RESULTS AND DISCUSSION

4. RESULTS AND DISCUSSION

Specifications of the 90 observations pertaining to the nine varieties (G. 45, G. 70, G. 88, G. 85, G. 86, G. 89, G. 80, G. 83 and G. 90 and the five main cotton grades (FG, G, FGF, GF and FF) for various characters of relevance to the study are shown in *Appendix tables* (1 through 23). Results will be dealt with under these main categories;

I- Lint cotton grades

(1)- Cotton grade in relation to lint grade properties

Average values of lint cotton grade characteristics of various lint grades are given in *Table (1).* Evidently, varying cotton grades manifested highly significant differences in trash content (TC), reflectance percent (Rd %) and micronaire value (MIC). On the other hand, the differences among lint grades in yellowness degree (+b) were mostly insignificant except for grade FG which showed the lowest (+b). Irrespective of variety, the highest lint cotton grades showed less trash content, more brilliance (Rd %) and the highest micronaire values. With regards of correlations of lint grades with lint grade characteristics, it could be noted that trash content was negatively and highly correlated with lint grade. On the other hand, reflectance percent and micronaire value were positively and highly correlated with lint grade. Whereas, yellowness degree (+b) showed insignificant correlation with lint grade. *Ahmed et al. (1987)* found similar results when considering the reliability of visual rating of cotton grade with that derived from

Table (1):Overall mean values of trash content (TC), reflectance percent (Rd %), yellowness degree (+b) and micronaire value (MIC) with their correlations with lint cotton grade

Character / Grade	Trash content (TC)	Reflectance percent (Rd %)	Yellowness degree (+ b)	Micronaire value (MIC)
FG	0.89^{e}	71.8^{a}	10.3^{b}	4.28^{a}
G	2.03^{d}	66.7^{b}	10.5^{a}	3.63^{b}
FGF	3.45^{c}	60.4^{c}	10.9^{a}	3.17^{c}
GF	5.58^{b}	58.8^{c}	10.8^{a}	3.16^{c}
FF	9.47^{a}	55.6^{d}	10.9^{a}	3.10^{c}
Correlation coefficients	-0.851**	0.764**	-0.186ns	0.719 **

Means followed by the same letter are not significantly different at 0.05 level according to Duncan's multiple range test

* *: Significant at 0.01 level of probability.

ns : Denotes non significance

using instrumental measurements for trash content, color of cotton and micronaire value in the evaluation of lint cotton grades.

Intuitively, the positive association observed between lint grade and reflectance percent *(Table, 1)* is attributable to the fact that low grades usually contain high amount of trash residues and this could be seen from the negative high association between cotton grade and trash content. Other contaminants in addition to black and yellow spots induced by insects, diseases infestation and pesticides are also among the factors that have their impact on this relationship. It is worth mentioning that the differences of trash content, percent reflectance, yellowness degree and micronaire value among lint grades are oftentimes a matter of bias as much as, the cotton classer is by and large influenced by cotton variety when he makes his assessment of grades on the basis of the three factors; trash content, color of cotton (Rd% and +b) and micronaire value in combination.

(2)- Calculated grade factor (Gr.F)

Calculated grade factors for the 90 observations are listed in *App. table (3)*. Overall average values of grade factor are shown in *Table (2)*. Results depict wide differences among cotton grades for grade factor (Gr.F). Also, it could be seen that the decrease in the values of grade factor is associated with a decrease in lint grades. Great differences could be observed between cotton varieties. Extra-long staple varieties namely Giza 45, Giza 70 and Giza 88 are very much close in estimated Gr.F with no apparent significance. Whereas, these for long staple varieties varied significantly. This is understandable since cotton varieties have different values of colorimeter reflectance, trash content and micronaire value *(Table, 1)*.

Within the same cotton variety, high variation of grade factor especially between the high grade Fully Good (FG) and the other grades could be clearly seen. Also, the same nominal grade for different varieties has different values of grade factor.

Table (2): Estimated grade factor (Gr.F) among lint grades and cotton varieties

Variety / Grade	G.45	G.70	G.88	G.85	G.86	G.89	G.80	G.83	G.90	Mean
	Estimated grade factors (Gr.F)									
FG	a 264.9	a 283.7	a 211.2	a 1163	a 1621	a 399	a 810	a 493.3	a 394.6	a 627
G	b 86.6	b 84.8	b 87.3	b 368.3	b 193.8	b 161.8	b 328.1	b 132.9	a 254.4	b 188.7
FGF	b 36.6	b 53.2	b 51.2	b 110	b 82.3	c 64.7	c 58.7	b 69.8	c 95.6	c 69.1
GF	b 22.9	b 42.6	b 33.3	c 66.2	b 62.2	c 28.8	c 25.1	c 28.0	c 45.3	c 39.3
FF	c 10.7	b 16.4	c 11.7	c 41.6	b 56.0	c 21.7	c 16.9	c 16.7	c 22.1	c 23.8
Mean	c 90.5	c 96.2	c 79.0	a 349.8	a 403	b 135.2	a 247.8	b 148.1	b 162.4	190
Correlation of lint grade with Gr.F = 0.623**										

Means followed by the same letter are not significantly different at 0.05 level according to Duncan's multiple range test

* *: Significant at 1% level of probability

Strangely enough, in some instances a low grade, i.e., Fully Fair (FF) gave value of grade factor higher than the higher grades FGF and GF. This could be witnessed with the FF for Giza 86 variety and grades FGF and GF for Giza 45, Giza 70 and Giza 88 varieties. These differences are due to differences in the parameters determining lint grade, and also, are due to the interplay between factors used to derive grade factor from these parameters; $(Gr.\ F = Rd\ \%\ * MIC\ /\ TC)$.

An increase of grade factor would result from a low value of the denominator (trash content) which by far implies greater effect in the equation than the effect of the numerator, i.e., reflectance percent and micronaire value. In other words, the highest value of the grade factor would be expected from a maximal value of the numerator, i.e., Rd % and MIC; along with a minimal value of the denominator, TC.

As a result of the previous reasons, the esimator grade factor can not be use to compare between all cotton varieties, but should be confined to compare the quality of cotton grades within each cotton variety, separately. This trend was suggested previously by Ahmed and *Kamal (1981)*, who found high correlation coefficients between lint cotton grades and grade factor (Gr.F).

-Interrelationships of grade factor (Gr.F) with trash content (TC), reflectance percent (Rd %) and micronaire value (MIC)

As shown in *Table (3),* strong relations among these parameters are as expected. Simple correlation coefficients of trash content, reflectance percent, and micronaire value with grade factor were highly significant. Correlation coefficients of TC were of negative. In contrast, correlations to Rd %, MIC and Gr.F were of positive values. These results agree with the high association of these characteristics found by *Abdel- Mohsen and Ahmed (1978), El-Sourady et al. (1979)* and *Kamal et al. (1991).*

The highly significant correlation coefficients among TC, Rd%, MIC, and the calculated Gr.F, denote that the use of these parameters in calculating Gr.F is justifiable. Nevertheless, it could be noted that the values of correlation coefficients among these parameters and among these parameters and Gr.F were not numerically high, although computed correlations in separate analyses were high *(App. table, 4)*. This adds another evidence to that the use of grade factor should be confined to evaluate lint cotton grades within the same variety.

Table (3):Correlation coefficients of trash content (TC), reflectance percent (Rd %), micronaire value (MIC) and grade factor (Gr.F)

Character	TC	Rd %	MIC
Gr.F	-0.520**	0.541**	0.644**
MIC	-0.600**	0.560**	
Rd %	-0.641**		

* *: Significant at 1% level of probability

(3)- Lint cotton grade in relation to fiber quality properties

Fiber quality is a composite characteristic. That is, it includes a variety of fiber properties that affect the processing of fibers and quality of the end product. However, the emphasis here will be on the main factors, i.e., fiber length expressed as upper half mean (UHM), length uniformity expressed as uniformity index (UI %), fiber strength at 1/8" gauge (FS), fiber elongation (FE) and micronaire value (MIC).

Overall averages obtained in *Table (4)* show that there are highly significant differences among the mean values of UHM, UI%, FS and FE % of different lint grades. The highest lint cotton grades manifested the highest fiber length, more uniformity and strongest fibers. These results to a large extent are in agreement with those of *Moursi et al. (1973), Samra et al. (1980), El-Shaer et al. (1983), Hossam El-Din et al. (1986)* and *Yousef et al. (1992),* who found high relations of lint cotton grade with fiber length, fiber length uniformity and fiber strength.

Table (4): Average values of fiber length (UHM), length uniformity (UI%), fiber strength (FS), and fiber elongation (FE %) with their correlations with lint grade

Characters / Grade	UHM	UI%	FS	FE%
FG	32.42[a]	87.1[a]	39.9[a]	7.5[a]
G	31.36[b]	85.6[b]	38.1[b]	7.1[b]
FGF	30.26[c]	83.4[c]	35.5[c]	6.3[c]
GF	30.10[C]	83.3[c]	33.6[d]	6.2[d]
FF	29.70[d]	81.9[d]	32.2[e]	5.8[e]
Correlation coefficients	0.420**	0.726**	0.637**	0.261*

Means followed by the same letter are not significantly different at 0.05 level according to Duncan's multiple range test.

*, * *: Significant at 1% level of probability, respectively.

Fiber quality properties are listed per entry in *App. table (5).* Within the same variety in some instances, a low grade gave high value of UHM, UI% and FS than a high grade. Fiber elongation showed inconsistent trend with lint grades for all cotton varieties. Simple correlation coefficients shown in *Table (4),* confirmed this inconsistent trend, since the correlation coefficients of fiber length, length uniformity and fiber strength with lint grade were highly significant except for fiber elongation which showed only significant relation with lint cotton grades.

The results obtained show in general that, cotton nominal grades are not always a good indicator of fiber quality properties; this may be attributed to the fact that these characters are beyond visual rating of the classer.

(4)- Fiber quality index (FQI)

Calculated fiber quality index (FQI) per observation are shown in *App. table (7)*. Average values of fiber quality index of the commercial cotton varieties for the main studied lint grades are shown in *Table (5).* It could be seen that the calculated FQI showed highly significant differences among cotton varieties; whereas, the differences among lint grades were slightly significant and insignificant. The extra-long staple varieties, i.e., G. 45, G. 70 and G. 88 showed higher values of FQI than the long staple varieties, i.e., G. 85, G. 86, G. 89, G. 80, G. 83 and G. 90.

The low values and insignificant correlation coefficients between lint grades and fiber quality index (r=0.023) substantiated the poor association of FQI with lint grades *(Table, 5)*. Several factors could be held responsible of such poor association. One, the same nominal grade has different values of FQI for different varieties. Second, within the same variety, it could be seen that differences among lint grades were mostly insignificant. Oddly enough is that low grades are usually accompanied with higher values of FQI than higher grades, in particular the FG lint grade.

Although micronaire value *(Table 1)*, fiber length and fiber strength *(Table 4)* tended to decrease progressively and consistently with the decrease of lint cotton grade, the values of fiber quality index (FQI) derived from them did not behave the same all the time. Unexpected deviations could be due to the interplay effects of the three factors in the equation used to assess fiber quality index; *(FQI = UHM*FS / MIC)*.

Table (5):Mean values of fiber quality index (FQI) for varieties and the main lint grades

Character / Grade	G.45	G.70	G.88	G.85	G.86	G.89	G.80	G.83	G.90	Mean
FG	a 444.2	a 364.7	b 350.2	a 271.1	b 305.7	a 273.6	a 269.3	b 270.2	b 234.9	a 309.3
G	a 440.4	a 385.3	a 402.1	a 311.9	a 367.5	a 274	a 293	a 302.9	a 255.8	a 337
FGF	a 474.6	a 355.9	a 424.5	a 282.9	a 337.8	a 271.3	a 284.8	a 286.9	a 261.7	a 331.2
GF	a 432.6	a 375.3	a 385	b 268.1	b 318.4	a 281.5	b 258.6	b 265.9	a 287	a 319.2
FF	b 423.1	b 337	a 422.4	b 257.2	a 340.9	a 280.4	b 257.9	b 257.8	a 258.8	a 313.9
Mean	a 440.2	b 363.6	b 396.8	d 278.2	c 334.1	d 276.1	d 272.7	d 276.7	d 259.6	322.1
Correlation of lint grade with FQI = 0.023 ns										

Means followed by the same letter are not significantly different at 0.05 levels according to Duncan's multiple range test.

ns: Denotes non significance

Generally, the highest value of FQI would be expected from high value of the numerator, i.e., fiber length (UHM) and fiber strength (FS) with a low value of the denominator (MIC). Similar results were found by *Kamal and Ragab (1991),* who suggested the estimated FQI, to rating and ranking Egyptian cotton varieties. It could be confirmed that within the same variety, a low lint cotton grade with low UHM and FS may give misleading high value of FQI because of very low micronaire value. Therefore, the obtained results suggest that the using of fiber quality index to compare lint cotton grades is not recommendable, except for comparing lots or cotton varieties of the basic high grades, i.e., FG or G/FG.

-Relationships of fiber quality index (FQI) with fiber length (UHM), length uniformity (UI %), fiber strength (FS) and micronaire value (MIC)

As shown in *Table (6),* there were strong relations among fiber quality properties. Since simple correlation coefficients among fiber length, length uniformity, fiber strength and micronaire value were highly significant, except for the correlation coefficient of MIC with UHM. Likewise, correlations of fiber quality index with UHM, UI %, FS and MIC were highly significant except for MIC which showed significant correlation with FQI. Checking the data of fiber quality index for individual observations *(App. table 8)* show inconsistent correlations of FQI with these parameters and correlation coefficients were negative in some cases, and positive in others, especially for 2005 season. Thereupon, these results add another drawback to fiber quality index as being a suitable estimate of fiber quality. Moreover, it is evident that the correlations among fiber length, length uniformity, fiber strength, micronaire value and fiber quality index differed from one season to another, suggesting that these characteristics are prone to be affected by seasonal variations *(App. table 8 and App. table 9).*

Table (6): Correlation coefficients of fiber Length (UHM), length uniformity (UI %), fiber strength (FS),micronaire value (MIC) and fiber quality index (FQI)

Character	FQI	MIC	FS	UI %
UHM	0.794**	0.228*	0.875**	0.793**
UI %	0.458**	0.564**	0.903**	
FS	0.630**	0.469**		
MIC	-0.312*			

' *: Significant at 0.05 and 0.01 levels of probability, respectively

(5) Lint grade properties in relation to fiber quality properties

Overall, simple correlation coefficients between trash content (TC), reflectance percent (Rd %), micronaire value (MIC) and grade factor (Gr.F) and fiber length (UHM), length uniformity (UI %), fiber strength (FS) and fiber quality index (FQI) are shown in *Table (7).* Trash content, reflectance percent, micronaire value and grade factor exhibited highly significant correlations with UI % and FS, whereas, correlation with UHM and was insignificant, except for the correlation of Rd % with

UHM, that was highly significant and the correlation of MIC with FQI which was significant. These results are in agreement with what was found by *Salluma (1970), Hegab et al. (1986)* and *Ahmed (1988)* who pointed out that TC, Rd % and MIC were highly associated with fiber length, length uniformity and fiber strength. It could be seen that FQI showed poor association with lint grade and lint grade properties, except MIC.

Table (7): Overall simple correlation coefficients of lint grade properties with fiber quality properties

Character	UHM	UI%	FS	FQI
TC	-0.127	-0.564**	-0.466**	0.182
Rd %	0.457**	0.757**	0.676**	0.164
MIC	0.228	0.564**	0.469**	-0.312*
Gr.F	0.123	0.488**	0.386**	-0.198

, *: Significant at 0.05 and 0.01% levels of probability, respectively.

II- Ginning out-turn and components

(1)- Ginning out-turn

Ginning out-turn is one of the most important characters that have direct effect on lint cotton yield per feddan. Thus, it is highly considered in the evaluation of cotton price. Ginning out-turn is a varietal characteristic and is affected somehow by environmental conditions. Overall averages of ginning out-turn (GOT) for the nine cotton varieties and the five main lint grades are shown in *Table (8)*. Ginning out-turn manifested highly significant differences among cotton varieties, and also among lint grades. The extra-long staple varieties, i.e., G. 45, G.70 and G. 88 yielded ginning out-turns lower in value than the long staple counterpart varieties, i.e., G. 85, G. 86, G. 89, G. 80, G. 83 and G. 90. These results are in harmony with those found by *Kamal and Ragab (1991)*.

Also, it could be seen that infrequently, a cotton variety of a low grade may have a higher value of GOT than a high grade of another variety. Likewise, within the same variety, a low grade may yield GOT values higher than a high grade. To illustrate, G. 83 and G. 90, the lint grade GF and G gave higher GOT than lint grades G and FG, respectively.

Because of the unexpectedly high values of ginning out-turn exhibited by rather low grades; it seems that GOT would give misleading judgment of cotton grades. In addition, determination of GOT needs a large samples of cotton and is time consuming. So the results of this study implicate that GOT may not be appropriate to evaluate lint cotton grades in commercial transactions.

Table (8): Overall mean values of ginning out-turn (GOT) for nine commercial cotton varieties and the main five lint grades

Character / Grad	G.45	G.70	G.88	G.85	G.86	G.89	G.80	G.83	G.90	Mean
FG	a 108.9	a 116.9	a 120.3	a 121.6	a 128.9	a 121.5	a 128.2	a 115.8	c 115.6	a 119.8
G	a 108.8	a 116.4	b 118.8	b 119.9	b 126	b 118.9	b 126.2	d 103	a 120	b 117.5
FGF	b 103.3	a 116.5	c 113.3	c 117.8	c 121	c 117.8	c 123.7	c 104	b 118.3	c 114.6
GF	c 101.9	b 115	d 103.6	[illegible] 113.6	d 114.2	d 109.9	d 117.3	b 107.1	d 112.9	d 111.3
FF	d 97.2	c 92	e 82.1	e 79.8	e 80.3	e 101.1	e 87.5	c 104.1	e 109.1	e 92.1
Mean	d 104	c 111.4	d 107.6	c 110.5	b 114.1	b 113.8	a 116.6	d 106.8	a 115.2	111.1

Means followed by the same letter are not significantly different at 0.05 levels according to Duncan's multiple range test.

(2)- Lint cotton grade in relation to ginning out-turn (GOT) and its components

Ginning out-turn estimated per entry are listed in *App. table (10)* and *App. table (11)*, and averages are shown in *Table (9)*. Results indicate that ginning out-turn (GOT), seed index (SI) and lint index (LI) manifested highly significant differences among lint cotton grades. A decreasing trend could be observed in GOT, SI and LI with the decrease of lint grade. Simple correlation coefficients of these parameters with lint grades are positive and highly significant, indicating that the increase of GOT is associated with the increase of SI and LI. These results agree with what was found by *Hegab et al. (1981)* and *Al-Shafei*

(1989) who pointed out that GOT, SI and LI increased with the increase of lint grades.

Table (9):Average values of ginning out turn and its components and their correlations with lint grades

Characters / Grade	GOT	SI	LI
FG	119.8[a]	10.20[a]	6.41[a]
G	117.5[b]	9.21[b]	5.47[b]
FGF	114.6[c]	8.09[c]	4.73[c]
GF	111.3[d]	7.65[d]	4.20[d]
FF	92.1[e]	7.53[d]	3.07[e]
Correlations	0.683**	0.832**	0.897**

Means followed by the same letter are not significantly different at 0.05 level according to Duncan's multiple range test

* *: Significant at 1% level of probability

(3)-Lint grade properties in relation to ginning out-turn and its components

Simple correlation coefficients of trash content (TC), reflectance percent (Rd %), micronaire value (MIC) grade factor (Gr.F) with ginning out-turn (GOT), seed index (SI) and lint index (LI) are shown in *Table (10)*. Results denotes that TC showed negative and highly significant correlations with GOT, SI and LI; whereas, Rd %, MIC and Gr.F exhibited positive and highly significant correlations. These results to some extent, agree with the findings of *Eweida et al. (1984)* and *Hegab et al. (1985)* who found high relations of ginning out-turn and lint index with trash content and reflectance percent. *Al-Shafei (1989)* pointed out that trash content and micronaire value associated highly with GOT and LI.

Table (10):Overall simple correlation coefficients of lint grade properties with ginning out-turn and its components

Character	GOT	SI	LI
TC	0.618**	0.499**	0.619**
Rd%	0.498**	0.612**	0.643**
MIC	0.509**	0.652**	0.694**
Gr.F	0.533**	0.586	0.528**

* *: Significant at 0.01 level of probability

III- Yarn quality properties

(1)- Lint cotton grade in relation to yarn quality properties

Yarn quality properties, i.e., yarn strength, yarn evenness and neppiness have been used frequently by manufacturers as major indications of yarn quality. Results in *Table (11)* illustrate that yarn strength expressed as single yarn strength (YS), percent yarn unevenness (CV %) and nep count (neps) differed significantly among lint cotton grades for all varieties. Yarn elongation (YE) showed significant differences among lint grades and tended to decrease with the decrease of lint grade. Likewise, yarn strength tended to decrease progressively in the same manner; whereas, yarn unevenness and nep count showed increases with lowering lint grade. These results are in agreement with the findings of *Ismail and Shaker (1982)* who found high relationship between lint cotton grade and each of YS, YE, CV% and neps.

With regard to simple correlation coefficients with lint grade shown in *Table (11),* overall simple correlation coefficients of lint grades with YS, CV% and neps were highly significant (r=0.826, -0.878 and -0.836, respectively). Whereas, YE showed significant correlation coefficient with lint grade (r=0.307). YS and YE correlated positively with lint grade; in contrast, yarn unevenness and nep count correlated negatively. Checking analysis of individual varieties *(App. table 13)*, YS, CV % and neps showed wide variation among lint grades of the same season and between seasons. YE showed inconsistent relations with lint grades.

To illustrate, very poor simple correlation coefficients could be seen for YE and lint grade in connection with Giza 70 and Giza 86 in both seasons and Giza 89 and Giza 80 in one season for each, *(App. Tab. 14)*. So, in this study, because of the inconsistency of yarn elongation (YE) with lint grade, YE would be discarded when considering lint grade.

Table (11): Overall averages of yarn quality properties and their correlations with lint grades

Characters / Grade	YS	YE	CV %	neps
FG	18.29[a]	5.7[a]	23.08[d]	152[e]
G	17.50[b]	5.7[a]	24.44[d]	205[d]
FGF	14.98[c]	5.6[b]	27.19[c]	468.0[c]
GF	13.63[c]	5.5[c]	29.40[b]	715.0[b]
FF	11.90[d]	5.5[c]	30.81[a]	902[a]
Correlations	0.826**	0.307*	-0.878**	-0.836**

Means followed by the same letter are not significantly different at 0.05 level according to Duncan's multiple range test.

*, * *: Significant at 5% and 1% levels of probability

-Interrelationships among yarn quality properties

Simple correlation coefficients among yarn strength (YS), yarn unevenness (CV %) and nep count are shown in *Table (12)*. These characters were strongly interrelated. Simple correlation coefficients between all possible pairs were highly significant.

Correlations of yarn strength with yarn unevenness and nep count were negative, in contrast, correlations of CV % with neps was positive. Generally, the strongest is the yarns the highest is evenness and the lowest is neppiness. It could be noted that the high significant correlations among these characteristics are due to the indirect effects of other variables that have high relations with YS, CV % and neps such as twist factor and count of yarns.

Table (12): Correlation coefficients of yarn strength (YS), yarn unevenness (CV%) and nep count (neps)

Character	YS	CV%
neps	-0.786**	0.953**
CV%	-0.788**	

(2) Lint grade properties in relation to yarn quality properties

The results obtained in *Table (13)* show that lint grade properties namely trash content (TC), reflectance percent (Rd %) and micronaire value (MIC) gave highly significant correlation coefficients with yarn strength (YS), yarn unevenness (CV %) and nep count (neps). From data in *App. table (16)*, for some varieties, such as Giza 85 in 2004 season, micronaire value correlated insignificantly with YS, CV % and neps. With the exception of the direct effect of micronaire on fiber and yarn quality, trash content and reflectance percent has indirect effects due to the influence of TC and Rd % on lint cotton grade.

The presence of the high relation of factors determining lint cotton grade, i.e., trash content, reflectance percent and micronaire value with fiber and yarn quality, substantiated the requirement of using instrumental measurements of these factors in the evaluation of lint cotton grade. So in this respect, plotted these factors to form numerical criteria named grade factor as it is; $Gr.F = Rd\ \%*MIC/TC$

Table (13):Overall simple correlation coefficients of lint grade properties with yarn quality properties

Character	YS	CV%	neps
TC	-0.623**	0.829**	0.860**
Rd %	0.662**	-0.698**	-0.758**
MIC	0.517**	-0.677**	-0.681**
Gr.F	0.458**	-0.531**	-0.577**

* *: Significant at 0.01% levels of probability.

- Grade factor (Gr.F) in relation to yarn quality properties

Overall simple correlation coefficients of yarn strength (YS), yarn unevenness (CV%) and nep count (neps) with grade factor are shown in *Table (13)*. Grade factor (Gr.F) gave positive and highly significant correlation coefficient with YS; whereas, correlation coefficients with CV% and neps were negative and highly significant. In this respect, Gr.F is behave the same trend in its relation with yarn quality properties as the factors used to form it, i.e., trash content, reflectance percent and micronaire value.

(3)Fiber quality properties in relation to yarn quality properties

Overall simple correlation coefficients of fiber length (UHM), length uniformity (UI %) and fiber strength (FS) with yarn strength (YS), yarn unevenness (CV %) and nep count (neps) are shown in *Table (14)*. It could be clearly seen that overall simple correlation coefficients between both of fiber and yarn quality properties are significant or highly significant. Yarn strength showed high positive values and highly significant correlation coefficients with UHM, UI % and FS. Yarn unevenness and nep count showed high negative and high significant correlations with UI %. On the other hand, moderate negative values and highly significant correlations with FS and low negative values and significant correlations were obtained with UHM. These results to a large extent are in agreement with the findings of *El-Hattab et al. (1972), Al-Mashouly et al. (1979), El-Shaer et al. (1983)* and *El-Hariry et al. (1990)* who found high relations of fiber length, length uniformity, fiber strength and micronaire value with yarn strength, unevenness and neps.

From data in *App. table (17)*, the three characteristics, i.e., YS, CV % and neps were insignificantly correlated with length uniformity index for Giza 70 in 2004 season and for Giza 86 in 2005 season, respectively. Whereas, correlation coefficients of YS and neps with fiber length were insignificant for Giza 89 in 2004 season.

Table (14): Overall simple correlation coefficients of fiber quality properties with yarn quality properties

Character	YS	CV%	neps
UHM	0.758**	-0.320*	-0.339*
UI%	0.856**	-0.667**	-0.723**
FS	0.871**	0.551**	-0.586**
FQI	0.457**	-0.061	-0.029

, *: Significant at 0.05 and 0.01% levels of probability, respectively.

- Fiber quality index (FQI) in relation to yarn quality properties

Overall simple correlation coefficients of yarn strength (YS), yarn unevenness (CV%) and nep count (neps) with fiber quality index (FQI) are shown in *Table (14)*. Fiber quality index exhibited positive and highly significant correlation coefficient with YS; whereas, correlation coefficients with CV% and neps were positive and insignificant. Therefore, FQI did not behave the same trend in its relation with yarn quality properties as the factors used to calculate it, i.e., fiber length (UHM), fiber strength (FS) and micronaire value (MIC) that showed highly significant correlation coefficients with yarn quality properties.

(4)The relative contribution of fiber quality properties to variation in yarn quality properties

For the purpose of predicting fiber characteristics affecting single yarn properties the most important and of potential applicability in fiber quality index (FQI) equation, that is the relative contributions of fiber length (UHM), length uniformity

(UI%), fiber strength (FS) and micronair value (MIC) to single yarn strength (YS) , yarn unevenness (CV %) and nep count (neps) were investigated.

a)- Yarn strength

The relative contributions of UHM, UI%, FS and MIC to YS are shown in *Table (15)*. The highest contributions to yarn strength came apparently from fiber strength (FS) which contributed about 76 % to the variation in yarn strength. Length uniformity contributed 2.7 % to the variation in YS, and then came MIC and UHM with minor contributions. Results are antagonistic with calculated simple correlation coefficients for the same in variables that were high in magnitude and significance *(Table 13 and Table 14)*. These simple correlations were 0.517, 0.758, 0.856 and 0.871 for MIC, UHM, UI% and FS, respectively. The results show clearly that the two analysis agree partially as to the important affect of fiber strength on yarn strength.

Table (15):Relative contributions of each of micronaire value (MIC), fiber length (UHM), length uniformity (UI %) and fiber strength (FS) to yarn strength (YS)

Variable entered	R	Model R^2 %	Increase in R^2 %	F value
FS	0.871	0.758	0.758	5.23*
UI%	0.886	0.785	0.027	2.71ns
MIC	0.888	0.789	0.004	0.96ns
UHM	0.889	0.790	0.001	0.11ns

*: Significant at 5 level of probability.

ns: Denotes non significance.

These results are in disagreement with the results obtained by *Sief (1984)* and those of Meredith *(1992)*, *Hsieh (1996)* and *Nadia abdel Gawad (2000)* who found that the factor affecting yarn strength the most is the micronaire value followed by fiber strength.

b) - Yarn unevenness

The relative contributions of UHM, UI %, FS and MIC to yarn unevenness are shown in *table (16)*. The highest contribution to yarn unevenness came from the micronaire value (MIC). That is about 46% of the variation in CV % is attributable to MIC, and this result is in conformity with the simple correlation coefficient of CV% with MIC *(Table 13)*. Length uniformity (UI%) accounted for 12 % of the variation in CV %. On the other hand, UHM and FS showed low contributions (4.1% and 0.4%, respectively), in spite of their highly significant simple correlation with CV%.

Table (16): Relative contributions of each of micronaire value (MIC), fiber length (UHM), length uniformity (UI %) and fiber strength (FS) to yarn unevenness (CV %)

Variable entered	R	Model R^2 %	Increase in R^2 %	F value
MIC	0.677	0.458	0.458	5.16*
UI%	0.760	0.578	0.120	7.83**
UHM	0.787	0.619	0.041	4.19*
FS	0.789	0.623	0.004	0.41ns

*, **: Significant at 5% and 1% level of probability, respectively.

ns: Denotes non significance.

These results are in disagreement with the findings of *EL-Gawas et al. (1978), Mansour (1984)* and *EL-Tabakh et al. (1985)* who reported that fiber mean length ranked first in importance of affecting variations in yarn unevenness. However, in a study by *Ashour (1979),* length uniformity ratio ranked first followed by micronaire value and fiber length.

c) - Yarn neppiness

Excessive neps in cotton is a persistent problem and is associated with poor yarn and fabric appearance and poor dying quality. As shown in *Table (17)*, the first contribution to variation in nep count (nep) in yarns is the length uniformity (UI %) which contributed about 52 % of the variation in neps. After removal of the effect of UI %, fiber length (UHM) contributed about 15 %, and then came the micronaire value (MIC) with low contribution (3.3 %). Fiber strength (FS) does not seem to influence nep count, in spite of the fact that it correlated highly with yarn neppiness.

Table (17): Relative contributions of micronaire value (MIC), fiber length (UHM), length uniformity (UI%) and fiber strength (FS) to yarn neppiness (neps)

Variable entered	R	Model R^2 %	Increase in R^2 %	F value
UI%	0.723	0.523	0.523	16.5**
UHM	0.819	0.671	0.148	8.42**
MIC	0.938	0.704	0.033	3.69*
FS	0.841	0.708	0.004	0.52ns

*, **: Significant at 5% and 1% level of probability, respectively.

ns: Denotes non significance.

These results agree partially with the findings by *Herbert et al. (1985), Subrahmanyam et al. (1987)* and *Kamal et al. (1988)* who reported that fiber length parameters, i.e., UHM and UI % are the two highest contributions to variation in nep count, followed by the micronaire. On the other hand, *El-Tantawy (1977)* and *Marzook et al. (1987)* ranked micronaire value firstly in contribution to variation in nep count.

Generally, the overall contributions of the four variables involved in the study, i.e., UHM, UI %, FS and MIC equaled 79 %, 62 % and 71 % of the variation in yarn strength, unevenness and nep count, respectively. Accordingly, other variables not considered in this study are responsible for 21 %, 38 % and 29 % of contributions. Those variables most likely are related to fiber stiffness and toughness and some spinning variables such as count, twist and frictional forces among fibers within the yarn.

It is worth mentioning that because of the narrow range of variation of length uniformity and because its value is calculated as the ratio of 50 % span length to fiber length (UHM), in addition to the desire of decreasing the number of variables used to calculate fiber quality index (FQI) and make it easier and accurate, length uniformity ought to be avoided in calculating FQI.

IV- Verification of both grade factor (Gr.F) and fiber quality index (FQI) models

This part dealt with the verification of the most important equations of lint grading, namely grade factor (Gr.F) and fiber quality index (FQI) using stepwise regression analysis.

(1)-Factors contributing to variation of grade factor (Gr.F)

The relative contribution of trash content (TC), reflectance percent (Rd %) and micronaire value (MIC) to grade factor are shown in *Table (18)*. The highest contribution to Gr.f came from micronair value. About 44% of the variation in grade factor is attributable to micronaire value. After removal of the effect of MIC, reflectance percent contributed only 4.2 % of the variation in Gr.F and trash content contributed 0.4%.

Table (18): Relative contribution of trash content (TC), reflectance percent (Rd %) and micronaire value (MIC) to grade factor (Gr.F)

Variable entered	R	Model R^2 %	Increase in R^2 %	F value
MIC	0.664	0.441	0.441	11.5**
Rd %	0.695	0.483	0.042	1.83ns
TC	0.698	0.487	0.004	0.33ns

* *: Significant at 1 % level of probability.
ns: Denotes non significance.

Partial correlation coefficients of lint grade properties, i.e., TC, Rd % and MIC used in modeling grade factor are shown in

Table (19). These partial correlation coefficients explain the order of variable removal in the stepwise regression program. With Gr.F the variable with the highest simple correlation coefficient (r=0.644) was the micronaire value *(Table, 3)*, is also the variable with the high partial correlation. When the effect due to MIC was removed (held constant), Rd % showed the highest partial correlation coefficient .These results are in contrast with what was found *Ahmed and kamal (1981)* and *Kamal and Ragab (1995)* who ranked trash content first in the variation of Gr.F followed by reflectance percentage and micronair value.

Table (19):Partial correlation coefficients of grade factor (Gr.F) and trash content (TC), reflectance percent (Rd %) and micronaire value (MIC)

Variable correlated	Variable constant(s)	Partial correlation coefficients
Gr.F vs. Rd%	MIC	0.273*
Gr.F vs. TC	MIC	-0.203ns
Gr.f vs. TC	MIC + Rd %	0.090ns

*: Significant at 5% level of probability.
ns: Denotes non significance.

It is worth mentioning that in separate analysis for each variety in the two seasons *(App. table 21)*, the three factors in combination showed high contribution to variation in Gr.F (more than 92%). Trash content was the highly significant factor contributing to variation in Gr.F followed by micronair value;

whereas, reflectance percent showed insignificant contribution, although it correlated highly (r=0.541) with Gr.F *(Table, 3).* A point of interest is that partial correlation coefficients of these factors are very low compared to their simple correlations with Gr.F. Thus it means that high values of simple correlation per se are not always good enough to estimate the relationship between two variables. So other variable (lint grade) has the most effect on grade factor.

Noticeably, the overall contribution of the three factors involved, i.e., trash content, reflectance percent and micronair value equals 49 %. Accordingly, other variables not considered in the model could be held responsible for the remaining 51% of the variation in grade factor. That is, the residual effect of variation in Gr.F due to cotton grade is higher than the contribution from the factors used collectively in its computation.

These findings revealed that using grade factor to assess the quality of cotton grades is appropriate only for separate variety. That is, using Gr.F dose not suit assessing the quality of cotton grades in all cases. In addition to easiness of assessment and suitability to routine work in Egypt, the classer grade as it is, still a very good criterion to compare cotton grades for all cotton varieties.

(2) Factors contributing to variation of fiber quality index (FQI)

The relative contributions of fiber length (UHM), fiber strength (FS) and micronaire value MIC) to fiber quality index (FQI) are shown in *Table (20)*. The first contribution to FQI came from fiber length which contributed about 63 % of the variation in FQI. Micronaire value contributed about 26 % to FQI. Minor contribution came from fiber strength (3.6 %).

Table (20):Overall relative contributions of micronaire value (MIC), fiber length (UHM) and fiber strength (FS) to fiber quality index (FQI)

Variable entered	R	Model R^2 %	Increase in R^2 %	F value
UHM	0.794	0.631	0.631	73.4**
MIC	0.942	0.888	0.257	96.1**
FS	*0.961*	*0.924*	*0.036*	19.38**

* *: Significant at 1% level of probability.

The partial correlation coefficients of fiber quality properties involved in computing FQI are shown in *Table (21)*. The variable with the highest simple correlation coefficient with FQI (r=0.794) was fiber length (*Table 6)*. So, when the effect of the variation due to UHM was removed, MIC showed the highest partial correlation coefficient (r=0.834). These results coincide to a large extent those reported by *Foster et al. (1983), El-Mougazy et al. (1991)* and *Majundar et al. (2005)* who found that fiber length ranked first in the importance in the calculated FQI, followed by micronaire value and fiber strength.

Table (21): Overall partial correlation coefficients of fiber quality index (FQI) and fiber length (UHM), fiber strength (FS) and micronaire value (MIC)

Variable correlated	Variable constant(s)	Partial correlation coefficients
FQI vs. MIC	UHM	0.834**
FQI vs. FS	UHM	-0.219*
FQI vs. FS	UHM + MIC	0.567**

, *: Significant at 5% and 1% level of probability, respectively.

It could be noted that the multiple correlation coefficient (R) approximately equals the unity (R=0.961) for the model. This indicates that the model contains the appropriate entities. A point of interest is that for each cotton variety across the two seasons *(App. table 22)*, the three fitted factors (UHM, FS and MIC) jointly showed high contributions to the variation of FQI; in as much as R^2 % was higher than 90 % for individual varieties. Therefore, the overall contributions of these factors involved over varieties were 92.4 %. So, variables not considered in the model are responsible for only 7.6 % of the variation in FQI. Those variables may be ascribed to other fiber quality properties such as short fiber content, fiber length uniformity... etc. The low residual effect due to left out variables in calculating FQI, confirms that the need to use length uniformity with UHM, FS and MIC in the equation of FQI is not necessary so as to facilitate the routine work to evaluate lots of lint cotton by HVI measurements. Thus, the FQI briefly will be as follows, $FQI = UHM*FS / MIC$.

-Fiber quality index (FQI) as a criterion for rating Egyptian cotton varieties:

Despite the falidity confirmed from the previous results, fiber quality index (FQI) is not apparently indicative of the divergence between lint cotton grades, though it is based on the most important characters, i.e., fiber length, fiber strength and micronaire value that have high relation with yarn quality and end product. Fiber quality index could be preferred in comparison of high grades of cotton varieties namely FG or G/FG.

In this respect, *Table (23)* illustrates rating Egyptian cotton varieties according to fiber quality index as reported by Cotton Research Institute (CRI) and Cotton Arbitration and Testing General Organization (CATGO). The data obtained showed that values of the fiber quality index across seasons differed for each variety. These differences are logical due to the divergences in those parameters forming FQI. The extra long staple varieties exhibit higher values of FQI than long staple varieties. The finer varieties G. 45 and G. 87 manifested the highest FQI because of their low micronaire value in comparison with that higher length or fiber strength. So, FQI of G. 70 and G. 88 (extra long staple varieties) valued lower than G. 45 and G. 87 as a result of their highest micronaire values.

Fiber quality index did not show either increasing or decreasing tendency across seasons, except for G.86 which to some degree, shown increase of FQI values.

Table (22):Rating Egyptian cotton varieties according to fiber quality index (FQI)

Varieties \ Years		Fiber quality index (FQI)						
		2002*	2003*	2004*	2005*	2006*	2007*	2007**
Extra-long staple	Giza 45	503	512	463	426	527	540	464
	Giza 70	378	400	399	351	415	-	413
	Giza 87	522	503	517	-	522	529	452
	Giza 88	383	414	427	339	423	433	402
Long staple	Giza 85	285	317	281	320	325	328	293
	Giza 86	300	309	326	312	347	335	320
	Giza 89	284	298	288	270	312	292	281
	Giza 80	268	281	267	259	285	262	273
	Giza 83	245	275	268	263	-	-	-
	Giza 90	268	274	277	252	277	268	244

*: Derived from the annual reports of Cotton Research Institute (CRI).

**: Derived from the annual report of Cotton Arbitration and Testing General Organization (CATGO).

It is obvious that the magnitude of variability of cotton varieties in fiber properties and fiber quality index was greater than the variability ascribed to varying environmental conditions *(Kamal, et al. 1990)*. Fiber quality index may become a good criterion for rating Egyptian cotton varieties but not as good as measuring the quality characteristics of fibers individually.

(3)- Relationship between Gr.F and FQI

As shown in *App .table (23)*, very poor negative association is observed between Gr.F and FQI (r=-0.198). This is quite expected because every estimator of them focuses on different aspects of fiber characteristics.

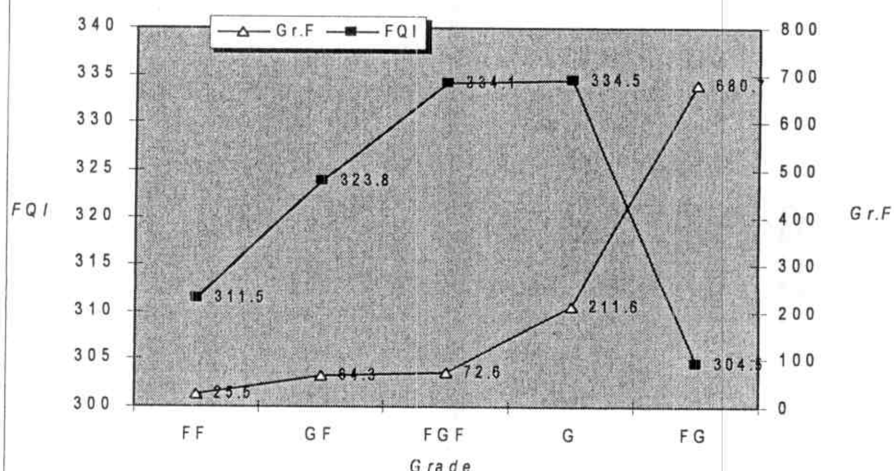


Fig. (1): Relationship between grade factor (Gr.F) and fiber quality index (FQI)

Figure (1) illustrates the relationship between Gr.F and FQI. Both Gr.F and FQI values for different lint grades were plotted against lint grades. FQI loses its advantage in judging fiber quality for lint grades higher than FG grade. In the same time Gr.F has the advantage of better judging lint grade for grades higher than FG grade. FQI and Gr.F are linear in their relation with lint grades, up to grade FGF then they both flatten out with grade and followed by sudden drop from grade Good to grade FG. Both curves follow the same trend, however in opposite direction.

V- The new approach

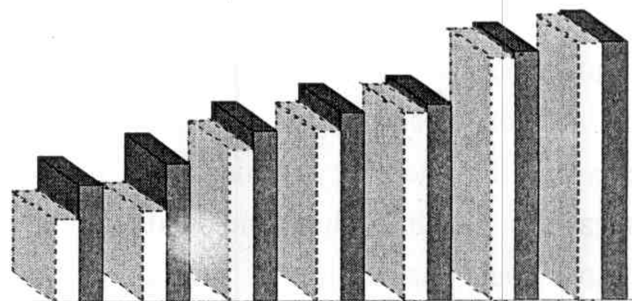
The new approach is based on the micronaire value as aid criterion with classer grade in determination of cotton value.

As trash content being the most important factor determining cotton grade in addition to cotton color and maturity, it is necessary then to relate micronaire value with trash content because of the high relation of micronaire value to lint cotton grade, fiber and yarn quality properties in addition to fast, easy and high accuracy in measuring micronaire compared with measuring trash content and also ginning out-turn. This application could be useful in pricing cotton grades using micronaire value.

For this purpose Figures *(2 through 7)* illustrate the relation of micronaire value with trash content before and after cleaning for different lint grades of tested varieties in 2006 season for the two staple length categories of Egyptian cottons.

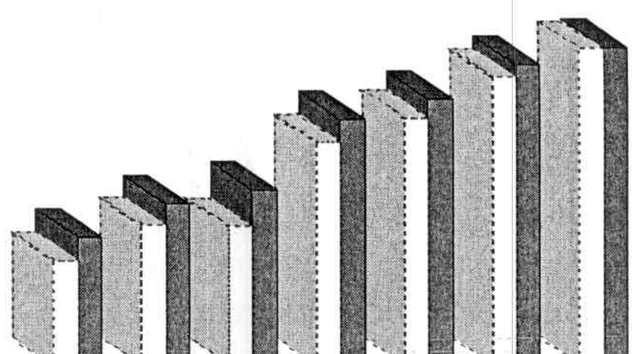
It is apparent that micronaire values decreased after cleaning and it is also obviously seen that the largest reduction in micronaire values occurs in the moderate and low grades. In other words, high grades after cleaning exhibited very slight deviations in micronaire values, and then in some extent, there was no difference between before and after cleaning in micronaire values of FG cotton grade (Giza 70 and Giza 90). In addition to the basic effect of specific surface area of fibers on air flow and hence, maturity and fineness on micronaire value, it is worthy to observe that the presence of trash in raw cotton specimen causes spaces among fibers to increase slightly, so an increase in airflow occurs, causing micronaire value to increase.

Inversely, low and/or absence of trash of the same sample causes large specific surface area, hence, decreases air flow and cause micronaire value to decrease.



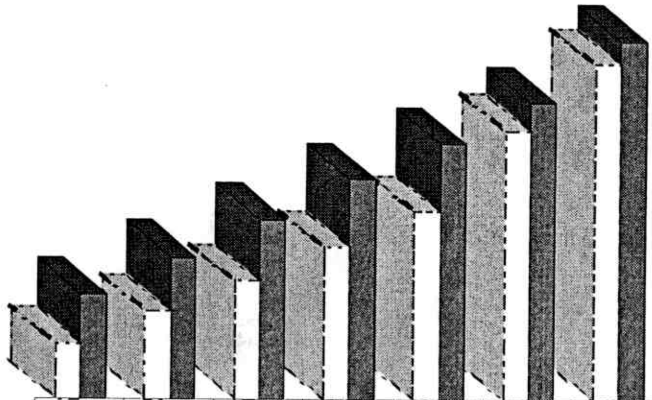
	GF	GF/FGF	FGF	FGF/G	G	G/FG	FG
Mic. before cleaning	2.58	2.69	2.85	2.94	2.98	3.25	3.3
Mic. after cleaning	2.41	2.45	2.76	2.85	2.94	3.22	3.29

Fig. (2): Divergences in micronaire value (Mic.) due to cotton cleaning in Giza 45



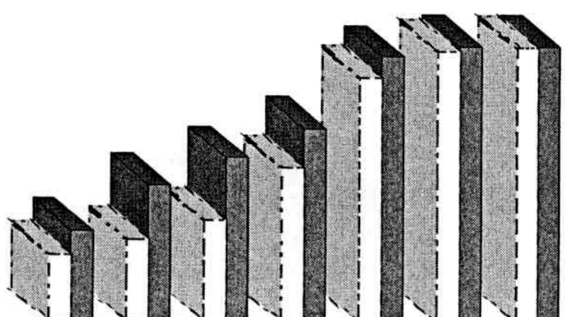
	GF	GF/FGF	FGF	FGF/G	G	G/FG	FG
Mic. Before cleaning	3.11	3.35	3.45	3.95	4.09	4.34	4.46
Mic. After cleaning	2.95	3.2	3.19	3.79	3.96	4.25	4.45

Fig. (3): Divergences in micronaire value (Mic.) due to cotton cleaning in Giza 70



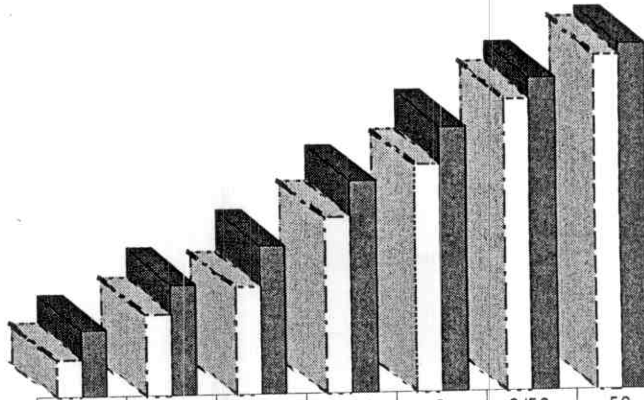
	GF	GF/FGF	FGF	FGF/G	G	G/FG	FG
Mic. Before cleaning	2.7	2.88	3.06	3.25	3.42	3.62	3.92
Mic. After cleaning	2.46	2.62	2.77	2.93	3.1	3.49	3.81

Fig.(4): Divergences in micronaire value (Mic.) due to cotton cleaning in Giza 85



	GF	GF/FGF	FGF	FGF/G	G	G/FG	FG
Mic. before cleaning	3.65	3.98	4.18	4.39	4.91	4.98	4.98
Mic. after cleaning	3.48	3.59	3.73	4.12	4.76	4.96	4.98

Fig.(5): Divergences in micronaire value (Mic.) due to cotton cleaning in Giza 86



	GF	GF/FGF	FGF	FGF/G	G	G/FG	FG
Mic. Before cleaning	2.63	2.99	3.29	3.79	4.22	4.6	4.86
Mic. After cleaning	2.41	2.77	2.97	3.52	3.92	4.45	4.79

Fig.(6): Divergences in micronaire value (Mic.) due to cotton cleaning in Giza 80

	GF	GF/FGF	FGF	FGF/G	G	G/FG	FG
Mic. Before cleaning	2.92	3.28	3.51	3.97	4.19	4.56	4.62
Mic. After cleaning	2.62	2.89	3.25	3.81	3.95	4.53	4.56

Fig.(7): Divergences in micronaire value (Mic.) due to cotton cleaning in Giza 90

Noteworthy, these results contradict those reported by *Yousef (1972), Aboul-Fadl et al. (1982)* and *Ahmed et al. (1984)* who stated that the increase in micronaire value among the samples of cotton due to cleaning processing, and this effect probably ascribed to the removal of a proportion of trash and immature fibers.

The advantage that could be obtained from these interrelations between micronaire value and trash content is that micronaire value may correct some or all the bias that may occur on the part of classer who depends to large extent on trash content in his evaluation of cotton grades. Accordingly, micronaire value could be satisfactorily used as a criterion for cotton marketing value with classer grade.

Conclusion

Cotton grading is a swift tool to determine the market value and the spinning utility, hence cotton price. As long as, determination of cotton grade is usually dependent on the capability of human perception of classers along with their experience and skills, cotton grading is likely material to be exposed to some errors which would result in misjudgment of grade standards.

Cotton varieties and grades have different values of trash content (TC), reflectance percent (Rd%) and micronaire value (MIC), so the same nominal grade has different values of the calculated grade factor. TC, Rd% and MIC contributed 49% of the variation to Gr.F, so lint grade is responsible for the most residual effect (51%). This implicates that Gr.F may be suitable to compare lint cotton grades for each variety separately, therefore, the classer grade as it is, still the ideal assessment of lint grade quality because of its feasibility, fastness, low cost and suitability to the routine work of classing cotton in Egypt.

Because ginning out-turn (GOT) exhibited unexpectedly higher values for extremely low grades than high grades; it seems that GOT has no direct relation with lint grade. In addition, it is exposed to some errors related with processing, scaling, and it demands a lot of work and more time. So in commercial transactions, another parameter adjunct with classer grade could be suggested to evaluate cotton value instead of GOT.

Micronaire value (MIC) has high relation with the other fiber characters, cotton grade, lint yield and yarn quality. Presence of trash content increases micronaire value, in contrast, cleaning the same sample decreases MIC. Trash content (TC) is the most important factor which classers depend on in determining cotton grade. Micronaire value could correct the errors that may occur in classer grade due to mistakes in assessment of trash content. In addition to feasibility, accuracy and also low costs of evaluating micronaire value compared with ginning out-turn or trash content; so using micronaire value in lieu of ginning out-turn synchronizes with classer grade to evaluate the value of lint grade in classing system in Egypt.

Quality of textiles is determined by many properties; such as the properties that make it possible for the product to fulfill its function. So fiber quality index (FQI) was suggested in some certain ways to aggregate fiber quality properties, i.e., fiber length (UHM), fiber strength (FS) and micronaire value (MIC). UHM, FS and MIC are responsible most contribution to the variation in FQI (about 92%). So it is of no worth to add length uniformity in calculating fiber quality index, although it is one of the most factors affecting yarn quality characters, in addition, it is calculated as a proportion of 50 %span length and UHM. As a result of inconstant variation of fiber quality properties among lint grades, fiber quality index failed to account for divergences among lint grades. However, it could recommend to compare lots of cotton varieties on basic grade FG or G/FG to meet the world cottons.