THE MIXING ABILITY OF THE EGYPTIAN COTTONS VIA CMI

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Abstract

In the present work, 6 varieties of the Egyptian cottons were selected for our study where the years of cultivation were recorded. The cotton varieties were G45, G85, G86 and G87 [crops 2009], G85, [crop 2003], G86 [crops 2003, 2006, 2009] and G70 [crop 2003]. The mixing ability of the Egyptian cottons was investigated and calculated by using a formula based on HVI measurements.

The different previously mentioned values of the formula are based on HVI measurements, taking into consideration that any cotton fiber characteristic follow statistical distribution (usually normal) i.e the fiber attributes are characterized by the mean value and the standard deviation or coefficient of variation (C.V%).

The aim of this work is for beneficiarising from the information technology in the cotton spinning industry. An accumulated scientific raw data from Information Data Mining (IDM) were extracted and embodied in formula (1) to generate an important and appreciable value of the cotton mixing performance index of different Egyptian cottons (CMPI). This index can be used for the sake of comparison of the Egy cotton mixinability in the spinning mills by using different fiber to yarn conversion systems. The plan of the study is to measure the fiber attributes of the selected Egyptian cottons - the most commercial ones – by using the HVI instruments.

The obtained measurement [raw data] were kept & saved in an Information Data Mining [IDM] where they have processed Via formula (1) to capture a beneficial knowledge.

The values of the CMPI were recorded for each type of cotton. The values of the CMPI of the used cottons were: for G45 [crop 2009], 66 for G85 [crop2003], 77 for G70 [crop2003], 97 & 98 for G85 [crop 2006 & 2003 respectively], 195 for G86 [crop 2009] and 888 for G87 [crop 2009]. Some interesting value of this work is that the cotton fiber strength was expressed in Mega Pascal (Mpa) where it ranged from 597 for G85 to 712 for G70 where this fulfill the Engineering materials requirement.

Introduction

For many years, the process of cotton fiber mixing has received a great deal of attention particularly in the practical environment. The need to produce a homogenous fiber mixture from hundreds of fiber lot processed together through the opening line has resulted in the development of many innovative fiber handling equipments such as high capacity automatic bale openers and multimixers. The introduction of capable and efficient fiber testing and information system has resulted in improving the knowledge of fiber characteristics critical for efficient fiber blending.

Fiber cotton blending is commonly defined as the process of forming a fiber mixture by combining different cotton fiber components, (e.g cotton lots or cotton bales of different characteristics) are blended together to produce consistent fiber mixture in which fibers from these component are equally presented in the cross section and along the length of the fiber assembly [1].

Yehia El Moghazy and Charles H. Chewning, TR., 2001 [2] have written that in practice, the extent of meeting two basic criteria [homogeneity & attributively] of the blending process, the following factors are included; the fiber selection scheme, the capability of the blending equipment, the extent of fiber attributes variability and the dynamics changes in the distribution of fiber attributes of the bale population.

In the work [3], an Egyptian cotton G89 was processed inside a spinning mill, using two systems of fiber to yarn conversion systems, i-e carding line and combing line. The fiber machine interaction was investigated. It has been found that % change in the fiber length was ranging from 3-7 % while it was ranging from 11-13% for the fiber tenacity.

Dan J. Mccreight, Ralph W. Feil, James H. Booterbauph and Everette E. Backe [4] have stated that definitions of how the term "blending" and "mixing" are and should be used will be helpful. Blending and mixing are often used interchange ably, but really do not mean the same thing. Blending refers to the exact measurement of

important fiber properties and scientific proportioning and combining of these properties. Proper blending of fibers in this case contributes to predictable and reproducible yarn physical properties. Effective blending of a single fiber type is then the condition of finding each fiber property in a cross section of yarn in proportion to its presence in the mix, and with variations of these proportions only as a consequence of random selection. Mixing is more mechanical them scientific, although the mixing power of a machine can now be expressed with a number. To complicate matter this number is referred as a Blend Factor. Mixing is a means to get to good blending. In the same work [4] an openness index was developed where it is directly relate to the cotton mixing performance.

Zellweger Uster Inc. 1999 [5] has introduced to the spinning industry a spinning consistency Index (SCI) that HVI measurements based index. Cevesteanov A.G., 1982 [6] has established different cotton fiber length relationships that concern both of the staple length and the modal length.

Kothari V.K., 2000 [7] has mentioned that cotton fiber quality is the most dominant factor that determines, to considerable extent, the quality of the yarn, fabric and ready-made garment. Any error or negligible in the selection of raw cotton material can not be corrected by any means in the subsequent processes.

Ibrahim A. Elhawary, 2008 [8] has written that the nano yarn quality index (NYQI) is the master of quality prediction for the Egy cotton yarns. The study of the nano quality index was underlined as an implementation of information technology in the cotton spinning industry.

Ibrahim A. Elhawary, [9] has introduced to the cotton fiber quality technology a new terminology or definition that concerns the Giga Quality Index of the Extras Egyptian cottons. That index was HVI measurements-based. The index was calculated for 4 extras Egy cottons i.e G45, G77x 56 (hybrid type), G86 and G92.

Experimental Work

All the experimental work of the study can be emphasized on the samples withdrawal from the bale laydown that prepared for the mixing mix before the bale openers inside the opening line. From each bale three samples were picked from three different areas of each bale. The picked samples were collected on a cartoon board where they were left for 24 hrs in a conditioned atmosphere inside the testing lab. The conditioned samples were processed through the HVI spectrum according to the procedure mentioned in HVI handbook [5]. The formula used to calculate the mixing ability is:

$$CMPI = \frac{len. \times str. \times Rd \times SCI}{Mic} \times \frac{1}{CV_L \times CV_{str.} \times CV_{Rd} \times CV_{SCI} \times Cv_{Mic}} = \frac{A}{B} \quad \ldots\ldots\ldots\ldots \quad (1)$$

Where:
A : Mean Values of cotton fiber characteristics.
CMPI – Cotton mixing performance Index, Len - UHML of cotton fiber in (mm).
Str. – Cotton fiber strength in Mega Pascal (Mpa), Rd - Color reflectance of cotton fiber.
SCI- Cotton fiber spinning consistency index, Mic - Micronaire value of the cotton fiber.
B : Variabilities values (C.V%) of cotton fiber properties.
CV_L% - Cotton fiber length coefficient of variation, $CV_{str.}$% - Coefficient of variation of the cotton fiber strength, CV_{Rd}% - Cotton fiber color reflectance coefficient of variation, $CV_{SCI\%}$ - Coefficient of variation of the cotton fiber spinning consistency, CV_{Mic}% - Micronaire values variabilities expressed in coefficient of variation.

Results and Discussions

Table (1) shows a summary of the different Egyptian (Egy) commercial cottons fibers attributes: mean values ($\overline{X}$), standard deviation (σ) and coefficient of variation. Usually these fiber characteristics are highly & directly connected with the CMPI – cotton mixing performance index. From table (1) it could be shown that the mean values of the fiber attribute are as follow:

1. The UHMLs of the used Egy cottons are ranging from 30 mm to 35 mm, i.e they follow long and extra long cottons. Giza 70 (G70) UHMLs = 35 mm. cotton occupies the top, while G85 UHMLs= 32 mm. cotton occupies the bottom.
2. The Egy cotton fibers strength is changing from 596 Mpa- Mega Pascal- to 685 Mpa. The highest tenacity concerns G87 cotton while the lowest strength refers to G85 cotton.
3. Taking into consideration, the color reflectance property Rd%, it varies from 72 to 78. The greatest value concerns G86 cotton (crop 2003). The lowest value is to be recorded for G45 cotton.

4. The micronaire values of the commercial Egyptian cottons are ranging from 3.35 for G45 to 4.71 for G86 (crop2009).
5. The spinning consistency index – SCI- varies from 178 for G85 to 216 for G87. This means that G87 is the best while G85 is relatively worst.

Referring to the Egy cotton fibers variabilities – C.V% as a measure, table (1) reveals the following:

1. For fiber length (len – UHML), the CV% is ranging from 1.5% for G87 to 2.4% for G86 cotton (crop 2006).
2. The variabilities C.V% of the strength of the commercial Egyptian cottons fibers are ranging from 3.6% for G87 to 11% for G70 cotton. The most interesting note is that the extras cottons G45 & G70 have the highest C.V% of tenacities.
3. The color reflectance Rd% coefficients of variation are changed from 2% for G86 cotton (crop 2009) to 4% for G70 cotton fiber. The most interesting thing is that the extra long staple cotton G70 has the highest C.V% of color reflectance.
4. Referring to the variabilities in the micronaire values of the commercial Egyptian cottons it could be noted that the highest value is 8.3% for G70 while the lowest value is 2.3 % for G86 cotton fiber (crop 2003).
5. Taking into consideration the coefficients of variation of the spinning consistency index (SCI) we can state that the minimum coefficient of variation C.V% is 3% for G87 but the maximum C.V% is 9% for G70 cotton fiber. The C.V% of SCI for G45 is relatively high.

It could be noted in general that table (1) indicates that the extras Egy cottons have high variabilities as expressed in C.V% affect negatively on the cotton mixing performance index CMPI.

Fig (1) – Fig (10) show the graphical representations or exhibit of all the Egy cotton fibers characteristics as measured by High Volume Instrument HVI as they have been expressed and tabulated in table (1). From these figures, the following notes could be recorded.

1. The highest UHML is 35 mm for G70 while the lowest value is 29.6 mm for G85 cotton.
2. The biggest tenacity is 684.2 Mpa for G87 cotton while the smallest value is 595.5 Mpa for G85.
3. The best Rd% is 77.8 for G86 (crop 2003) while the relative of the worst value is 72.18 for G45 cotton.
4. The largest measure for Mic readings is 4.65 for G86 (crop 2006), while the smallest measure is 3.35 for G45. It is well known that usually the low Mic value is relatively better than the high Mic reading.
5. The distinguished cotton type for the spinning consistency index (SCI) is G87 cotton (SCI = 216.1). G85 has the relatively inferior value (SCI =178).
6. The maximum C.V% for the (SCI) spinning consistency index is 9.2% for G70 cotton while the min value is 3.18% for G87 Egy cotton fiber.
7. The best value of the Mic reading coefficient of variation is 2.3%for G86 (crop 2003) while the worst value of C.V% is 8.3% for G70 cotton.
8. The largest HVI measure for C.V% of the (Rd%) color reflectance is 3.172%for G45 cotton while the least value of Rd% C.V% is 2.3% for G86 (crop 2003).
9. The most prominent C.V% of fiber strength is 10.6% for G70 and the least value is 3.621% for G87 cotton.
10. The biggest C.V% of fiber length (len UHML) is 2.4% for 686 (crop 2006) while the smallest C.V% is 1.508 for G87 cotton.

General speaking, the increase of the coefficient of variations C.V% for any Egy cotton fiber attributes is not desirable and must not be affordable, because it has a negative effect on the cotton mixing performance index (CMPI). On the opposite side any increase of the mean value for any fiber attributes except for micronaire values (Mic) is a good thing and is highly desirable.

Table (2) and figure (11) show the final calculated values of the cotton mixing performance index (CM|PI) where:

1. The highest value for the CMPI is 888 K for G87 cotton.
2. The lowest value of the CMPI is 59 K for G45 cotton in spite of it is an extra long staple cottons.

Seemingly some Egy extras cottons such as G45 & G70 have low mixability. This may be related to; low openness index and relative great variabilities in fiber attributes as expressed in C.V%:

a) G45 has C.V =7% in strength while G70 has C.V =11% also, in strength.

b) G45 has 6% as C.V of micronaire reading while G70 has 8% for the same attribute.
c) The SCI coefficient of variation C.V =7% for G45. G70 cotton has 9% for the SCI value.

The mixability of the Egy cotton fiber G87 is the optimum where it has been highly pronounced. This may be related to the low values of its fiber attributes variabilities as expressed in C.V%, eg UHML C.V = 1.5; Rd% C.V= 1%, strength C.V= 3.6% and C.V of the SCI is 3%. In addition the mean values of the G87 cotton fiber attributes are relatively high.

Conclusions

From the previous results and discussions the following conclusions, can be drawn out:

1. Any Egy cotton fiber attribute follows the normal distribution with its distinguished parameters; mean values ($\overline{X}$), standard deviation (σ). From both of then, the coefficient of variation of the Egy cotton fiber attributes could be calculated as C.V%.
2. Each variety of the Egy cotton fiber has its own specified & individual values of $\overline{X}$, σ and C.V%:
   a) The highest tenacity is 684 Mpa for G87 while the lowest one is 595.5 Mpa for G85 cotton.
   b) The extra UHML is 35 mm for G70 cotton while the minimum value is 30 mm for G85 cotton.
   c) The best value of micronaire reading is 3.35 for G45 cotton fiber and the relative worst value is 4.65 for G86 (crop 2006).
   d) The maximum value of the SCI is 216.1 for G87 cotton fiber while the minimum value of the same attribute is 178 for G85 Egy cotton fiber type.
   e) The largest Rd% ($\overline{X}$ - value) is 79.4 for G85 while the lowest value is 72.18 for G45 Egy cotton fiber.
3. The Egy cotton fibers attributes variabilities as expressed in C.V% have identical values for each type of cotton:
   a) For UHML, the highest C.V% is 2.3% for G85 (crop 2003) while the lowest value is 1.3% for G86 (crop 2009).
   b) The maximum value for C.V% of strength= 10.6 for G70 while the minimum value of tenacity 3.621% for G87.
   c) Referring to the Rd% - C.V% - the largest value is 3.172 for G45 while the minimum value is 1.096 for G87 cotton.
   d) The variability of the micronaire measurements as expressed in C.V% is 8.3% for G70 cotton while it is 2.3 for G85 cotton (crop 2003).
   e) The spinning consistency index (SCI) C.V% is 4.2% for G70 cotton while it is 3.18% for G87 Egy cotton fibers.
4. The proposed formula for calculating the CMPI is:

$$CMPI = \frac{A}{B}$$

Where:

$$A = \frac{Len \times Str. \times Rd\% \times SCI}{Mic}$$

$$B = \left(CV_L\% \times CV_{Str.}\% \times CV_{Rd}\% \times SCI\right)$$

Where:

A – Egy cotton fiber attributes expressed as mean values ($\overline{X}$)
B – Egy cotton fiber attributes expressed as coefficient of variations C.V%

All the symbols embodied in the formula have been explained in the body of the work.

5. For Egy commercial cotton fibers varieties G45, G70, G85, G86 and G87. The value of the cotton mixing performance index is ranging from 59 K for G45 to 888 K for G87.
6. The inferiority in mixability of the Egyptian cotton concerns G45, G70, G85 and G86. The extras Egy cottons G45 & G70 has too low mixability.
7. G87 Egy cotton has a superior mixability and blendability.

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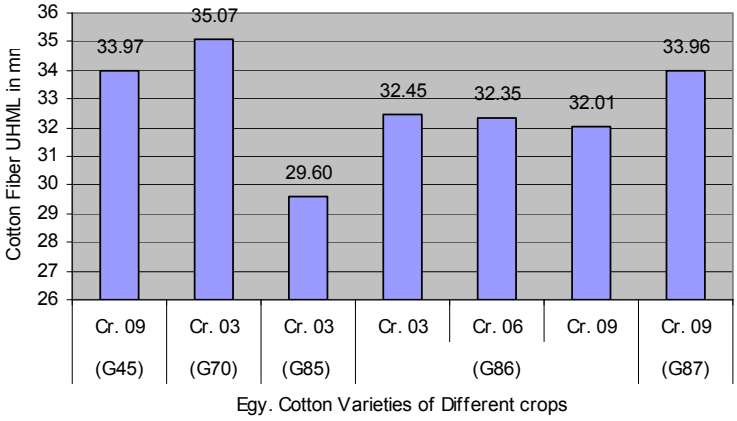
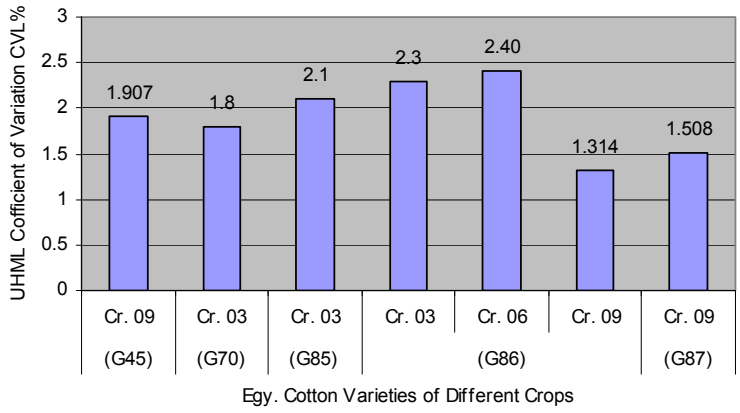
Table (1) A comparative HVI measure of Egyptian cotton of different crops.

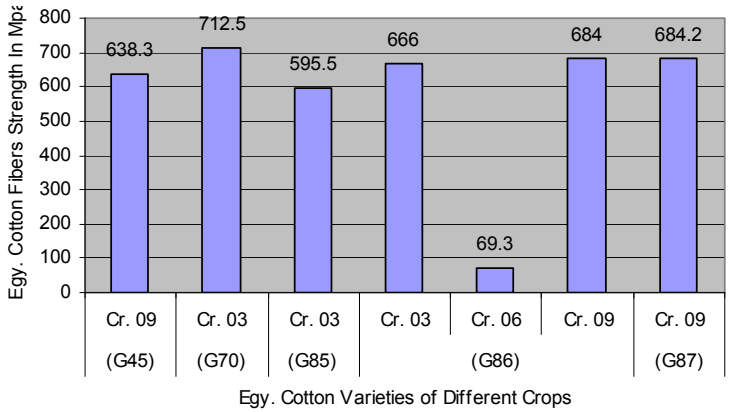
		G45 Cr. 2009	G70 Cr. 2003	G85 Cr. 2003	G86 Cr. 2003	G86 Cr. 2006	G86 Cr. 2009	G87 Cr. 2009
Len(mm) UHML	$\overline{X}$	33.97	35.07	29.60	32.45	32.35	32.01	33.96
	σ	0.648	0.64	0.64	0.734	0.79	0.42	0.512
	c.v %	1.907	1.8	2.1	2.3	2.40	1.314	1.508
Str.(Mpa)	$\overline{X}$	638.3	712.5	595.5	666	69.3	684	684.2
	σ	3.086	5.0	3.2	3.8	3.5	2.713	1.635
	c.v %	7.327	10.6	8.2	8.6	7.7	6.01	3.621
Rd%	$\overline{X}$	72.18	77.6	79.4	77.8	76.1	75.49	75.19
	σ	2.29	3.0	2.2	1.8	1.7	1.512	0.824
	c.v %	3.172	3.9	2.8	2.3	2.3	2.004	1.096
Mic.	$\overline{X}$	3.35	3.99	4.08	4.52	4.65	4.71	3.36
	σ	0.187	0.33	0.10	0.37	0.12	0.187	0.223
	c.v %	5.59	8.3	2.40	2.3	2.5	3.95	6.648
SCI	$\overline{X}$	202.6	226	178	200	203	196.5	216.1
	σ	13.12	21	14	15	15	11.3	6.88
	c.v %	6.48	9.2	8.1	7.3	7.2	5.61	3.18



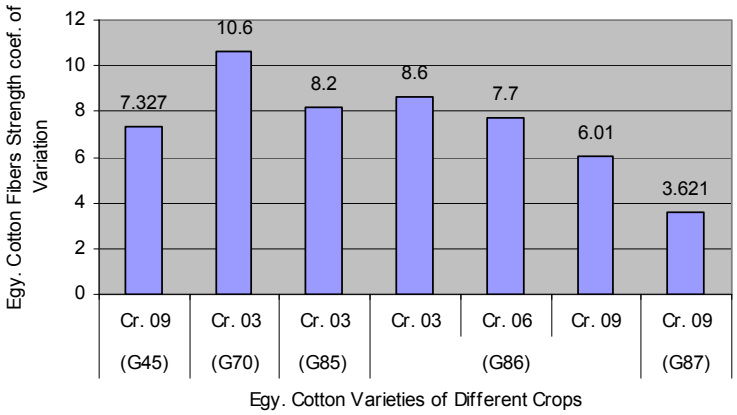
Fig(1) Relationship bet. UHML of cotton fibers & Egy. cotton varieties of different crops



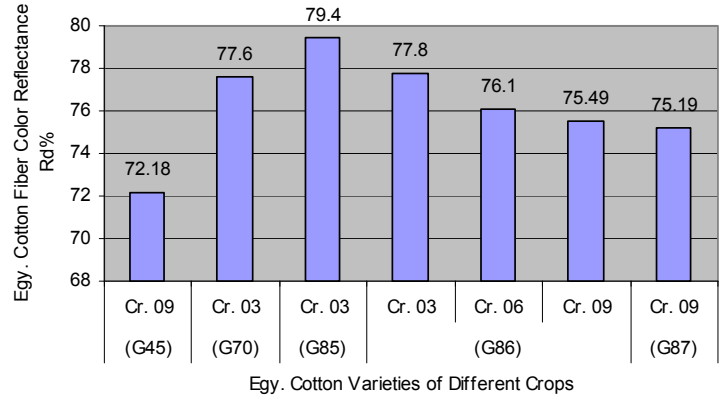
Fig(2) Relationship bet. UHML coef. of variation CVL% of different & Egy. cotton varieties of different crops



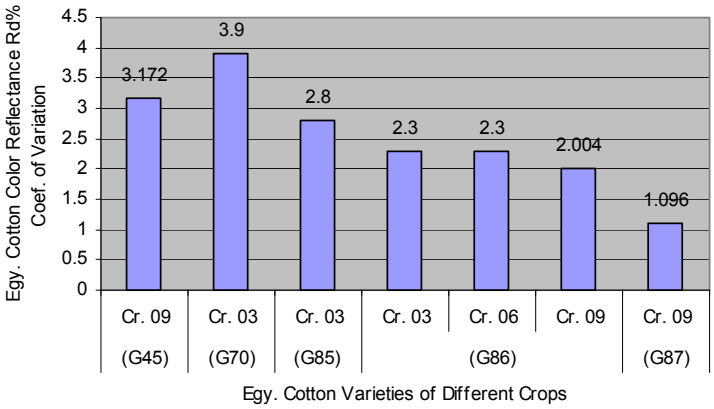
Fig(3) Relationship bet. Egy. cotton fiber strength & Egy. cotton varieties of different crops



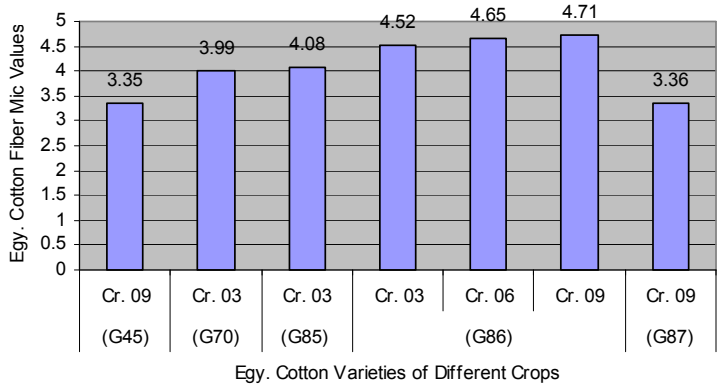
Fig(4) Relationship bet. Egy. cotton fibers strength & Egy. cotton varieties of different crops



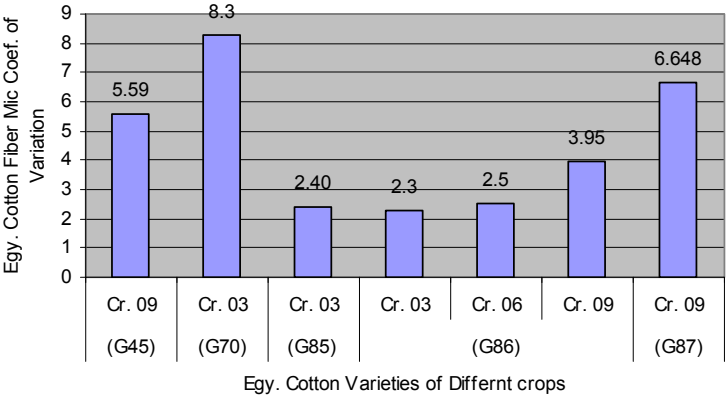
Fig(5) Relationship bet. Egy.cotton fibers color reflectance Rd% & Egy. cotton varieties of different crops



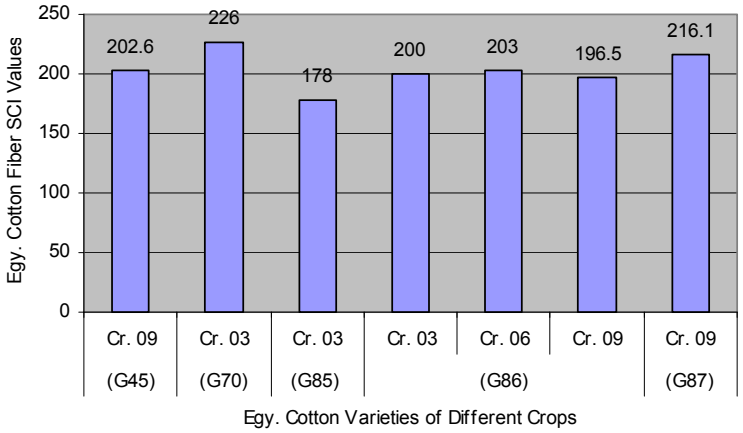
Fig(6) Relationship bet. Egy. cotton fibers color reflectance Rd% coef. of variation & Egy. cotton varieties of different crops



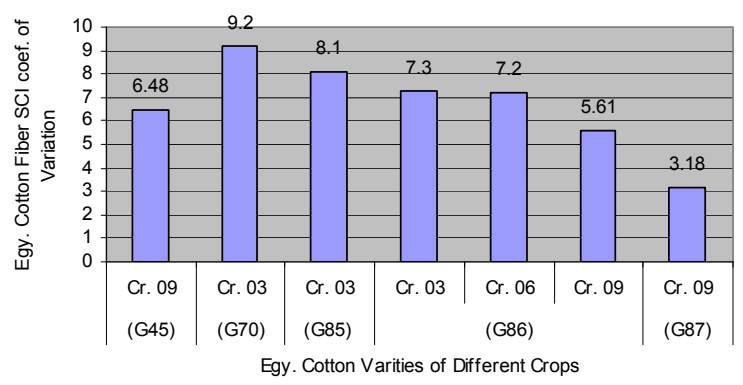
Fig(7) Relationship bet. Mic Values &Egy. cotton varieties of different crops



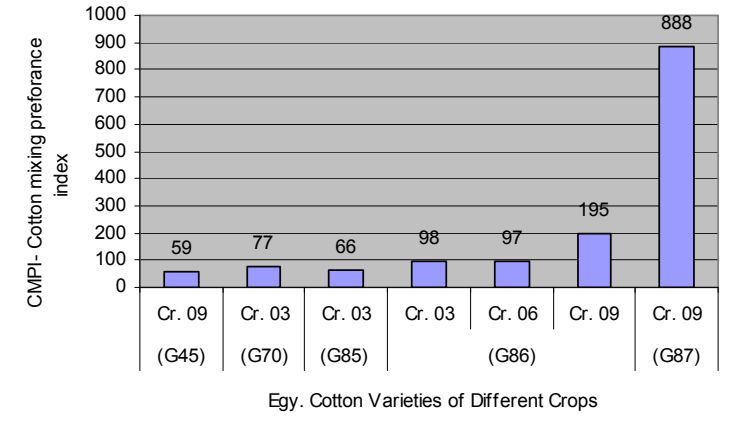
Fig(8) Relationship bet. Egy. cotton fibers Mic coef. of variation & Egy. cotton varieties of different crops



Fig(9) Relationship bet. Egy.cotton fibers SCI values & Egy.cotton fibers varieties of different crops



Fig(10) Relationship bet. Egy. cotton fiber SCI coef. of varition & Egy. cotton fibers varieties of different crops



Fig(11) Relationship betw een CMPI& Egy. cotton varieties of different crops