Part 1 - Summary Details

Please use your TAB key to complete Parts 1 & 2.

CRDC Project Number: CRC91 Cotton CRC Project Number: 4.04.02

Project Title: Commercial Preparation of SiroMat

Project Commencement Date: 1/7/05 **Project Completion Date:** 30/6/07

CRDC Program: Off Farm

Part 2 – Contact Details

Administrator: Sandra Rogers
Organisation: CSIRO Textile and Fibre Technology
Postal Address: PO Box 21, Belmont, Victoria 3216
Ph: 03 5246 4000 **Fax:** 03 5246 4057 **E-mail:** sandra.rogers@csiro.au

Principal Researcher: Stuart Gordon
Organisation: CSIRO Textile and Fibre Technology
Postal Address: PO Box 21, Belmont, Victoria 3216
Ph: 03 5246 4000 **Fax:** 03 5246 4057 **E-mail:** stuart.gordon@csiro.au

Supervisor: Geoff Naylor
Organisation: CSIRO Textile and Fibre Technology
Postal Address: PO Box 21, Belmont, Victoria 3216
Ph: 03 5246 4000 **Fax:** 03 5246 4057 **E-mail:** geoffrey.naylor@csiro.au

Signature of Research Provider Representative: _____

Part 3 – Final Report Guide (due 31 October 2008)

(The points below are to be used as a guideline when completing your final report.)

Background

Cotton fibre maturity is a central property because it determines how well fibres process both from a chemical and physical perspective. Immature cotton fibre, that is fibre with little or no fibre wall thickening, is associated with the formation of small entanglements called neps, irregularities in processed fibre assemblies including finished yarns, non-uniform dyeing of fabrics and decreased processing efficiency. At the moment there is no fast and accurate test method for testing fibre maturity for commerce and industry.

SiroMat is an instrument that has been developed to measure cotton fibre maturity directly and accurately. The instrument measures the proportion of particular interference colours transmitted by cotton fibre snippets viewed between crossed polars of a polarizing light microscope. The interference colours measured by SiroMat are directly related to cotton fibre's maturity or cell wall thickening.

The advantages of SiroMat are that it measures fibre maturity directly and because it does this on individual fibre snippets it is able to measure the fibre maturity distribution in a sample. The distribution of mature and immature fibres in a sample is important from the perspective of predicting textile problems, such as nep formation and dye uptake variation. Moreover, the speed of the SiroMat test means that it has excellent potential for use as a stand alone, medium volume instruments in mill and merchant laboratories, replacing indirect maturity methods such as the 'Shirley' FMT, the Lintronics FQT and the AFIS Pro.

Objectives

1. Build a third SiroMat instrument.
    - Three SiroMat instruments are currently built. Two of these are updated versions of the SiroMat instruments built before the end of 2005 (DMLSP1 & DMLSP2) and the third is a brand new instrument (DME4) recently commissioned.

      In late 2006 the older DMLSP instruments were fitted with crystalline (glass) wave-plate compensators and these were set to a fixed position (a 45 degree position to the crossed polars) to reduce the variation in colour space that occurred between old instruments, which used polymer compensators that were not consistent across their field-of-view (FoV) and that were not set in a fixed position.

      The updated instruments required re-setting of the colour space and a recheck against the old calibration. At the same time a new instrument based around a newer microscope base was commissioned (DME4). This instrument is nominally the same as the updated SiroMats in that it uses exactly the same camera, objective, fixed position compensator and analyser, and a similar (filament) light source. However, it uses a crystalline polarizer as opposed to the film polarizer's used in the older SiroMat instruments. No difference has been measured or is anticipated between these polarizer's.

      A day- light filter is also now used on the new (DME4) and updated (DMLSP) instruments to bring the colour space transmitted by the new wave-plate compensators back to the 'old' colour space originally transmitted by the polymer compensators and allowing the old calibration to be applied.

2. Streamline the current user interface.
   - A MATLAB-based program has been successfully written to integrate all hardware, data acquisition, image analysis and data analysis controls in SiroMat. The advantages of MATLAB over other software systems are many; they include its large library of already written functions, particularly with respect to colour analysis and transformations, its conciseness and its ability to integrate all required computer-controlled functions. The software now runs on all instruments.

3. Conduct inter-laboratory trials within Australian research laboratories and merchant classing houses, including the ACRI laboratory.
   - Extensive inter-laboratory trials have not been conducted as yet due to unforseen difficulties and time delays in matching and then correcting the colour-spaces of the various optical components, e.g. the light source, camera, lenses and filters, of each SiroMat instrument.
     Trials to date have shown generally good agreement between SiroMat and reference data measured on Upland cotton. However, in some trials anomalies have appeared between SiroMat Pima readings and reference data. We are unsure at this time whether the fault lies with the SiroMat or reference data. In response we are examining in more detail the properties of Pima cottons in order to be sure of this situation – see Appendix A1.

4. Apply SiroMat data to breeding, agronomy, ginning and spinning projects funded by the CRDC and the CCC CRC to determine the value of its data to research efforts in these areas.
   - Cotton samples from a wide range of CRDC, CCC CRC and industry funded projects have been measured using the 'standard' SiroMat (the instrument against which all other SiroMats will be calibrated) to determine the value of SiroMat data to industry and research. Important demonstrations on the application of SiroMat data to agronomy, ginning and spinning data have been published in the Beltwide Cotton Conference proceedings. These reports appear in Appendices B1 to B3.

5. Present results of the above trials at local cotton grower, ginner and merchant forums as well as at international forums such as the Bremen ITMF Cotton Test Method Committee Meetings and thus engage potential users and manufacturers of the SiroMat technology.
   - See above. Reports on SiroMat, the development of SiroMat and the potential from SiroMat have been made at a number of public and private company forums. Important forums have included the:
     i. The ITMF International Cotton Test Method Committee Meetings in Bremen, Germany March 2006 : see Appendix C1
     ii. Discussion with Uster Technologies in Knoxville, TN January 2007: see Appendices A1, A2 and A3
     iii. ICAC Recorder Article published July 2006: see Appendix C2.
     iv. CCC CRC Conference in Narrabri August 2007

Methods

A study in mid 2006 using a spectrophotometer connected by an optical fibre mounted to the top of the body tube of a polarizing microscope was used to record the wavelength of the interference colours transmitted by mature and immature cotton fibres regions. In order to make the spectrum correspond to a particular spot on the image a centralised cross in the eyepiece was used. The set-up enabled exact regions of interest to be examined with both the

spectrophotometer and a digital camera, allowing comparison between the wavelength of light measured by the spectrophotometer and the digital colour spaces. The work was conducted to confirm earlier work – see Gordon, S. G. and Phair, N. L., An investigation of the interference colours transmitted by mature and immature cotton fibre under polarised light microscopy, *proceed*. Beltwide Cotton Conferences, New Orleans LA, 2005.

An approach to bringing the SiroMat instruments in-line with each other has been developed and is currently being tested in the new CCC CRC project entitled 'Support and Extension of SiroMat (Generation I)'. It involves establishing a validated calibration on a 'standard' instrument using the 104 International Textile Center cottons from Texas Tech, measuring the colour space associated with this 'standard' instrument calibration and mathematically transforming the colour space measured by other SiroMat instruments to the standard. At this point in time a 'standard' instrument (DMLSP2) has been nominated. The value of having a 'standard' instrument that records a good correlation between measured colours, e.g. measured as RGB, and maturity reference data means that a physical calibration of a colour standard is not required.

Outcomes
See above and in the attached appendices.

Technical Advances:
Progression of full international patent: Gordon, S. G., Lucas, S. R. and Phair, N. L.,'Method and Apparatus for Testing Fibres', Patent No. AU2005000061, 2005

Conclusion

Refer to 'Business Case Report to the CRDC and ACGRA, Support and Extension of SiroMat (Generation I)', CRC Project Number 4.04.02, Milestone 1.1 submitted August 2007.

Extension Opportunities
Refer to Appendices A, B and C.

Part 4 – Final Report Executive Summary

SiroMat is an instrument that measures fibre maturity directly and accurately. Its advantage over other test methods is that it measures maturity directly and is able to measure the fibreto- fibre distribution of maturity in a specimen. Moreover the test time is around two minutes, which is comparable with other low volume instrument test times. SiroMat is currently undergoing technical trials with a view to preparing it for commercialisation.

In order for SiroMat to be taken up by the wider industry its utility needs to be realised by the wider research and commercial cotton testing and marketing segments. During a recent meeting with Uster Technologies (USA) interest was expressed in the SiroMat on this basis. In order to continue to highlight its value SiroMat data will be recorded on samples from a wide number of Australian and international industry sponsored cotton breeding, agronomy and textile projects.

Appendices A1, A2 and A3
Reports from ongoing comparative testing and discussions with Uster Technologies, January through November 2007

Appendix B1
Gordon, S. G., Long, R. L., Bange, M., Lucas, S. R. and Phair-Sorensen, N. L., Measurement of average maturity and maturity distribution statistics by SiroMat in Cotton fibre subject to differential defoliation timing treatments, *proceed.* Beltwide Cotton Conferences, National Cotton Council, New Orleans LA, Jan 2007

Appendix B2
Gordon, S. G., Long, R. L., Lucas, S. R. and Phair-Sorensen, N. L., Using SiroMat to distinguish fibre maturity related issues in the mill, *proceed.* Beltwide Cotton Conferences, National Cotton Council, Nashville TN, Jan 2008

Appendix B3
Long, R. L., Bange, M., Gordon, S. G. and Van der Sluijs, M. J. H., The effect of different harvest aid timing treatments on fibre quality and textile performance, *proceed.* Beltwide Cotton Conferences, National Cotton Council, Nashville TN, Jan 2008

Appendix C1
Presentation (PowerPoint) to ITMF Cotton Test Method Committee Meetings, Bremen Germany, March 2006

Appendix C2
Gordon, S. G. and Naylor, G. R., New research and development work from Australia in cotton fineness and maturity assessment, ICAC Recorder, **24(2)**:13-18, 2006