

Fiber quality index (FQI):-

This model had been chosen for its newless and simplicity.

FQI = UHM x UI x STRf x (1+EL) x (1-SF)/ MIC

El-Messiry and Abd- Ellatif (2013).

Spinning Consistency Index (SCI):-

It is a linear regression equation that included the most HVI measurements for calculating the prediction of the quality and spin ability of the cotton fiber

SCI = - 414.67 + 2.9 STR+ 49.17 UHML+ 4.74 UI - 9.32 Mic + 0.95

Rd% + 0.36 (+b) (Uster, 1999).

Premium Discount Index (PDI):-

It is a linear equation that contains the difference factor (D) for the fiber properties (UHML, F.S, F.FL, UI, SFC and MIC) and the standardized ((β)) Coefficient value (22.15, - 4.75, - 4.37, 11.19, - 20.68, - 7.8) for each fiber properly.

PDI= 22.15 **x** STR - 4.75 **x** EL - 4.37 x UHML**+** 11.19 **x** UI - 20.68 **x**SFC-7.8 **x** MIC. *(Majumdar et al. 2005)*

Multiplicative Analytic Hierarchy Process MCDM or (MI_{AHP})

It consists of fractional exponential equation included fiber properties (F.STR, F. EL, UHM, UI, MIC. And SFC.). The exponent for each fiber property defines its importance in quality of cotton fiber as follow:-

MIAHP=$STR^{0.27*}El^{0.039*}UHM^{0.291*}UI^{0.145}/Mic^{0.11}*SFC^{0.143}$

RESULTS AND DISCUSSION

Table (1): Exhibited the fiber properties through the four studied grades for (Giza 86, Giza 90 and Giza 95) varieties during 2016 and 2017 seasons that were considered as inputs for the results of the prediction equations.

Coefficient of correlation between the four studied models equation and yarn quality traits under the two yarn counts for some long staple Egyptian cottons varieties manufactured by ring spinning system in 2016 and 2017 seasons are presented in Table (2).

Considering Giza86 cultivar results in Table (2) indicated that there was positive and highly significant rank correlation (0.977** and 0.955**) between the application of MI_{AHP} model equation and Lea product in both seasons., respectively.

As for Single Yarn Strength (SYS) its value was positive and highly significant correlated (0.990** & 0.973**) with MI_{AHP} models in 2016 and 2017 season. On the other hand, there was a negative highly significant correlation between Giza 86 variety (-0.945**and-0.979**) and MI_{AHP} model equation due to Unevenness property in the two seasons.

With respect to Giza 90 var., the values estimated by PDI, SCI and FQI models equation gave the highest significant correlation (0.990**and 966**) with Lea product in the first and second seasons, respectively. On the same trend, MI_{AHP} model equation gave the highest positively correlation (0.971** and 0.950**) with Single Yarn Strength (SYS) in both seasons. On the other hand, there was a negative highly significant (- 0.944**and- 0.944**) between MI_{AHP} model equation and Unevenness property.

For Giza 95 var., PDI and MI_{AHP} models equation gave positive highly significant correlation (0.947**, 0.981**, 0.954** and 0.966**) with Lea product and Single Yarn Strength (SYS) traits, respectively. On the other hand, there was a negative highly significant correlation (- 0.933** and - 0.934) between the application of MI_{AHP} model and yarn Unevenness trait in the two seasons.

From Table (2) it could be indicated that (FQI) model equation gave the lowest correlation values for Lea product and Single Yarn Strength traits in both seasons. These results were in agreement with those obtained by El-Mogazhy et al. (1990) who found that the maker plays role indicator mining the criteria weights in the proposed multiplicative MI_{AHP} model equation. They also indicated that (PDI) model equation shows the maximum rank correlation between technological value of cotton and yarn tenacity. Ureyen and Kadoglu (2007) also found that the correlation between yarn properties as independent variable and fiber traits as indecent variable are nearly linear for each yarn property.

The results of multiple linear regression analysis between Lea product, Single Yarn Strength as well as Unevenness (cV%) under two yearn counts (40's and 60's) (depended variable) and long Egyptian cotton fiber properties under study (explanatory variables) are presented in Tables (3 and 4) in 2016 and 2017 seasons.

The results indicated that the supposed multiple regression models were significantly contributed the most variability of the three above mentioned yarn properties. Statistically, goodness of fit was satisfied for the three multiple regression models for each yarn property, each cotton variety under the study and for each yarn count, where more than 80% of Lea product, Single Yarn Strength and Unevenness (cV%) explained as R^2% was attributed to the fiber properties for the two yarn count. Also, it was interesting to note the negative relation between above studied yarn properties and some of fiber ones that differed between the varieties in the first season, the contribution of the most fiber properties in yarn quality traits was significant, with the exception of

Y_1M_1 = 58083.354 - 851.799 UHM - 413.319 UI - 443.856 SFC+ 6483. 121Mic - 25821.81MR - 98.611FS + 476.717 El., That was insignificant contribution (0.168) at 40's yarn count for Giza95 var., same trend had been detected at 60's yarn count with the exception of

Y_3M_3=122.428-0.076UHM-1.707UI-0.016SFC+ 10.920 Mic -15.096MR - 257 FS + 2.376 El.,

Which was insignificant contribution (0.129) for Giza 95 var. during 2016 season.

As for 2017 season, at 40's yarn count, all models equations, that contained some of fiber properties are significant contribution, where R^2% ranged between 0.912 up to 0.996% with the exception of Y_3M_3, which ,the level of significance was (0.052) for Giza 95 var.

On the other hand, at 60's yarn count, all the studied models are characterized by significant contribution, for example due to lea product with its equation Y_1M_1 had the highest value (0.987%) for Giza 90 var., while, the model equation Y_2M_2 for SYS property was the highest value (0.977%) for Giza 86 var., with addition to, cV% for Giza 95 var. its R^2% was (0.964) for Y_3M_3 model equation. The residuals content (1-R^2%) may be due to some errors during measuring the fiber and yarn properties, that some fiber properties were not into account under the current investigation and or unknown variation (random error). These results are in agreement with Hager et al. (2011), Fares and Hassan (2015) and Abdel Daim et al. (2020). They indicated that Upper Half Mean Length (UHML), Fiber Strength (FS), Uniformity index and Short Fiber index play an important role in determining technological value of cotton under Multi Criteria Decision Making (MCDM) model.

Stepwise multiple regression parameters of Lea product, Single yarn strength and Unevenness (cV%) using seven fiber properties for some long staple Egyptian cotton varieties (Giza 86, Giza 90 and Giza 95) manufactured by ring spinning system are presented in Tables (5 up to 8).

From these Tables, we can get the available or suitable equation to determine (R^2%) and rank of contribution of the studied fiber traits to Lea product, Single yearn strength and Unevenness (cV%) within 40s yarn count for long staple varieties.

as for the stepwise multiple linear regression, results in Tables (5 and 6) showed that the accepted limiting properties of cotton fibers were significantly accounted for most variation of Lea product (Y_1) at 40's count of Giza 86 var. they were Short fiber content (SFC) (X_3), Fiber strength (FS) (X_6) and Fiber elongation (FEL) (X_7), that the value of coefficient of determination R^2 for these trait was 0.983, as well as, same the traits rank of contribution due to Lea product (Y_1) for Giza 90 var., the highest value for coefficient of determination (R^2%) was (0.986), while, most of the traits that contributed in lea product of Giza 95var. were X_1, X_2 and X_4, that the maximum value of (R^2%) was (0.932), during 2016 season with model 1 equation.

On the same trend, contributors' fiber traits are important due to Single yearn strength (Y_2) at 40's yarn count for Giza 86 var. were X_3, X_5 and X_6, had the highest value of (R^2) being (0.993) while fiber traits are important for Single yarn strength for Giza 90 var. were X_1, X_4 and X_7, that the maximum value of (R^2) that was (0.973), as well as, contribution traits for Giza 95 var. that was the same traits for Giza 90 var. That (R^2) value was (0.982) in 2016 season with model 2 equation.

With regard to the important contributor fiber traits due to Unevenness (cV%), (Y3) at 40's count for Giza 86, Giza 90 and Giza 95 varieties they were Upper Half Mean Length (UHML) (X_1), short fiber content (SFC) (X_3), Micronair value (Mic) (X_4), length uniformity % (U%) (X_2), Fiber strength (FS) (X6) and Fiber elongation % (FE) (X_7), that the maximum values for (R^2) were (0.981, 0.905 and 0.857) respectively with model 3 equation through 2016 season.

Concerning the stepwise multiple linear regression in 2017 season, results in Table (8) indicated that limiting properties of cotton fiber is characterized by a significant contribution for the studied yarn quality traits.

The important fiber traits contribution due to Lea product (Y_1), at 60's count for Giza 86, Giza 90 and Giza 95 varieties were Short Fiber Content (SFC) (X_3), Upper Half Mean Length (UHM) (X_1), Micronair value (MIC) (X_4), Maturity ratio (MR) (X_5) and Fiber elongation (FE%) (X_7), that the highest values for (R^2%) were 0.931, 0.981 and 0.966, respectively with the application of model I equation.

On the same trend, contribution fiber traits for Single yarn Strength (SYS), (Y_2) at 60's yarn count for the three tested varieties were Short Fiber Strength (X_3), Upper Half Mean Length (X_1), Micronair value (X_4), Uniformity% (X_2) and Fiber elongation % (X_7), respectively, that the maximum values for (R^2%) of the studied varieties were 0.961, 0.941 and 0.970, respectively with model 2 equation in the second season.

With respect to the important contributors' fiber traits for Unevenness (cV%), (Y3) at 60's yarn count for Giza 86, Giza 90 and Giza 95 var. they were Short Fiber Strength (X_3), Upper Half Mean Length (X_1), Micronair value (X_4), Uniformity % (X_2) and Maturity ratio (X_5), that the maximum values for (R^2%) of the studied varieties were 0.914, 0.901 and 0.944, respectively, with model 3 equation in 2017 season. These results were in agreement with Fares et al. (2010), Hager et al. (2011), Fares and Hassan (2015) and Mesbah and Hassan (2016). They indicated that Upper Half Mean, Fiber Strength, Fiber elongation and Maturity percent were the most effective fiber traits to predict yarn quality properties and technological value for long staple on different yarn counts. Results showed that all the supposed models of regression were significant and reflected large part of the variation of studied yarn traits expressed as high values of R^2 and near values of the corresponding adjusted R^2 indicating the validity and goodness of fit for these models.

CONCLUSION

Most of the fiber properties i.e. Upper Half Mean Length, Fiber strength, Maturity percentage and Short fiber content (%) contribute significantly towards cotton yarn quality under study, by using four mathematical models i.e. FQI, PDI, SCI and MI_{AHP}. Previous fiber properties were estimated for the long Egyptian cotton varieties and were considered as inputs to calculate their equations and detected the comparison between the prediction equation results and the obtained ones from ring spinning at 40's and 60's yarn count. The results of prediction equations rely on rank correlation matrix, multiple liner regression analysis and stepwise multiple linear regression analysis that cleared the main fiber properties contribution and the rate of contribution (R^2%) that differed with varietal difference. for example, it was found that the main fiber property towards Lea product was UHML for Giza86 var. whereas, it was SFC for Giza 90 var. R^2% also varied from one variety to another, being 0.9810% for Giza 86 var. and 0.9549% for Giza 90 var.

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Table 1:- The difference between the three Long Egyptian cotton varieties due to their fiber properties during 2016 and 2017 season.

Var	G	U.H.M (mm)	UI%	SFC	MIC	MR%	F.S (g/tex)	FE%	Rd%	b+	Tr_b	Tr_a
2016 Season												
G.86	FG	33.02	85.83	3.39	4.78	0.88	43.90	8.77	74.70	8.23	1.00	0.18
	G	32.10	85.37	5.22	4.58	0.86	42.00	8.37	72.50	8.40	1.77	0.37
	FGF	31.31	83.47	6.78	4.40	0.84	38.53	8.00	70.17	8.60	3.77	0.85
	GF	31.06	82.90	8.86	4.30	0.79	36.43	7.53	69.27	8.70	6.38	1.53
	2017 Season											
	G	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓
	FG	32.97	85.80	4.21	4.76	0.88	43.30	8.57	74.77	11.40	1.02	0.18
	G	32.07	84.57	5.07	4.62	0.85	42.53	8.30	73.23	11.80	2.58	0.51
	FGF	31.32	82.53	6.74	4.35	0.82	41.00	7.87	71.53	12.17	4.68	0.98
	GF	30.18	81.17	9.48	4.08	0.79	38.63	7.53	68.90	11.87	6.15	1.45
2016 Season												
G.90	G	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓
	FG	30.15	85.13	4.46	4.23	0.87	38.50	9.00	62.93	11.57	1.07	0.20
	G	29.43	83.93	6.06	4.06	0.84	37.07	8.40	60.83	11.60	2.13	0.45
	FGF	29.07	83.27	8.16	3.79	0.82	34.43	8.20	58.17	12.00	4.38	0.97
	GF	28.68	82.30	9.84	3.64	0.79	33.30	7.43	56.47	12.07	6.09	1.40
	2017 Season											
	FG	30.05	85.43	3.97	4.43	0.88	39.23	8.53	62.73	11.20	1.13	0.20
	G	29.52	84.67	5.75	4.29	0.86	37.63	8.30	61.07	11.73	2.56	0.50
	FGF	29.14	83.33	8.15	4.11	0.82	35.40	8.07	57.97	12.33	4.86	0.98
	GF	28.42	81.70	10.19	3.79	0.79	31.83	7.83	56.57	12.03	7.10	1.50
2016 Season												
G.95	G	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓
	FG	30.75	85.67	3.24	4.54	0.86	38.50	8.33	60.90	11.67	1.10	0.20
	G	29.82	84.27	5.56	4.41	0.85	36.83	8.07	59.53	11.83	2.52	0.52
	FGF	28.94	82.60	7.99	4.24	0.82	34.50	7.50	56.50	12.13	4.30	0.95
	GF	28.78	81.67	9.57	4.11	0.79	31.67	7.33	54.33	12.30	6.48	1.47
	2017 Season											
	FG	31.41	84.80	3.78	4.22	0.87	37.77	8.83	64.73	11.20	1.14	0.21
	G	30.22	83.67	5.94	3.96	0.84	34.40	8.67	62.63	11.53	2.32	0.47
	FGF	29.31	82.77	8.18	3.71	0.82	32.63	8.30	61.03	11.73	4.52	0.96
	GF	28.12	81.80	10.77	3.42	0.78	30.07	7.90	58.10	11.67	7.30	1.61

Table 2: Rank correlation matrix between the four models' equations and lea product (LP), Single yarn strength (SYS) and yarn unevenness (cV%) for Giza86, Giza90and Giza95 (long Egyptian cotton varieties) during 2016 and 2017 seasons.

Varieties (V)	Models	2016 Season			2017Season		
		L.p	SYS	cV%	L.p	SYS	cV%
G.86	FQI	0.945**	0.975**	-0.897**	0.915**	0.935**	-0.937**
	SCI	0.959**	0.975**	-0.914**	0.942**	0.954**	-0.954**
	PDI	0.983**	0.990**	-0.924**	0.914**	0.952**	-0.956**
	MI_{AHP}	0.977**	0.990**	-0.945**	0.955**	0.973**	-0.979**
G.90	FQI	0.950**	0.919**	-0.862**	0.966**	0.935**	-0.932**
	SCI	0.952**	0.963**	-0.915**	0.966**	0.911**	-0.922**
	PDI	0.990**	0.960**	-0.923**	0.959**	0.941**	-0.941**
	MI_{AHP}	0.967**	0.971**	-0.944**	0.958**	0.950**	-0.944**
G.95	FQI	0.927**	0.916**	-0.898**	0.933**	0.912**	-0.900**
	SCI	0.944**	0.950**	-0.917**	0.974**	0.957**	-0.935**
	PDI	0.947**	0.918**	-0.901**	0.981**	0.966**	-0.926**
	MI_{AHP}	0.917**	0.954**	-0.933**	0.968**	0.965**	-0.934**

Table 3: Multiple linear regression analysis of lea product, Single yarn strength (cN/tex) and Unevenness (cV%) at 40's and 60's yarn count for Giza 86,Giza90 and Giza 95 varieties during 2016.

Yarn properties	model	Prediction equation	Goodness of fit R^2%	F Value	Sig.
40's yarn count					
Lp (Y_1)	G.86	M_1=6167.093-57.989UHM+16.488UI-136.098SFC-4.874 MIC-1615.060 MR+18.209FS-171.363FE	.986	40.35	.001
	G.90	M_1=1532.299-111.057 UHM+33.247 UI -34.393 SFC+ 22.400MIC-411.160 MR+ 37.420 FS+38.309FE	.996	156.8	.000
	G.95	M_1=58083.354-851.799UHM-413.319UI-443.856SFC+6483.121MIC-25821.81MR-98.611 FS+476.717FE	.830	2.799	.168
SYS (Y_2)	G.86	M_2=-72.524 +1.370UHM+0.782UI+0.782 SFC+0.959 MIC+ 35.916 MR+0.209 FS+1.549 FE	.995	115.9	.000
	G.90	M_2=-25.065+1.890UHM-0.493 UI-0.002 SFC+3.514 MIC+11.152 MR-0.040 FS+0.263FE	.979	26.86	.003
	G.95	M_2=-107.000+0.370UHM+1.832 UI-0.104 SFC-10.353MIC+ 20.999 MR -0.039FS-1.902 FE	.945	9.863	.022
CV% (Y_3)	G.86	M_3=176.319-3.535UHM+0.081UI-.853SFC-4.148MIC-46.006 MR+0.654 FS-1.807FE	.993	76.95	.000
	G.90	M_3=35.609-1.953 UHM+0.746UI-0.039 SFC-4.090MIC-4.811MR-0.028 FS+219FE	.928	7.340	.036
	G.95	M_3=155.311+0.352 UHM-2.639 UI-0.012 SFC+13.903MIC+12.007MR -0.610 FS+3.490FE	.957	12.85	.013
60's yarn count					
Lp (Y_1)	G.86	M_1=-4185.418+187.002UHM+1.083UI+ 3.246SFC-110.856MIC+1223.971MR -4.616FS+49.090 FE	.981	29.51	.003
	G.90	M_1=-1223.547-44.500UHM+28.851UI-9.517SFC+244.671MIC+1268.935MR+2.264FS+23.879FE	.965	15.59	.009
	G.95	M_1=-6488.489-6.429UHM+86.755UI+4.359SFC-2.900MIC+2459.637MR -35.175FS+98.697FE	.988	45.29	.001
SYS (Y_2)	G.86	M_2=-52.555+0.781 UHM+0.411UI-0.066 SFC-1.198MIC+9.347MR+0.007FS+ 0.547FE	.990	55.58	.001
	G.90	M_2=-27.643+2.930UHM-0.617UI-0.046SFC+1.260MIC-.175MR+0.119FS-0.364FE	.931	7.758	.033
	G.95	M_2=-148.801-0.001UHM+2.096UI+0.224SFC-6.248MIC+28.526MR -0.197FS -0.713 FE	.977	24.81	.004
CV% (Y_3)	G.86	M_3=60.538-2.962UHM+1.084UI+0.032SFC-1.529 MIC-49.859MR+0.473FS-0.995FE	.984	35.20	.002
	G.90	M_3=116.650-0.072UHM-1.026UI-0.146 SFC-1.157 MIC-1.218 MR-0.361FS+0.972 FE	.959	13.48	.012
	G.95	M_3=122.428-.076UHM-1.707UI -0.016SFC+10.920MIC-15.096MR-0.257FS+2.376FE	.855	3.371	.129

M_1,$M_2$$M_3$ equal $Model_1$, $Model_2$,and $Model_3$

Explanatory variables:-

X_1 Upper Half Mean Length(UHML)mm

X_2 Length uniformity Percentage (U)%

X_3 Short Fiber Content(SFC)

X_4 Micronaire value (Mic)

X_5 Maturity Ratio (MR%)

X_6 Fiber strength (FS g/tex)

X_7 Fiber Elongation (FE %)

Table 4: Multiple linear regression analysis of lea product, Single yarn strength (cN/tex) and Unevenness (cV%) at 40's and 60's yarn count for Giza 86, Giza90 and Giza 95 varieties during 2017.

Yarn properties	model	Prediction equation	Goodness of fit R^2%	F Value	Sig.
		40's yarn count			
Lp (Y_1)	G.86	M_1=6167.093-57.989 **UHM**+16.488**UI**-136.098 **SFC**-4.874**MIC**-1615.060**MR** + 18.209**FS** -171.363 **FE**	.986	40.35	.001
	G.90	M_1=4128.590-131.087 **UHM**+2.226 **UI**-40.125 **SFC**-92.869 **MIC** -743.461**MR**+36.272 **FS** +211.479 **FE**	.963	14.69	.010
	G.95	M_1=-1513.490-27.025 **UHM**+40.917 **UI** -14.686 **SFC**+5.041 **MIC**+1738.820 **MR**+.626 **FS**-20.710**FE**	.990	55.40	.001
SYS (Y_2)	G.86	M_2=-14.235-.315**UHM** + 0.088 **UI** -0.258**SFC**+2.938 **MIC**+22.405 **MR**-0.119**FS** +.674 **FE**	.996	149.3	.000
	G.90	M_2=-15.608+2.809**UHM**-0.171**UI**-0.872 **SFC**-3.257 **MIC**+33.235 **MR** -0.445**FS**- 3.862 **FE**	.972	19.87	.006
	G.95	M_2=-62.220-1.863**UHM**+1.444**UI** -0.345 **SFC**+0.296 **MIC**+3.959 **MR**+0.569 **FS**-1.231**FE**	.993	76.63	.000
CV% (Y_3)	G.86	M_3=81.292-.647**UHM**-0.317**UI**+0.210 **SFC**-0.356**MIC**-32.209 **MR**+0.087**FS**+1.023 **FE**	.969	17.70	.007
	G.90	M_3=27.531-1.091**UHM** -0.461**UI**+1.105 **SFC**-3.261**MIC**+3.575**MR**+0.765 **FS**+4.777**FE**	.952	11.23	.017
	G.95	M_3=166.292-.643 **UHM**-1.721**UI**-0.032 **SFC**+2.073**MIC**-7.200**MR**+0.063 **FS**+1.475**FE**	.912	5.954	.052
		60's yarn count			
Lp (Y_1)	G.86	M_1=-10518.04+213.766**UHM**+76.151**UI**+81.542 **SFC**-58.381**MIC**+2928.128**MR**-26.041**FS**-199.242 **FE**	.981	29.70	.003
	G.90	M_1=-4946.280+30.303**UHM**+71.391**UI**-6.018**SFC**+74.031**MIC**+3861.505**MR**-29.426**FS**-275.756 **FE**	.987	43.72	.001
	G.95	M_1=10408.307-42.152**UHM**-112.257**UI**-59.425 **SFC**+248.934**MIC**+1232.380**MR**+3.092**FS**+86.720 **FE**	.973	20.96	.005
SYS (Y_2)	G.86	M_2=-31.203+.261**UHM**+0.617**UI**-0.406**SFC**+1.363 **MIC**+ 13.834 **MR** -0.509 **FS**-1.093**FE**	.977	24.40	.004
	G.90	M_2=107.759-.365**UHM**-0.350**UI**-1.608**SFC**+4.103**MIC**-43.574**MR**-0.220**FS**-1.979**FE**	.953	11.65	.016
	G.95	M_2=-19.771+1.073**UHM**-0.158**UI**+0.082 **SFC**+1.563**MIC**+13.358**MR**+0.249**FS**-1.482**FE**	.956	12.51	.014
CV% (Y_3)	G.86	M_3=412.697-11.255**UHM**+0.894**UI**-5.180**SFC**+5.192**MIC**+63.258**MR**-3.640**FS**-0.547 **FE**	.943	9.415	.023
	G.90	M_3=-46.551-.591**UHM**+0.316**UI**+1.541**SFC**-6.476 **MIC**+ 26.936**MR**+0.752**FS**+3.077**FE**	.940	8.959	.026
	G.95	M_3=169.063+1.411**UHM**-1.915**UI**-0.249**SFC**-1.101**MIC**-35.547**MR**-0.220**FS**+1.440**FE**	.964	15.41	.009

M_1,$M_2$$M_3$ equal Model$_1$, Model$_2$,and Model$_3$

Explanatory variables:-

X_1	Upper Half Mean Length(UHML)mm	X_5	Maturity Ratio (MR%)
X_2	Length uniformity Percentage (U)%	X_6	Fiber strength (FS g/tex)
X_3	Short Fiber Content(SFC)	X_7	Fiber Elongation (FE %)
X_4	Micronaire value (Mic)		

Table 5:- Stepwise multiple linear regression analysis of lea product, Single yarn strength (cN/tex) and unevenness (cV%) at 40's yarn count for Giza 86,Giza90 and Giza 95 varieties during 2016.

Yarn properties	Var.	model	Prediction equation	Goodness of fit R^2%	F Value	Sig.
Lp (Y_1)	G.86		M_1=3346.48439 -84.12599 SFC	0.9586	208.4	<.0001
			M_1= 4834.08400 -120.06513 SFC -155.48972FE	0.9787	184.0	<.0001
			M_1=3895.13634-94.63164SFC+13.30541FS-124.87990FE	0.9833	137.1	<.0001
	G.90		M_1= -110.96520 + 64.94528FS	0.9544	188.3	<.0001
			M_1= 987.76845 -28.15629 SFC+ 39.88926 FS	0.9774	173.2	<.0001
			M_1= 996.75612 -27.35463 SFC+30.97587FS+36.83874FE	0.9867	173.0	<.0001
	G.95		M_1= -571.75676+3444.98069MR	0.8937	33.64	0.0001
			M_1= -1583.89788+22.75788 UI + 2375.40450 MR	0.8937	33.64	0.0001
			M_1=-2294.21846-84.61798UHM+56.84543UI+2815.45826MR	0.9326	32.29	0.0002
SYS (Y_2)	G.86		M_2= -10.60939 + 0.61276FS	0.9744	342.4	<.0001
			M_2= 1.53162 -0.37741 SFC+ 0.36783 FS	0.9926	534.2	<.0001
			M_2= 6.00454 -0.44919 SFC-5.31047MR+ 0.37868 FS	0.9933	345.6	<.0001
	G.90		M_2= -14.53036+6.97190 MIC	0.9435	150.2	<.0001
			M2= -41.11361+ 1.26063 UHM+ 4.33348 MIC	0.9709	133.4	<.0001
			M_2= -38.57845+ 1.14115 UHM+ 4.17831 MIC+ 0.19111FE	0.9730	84.23	<.0001
	G.95		M_2= -39.00955 +1.76138 UHM	0.9531	182.7	<.0001
			M_2= - 49.08343+1.16216UHM+ 0.33283 UI	0.9663	114.8	<.0001
			M_2= -60.88517+1.40883UHM0.53203UI -2.80135 MIC	0.9822	129.0	<.0001
CV% (Y_3)	G.86		M_3= 102.37312 -2.60225 UHM	0.9385	137.2	<.0001
			M_3= 69.41085 -1.63857 UHM+ 0.37482 SFC	0.9567	88.43	<.0001
			M_3= 77.56525 -2.43995 UHM+ 0.64213 SFC+ 0.39155 FS	0.9813	122.5	<.0001
	G.90		M_3= 41.09046-5.05813MIC	0.8873	70.88	<.0001
			M_3= 52.79608-0.55510 UHM -3.89633 MIC	0.8968	34.77	<.0001
			M_3= 30.94888 -1.70454 UHM+ 0.68325 UI -4.30585 MIC	0.9056	22.38	0.0006
	G.95		M_3= 63.09968 -1.44164 UHM	0.8373	46.32	<.0001
			M_3= 45.55951 -0.89343 UHM+ 0.19911 SFC	0.8497	22.62	0.0005
			M_3= 36.69696 -0.79296 UHM+0.33385 SFC+0.64156 FE	0.8570	13.99	0.0024

M_1, $M_2$$M_3$ equal $Model_1$, $Model_2$ and $Model_3$

Explanatory variables:-

X_1	Upper Half Mean Length(UHML)mm	X_5	Maturity Ratio (MR%)
X_2	Length uniformity Percentage (UI)%	X_6	Fiber strength (FS g/tex)
X_3	Short Fiber Content(SFC)	X_7	Fiber Elongation (FE %)
X_4	Micronaire value (Mic)		

Table 6:- Stepwise multiple linear regression analysis of lea product, Single yarn strength (cN/tex) and Unevenness (cV%) at 60's yarn count for Giza 86,Giza90 and Giza 95 varieties during 2016.

Yarn properties	Var.	model	Prediction equation	Goodness of fit R^2%	F Value	Sig.
Lp (Y_1)	G.86		M_1=-3987.17972+207.59230 **UHM**	**0.9542**	**187.3**	**<.0001**
			M_1= -941.19540+ 118.54065 **UHM** -34.63617 **SFC**	**0.9791**	**187.1**	**<.0001**
			M_1=-990.46428+135.23008**UHM**-38.00192**SFC**-102.21762**MIC**	**0.9810**	**120.3**	**<.0001**
	G.90		M_1= -119.41115 + 567.41665 **MIC**	**0.9335**	**126.3**	**<.0001**
			M_1= -689.74252 + 369.79088 **MIC+** 1619.73032**MR**	**0.9458**	**69.84**	**<.0001**
			M_1= -637.01485+322.29832**MIC+**1477.16290**MR+**30.60117**FE**	**0.9549**	**49.39**	**<.0001**
	G.95		M_1= 2568.08227 -57.62475 **SFC**	**0.9514**	**176.2**	**<.0001**
			M_1= -447.68857 + 34.39275 **UI** -36.05920 **SFC**	**0.9654**	**111.5**	**<.0001**
			M_1=-1423.09983 +37.96375 **UI** -21.94954 **SFC+** 74.91875**FE**	**0.9741**	**87.90**	**<.0001**
SYS (Y_2)	G.86		M_2= 18.26354-0.74099 **SFC**	**0.9534**	**184.2**	**<.0001**
			M_2= -25.45413+0.49807 **UI** -0.46135**SFC**	**0.9831**	**232.0**	**<.0001**
			M_2= -30.36118 + 0.26742 **UHM+** 0.45069**UI** -0.39687**SFC**	**0.9848**	**151.5**	**<.0001**
	G.90		M_2=-57.03149+2.36504 **UHM**	**0.8822**	**67.43**	**<.0001**
			M_2= -42.62203+1.62342 **UHM+** 1.86721**MIC**	**0.8999**	**35.94**	**<.0001**
			M_2= -46.43832+ 1.80327**UHM+** 2.10080**MIC**-0.28768 **FE**	**0.9074**	**22.85**	**0.0005**
	G.95		M_2= 17.12540 -0.71430 **SFC**	**0.9630**	**234.2**	**<.0001**
			M_2= 11.93900 -0.63663**SFC+** 1.07864 **MIC**	**0.9661**	**114.1**	**<.0001**
			M_2= 6.59200 -0.54659 **SFC+** 1.48749 **MIC+** 0.38247**FE**	**0.9672**	**68.82**	**<.0001**
CV% (Y_3)	G.86		M_3= 14.07588+0.95512 **SFC**	**0.9194**	**102.6**	**<.0001**
			M_3= -48.04117 + 0.70769 **UI** + 1.35246 **SFC**	**0.9541**	**83.13**	**<.0001**
			M_3= -29.16679 -1.02861 **UHM+** 0.88994 **UI** + 1.10444**SFC**	**0.9693**	**73.79**	**<.0001**
	G.90		M_3=38.86615-4.34827**MIC**	**0.9080**	**88.85**	**<.0001**
			M_3= 51.53851-0.60095**UHM** -3.09052**MIC**	**0.9234**	**48.25**	**<.0001**
			M_3=31.75515-1.64180**UHM+** 0.61871**UI**-3.46135**MIC**	**0.9334**	**32.69**	**0.0002**
	G.95		M_3= 18.57045 + 0.40828 **SFC**	**0.7467**	**26.52**	**0.0006**
			M_3= -1.27888+ 0.67267 **SFC+** 21.78588 **MR**	**0.7847**	**14.58**	**0.0021**
			M_3= -11.45921 + 0.84980 **SFC** + 23.05874**MR** + 1.02043**FE**	**0.8104**	**9.970**	**0.0064**

M_1,$M_2$$M_3$ equal $Model_1$, $Model_2$ and $Model_3$

Explanatory variables :-

X_1	Upper Half Mean Length(UHML)mm	X_5	Maturity Ratio (MR%)
X_2	Length uniformity Percentage (UI)%	X_6	Fiber strength (FS g/tex)
X_3	Short Fiber Content(SFC)	X_7	Fiber Elongation (FE %)
X_4	Micronaire value (Mic)		

Table 7:- Stepwise multiple linear regression analysis of lea product, Single yarn strength (cN/tex) and Unevenness (cV%) at 40's yarn count for Giza 86,Giza90 and Giza 95 varieties during 2017.

Yarn properties	Var.	model	Prediction equation	Goodness of fit R^2%	F Value	Sig.
Lp (Y_1)	G.86		M_1= -2547.74119+170.20861 **UHM**	**0.9626**	**231.87**	**<.0001**
			M_1= -3200.06041+138.71319 **UHM +** 19.76131 **UI**	**0.9678**	**120.05**	**<.0001**
			M_1= -6153.30137+185.50081**UHM+**34.64820**UI+**36.37402**SFC**	**0.9771**	**99.66**	**<.0001**
	G.90		M_1= 2597.20712-53.45089 **SFC**	**0.9431**	**149.2**	**<.0001**
			M_1= 931.73214 + 18.96998 **UI** -42.53986 **SFC**	**0.9465**	**70.80**	**<.0001**
			M_1= 1975.06010-56.45189 **UHM+** 26.99630 **UI** -51.54545 **SFC**	**0.9503**	**44.62**	**<.0001**
	G.95		M_1= 2594.53901 -42.14010 **SFC**	**0.9800**	**441.7**	**<.0001**
			M_1= -535.63034+ 36.28421 **UI** -26.91593 **SFC**	**0.9872**	**309.5**	**<.0001**
			M_1= -588.43859+ 29.33992 **UI** -20.35803 **SFC+** 704.35534 **MR**	**0.9892**	**213.4**	**<.0001**
SYS (Y_2)	G.86		M_2= -42.31511+1.77248 **UHM**	**0.9686**	**277.7**	**<.0001**
			M_2= -17.80378 + 1.07040 **UHM** -0.36216 **SFC**	**0.9799**	**195.0**	**<.0001**
			M_2= -2.92328 -0.40341 **SFC** 2.32412 **MIC+** 1.10479**FE**	**0.9898**	**227.1**	**<.0001**
	G.90		M_2= 17.68634 -0.68761 **SFC**	**0.9307**	**120.8**	**<.0001**
			M_2= 86.45627 -0.78330 **UI** -1.13814 **SFC**	**0.9651**	**110.6**	**<.0001**
			M_2= 90.84508 -0.74280 **UI** -1.20285 **SFC** -0.89771**FE**	**0.9701**	**75.82**	**<.0001**
	G.95		M_2= 2574.66045 -53.29698 **SFC**	**0.9338**	**127.0**	**<.0001**
			M_2= 9600.50103 -81.44194 **UI** -87.46848 **SFC**	**0.9555**	**85.83**	**<.0001**
			M_2= 10441 -100.73748 **UI** -84.35896 **SFC+** 88.35247**FE**	**0.9666**	**67.52**	**<.0001**
CV% (Y_3)	G.86		M_3= 77.26378 -69.77041 **MR**	**0.9399**	**140.7**	**<.0001**
			M_3= 95.66610 -0.45018 **UI** -46.80569 **MR**	**0.9590**	**93.49**	**<.0001**
			M_3= 75.21487 -0.31468 **UI+** 0.25661 **SFC** -37.79606 **MR**	**0.9623**	**59.61**	**<.0001**
	G.90		M_3= 17.27069 + 0.51115 **SFC**	**0.8840**	**68.57**	**<.0001**
			M_3= 0.72167+ 0.69447 **SFC+** 1.86997**FE**	**0.9223**	**47.46**	**<.0001**
			M_3= -7.13089+ 0.85509 **SFC+** 0.10315**FS+**2.23731**FE**	**0.9261**	**29.22**	**0.0002**
	G.95		M_3= 139.96865 -1.43930 **UI**	**0.8850**	**69.24**	**<.0001**
			M_3= 156.52692 -1.74035 **UI+** 1.01089**FE**	**0.8953**	**34.21**	**0.0001**
			M_3= 185.70046 -2.15932 **UI+** 1.69109 **MIC+** 0.91940**FE**	**0.8998**	**20.95**	**0.0007**

M_1,$M_2$$M_3$ equal Model$_1$, Model$_2$ and Model$_3$

Explanatory variables :-

X_1	Upper Half Mean Length(UHML)mm	X_5	Maturity Ratio (MR%)
X_2	Length uniformity Percentage (UI)%	X_6	Fiber strength (FS g/tex)
X_3	Short Fiber Content(SFC)	X_7	Fiber Elongation (FE %)
X_4	Micronaire value (Mic)		

Table 8:- Stepwise multiple linear regression analysis of lea product, Single yarn strength (cN/tex) and Unevenness (cV%) at 60's yarn count for Giza 86,Giza90 and Giza 95 varieties during 2017.

Yarn properties	Var.	model	Prediction equation	Goodness of fit R^2%	F Value	Sig.
Lp (Y_1)	G.86		M_1=-1785.71213+139.32313 UHM	0.8600	55.27	<.0001
			M_1= -4675.13451+222.08503 UHM+ 42.69185 SFC	0.8825	30.05	0.0002
			M_1=-9029.70128+193.54202UHM+60.35966UI+77.59239SFC	0.9311	31.54	0.0002
	G.90		M_1= -1009.86239 + 3720.18349 MR	0.9460	157.54	<.0001
			M_1= -3343.95998+ 43.89943 UI+ 2120.70229 MR	0.9691	125.2	<.0001
			M_1= -2989.23859+43.95338UI+3026.64424MR-137.17494FE	0.9818	126.0	<.0001
	G.95		M_1= 2574.66045-53.29698 SFC	0.9338	127.0	<.0001
			M_1= 9600.50103 -81.44194 UI -87.46848 SFC	0.9555	85.83	<.0001
			M_1=10441-100.73748UI-84.35896 SFC+88.35247FE	0.9666	67.52	<.0001
SYS (Y_2)	G.86		M_2= -12.61460 + 5.91798 MIC	0.9426	147.8	<.0001
			M_2= -18.29823 + 4.14048 MIC+ 16.32284 MR	0.9552	85.19	<.0001
			M_2= -30.71047+ 0.24406 UI+ 3.04236 MIC+ 12.66248 MR	0.9616	58.44	<.0001
	G.90		M_2= 16.99875 -0.59938 SFC	0.8548	52.98	<.0001
			M_2= 45.46091 -0.91467 SFC -3.21610FE	0.9345	57.03	<.0001
			M_2= 58.25156-1.14557 SFC -19.34529 MR -2.59519FE	0.9418	37.79	0.0001
	G.95		M_2= -107.52555 +1 1.45103 UI	0.9148	96.60	<.0001
			M_2= -140.61752+ 2.05268 UI -2.02029FE	0.9568	88.50	<.0001
			M_2= -97.27323+ 1.43947 UI+ 0.26596FS-2.17034FE	0.9706	76.99	<.0001
CV% (Y_3)	G.86		M_3= 109.95638 -2.86766 UHM	0.7046	21.47	0.0012
			M_3= 240.93302 -6.61923 UHM -1.93521 SFC	0.7942	15.43	0.0018
			M_3= 424.31864 -8.33356 UHM -5.09701 SFC -2.63661 FS	0.9145	24.97	0.0004
	G.90		M_3= 17.53268 + 0.54635 SFC	0.8717	61.13	<.0001
			M_3= -22.92712 + 0.46084 UI+ 0.81141 SFC	0.8893	32.15	0.0001
			M_3= -38.51008+ 0.43679 UI+ 1.07992 SFC+ 18.72040 MR	0.9012	21.28	0.0007
	G.95		M_3= 129.20691 -1.30108 UI	0.8820	67.28	<.0001
			M_3= 160.43998 -1.86892 UI+1.90680FE	0.9269	50.69	<.0001
			M_3= 124.92791 -1.24214 UI -23.97520 MR+ 2.28700FE	0.9440	39.30	<.0001

M_1, $M_2$$M_3$ equal $Model_1$, $Model_2$ and $Model_3$

Explanatory variables: -

X_1 Upper Half Mean Length(UHML)mm

X_2 Length uniformity Percentage (UI)%

X_3 Short Fiber Content(SFC)

X_4 Micronaire value (Mic)

X_5 Maturity Ratio (MR%)

X_6 Fiber strength (FS g/tex)

X_7 Fiber Elongation (FE %)

تقدير القيمة التكنولوجية لبعض أصناف القطن المصري الطويلة باستخدام بعض نماذج التحليل الرياضي

أشرف فتحي يونس [1], محمد شيرين سالم [2,*],السيد عبد الله مصباح [2] ابراهيم احمد عبيدو [1], عبد الباسط عبد الكريم حسان [3].

[1]قسم الرتب- معهد بحوث القطن- مركز البحوث الزراعية بالجيزة

[2]قسم المحاصيل كلية الزراعة بالقاهرة - جامعة الأزهر

[3]قسم الغزل - معهد بحوث القطن - مركز البحوث الزراعية بالجيزة

* البريد الإليكتروني للباحث الرئيسي:Mohamed sherien 205@azhar.edu.eg

الملخص العربى

أجريت هذه الدراسه بمعامل تكنولوجيا القطن وقسم الرتب التابعه لمعهد بحوث القطن- مركز البحوث الزراعية - الجيزة- مصر، ووحدات تصنيع الغزل بمنيا القمح محافظة الشرقية- مصر- وذلك لبحث العلاقة فيمابين صفات الألياف المختلفة وصفات الخيط الناتج (متانة الشلة ومتانة الخيط المفرد والنسبة المئوية للانتظامية) بالغزل عند نمرتي الخيط (40 ، 60) وعند معامل البرم 3.6 لأصناف القطن الطويلة (جيزة 86 ، جيزة 90، جيزة 95) ولبيان هذه العلاقة استخدم 4 نماذج رياضية وهم معامل جودة الألياف، ودليل ملائمة الغزل، ومعامل الخصم والإضافة، والتحليل الهرمي التسلسلي. وأظهرت النتائج عند قياس القيم التكنولوجية لصنف جيزة 86، وجيزة 95 على سبيل المثال ارتباطها الموجب العالي المعنوية بكل من: متانة الشلة ومتانة الخيط المفرد. وعلى العكس كان هذا الارتباط سالباً مع صفة النسبة المئوية للانتظامية. وتبين أن كلاً من محتوى الصنف من الشعيرات القصيرة، طول أطول الشعيرات، ومتانة الليفة، وقيم الميكرونير هي أهم صفات الألياف المساهمة في صفات جودة الخيط قيد الدراسة.

الكلمات الاسترشادية: القطن، القطن المصري الطويلة, القيمة التكنولوجيا، نماذج التحليل الاحصائى.