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EFFECT OF COTTON FIBER MATURITY ON ITS FINENESS MEASUREMENTS

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ABSTRACT

Aiming to study the effect of fiber maturity on fiber fineness measurements and using HVI micronaire and MR to calculate an estimate value of fiber, perimeter P, diameter D and cross section area ACS compared to image analysis cross section data. Lint cotton samples of three Mike levels from seven Egyptian cotton genotypes representing ELS, Delta and South Egypt LS cottons were tested by HVI, cutter & causticare and Cross section - Image analysis direct methods. The results indicated that mature fibers have bigger P, D and ACS than low mature fibers; the normal mature fibers (medium Mike level) showed calculated perimeter values similar to Image analysis determined ones while the low mature and high mature samples showed biased low and high values. Calculated D was smaller than the large width determined by image analysis, while calculated ACS showed higher values than Image analysis ones. Data of P, D, and ACS obtained from Applying Lord equation to HVI Mike and MR were more accurate and reliable than those obtained from using Mike* 39.37 to calculate these parameters. Regression equations were developed to make corrections to the calculated data:

Perimeter µ $Y = 4.792 + 0.899x$, **Diameter µ** $Y = - 2.905 + 1.262x$
Area of cross section µ^2 $Y = 56.192 + 0.591x$

INTRODUCTION

Fiber fineness is one of the most important fiber properties due to its effect on cotton processing and on the quality of yarn, fabric and the product. As the size of the yarn goes finer, fiber fineness becomes increasingly important. Fiber fineness is one of the main advantages in Egyptian cotton; therefore, Egyptian cotton breeders need an accurate, reliable and rapid measure for fiber fineness to be used in the selection from the high number of samples representing varieties, crosses and different generations in the breeding program. There are two famous terms for fiber fineness:

1-Intrinsic fineness (biological fineness): It is expressed by the diameter of a circular cross section, perimeter and area of fiber cross section. Intrinsic fineness is a varietal characteristic genetically determined **Bange *et al.*, (2009)**.

2- Gravimetric fineness: It is known as fineness by weight or weight per unit length or linear-density. Micronair is a measure for Gravimetric fineness that depends on both of intrinsic fineness and maturity. It is an expression of both characters in combination. **Ramy 1982** stated that gravimetric fineness could be refered to biological fineness if fiber maturity is known.

Intrinsic fineness could be measured directly from the fibers obtained from the green boll just before opening, but it is not an easy method. Image analysis and cross-section technique is acknowledged as a direct reference method for fineness and maturity measurements on cotton, **Thibodeaux *et al.*, (2000) ; Xu and Huang (2004)**. Measuring the diameter of the swollen fiber treated with 18% sodium hydroxide can provide an estimate of fiber diameter and perimeter. Averaging of the widths of the different parts along cotton fiber can also provide an estimate of fiber diameter. However, **Hequet and Wyatt (2001&2009)** reported that these direct methods are tedious and too slow to be of practical use in commercial operations or cotton breeding programs. On the other hand, airflow methods are most popular to measure fineness and maturity of cotton fibers, due to the testing speed and the acceptable accuracy level of their measurements, especially in cotton marketing purposes. As stated by **Lord and Heap 1988**, micronaire reading is a combination of fiber maturity (degree of secondary cell wall development) and fineness (cross section area, perimeter, and diameter) of cotton fibers, they also stated that fiber maturity and fineness are two obviously independent variables. Nemours efforts and intensive research work were conducted to study the relationships between micronaire components (fineness and maturity). In this concern **(May (1999) and Stewart *et al.*, (2010)** indicated that low micronaire could result from immature fibers or genetically fine fibers, While, higher micronaire indicates either coarse fibers or thinner fibers with thick cell walls making the problem of measurement more difficult. Furthermore, **Lord (1981)** stated that the variation in maturity has a magnified effect on micronaire value than its fineness. **Rose and Cauthen (1994)** added that micronaire value does not adequately assess varying fiber perimeter for different genetic cotton verities and thus is not satisfactory as a real measure of fiber maturity. The double compression methods like Arealometer, FMT and Micromat can provide separate measures for fiber fineness and maturity but they are not rapid and accurate enough for different reasons. New types of HVI provide mike value and calculated value for maturity ratio (MR).

Aiming to obtain separate values for fiber fineness and maturity parameters. **Lord and Heap (1988)** found a quadratic relationship between the product of fineness H, maturity ratio (M) and micronaire value: $MH= 3.86x^2 +18.16x + 13.0$, where x is micronaire. However, **Hequet *et al.*, (2006)** has suggested that some minor adjustment to this relationship might be appropriate since the linear density ranged from 160 to 203 mtex and maturity ratio ranged from 0.75 to 0.95 in same micronaire value (4.1). More equations were developed by **Thibodeaux *et al.*, (2000), Hequet and Wyatt (2001), Mohamed *et al.*, (2007)** to explain the relationships between fineness and maturity parameters as follows:

HS (hair weight standard) in mtex = $(HW*MR)/MR^2 = HW/MR$

ASCW (area of secondary cell wall) (μm^2) = HS/1.52 (cellulose density)

P (perimeter µm) = $3.7853\sqrt{(HS)}$

D (diameter µm) = P/3.1416, or $1.2047\sqrt{(HS)}$

Ɵ (cross section circularity) = MR* 0.577

Neelakantan (1977) modified this equation to be : Ɵ = 0.577MR+ 0.079

Nair and Nachane (2009) reported that one micronaire unit means 1 µg/inch which is equal to 39.37 mtex. They multiplied the micronaire values from HVI by 39.37 and found that the calculated values agreed very well with the actual gravimetrical fineness measured by AIFS.

Applying the mentioned equations to HVI micronaire value and maturity ratio (MR) can provide any of the needed fiber fineness and maturity parameters separately, which is very important in cotton breeding programs and research when dealing with high number samples from different cotton genotypes, crosses and varieties since the direct methods are slow and time consuming as aforementioned

Contrary to the common idea that fibēr diameter is set at fiber initiation and it is maintained through the duration of fiber development and the perimeter cannot change after the thick, less-extensible secondary wall begins to be deposited. **Boylston et al. (1993) and Seagull et al. (2000), Abd El-Gawad (2006), El-Marakby et al (2011) and Rodgers (2013)** found that fiber diameter and perimeter are dynamic traits change significantly throughout fiber growth and development, Indicating that both of them could be affected by degree of thickening (fiber maturity). **Hussain (2002)** found that fiber perimeter ranged from 43.57 to 46.83 µ when mike value ranged from 2.6 to 3.3 in Surabhi variety, While, ranged in Wagad coarse variety from 79.15 to 81.65 µ, when mike value ranged from 4.8 to 6.6 indicating that fiber perimeter of the same variety could change according to the change in m̱̄ike value (maturity). **El-Marakby *et al.*, (2011)** found that fiber perimeter of the Egyptian cottons estimated from HVI data was about 2-3µ higher than the actual perimeter of the cross-section in the ELS and Delta long staple cottons, while being 0.5-1.5µ lower in Upper and Middle Egypt long staple coarse cottons. **Arafa (2014)** found that perimeter readings by Image Analysis were slightly higher than those calculated from HVI data.

Therefore, the main objectives of this study are to:

Studying the effect of fiber maturity and measuring and calculating methods on measured and calculated fiber perimeter, diameter and area of cross section.

Comparing HVI calculated MR, HW and HS values with those obtained from Causticare and cutter direct methods.

Using HVI micronaire and MR to calculate an estimate value of fiber diameter, perimeter and cross section area compared to image analysis cross section direct methods data.

MATERIALS AND METHODS

Seven Egyptian cotton genotypes namely: Giza 88, Giza 93 and the promising cross [G84 (G70 x G51b)]S62 (ELS cottons), Giza 86 and Giza 94 (Delta LS varieties), Giza 90, and Giza 95(South Egypt LS varieties) were used in this study. The lint cotton samples of these cottons were selected from the yield trials of Cotton Research Institute delivered to (HVI) lab, Cotton Fiber Res. Section, Cotton Res. Institute in 2015 season. All the cotton samples were homogenized, conditioned and tested under standard temperature 20±2ºC and relative humidity 65±2% RH, as recommended by ASTM (D1776-05). HVI Spectrum II was employed for testing these samples according to **ASTM D5867-05. (2005)**. Based on HVI micronaire values, the different samples of each variety were divided to three levels of micronaire (three levels of maturity). The obtained data of micronaire and MR was computed to calculate the product of fineness and maturity (HW*MR) from the relationship: $HW*MR_1 = 3.86(Mic)^2 + 18.16(Mic) + 13.0$. In addition, HVI micronaire values were multiplied by 39.37 to be converted into HW in millitex according to **Nair and Nachane (2009)**. Causticare method and cutter method (direct methods) were used to determine actual values of MR and HW according to British Standard Methods, BSM 3085:1968. and BSM 2016:1961. All the obtained HW and MR values were used to calculate hair weight standard (HS). Applying the following equations to these parameters provided calculated fiber perimeter ($P_)$), diameter (D) and area of fiber cross section ACS.

$HS\ (mtex) = HW*MR_1/MR^2 = HW / MR$

$Perimeter\ P\ (\mu m) = 3.7853\sqrt{(HS)}$

$Diameter\ D\ (\mu m) = P / 3.1416$

Area of cross section $ACS = (1/2\ D)^{2\ *}\ 3.1416$ (area of a circle having the same perimeter)

Cross sections were prepared from the samples of each micronaire level within each variety and cross to be tested by image analysis direct method. The procedure was conducted as explained and used by **Boylston *et al.*, (1993)** at the lab of Fiber Chemical and Structural Properties, Fiber Res. Section Cotton Res Institute to determine fiber perimeter (P), diameter (D), and area of fiber cross section ACS.

The obtained data were computed using **SAS(2001)** program. Analysis of variance and LSD 5 % test, outlined by **Snedecor and Cochran (1986)** were employed to study the effect of mike levels (maturity), measuring and calculating method on the measured and calculated values of fiber fineness and maturity parameters. Regression and correlation analysis was used to study the relationship between the calculated and measured parameters of fineness.

RESULTS AND DISCUSSION

Analysis of variance for the measured and calculated fineness and maturity parameters showed that the effect of micronaire levels (maturity levels); measuring and calculating methods had significant effects at 5% level on most of these parameters.

Effect of micronaire levels, measuring and calculating methods on MR, HW, and Hs values:

Data in Table `1 and Figure 1 showed that cotton genotypes, the three-micronaire levels, measuring and calculating methods recorded significant differences in MR, HW and Hs in most cases. The three levels of micronaire (Mike) averaged 3.08, 3.96 and 4.55 while HVI and Causticare MR recorded nearly similar averages being around 0.87, 0.95 and 1.02 for the three levels of micronaire with no significant differences. HVI MR values match well Causticare MR values in most of the studied genotypes specially in the LS varieties.

Concerning HW (hair weight or weight of 1 cm in mellitex), the low mike level showed higher values and means of HW when measured by Cutter method (HW3) than the calculated HVI HW1 and HW2, the recorded means for this level were, , 123.7, 120 and 130.7 m/tex for HW1, HW2 and the HW3 respectively. While, in the medium mike level (normal maturity) both of Cutter method (HW3) and HVI HW1 showed nearly similar means and values over the studied genotypes. The differences between them ranged from 1 to 4 m/tex. Within this normal maturity level both calculated HWI and measured HW3 arranged the studied genotypes similarly according to their HW values as follows: Giza 93, Giza 88, [G84 (G70 x G51b)]S62, Giza 94, Giza 90, Giza 86 and Giza 95. Moreover, HVI HW2 recorded higher means and values than HW1 and HW3 in both of the medium mike level and the high mike level (very mature) in all the studied varieties. The obtained results indicated that the calculated HW1 obtained from applying Lord Equation (MH= $3.86x^2$ +18.16x + 13.0) to HVI mike and MR match well the Cutter method HW3 when dealing with mature fibered samples than when dealing with low or very mature samples, while HW2 calculated from HVI mike only (mike* 39.37) showed higher biased HW values under the normal and high mike levels of the studied varieties. The differences between HW1, HW2 and HW3 differed from one genotype to another and between the three Mike levels as well.

Table 1: Micronaire, MR, HW and Hs for some Egyptian cotton genotypes measured and calculated from HVI, Cutter and Causticare methods

Genotypes	HVI Data and calculated HW &Hs						Cutter method method	Causticcaire method	
	Mike	MR	HW1* (m/tex)	Hs1 (m/tex)	HW2** (m/tex)	Hs2 (m/tex)	HW3 (m/tex)	MR	Hs3 (m/tex)
Giza 88	2.75	0.86	110.0	125.0	108.3	123.1	120.0	0.87	137.0
	3.70	0.95	139.0	146.3	145.7	153.4	138.0	0.95	145.3
	4.34	1.01	161.0	159.4	172.8	171.1	154.0	1.04	148.1
Mean	3.60	0.95	136.7	144.4	142.3	149.2	137.3	0.95	143.5
Giza 93	2.44	0.87	94.0	106.8	96.1	109.2	111.0	0.87	122.0
	3.00	0.94	120.0	122.1	125.1	125.6	118.0	0.92	128.3
	3.60	1.00	135.0	133.7	141.7	144.6	132.0	1.02	129.4
Mean	3.01	0.94	116.3	120.0	121.0	126.5	120.3	0.94	126.6
Giza 96	3.11	0.87	122.0	140.4	122.0	140.2	125.0	0.88	143.0
	3.85	0.95	144.0	150.7	151.0	158.9	143.0	0.97	147.0
	4.31	1.02	159.0	158.9	169.0	165.7	153.0	1.03	148.5
Mean	3.76	0.95	141.7	149.3	147.3	153.9	140.3	0.96	146.2
[G84 (G70 x G51b)]S62	3.33	0.87	132.0	151.2	131.0	145.6	138.0	0.87	158.6
	4.35	0.95	164.1	178.9	171.0	176.3	160.0	0.98	161.2
	4.97	1.04	192.6	184.6	195.7	188.2	170.0	1.05	166.7
Mean	4.22	0.95	165.3	171.6	165.9	170.0	156.0	0.97	162.2
Giza94	3.31	0.86	134.0	152.3	130.0	147.7	139.0	0.87	159.8
	4.25	0.96	161.0	167.1	167.0	174.0	158.0	0.95	166.0
	4.85	1.03	184.0	178.6	190.9	185.3	170.0	1.03	165.0
Mean	4.14	0.95	159.7	166.0	162.6	169.0	155.7	0.95	163.6
Giza 90	3.20	0.86	129.0	146.6	125.0	134.1	145.0	0.86	160.0
	4.10	0.95	158.0	166.4	161.4	170.0	157.0	0.97	161.9
	4.84	1.02	181.0	177.5	191.0	187.3	172.0	1.03	165.0
Mean	4.05	0.94	156.0	163.5	159.1	163.8	158.0	0.95	162.3
Giza 95	3.42	0.87	140.0	157.3	134.6	151.2	150.0	0.87	164.0
	4.44	0.95	168.0	175.3	174.8	184.0	164.0	0.97	169.0
	4.92	1.03	185.0	179.6	193.7	188.1	178.0	1.04	171.2
Mean	4.26	0.95	164.7	170.7	167.7	174.4	164.0	0.97	168.1
Mike levels (maturity)	3.08	0.87	123.7	130.6	120.0	135.4	130.7	0.87	149.8
	3.96	0.95	148.7	154.7	155.8	163.9	146.3	0.96	153.9
	4.55	1.02	170.4	167.0	179.3	175.7	163.1	1.04	155.4
Mean	3.86	0.95	147.4	150.8	151.7	158.4	145.7	0.96	153.0

* calculated by applying Lord Equation
** calculated from Mike * 39.37
*L.S.D. at 5% level of significance

	MR	HW	Hs
L.S.D Mike level (m)	0.02	3.6	3.7
L.S.D. Genotype (g)	0.02	3.3	3.5
L.S.D. measuring methods (th)	0.03	3.6	3.8
L.S.D. m × g	0.04	4.2	4.4
L.S.D. m × th	0.04	4.3	4.5
L.S.D. g × th	0.05	4.5	4.7
L.S.D. m × g × th	0.05	5.1	5.6

Hs (hair weight standard) is a fiber fineness parameter that express hair weight without the effect of maturity by dividing hair weight by maturity ratio (MR). HS in mtex = HW/ MR . It is an important parameter that used for calculating fiber Perimeter (P (perimeter µm) = 3.7853√ (HS), fiber diameter D µm = 1.2047√ (HS), area of secondary cell wall ASCW (ASCW (µm2) = HS/1.52 (cellulose density), area of cross section ACS and other fineness and maturity parameters, therefore it is worthy and important to study and compare the different Hs values and means. Data in Table 1 indicated that Hs means and values showed nearly the same trend of HW calculated and measured values. In all the studied varieties, samples of the low mike level showed lower values of Hs1 calculated from HVI Mike and MR than Hs3 obtained from Cutter method and Causticare data. The differences between them in Hs values ranged from 5 to 17 mtex, whereas in the medium (normal) micronaire level, HVI Hs1 showed nearly similar Hs values as compared to Hs3. The differences between their values did not exceed 4 mtex. Both of them ranked the studied varieties similarly just like in case of HW1 and HW3. In the high mike level (very mature), both Hs1 and Hs2 showed significantly higher Hs values than Hs3 specially in Delta and south Egypt LS varieties. The differences amounted to 18 mtex. The similarity of the trend of HW and Hs is expected since Hs is obtained from HW divided by MR which is nearly similar in HVI and Causticare data. The differences between calculated and measured Hs will affect directly all the calculated fineness and maturity Parameters as, D, P, ACS, ϴ and ASCW(area of secondary cell wall)

Effect of micronaire levels, measuring and calculating methods on P, D and ACS values:

The results in Table 2 showed significant differences between genotypes, Mike levels, measuring & calculating methods and their interactions in measured and calculated fiber intrinsic fineness parameters; perimeter P, diameter D and area of cross section ACS of the studied cotton varieties. The obtained results led to the following conclusions:

Concerning fiber Perimeter (P), both of the measured and calculated perimeter values showed clear increase in fiber perimeter of the mature and very mature fibers (middle & high Mike levels) compared to the low mature fibers (low Mike level) over the studied genotypes. This increase ranged in the image analysis P4 and cutter & causticare data P3 from 1 to 2 **µ**, while this increase was more clear in P1 and P2 calculated from HVI data, it ranged from 2.8 to 7.5 **µ**. The increase in fiber perimeter due to maturity differed from one genotype to another and between maturity levels as well.

Table 2: Fiber diameter D, Perimeter P and area of cross section ACS for some Egyptian cotton varieties measured and calculated from HVI, Cutter and Causticare methods

Genotypes	HVI Data and calculated diameter, perimeter & ACS						Data of cutter & Causticaire			Data of Image analysis		
	Application of Lord equation*			Mike*39.37			direct methods			direct method		
	D1	P1	ACS1	D2	P2	ACS2	D3	P3	ACS3	D4	P4	ACS4
	μ	μ	μ^2	μ	μ	μ^2	μ	μ	μ^2	μ	μ	μ^2
Giza 88	13.8	42.3	149.5	13.4	42.0	141.0	14.2	44.3	158.2	15.3	43.2	143.4
	14.6	45.8	167.3	14.9	46.9	177.8	14.5	45.6	165.0	15.8	45.1	145.8
	15.2	46.8	181.4	15.8	49.5	196.6	14.7	46.1	173.4	16.4	45.2	147.6
Mean	14.5	45.3	166.1	14.7	46.1	171.8	14.5	45.3	165.4	15.8	44.5	145.6
Giza 93	12.5	39.1	122.7	12.6	39.6	125.8	13.3	41.8	138.3	12.9	40.8	132.0
	13.4	42.1	141.0	13.5	42.4	144.7	13.5	43.3	144.2	13.9	42.0	139.0
	13.9	43.8	151.7	14.5	45.5	164.8	13.7	43.3	146.2	14.6	42.1	141.0
Mean	13.6	41.6	138.8	13.5	42.5	145.2	13.5	42.8	142.8	13.8	41.6	137.3
[G84 (G70 x G51b)]S62	14.3	44.9	167.3	14.1	44.8	154.3	14.4	45.3	162.7	14.1	45.0	146.0
	14.8	46.9	171.6	15.2	47.7	181.2	14.6	46.9	167.3	15.4	46.0	149.0
	15.2	47.7	181.4	15.5	48.7	188.0	14.7	46.9	173.6	15.4	46.6	151.0
Mean	14.8	46.5	173.5	14.9	46.9	174.3	14.6	46.4	167.7	15.0	45.9	148.7
Giza 86	14.8	46.5	171.7	14.5	45.7	165.0	15.2	47.7	181.4	15.0	47.0	154.0
	16.0	49.4	201.0	16.2	50.3	206.0	15.3	48.9	184.7	16.4	48.8	156.0
	16.2	50.9	206.0	16.5	51.9	213.7	15.6	48.9	191.6	17.0	49.1	161.0
Mean	15.7	49.0	193.0	15.7	49.6	195.2	15.4	48.5	185.9	16.1	48.3	157.0
Giza 94	14.5	46.7	165.0	14.6	46.0	167.4	15.2	47.1	181.5	15.8	47.8	150.0
	15.6	49.0	191.5	15.9	49.9	199.3	15.3	48.8	184.2	16.2	48.5	154.0
	16.1	50.6	203.5	16.4	51.5	211.1	15.5	48.7	188.6	16.4	49.0	156.0
Mean	15.3	47.8	187.0	15.6	49.2	192.6	15.3	48.2	184.8	16.1	48.4	153.3
Giza 90	14.6	45.8	167.1	14.4	45.3	162.9	15.2	47.9	181.4	16.2	49.2	185.0
	15.6	50.7	191.5	15.8	49.4	194.3	15.3	49.5	184.2	18.1	51.0	191.0
	16.1	50.6	203.5	16.5	51.8	213.7	15.5	49.8	188.5	18.3	51.6	193.0
Mean	15.4	49.0	187.3	15.6	48.8	192.3	15.3	49.1	184.5	17.5	50.9	189.7
Giza 95	15.1	47.5	179.0	14.8	46.6	171.9	15.4	48.5	186.3	16.1	50.1	190.0
	16.0	51.7	201.0	16.3	51.3	209.8	15.6	50.6	191.4	18.2	52.0	195.0
	16.2	51.7	205.8	16.5	51.9	213.7	15.8	50.5	196.5	18.3	52.3	197.0
Mean	15.8	50.3	195.3	15.9	49.9	198.1	15.6	49.7	191.4	17.5	51.5	194.0
Mike levels (maturit)	14.2	44.6	158.2	14.0	44.0	153.9	14.9	45.8	174.6	15.1	46.5	157.2
	15.2	47.9	181.2	15.4	48.4	187.3	15.2	47.6	181.2	16.2	47.3	161.4
	15.6	48.9	191.4	16.0	50.1	201.0	15.2	47.6	185.4	16.5	47.9	163.8
Mean	15.0	47.1	177.1	15.1	47.5	180.7	15.1	47.0	180.4	15.9	47.2	160.8

***L.S.D. at 5% level of significance**

	D	P	ACS
L.S.D Mike level (m)	0.4	0.6	0.8
L.S.D. Genotype (g)	0.5	0.6	0.8
L.S.D. measuring methods (th)	0.7	0.7	0.9
L.S.D. m × g	0.7	0.8	1.1
L.S.D. m × th	0.7	0.9	1.3
L.S.D. g × th	0.8	1.1	1.6
L.S.D. m × g× th	1.0	1.4	2.2

Calculated perimeters P1, P2, P3 and the measured P4 ranked the studied cottons similarly but with different means and values. Furthermore, P3 and P4 obtained from cutter & Causticare and image analysis direct methods showed nearly similar means of perimeter being 47.1 and 46.7 microns; however, the differences between their corresponding values ranged from 0.0 to 2.0 microns and differed from one variety to another being slightly higher in Giza 90 and Giza 95 South Egypt varieties, While the calculated P1 and P2 drown from HVI data exhibited the same trend of Msoreover, P1 showed nearly similar values to P4 in case of the medium mike level (mature fibers). The differences between them in this level did not exceed 1 **µ.** However, P2 showed slightly higher P values than all the obtained values under the middle and high Mike levels. . these results agreed with **Boylston *et al.*, (1993), Seagull *et al.*, (2000), Hussain (2002), Abd El-Gawad (2006), El-Marakby *et al.*, (2011) and Rodgers (2013).**

It could be concluded that using HVI data to calculate fiber perimeter is more accurate and provide perimeter values closer to image analysis data when dealing with mature samples than using data of low or very high mature samples, which can provide biased low or high calculated perimeter values. This is very important to optimize the use of HVI Mike and MR data to calculate fiber perimeter as an expression of fiber intrinsic fineness, which is essential in breeding programs and in spinning processing. **Arafa 2014** found insignificant differences in the calculated and measured perimeter between maturity levels

The results in Table 2 indicated that the estimated fiber diameter obtained from HVI data D1 and D2 in addition to D3 calculated from cutter & causticare data is smaller than the large width of fiber cross section determined by image analysis technique the decrease in the calculated diameter ranged from 0.5 to 1.2 **µ** in ELS and Delta LS cottons, while ranged in south Egypt varieties from 0.9 t0 2.0 microns. The low Mike level (low mature) showed lower calculated diameter and measured cross section large width than the middle and high Mike levels (mature and very mature), while the medium and high Mike showed nearly similar D values, indicating the effect of fiber maturity on the calculated fiber diameter and measured cross section large width. D1, D2, D3, and D4 ranked the studied genotypes similarly and similar to the rank of fiber perimeter. It is worthy to report that the calculated diameter is not a diameter of the fiber irregular flattened cross section. It is a diameter of a circle having the same perimeter of the fiber cross section; therefore, it is logic to be smaller than the measured large width of the cross section. **Elmarakby, *et al*. (2011)** came to similar findings .

Area of cross section measured by image analysis (ACS4) averaged 157.2, 161.4 and 163.8 for the three levels of micronaire (maturity); low, medium and high respectively. ACS1 and ACS2 calculated from HVI data as well as ACS3 calculated from Cutter& causticare data showed the same trend of ACS4 being increased as fiber maturity increased. The increase in fiber P, D and ACS due to maturity could be explained by the pressure of the deposited cellulose layers during fiber maturity on the fiber primary wall forcing it to expand and increasing fiber perimeter, diameter and area of cross section **Seagull *et al*., (2000), Hussain (2002), Abd El-Gawad (2006), El-Marakby *et al*., (2011) and Rodgers (2013)**

The calculated ACS1, ACS2 and ACS3 recorded higher values than ACS4 (determined area of cross section) this increase amounted to 10 – 15 % in the ElS genotypes, while amounted to 15 -20 % in Delta LS and South Egypt LS varieties. All the calculated and measured areas of cross section ranked the studied varieties similarly and similar to the rank according to perimeter and diameter. However, the differences between measured and calculated ACS differed from one variety to another as well as from micronaire level to another. It is worthy report that ACS1, ASC2 and ACS3 are areas of circles having the same perimeter of the cross section and expected to be larger than the actual fiber cross section area, which is not a circle, and its circularity is affected so much by cellulose deposition (maturity). **Hussain (2002) ; Abd El-Gawad (2006) El-Marakby *et al*., (2011)** came to similar conclusions.

Aiming to make the calculated perimeter, diameter and area of cross section closer to cross section - Image analysis measurements, the following Regression equations were developed:

HVI data application of Lord equation:

Perimeter µ $Y = 4.792 + 0.899x$ where x is the calculated perimeter

Diameter µ $Y = - 2.905 + 1.262x$ where x is the calculated diameter

Area of cross section μ^2 $Y = 56.192 + 0.591x$ where x is the calculated area of cross section

HVI data Mike*39.37:

Perimeter µ $Y = 10.629 + 0.770x$ where x is the calculated perimeter

Diameter µ $Y = - 0.530 + 1.091x$ where x is the calculated diameter

Area of cross section μ² Y = 79.579 + 0.448x where x is the calculated area of cross section

Data of cutter & Causticare direct methods:

Perimeter μ Y = 16.633 + 1.356x where x is the calculated perimeter

Diameter μ Y = - 9.549 + 1.716x where x is the calculated diameter

Area of cross section μ² Y = - 4.333 + 0.954x where x is the calculated area of cross section

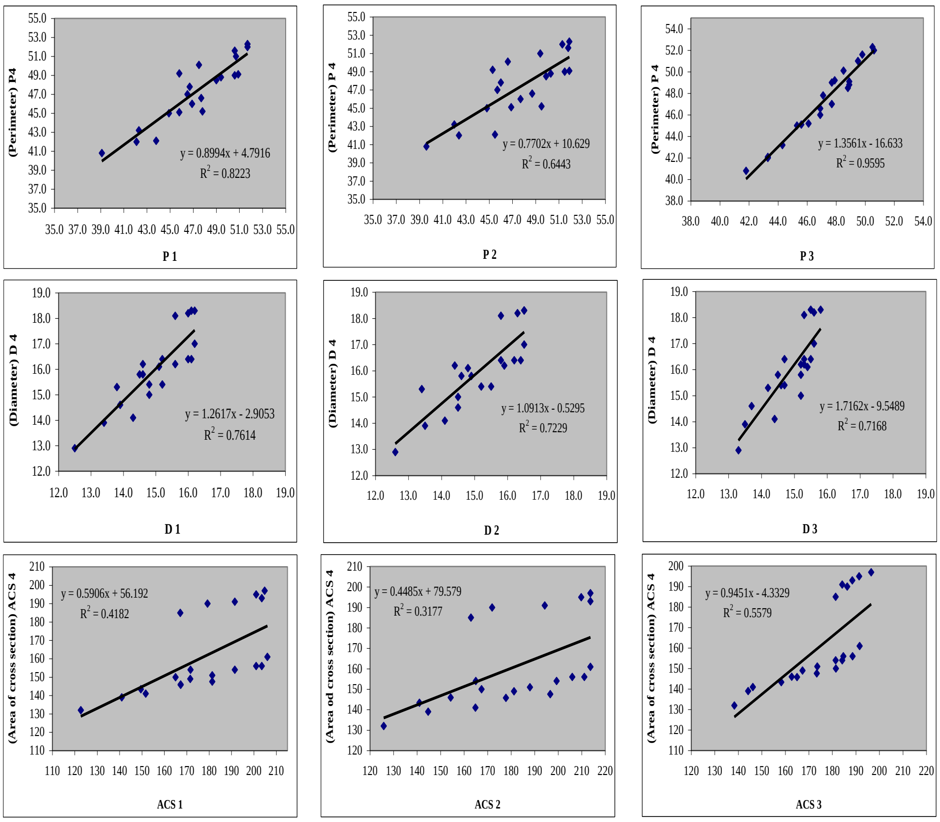

Fig 1: Relationship between measured and calculated values of fiber perimeter, diameter and area of cross section

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تأثير نضج تيلة القطن علي قياسات نعومتها

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تعتبر نعومة التيلة من الصفات الهامة التي تميز القطن المصري وترفع من كفاءته الغزلية وصفات جودة خيوطه ومنتجاته ، ويحتاج مربي القطن إلي قياسات سريعة ودقيقة لنعومة التيلة (محيط وقطر الشعرة ومساحة مقطعها العرضي) لإستخدامها في الإنتخاب لها وتتبعها في الأجيال والمراحل المختلفة لبرامج التربية إلا أن هذه القياسات تتأثر بنضج التيلة كما يحتاج تقديرها بالطرق المباشرة الي كثير من الجهد والوقت والتجهيزات كما أن حساب هذه القياسات من قراءة الميكرونير ونسبة النضج السريعة التقدير بجهاز HVI يحتاج الي إختبار مدي دقتها تحت مستويات النضج المختلفة في أصناف تختلف في نعومتها . وقد أجري هذا البحث لدراسة مدي تأثير نضج التيلة علي قياسات النعومة المقدرة من مقطعها العرضي بإستخدام طريقة تحليل الصورة image analysis والمحسوبة من قراءة الميكرونير ونسبة النضج MR المقدرة بجهاز HVI والمحسوبة من بيانات وزن الشعرة (النعومة بالوزن) HW المقدرة بطريقة القاطع ونسبة النضج بطريقة الصودا الكاوية ومدي دقة قياسات النعومة المحسوبة مقارنة بالمقدرة من القطاعات العرضية للشعرة.

أجري هذا البحث علي 168 عينة قطن شعر من الأقطان المصرية جيزة 88 ، جيزة 93 والهجين المبشر ج84 [ج70 x ج51 ب] س62 (أقطان فائقة الطول) جيزة 86 ، جيزة 94 (طويل بحري) جيزة 90 ، جيزة 95 (طويل قبلي) حيث تم تقسيم عينات كل صنف بناءا

علي قراءة الميكرونير ونسبة النضج الي ثلاثة مجموعات مختلفة النضج (منخفضة وناضجة وعالية النضج).

تم تطبيق معادلة لورد 1981 $MH = 3.86x^2 + 18.16x + 13.0$ لحساب HW من بيانات الميكرونير ونسبة النضج المقدرة بجهاز HVI كما تم حساب HW بطريقة أخري بضرب الميكرونير x 39،37 وحساب النعومة القياسية Hs وإستخدامها في حساب محيط الشعرة وقطرها ومساحة مقطعها العرضي وتتلخص النتائج المتحصل عليها فيما يلي:

- إرتفعت معنويا قياسات HW ، Hs ومحيط وقطر الشعرة ومساحة مقطعها العرضى المقدرة والمحسوبة في الشعيرات الناضجة وعالية النضج عنها في الشعيرات منخفضة النضج.
- قلت قيم HW ، Hs المحسوبة من بيانات HVI في الشعيرات منخفضة النضج بمقدار 5 – 17 ملليتكس عن المقدرة بطريقتي القاطع والصودا الكاوية بينما في الشعيرات الناضجة تساوت قيم HW ، Hs المحسوبة مع المقدرة ولم يزيد الفرق عن 4 مللتكس أما في الشعيرات عالية النضج فقد زادت المحسوبة عن المقدرة خصوصا في صنفي الوجه القبلي وبلغت الزيادة 18 ملليتكس.
- الفرق غير معنوي بين قياسات المحيط المقاسة من المقطع العرضي للشعرة والمحسوبة من بيانات HW ، Hs المقدرة بطريقتي القاطع والصودا الكاوية وتراوح من صفر الي 2 ميكرون.
- إنخفضت معنويا قياسات محيط الشعرة المحسوبة من بيانات HVI بتطبيق معادلة لورد 1981 عن المقاسة من المقطع العرضي للشعرة عند مستوي النضج المنخفض وزادت عنها معنويا في الشعيرات عالية النضج أما في الشعيرات الناضجة فقد تساوت تقريبا معها ولم يصل الفرق لمستوي المعنوية مما يوضح أن حساب محيط الشعرة من بيانات HVI يكون أدق وأقرب للقياسات المتحصل عليها من المقطع العرضي للشعرة في حالة الشعيرات الناضجة أما الشعيرات منخفضة النضج فتعطي قياسات منخفضة وتعطي العالية النضج قياسات أعلي بالمقارنة بالمقاسة من المقطع العرضي.
- قياسات القطر المحسوب من بيانات HVI (قطر دائرة لها نفس محيط الشعرة) أقل من أكبر عرض مقاس للمقطع العرضي للشعرة بمقدار وصل الي 1 ميكرون في الأقطان فائقة الطول وطويل بحري ووصل الي 2 ميكرون في صنفي طويل قبلي.

- مساحة المقطع العرضي المقاسة من المقطع العرضي للشعرة أقل من مساحة الدائرة المحسوبه من بيانات HVI وطريقتي القاطع والصودا الكاوية بمقدار 10 – 15 % في الأقطان فائقة الطول وطويل بحري وبمقدار 15 – 20 % في صنفي الوجه القبلي.
- القياسات المتحصل عليها من حساب HW بضرب الميكرونير x 39،37 كانت أقل دقة واختلفت معنويا عن القياسات المتحصل عليها من طرق التقدير والحساب الأخري.
- تم حساب معادلات إنحدار لتصحيح قيم المحيط والقطر والمقطع العرضي المحسوبة من قياسات الميكرونير والنضج بجهاز HVI والمحسوبة من بيانات طريقتي القاطع والصودا الكاوية.