SAMPLING VARIANCE WITHIN WEST AFRICAN COTTON BALES

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Cotton Beltwide Conferences, Orlando, FL, USA, January 3-6, 2012

Introduction

World cotton trade is impacted by changes in fiber classification:
Change from manual / visual classification to instrument classification with “Standardized Instruments for Testing Cotton” (SITC).

50% of the cotton traded in the world classified with SITC for Micronaire, Length (UHML), Uniformity (UI), Strength (STR), Reflectance (Rd) and Yellowness (+b).

Precision of these measurements depend on the within-bale variability
Larger within bale variability
\[\Rightarrow\] lower precision of the measurements
\[\Rightarrow\] higher litigation risk.

West African production conditions differ from those in USA: cotton farms are smaller => each bale includes fiber produced in different farms under different field conditions
Transposing the USA methods as is verbatim in other countries could lead to increased litigation risks

There is a need to study within bale variability of technological characteristics of cotton fibers in West African conditions to set sampling and testing operating methods.

OBJECTIVE

Quantify the level of within bale variability as measured by SITC to deduce:
1- Number of samples per bale of West African cotton
2- Number of replicates per sample for each technological characteristic: Micronaire, UHML, UI, STR, Rd, +b

Sampling design

8 samples per bale
1 bale sampled out of every 20 bales
10 bales were sampled / Gin in season 1
5 bales were sampled / Gin in season 2

2-3 gins / country
in 8 West African countries

Sample testing

1720 fiber samples from 215 bales were analyzed in controlled conditions with SITC.

ASTM 5867 requirements with one measurement of Micronaire and two measurements of the Length/ Uniformity Index, Strength, Color Rd and Yellowness.

Data analysis

The model for analyzing the acquired results was the following: for any result \( Y_{ijkl} \) acquired in bale \( i \), layer \( j \), replicate \( k \):

\[ Y_{ijkl} = m + A_{ij} + E_{ijkl} \]

\( A_{ij} \) is the variance of the random layer effect,
\( E_{ijkl} \) is the variance of the residual error

From the estimation of \( \sigma_A^2 \) and \( \sigma_E^2 \) we can deduce the sampling variance \( \sigma_D^2 \)

\[ \sigma_D^2 = \frac{\sigma_A^2}{j} + \frac{\sigma_E^2}{K^2} \]

for separate samples

\( j \) layer samples, each tested \( K \) times

\[ \sigma_D^2 = \frac{\sigma_A^2}{j} + \frac{\sigma_E^2}{N^2} \]

for mixed samples

\( j \) layer samples mixed, tested \( N \) times overall

Parameters for choosing sampling and testing conditions

The objective is to comply with commercial usual tolerances with less than 10% litigation risk balewise.

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Commercial tolerance</th>
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<tbody>
<tr>
<td>Micronaire</td>
<td>± 0.1 unit</td>
</tr>
<tr>
<td>UHML</td>
<td>± 0.508 mm</td>
</tr>
<tr>
<td>UI</td>
<td>± 1%</td>
</tr>
<tr>
<td>STR</td>
<td>± 1.5 g/tex</td>
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<tr>
<td>Rd</td>
<td>± 1%</td>
</tr>
<tr>
<td>+b</td>
<td>± 0.5 unit</td>
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Results

Design of iso-variance envelope curves for determining:
1- the number and type of sample (separate or mixed) per bale
2- the number of measurements per bale and the type of testing (composite or cluster) of each technological characteristic tested.

CONCLUSION

Number of samples per bale and number of measurements per sample in USA and in our new proposition for West Africa

<table>
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<th>Type of testing</th>
<th>Nb of replicates</th>
<th>Nb of meas. per sample</th>
<th>Total Nb of meas. per bale</th>
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<td>Micronaire</td>
<td>2 Composite</td>
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<td>1</td>
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</tr>
<tr>
<td>UHML</td>
<td>2 Cluster</td>
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<td>1</td>
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<td>2 Cluster</td>
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RECOMMENDATION FOR WEST AFRICA

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REFERENCES

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6. USDA. The classification of cotton 2001

Acknowledgements
We are grateful to the Common Fund for Commodities and to the European Union for funding the CSITC (project csitc.org) and to the cotton companies for allowing sampling in their ginning facilities.