Limits of accuracy and improvements on the HVI cotton fiber test

Cotton, from the plant to the final product

Jean-Paul Gourlot
Cirad-ca, Cotton Technology Laboratory
Plan of presentation

• Introduction
• Different ways of fibers characterization
• A point about the standardization process
• How does work an HVI
• An example of relation between fiber and yarn quality
• Conclusions
Cotton plant cycle

60 days
Cotton plant growth

From Cirad ‘Cotons’ software
Cotton bolls harvest

Cotton ginning

Saw
Cotton cycle* (1/3)

Seeds → Sowing → Cropping (IPM, fertilizers …) → Harvesting → Ginning

Seeds → Fibers

Oil → Bales → Samples for quality control → Grouping / quality → Marketing


Commercial parameters
Length, Length unif, Strength
Grade, Micronaire
Average and variability

Length, Length unif, Strength
Grade, Micronaire
Average and variability

Length, Length unif, Strength
Grade, Micronaire
Average and variability

Length, Length unif, Strength
Grade, Micronaire
Average and variability

Length, Length unif, Strength
Grade, Micronaire
Average and variability

Length, Length unif, Strength
Grade, Micronaire
Average and variability
Cotton cycle (2/3)

Opening / cleaning / mixing
- Other fibers → Card
- Drawing frame
- Ring spinning → Rotor spinning
- Yarn cleaning

Preparation to weaving → Knitting
- Weaving
- Dying / Finishing / Clothing

Strength, fineness, Maturity, Length, Length unif., pollutions
- Average, and variability

Strength, fineness, Maturity, Length, Length unif., pollutions
- Yarn strength and eveness
- SCF, yarn imperfections

Maturity
- Easy care
Cotton cycle (3/3)

Seeds
Sowing
Cropping (IPM, fertilizers …)
Harvesting
Ginning
Seeds
Fibers
Bales
Quality control
Oil
Flour, …
Grouping / quality
Marketing

Commercial parameters
Length, Length unif, Strength
Grade, Micronaire
Average and variability

Opening/cleaning/mixing
Other fibers
Card
Drawing frame
Ring spinning
Rotor spinning
Yarn cleaning
Preparation to weaving
Knitting
Weaving
Dying / Finishing / Clothing

Strength, fineness,
Maturity, Length,
Length unif., pollutions
Average, and variability

Yarn strength and eveness
SCF, yarn imperfections

Maturity
Easy care
Fiber quality development

Age of the boll (days)

Primary wall

Secondary wall

Length

Perimeter

Primary wall

Secondary wall

CIRAD
## Fiber constitution

<table>
<thead>
<tr>
<th>Constituents</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cellulose</td>
<td>95.0</td>
</tr>
<tr>
<td>Proteins</td>
<td>1.6</td>
</tr>
<tr>
<td>Waxes</td>
<td>0.9</td>
</tr>
<tr>
<td>Physiological sugars</td>
<td>0.3</td>
</tr>
<tr>
<td>Other</td>
<td>2.2</td>
</tr>
</tbody>
</table>
Fiber quality measurement

- Measured
- Length
- Perimeter or fineness
- Wall thickness or maturity

‘Micronaire’
Mike, IM

Color + contaminants
Tensile behavior
Fiber quality measurement

Could be measured

- Cellulose types
- Wax content
- Flexion / flexibility
- ‘Curling’ / crimp
Plan of presentation

• Introduction
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• Conclusions
Why do we measure length?

Define what type of final product will be made out of the fibers
Check the settings of ginning equipments
Define a commercial price of the fibers
Allow settings of the processing equipments
Fiber quality measurement

Manual:

- Pulling => commercial length
- Comb sorter => length diagrams (W, N)
- => ML, CV%, SFC Could be measured
Fiber quality measurement

**Instrumental:**

**with classical instruments:**

- Fibrograph => SL2.5%, SL 50%, UR%
- Almeter 101 => diagrams (W, N)
- => ML, CV%, SFC
Fiber quality measurement

**Instrumental:**

*with classical instruments:*
- Fibrograph => SL2.5%, SL 50%, UR%
- Almeter 101 => diagrams (W, N)
  => ML, CV%, SFC

*with High Volume Instrument (HVI)*
  => UHML, ML, UI%, SFI
Fiber quality measurement

**Instrumental:**

**with classical instruments:**
- Fibrograph => SL2.5%, SL 50%, UR%
- Almeter 101 => diagrams (W, N)
  => ML, CV%, SFC

**with High Volume Instrument (HVI)**
  => UHML, ML, UI%, SFI

**with Advanced Fiber Information System (AFIS)**
  length (W, N)
  => ML, CV, UQL, SFC
Fiber quality measurement

Length histograms on 2 seeds (AFIS)

Mean and variability parameters
Fiber quality measurement
Length diagram (AFIS)
Fibre length
Part of the optical sensor
Fiber quality measurement
Length Fibrogram

Uniformity Index % = \( \frac{\text{ML} \times 100}{\text{UHML}} \)

Mean Length
Upper Half ML

Length group (mm)
Length Fibrogram

Fiber quality measurement

UR\% = \frac{SL\ 50\ \%}{SL\ 2.5\ \%} \times 100

SL 50 %  SL 2.5 %
Fiber quality measurement

**Length parameters**

<table>
<thead>
<tr>
<th>SL 2.5 ~ UHML ~ Pulling</th>
<th>22 – 40 mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>SL 50 %</td>
<td>ML</td>
</tr>
<tr>
<td>10 – 18 mm</td>
<td>18 – 30 mm</td>
</tr>
<tr>
<td>UR % &lt;&gt; UI %</td>
<td></td>
</tr>
<tr>
<td>38 – 50 %</td>
<td>78 – 85 %</td>
</tr>
</tbody>
</table>
Fiber quality measurement

Why do we measure Fineness and Maturity?

Predict the number of fibers per yarn cross-section

=> yarn strength and eveness

Chemical treatments and dye consumption

Dye uptake ability
Fiber quality measurement

**Manual:**
- Perimeter: using microscope on longitudinal fibers
- Wall thickness: using microscope on fibers sections
Fiber quality measurement

Manual:

with classical instruments

Fibronaire => Micronaire

perimeter

wall thickness
Fiber quality measurement

**Manual:**

- with classical instruments
  - Fibronaire => Micronaire

- with Fineness Maturity Tester (FMT)
  - IM, MR, PM%, H, HS
Fiber quality measurement

**Manual:**

- with classical instruments
  - Fibronaire => Micronaire
- with Fineness Maturity Tester (FMT)
  - IM, MR, PM%, H, HS
- with High Volume Instrument (HVI)
  - Micronaire
Fiber quality measurement

**Manual:**

- with classical instruments
  - Fibronaire => Micronaire
  - with Fineness Maturity Tester (FMT)
    - IM, MR, PM%, H, HS
  - with High Volume Instrument (HVI)
    - Micronaire

- with Advanced Fiber Information System (AFIS)
  - Distribution of Diameter, Theta, MR, H
Fiber quality measurement

Recorded results:
IM : micronaire [2, 7]
MR : Maturity Ratio [0, 1.2]
PM% : Percent Mature fibers [0, 100]
H : Linear Fineness (mtex) [120, 350]
Hs : Standard Fineness (mtex) [120, 400]

\[ Hs = \frac{H}{MR} \] (tex = grams/1000 m)
Micronaire, maturity and fineness

Fine

Large

Mature

Immature

=> Some combinaisons of MR and H correspond to close IM for very different fibres
Micronaire, maturity and fineness

IM = 4.1

MR = 1.04
H = 150
Hs = 144

MR = 0.67
H = 220
Hs = 328
Fiber quality measurement

Warp, IM = 6.0

Weft
IM = 2.4
IM = 3.5
IM = 4.7
Relation between IM, MR and Hs

MR² = (3.86 x IM² + 18.16 x IM + 13) / Hs

PM = (MR - 0.2) x (1.565 - 0.471 x MR) x 100
Relation between IM, MR and Hs

Growing conditions problems induce lower MR and lower IM.
Fiber quality measurement

Why do we measure color and trash?

- To identify bales having homogeneous characteristics and group them per lot
- To avoid variations in color in raw and dyed fabrics
- To limit wastes during processing
Fiber quality measurement

- Pressure plate
- Cotton Sample
- Glass support
- Light bulbs or flash light

Reflectance Rd %  Yellowness + b  Image analysis ...
Fiber quality measurement

HVI COLOR GRADES FOR AMERICAN UPLAND COTTON

HVI COLOR DIAGRAM

American Upland Cotton

DECREASING YELLOWNESS

INCREASING YELLOWNESS
Fiber quality measurement
Trashmeter image

Binarisation and threshold applied …
Fiber quality measurement
Trashmeter image

8 pixels considered as trash particle

Trash count, Trash area, Leaf, Leaf grade
Fiber quality measurement

Why do we measure strength?

• To define what product can be made from these fibers
• To define a commercial price
• To predict yarn strength
Fiber quality measurement

**Manual:**

- with classical instruments
  - Stelometer: $T_1$ (cN/tex) and elongation $E_1$ (%)

- with High Volume Instrument (HVI)
  - Strength (cN/tex) and elongation Elong (%)

- with devices measuring individual fibers
  - Breaking force and elongation
Fibrogram curve

Strength (g/tex) = \frac{\text{Force} \times K}{\text{Estimated weight}}

% of fibers

1/8° inch

Force

Fiber length

Clamping zone

jaws
Fibrogram curve after a break

Strength (g/tex) = Force \times K

Estimated weight

f(nb de fibres et IM)

% of fibers

Clamping Zone

Fiber length

Jaws
Caractérisation de la fibre

Les principales caractéristiques de fibre peuvent être établies soit manuellement, soit sur appareils classiques ou soit sur chaînes HVI.

Seules les chaînes HVI :

- permettent des mesures instrumentales, automatisées, rapides et intégrées des critères commerciaux,
- et autorisent un classement balle à balle sur l’ensemble de ces critères.
## Fibre quality per spinning method

<table>
<thead>
<tr>
<th>Rank</th>
<th>Ring spinning</th>
<th>Open end</th>
<th>Air-jet</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Length</td>
<td>Strength</td>
<td>Length</td>
</tr>
<tr>
<td>2</td>
<td>Strength</td>
<td>Fineness</td>
<td>Trash</td>
</tr>
<tr>
<td>3</td>
<td>Fineness</td>
<td>Length</td>
<td>Fineness</td>
</tr>
<tr>
<td>4</td>
<td>Trash</td>
<td>Trash</td>
<td>Strength</td>
</tr>
</tbody>
</table>

Deussen, 1992
Fiber quality measurement

- Length
- Micronaire
- Length uniformity
- Color
- Trash content
- Strength
- and more

Example of ITC

(This display does not constitute any type of recommendation for this equipment, picture from an advertisement from Uster Technologies)
Example of HVI classification in Dumas (AK)
Fiber quality measurement

Actual major manufacturers of so-call HVI equipments (alphabetical order)

- Lintronics (Israel)
- Premier (India)
- Schaffner Technologies (USA)
- Zellweger Uster (USA)
Fiber quality measurement

From Hunter, 2000
High Volume Instrument (HVI) in the world

North America 46.9%
Far East 23.3%
Africa 3.9%
Europa 15.2%
Cent. South America 7.4%
Middle-East 1.8%
Australia 1.6%

Total = 883 HVI

Source: HUNTER L., ITMF Committee, Brême, Mars 1994.
Plan of presentation

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• Conclusions
Normalization steps

1923
Universal Standards:
Grade, Pulling;
Transactions.

1940-1950
International Calibration
Cotton Standards (ICCS);
Research + Transactions.

1986
HVI Calibration Cotton;
Transactions, USA.

- ICCS restricted for
research;
- HVI Calibration Cotton
Transactions, world.

Based on so-call 'reference methods'
Expected precision for international market

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Confidence interval</th>
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<tbody>
<tr>
<td>IM</td>
<td>(+/-) 0.1 unit</td>
</tr>
<tr>
<td>Length</td>
<td>(+/-) 0.02 inch</td>
</tr>
<tr>
<td>Length uniformity</td>
<td>(+/-) 0.51 mm</td>
</tr>
<tr>
<td>Strength</td>
<td>(+/-) 1.5 %</td>
</tr>
<tr>
<td>Rd %</td>
<td>(+/-) 1 %</td>
</tr>
<tr>
<td>+b</td>
<td>(+/-) 0.5</td>
</tr>
<tr>
<td>Trash</td>
<td>(+/-) 0.1 %</td>
</tr>
</tbody>
</table>

## Reference cotton use in the world: 1991

<table>
<thead>
<tr>
<th>Who</th>
<th>No HVI</th>
<th>Consumption</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>kg</td>
<td>kg/HVI</td>
</tr>
<tr>
<td>USDA</td>
<td>212</td>
<td>19214</td>
</tr>
<tr>
<td>USA except USDA</td>
<td>91</td>
<td>828</td>
</tr>
<tr>
<td>Outside USA</td>
<td>318</td>
<td>192</td>
</tr>
<tr>
<td>Total</td>
<td>621</td>
<td></td>
</tr>
</tbody>
</table>
Reference cotton use in the world: 1994

<table>
<thead>
<tr>
<th>Who</th>
<th>No HVI</th>
<th>Consumption</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>HVICC</td>
<td>Ratio</td>
</tr>
<tr>
<td></td>
<td>kg</td>
<td>kg/HVI</td>
</tr>
<tr>
<td>USDA</td>
<td>x</td>
<td>14145</td>
</tr>
<tr>
<td></td>
<td></td>
<td>-21%</td>
</tr>
<tr>
<td>USA except USDA</td>
<td>x</td>
<td>766</td>
</tr>
<tr>
<td></td>
<td></td>
<td>-7%</td>
</tr>
<tr>
<td>Outside USA</td>
<td>x</td>
<td>245</td>
</tr>
<tr>
<td></td>
<td></td>
<td>+27%</td>
</tr>
<tr>
<td>Total</td>
<td>883</td>
<td></td>
</tr>
</tbody>
</table>
## Existing reference cottons after 1998

<table>
<thead>
<tr>
<th></th>
<th>ICCS</th>
<th>ICCS Mike only</th>
<th>HVICC</th>
</tr>
</thead>
<tbody>
<tr>
<td>* Stelometer</td>
<td>HVI</td>
<td></td>
<td>HVI</td>
</tr>
<tr>
<td>* Carded cotton</td>
<td>Raw cotton</td>
<td></td>
<td>Raw cotton</td>
</tr>
<tr>
<td>* 3 types</td>
<td>6 types</td>
<td></td>
<td>2* 2 types</td>
</tr>
<tr>
<td>* Measurement of T1 E1 (1 type with SL%)</td>
<td>Mike</td>
<td></td>
<td>Length (UHM) UI% Strength</td>
</tr>
</tbody>
</table>
6 - International normalisation of the measurements
ICCS Mike only standards

Length of ICCS standards

Upper Half Mean Length Histogram
2356 Cottons from different origins

Strength Histogram
2356 Cottons from different origins
Existing reference cottons after 1998

**UNIVERSAL HIGH VOLUME INSTRUMENT**

**LONG-STRONG CALIBRATION COTTON**

**AMERICAN UPLAND**

<table>
<thead>
<tr>
<th>Value</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Micronaire</td>
<td>3.99</td>
</tr>
<tr>
<td>Strength (g/tex)</td>
<td>33.1</td>
</tr>
<tr>
<td>Upper Half Mean Length (in.)</td>
<td>1.173</td>
</tr>
<tr>
<td>Uniformity Index (%)</td>
<td>83.5</td>
</tr>
</tbody>
</table>

Micronaire Standard Deviation based on single specimen HVI testing. Standard Deviations of Strength, Length and Uniformity are based on two specimen HVI testing.

APPROXIMATE NET WT.

5 POUNDS
Existing reference cottons after 1998
HVI modules calibration : IM

Calibration = change slope and offset between observed vs theoretical values.
Question: is there any drift in the establishment of Calibration Cotton reference data?

- A set of calibration cotton = at least 2 cottons
- These can also be analyzed as samples

<table>
<thead>
<tr>
<th>Calibration</th>
<th>Samples</th>
<th>Issue/Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Set 1</td>
<td>Set 1, 2, 3, ...</td>
<td>1</td>
</tr>
<tr>
<td>Set 2</td>
<td>Set 1, 2, 3, ...</td>
<td>2</td>
</tr>
<tr>
<td>Set 3</td>
<td>Set 1, 2, 3, ...</td>
<td>3</td>
</tr>
</tbody>
</table>

Comparison between results => drift?
Preliminary experiment

- Illustrer dérive
- et modifier diapo précédente

Slope 0.48 cN/tex / year

Slope 0.68 cN/tex / year

Slope 0.11 cN/tex / year
Drift and other troubles

- Observed Drift
- Delay to access to recent generations of reference cottons

Consumption in 1991

=> Differential in reading levels
=> Lower accuracy in the yarn quality prediction from fiber quality measurement

=> Use / consume reference materials !!!!
Economical incidence of quality on fiber exchange price
Evolution of premium/discounts for HVI strength over 5 years (P. SASSER EFS 1995)

Data collected during M. Sasser’s presentation

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>US cents/lb</td>
<td>-300</td>
<td>-200</td>
<td>-100</td>
<td>0</td>
<td>100</td>
</tr>
<tr>
<td>1991</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1992</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>1993</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>1994</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>1995</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
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Hardware design

- Light sensor
- Fixed clamp (front)
- Mobile clamp (back)
- Calibrated with ‘reference’ masses
- Comb + fibers
- Force sensor
- Light emission
- Step motor

Cb + fib
Tenacity
Material

Force sensor
Optical sensor
Tenacity
Material

Force sensor
Traction jaws
Fibrogram curve

- Light sensor, measure of variation
- % of fibers
- Quantity of fibers for tensile test
- Displacement
- Light emission
- Displacement
- Fiber length

CIRAD
Fibrogram curve

100% of fibers

Fibrogram

1/8° inch

Force

Fiber length

Clamping zone

jaws
Force / elongation curve

Strength = Tenacity (cN/tex)
= Constraint
= Force/Broken surface
+/-= Force/fineness
Fibrogram curve after a break

% of fibers

Clamping zone

Fiber length

jaws
Fibrograms

Fibrogram after break
Fibrogram before break

Length

% fibers
Position of the break

Cas d’un coton long

Pourcentage fixe de fibres à rompre

Axe des longueurs

Cas d’un coton court

Pourcentage fixe de fibres à rompre

Axe des longueurs

Vue de face :

Hauteur

pinces avant

1/8° de pouce

pinces arrière

Vue de côté :

a

b < a

1/8° de pouce
Rheology

Constraint

Elasticity of reorganization

Elasticity

Plasticity

Slippage

Deformation
Tenacity or strength

Results and conclusions

HVI Single fibers

Tenacity $\equiv F / S$ should be constant
Optical sensor

Light sensor

Transmission

Diffraction
- inside
- outside

Scattering
- inside
- outside

Absorption

Light emission

Original drawing: Gourlot 12/97
Possible effects of fiber properties (example on strength)

- 1-Sensor linearity
- 2-Shape factor
  - micronaire
  - scouring / swelling
- 3-Maturity and fineness distributions
- 4-Color
- 5-Length distribution
- 6-Ambiant conditions

Attention: the mass of broken fibers is estimated from this signal for the calculation of strength.
Ambiant conditions

Should be at any time:

- 21 °C +/- 1 °C
- 65 % Relative Humidity (RH%) +/- 2 %
Ambiant conditions

Material and method

Hypothesis: ambiant conditions should be stable around thefibers.

- Use of temperature and relative humidity probes
- Use of HVI or RST

Brush

Optical sensor

Fibrosampler

Ejection

Air ejection OFF

ON
Ambiant conditions

Results and conclusions: air suction OFF

- Graph showing temperature differences (°C) and heart rate differences (%)
  - External vs. Built-in
  - Devices: Room, Fibrosampler, Brush, Sensor, Optical sensor, Comb, Fibrosampler
Ambiant conditions

Results and conclusions: air suction ON

[Graph showing temperature and heart rate differences for various sensor types: Fibrosampler, Brush, Sensor, Optical sensor, Comb, and Ejection.]
Source: USDA

⇒ More than 1 cN/tex difference! (Sasser 1990)

Relative humidity in the air (%)
Strength stability: HVICC bale 27985
Measuring unit covered vs uncovered
Motion Control 3500

Accepted range after calibration

(Time (mn))

(Covered) (Uncovered)
Strength stability: HVICC bale 28484

Measuring unit covered vs uncovered

Motion Control 3500

Accepted range after calibration

<table>
<thead>
<tr>
<th>cN/tex</th>
<th>29</th>
<th>30</th>
<th>31</th>
<th>32</th>
<th>33</th>
<th>34</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Covered)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Uncovered)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Time (mn)

0  30  60  90  120  150  180  210  240
Other possible bias in HVI measurement

Mass of this deposit = 0.0175 g
Sources of variability in the results

- Variety
- Growing conditions (fertilizer, insects)
- Plant to plant
- Picking technique
- Farm size
- Seed cotton preparation
- Ginning technique (R/S)
- Lint cleaning

- Precision
- Accuracy
- Repeatability
- Reproducibility

- Number of samples / bale
- Number of bales / lot
- Method of sampling

- RH conditions,
- HVI calibration
- Nb tests / sample
Confidence Intervals (research samples in specific sampling conditions)

Units

Upland Saw ginned samples

Barbadense cottons

 Nb measures / sample
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Relations between yarn versus fiber quality

Card

Open End

Drawing frame

Ring spinning
Relations between yarn versus fiber quality

<table>
<thead>
<tr>
<th></th>
<th>Coton A</th>
<th>Coton B</th>
</tr>
</thead>
<tbody>
<tr>
<td>ML (mm)</td>
<td>22.6</td>
<td>24.2</td>
</tr>
<tr>
<td>UHML (mm)</td>
<td>28.4</td>
<td>28.9</td>
</tr>
<tr>
<td>UI (%)</td>
<td>79.6</td>
<td>83.7</td>
</tr>
<tr>
<td>Strength (cN/tex)</td>
<td>25</td>
<td>30.3</td>
</tr>
<tr>
<td>Elong (%)</td>
<td>5.0</td>
<td>5.7</td>
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<tr>
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<td>MR</td>
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<tr>
<td>PM (%)</td>
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<td>H (mtex)</td>
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<td>155</td>
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<td>HS (mtex)</td>
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<td>173</td>
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<tr>
<td>Rd (%)</td>
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<td>72.8</td>
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<tr>
<td>+b</td>
<td>11.9</td>
<td>11.3</td>
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Relations between yarn versus fiber quality

CRL yarn tenacity tests

Breaking force = 14.45 x Tex - 79.07

Breaking force = 11.38 x Tex - 62.20
Relations between yarn versus fiber quality

CRL yarn tenacity tests

Breaking force = 17.27 x Tex - 39.14

Breaking force = 14.75 x Tex - 78.92
Relations between yarn versus fiber quality

CRL yarn tenacity tests (RS)

Breaking force = 17.27 x Tex - 39.14

Breaking force = 14.45 x Tex - 79.07
Relations between yarn versus fiber quality

Eveness tester UT3 : thick places (RS)

thick places 1000 m

Coton A

Coton B
Relations between yarn versus fiber quality

Eveness tester UT3 : thin places (RS)

Thin places 1000 m

Coton A

Coton B

Tex
Relations between yarn versus fiber quality

Eveness tester UT3 : neps places (RS)
Relations between yarn versus fiber quality

Eveness tester UT3 : hairiness (RS)

Hairiness H

Coton A

Coton B
Relations between yarn versus fiber quality

Eveness tester UT3 : CV% (RS)

- Coton A
- Coton B

Yarn tex vs CV% graph
Relations between yarn versus fiber quality

Breaking force (cN)

- RS 20 tex  $r = 0.96$
- OE 20 tex  $r = 0.96$
- RS 27 tex  $r = 0.97$
- OE 27 tex  $r = 0.98$
- RS 37 tex  $r = 0.97$
- OE 37 tex  $r = 0.98$

HVI strength (cN/tex)
Effect of fibre parameters on yarn resistance

• 191 cottons from various origins
• Fibre analysis + spinning RS 20tex

\[ \text{Ten Fil} = 0.44 \times \text{TenHVI} - 0.0016 \times H + 2.58 \times MR + 0.33 \times UI - 27.03 \]
\[ R^2 = 0.76 *** \]
Fibre strength and UI vs yarn strength RS 20 tex

Yarn strength (cN/tex)

HVI strength (g/tex, HVICC)

UI%
Fibre strength and UI vs yarn strength RS 20 tex

Yarn strength (cN/tex)

HVI strength (g/tex, HVICC)

UI%
Fibre strength and MR vs yarn strength RS 20 tex

Yarn strength (cN/tex)

HVI strength (g/tex, HVICC)

MR

0.70
Fibre strength and MR vs yarn strength RS 20 tex

Yarn strength (cN/tex)

HVI strength (g/tex, HVICC)

MR
0.97
0.90
0.80
0.70
Fibre strength and H vs yarn strength RS 20 tex

Yarn strength (cN/tex)

HVI strength (g/tex, HVICC)
Fibre strength and H vs yarn strength RS 20 tex

Yarn strength (cN/tex)

HVI strength (g/tex, HVICC)
Fibres characteristics vs yarn strength RS 20 tex

Yarn strength (cN/tex) vs HVI strength (g/tex, HVICC)

UI% 86 84 82 80

MR 0.97 0.90 0.80 0.70

H 130 170 210
Fibres characteristics vs yarn eveness RS 20 tex

• 30 cottons
• Fibres characterization
• Spinning OE 20, 27 and 37 tex
• Spinning RS 20, 27 and 37 tex
Correlations coefficients between fibres characteristics and OE yarn eveness

<table>
<thead>
<tr>
<th></th>
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<th>UHML</th>
<th>UI</th>
<th>ST</th>
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Correlations coefficients between fibres characteristics and RS yarn evenness

<table>
<thead>
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<td>-0.86</td>
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</tbody>
</table>
Plan of presentation

- Introduction
- Different ways of fibers characterization
- A point about the standardization process
- How does work an HVI
- An example of relation between fiber and yarn quality
- Conclusions
Conclusion

HVI cotton fiber measurements may be used to:

- Commercially characterize cotton fibers properties
  - standardization ongoing for all measured parameters
  - future evolutions to integrate new properties characterization
  - that may induce new rules in the trade
Conclusion

HVI cotton fiber measurements may be used to:

- Arrange laydowns to stabilize or control:
  - mean values
  - variability around those mean values according to production means (from field to ginning mill), sampling procedures (from ginning to spinning mills) …
Conclusion

HVI cotton fiber measurements may be used to:

• Predict the fiber behavior in the processing steps both in terms of:
  
  – quality
  
  – productivity
Conclusion

HVI cotton fiber measurements may be used to:

• Control,

• Check,

• And set spinning machineries

  to get the highest yarn quality as demanded by the market
Conclusion

HVI cotton fiber measurements may be used to:

- Breed new varieties depending on the improvements made in the transformation stages.

  depending on commercially recognised characterization
What Cirad does and recommends

1) Apparatus calibration to insure a proper reading level.
2) Check and set-up of procedures to warrant proper precision and accuracy levels.
3) Check of the results through a participation to periodical international round tests.
4) Check the precision in classing routine.

TO GET

- Homogeneous results on the cotton market
- Limited number of claims.
Thank you for your attention