Methods of within bale variability study for cotton produced in Africa

LUKONGE Everina

ABOÉ Modeste

GOZÉ Eric

GOURLOT Jean-Paul

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- 50% of the cotton traded in the world classed with SITC measuring Micronaire, length, uniformity, Strength, Reflectance and Yellowness
- In Africa, few bales sold with instrumental result

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  - the cotton plant
  - cropping system used
  - supply area of the ginning mill
  - seed-cotton management practices
  - ginning equipment and practices

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- Within bale variability depends on
  - the cotton plant
  - cropping system used
  - supply area of the ginning mill
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- Sampling and testing procedures take the within bale variability into account to determine the precision and trueness of fibre characterization

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- African production conditions differ from the USA
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  - cropping system is largely manual.

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=> Need to study within bale variability of technological characteristics of cotton fibers in African conditions to set sampling and testing operating conditions

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Objectives of the study

This study focused:

- The supply area of the ginning mills
- The ginning equipment

Goal: to quantify the level of within bale variability as measured by SITC to deduce the most appropriate sampling and testing procedures for African countries

- Bales from 14 African countries

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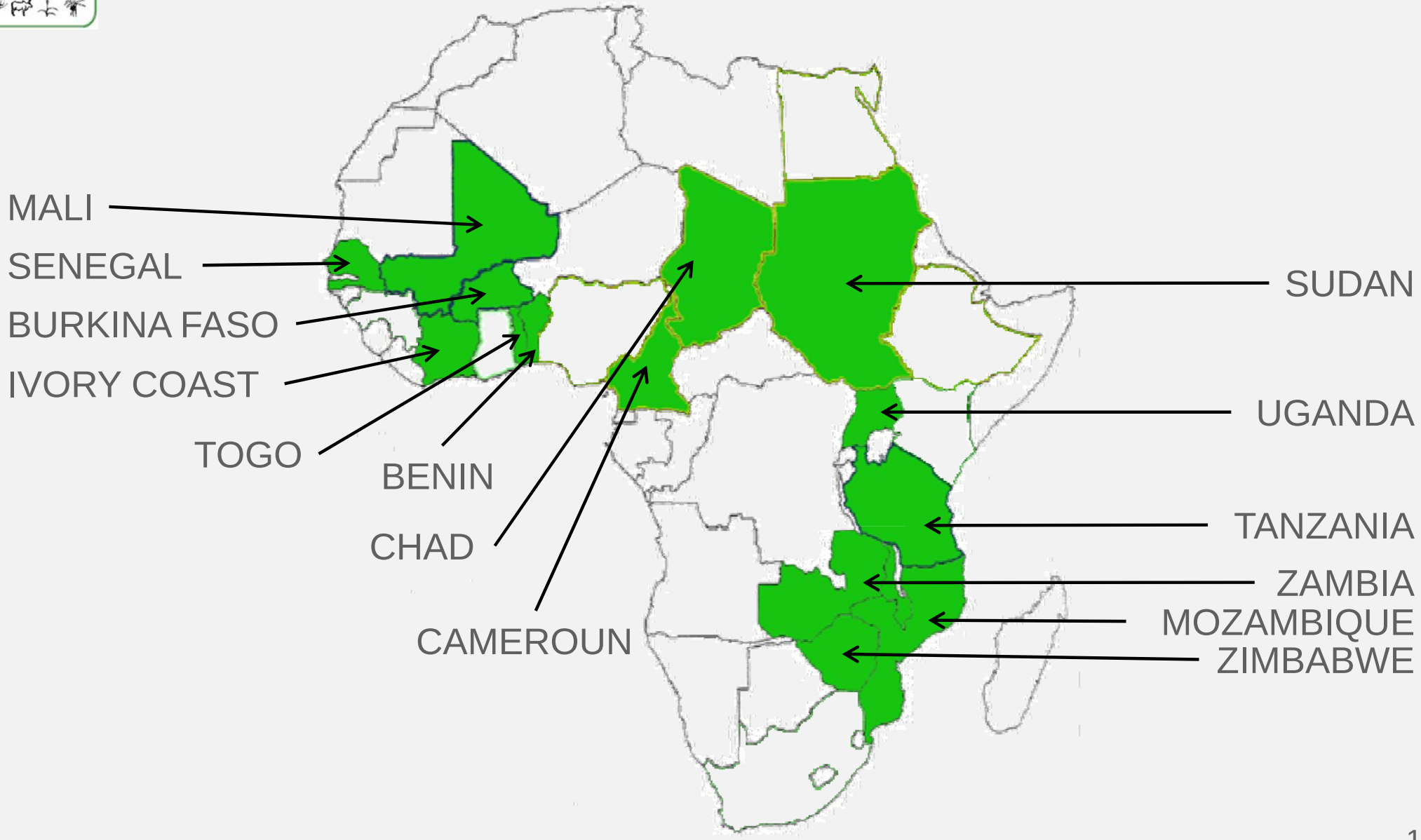
14 countries involved in the study



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Materials and methods

- Two seasons: 2008-2009 season 1 and 2009-2010 season 2
- Sixty three situations were studied for:
  - their seed-cotton supply areas,
  - ginning equipment (roller vs saw) and presence or absence of lint cleaners
  - Season 1, 28 situations were sampled
  - Season 2, 35 situations were sampled
  - Some situations remained the same in both seasons
  - Others were added in the 2nd season to extend the situations

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Sampling cotton fiber for the characterization

- Assumption:
  - Cotton transported in different trucks came from various villages (this may induce different levels of variability)
  - One truck holds around 18 bales of 225 kg of fibres each

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- 10 bales were sampled in season 1 and 5 bales season 2
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=>Season 1: 280 bales and 2239 samples tested

=>Season 2: 175 bales and 1400 samples

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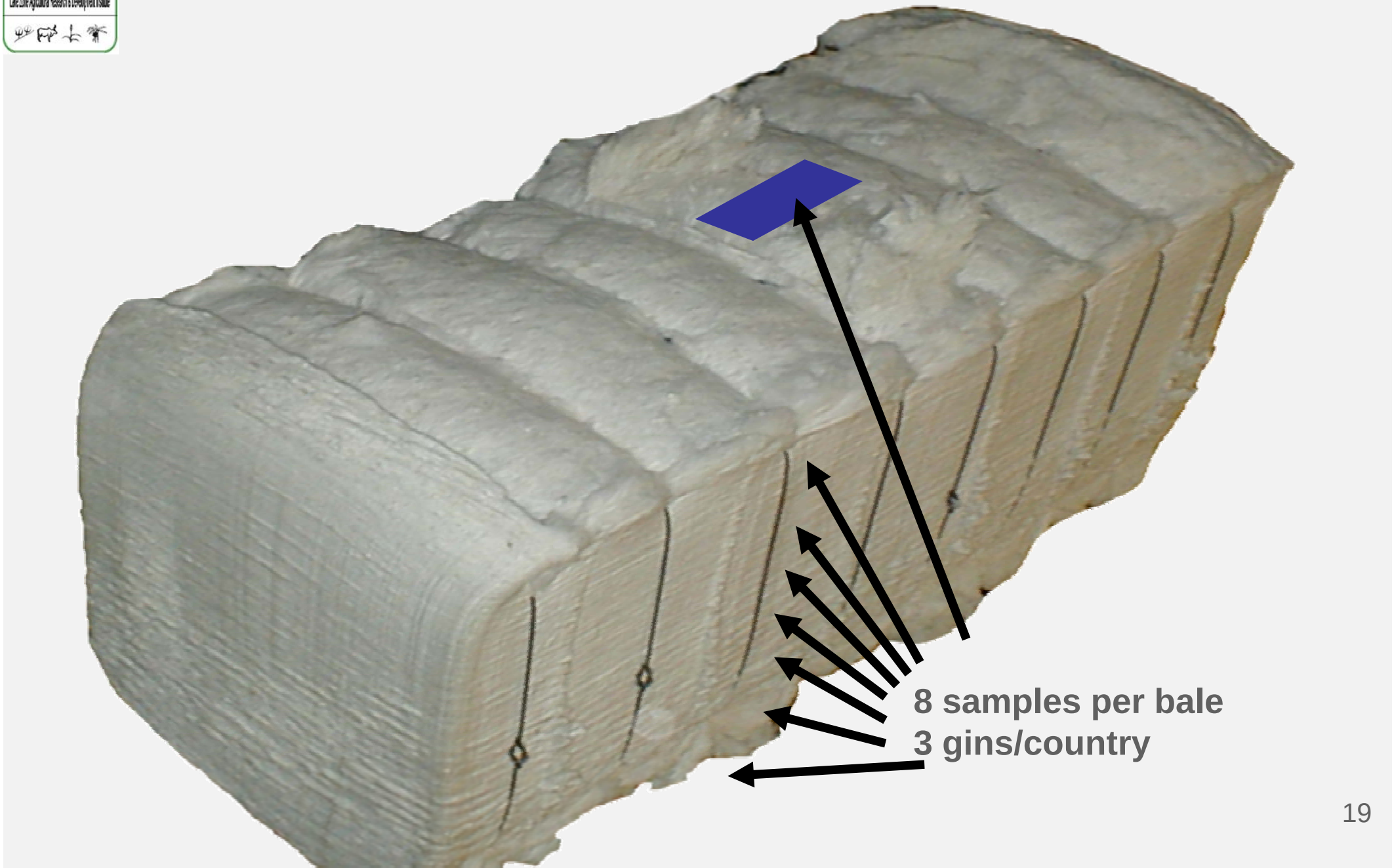
Samples taken from a bale



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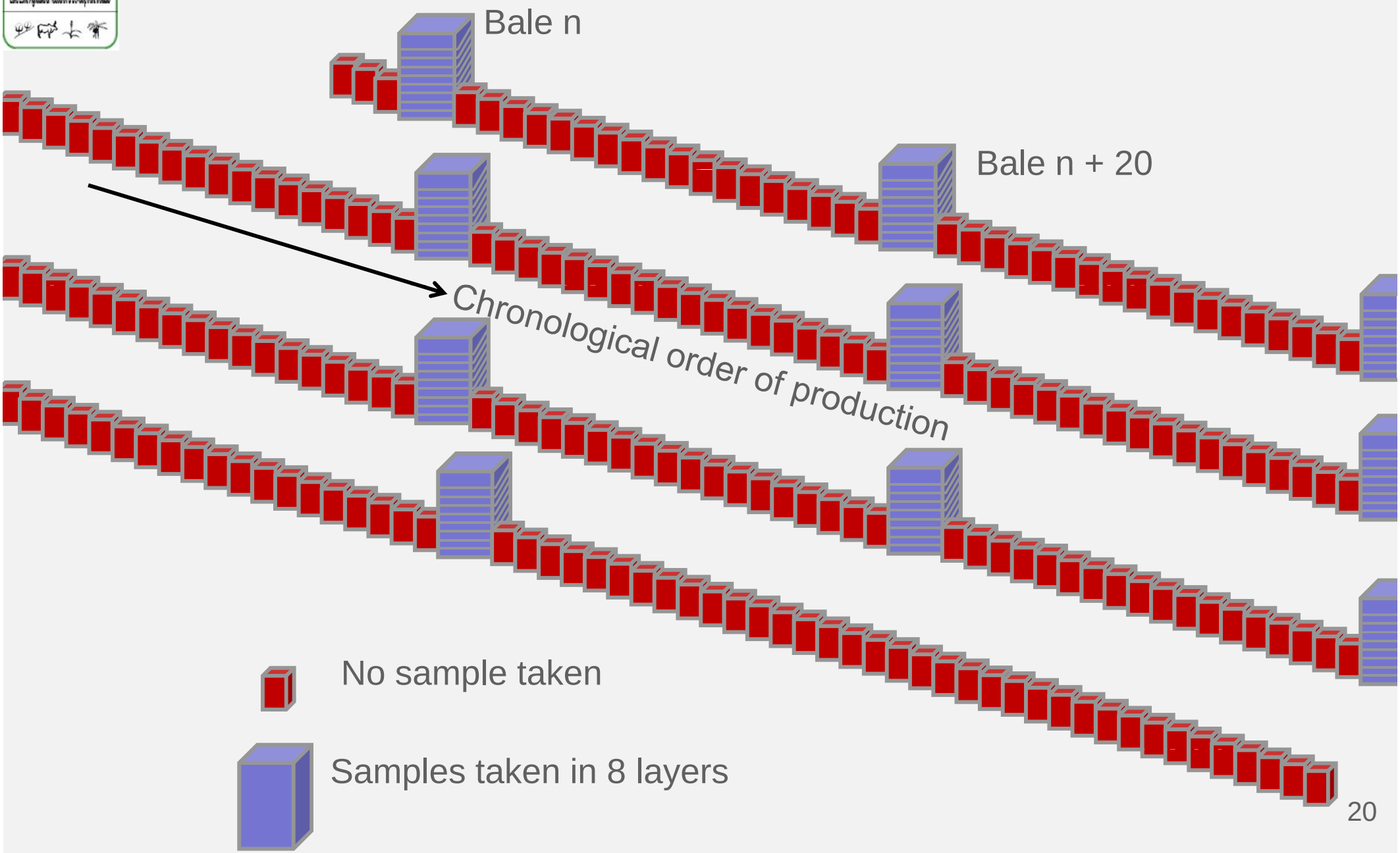
Samples taken for the study



M11 JPG I need your help to explan in English this part.
Modeste; 29.05.2011

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6 measured characteristics

Micronaire (Mic, Micronaire unit)

Upper Half Mean Length (UHML, mm)

Length Uniformity Index (UI, %)

Strength (Str, g/tex)

Reflectance (Rd, %)

Yellowness (+b, Yellowness unit)

- Uster Technologies model HVI 1000 were used according to CSITC Task Force recommendations.
- Statistical analysis: R software, SAS

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Material and methods

Facts:

- One bale is the result of stacking successive layers
- One sample from each of the eight layers was evenly distributed in each bale and measured twice

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Model for data analysis

The model for analysing the acquired results was the following:

Measured result Y =

m bale fixed effect

+ A layer random effect , with std deviation σ_A

~~+ B block effect~~

+ E experimental error, with std deviation σ_E

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Model for data analysis

$$Y_{i,j,k} = m_i + A_{ij} + E_{i,j,k}$$

the measured result Y is :

m_i mean of the bale i

$+ A_i$ random effect of the layer j in the bale i

$+ E_{i,j,k}$ measurement error of the replicate k of the layer j of the bale i

with i in $1 \ldots I$ bales

j in $1 \ldots J$ layers in each bale

k in $1 \ldots K$ replicates in each layer.

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Planned mode of exploration of the data

The two retained random effects retained as variability sources (*A* and *E*) as:

σ_A is the variance of the random layer effect,

σ_E is the variance of the residual effect

to measure the “overall sampling variance” due to the operational sampling and testing conditions using a SITC

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Parameters for choosing sampling and testing conditions

Not exceed a 10% litigation risk on individual bales

Respect commercial usual tolerances

Characteristic	Commercial tolerances
UHML	+/- 0.508 mm
UI	+/- 1 %
Strength	+/- 1.5 g/tex
Micronaire	+/- 0.1 unit
Rd	+/- 1 %
X.b (Yellowness)	+/- 0.5 unit

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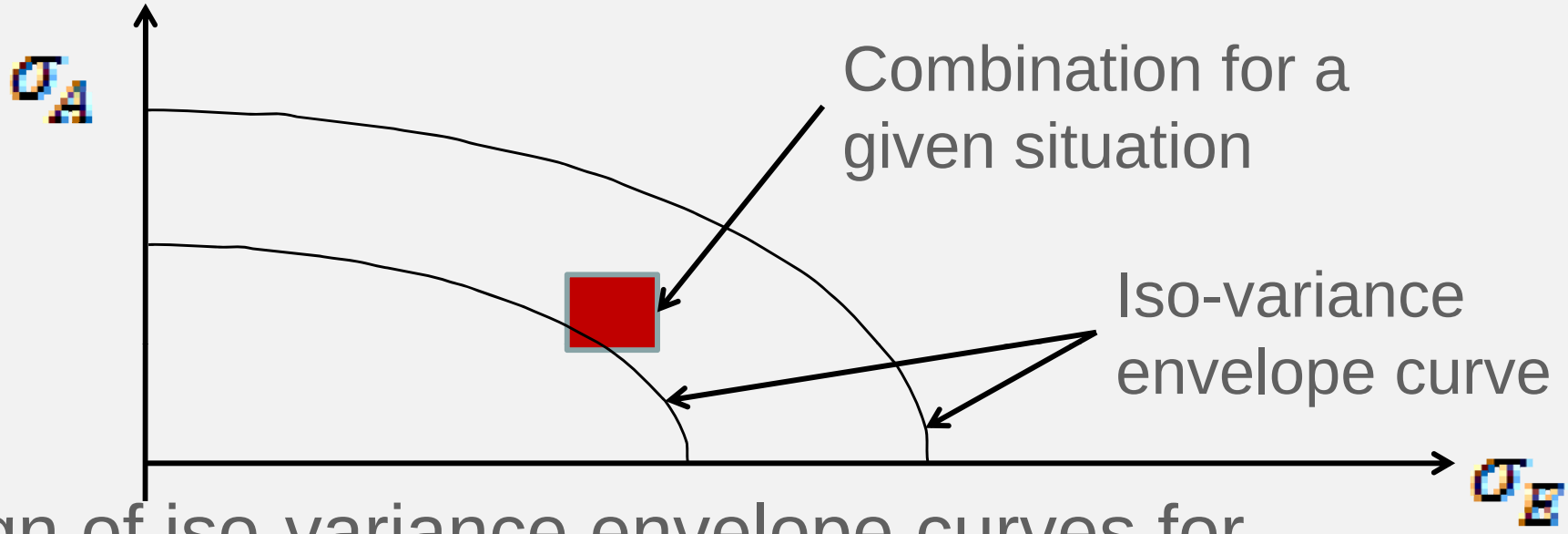
Iso-variance curves



Design of iso-variance envelope curves for determining:

- the number and type (single or combined) of samples per bale
- the number of measurements per bale and the type (composite or cluster) of testing

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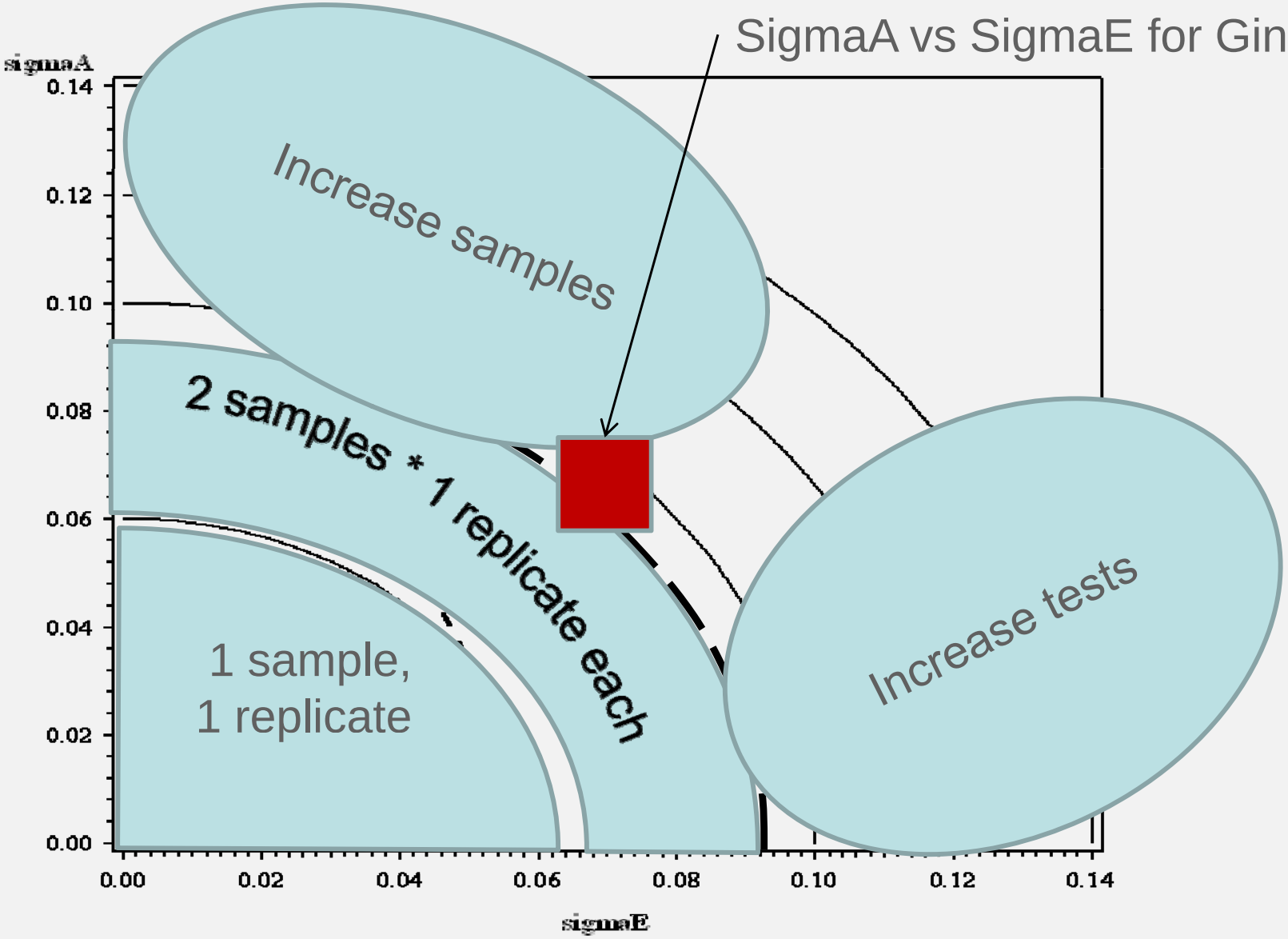
Iso-variances curves



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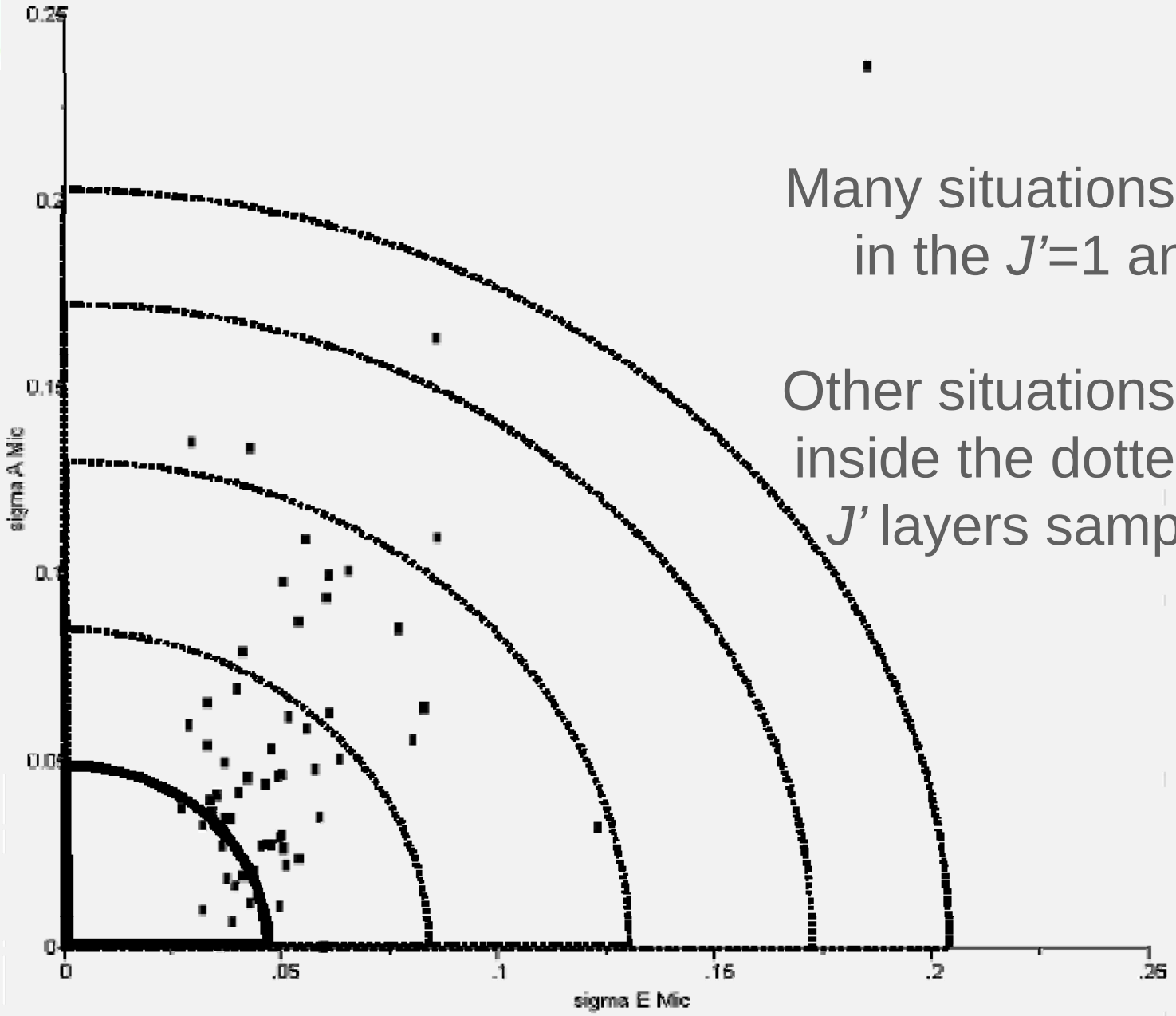
Iso-variance curves for Micronaire



Many situations are included in the *J'*=1 and *K'*=1 circle

Other situations are included inside the dotted circles with *J'* layers sampled and *K'*=1 replicate

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Formulas underlying the graphs

From the estimation of standard deviations, we can deduce the variance of the error of estimation of the bale mean :

- ✓ For any sample made of J' layers, each tested K' times (cluster)

$$\sigma_M^2 = \frac{\sigma_A^2}{J'} + \frac{\sigma_E^2}{J'K'}$$

- ✓ For any combined sample from J' layers, and tested N' times (composite)

$$\sigma_M^2 = \frac{\sigma_A^2}{J'} + \frac{\sigma_E^2}{N'}$$

- ➢ Upon hypothesis for J', K' and N', study of the improvement of sigma M as a function of sample and test numbers

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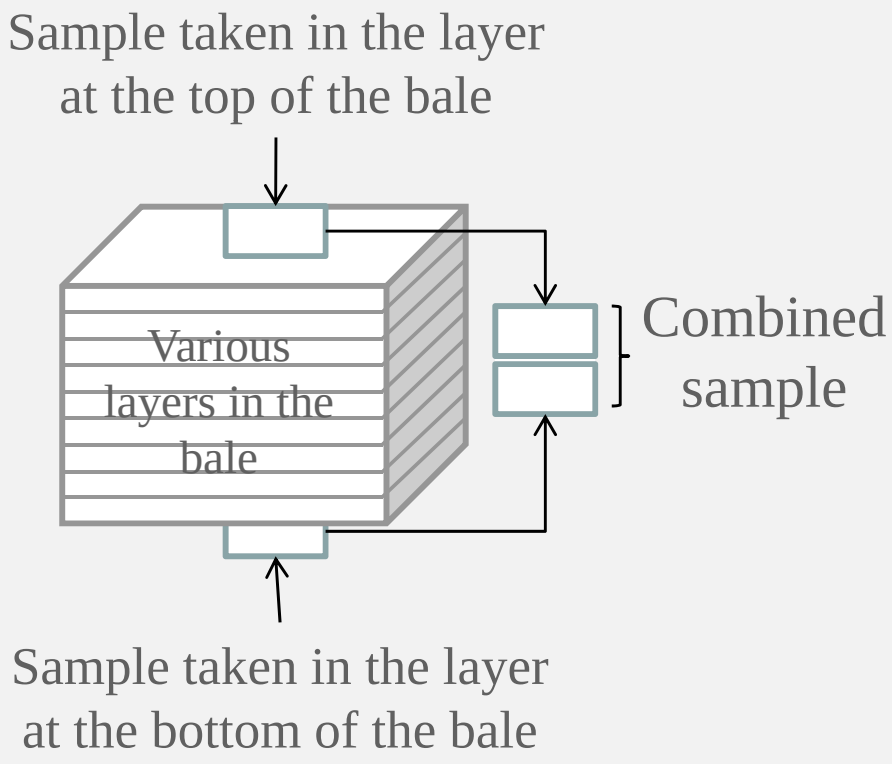
Possibilities in sampling and testing

Sampling in the bale



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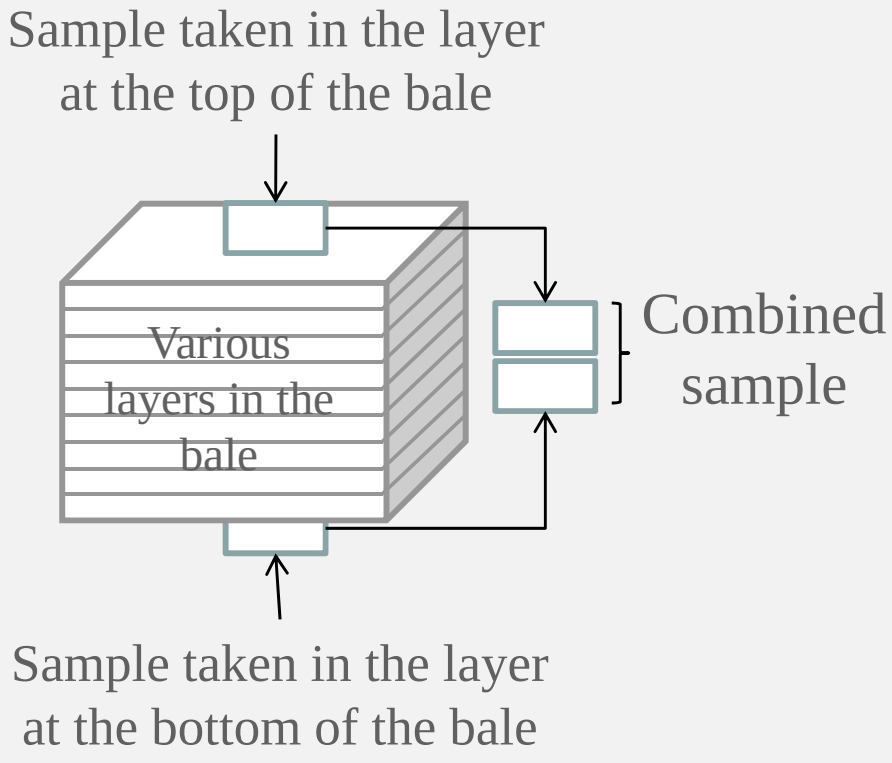

Sample testing

Sample analysis with one replicate of one measurement per sample

Composite testing


1 measurement (meas.)

Cluster testing


1 meas.
1 meas.

Sample analysis with one replicate of two measurements per sample

Composite testing


2 meas.

OR


1 meas.
1 meas.

Cluster testing


1 meas.
1 meas.


1 meas.
1 meas.

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Operating methods to be decided by situation - prospects

- Contribution of ‘layer’ and ‘replicate’ differed depending on the technological characteristic and the studied situations

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- Else, adjustments may be necessary in the seed-cotton management practices from field to gin

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Positive extension of the study: Periodical monitoring of the within-bale variability for each situation for adjusting / confirming sampling and testing settings while respecting the agreed commercial tolerances and the litigation risk level

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Thank you for your attention

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