Cotton Testing Standardization and Interlaboratory Harmonization

Axel Drieling
Bremen Fibre Institute (FIBRE) /
ICA Bremen

19th Meeting of the CSITC Task Force
Raleigh, NC, USA, June 19, 2013

Standardization / Harmonization

- Aim of Cotton Testing Standardization / Harmonization
  - Laboratories all over the world should, for the same cotton samples, come to “the same“ test results (not exceeding unavoidable tolerances)
  - Test results have to be a reliable, objective estimate of the quality of the cotton samples
    - For production (breeding, growing, ginning): Improve, obtain better price
    - For trading in global markets
    - For processing: economic production: produce suitable yarn quality on lowest input

CSITC Task Force

- ICAC Task Force for the Commercial Standardization of Instrument Testing of Cotton (CSITC Task Force)
- Formed in December 2003; Chairman: Andrew Macdonald
- Objective: Introduction of a worldwide acceptable, adoptable and reliable instrument based cotton quality assessment, finally replacing manual classing as basis for trading
  - with defined test rules and operating practices
  - based on reliable instrument test results
  - based on a worldwide cotton testing laboratory evaluation system
- Several related activities implemented by the Task Force / its members through the last years

Standardization / Harmonization

- Steps for Standardization / Harmonization
  - Standardization
    - Standardized test and calibration procedures
    - Approved, valid cotton calibration material
  - Harmonization
    - Suitable laboratory quality management (*)
    - Guideline for standardized instrument testing (*)
  - Verification
    - Instrument qualification
    - Within-lab verification
    - Interlaboratory Round Trials (**)
    - Re-tests (*)

Harmonization: CSITC Guideline

Several factors are determining the reliabilty of the test data

<u>Guideline for Standardized Instrument Testing of Cotton</u>

- Detailed elaboration (44 pages) plus short version reduced to the most important prerequisites
- Covering all topics from the laboratory building to the data handling
- Editors: Axel Drieling (FIBRE), Jean-Paul Gourlot (CIRAD, France), James Knowlton (USDA-AMS)
- Contributions from 12 contributors from all continents
- Replaces given ITMF and USDA User Guides
- Published in English, French, Chinese, Spanish, Portuguese, Russian
- Available for free on CSITC and ICAC and ITMF websites

<u>Reports on proper climate control, conditioning, power supply …</u>

Harmonization: CSITC Guideline

Guideline for Standardized Instrument Testing of Cotton

ICAC Task Force on Commercial Standardization of Instrument Testing of Cotton (CSITC)

and

ITMF International Committee on Cotton Testing Methods (ICCTM)

Editors:

- Axel Drieling, Faserinstitut Bremen e.V. (FIBRE) / ICA Bremen, Bremen, Germany
- Jean-Paul Gourlot, CIRAD-LTC, Montpellier, France
- James Knowlton, USDA-AMS, Memphis, TN, USA

Contributors:

- Axel Drieling, Faserinstitut Bremen e.V. (FIBRE) / ICA Bremen, Bremen, Germany
- Jean-Paul Gourlot, CIRAD-LTC, Montpellier, France
- James Knowlton, USDA-AMS, Memphis, TN, USA
- Lawrance Hunter, CSIR and Nelson Mandela Metropolitan University, Port Elizabeth, South Africa
- Philipp Lehne, Faserinstitut Bremen e.V. (FIBRE), Bremen, Germany
- Andrew Macdonald, AMCON Consulting, Sao Paulo, Brazil
- Greg Parle, Auscott, Sydney, Australia
- Mona Qaud, Rieter, Switzerland / ITMF ICCTM HVI Working Group
- Anja Schleth, Uster Technologies Inc., Knoxville, TN, USA
- Ralph Schulzé, Consultant, Narrabri, Australia
- Marinus van der Sluijs, CSIRO, Materials Science and Engineering, Geelong, Australia
- V. Srinivasan, Premier Evolvics, Coimbatore, India

Published by:

- International Cotton Advisory Committee (ICAC), Washington, D.C., USA
- International Textile Manufacturers Federation (ITMF), Zurich, Switzerland

This publication is available at:

- www.csitc.org
- www.icac.org
- www.itmf.org

Date of issue: V1.1 – May 24, 2012

Version: LONG

INTERNATIONAL COTTON ADVISORY COMMITTEE

1629 K Street NW, Suite 702,
Washington DC 20006
USA

Telephone +1-202-463-6660
Fax +1-202-463-6950
e-mail: secretariat@icac.org

Task Force on Commercial Standardization of Instrument Testing of Cotton (CSITC)

INTERNATIONAL TEXTILE MANUFACTURERS FEDERATION

Wiedingstrasse 9
CH-8055 Zürich
Switzerland

Telephone +41-44-283-6380
Fax +41-44-283-6389
e-mail: secretariat@itmf.org

International Committee on Cotton Testing Methods (ICCTM)

Verification: Round Trials

- How do laboratories know that they are producing results that are comparable to results from other labs?
- How do labs know that they have to improve their performance in order to comply with other labs?
- How do labs know where they have to improve in testing?
- How can labs prove that their results are more reliable than those of other labs?

→ Participate in Round Trials !

Round Trials in Comparison

Attribute	USDA HVI Checktest	ICA Bremen Round Trial	CSITC Round Trial
Realization	USDA-AMS	FIBRE	FIBRE and USDA-AMS, Headed by ICAC
Number of participants	50 to 80 HV instr.	110 to 150 HV instr.	125 registered labs (2013) 112-160 HV instr. (2012)
Kinds of instruments	Restricted to High Vol. Testing	Every kind of Testing instrument	Restricted to High Volume Testing
Cottons: Origin and type	USA; Upland	World; broad range of properties	4 US Upland; (plus 1 other origin or processing if demanded)
Costs	Annual fee	Free of charge	Annual fee: 2013: 1000 USD
Frequency	12 times/year each 2 samples	3 times/year each 1 sample	4 times/year each 4 / 5 samples
Number of tests per sample	Asked for 12 tests per sample	Proposed: 6 tests per sample	30 tests per sample (fixed)

Round Trials in Comparison

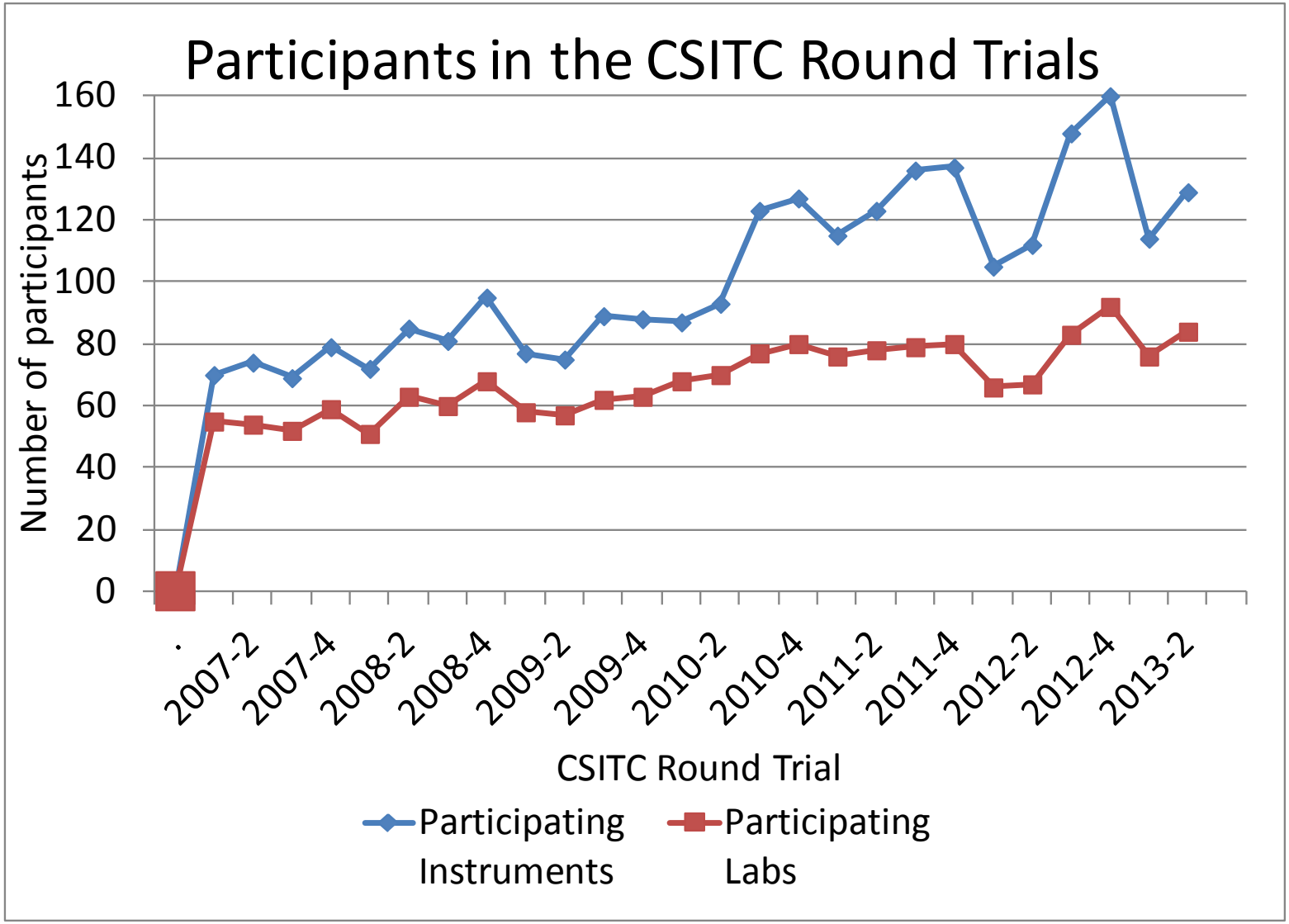
Attribute	USDA HVI Checktest	Bremen Round Trial	CSITC Round Trial
Aim	Information for the laboratory	Information for the laboratory	a) Official laboratory evaluation b) detailed analysis for the laboratory
Evaluation of	Laboratory average	Laboratory average	Laboratory average and all single data
Evaluation of	Accuracy only	Accuracy only	Accuracy and precision
Additional benefit			Calibration Material delivered with the RT samples

CSITC Round Trials

<u>Aims</u>

1. **Evaluation of the test methods / test result variation → Improvement**
   - Within-instrument variation
   - Inter-instrument variation
   - Possible additions as the variations between instrument types etc.
2. **Rating of the participating laboratories**, based on the accuracy of the results
3. **Detailed analysis of laboratory results** to achieve more accurate results, based on accuracy and precision

CSITC Round Trial Participation



CSITC Round Trial Participation

Registered participant laboratories 2013

- Asia 48
- South America 25
- North America 19
- Africa 17
- Europe 12
- Australia 4

Countries with highest no. of registered labs

- Brazil, India, USA, Uzbekistan

Types of Labs 2013

- Production/Assoc. 40 %
- Control 14 %
- Spinning 9 %
- Research / Manuf. 15 %
- Others / not specified 22 %

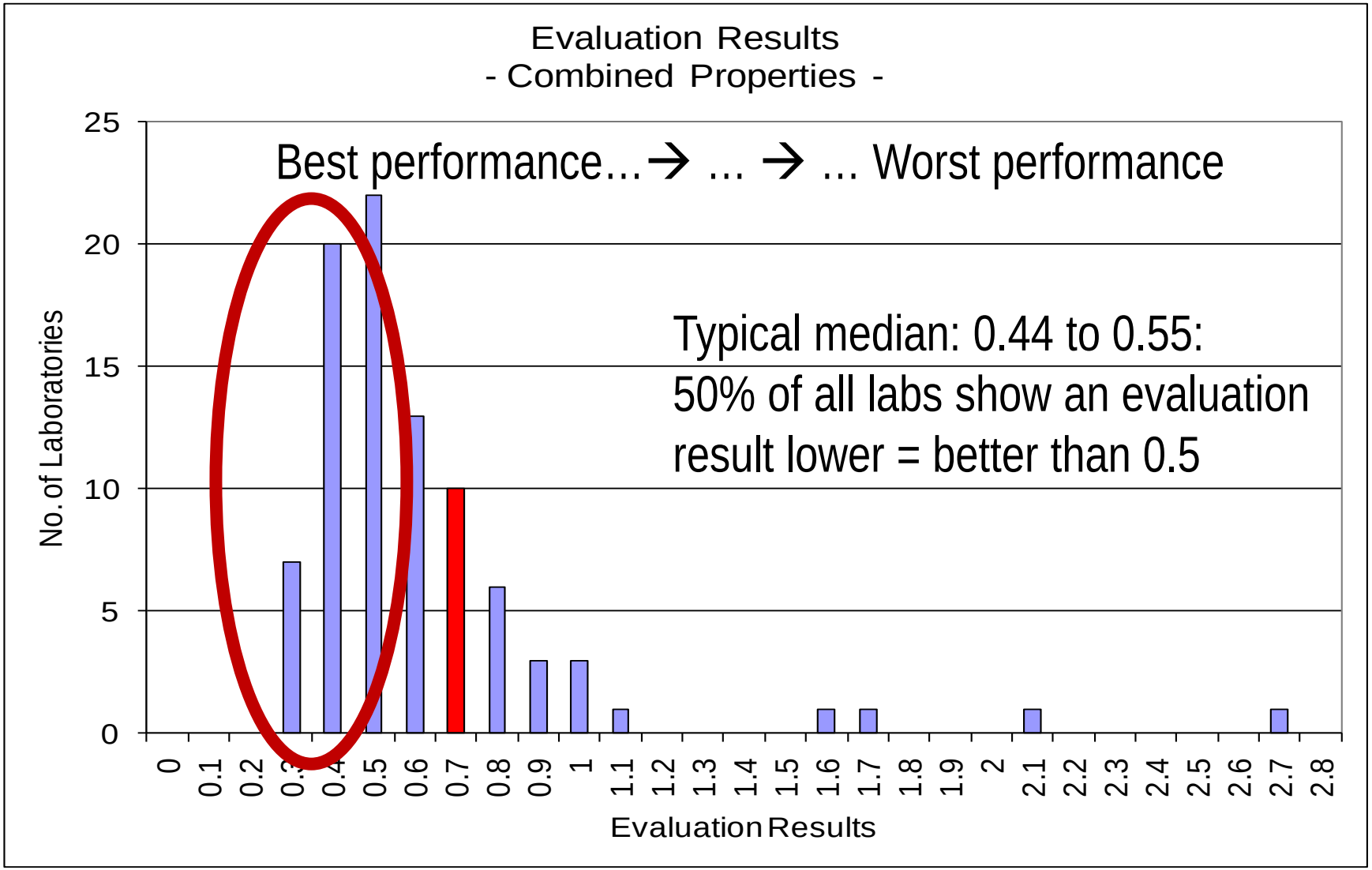
Currently CSITC is focused on Cotton production,

Participation from spinners‘ side is limited

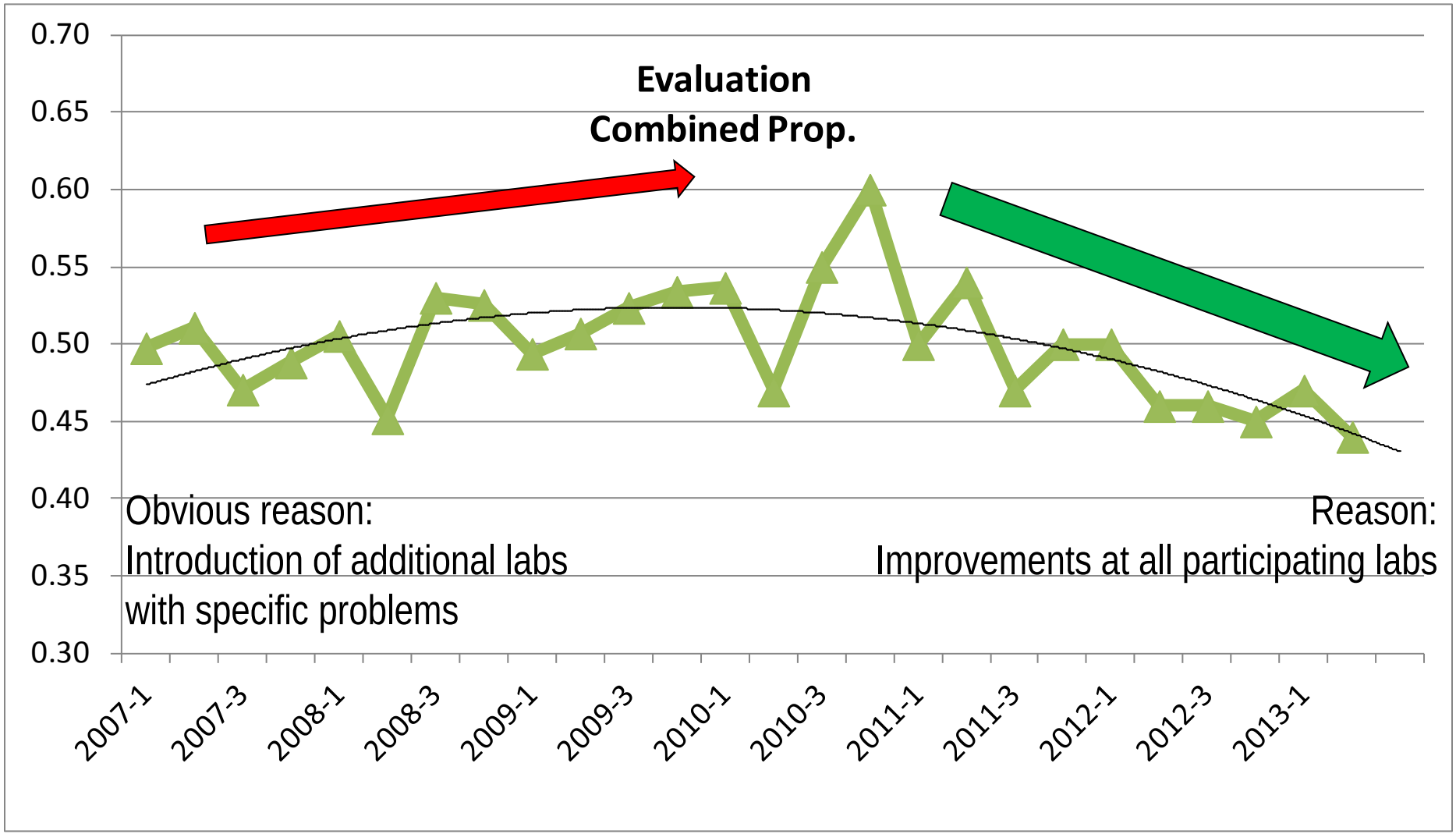
CSITC Round Trial Evaluation

Performance of Laboratory 115							
		Micronaire	Strength	Length	Uniformity	Color Rd	Color +b
Reference Values	Cotton 1	3,83	32,82	1,207	82,42	76,31	12,14
	Cotton 2	5,17	28,22	1,136	81,90	78,06	11,53
	Cotton 3	4,40	25,54	0,948	78,53	74,86	10,86
	Cotton 4	3,81	32,89	1,177	83,65	76,08	10,98
Laboratory Average of All Days	Cotton 1	3,80	33,62	1,207	82,71	75,37	11,38
	Cotton 2	5,23	28,50	1,134	81,44	76,05	10,82
	Cotton 3	4,36	26,11	0,969	76,13	73,62	10,41
	Cotton 4	3,79	32,72	1,182	83,83	75,29	10,17
Rel. Distance to Reference	Cotton 1	-0,03	0,80	0,000	0,29	-0,94	-0,76
	Cotton 2	0,06	0,28	-0,003	-0,46	-2,00	-0,71
	Cotton 3	-0,04	0,57	0,021	-2,40	-1,24	-0,45
	Cotton 4	-0,02	-0,18	0,005	0,18	-0,79	-0,81
Mean Absolute Distance to Reference		0,04	0,46	0,007	0,83	1,24	0,68
Scale Factor (Based on USDA Reproducibility Limits except Rd)		0,10	1,50	0,02	1,00	1,50	0,50
Summary Evaluation for Each Property (=Mean Abs. Distance divided by Scale Factor)		**0,38**	**0,31**	**0,36**	**0,83**	**0,83**	**1,37**
Relevance of Property		1,00	1,00	1,00	1,00	1,00	1,00
Summary Evaluation of All Properties (=Average of all properties)		**0,68**					

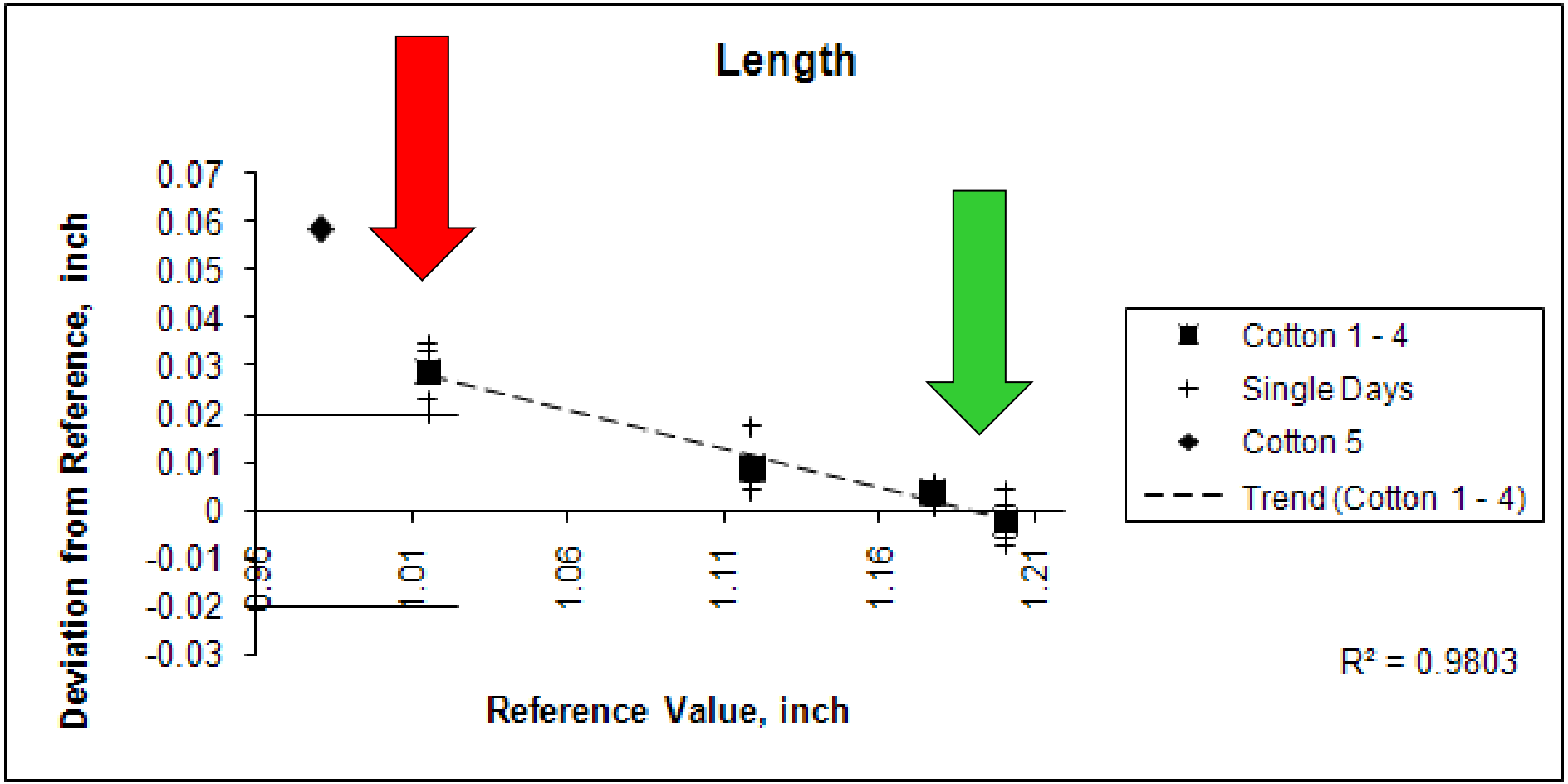
CSITC Round Trials: Laboratory Evaluation (Combined Properties)



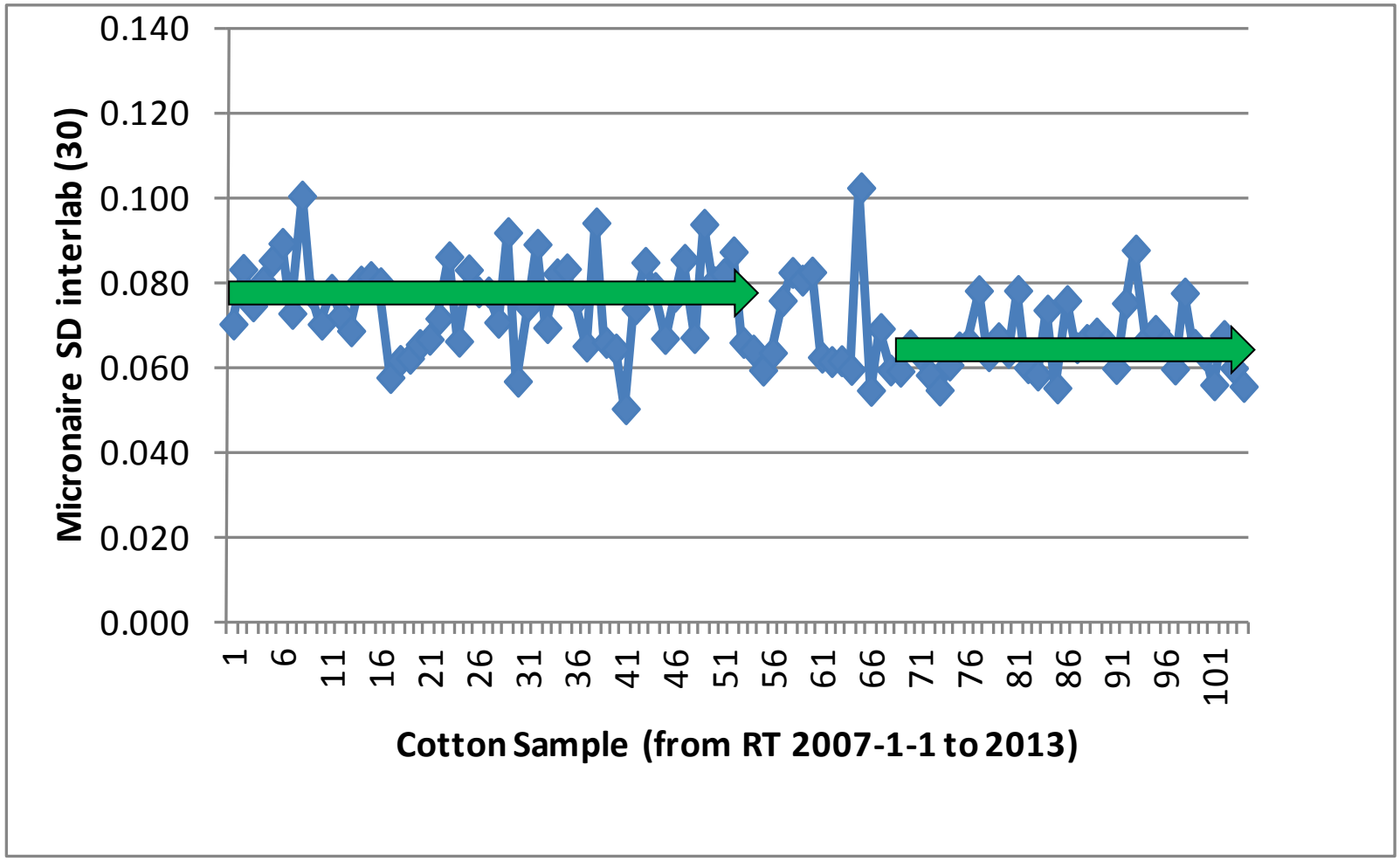
CSITC Round Trials: Laboratory Evaluation (Combined Properties)



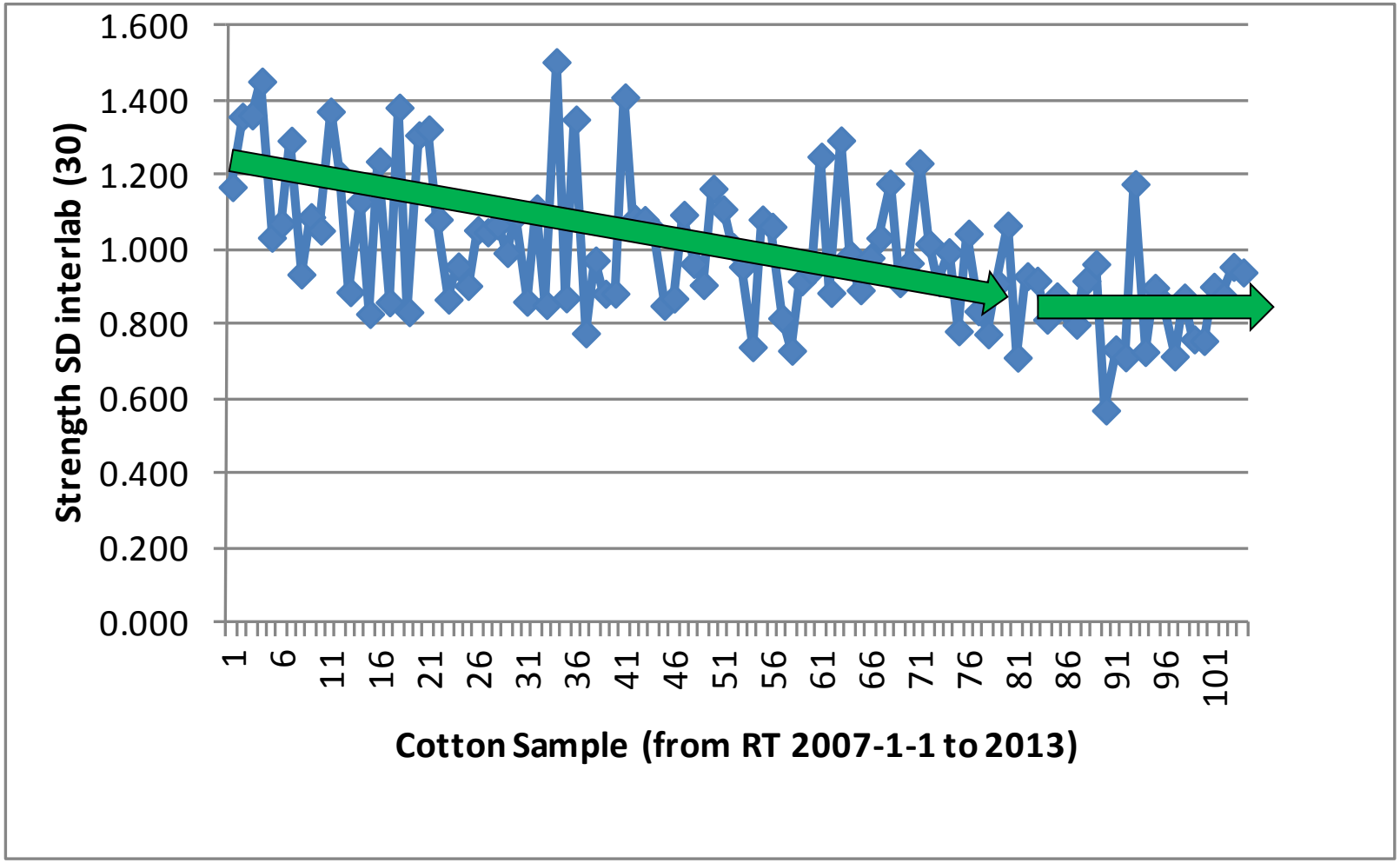
CSITC Round Trials: Detailed Analysis for Each Instrument



CSITC-RT: Interlab SD for Micronaire



CSITC-RT: Interlab SD for Strength



CSITC-RT: SDs and Comm. Trade Limits

All results are based on104 cottons from 2007-1 to 2013-2

Restricted to US Upland

Average: 102 High Volume Instruments per Round Trial

Each instrument with 30 tests for each sample

Property / Parameter	SD inter-instrument (30)	SD inter-instrument (1)	Proposal for Commercial Trade Limits
			2*SD(1)? 2*SQRT(2)*SD(1)?
Micronaire	0.071	0.086	0.2 ?
Strength, g/tex	1.00	1.25	2 ?
UHML, Inches	0.012	0.017	0.03 ?
Uniformity Index	0.53	0.81	2 ?
Color Rd	1.03	1.09	1.5 ?
Color +b	0.36	0.41	1 ?

CSITC Round Trials: Currently Achievable Improvements

How far will the SD be improved by only choosing the better 50%* of the laboratories?

	SD inter-instrument (1)	
Property / Parameter	All laboratories	50%* best laboratories
Micronaire	0.092	0.074
Strength, g/tex	1.40	1.13
UHML, Inches	0.0171	0.0137
Uniformity Index	0.81	0.68
Color Rd	1.03	0.80
Color +b	0.38	0.29

Possible reduction of SD interlab: approx. 20% for each property

Data based on CSITC RT 2007-1 to 2008-2 (24 cotton samples)
* 50% of the best labs were chosen based on their overall RT Evaluation in each RT

Verification: Re-Tests

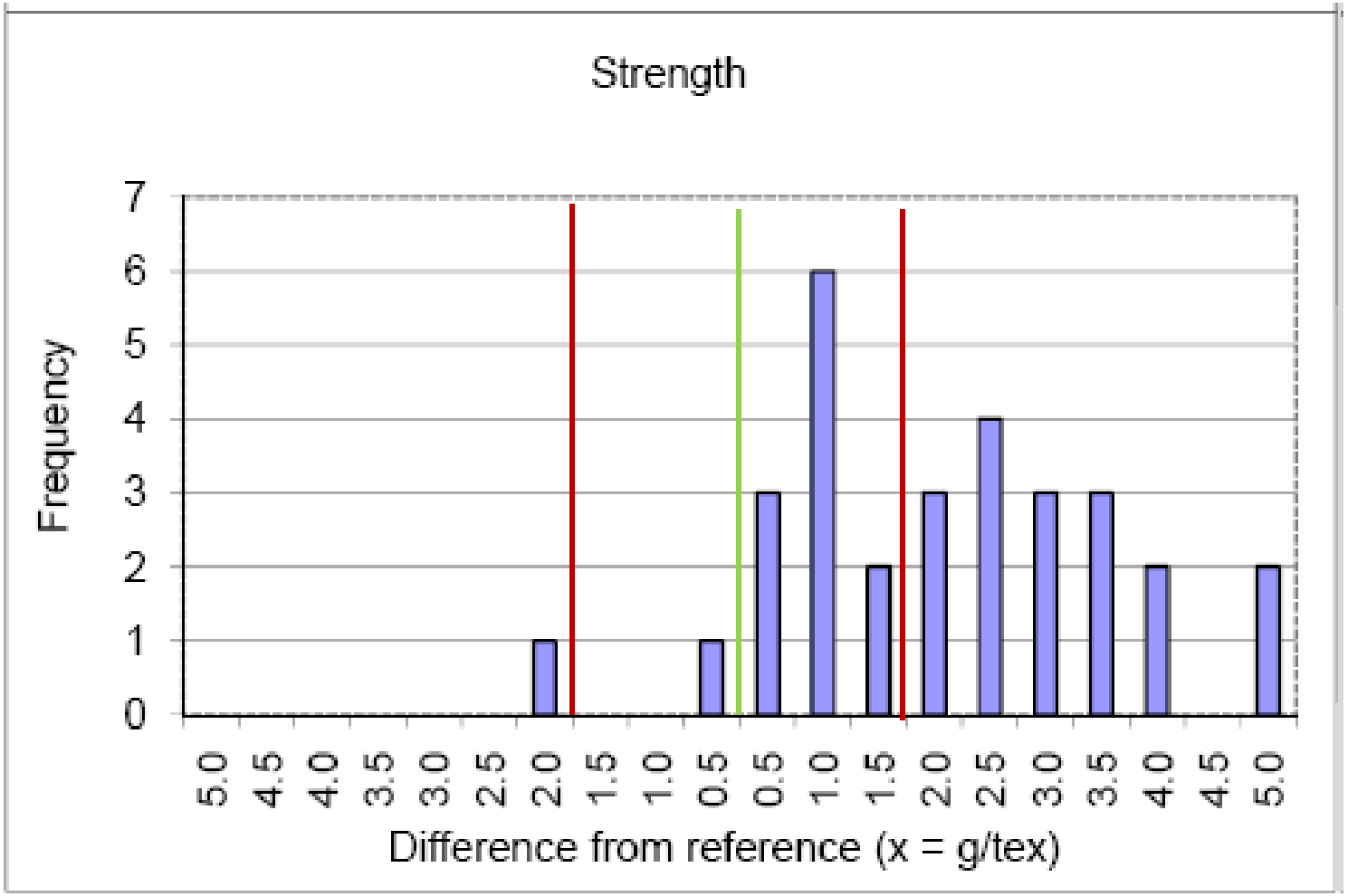
- How does the laboratory know and prove that the results measured every day are meaningful / true?

→ External RE-TESTS ON DAILY SAMPLES

  – Send a fixed subset of the samples tested in one laboratory to another for a second, more intense test

- Given at USDA with reproducibility check
- In other countries perhaps not possible on over-night basis, but still extremely useful

Verification: Re-Tests



Support: Regional Technical Centers

- Laboratories need support
  - Information / trainings / expertise
  - Reference
    - Re-tests
    - Regional Round Trials on cottons from the region
  - Central (national / regional) cotton result data base, including result verification

- Central Quality Management Structure in US given with USDA-AMS
- Central Quality Management Structure given e.g. in Australia, Uzbekistan, and under construction in Brazil (ABRAPA)
- Regional Technical Centers for lab support installed in Africa (Mali, Tanzania) based on CFC/EU project

Next Step: Adaption of Instrument Testing to Other Origins

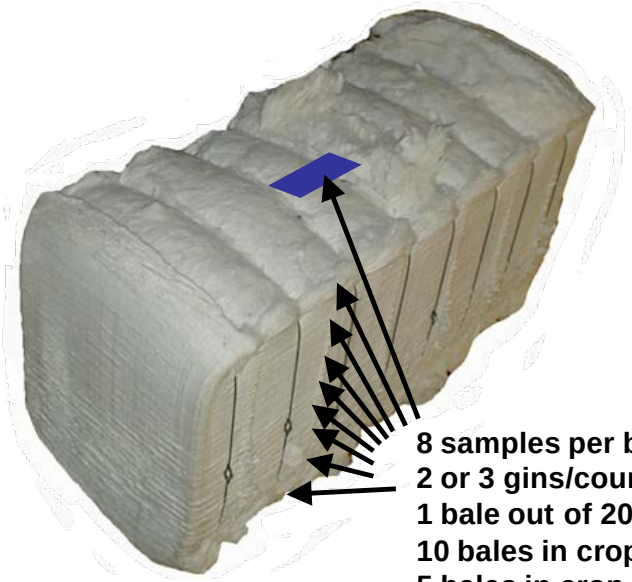
- The standard test method was developed basing on experience for US Upland
- The CSITC RT is based on USDA Upland cotton bales to assure homogenous bales
- Cotton from other origins may show different variation between test results
  - Based on field size
  - Based on mix of varieties
  - Based on the type of gin (saw /roller)
  - Based on gin management
- With this, different number of samples / tests per samples might be necessary

Variability Study for African Cotton

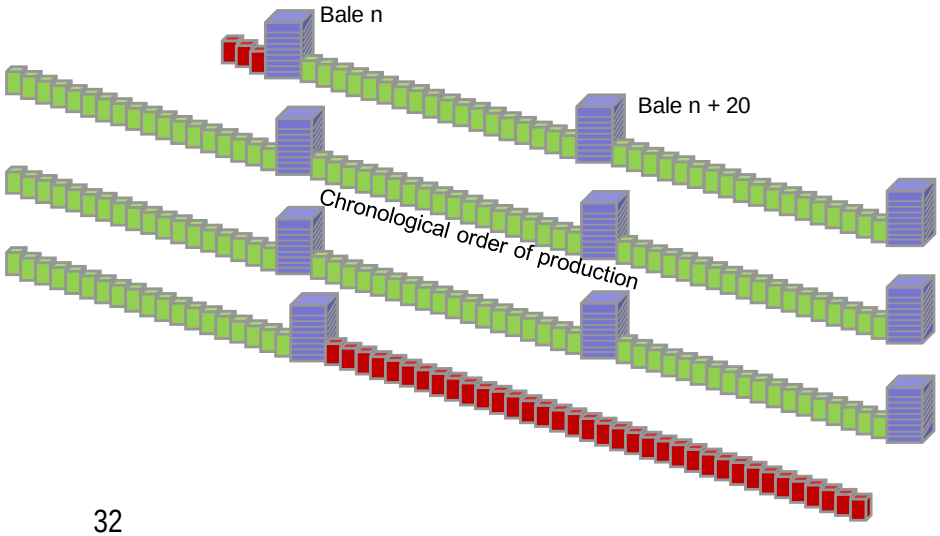
Realized by J.P. Gourlot, CIRAD, with Modest Aboe (Benin) and Everina Lukonge (Tanzania)

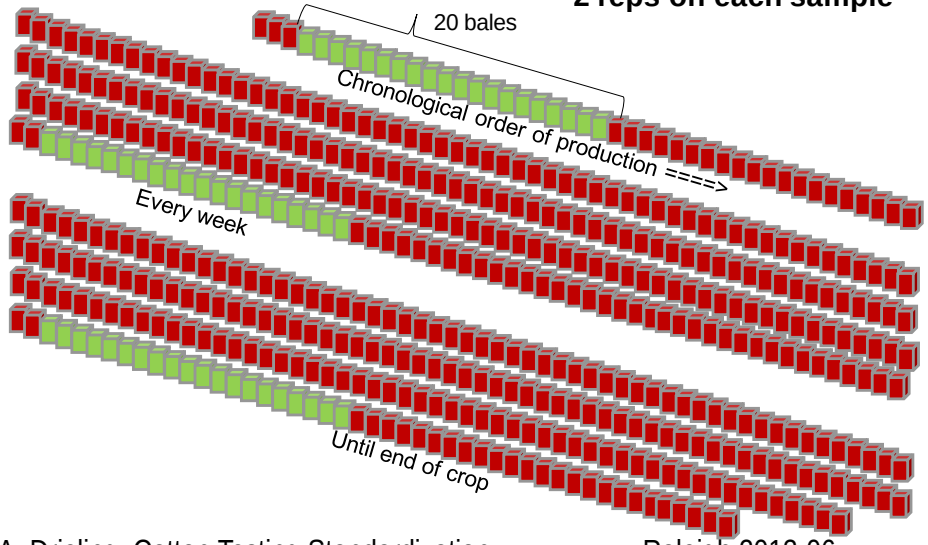
Cotton production analyzed

- in 14 African countries (West/Central and East/Southern Africa)
- 63 gins
- 2 crop seasons



8 samples per bale
2 or 3 gins/country
1 bale out of 20
10 bales in crop 1
5 bales in crop 2
2 reps on each sample





Variability Study for African Cotton

- Based on pre-defined litigation risks and defined criteria
- Suitable numbers of samples per bale and of tests per sample analyzed

Characteristic	Nb of samples per bale	Type of sampling	Nb of replicates	Nb of measurements per sample	Total Nb of measurements per bale
USA					
Micronaire	2	Composite	1	1	1
UHML	2	Cluster	1	1	2
UI	2	Cluster	1	1	2
STR	2	Cluster	1	1	2
Rd	2	Cluster	1	2	4
+b	2	Cluster	1	2	4
Proposition for Africa for saw-ginned cottons					
Micronaire	2	Composite	1	1	1
UHML	2	Cluster	1	2	4
UI	2	Cluster	1	2	4
STR	2	Cluster	1	2	4
Rd	2	Composite	1	2	2
+b	2	Composite	1	2	2

Trade Rules

- Trade rules are still very much defined based on manual classing
- For trading based on instrument test results, many details have to be regarded
  - Use of instrument results without transformation to manual classing grades / staples
  - Which control limits have to be applied
  - Which number of digits / rounding have to be applied
  - Combined interpretation of results (Color Rd and +b)
  - Trading based on sales lot result averages and variations (SD)
- Relying solely on laboratories with suitable quality management – and proven performance (in CSITC Round Trials)

Summary / Acknowledgements

With the given steps, it will hopefully be possible to continue the way towards trading based on reliable instrument test results, and with this improving cotton competitiveness in global markets.

All project partners like to express their thank the financial contributors CFC and EU, who made these activities possible as part of the CFC/ICAC/33 project.

This project is co-funded by
the European Union and the
Common Fund for Commodities