Fiber Quality

* Determined by Many Factors

- Physiology of the plant
- Variety
- Defoliation Timing
- Harvest Timing
- Agronomic Practices
Fiber Development

• Initiated at pollination of the cotton flower.

• 3 stages of development
  – Elongation
  – Secondary wall thickening (maturation)
  – Drying
Fiber Development

- Cotton fibers originate from the outer epidermal cells of the ovule. “Seed Hair”
FIBER ELONGATION

Stage 1
Fiber Elongation

**Stage 1**

- Elongation of the fiber is driven by the internal water pressure of the elongating cell.

- **Length**
  - Determined in the 18 to 21 days after pollination.
  - Cell expansion.
  - Variety sets the bar
    - influenced by environment.

Schubert, A.M., 1975
Fiber Quality

Length

- Reported to the nearest 32\textsuperscript{nd} of an inch.
- Upper ½ mean length
Fiber Quality

Length

• Base is 34
  – Below 34 incurs discounts
  – Above 34 may incur premiums depending on color.

• How bad can it hurt?
  – 33 = -2.2 cents
  – 32 = -3.85 cents
  – 35 = 1.40 cents
Factors Influencing Fiber Elongation

• Temperature
  – Affected by extremes in temperature early in development.

• Plant Nutrition
  – K is essential for maintaining internal water pressure.

• Variety!

• Water
  – Length usually not affected by water deficit, yield is much more susceptible. ??
$K^+$ accumulates in primordial fiber cells at initiation of expansion
%Short vs Rainfall 2002
Rainfall vs Staple
2001 and 2002
Timing of Defoliation

4 NACB

7 NACB

Both 60% open
AFIS-Length(n) 1999

P>F  0.0006
AFIS-Length(n) 2000

F = 8.70**
Fiber Quality

*Length Uniformity*

- Reported as a ratio of mean length to upper ½ mean length.
- Base is 81
- Indirect measure of short fibers.
- How bad can it hurt?
  - 79 = -.35 cents
  - Mill problems – short fibers

\[
\text{Uniformity} = \frac{\text{Mean}}{\text{Upper 1/2}}
\]
Fiber Quality

Short-fiber content

• Problems
  – Lower yarn strength
  – Reduce spinning efficiency
  – Limit the use of the yarn
  – Increase imperfections in the yarn

• Causes
  – Weathering
  – Ginning
Fiber Uniformity in the S.E.  
1999-2003
AFIS-SFC(w) 1999

P>F  0.0071
AFIS-SFC(n) 2000

F = 9.24**

% Open Boll

SFC (n) %

28
27
26
25
24
23
22

9 30 57 58 76 80 88 94 100 100 100 100

def fg fg g efg def bcd cde bc ab a abc a
FIBER THICKENING

Stage 2
Fiber Thickening

**Stage 2**

- Secondary wall thickening occurs from 17 to 53 days after pollination.
  - Cellulose is deposited inside the elongated cell.
  - The cellulose is deposited at slightly differing angles.

- Fiber thickening will determine fiber fineness, or micronaire.
Fiber Quality

**Micronaire**

- Indirect measure of fiber fineness and maturity.
- The air-permeability of a specimen enclosed in a container of fixed dimensions.
Fiber Thickening

- Low micronaire cotton – thin fibers
  - Insufficient carbohydrate supply.
    - Nutrient deficiency
    - Excessive vegetative growth
    - Heavy boll set

- High micronaire cotton – thick fibers
  - Ample carbohydrate supply.
    - Poor boll set
    - Short fibers
Fiber Quality

Micronaire

3.5  3.7  4.2  5.0  5.2

Premiums

Base Range

Deductions

-4.15 cents

-3.65 cents
Fiber Quality

**Micronaire**

- How to manage a crop for micronaire.
  - Variety selection
  - Irrigation where possible
  - Insect control
  - Harvest preparation
  - Once-over harvesting
HVI Micronaire 1998

P>F  0.0011
Fiber Quality

**Strength**

- The breaking strength of the cotton fiber is considered to be the most important factor in determining yarn strength.

- Fiber strength varies along the length of the fiber.

- Reported as grams of breaking load per tex.
Fiber Quality

Strength

• Reported in grams per tex.

• Base is \(~28\)
  – Below 25.5 = discounts
  – Above 29.4 = premiums
Strength 1998

P>F 0.0001
Strength 1999

P>F 0.0001
Strength 2000

F = 13.91**
Fiber Drying

Stage 3

- Once mature the fiber dries.
- Fiber shrinks in diameter by approximately one-third.
- Drying causes fibers to twist and crimp.
Fiber Quality

Color

• Determined by the degree of reflectance (Rd) and yellowness (+b).

• Base is 41-4 (white-strict low middling)
  – First number determines good middling, strict middling etc…
  – Second number determines white(1), light spotted(2), spotted(3), tinged(4) or yellow stained(5)
  – Number after “-” determines leaf grade, roughly a percentage.
  – Premiums and discounts are relative to length.
Fiber Color

• Most directly linked to growth environment.
  – Weathering leads to fiber to darkening and loss of brightness

• Also correlated with overall fiber quality.
## Color Grades

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<tr>
<th>Week</th>
<th>1998</th>
<th>1999</th>
<th>2000</th>
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<td>0</td>
<td>41</td>
<td>31</td>
<td>42</td>
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<tr>
<td>1</td>
<td>41</td>
<td>31</td>
<td>41</td>
</tr>
<tr>
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<td>41</td>
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</tr>
<tr>
<td>12</td>
<td>61</td>
<td>41</td>
<td>51</td>
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</table>
Application of Harvest-Aids at 60-80% Open Boll:

- Maximized
  - Length Uniformity
  - Fiber Length
  - Lint Yield (1999)
  - Profit (1999)

- Minimized
  - Short Fiber Content
Early Management System?

**Why:**
- TSWV has shifted “prime time” for peanut planting from mid-April to mid to late May,
- Peanut harvest now in October - traditional cotton harvest time.
- A range of maturity spreads out harvest.

**What:** Should we consider planting 10 to 20 percent of acreage for harvest prior to September 20?
What/How Early Management

- Manage for harvest prior to September 20
  - Plant by April 20
  - Use Pix to encourage earliness
  - Avoid excessive N
  - Avoid fruit losses from pest management mistakes (ex. insects, herbicides)
  - Be prepared to apply defoliants/boll opener Aug 20 to Sep 5
Risks of Early Management

• April plantings may encounter stand problems related to cool temperatures

• Significant potential for rainfall events in late August to early September >> boll rot, hard lock, reduced color grade
Other Fiber Quality Questions
Misapplications of glyphosate in RR Cotton adversely affect fiber quality.

True or False?
Misapplications of glyphosate in RR Cotton adversely affect fiber quality.

FALSE
<table>
<thead>
<tr>
<th>Timing</th>
<th>RDC Pvt, lint lb/A</th>
<th>Ponder Fm, lint lb/A</th>
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<tbody>
<tr>
<td>Conv</td>
<td>PRE, OTT, Prec PDIR</td>
<td>1958 a</td>
</tr>
<tr>
<td>Roundup</td>
<td>4 lf OTT, Prec PDIR</td>
<td>1953 a</td>
</tr>
<tr>
<td>Roundup</td>
<td>1,4,9 lf OTT</td>
<td>1974 a</td>
</tr>
</tbody>
</table>

**Cotton Fiber Analysis**: NS NS

2002 results, DP 555 BG/RR
Stinkbug damage in cotton can adversely affect fiber quality. True or False
TRUE!
Fiber Length as Influenced by Stink Bug Control, Irwin Co. 2000

- Nodes 5-8
- Nodes 9-11
- Nodes 12-14
- Nodes 15-17
- Nodes 18+

![Bar Chart](chart.png)

- Len (w) in Untreated
- Len (w) in Pyrethroid

- Values:
  - 0.78
  - 0.8
  - 0.82
  - 0.84
  - 0.86
  - 0.88
  - 0.9
  - 0.92
  - 0.94
  - 0.96

**Legend:**
- Green: Untreated
- Blue: Pyrethroid

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**Source:** Irwin Co. 2000
Aggressive fertilization with N, K, and B can eliminate fiber quality problems.

True or False?
Aggressive fertilization with N, K, and B can eliminate fiber quality problems.

FALSE

.......but K needs study
Which is the most important in avoiding fiber quality problems – variety selection or environmental conditions?
Which is the most important in avoiding fiber quality problems – variety selection or environmental conditions?

ENVIRONMENTAL CONDITIONS

...temperature, water, harvest conditions, etc.
There are fiber quality differences among varieties. True or False?

There are fiber quality differences among varieties because of the insertion of transgenes? True or False?
There are fiber quality differences among varieties.  TRUE

There are fiber quality differences among varieties because of the insertion of transgenes?  FALSE  but....