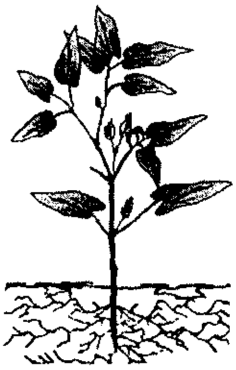

77
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QUANTIFICATION OF FIBER QUALITY IN EGYPTIAN COTTON VARIETIES AND PROMISING CROSSES

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ABSTRACT

Quantification of the quality of cotton fiber is an interesting field of textile research because of cotton may have conflicting standards in terms of different fiber quality. Therefore, the ranking or grading of cotton fibers in terms of different quality will certainly not be the same. The solution should imply an index of quality of cotton fiber (quantitative measurements), and the index should incorporate all the important fiber properties, also that fiber properties should be commensurate with their importance on the final yarn quality. Therefore, it is imperative in this investigation to quantify the quality of cotton fiber by using the methods, premium-discount index (PDI), fiber quality index (FQI) and Spinning consistency index (SCI).

The most important results were

1- Based on the percentage contribution of fiber property (Ci %) and the difference factor (**Di**), the premium-discount index (PDI) could be calculated using the following equation

$$PDI = 3.88\ (D_{UHML}) + 2.48\ (D_{FS}) - 4.81\ (D_{SFC}) - 7.75\ (D_{MIC})$$

2- The % contribution (**Ci %**) cleared that, the most positive %contribution to carded ring skein strength was Upper **Half** Mean Length (UHML), on the contrary, Short Fiber Content (SFC) was the most negative % contribution, in next from the standardised 'β' coefficient values in the premium-discount index equation (PDI) we can receive a clear idea of the influence of fiber properties on skein strength.

4- Values of Spearman rank correlation (**R_s**) cleared that, the differences between the three methods PDI, SCI, FQI were marginal, beside the highest values of (**R_s**) were in favor of Premium-Discount Index (PDI).

5- The model of Premium-Discount Index (PDI) can be used in quantification of cotton fiber quality, and estimating skein strength values by using the regression equation which belongs it within $R^2 = 0.82$.

INTRODUCTION

Quality is very frequently used in industry as synonym for good product, technologies etc. Strictly speaking, this word is frequently misused or misinterpreted. In some cases word "quality" is used for the expression of maintainability, reliability or economy of production. Especially in the textile branch, it is necessary to define quality very precisely because textile products can be used for a lot of various applications.

One general definition of quality is: "Quality express ability to fulfill needs of applicability".

The quality of the textile fibers is dependent on the aims of evaluation:

- Fiber producers: quality means the achievement of required technological parameters (evenness, fineness, mechanical and physical parameters etc.).

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- Textiles producers: quality means the ability to fulfill requirements of technologic operations and process ability (friction, surface properties, cohesion, selected mechanical and physical properties, and evenness).
- Consumers: fiber quality is hidden in the properties and comfort of fabrics (hand, wearing pleasance, thermal comfort, transport properties etc.).

Basic cotton fiber properties, i.e. Fiber length (expressed as upper half mean UHML mm), fiber length uniformity (expressed as uniformity index UI %), fiber strength (as bundle strength FS cN/tex), fiber elongation at break (FE %), fiber fineness and maturity (expressed by micronaire reading (MIC), short fiber content (SFC) having potential influence to the cotton yarn strength (skein strength or single yarn strength), also the importance of these fiber properties are generally dependent on the spinning technology. **(Militky, 2006).**

The basic idea of fiber-yarn quality modeling is to develop a fiber-to-yarn relationship for the purpose of either exploring the effects of fiber properties on yarn quality or predicting yarn performance corresponding to the use of certain fiber types or fiber properties. The need to use a reliable fiber-to-yarn relationship stems from the fact that it can provide a powerful tool to assist and guide technologists and machine makers in identifying quality problems, improving system performance, and enhancing existing designs. Such relationships can also assist cotton breeders in selecting and enhancing cotton varieties that are suitable for particular yarn type or end product, **(El Mogahzy and Farag, 2007).**

A statistical approach for determining the quantification value of a variety of cotton suggests that the value of cotton should correspond to its fiber properties in a particular manufacturing system. A model relating fiber to yarn properties (single yarn strength or skein strength) is a basic requirement for implementing the approach. The procedures used in this approach include developing a multiple regression model relating HVI fiber properties to the desired quality parameter of yarn, determining the percent relative contribution of a fiber property with respect to yarn quality, selecting a reference set of HVI fiber properties, determining a difference factor of the difference in value between fiber properties of a particular variety and the reference set, and finally, developing a premium/discount formula. The main feature of the approach is its flexibility in accommodating different fiber properties and yarns of different counts. **(El-Mogahzy *et al* 1990).**

The use of HVI data seems very complex, as much more is actually learned than can be utilized in a real situation. Therefore, the selection of suitable cotton fiber to meet the customer's end-use requirement has remained a perennial challenge to the spinner. Researchers have developed several mathematical, statistical and artificial neural network models to predict the yarn properties from the properties of constituent fibers. Therefore, the problem of cotton bale selection remains unresolved, **(Majumdar *et al* 2004; Majumdar *et al* 2005).**

The premium-discount index is the best method to determine the quality of cotton fiber because of the premium-discount index model receives a clear idea of the influence of fiber properties on skein strength. **(Majumdar *et al* 2005).**

The strength properties of a spun yarn (single yarn strength or skein strength) have always been very important in determining the quality of the yarn, since they directly affect the final spinning processes. It is, therefore, 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)] (Skein Strength) using fiber properties, **(Üreyen and Kadoğlu, 2007).**

A different view for utilizing the rapid instrument testing data that 'Fiber Quality Index' value based on the instrument testing data be created and fiber quality could be determined based on the Fiber Quality Index rather than individual fiber quality characters. The Fiber Quality Index would take into account the combined effect of premiums and discounts for various characters. **(Estur, 2008).**

Spinning consistency index (SCI) described as a calculation for predicting the overall quality and spinnability of the cotton fiber. It is chiefly used to gain within and between lay-down consistencies of major cotton properties. **(Zellweger Uster, 1999).**

Therefore, the aim of this study was to quantify the quality of cotton fiber by using the quantitative measurements: premium-discount index (PDI), fiber quality index (FQI) and Spinning consistency index (SCI).

MATERIALS AND METHODS

The materials used in this study included the commercial Egyptian cotton varieties $Giza_{88}$,

$Giza_{70}$ $Giza_{86}$, $Giza_{80}$, $Giza_{90}$, all of these varieties belong to the Long Staple category except $Giza_{88}$ and $Giza_{70}$ which belongs to the Extra- Long Staple category according to the local practise in Egypt, and promising crosses $G._{77}$ x S_6, $G._{89}$ x $G._{86}$, and $G._{84}$ ($G._{74}$ x $G._{86}$). The previously mentioned varieties and promising crosses were tested for fiber and yarn measurements using samples taken from crop seasons 2008 and 2009.

The promising cross **$G._{84}$ ($G._{74}$ x $G._{86}$)** during season 2009 became the extra long staple variety **$Giza_{92}$**.

Fiber and yarn measurements recorded in seasons 2008 and 2009 for commercial Egyptian cotton varieties $Giza_{88}$, $Giza_{70}$, $Giza_{92}$, $Giza_{86}$, $Giza_{80}$, $Giza_{90}$ and promising crosses $G._{77}$ x S_6, $G._{89}$ x $G._{86}$ were carried out at the laboratories of the Cotton Research Institute, Giza, under controlled atmospheric conditions of $20^{\pm}$ 1.1^{C° temperature and $65^{\pm}$ 2% relative humidity.

Methods of testing were used for determining the fiber parameters as follows:

Spinlap, HVI Instrument System was used according to **ASTM (D- 4603-86-1776-98)** to determine Upper Half Mean Length (UHML) by mm., Uniformity Index (UI %), Micronaire value (MIC), fiber elongation (FE %) and fiber strength(FS)(cN /tex). **Suter-Webb** Array comb sorter was used according to the **ASTM (D- 1440- 65)** to estimate the short fiber content % by weight (SFC), fibers shorter than ½ inch.

Determining fiber fineness by using **Micromat Tester (SDL 089), 1994.**

Fiber of the commercial Egyptian cotton varieties $Giza_{88}$, $Giza_{70}$, $Giza_{92}$, $Giza_{86}$, $Giza_{80}$,$Giza_{90}$ and promising crosses $G._{77}$ x S_6, $G._{89}$ x $G._{86}$ spun to produce carded ring yarns at twist multiplier 3.6.with two counts (Ne) 50 and 60.

Yarn skein strength (Lea product) was measured according to **ASTM, (D- 1578-67, 1998).**

Means were calculated from the 6 repetitions during seasons 2008, 2009 for each variety and promising crosses to compute rank correlation and the stepwise multiple regression analysis by using **SAS** statistical software, version 9.1 **SAS, 2004,** which was carried with a regression equation of the following form:

$Y= \beta_o + \beta_1 X_1 + \beta_2 X_2 +...+\beta_p X_p$ Where Y is the independent variable "yarn skein strength", βo is the constant, X_1,X_2...to X_p are the dependent variables "fiber measurements" and β_1, β_2 ...to β_p are the regression coefficients according to **Draper and Smith, 1966.**

The following three methods were used to quantify the quality of cotton fibers:

Fiber quality index (FQI)

$$FQI_{HVI} = \frac{UHML^* UI^* FS}{FF}$$

(Lord, 1961 and Kang *et al* 2000).

Spinning consistency index (SCI)

$$SCI = -414.67 + 2.9FS + 49.17UHML + 4.74UI - 9.32FF + 0.65Rd +0.36(+b)$$

Where Rd is the reflectance degree and +b is the yellowness of cotton fiber. **(Zellweger Uster, 1999).**

Premium-Discount Index (PDI)

$$PDI = \sum_{i=1}^{N}(Ci \times Di).$$ ***(Majumdar et al 2005).***

RESULTS AND DISCUSSION

This study was carried out to investigate the quantification of cotton fiber quality by using various methods, Fiber quality index (FQI), Spinning consistency index (SCI) and Premium-Discount Index (PDI).

Six varieties included $Giza_{88}$, $Giza_{92}$, $Giza_{70}$, $Giza_{86}$, $Giza_{80}$, $Giza_{90}$ and two promising $G._{77}$ x S_6, $G._{89}$ x $G._{86}$ were used in this investigation, and the summary of their fiber properties are given in **Table (1).**

Fiber quality Index (FQI)

$$FQI_{HVI} = \frac{UHML^* UI^* FS}{FF}$$

FQI $_{HVI}$ is the HVI quality index, (UHML) is the upper half mean length, (UI) is the uniformity index and (FF) is the fiber fineness, (FS) is the fiber bundle strength.

This is the most widely used method to determine the quality of cotton fiber attributed to the simplicity of the equation used, **(Lord, 1961; Kang *et al* 2000 and Murthy & Samanta, 2000).**

Table 1. Summary of cotton fiber properties of the studied varieties and promising crosses

Fiber property	Minimum	Maximum	Mean
Upper Half Mean Length (UHML)	28.90	37.50	33.63
Short Fiber Content (SFC) (%)	4.50	17.50	10.07
Fiber Strength (FS) (g / tex)	36.60	53.20	44.96
Micronaire Value (MIC) units	3.10	4.80	4.09
Uniformity Index (UI) (%)	81.00	89.70	87.31
Fiber Fineness (FF) (m tex)	108.00	168.70	144.58
Reflectance degree (Rd)	63.20	77.90	70.31
Yellowness (+b)	7.90	13.30	10.46

Spinning consistency index (SCI)

SCI = −414.67 + 2.9FS + 49.17UHML + 4.74UI − 9.32FF + 0.65 Rd +0.36(+b)

Where (Rd) is the reflectance degree and (+b) is the yellowness of cotton fiber.

Spinning consistency index (SCI) described as a calculation for predicting the overall quality and spinnability of the cotton fiber. It is chiefly used to gain within and between lay-down consistencies of major cotton properties. The regression equation of SCI uses most of the individual HVI measurements, and it is based on the five-year crop average of U. S. Upland and Pima cotton. (**Zellweger Uster, 1999 and Majumdar *et al* 2005**).

Premium-Discount Index (PDI)

Premium-Discount Index includes the development of a multiple regression equation relating fiber properties and yarn strength, the determination of the percentage contribution of fiber properties to yarn strength (single yarn strength or skein strength), the selection of a reference set of cotton properties, the determination of a difference factor between the fiber property and the reference set, and finally the development of a premium-discount formula:

Yarn strength (expressed by skein strength) = $C_1+C_2FS+C_3\,FE+C_4\,UHML+C_5\,UI+C_6\,SFC+C_7\,FF$. **(El-Mogazhy *et al* 1990).**

Where C_1, C_2, ...C_7, are the regression coefficients, **FS** is the fiber bundle strength in (g/tex), **FE** is the fiber breaking elongation in percentage, **UHML** is the upper half mean length in (m.m), **UI** is the uniformity index in percentage (as measured by H.V.I), **SFC** is the short fiber content as measured by Suter-Webb Array comb sorter and **FF** is the fiber fineness as expressed by micronaire value (MIC).

The regression coefficients are dependent on the scales of measurement, and therefore cannot be used as a measure of their importance. To overcome this problem, 'β' coefficients of the variables are determined using the standardized variables in the regression equation. The relative contribution of the i th fiber property can be determined by the following equation:

$$Ci\,\% = 100 \left(\frac{Bi}{\sum_{i=1}^{N} Bi} \right) R^2 \quad (1)$$

Where '**βi**' is the 'β' coefficient of the **i** th variable, **N** is the number of HVI fiber properties and R^2 is the coefficient of determination. The reference set is expressed in terms of the average and standard deviation of a fiber property.

In the next step, the relative difference factor for each cotton fiber is determined by the following equation:

$$Di = X_i - \mu_i \setminus \sigma_i \quad (2)$$

Where x_i is the i th fiber property of a cotton, μ_i and σ_i are the overall average and standard deviation of all the cottons in the **i** th property.

Based on the percentage contribution of fiber property (**Ci %**) and the difference factor (**Di**), the premium-discount index (PDI) could be calculated using the following equation:

$$PDI = \sum_{i=1}^{N} (Ci \times Di) \quad (3)$$

Here the sign of the product in the summation should follow the sign of the variable as obtained in the regression equation. **(Majumdar *et al* 2005 and Militky, 2006).**

Formulating Premium-Discount Index (PDI)

The R^2 values of the multiple regression equation were 0.97 and 0.96 for 50 Ne and 60 Ne respectively.

Uniformity Index (UI) was associated with negative sign in regression equation and that's unexpected, and may be ascribed to the prevailing autocorrelation among the fiber properties. **(Militky, 1980 and Majumdar *et al* 2005).** Fiber Fineness (FF) and Micronaire value (MIC) were the same trend during the stepwise analysis so; we used Micronaire value (MIC) attributed to the simplicity of the measuring.

Fiber Elongation (FE) didn't give significant improvement to carded ring skein strength.

By using Equation **(1)**, the % contribution of cotton properties (Upper Half Mean Length, Fiber Strength, Short Fiber Content and Micronaire value) to ring skein strength was determined separately for 50 Ne and 60 Ne.

The resultant formula to calculate the premium-discount index (PDI) of cotton fiber quality is as follows:

$$PDI = 3.88\ (D_{UHML}) + 2.48\ (D_{FS}) - 4.81\ (D_{SFC}) - 7.75\ (D_{MIC})$$

Where **D** $_{UHML}$, **D** $_{FS}$, D_{SFC} and D_{MIC} are the difference factors for Upper Half Mean Length, Fiber Strength, Short Fiber Content and Micronaire value.

The % contribution (**Ci %**) of cotton fiber properties Upper Half Mean Length, Fiber Strength, Short Fiber Content and Micronaire value to carded ring skein strength for counts (Ne) 50 and 60 respectively are shown in **Table (2).**

The average of % contribution (**Ci %**) cleared that, the most positive % contribution to carded ring skein strength in two counts (Ne) 50 and 60 was Upper Half Mean Length (UHML = +3.88), on the contrary, Short Fiber Content was the most negative % contribution (SFC = -4.81).

Table (3) included fiber properties of $Giza_{92}$, $G._{77}$ x S_6, $Giza_{88}$, $Giza_{70}$, $Giza_{86}$, $G._{89}$ x $G._{86}$, $Giza_{80}$, $Giza_{90}$ and values of the three methods Premium-Discount Index (PDI) Spinning Consistency Index (SCI) and Fiber Quality Index (FQI).

With respect to values of Spinning Consistency Index (SCI) and Fiber Quality Index (FQI), values of Premium-Discount Index (PDI) had positive sign in $Giza_{92}$, $G._{77}$ x S_6, $Giza_{88}$ and negative sign in $Giza_{86}$, $G._{89}$ x $G._{86}$, $Giza_{80}$, $Giza_{90}$, while $Giza_{70}$ was in positive and negative signs, and that's accepted due to the most positive % contributor Upper Half Mean Length (UHML), **(Militky, 1980 and Majumdar *et al* 2005).**

Table 2. % Contribution of fiber properties to carded ring skein strength

Fiber property	Yarn Count (50 Ne)	Yarn Count (60 Ne)	Average
Upper Half Mean Length (UHML)	5.71	2.05	3.88
Short Fiber Content (SFC)	-6.41	-3.21	-4.81
Fiber Strength (FS)	4.89	0.07	2.48
Micronaire Value (MIC)	-8.61	-6.89	-7.75

Table 3. Cotton fiber properties and values of the three methods PDI, SCI and FQI

Varieties and Promising	Fiber Properties							The Methods		
	UHML	UI	SFC	FS	MIC	Rd	(+b)	PDI	SCI	FQI
GIZA92	34.6	88.6	5.1	51.7	3.9	76.9	7.9	15.3	632.5	1156.9
	34.8	88.9	4.1	51.9	3.8	77.7	7.9	18.6	644.9	1172.0
	34.6	88.5	5.0	51.0	3.7	76.0	8.3	9.1	638.9	1148.3
	34.5	88.7	4.6	50.1	3.8	76.7	8.2	17.0	623.4	1119.1
	34.7	88.8	4.6	52.0	3.7	77.5	8.7	20.4	649.2	1178.2
	34.5	88.7	5.5	53.2	3.9	77.4	8.6	15.4	639.5	1194.4
GIZA 77 X S6	36.9	89.0	6.1	49.5	3.1	64.2	11.3	32.8	1085.8	1496.9
	36.1	89.5	5.9	49.0	3.2	64.2	11.4	30.0	936.2	1461.8
	37.4	89.1	6.2	50.2	3.1	65.0	11.5	34.0	1032.0	1548.9
	37.5	89.4	6.0	49.7	3.3	66.2	12.4	30.2	1038.0	1542.8
	37.0	89.2	6.0	51.3	3.2	66.7	12.0	32.1	1010.8	1557.6
	36.6	89.7	6.6	51.3	3.1	66.9	11.9	32.6	990.8	1545.1
GIZA 88	36.0	87.7	7.9	47.9	3.9	66.1	11.7	12.2	673.9	1098.3
	35.9	87.8	9.3	48.2	4.0	66.1	11.7	8.4	664.7	1098.5
	35.8	88.8	8.3	46.1	3.9	65.7	11.8	10.4	655.1	1062.0
	36.3	88.4	8.8	46.6	4.1	64.8	12.7	7.0	675.6	1075.8
	35.1	88.8	6.4	46.2	4.0	65.8	13.3	6.2	621.0	1038.2
	35.5	89.3	7.2	46.4	4.1	65.8	13.2	7.6	652.9	1068.2
GIZA 70	35.4	83.3	9.6	41.0	4.2	75.0	9.0	-0.5	661.7	847.2
	35.0	85.0	9.9	42.1	4.1	75.0	9.0	0.6	550.5	875.9
	34.4	83.0	9.4	41.0	4.2	71.2	10.4	-2.0	506.4	818.6
	33.9	81.0	9.1	41.3	4.0	71.2	10.6	1.6	466.7	789.2
	35.0	83.9	8.5	43.2	4.3	71.5	10.2	-0.6	549.4	884.7
	34.9	84.1	8.6	43.5	4.2	71.7	10.2	1.2	546.5	894.7
GIZA 86	32.7	87.6	12.3	45.5	4.4	76.5	8.6	-11.7	302.0	817.6
	33.0	87.3	11.9	45.7	4.5	76.6	8.5	-11.2	315.9	822.9
	32.6	87.9	11.3	45.7	4.4	76.6	8.5	-9.2	329.9	835.7
	32.9	88.3	11.3	46.0	4.6	77.7	8.7	-12.4	357.5	858.3
	32.1	89.5	10.8	45.8	4.5	77.8	8.7	-11.3	339.2	854.4
	32.8	89.3	11.3	46.0	4.8	77.9	8.5	-16.6	366.7	870.9
GIZA 89 X GIZA86	32.6	87.4	10.8	46.5	4.2	74.5	8.9	-4.1	353.7	860.3
	32.9	88.0	11.5	46.9	4.4	74.5	8.9	-5.7	372.5	881.7
	32.9	87.7	9.4	46.5	4.3	75.5	8.8	-2.5	364.0	851.5
	33.5	88.5	9.6	46.0	4.4	75.7	8.5	-5.2	395.9	881.6
	33.1	88.8	10.2	47.2	4.5	75.8	8.8	-8.0	371.6	891.0
	32.9	88.8	10.0	46.0	4.4	75.8	8.8	-6.8	355.9	861.5
GIZA 80	31.5	85.8	14.8	38.1	4.5	63.2	12.5	-21.6	134.0	614.0
	31.9	86.6	15.5	38.5	4.3	63.7	12.7	-17.5	165.5	636.9
	31.1	86.7	13.5	36.4	4.4	63.7	12.5	-17.9	126.4	635.0
	31.3	86.5	14.3	38.7	4.5	63.8	12.6	-21.0	124.0	622.6
	31.5	87.5	14.0	39.2	4.5	63.8	11.8	-20.0	226.5	679.5
	31.6	88.0	13.7	39.2	4.2	63.9	11.8	-13.4	143.4	646.2
GIZA 90	29.5	84.5	17.0	37.3	4.0	65.1	11.9	-18.5	147.5	611.7
	28.9	84.1	17.5	36.3	4.1	65.2	11.5	-22.4	134.5	582.6
	30.1	85.6	16.1	38.3	4.1	65.8	11.5	-15.9	205.9	646.2
	30.2	85.7	16.2	37.7	4.3	65.7	11.7	-21.8	222.6	644.9
	30.3	85.8	15.6	38.2	4.3	65.1	11.8	-20.6	213.3	649.1
	30.4	86.0	16.1	38.8	4.3	65.8	11.8	-20.8	221.3	663.0

The promising $G_{77} \times S_6$ gave the highest values of Premium-Discount Index (PDI), while the lowest values were belongs to $Giza_{80}$ and $Giza_{90}$. Same trend was in Spinning Consistency Index (SCI) and Fiber Quality Index (FQI).

Rank correlation between carded ring skein strength and values of (PDI), (SCI) and (FQI)

Spearman rank correlation coefficient most frequently used today. **(Bolboacă and Jäntschi, 2006).**

The Technicality of Spearman rank correlation coefficient as follows:

1- Ranking the cotton fiber properties according to their PDI, SCI and FQI.

2- Ranking the cotton fiber properties according to the carded ring skein strength.

3-Calculating the difference between the two rankings (1, 2) to measure the Spearman rank correlation coefficient by using the following equation:

$$R_s = 6 \sum d^2 / M (M^2 - 1)$$

Where R_s is the Spearman rank correlation, **d** is the absolute difference between the two rankings (1, 2) and **M** is the total number of alternatives (48), **(SAS, 2004).**

Results for spearman rank correlation (R_s) between PDI, SCI, FQI and carded ring skein strength are shown in **Table (4)**. Values of (R_s) for the two counts (Ne) 50 and 60 respectively cleared that, (R_s) for PDI were 0.82, 0.75 for counts (Ne) 50 and 60, while were 0.79, 0.71, 0.81, 0.74 for SCI and FQI respectively.

Table 4. Values of spearman rank correlation between PDI, SCI, FQI and carded ring skein strength in two counts (Ne) 50 and 60

The three methods for quantification of quality cotton fiber	Yarn count	
	50 Ne	60 Ne
	Spearman rank correlation (Rs)	
Premium-Discount Index (PDI)	0.82	0.75
Spinning Consistency Index (SCI)	0.79	0.71
Fiber Quality Index (FQI)	0.81	0.74

Values of spearman rank correlation (R_s) cleared that, the differences between the three methods PDI, SCI, FQI were marginal in the two counts (Ne) 50 and 60, and the highest values of (R_s) were belongs to PDI (0.82, 0.75).

According to the results of spearman rank correlation we ranked fiber properties of the varieties and promising crosses included in this study by using values of method Premium-Discount Index (PDI) into 48 sample and the results are shown in **Table (5).**

The rank was from the highest value of PDI (43.0) in sample No. 1 to sample No.48 which had the lowest value of PDI (-22.4) **(Majumdar *et al* 2005)**.

Regression analysis between values of PDI, SCI, FQI and carded ring skein strength

Regression equations for PDI, SCI and FQI to carded ring skein strength are shown in **Table (6).**

Regression analysis has been applied to determine how the independent variable (carded ring skein strength) changes as well as the changes of the dependent variable (PDI, SCI and FQI), **(Draper and Smith, 1966).**

The coefficients of determination (R^2) were 0.82, 0.77, 0.76 for equations which belongs PDI, SCI and FQI respectively, hence the highest (R^2) value was (0.82) and belongs PDI.

Generally, from the previously finding it can be noticed that, Premium-Discount Index (PDI) model was in high values of (R_s) and (R^2). These findings qualifies model of Premium-Discount Index (PDI) for its use in quantification of cotton fiber quality and estimate skein strength value by using the regression equation which belongs it within $R^2 = 0.82$.

From the standardised 'β' coefficient values in the premium-discount index model (PDI) we can receive a clear idea of the influence of fiber properties on skein strength.

The real accuracy of the premium-discount index model can be judged by subjecting that model to some new test samples, which were not used for developing the regression equation relating the fiber properties and skein strength.

Table 5. Fiber properties as well as their ranking according to values of Premium-Discount Index (PDI)

Sample No	Fiber Properties				PDI
	UHML	SFC	FS	MIC	
1	37.4	6.2	50.2	3.1	34.0
2	36.9	6.1	49.5	3.1	32.8
3	36.6	6.6	51.3	3.1	32.6
4	37.0	6.0	51.3	3.2	32.1
5	37.5	6.0	49.7	3.3	30.2
6	36.1	5.9	49.0	3.2	30.0
7	34.7	4.6	52.0	3.7	20.4
8	34.8	4.1	51.9	3.8	18.6
9	34.5	4.6	50.1	3.8	17.0
10	34.5	5.5	53.2	3.9	15.4
11	34.6	5.1	51.7	3.9	15.3
12	36.0	7.9	47.9	3.9	12.2
13	35.8	8.3	46.1	3.9	10.4
14	34.6	5.0	51.0	3.7	9.1
15	35.9	9.3	48.2	4.0	8.4
16	35.5	7.2	46.4	4.1	7.6
17	36.3	8.8	46.6	4.1	7.0
18	35.1	6.4	46.2	4.0	6.2
19	33.9	9.1	41.3	4.0	1.6
20	34.9	8.6	43.5	4.2	1.2
21	35.0	9.9	42.1	4.1	0.6
22	35.4	9.6	41.0	4.2	-0.5
23	35.0	8.5	43.2	4.3	-0.6
24	34.4	9.4	41.0	4.2	-2.0
25	32.9	9.4	46.5	4.3	-2.5
26	32.6	10.8	46.5	4.2	-4.1
27	33.5	9.6	46.0	4.4	-5.2
28	32.9	11.5	46.9	4.4	-5.7
29	32.9	10.0	46.0	4.4	-6.8
30	33.1	10.2	47.2	4.5	-8.0
31	32.6	11.3	45.7	4.4	-9.2
32	33.0	11.9	45.7	4.5	-11.2
33	32.1	10.8	45.8	4.5	-11.3
34	32.7	12.3	45.5	4.4	-11.7
35	32.9	11.3	46.0	4.6	-12.4
36	31.6	13.7	39.2	4.2	-13.4
37	30.1	16.1	38.3	4.1	-15.9
38	32.8	11.3	46.0	4.8	-16.6
39	31.9	15.5	38.5	4.3	-17.5
40	31.1	13.5	36.4	4.4	-17.9
41	29.5	17.0	37.3	4.0	-18.5
42	31.5	14.0	39.2	4.5	-20.0
43	30.3	15.6	38.2	4.3	-20.6
44	30.4	16.1	38.8	4.3	-20.8
45	31.3	14.3	38.7	4.5	-21.0
46	31.5	14.8	38.1	4.5	-21.6
47	30.2	16.2	37.7	4.3	-21.8
48	28.9	17.5	36.3	4.1	-22.4

Table 6. Regression analysis between values of PDI, SCI, FQI and carded ring skein strength

The methods	Regression equation	R^2
Premium-Discount Index (PDI)	Skein strength = 2879.04 + 23.93 x PDI	0.82
Spinning Consistency Index (SCI)	Skein strength = 2159.41 + 1.49 x SCI	0.77
Fiber Quality Index (FQI)	Skein strength = 1532.66 + 1.42 x FQI	0.76

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حوليـــات العلــوم الزراعية
جامعة عين شمس ، القاهرة
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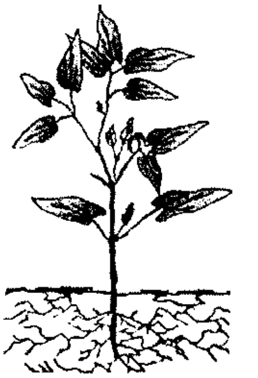

القياس الكمى لجودة الألياف فى بعض الأصناف والهجن المبشرة من القطن المصرى

[٦]

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الموجـــز

توجد اختلافات كبيرة فى جودة ألياف القطن مما يجعل ترتيب أو تدريج تيلة القطن حسب توقع جودة المنتج النهائى منها (غزول- نسيج) عملية صعبة.

وهذه المشكلة من الممكن حلها باستخدام طرق القياسات الكمية التى تعطى مؤشر (معيار جودة) يعبر عن جودة تيلة القطن يتضمن جميع صفات التيلة المهمة كما أن أهمية هذه الصفات يكون لها تأثير على جودة المنتج النهائى من تيلة القطن.

استخدم فى هذا البحث ثلاث طرق من القياسات الكمية للحكم على جودة تيلة القطن هى:

1- Premium-Discount Index (PDI)
2- Spinning Consistency Index (SCI)
3- Fiber Quality Index (FQI)

وكانت أهم النتائج

١- أظهرت قيم الارتباط التدريجى بطريقة سبيرمان (R_s) أن الاختلافات بين الثلاث قياسات كانت هامشية.

٢- قيم المساهمة النسبية الفعلية (Ci %) تعطى فكرة واضحة عن تأثير كل صفة من صفات الألياف على متانة الشلة. فقد أظهرت قيم المساهمة النسبية الفعلية أن أعلا مؤثــر مضيف (موجب = 3.88 +) كان طول التيلة والشعرات القصيرة أعلا مؤثرخصم (سالب = 4.81 -).

٣- بحساب المساهمة النسبية الفعلية (Ci %) ومعامل الاختلاف (Di) يمكن حساب القياس الكمى (PDI) باستخدام المعادلة:

$$PDI = 3.88\ (D_{UHML}) + 2.48\ (D_{FS}) - 4.81\ (D_{SFC}) - 7.75\ (D_{MIC})$$

٤- يمكن استخدام هذه المعادلة في ترتيب جودة التيلة على أساس أهم صفاتها ؛ كما يمكن توقع جودة المنتج النهائى منها (متانة الشلة) من معادلة الانحدار الناتجة من تحليل الانحدار بين متانة الشلة المقاسة و طريقة القياس الكمى (PDI) بحدود ثقة ($R^2 = 0.82$) .

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