دراسة في الجدار الثانوي و درجة النضج لشعرة القطن

الأستاذ الدكتور طلال العيبان
كلية الهندسة الزراعية
قسم المحاصيل الحقلية
جامعة الفرات

الدكتور صالح الرزوق
كلية الهندسة الزراعية
قسم المحاصيل الحقلية
جامعة حلب

الملخص

يعتبر كل من معامل النضج و تغلظ أو درجة نمو جدار خلايا الشعرة في القطن من الصفات الفيزيائية الهامة التي بها نقدر جودة المحصول و قابليته للتصنيع. و حتى الوقت الحاضر، كل الأدوات المستخدمة التي تقدر هذه الصفة بشكل غير مباشر و تتبنى طريقة نفوذية و ضغط الهواء تعتمد في تحليلها على معادلات وضعها لورد (في معهد شيرلي خلال النصف الأول من القرن الماضي)، و هي جميعا معادلات محسوبة من طرق تقدير النضج بشكل مباشر، و هو ما يعرف باسم طريقة العد، و تستخدم المجهر الضوئي بدرجة تكبير صغيرة.

و بما أن بعض القيم المحسوبة تأخذ أرقاما غير معقولة و فوق الحدود المسموح بها أو دون هذه الحدود، حتى أنه يفهم من ذلك أن بعض الشعرات ليس لها وجود، أو أنها ناضجة بنسبة تزيد على الحد الأقصى، و هذا غير ممكن، تمت مقارنة النتائج المحسوبة مع النتائج المقدرة بطريقة نفوذية و ضغط الهواء، و ذلك للتوصل إلى طريقة معدلة انطلاقا من الأسس التي أرسى لورد دعائمها. و استخدمنا لتحقيق ذلك برنامجا إحصائيا جاهزا بواسطة الحاسوب. و بعد التعديلات المقترحة تبين أن الانحرافات و القيم الغريبة غير المنطقية بدأت

INTRODUCTION

Maturity of cotton fibre is an element among others give estimates of secondary wall thickening, or scan the fibre whether is solid similar to a rod or empty in form of shell like, but this does not give number of days of fibre on life.

However, maturity ratio, the procedure and the term, gained an outstanding position in quality determination, and had high relationships with other technical elements, like tenacity, a description of how much stress the fibre withstands; and like affinity to dyes, a feature expects the depth of colour shades after submersion in the solutions . It was long and strongly accepted mature fibers, with well developed walls, absorb dye better and are less prone to cause defects of various sorts in the finished product (Montalvo et al., 2002).

Maturity was seen by many as a structural factor which is of most importance in determining mechanical behavior especially failure and deformation (Hearle, 1985). Add to it with normalized micronaire fiber friction increases moisture and electrolyte content decreases, indicating that moisture in conjunction with surface salt content affects the surface characteristics of the fiber, possibly through an anti-electrostatic effect (Gamble , 2005).

Even though micronaire is of great practical value for trade and industry, one must assume a usage of fineness and maturity components – wall thickness and perimeter – altogether , to estimate other geometric dimensions ; and to simulate the interaction of fineness and maturity and the resultant micronaire; and at last to quantify the relative sensitivity of the models to the changes in thickness and perimeter; and to demonstrate variability in the coefficients of determination between micronaire and the other variables (Montalvo , 2005).

In literature it was proved that double compression air flow method has the same maturity values as microscopic count procedure (Razzouk, 1997; Fransen and Verschraege, 1987) , with a tendency for insignificant little lower values (Lawson and Ramey, 1987) . This is true, also, as far as Micromat goes (Montalvo et al., 2002).

Nonetheless, equations that tell one aspect of maturity from another were based in both instances on Lord's , where application of observations are limited to the central portions of fibre body only, which is not , necessarily, applicable in practice. Fibre specimen, in microscopic count, could be limited fairly to certain regions of fibres, but in air flow procedure, we could not. Therefore, distant values were not observable scarcely , but were expected every now and then.

In this instance further focus on the term " Maturity Ratio" was established to examine the meaning of wall thickening, and to what extent practice coincides with theory, when other dimensions of wall fibres are estimated depending on the main standardized procedure.

Observations based in good link with overseas development administration ODA (England), in a long term project lasted for 15 years (1986-2001), in which different institutions had participated, were mostly referred to in literature cited such as Fransen and Verschraege (1987), and petters et al. (1987) where in both instances emphasis were made to prove that overall coefficients of variation can be reduced by using standard cotton to calibrate the procedure to bellow the level of 5% which is considered acceptable on the international arena.

Materials and Methods

Number of different varieties were grown in diverse environments, throughout wide range of periods (3 years).

The source of cotton raw materials were as follows :

I- Chamber grown plant at 30^{o} C day temperature.

II- Green house grown plants at 28 ± 5^{o} C average day temperature.

III- Field grown plants, supplied by the cotton bureau of Aleppo, Syria.

Fibres were examined by IIC Shirley Fineness Maturity Tester to obtain linear density (Hs), maturity ratio (Mr), and maturity percent (Pm2%).

Cultural procedure and instrumental practice were reported in case I and II, elsewhere, in (Razzouk, 1989), and in case III in (Razzouk, 1997).

Maturity ratios were, then, derived from microscopic counts after Lord (1956), where : $Mr = [(N - D) / 200] + 0.70$

N, D indicate normal and dead fibres respectively.

VI- Other values from literature were included. Some adopted direct count methods (Abdel-Salam, 1999 ; Lord, 1956), other followed the methods as given in group I and II (Awad, 2001).

Different quality elements were, in next step, evaluated as follows:

Maturity Percent (Pm) = (Mr – 0.2) (1.565 – 0.471 Mr) (100)

Degree of wall thickening (θ) = Mr 0.85

Wall thickness ω in μm. =

$$0.60\sqrt{Hs[1-\sqrt{1-\theta}\,]}$$

Hs indicates the specific linear density of fibers. All methods of mathematications were taken out from the studies of Lord (1956).

The objectives of this study were to compare airflow methods readings and the direct count data, and then to abridge the gap, if any, between both, by working out a modified formulas better relate both techniques, and to maintain the values of maturity in order without erratic behavior, like estimates above highest theoretical value or unexpected and unreal negative value. For this perspective data were fitted in computer, and analyzed by Microsoft Excel 97 Program .

Results and Discussion

In all instances degree of wall thickening (θ) better indicated the notion of cellulose deposition on the inner side of fibres (Figure 1, Table 1).

Somehow, air flow methods were not able to represent constants for maturity measures (ratio and percent), nor for calculated wall thickness, either when the values converged up or below the medians (Table 1, 2), particularly when materials were obtained from chambers experienced, relatively, high day temperatures (Table 1), for maturity ratios (Mr) ascended to utmost levels above the maximum real value (1.20). Obstacles, then, showed up when forcing the fraction 1- θ square rooted for the determination of wall thickness (Table 1), and values fell to negativity, which suggested the absence of fibres themselves.

Practice did not agree with theory, for when θ is maximized and reached unity, Mr ultimate value will be well above range and score (1.70, Figure 2). On other hand, when Mr is maximized to 1.20 as the British standards would do, the maximum value for θ will come to only (0.69), but when both θ and Mr prevailed and reached top, the constant will rise from 0.577 to 0.8333.

$y = xb - a \rightarrow \theta = 0.8846Mr - 0.06152 = 0.885Mr - 0.062$

To aid a correction a fraction was attempted in the following modified simple formula

The consequences of original formula will shed , even, more doubts on the true meaning of maturity percent (Pm).

When Mr and θ are at top (1.70, 1.20), Pm happens to score 125.13 – 114.6 %. So did air flow method in high temperature environments (105.9%, Table 1), although θ was significantly below unity. Derived Pm, when equation was imposed, is inclined to more erratic models.

On inclusion the maximum and minimum values along with observed ones in Excel Microsoft 1977 program, another form of determination proved convenient as follows θ = 0.8333 Mr.

The correlation coefficient between the two components was (0.9999), and the limits inclined to the expectations (Table 3).

The modified equation did not force Pm to spring up far from solid cylinder by more than 25% (Table 3). The samples grown in confinements at high temperatures, gained, also, out-ranged linear densities (Table 1), and negative ω . Difficulties were probably due to the biased relationships between air flow and dimension changes.

When law density pressure was, on average, about 222 high density pressure equals 116.242 ≈116. On fitting these data in a computer programme the formula would assume this model :

$Mr = 0.246 + 0.1339(Pl^{2.125} / PH^{2})$

Mr values would, thereafter, keep down the 1.77 dangerous grade to just 1.21, and so on. One should note the remarkable agreement between air flow and count procedures.

When samples were selected from standard environments. Pressure drop, in this case, was greater, only, when Mr near to the climax, but when (PL/PH) is about unity Mr would not exceed the intercept of the curvature (Figure 3). The very same modified formula did not correspond with the middle region of the curvature, and proved better

$$Mr = 0.246 Pl / PH + 0.1339 (Pl^{2.125} / PH^{2})$$

coincide with (b X PL/PH), hence the equation took this more exact mode .

Conclusion

Dimensions of cotton fibres were not easy to determine. Despite Lord's highly praised efforts, experience uncovered some incident of biases. And these were bound to add on further difficulties, particularly after taking the air flow as a basic reference in estimation.

To avoid the fall in the abyss, data were fitted in a computer programme, and exposed to minor modifications in order to calculate (a) degree of thickening from microscope counts, (b) and maturity ratio from the drop in air flow at two pressure densities. Values, then, obeyed the true limits, and conflicts did not pop in any further.

Acknowledgments

The discussion of this work was initiated and anticipated at the Cotton Research Institute, Egypt, with particular supervision from Prof. H. A. Awad the past director of the institute and Prof. A. A. M. Al-Ashwat the expert in chemistry of cotton fibres at the same institute, and with helpful advice from prof. M. S. Abel-Salam the cotton technologist at the institute.

Table 1.Cellulose deposition elements

Mr	Hs m.tex	Pm1 %	Pm2 %	θ	ω µm	Source
1.73	69.54	70.4	114.75	0.998	4.89	Chmbers grown 30° C day temp.air flow.
1.77	59.77	90.7	114.77	1.021	-	
1.60	71.56	98.0	113.54	0.923	4.32	
1.51	81.99	105.9	111.87	0.871	4.35	
1.12	129.3	94.2	95.40	0.646	4.34	Grown in glass house, 28 ±5° C air flow
1.06	159.4	90.6	91.68	0.612	4.65	
0.97	151.3	84.5	85.32	0.560	4.28	
0.93	203.4	81.1	82.27	0.537	4.84	
1.130	97.35	-	-	0.652	3.79	Abdel Salam (1999), microscope
1.100	131.82	-	-	0.635	4.34	
1.125	133.33	-	-	0.646	4.41	
1.150	168.70	-	-	0.664	5.05	
1.00	148.00	90	91.29	0.58	4.33	Awad (2001), air flow.
1.03	137.86	91	89.63	0.60	4.27	
0.90	193.86	81	79.88	0.52	4.64	
0.93	194.62	83	82.27	0.54	4.75	
1.04	158.65	90	90.31	0.60	4.59	

Pm1, Pm2 : maturity percent derived from direct and formula calculation respectively. Mr , Hs : maturity ratio and linear density respectively.

θ, ω : degree of thickening and wall thickness respectively.

Table 2. Maturity estimates

Mr1	Mr2	Pm1%	Pm2%		Source
			a	b	
0.61	0.69	68	52.39	60.76	Razzouk,
0.76	0.79	69	67.59	70.39	1997
0.88	0.88	80	78.27	78.27	
0.93	0.93	85	82.27	82.27	
1.09		94	93.63		Lord, 1956
0.86		77	76.56		
0.785		66	69.91		
1.105		95	94.57		
0.84		74	74.82		
0.96		86	84.59		
0.57		46	47.99		
0.465		37	35.67		

Mr1, Mr2, Pm1 : observed, air flow, observed respectively.

Pm2 a, b : calculated from observed and air flow methods respectively.

Table 3. Quality elements derived from new and Lord's equations

θ	Mr	Pm%	Source
1.00 max.	1.20	99.98	New equation
0.83 stand.	0.99	86.96	
0.75	0.90	79.87	
0.50	0.60	51.28	
0.17 minim.	0.20	0.00	
1.00 max.	1.73	125.13	Lord, 1956
0.83 stand.	1.43	109.93	
0.75	1.30	104.80	
0.50	0.87	77.17	
0.17 minim.	0.29	0.00	

Mr, Pm%, θ : maturity ratio, maturity percent and degree of thickness respectively.

max, stand, minim : maximum, standard and minimum respectively.

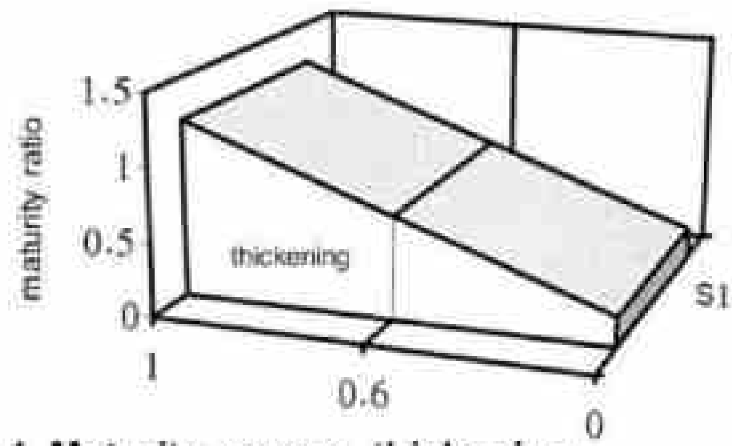
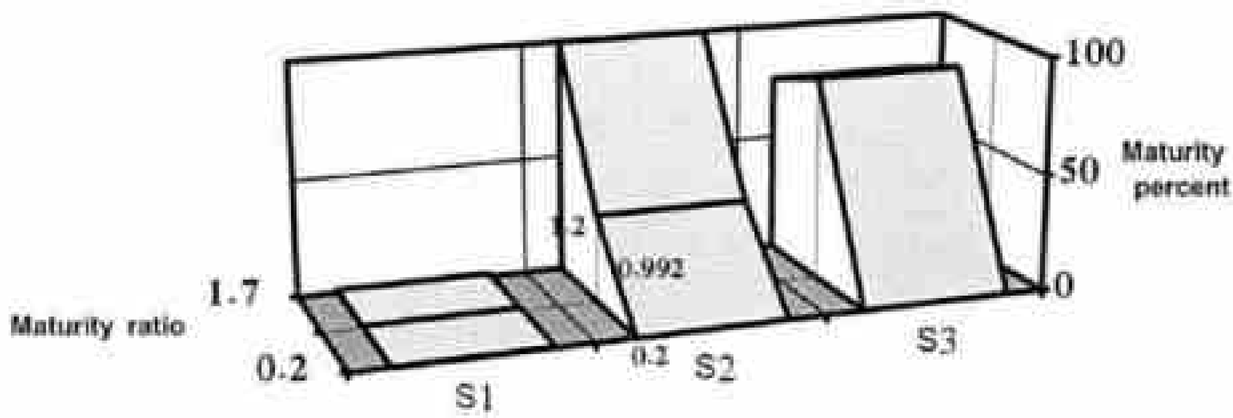


Fig 1. Maturity versus thickening

Fig 2.Maturity ratio observed and calculated versus Maturity percent observed and calculated



$$Mr = 0.246PL / PH + 0.1339PL^{2.125} / PH^{2}$$

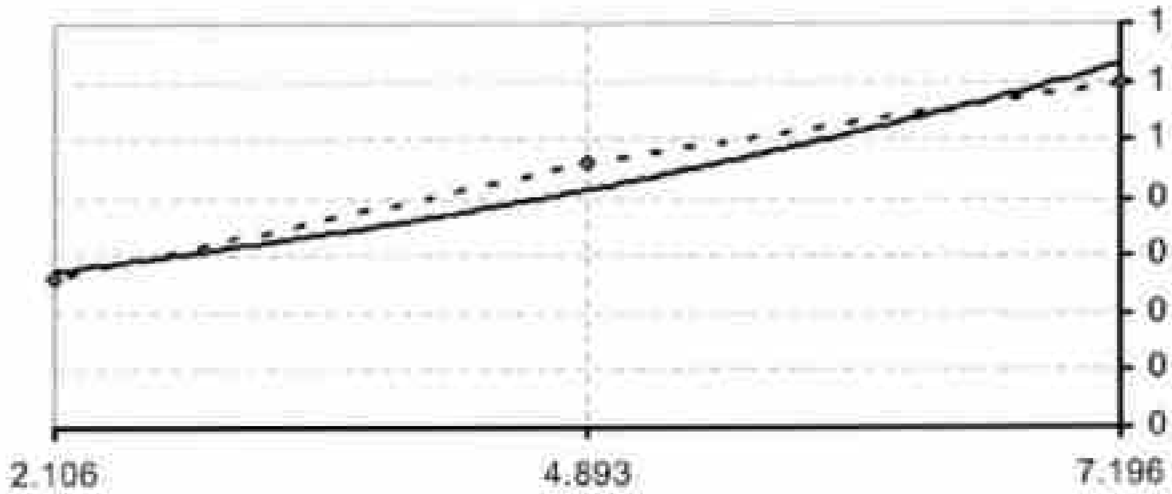


FIG 3.Calculated Maturity Ratio

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تختفي. و بذلك توافقت قيم تقدير النضج بطريقة العد المباشر مع طريقة النضج بنفوذية الهواء و لم تتجاوز العتبة المقبولة سواء فوق المعدل أو تحته.

Studies on Secondary Wall of Cotton Fibres and Maturity Degree

Prof. Talal Al-Eban **Assistant prof. Saleh Razzouk**

Faculty of Agriculture Engineering **Faculty of Agriculture Engineering**

University Of Al-Furat **University of Aleppo**

Syria **Syria**

Abstract

Maturity ratio and degree of wall thickening of cotton fibres were established as a measure of fibre dimension and quality.

To the present moment, all instruments adopted airflow method built their equations on Lord's formulas, those taken from count procedures. Since some values, incidentally, happen to throw their dice over limits, two modified formulas, based on Lord's establishment in cotton quality, were worked out through the fitting data in computer programme models. Biases proved to diminish to a convenient extent in both cases. Thereafter, air flow at two pack densities and microscope counts did not exceed the threshold of either high or low limits.

Received for publication: Accepted for publication:

Abbreviations :

Hs :linear density, Max : maximum, Min : minimum ,Mr: maturity ratio,

Pm1% : maturity percent (count method),

Pm2%: air flow maturity percent (lord's equation), θ : degree of thickening ,

ω : wall thickness.