RIBBON WIDTH, MICRONAIRE READING, AND FIBER MATURITY AS MEASURED BY THE DEGREE OF THICKENING PERCENT, LORD METHOD AND SHIRLEY F/MT INSTRUMENT IN EGYPTIAN COTTON CULTIVARS

Mahmoud T. Nawar, A.M. El-Marakby, M.H. El-Agroudy and R.M. Mohamed
Cotton Research Institute
Agric. Res. Center
Giza, Egypt
Faculty of Agriculture
Ain Shams University
Egypt

Abstract

Twelve commercial Egyptian cotton cultivars were used in this study. Samples of the studied cultivars were taken from the miniature experiments conducted by CRI, ARC, Giza during the two successive seasons i.e.1992 and 1993 from ten growth regions in Egypt.

"Standard Method" for estimating fiber maturity was performed as degree of thickening percent by swelling fibers with NaOH 18% on different group lengths of samples which sorted by the Suter-Webb device. Among the three methods used to estimate fiber maturity, viz., DTP, LORD 1961 and Shirley F/MT instrument. The F/MT seemed to be preferable by the cotton breeder to be used in routine work, since its measurements were close to the standard method "DTP" and it is rapid and accurate as compared to the "DTP" and LORD methods, which are tedious and time consuming. Ribbon width as well as micronaire reading were discussed in this study.

Introduction

One of the most significant problems associated with the assessment of the quality of a sample of cotton fibers is developing an accurate and precise measure of the distribution of fiber maturity in the cotton sample. Preferably the method has to be direct, fast and inexpensive. No existing or proposed method meets all these criteria. The new methods have the greatest potential and its adaptation is the subject of a major research in the world. Fiber maturity which obtained by the Causticaire method is apparently strongly influenced by the treatment technique. It appears that this is difficult to define in such a way that each operator can carry out exactly the same operation. The Cousticaire method is not reliable if the degree of fiber maturity is low. These judgments are based on an inter laboratory testing of three cultivars each containing samples of different maturity Fransen, 1985. Thibodeaux and Evans 1986 applied the image analysis techniques to measuring cotton fiber maturity. Vuljanic et al. 1986 found that the microscope and polarized light techniques are found to give equally objective results. The Causticaire method is shown to give no real picture of the fiber maturity. Thibodeaux and Price 1989 stated that the F/MT method, have proven to be most useful.

Materials and Methods

Twelve commercial Egyptian cotton cultivars were used in this study. Six of them representing ELS namely; Giza 45, Giza 76, Giza 77, Giza 70, Giza 84 and Giza 87' and the others representing LS namely, Giza 75, Giza 81, Giza 85, Giza 80. Giza 83 and Dendera.

Lint samples of the studied cultivars were taken from the miniature experiments conducted by Regional Evaluation of Cotton Cultivars Research Department, CRI, ARC, Giza, Egypt; during the two successive seasons 1992 and 1993. The different growth regions were: Kafr El-Sheikh, El-Beheira, Dommietta, Dakahlia, Al-Sharkeih, Al-Gharbia, El-Fayoum, El-Menya, Assuit and Sohag. All tests were carried out the Lab. Of the Cotton Fiber Research Dept., CRI, ARC, Giza, Egypt. Three methods of maturity are used:

(1) Maturity method described by Lord 1961 was used. About 200 fibers are laid parallel on microscope slides, covered with a cover of glass for each slide, 2-3 drops of 18% solution of sodium hydroxide were added to the fibers. Visopan microscope was used for viewing the fibers at a magnification of 400X.
   a) Normal fibers (N).
   b) Half-mature fibers.
   c) Dead fibers (D).

Maturity ratio (M) was calculated according to the following formula:

$$M = \frac{N\% - D\%}{200} + 0.7$$

Such that mature percent (Pm) was calculated according to the following equation:

$$Pm = (M-0.2)\ (1.565-0.47\ M) \times 100$$

(2) Degree of wall thickening ad lumen for the fibers of the different group lengths were used to represent the whole fibers in the cotton sample. Such that each sample of cotton fiber was sorted into different group lengths with the help of Suter Webb Sorter. Fifteen fiber of each group were taken and laid parallel on microscope sliders, covered with a glass cover for each slide, 2-3 drops of 18% solution of sodium hydroxide were added to fibers on each slide. Ribbon width (RW) (μ), Lumen (L) (μ) and wall thickness WT (μ) were measured by Visopan at a magnification of 500X. Maturity was calculated according to the following formula:

$$\text{Maturity } \% = \frac{WT}{RW} \times 100$$

(3) Maturity percent was determined by Shirley Fineness/Maturity Taster (F/MT) according to ASTM, 1992 Designation (D-3818-79).

Results and Discussion

Fiber Maturity

Degree of thickening (DTP) of the ELS and LS of Egyptian cotton proved to be significantly affected by cultivars as well as when the cultivars involved grown at different locations varying in growth environments.

Results in Table 1 showed the values of fibers maturity (DTP), Lord method, and F/MT method. The mean values of Lord, F/MT and DTP were 92.3%, 79.0% and 81.6%; respectively. The mean value of Lord was the highest, DTP moderate and F/MT were the lowest. The differences between fiber maturity percent measured by each of Lord, F/MT and DTP methods varied from one cotton cultivar to another. On the other hand, the variation of differences were lower, in Lord method than in the other two methods.

It is clear that within each cultivar, there is a specific trend in which maturity values measured by Lord method was consistently higher as compared to DTP. The swelling DTP method is considered the standard method for estimating fiber maturity percent, since it took in this investigation. The Lord method appeared to give over estimates than DTP, while the values of F/MT were closer to values of DTP despite that they are consistently lower. Since the standard DTP method is tedious, time consuming and not adapted with the heave routine tests, the cotton technologists and breeders should depend on F/MT; the rapid and accurate instrument especially when the sample is well prepared and the instrument is correctly calibrated. Other investigators were in the opinion that swelling methods are not accurate.

Ribbon Width

The fiber ribbon width as a measurement for fiber fineness was determined for each group length of the Egyptian long and extra long staple cotton cultivars, to obtain an accurate value to be used in comparing and evaluating the different methods of measuring fiber fineness. Figure 2.

Width did not show and specific trend to be coarser or finer according to length groups, despite, in some cultivars (Giza 75 and Giza 80), the shorter groups seemed to be slightly coarser than the longer ones.

Regarding seasons, the results showed that the mean of ribbon width was increased by 0.13% in 1993 season than 1992 season.

In conclusion, the present findings proved that Giza 45, the Egyptian ELS cotton cultivar that has the lowest swelling ribbon width, is the finest cultivar in Egypt, as compared with the other five ELS cotton cultivars, the percentages of the differences between Giza 45 cv. and the other cvs. were 13.61, 20.12, 20.12, 20.71 and 27.81% for Giza 76, Giza 87, Giza 84, Giza 70 and Giza 77; respectively. This finding is in accordance with that stated by Nawar et al. 1989 who found that Giza 45 which has the lowest ribbon width, is the finest cultivar in the world.

The fineness of cotton fiber can be defined in two important ways, biological (genetic) fineness is a property strictly determined by the characteristics of the cultivar. It can be defined conveniently as the perimeter of the cross-section of the fiber, usually expressed in micrometers (microns). Physical (gravimetric) fineness, however is influenced by the growing history (maturity) of the fiber as well as the inherent characteristics of the cultivar. Physical fineness is expressed as a linear density; that is, mass per unit length by millitex, Robert 1990.

Comparison Between Micronaire Values Measured by Micronaire and F/MT Instruments. Figure 3 showed the micronaire values by each of Micronaire and Fineness and Maturity Taster (F/MT) instruments.

The micronaire readings determined by the Micronaire device for the majority of cultivars in both seasons tend to be higher than their respective micronaire values determined by the F/MT instrument. Also, the general mean of micronaire reading determined by Micronaire device was higher (3.8) than its respective mean determined by F/MT (3.7). This suggests that the cotton breeder should depend on either Micronaire instrument or F/MT instrument when selection is practiced in his segregating population or lines. This is confirmed with the findings reported by Nawar 1995, who found that micronaire values which were determined after using Shirley Fiber blender to provide a representative fully opened and cleaned cotton sample from trash and impurities, was lower than the micronaire instrument values.

References

ASTM 1992. Annual Book of ASTM Standards, American Society for Testing Materials-Designation : D-3818-79. Sec. 7. 07-02. Textiles (11), Philadelphia.

Fransen, T., S. Verschrage and L. Kiekens 1985. Critical study of the Causticaire method for measuring cotton fiber maturity. Cotton-et-Fibers-Tropical, 4 (1): 9-27.

Lord, E. 1961. Manual of Cotton Spinning, Part 1 : The characteristics of raw cotton. Vol. II: Textile Inst., Butterworths and Textile Institute, Manchester and London.

Nawar, M.T.A. 1995. Effect of trash content on micronaire reading and color measurements by high speed instrument. The 1995 Proceedings Beltwide Cotton Conferences, Jan. 4-7 1995, San Antonio, Tx, US Vol.

Nawar, M.T.A., M.G. Seif and M.A.M.Ghorab 1989 Structural properties of fibers of different group lengths in Egyptian cotton varieties. 14th Int. Cont. for Stat., Comp. Sc., Soc. Res. And Demo. Cairo. 25-30 March.

Pobert, K.Q 1990. Prospects for finer cotton fiber. SRRC, New Orleans Pubications, US : 41-44.

Thibodeaux, D.P. and J.P. Evans 1986. Cotton fiber maturity by Image Analysis. Text. Res. J., 56 (2): 130-139.

Thibodeaux, D.P. and J.B. Price 1989. Reference method for determination of the maturity of cotton fibers. The 19th International Cotton Test in Bremen, Mellian Textile Bericht., 70 (4) : 243.

Table 1. Fiber maturity percent as measured by degree of thickness percent, Lord method and F/MT in Egyptian cotton cultivars.

Cultivars	Degree of thickening %		Lord method %		F/MT %	
	1992	1993	1992	1993	1992	1993
Giza 45	79.7	79.9	90.3	89.8	71.5	79.8
Giza 70	80.0	80.4	90.6	92.3	76.3	80.2
Giza 76	81.8	81.4	89.2	89.3	77.4	79.8
Giza 77	81.0	81.4	89.4	93.7	0	81.2
Giza 87	81.0	81.9	90.2	92.0	76.7	81.7
Giza 84	80.7	81.5	92.2	92.8	78.7	81.4
Giza 75	82.8	82.7	91.1	92.0	79.4	86.7
Giza 80	82.2	82.5	91.9	92.1	77.8	77.6
Giza 81	82.5	83.1	90.8	91.3	78.1	81.5
Giza 83	82.5	82.9	90.4	89.8	78.1	76.9
Giza 85	81.8	81.8	90.9	92.2	78.7	81.9
Dendera	79.2	80.4	91.0	91.9	78.5	77.4
Mean	81.3	81.7	90.7	91.6	77.4	80.5
	81.5		91.1		78.95	