Steps towards suitable stickiness test results for trading and processing

Jean-Paul Gourlot *, Axel Drieling **

* CIRAD (France), ** FIBRE (Germany)

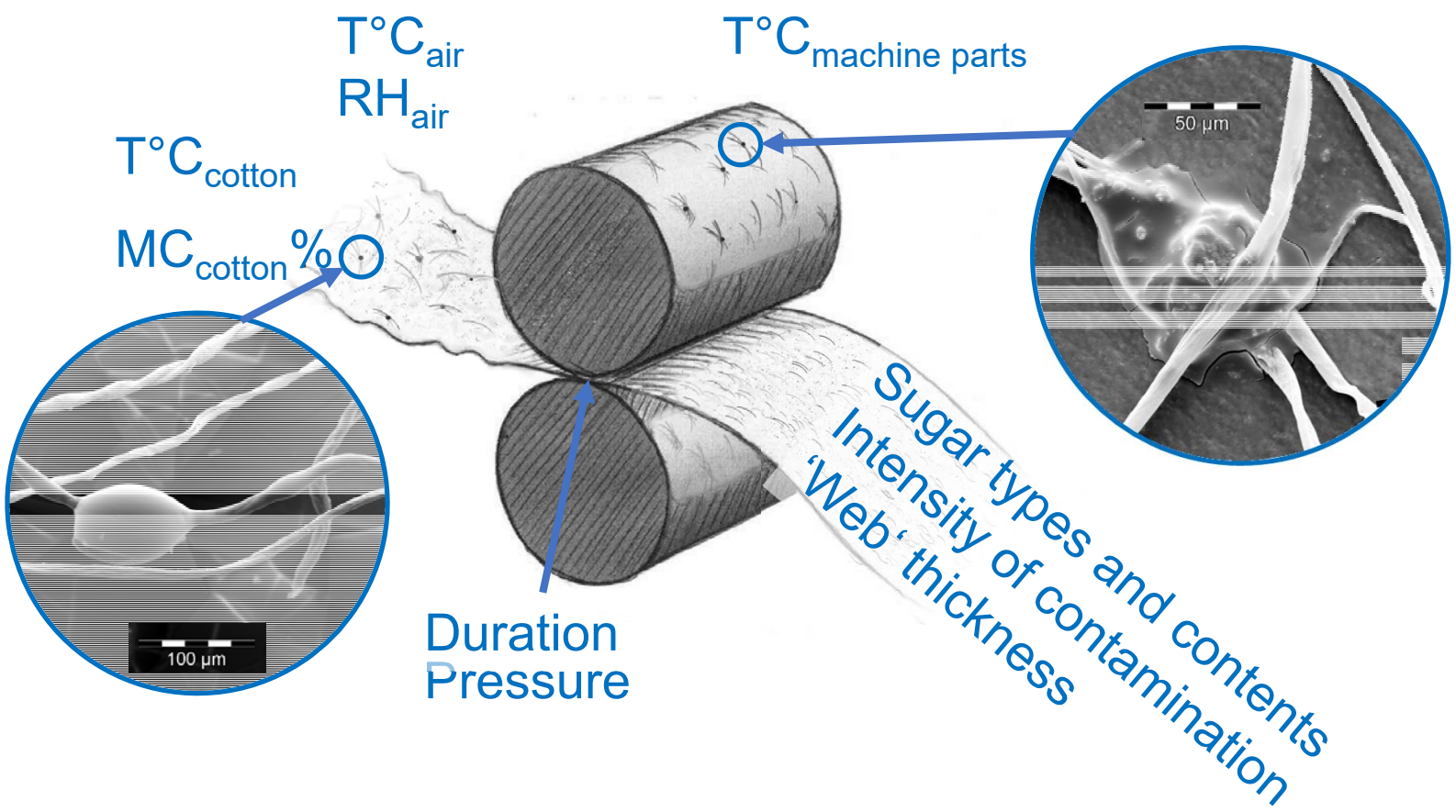
Stickiness: what is it, what are the incidences? (1/3)

- Deposits from insect honeydew mainly onto fibers; composed by several individual sugars
- Fibers + honeydew stick on machine parts such as cylinders at spinning with yarn quality (un-evenness) and productivity (lower turnout) incidences



Pictures by Cirad

Stickiness: what is it, what are the incidences? (2/3)



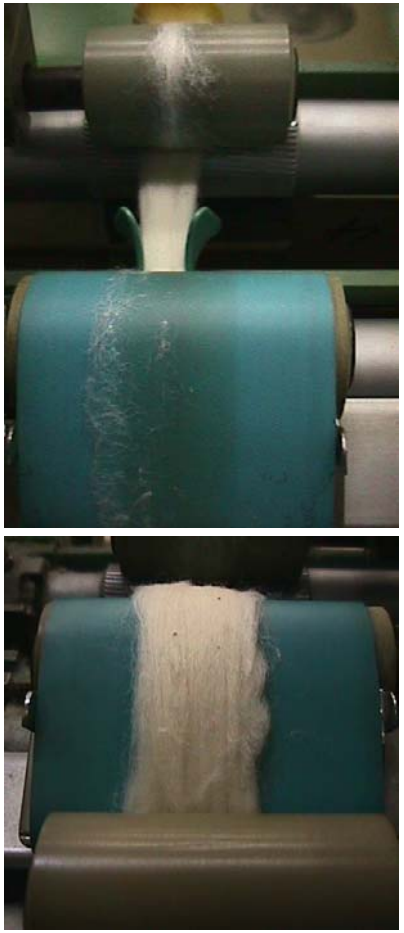


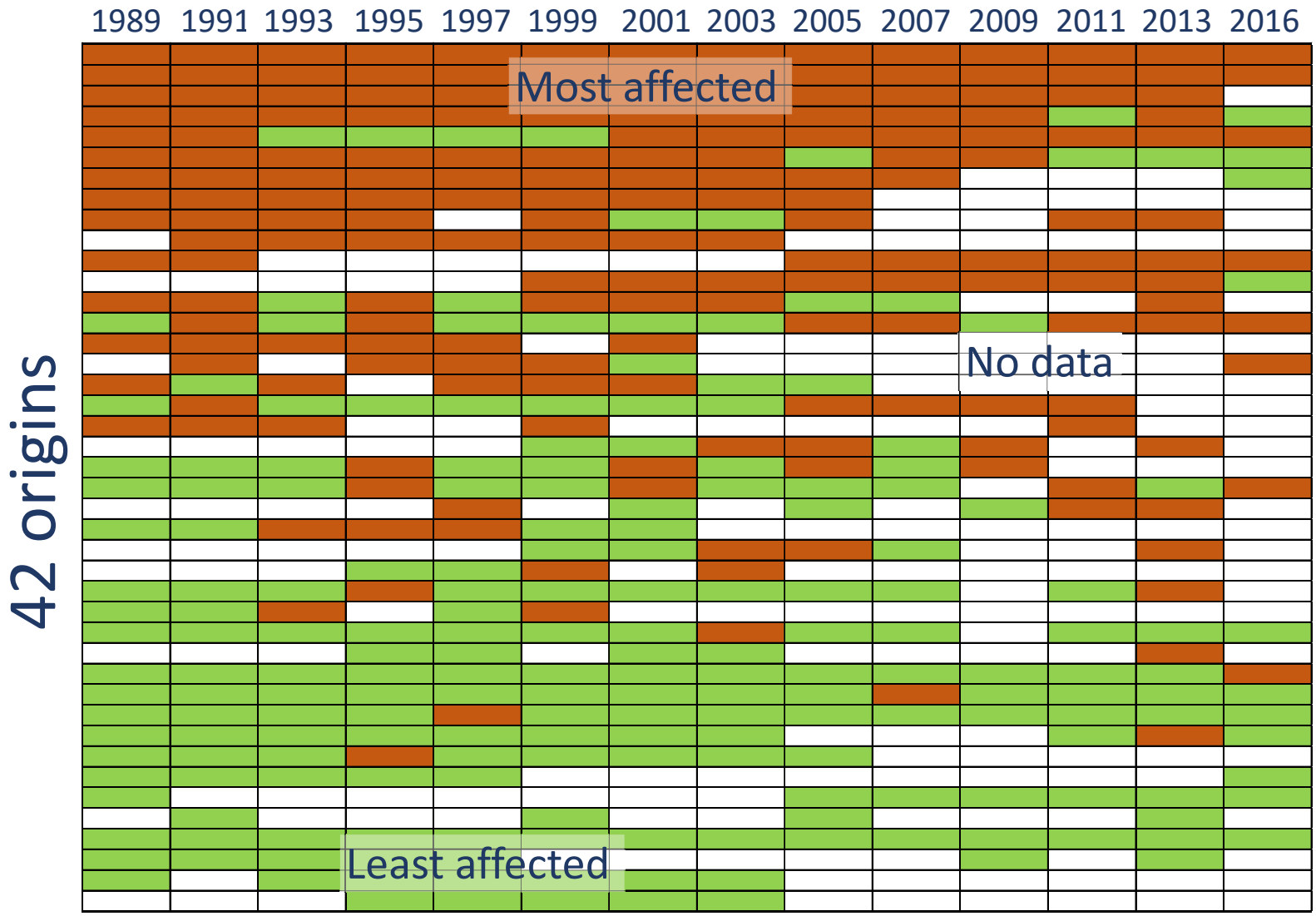
Illustration by Lena Kölsch, FIBRE

Stickiness:
what is it, what are the incidences? (3/3)

- Fibers + honeydew stick on machine parts such as cylinders at spinning with yarn quality (un-evenness) and productivity (lower turnout) incidences
- Economical incidences (claims, discounts, reputation)
- Solutions exist
  - Choose cottons
  - Blend origins
  - Change spinning mills conditions

➔**Need reliable measurement** (technical and trade uses)

ITMF Contamination Surveys over time



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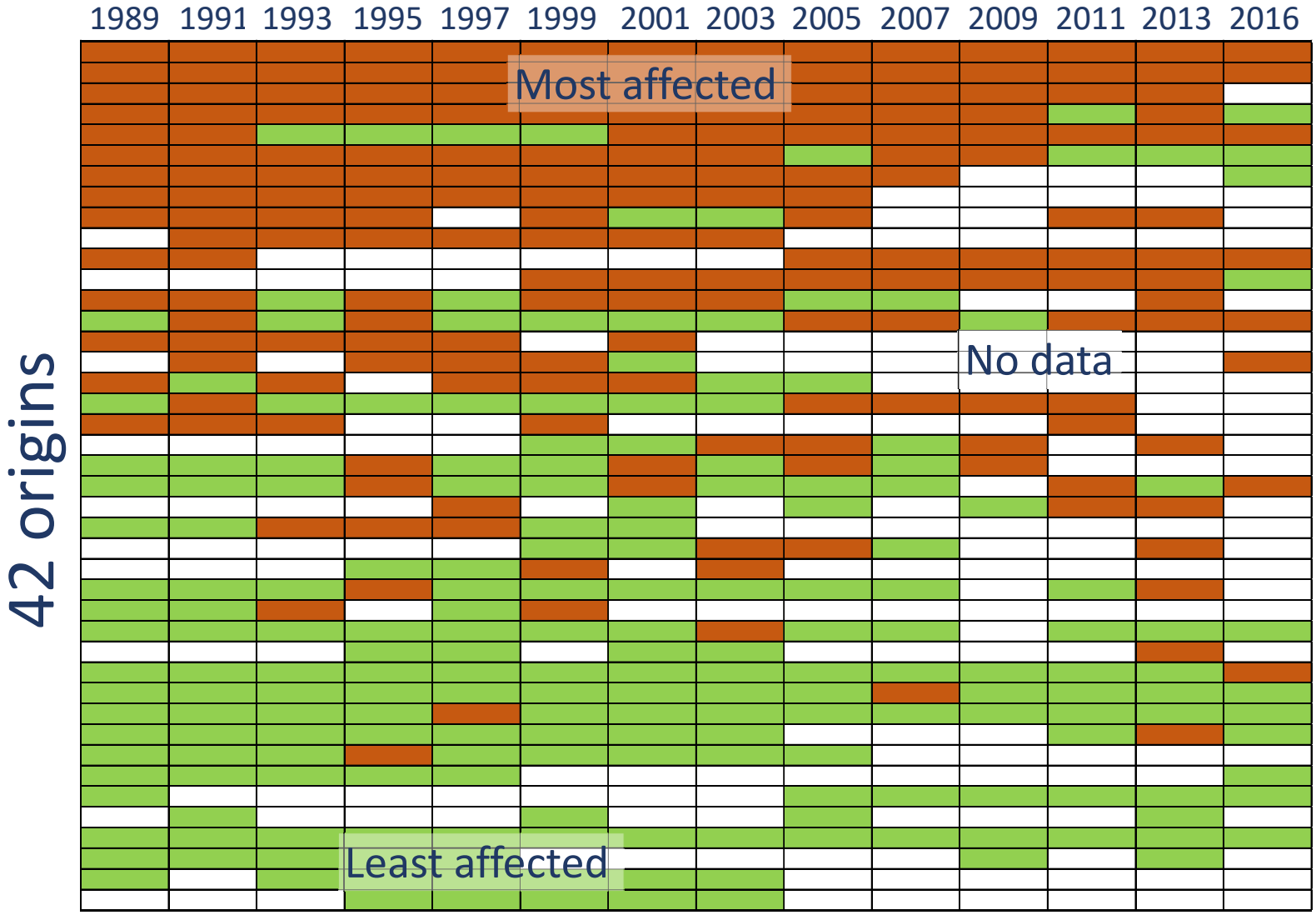
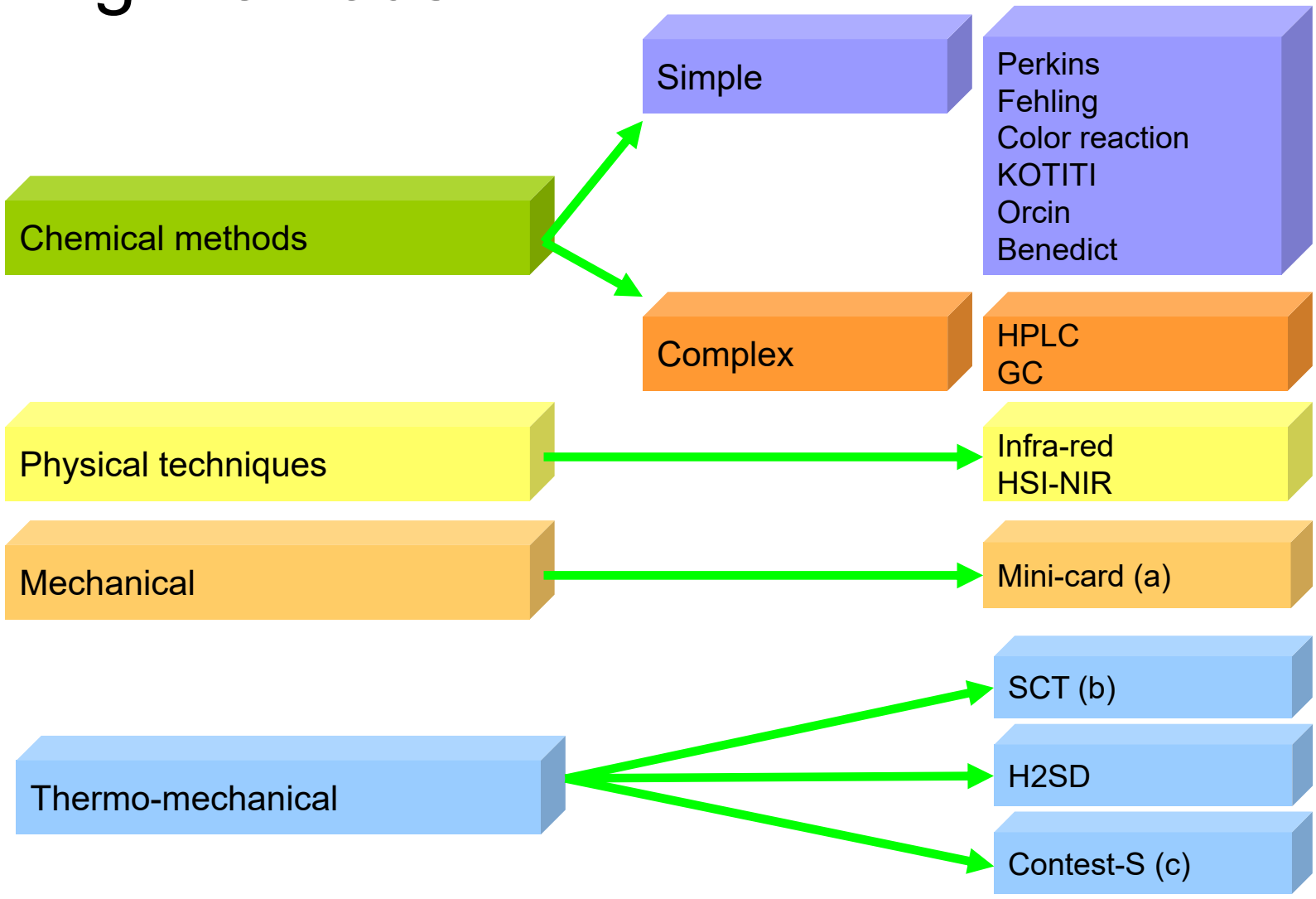


Stickiness: appreciations about origins not permanent nor stable

Existing methods



(a) ITMF Reference method (b) ITMF Recommended method (c) ITMF Recognized method

Stickiness: Evaluation and measurement Harmonization of results

Our aims

Show the variations and their causes

Harmonize between labs based on RTs including various methods

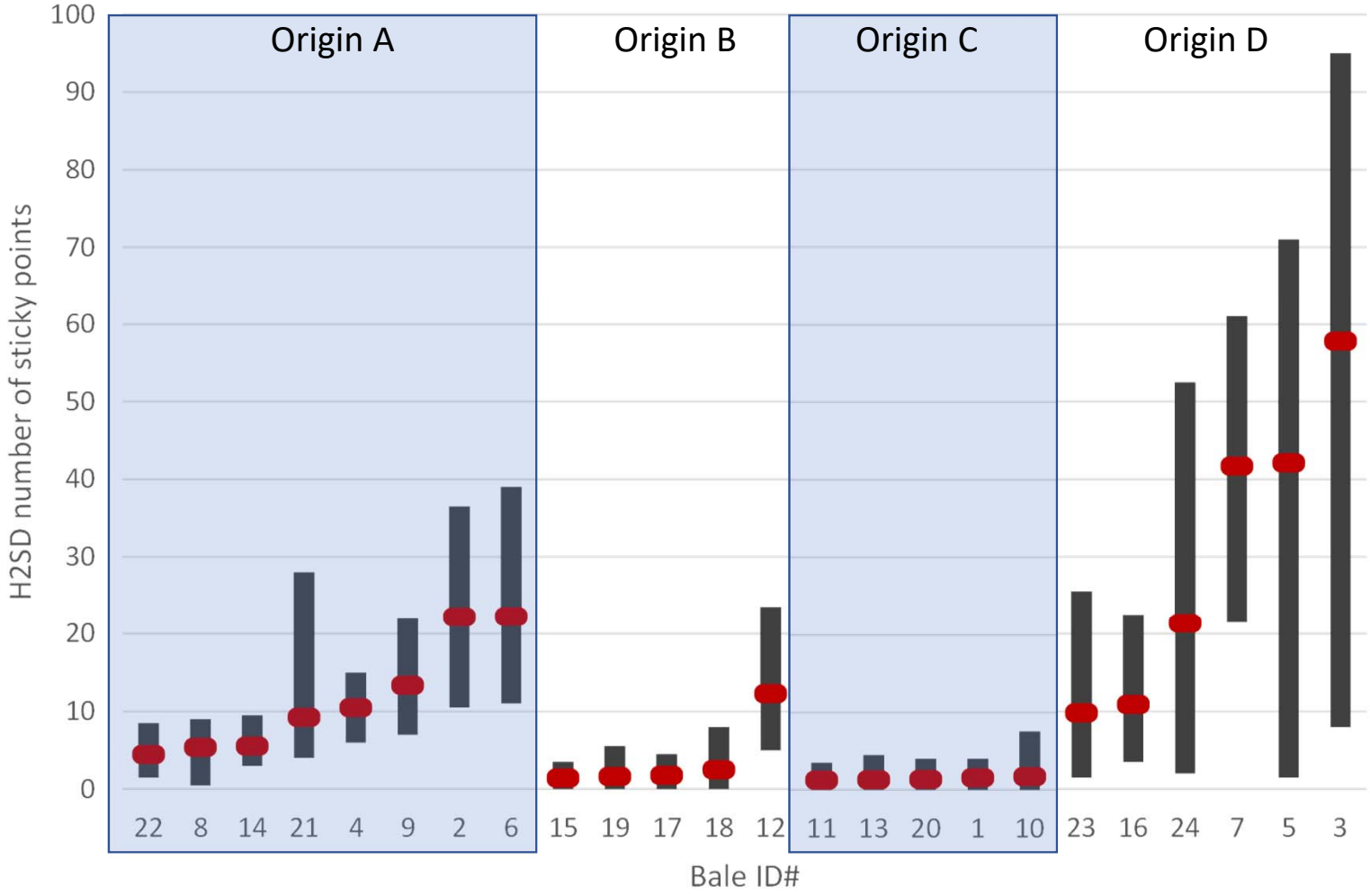
Choose methods based on

- Best correlations to SIP (stickiness in practice)
- Good correlations to each other

Allow comparisons between instruments and between methods

Propose future harmonization steps

Distribution of stickiness within bales



Min, Max and mean numbers of H2SD sticky points
(32 samples per bale, 24 bales from various origins. (Frydrych et al. 2004).

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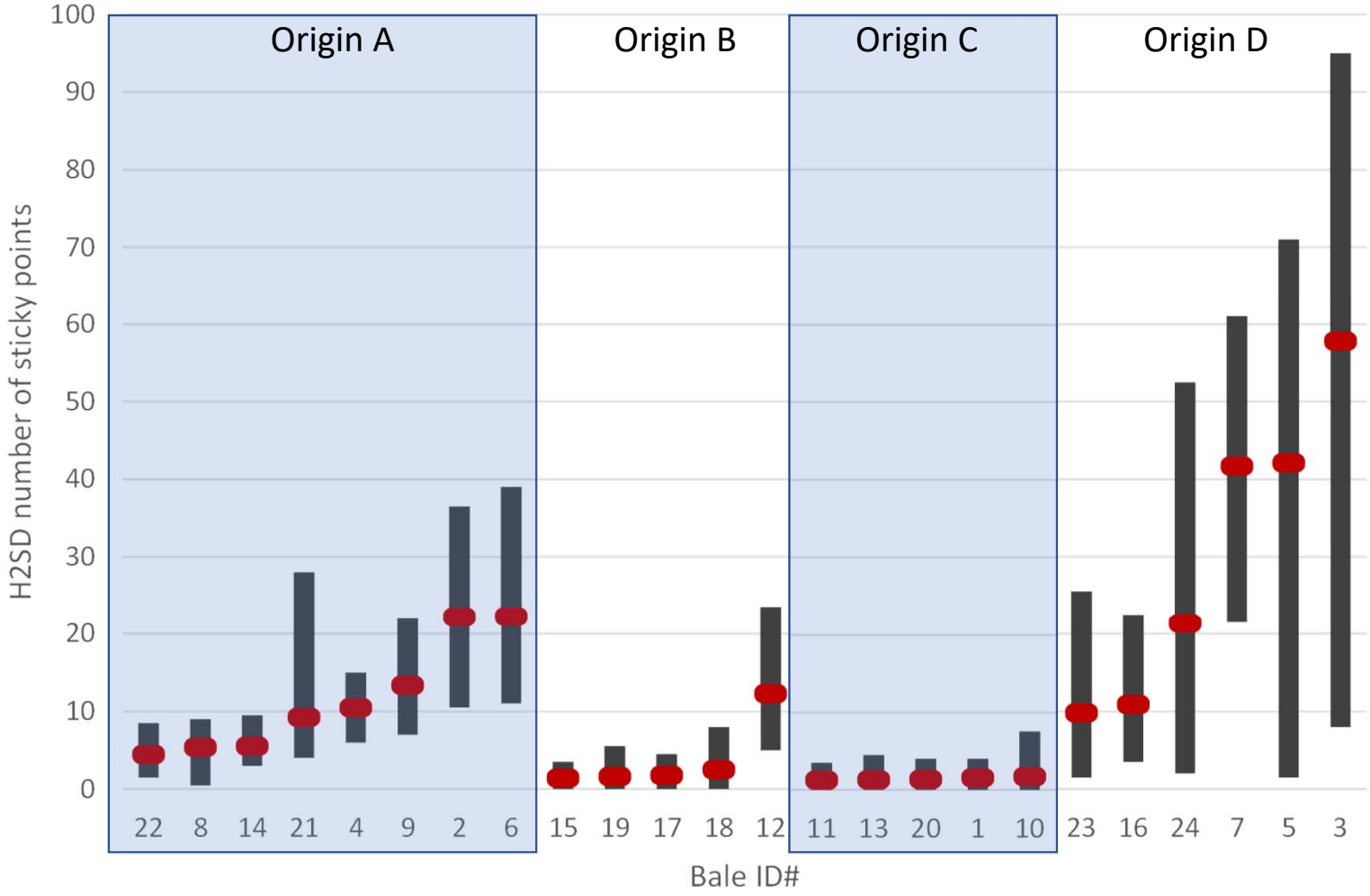

Min, Max and mean numbers of H2SD sticky points
(32 samples per bale, 24 bales from various origins. (Frydrych et al. 2004).

Extreme variation
even within bales
→ Difficulty
to get representative
samples

Stickiness: various predictive levels between results and SIP (Stickiness in practice)

Micro-ring-spinning

11 cottons

20 tex (Ne 30 or Nm 50)

23°C, 58% R.H.

Yarn productivity (8) and quality (24) parameters recorded

	Others	Card	H2SD	SCT
Productivity (max=8)	2 to 6	7	6	6
Quality (max=28)	17 to 22	22	22	22
Percent of significant relationships (α=5%) Yarn = f (Fiber)	**58 to 67**	**81**	**78**	**78**

Others are: Caramelization, Chemcare, Kotiti

Gourlot et al, ITMF-ICCTM, 2016

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Mechanical and thermo-mechanical methods show the most significant relationships with SIP

Gourlot et al, ITMF-ICCTM, 2016

Observations on variations in round-tests

1. Effect of the reading levels for each testing method
2. (Effect of the natural variability of stickiness)
3. Effect of the material preparation
4. Effect of sampling of any material into several samples
5. Effect of the measurement result levels on the level of variability in measurements
6. Finding a common scale to report results
7. Variability in stickiness results with one material along RTs
8. Correlations between methods

Observations on variations in round-tests

1. Effect of the reading levels for each testing method
   - 2 RT / year since 2017
   - 3 to 5 cottons / RT covering a stickiness range
   - 10-12 methods used by 25-35 labs
   - 1 to 6 results per instrument and cotton

Observations on variations in round-tests

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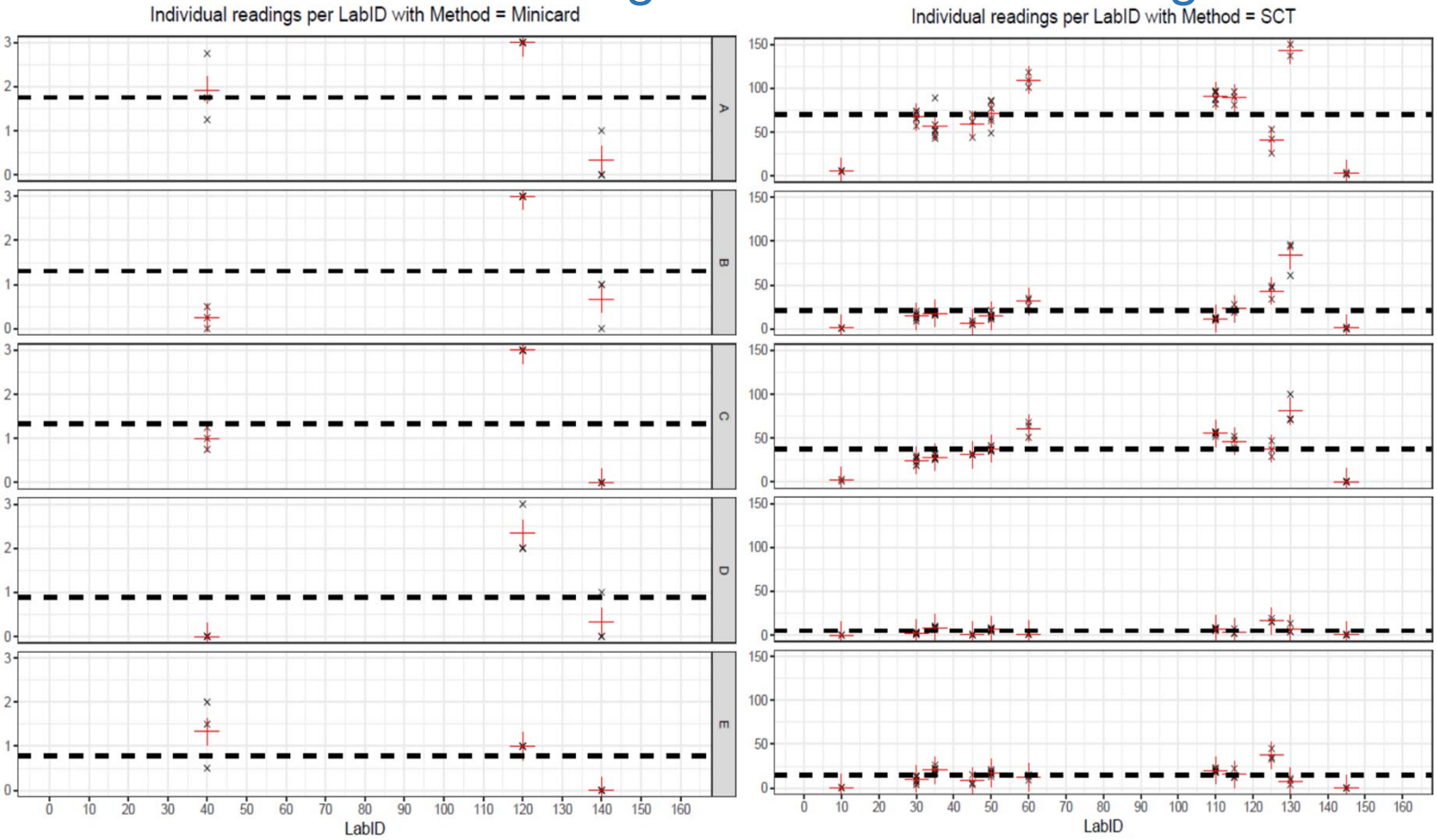

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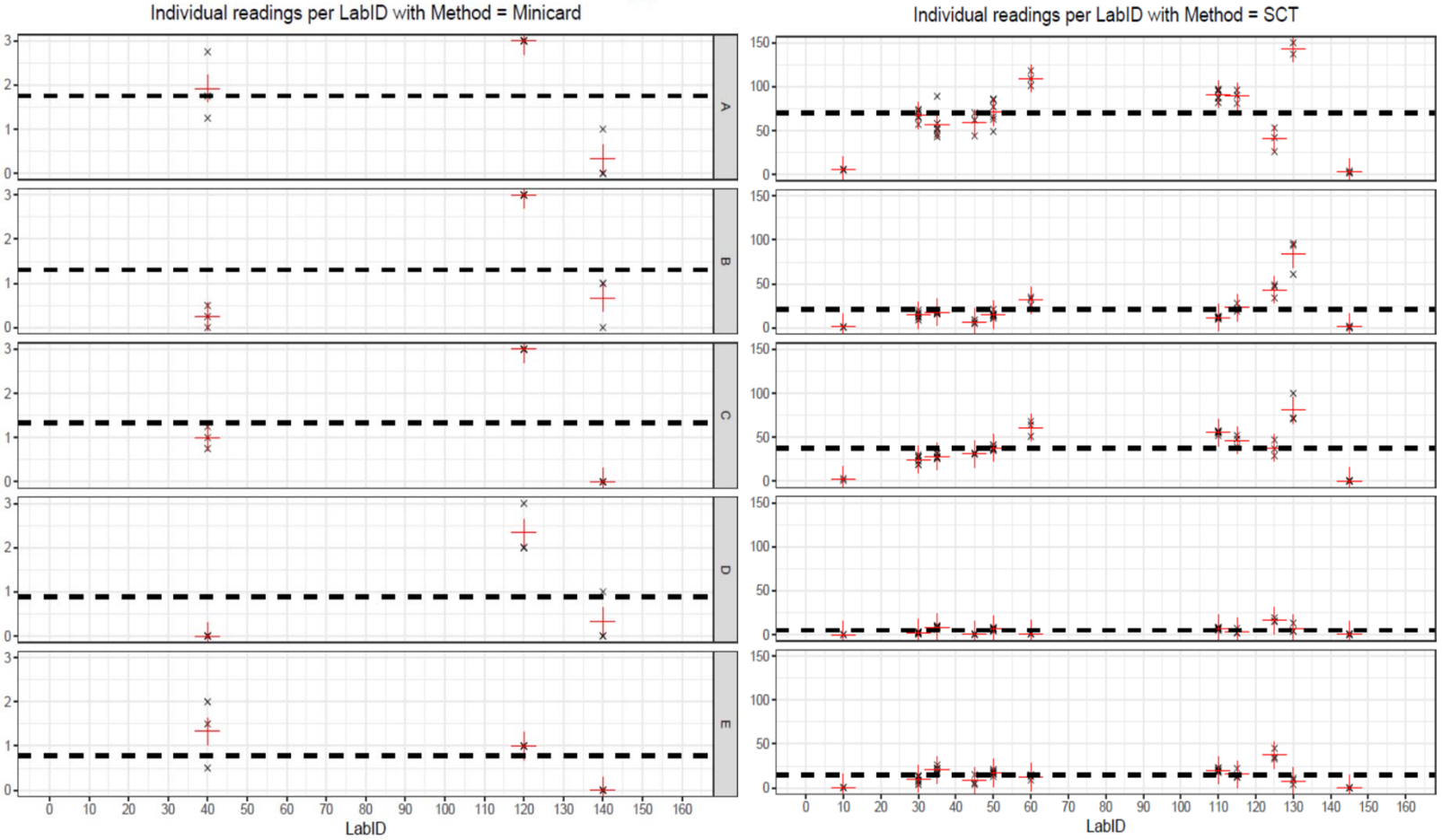


Easy to compare instrument variations within each method

- within lab.
- between labs.

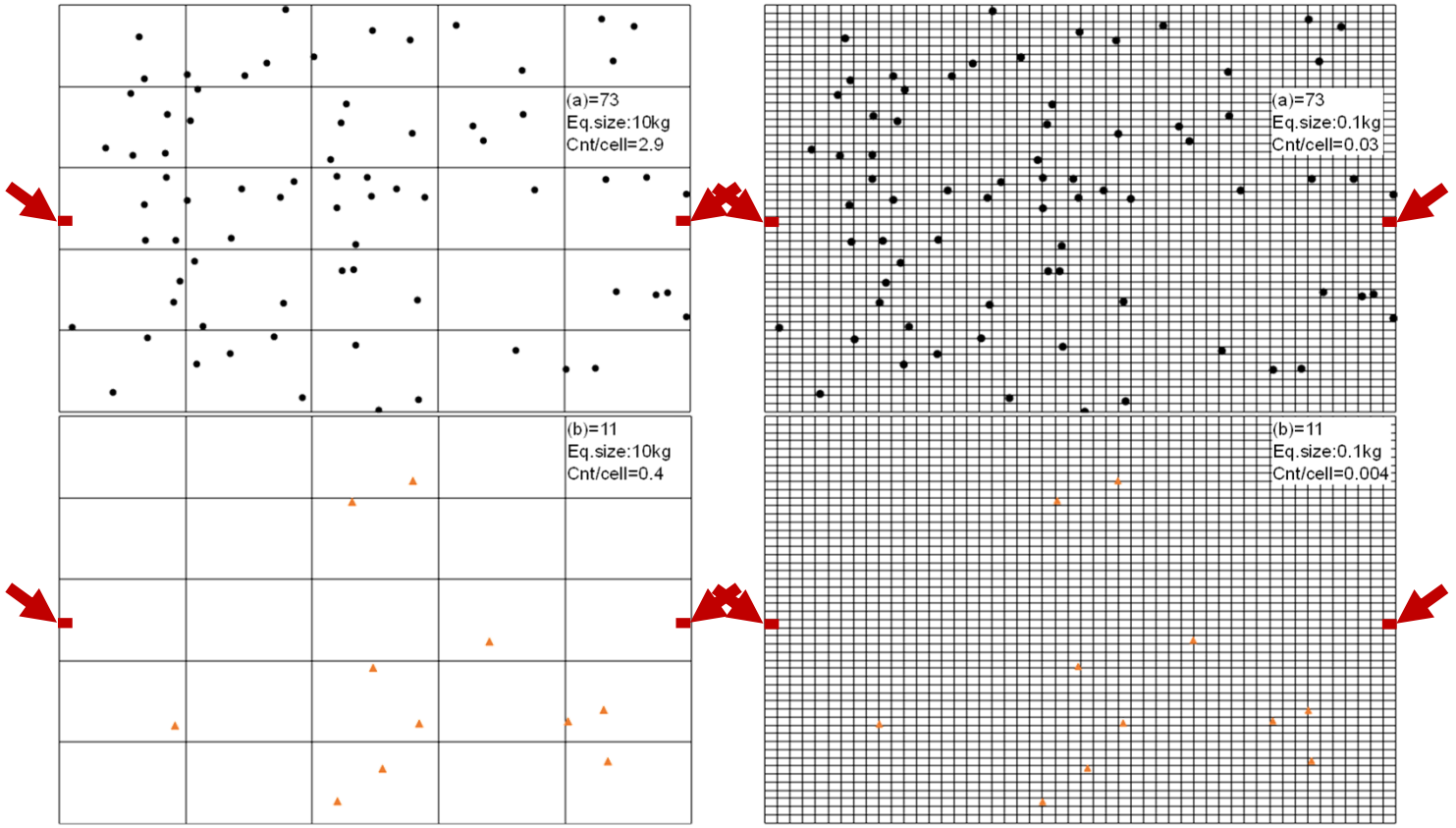
→ Labs improve

→ Best practices guide needed

Difficult to compare methods

Observations on variations in round-tests

2. Effect of the natural variability of stickiness



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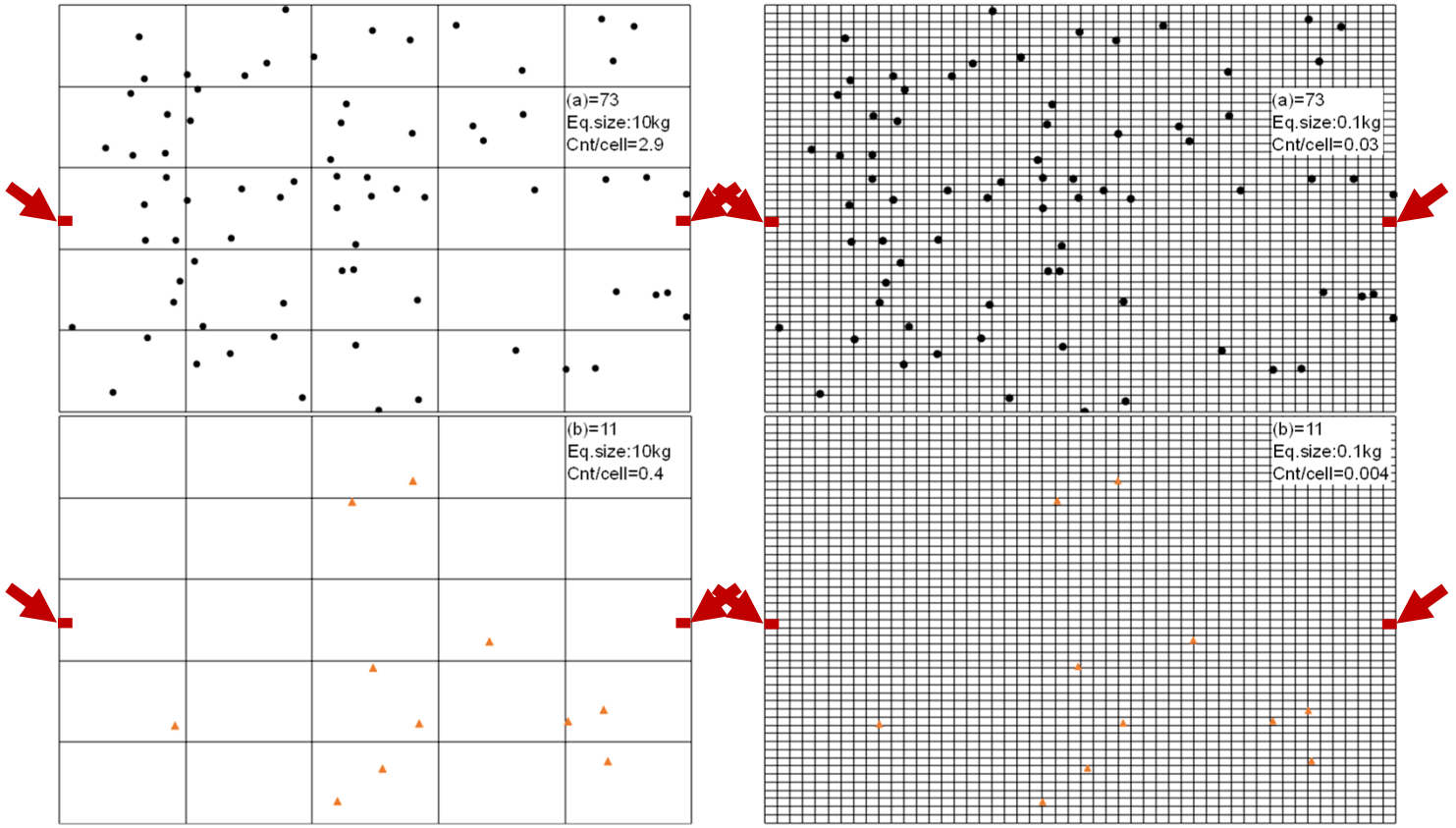
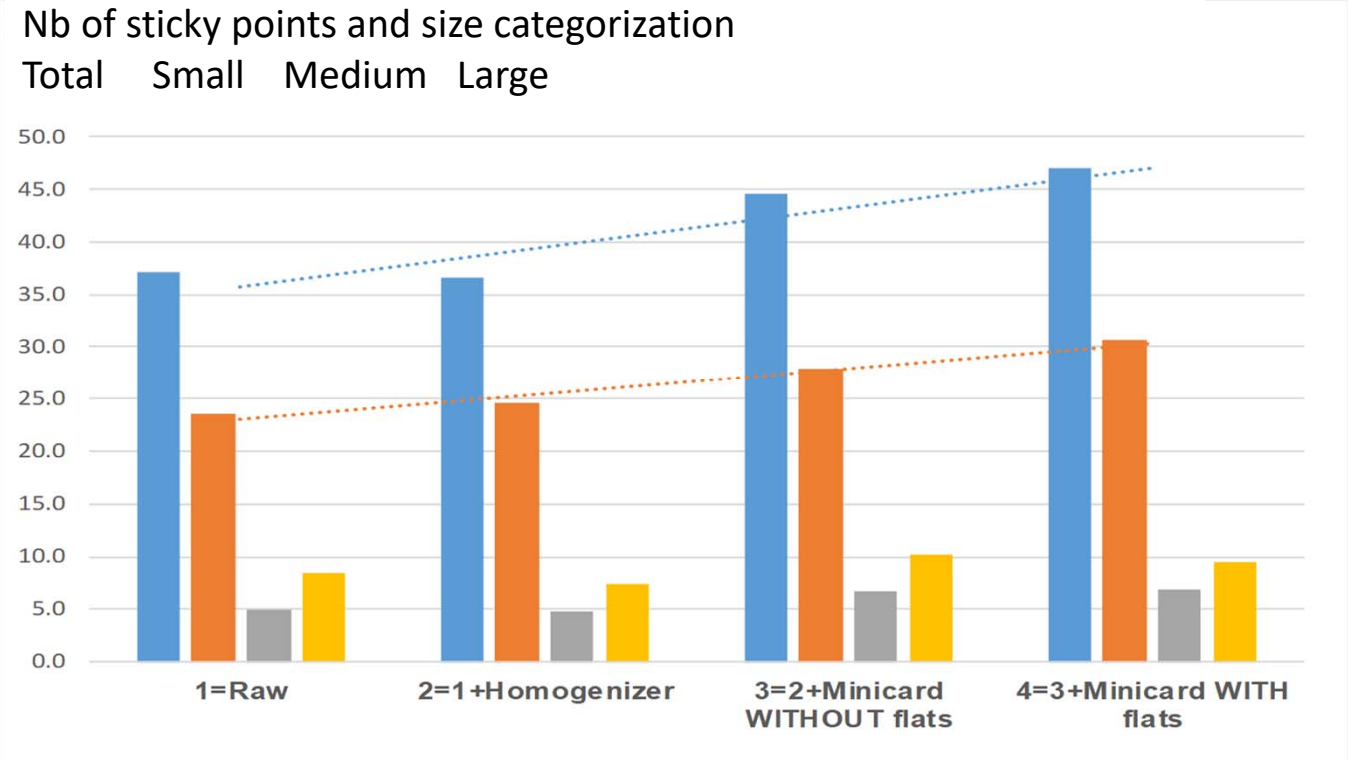


Honeydew distributed in bales
Probability to find this honeydew in sample is quite low

Observations on variations in round-tests

3. Effect of the material preparation
   - 4 accumulative ways to ‘prepare’ the material
   - H2SD counting



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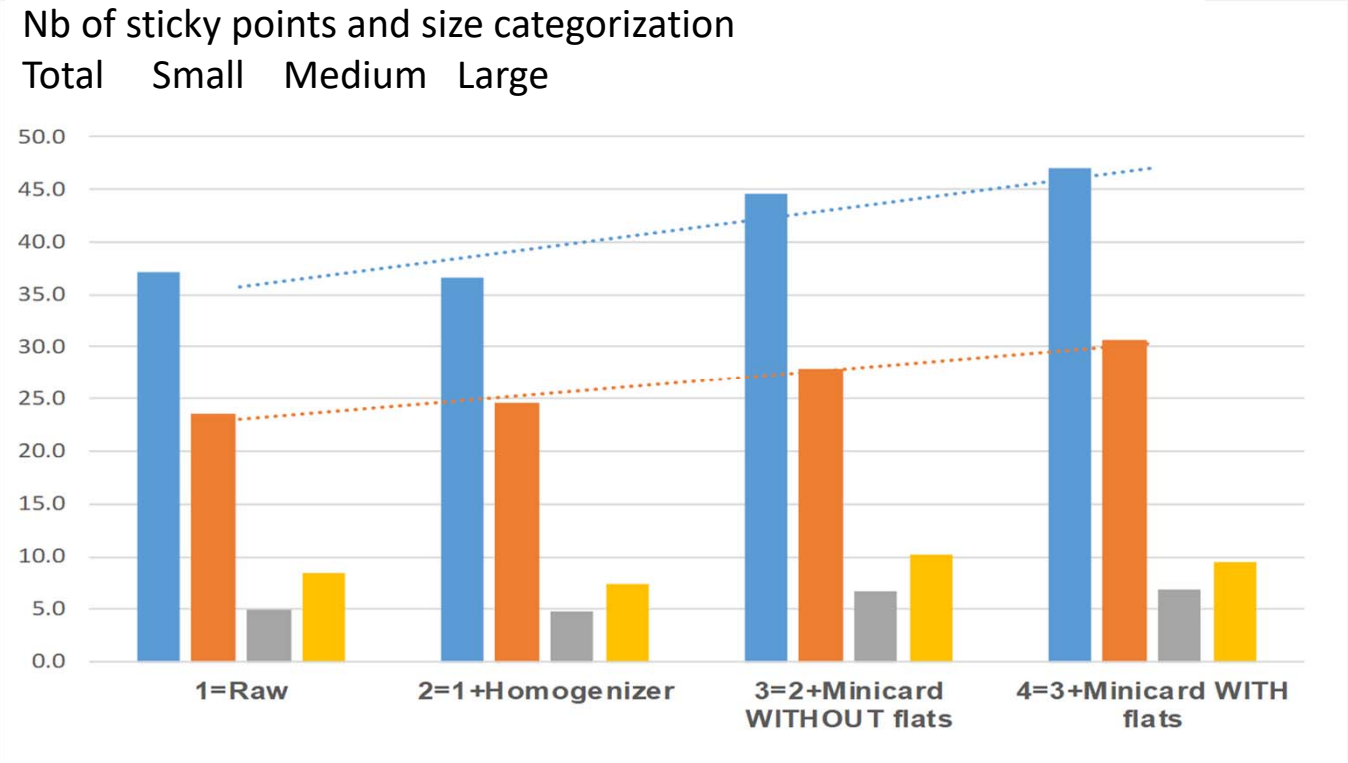


Impact of blending on number and size of sticky points →Keep homogenizer for next RTs

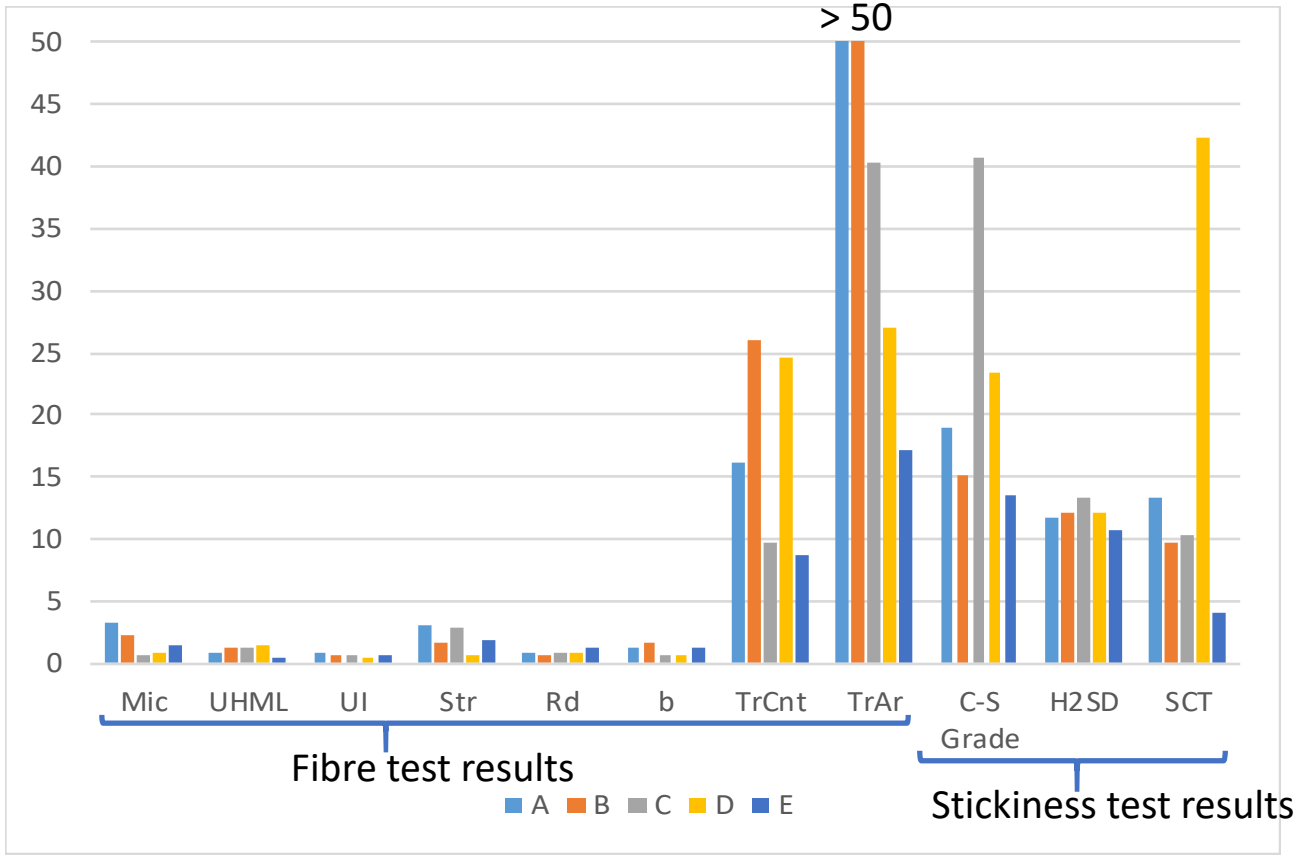
Observations on variations in round-tests

4. Effect of sampling of any material into several samples
   - Aim: checking if materials are properly homogenized: observation of variations between sets of samples
   - Special sets of samples for fiber testing in addition to stickiness testing

Observations on variations in round-tests

4. Effect of sampling a material into several samples

CV% between sets



Observations on variations in round-tests

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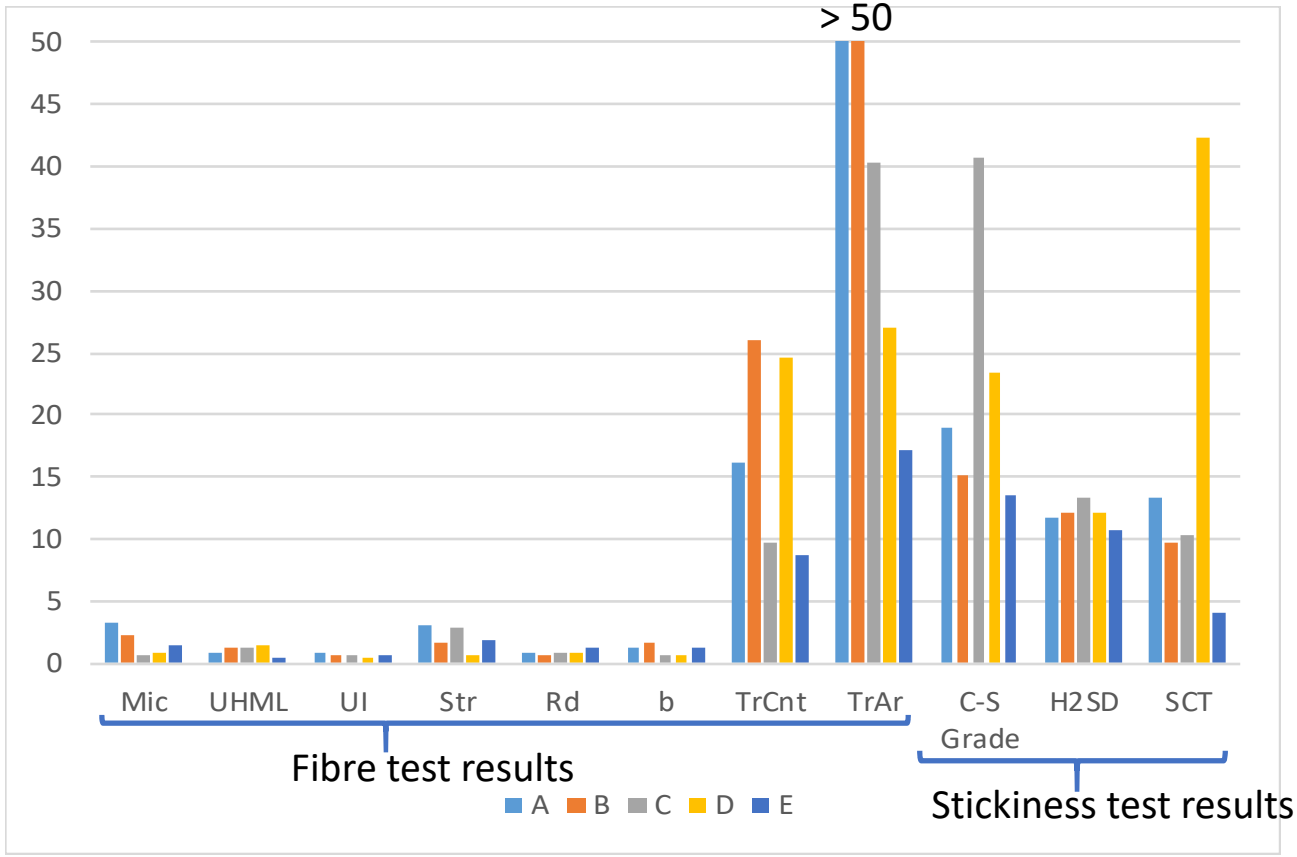


Usual fiber results CV% are low

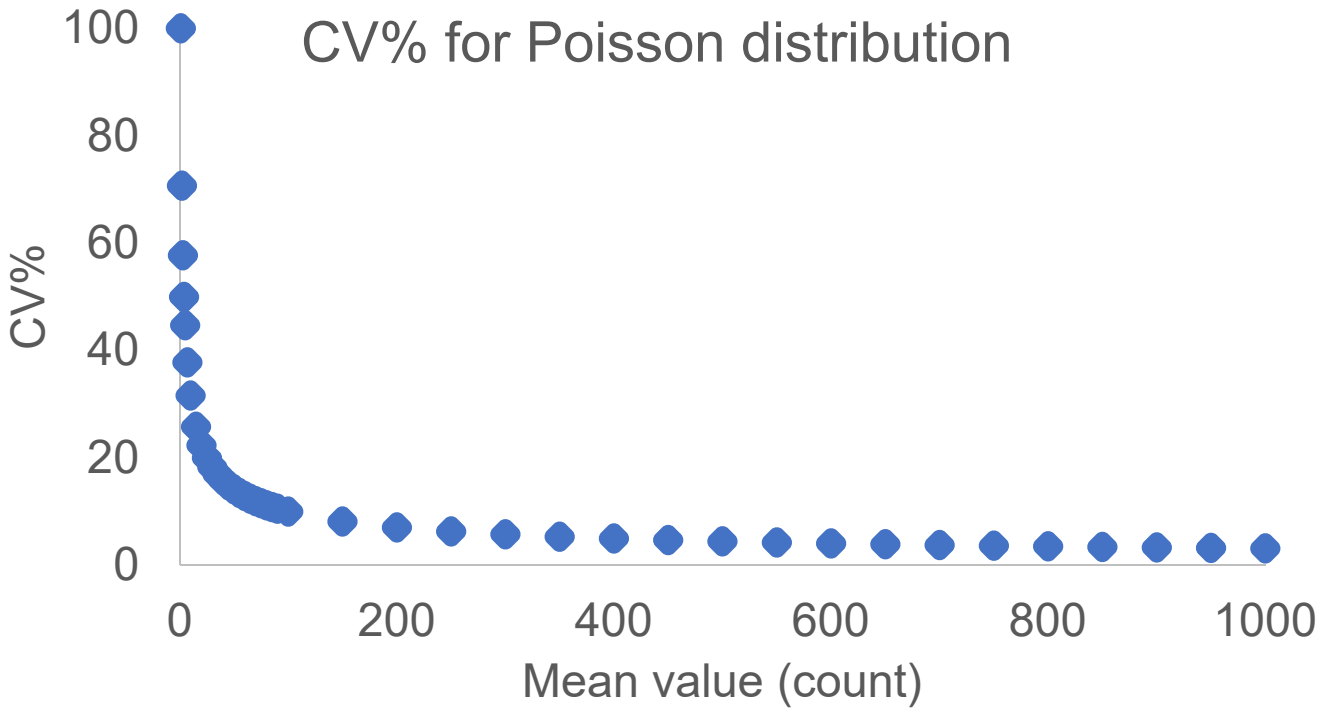
→ homogenization is good

→ Keep the homogenizer for next RTs

Comparable CV% for Trash and stickiness

Observations on variations in round-tests

5. Effect of the measurement result levels on the level of variability in measurements



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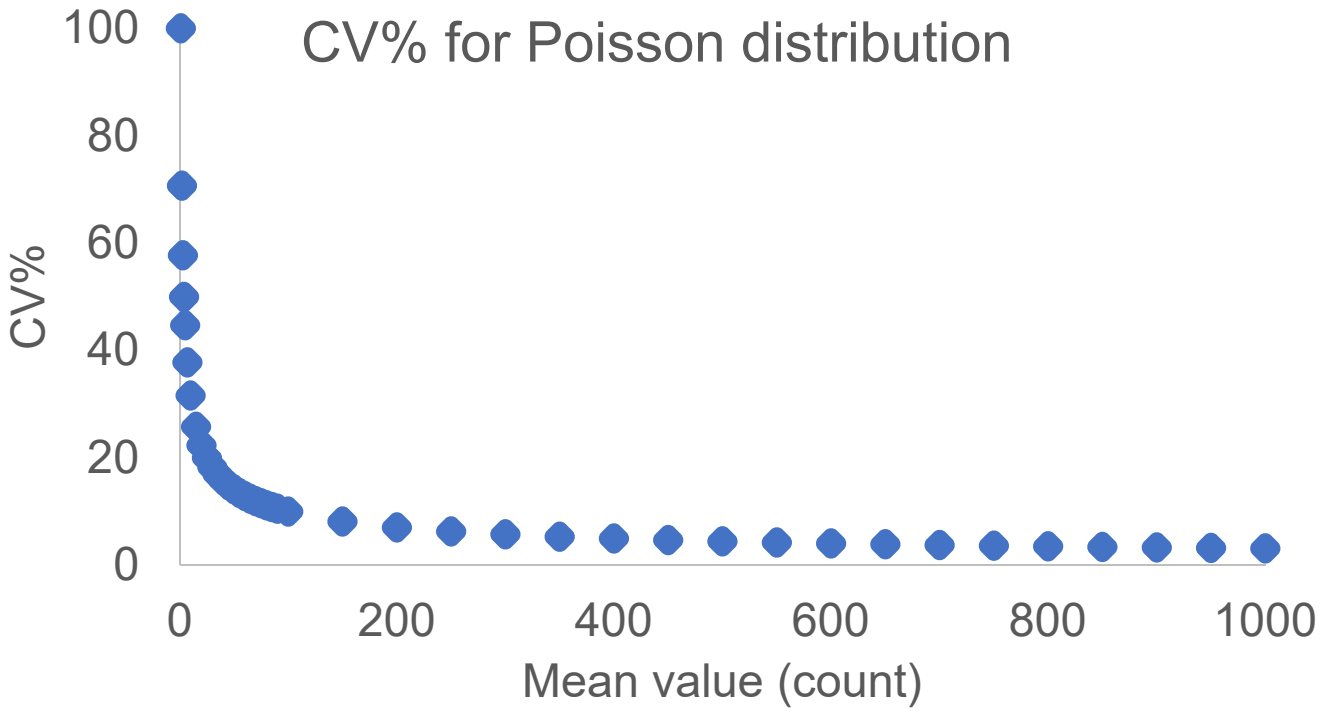


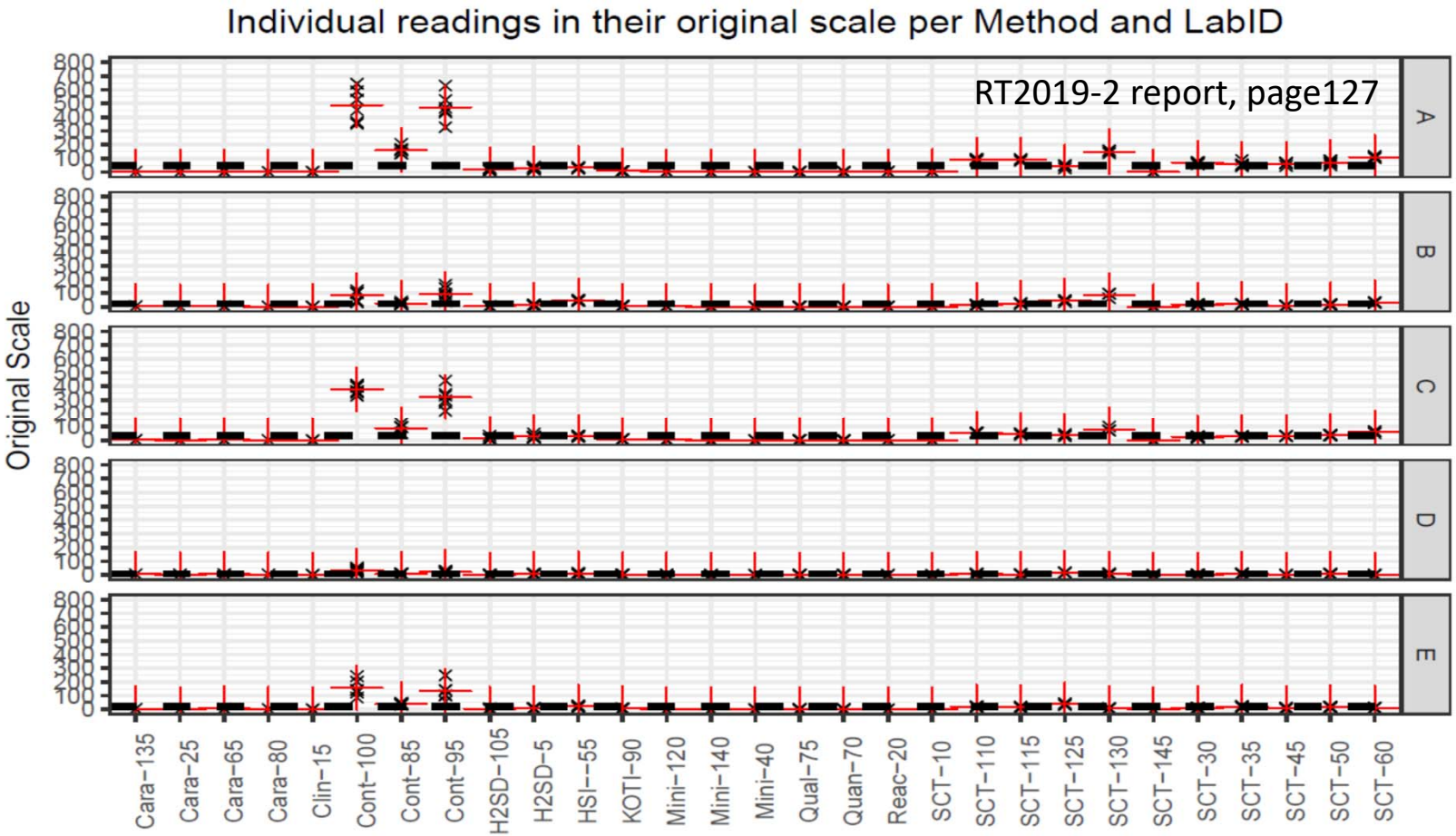
CV% changes with mean value

→ CV% not a good indicator for a fair comparison of methods

→ Need to look for better indicator

Observations on variations in round-tests

6. Finding a common scale



Observations on variations in round-tests

6. Finding a common scale

- Aim: Ease the comparison between methods

=>CommonScale(Max) has been developed as

$$\frac{\text{Measured Stickiness Raw" (MSR) * 100}}{\text{MaxEver}} = \text{Measured Stickiness Scaled (MSS)}$$

Methods	Unit	MaxEver
Minicard	ITMF grade	3
SCT	Sticky points	150
H2SD	Sticky points	70
Contest-S	Grade	750

Observations on variations in round-tests

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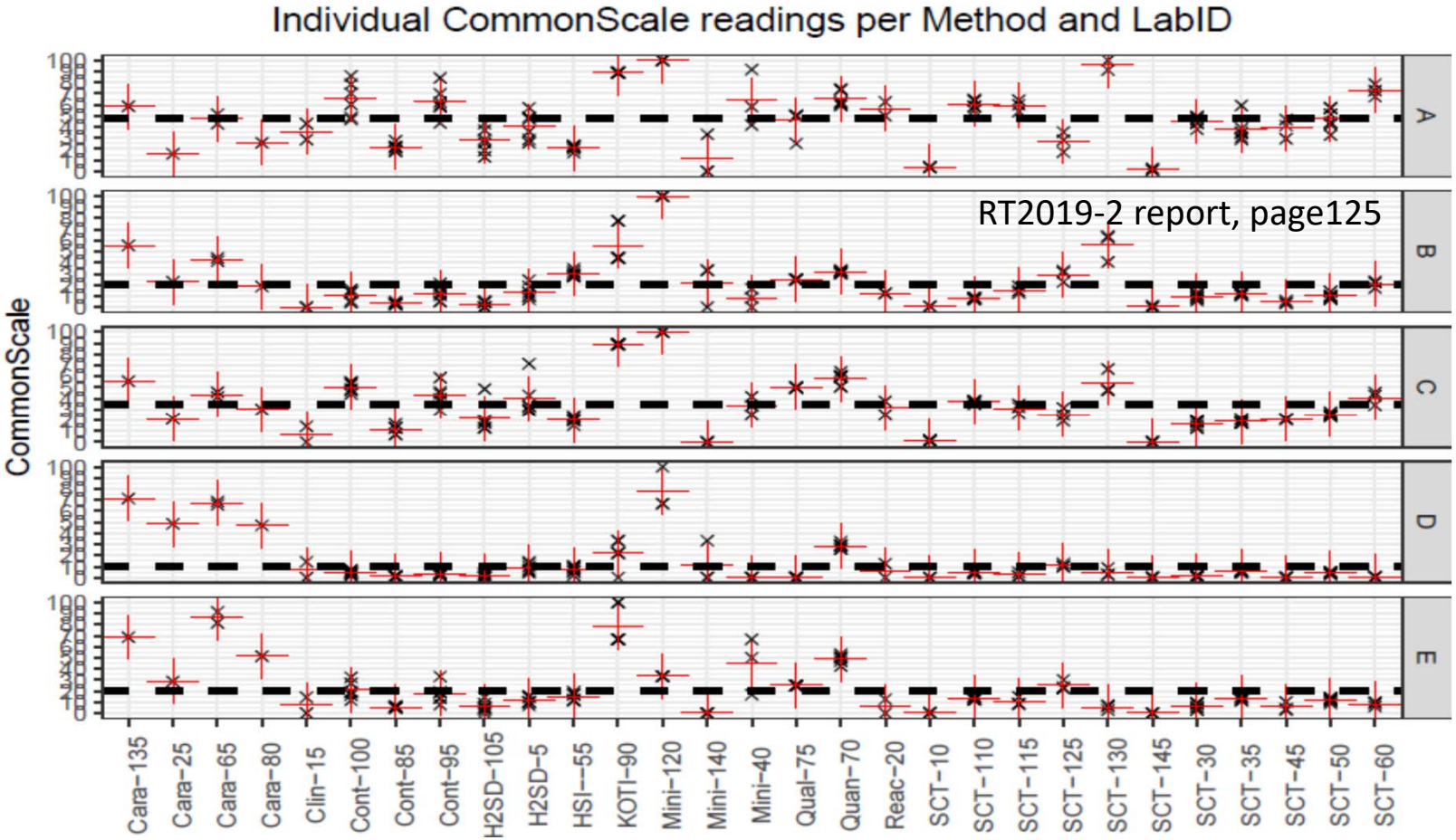

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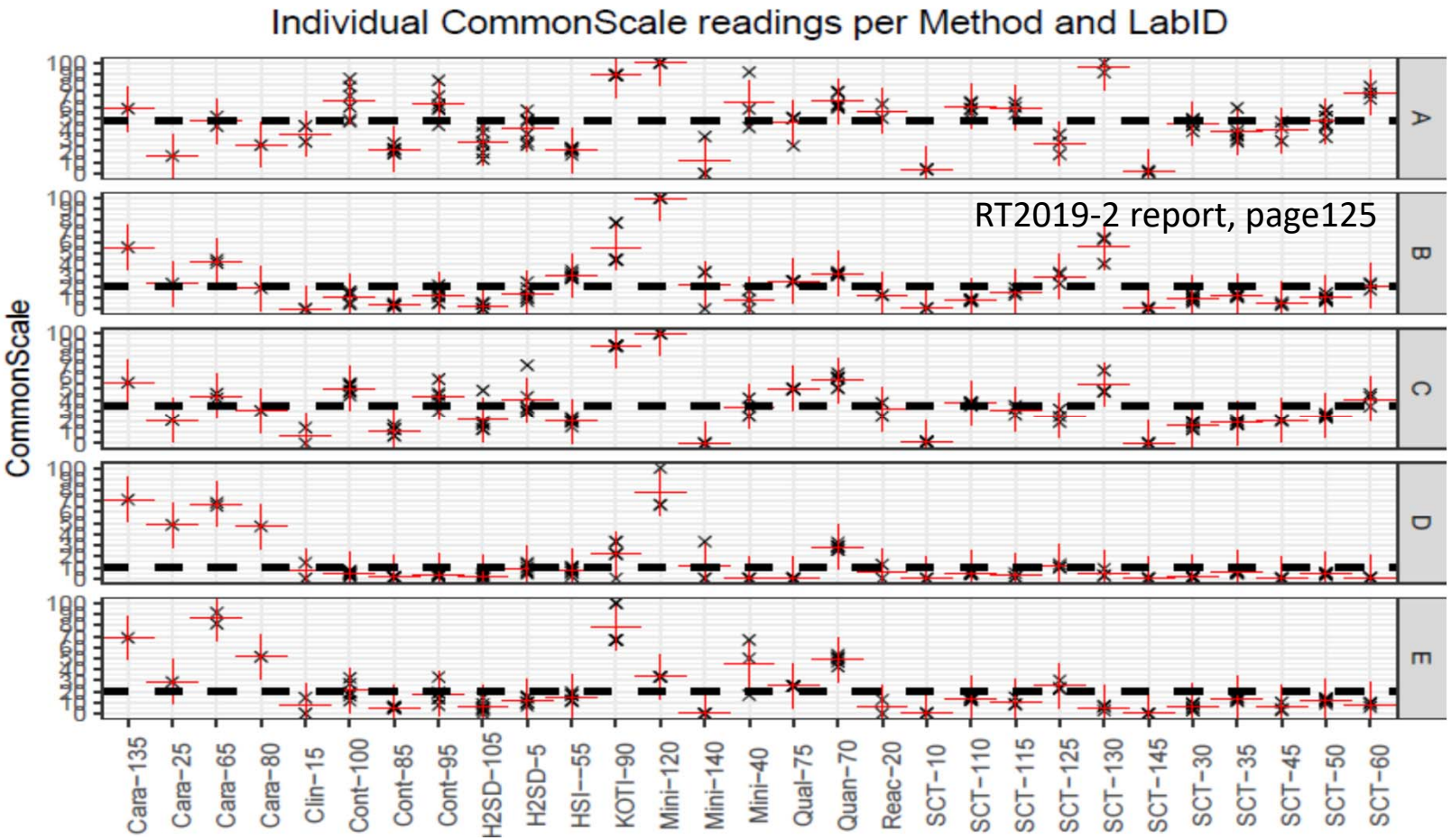


Easy to compare methods and instruments

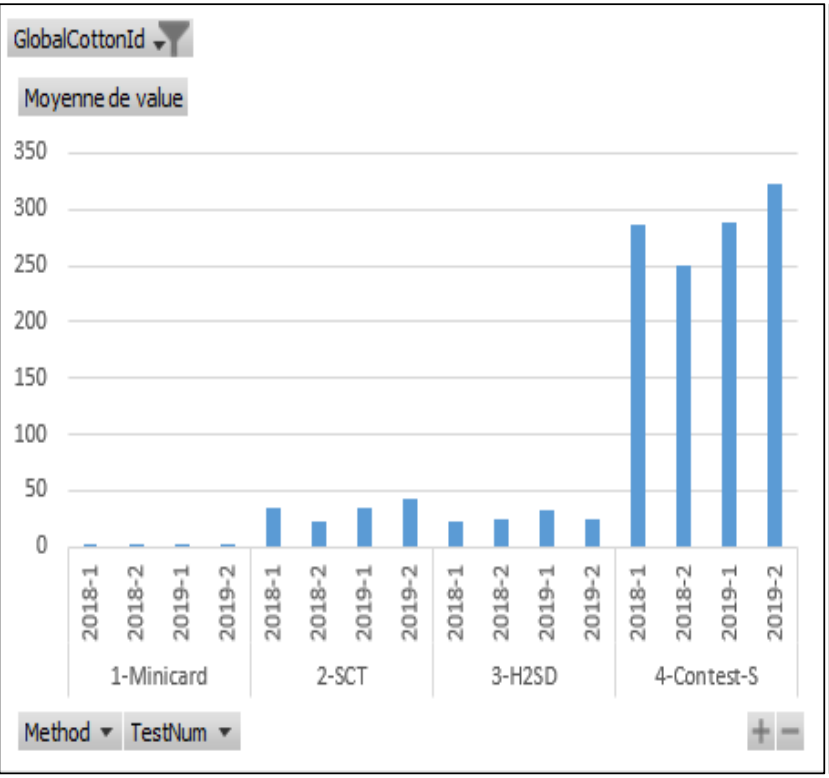
Easy to check/compare stickiness in cottons

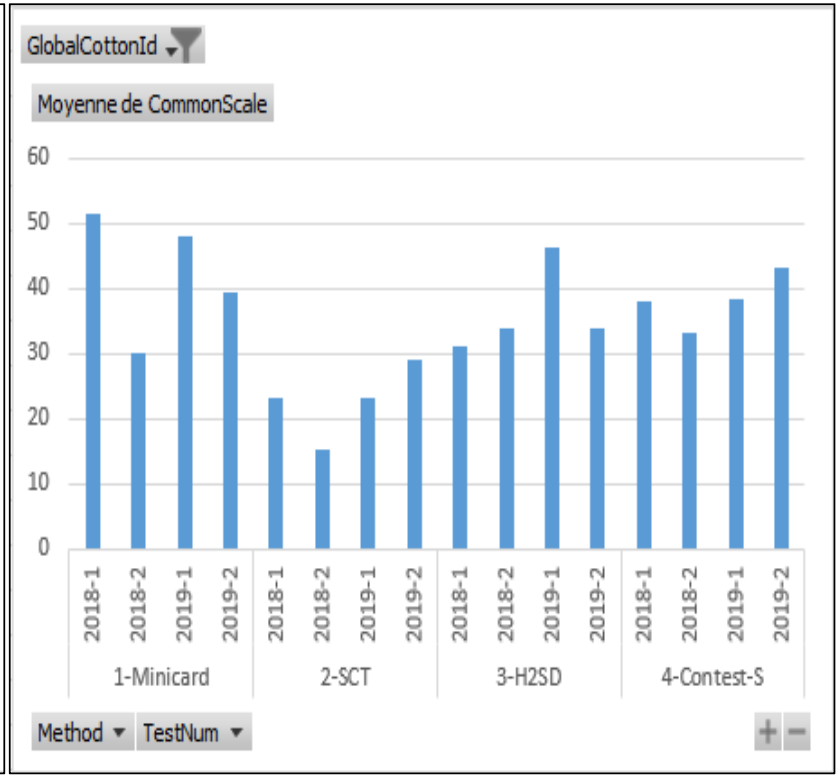
Observations on variations in round-tests

7. Variability in stickiness results with one material along RTs
   - Single instruments: mini-card, Contest-S, H2SD, SCT
   - One material
   - Four RTs: 2018-1, 2018-2, 2019-1 and 2019-2

Observations on variations in round-tests

7. Variability in stickiness results with one material along RTs

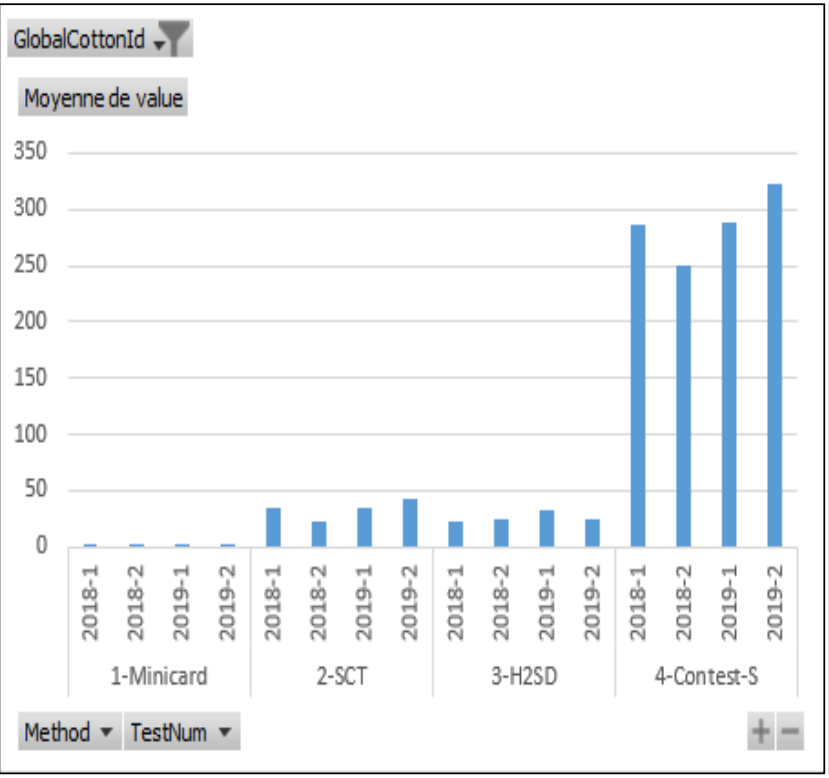


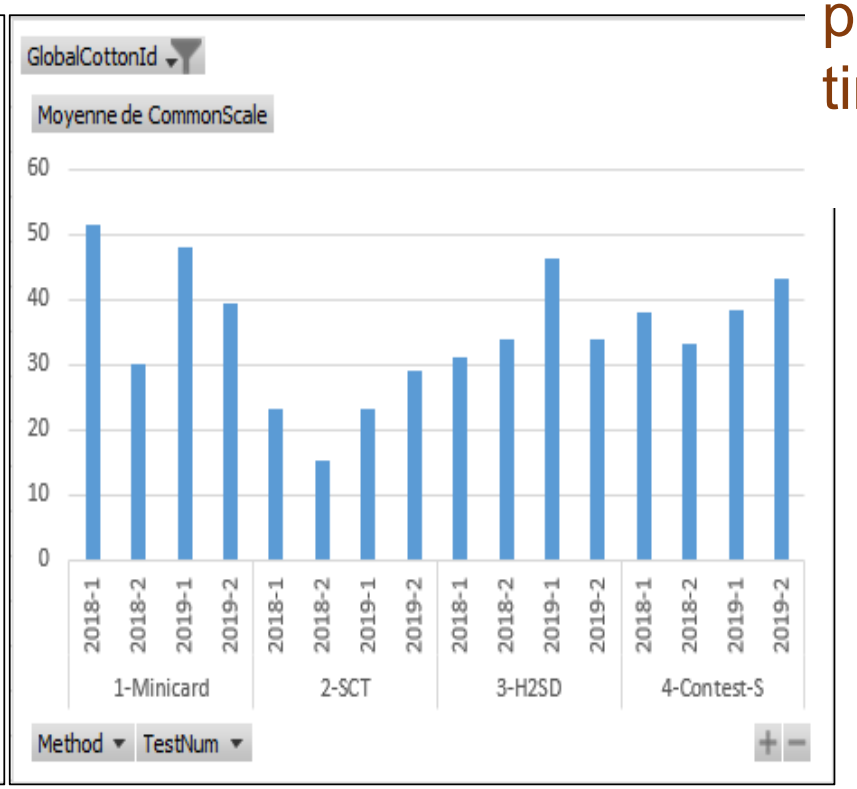


Observations on variations in round-tests

7. Variability in stickiness results with one material along RTs

RT results allow tracing lab performances over time





Observations on variations in round-tests

8. Correlations between methods

	Benedict	Carame-lization	Clinitest	**Contest-S**	**H2SD**	HSI-NIR	KOTITI	**Minicard**	Qualitative method	Quantitative method	Reactive Spray	**SCT**
Caramelization	-0.997 NS	1	0.069 NS	0.219 NS	0.188 NS	-0.302 NS	-0.496 **	-0.257 NS	0 NS	0.014 NS	0.484 *	-0.176 NS
Clinitest	-0.115 NS	0.069 NS	1	0.389 *	0.367 NS	-0.037 NS	0.217 NS	0.225 NS	0.009 NS	0.243 NS	0.007 NS	0.433 *
Contest-S	**-0.301 NS**	**0.219 NS**	**0.389 ***	**1**	**0.881 *****	**0.028 NS**	**0.609 *****	**0.859 *****	**0.248 NS**	**0.576 ****	**0.078 NS**	**0.880 *****
H2SD	**-0.613 NS**	**0.188 NS**	**0.367 NS**	**0.881 *****	**1**	**-0.071 NS**	**0.516 ****	**0.820 *****	**0.086 NS**	**0.587 ****	**0.03 NS**	**0.855 *****
HSI-NIR	0.3 NS	-0.302 NS	-0.037 NS	0.028 NS	-0.071 NS	1	0.283 NS	0.17 NS	0.427 NS	0.218 NS	0.048 NS	-0.162 NS
KOTITI	0.5 NS	-0.496 **	0.217 NS	0.609 *****	0.516 **	0.283 NS	1	0.594 **	0.368 NS	0.417 *	0.014 NS	0.472 *
Minicard	**-0.562 NS**	**-0.257 NS**	**0.225 NS**	**0.859 *****	**0.82 *****	**0.17 NS**	**0.594 ****	**1**	**0.208 NS**	**0.458 ***	**0.125 NS**	**0.716 *****
Qualitative method	1 ***	0 NS	0.009 NS	0.248 NS	0.086 NS	0.427 NS	0.368 NS	0.208 NS	1	0.432 NS	0.118 NS	0.155 NS
Quantitative method	-0.887 NS	0.014 NS	0.243 NS	0.576 **	0.587 **	0.218 NS	0.417 *	0.458 *	0.432 NS	1	-0.059 NS	0.623 **
Reactive Spray	-0.189 NS	0.484 *	0.007 NS	0.078 NS	0.03 NS	0.048 NS	0.014 NS	0.125 NS	0.118 NS	-0.059 NS	1	-0.194 NS
SCT	**-0.954 NS**	**-0.176 NS**	**0.433 ***	**0.880 *****	**0.855 *****	**-0.162 NS**	**0.472 ***	**0.716 *****	**0.155 NS**	**0.623 ****	**-0.194 NS**	**1**
Color code:	NS	*	**	***								

Observations on variations in round-tests

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Some methods do not correlate with others

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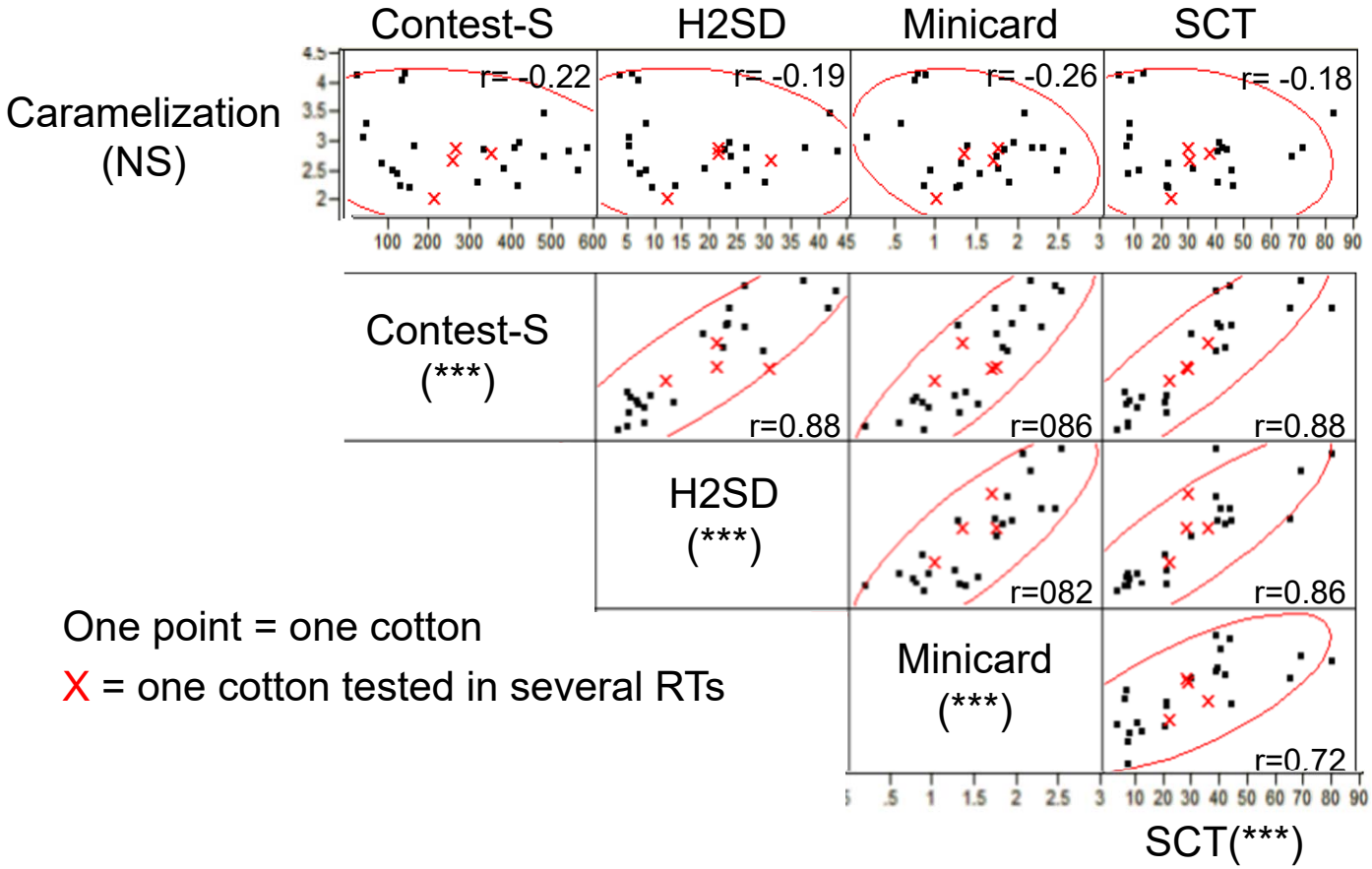
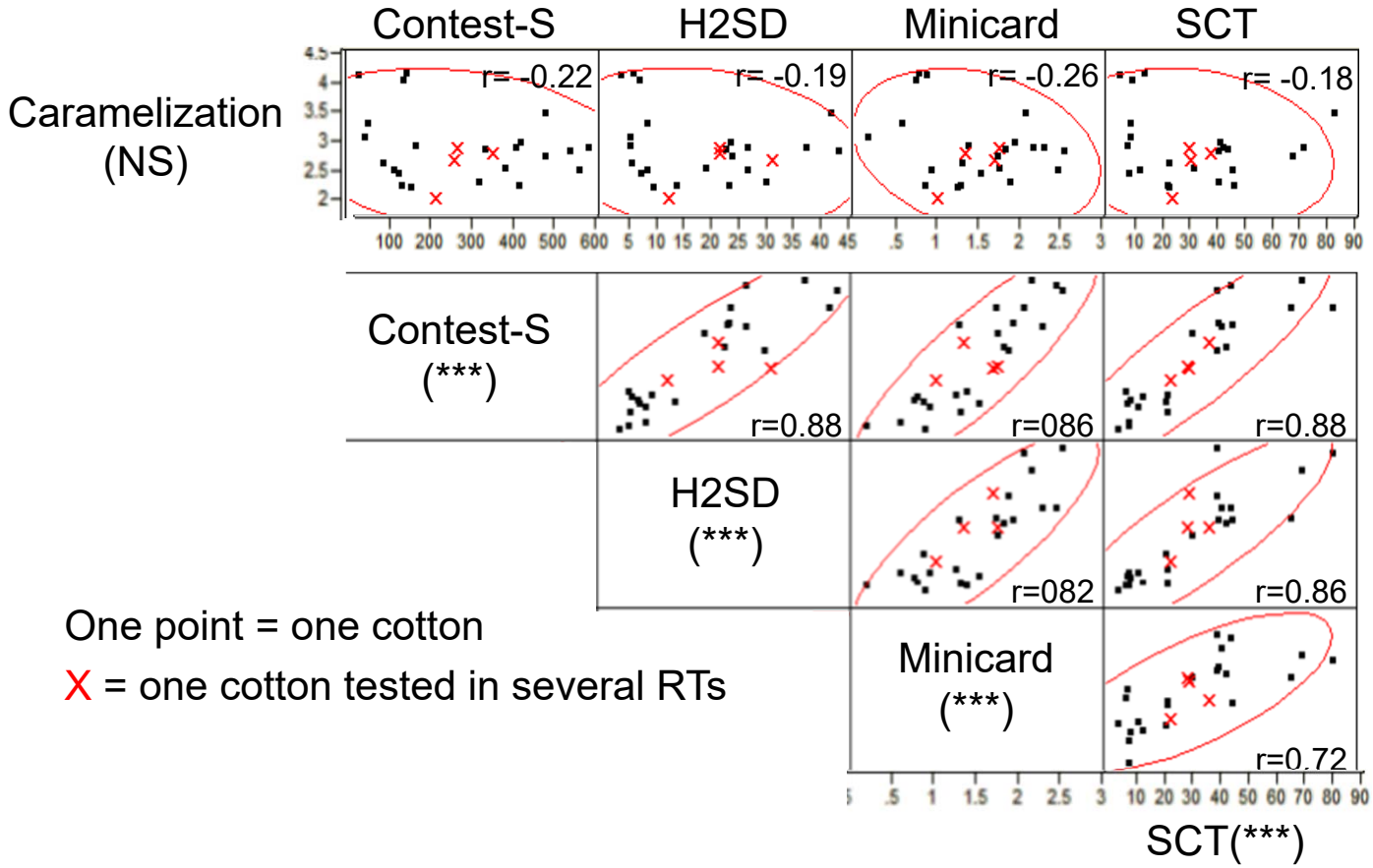


One point = one cotton

X = one cotton tested in several RTs

Observations on variations in round-tests

8. Correlations between methods



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Good correlations between thermo-mechanical methods, Minicard.
Good correlation to SIP.

→ Methods kept for further harmonization

- Contest-S
- H2SD
- SCT
- Minicard

Usual harmonization steps

- Definitions
- Technical and technological developments of the testing methods for achieving a proper sensitivity and quality of the results
- Production of reference materials
- Periodical comparisons between methods and instruments such as the USDA, Bremen or ICAC-CSITC-RTs
- Evaluation of the findings by international committees
- Application of the methods in laboratories at all levels in the supply chain, including in Cotton Association or Cotton Boards

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Challenges for stickiness:

- Stickiness is variable
- Various method principles and units
- Results to be linked to SIP, as well as between instruments and methods

What to keep in mind: next harmonization steps

- Continuation of RT as is (**welcome laboratories and materials**) with all methods
- Harmonization focus on mechanical / thermo-mechanical methods with SCT, H2SD and Contest-S, keeping Minicard as reference
  - Development of an “easy to use indicator” for the laboratories to see their deviations and their need for action
  - Continuation of the analysis of the sources of result variabilities
- Continue studying the impact on honeydew points with their number and their size on test results, spinning (SIP)
- Adoption of best practices by the laboratories with support of Manufacturers
- Development and application of CommonScale definitions on RT results
- When needed, development of a common categorization for all methods (for trade purposes), and suitably include stickiness testing in trade rules

Steps towards suitable stickiness test results for trading and processing

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* CIRAD (France), ** FIBRE (Germany)

Thanks for ‘your visit in Bremen’
to participating laboratories and material providers,
and funders for this work : CIRAD, FIBRE and BBB

We welcome your questions and comments