FIBER FINENESS AND MATURITY AND THEIR RELATION TO OTHER TECHNOLOGICAL PROPERTIES IN EGYPTIAN COTTON

By

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B.Sc. Agric. Sc. (Agronomy), Cairo University, 2003

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نعومة ونضج التيلة وعلاقتها بالصفات التكنولوجية الأخرى فى القطن المصرى

رسالة مقدمة من

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ABSTRACT

Shimaa Abdrabou Shahat Yuonis: Fiber Fineness and Maturity and Their Relation to Other Technological Properties in Egyptian Cotton. Unpublished M. Sc. Thesis, Department of Agronomy, Faculty of Agriculture, Ain Shams University, 2010.

The present study was carried out to investigate: 1) fiber fineness and maturity of uncollapsed and collapsed fibers, 2) studying the effect of boll age, measuring method and growing season on fiber fineness and maturity, 3) Estimation of fiber fineness parameters via HVI data, 4) the relationship of fiber fineness and maturity with other fiber quality properties. Fifteen Egyptian cotton varieties and promising crosses representing all the Egyptian cotton categories were grown in Giza Reseach Station during 2006 and 2007 seasons. Fibers taken from green bolls of different five ages were used to determine fiber fineness and maturity of uncollapsed fibers. Causticaire method was used to determine fiber fineness and maturity of the swollen fibers. Cross-section image analysis technique and dry fiber microscope testing were used for measuring fiber fineness and maturity of collapsed fibers.

Combined analysis indicated that fiber diameter of uncollapsed fibers (green boll data) ranged in the studied cottons from 15.32µ in Giza45 to 19.69 µ in Giza80 while the swollen fiber diameter (Causticaire method) ranged from 14.63 in Giza45 to 18.12 µ in Giza80. Swollen fiber diameter was 2.76 – 8.53% lower than the fresh fiber diameter. Growing season did not affect fiber diameter while affected significantly fiber maturity.

Degree of thickening of uncollapsed fibers ranged from 77.26 in Giza45 to 89% in Giza80 while degree of thickening of the swollen fibers were 0.18 – 3.78% lower than those obtained from green boll data.

Boll age showed little effect on fiber diameter while affected significantly fiber maturity. Cellulose deposition was rapid in 30 and 40 days boll ages while it was very slow until boll opening.

Cross-section area and perimeter of collapsed fiber obtained from image analysis ranged from 132.70μ^2 and 40.55µ in Giza45 to 222.80 μ^2 and 54·80µ in Giza80.

The estimated fiber perimeter obtained from HVI data was about 2-3 µ higher than actual perimeter of the fiber cross-section of the ELS and Delta (LS) cottons while being 0.5-1.5 µ lower in Upper and Middle Egypt (LS) cottons.

Uncollapsed and collapsed fiber diameter, perimeter and cross-section area showed negative relationship with Upper half mean length (UHM), Uniformity index (UI) and fiber strength while positive relationship with micronaire value, maturity ratio and fiber elongation, however it did no show significant relationship with other fiber quality properties.

Key words:

Cotton- Fiber- Boll age - Fineness – Maturity – Causticaire - Image analysis – HVI.

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CONTENTS

LIST OF TABLES

LIST OF FIGURES

INTRODUCTION

Fiber fineness and maturity are two of the most important fiber properties due to their effect on cotton processing, spinning potential and the quality of the end product. Finer cottons are usually of higher quality and could be spun to finer counts with higher quality than coarser cottons. On the other hand immature fibers are usually weak fibers, they cause pronounced fiber and yarn neppiness, irregularity and dying troubles.

From a botanical point of view, a cotton fiber is a tubular out growth of a specific diameter born from a single epidermal cell of the seed, this out growth elongates first as a thin walled tubular structure to its maximum length within 15-25 days post anthesis (elongation phase) and as the elongation ceases, secondary wall formation and cellulose deposition begins and continues for additional 20-30 days depending on the cotton variety (genetic make-up) and growth conditions (environment), therefor following up this wall thickening during the boll growth and fiber development in the different cotton genotypes is of great interest.

There are two famous terms for fiber fineness: 1- Intrinsic fineness that is defined as the diameter of the uncollapsed fiber in the green boll (diameter of circular cross section) 2- Gravimetric fineness which is known as mass per unit length or linear density. Gravimetric fineness depends on expresses both intrinsic fineness and maturity.

Measuring the diameter, perimeter, cross section area and wall thickness of the fibers obtained from the green boll just before opening is considered the most accurate method for measuring Intrinsic fineness and wall thickness, but is not easy to be carried out and requires green fresh bolls of known age every test. On the other hand, measuring fiber diameter (ribbon width) and wall thickness of the swollen fibers treated by 18% sodium hydroxide (causticaire method) can provide a relatively rapid estimate of the fiber diameter and degree of thickening however the obtained results are strongly affected by treatment technique.

Different methods are used for measuring fiber fineness and maturity whether separately or in combination as air permeability, dye ability, polarized light, near infrared spectroscopy, single and dual compression air flow method like micronaire, micromat and arealometer. Recently, the image analysis of the fibers cross sections provides reliable unbiased accurate technique for determining fiber fineness and maturity. This technique depends entail on using a computer program to obtain direct measurements of cotton fiber cross sectional characteristics as wall thickness, ribbon width (cross-sectional diameter), maturity ratio and degree of thickening. Although image analysis technique is very slow due to the long time and efforts of preparing fibers cross-sections, it could be used as a reference method for evaluating the other methodology and technique of measuring fiber fineness and maturity parameters of the dry cotton fiber which are commonly used with the large numbers of samples in cotton breeding programs, cotton trading and cotton spinning industry as well.

Therefore the main objectives of this study are:-

1- To determine fiber fineness and maturity of some Egyptian cotton varieties and crosses from green boll data (uncollapsed fibers) and causticaire method (swollen fibers).

2- To study the effect of boll age on fiber fineness and maturity

3- To determine fiber fineness and maturity of some Egyptian cotton varieties and crosses using image analysis technique (dry fiber data)

4-Estimation of intrinsic fineness from HVI data as compared to image analysis data.

5-The relationship between fiber fineness and maturity measurements with other fiber properties of Egyptian cotton.