Cotton Fiber Maturity

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Cotton Fiber Development

- Fiber length
- Fiber diameter
- Wall thickness

Graph showing:
- Immature fiber
- Mature fiber

Graph axes:
- Boll age
- Boll opening
- Anthesis

Graph units:
- Fiber length: mm
- Fiber diameter: μ

Key points:
- 0 mm
- 30 mm
- 20 μ
- 5 μ
- 10 μ
- 10 mm
Cotton Fiber Maturation

Pictures: R. Goynes
Defining Fiber Maturity

• Maturity(θ) is the area of the cell wall, $A_w$, relative to the area of a circle having the same perimeter, $P_2$, as the fiber section.

• Fiber maturity (θ) is expressed as a value between 0 and 1.
Typical cotton fiber cross-sections

- There is variation in fiber maturity within every bale, even “mature” bales.
- Immature fibers can cause problems during processing, and can degrade yarn and fabric quality.
Effect of maturity on dye uptake
Dye imperfection barré
Fiber nep
Fiber breakage related to immature fibers
Problems caused by immature fibers

- Poor secondary cell wall development can result in poor dye performance, or dying imperfections.
- Immature fibers have a poor secondary cell wall development, are weaker, and will tend to break and entangle during processing.

Fiber breakage during processing degrades fiber quality and can cause imperfections in spun yarn quality.
High Volume Instrument (HVI) micronaire provides an indirect measure of maturity and fineness using a laminar flow of air.

- **Micronaire (Mic):** “…a function of both fineness and maturity and is related to mill processing performance and to the quality of the end products (ASTM D1448.5.2)”.
Micronaire reading

3.0  3.5  4.0  4.5  5.0

Fiber Diameter

13  14  15  16  17  18  19

Fineness - millitex

MR-H-Micronaire-Diameter

Relationship

Maturity Ratio

0.5  0.6  0.7  0.8  0.9  1.0  1.1  1.2
Average Micronaire
Distribution of Micronaire

Micronaire

Bales


2005 2010 2001
Advanced Fiber Information System (AFIS) Maturity and Fineness

- AFIS is an individual fiber tester.
- It uses electro-optical sensors to measure the length, maturity, and fineness of individual fibers in the sample.
- We can compare HVI Micronaire with AFIS Maturity.
Measurement Comparison
AFIS Maturity Ratio vs. HVI Micronaire
Discussion

- The within bale distribution of fiber maturity and fineness are important quality concerns.
- HVI Micronaire alone is not enough to measure fiber maturity or fiber fineness separately.
- Faster methods are needed for evaluating the maturity and fineness complex.
Current Research

- Using varietal estimates of standard fineness to estimate fiber maturity from Micronaire.
- Creation of reference material to support the calibration of existing instruments, and the development of new maturity measurements.