If you are participating in the presentations this year, please provide a written report and a copy of your final report presentation by 31 October. If not, please provide a written report by 30 September.

Part 1 - Summary Details

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

CRDC Project Number: **CMSE1212**

Project Title: In-house Mill Trials of LS Cotton

Project Commencement Date: 01/01/2012 **Project Completion Date:** 30/06/2012

CRDC Program: Value Chain

Part 2 – Contact Details

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Part 3 – Final Report Guide

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

Background

1. Outline the background to the project.

There is considerable interest within the Australian cotton industry for new varieties with improved fibre quality that attract a price premium. Upland varieties that approach the long and fine quality attributes of Pima-type cottons are currently being produced by CSIRO Plant Industry (CPI). These are being tested by the Premium Cotton Initiative (PCI) which aims to identify and create markets for these new premium Upland cottons.

Commercial processing trials with Sicala 350B conducted in 2009 and 2010 in India, China, Thailand and Vietnam showed that it was possible to produce a fine count ring spun (both normal and compact) as well as low twist combed yarns for knitting or weaving, in the range of 40-70 Ne. Unfortunately the quality of the yarns produced by the various mills were disappointing and varied considerably, mainly due to the fact that the quality of the fibre used for these trials was variable and in most cases not within the specified fibre properties. Due to this the Australian cotton industry has not been able to determine the *real* value of the fibre and what spinners would be prepared to pay for Australian Long Staple Upland fibre.

A Formal Research Proposal (CMSE1307) has been approved to conduct a further commercial mill trial with cotton that meets the required specifications (see Table below). These specifications for Australian Long Staple Upland (LS) cotton have been determined from previous mill trials and are now being proposed as the minimum specifications for Australian LS cotton.

In this project trials were conducted at the CMSE cotton mill in Geelong with the newest variety of LS cotton; Sicala 340BRF, which largely meets these specifications.

Table I Proposed fibre properties for LS

Fibre Property	Value
Staple Length	≥1.24 inch; 31.5 mm (1 1/4 inch; 40/32)
Length Uniformity	≥ 83
Short Fibre Content	≤ 8.0
Strength	≥ 33 cN/tex
Micronaire	3.7 – 4.2

This bale will be processed at the CMSE Cotton Mill into fine count combed ringspun yarns suitable for weaving. We will attempt to produce a range of yarns from 40-74 Ne to determine the quality and processing performance of these yarns.

Information from these trials will assist in the commercial mill trials planned for 2013.

2. List the project objectives and the extent to which these have been achieved.

The objective of the project is to:
1) Determine processing parameters for commercial processing trial.

Methods

3. Detail the methodology and justify the methodology used. Include any discoveries in methods that may benefit other related research.

One bale of commercially saw ginned Sicala 340BRF cotton was purchased and supplied to CMSE by Queensland Cotton. This bale was grown during the 2010/11 season under commercial growing conditions in Bourke. Seed cotton was mechanically harvested by a spindle picker and saw ginned at North Bourke under standard commercial ginning conditions.

Fibre Testing

Fibre samples were conditioned under standard conditions of 20°C +/-2°C and 65% +/-3% relative humidity for 24 hours and tested on an Uster Technologies 1000 High Volume Instrument (HVI) testing 10 replicates per sample. Micronaire, staple length, uniformity and staple strength were measured (Table II).

Table II– Raw (Bale) Fibre Results by the HVI 1000

Variety	Length inch	Uniformity Index %	Micronaire (µg/inch)	Tenacity cN/tex
Sicala 340BRF	1.27	83.1	3.8	32.3

Calibrated using HVI ICC Upland Calibration Cotton
Average of 10 tests

Fibre fineness was determined using the Cottonscan™, which determines fibre fineness (linear density) by measuring the length of fibre in an accurately weighed specimen of fibre snippets. Combined with an independently measured Micronaire value from the HVI, the average fibre maturity was also calculated using Lord's empirical relationship between Micronaire, maturity ratio and fineness[1] (Table III).

Table III – Fineness Results by Cottonscan™ and Calculated Maturity Results

Variety	Fineness (mtex)	Maturity Ratio
Sicala 340BRF	185	0.74

Average of 5 tests

[1] Lord, E. (1956) *Airflow through plugs of textile fibres. Part II. The Micronaire Test of Cotton*. J. Text. Inst. **47**:T16 – T47

Fibre samples were also tested for nep, seed - coat neps (SCN) and short fibre content (SFC) by an Uster Technologies Advanced Fibre Information System (AFIS PRO) testing 5 replicates per sample (Table IV).

Table IV – Nep, Seed-Coat Nep and SFC Results by the AFIS PRO

Treatment	Neps/ gram	SCN/ gram	SFC(W) %
Sicala 340BRF	325	24	10.5

Average of 5 tests

Textile Processing

One hundred and fifty kilograms of fibre was processed into yarn using machines set to industry standard settings.

Production speeds were kept constant throughout the trial but machine settings e.g. draft distances, were optimised as is accepted practice in high-quality spinning mills. Residual trash was measured during the opening, cleaning and carding processes, using a Trützschler BR-WC Waste Collector (Table V).

Table V – Percent Trash Extracted in Opening, Cleaning and Carding

Treatments	Opening & Cleaning %	Carding %	Total %
Sicala 340BRF	0.75	2.46	3.21

Table VI gives the evenness results at the various preparation processing stages.

Table VI – Evenness results (in CV %) of preparation processing

Process	CV%
Card	4.29
1 st Drawframe Passage	3.85
Comber	5.00
2nd Drawframe Passage	3.04
Roving	4.92

Roving was spun into 40, 50 & 60 Ne combed ringspun yarns using a twist factor (α_e) of 4.0. For each yarn count, spinning performance and yarn quality was measured. We will also attempt to produce a 74 Ne yarn.

Figure 1 summarises the processing steps and equipment used to convert fibre into yarn.

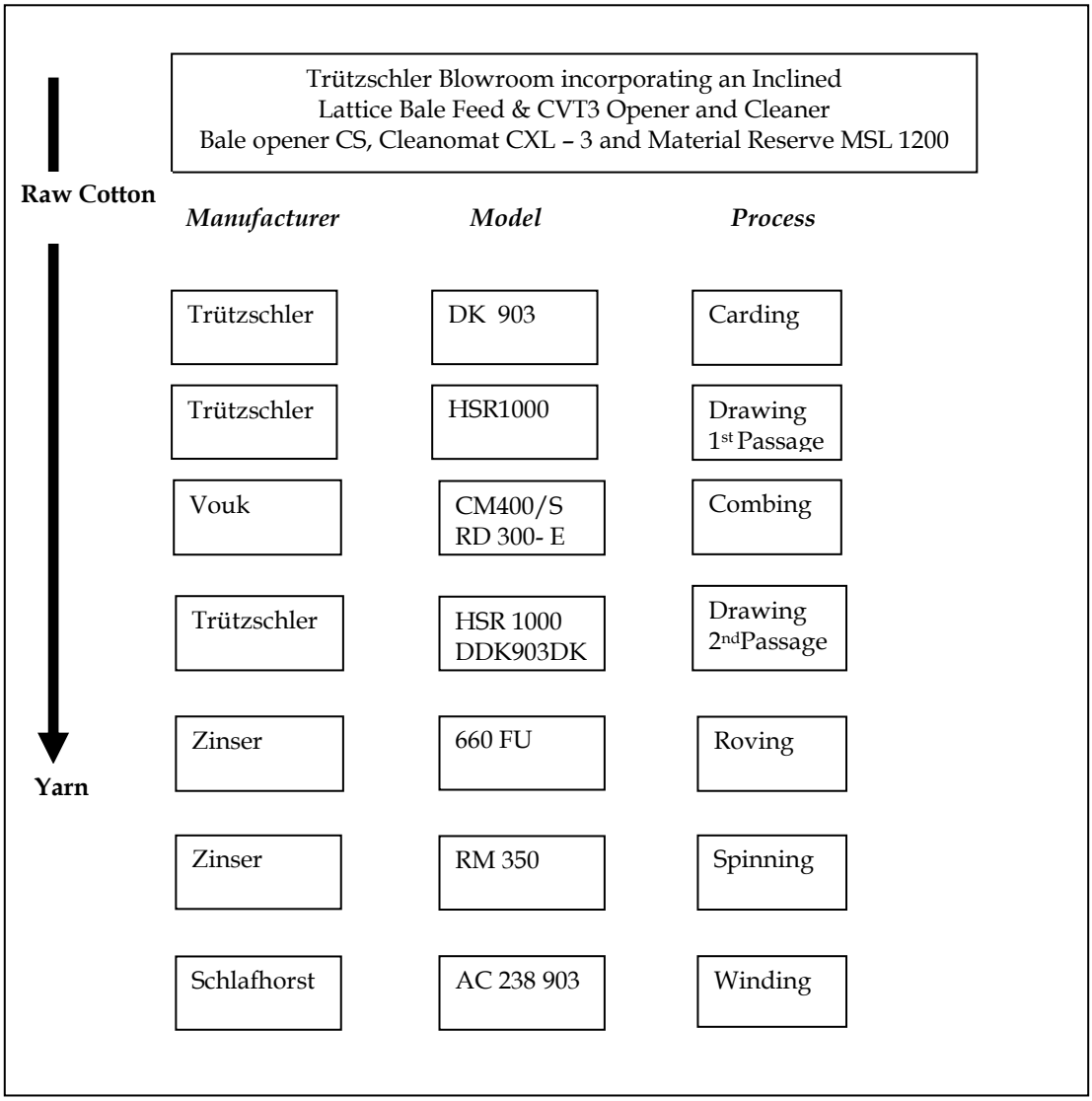

Figure 1 – Yarn Processing Route

Yarn Testing

Spun yarns were conditioned under standard conditions of 20°C +/-2°C and 65% +/-3% RH for 24 hours and tested for linear density (count) as per Australian Standard (AS) 2001.2.23, twist as per AS 2001.2.14, evenness, hairiness and imperfections using an Uster Technologies 4-SX evenness tester as per American Society for Testing and Materials Standard (ASTM) D1425. Tensile properties were determined using the Uster Technologies Tensorapid 3, as per ISO 2062: 1993(E). Table VIII shows the test results for the yarns spun from each blend treatment.

Results

4. Detail and discuss the results for each objective including the statistical analysis of results.

The fibre properties of the Sicala 340BRF tested in this study largely fall into the specifications for LS cotton that are being promoted (Table II).

For fibre properties not specified on sales contracts such as nep content and percent short fibre we used the 50 percentile of the current Uster® Statistics (2007) for benchmarking the fibre properties as determined by the AFIS instrument. The Uster® Statistics has been published by Uster Technologies Incorporated for close on sixty years and is widely used in the Textile Industry as a quality reference which allows for the classification and benchmarking of fibres and yarns produced worldwide. Although fineness was measured using the Cottonscan™ instrument and maturity was calculated, we compared the results to the Uster Statistics (Table VII).

Table VII -AFIS PRO Uster Statistic

Uster Statistics®	Total Neps/gram	SCN/ gram	SFC(w) %	Fineness mtex	Maturity Ratio
50%	270	22	7.8	163	0.74

Unfortunately the bale had a fibrous nep content of 325 neps/gram which is above the 50 percentile of the Uster® Statistics. This high nep content is in all likelihood due to the maturity which at 0.74 can be considered immature. At 24 neps/gram the seed coat nep content is slightly above the 50 percentile and at 10.5% the short fibre content is also above the 50 percentile **(**Table IV).

At 3.21% the amount of trash extracted during opening, cleaning and carding is generally considered to be low (Table V) and at 18.6% the amount of noil extracted during the combing process is also within the industry norm of ≤20%.

The evenness results from the preparation were acceptable and could be improved during commercial spinning trials when larger volumes of fibre are processed; allowing machine settings and evenness to be optimised (see Table VI).

The evenness and imperfections of the yarns were also influenced by the high nep count and immature fibre. However the tenacity of the cotton yarns produced can be considered suitable for knitting as all the yarns achieved yarn strengths above 13 cN/tex. The 40 Ne produced the most even and strongest yarn, with the least variation, followed by the 50 Ne and the 60 Ne yarns. Unfortunately the 74 Ne yarn did not perform well during spinning even when increasing the twist factor. (Table VIII)

Table VIII – Yarn Results

Instrument & Measurement	40 Ne	50 Ne	60 Ne	74 Ne
Evenness				
Coefficient of variation CV %	16.9	17.3	18.3	19.3
Thin places - 50 % /1000	85	101	157	259
Thick places + 50 % /1000	280	347	533	756
Neps + 200 % /1000	382	491	724	1113
Hairiness				
Hairiness H	4.4	4.0	3.8	3.7
Strength				
Breaking Tenacity cN/tex	17.3	16.7	16.1	15.6
CV % Tenacity	11.5	12.4	13.3	15.2
Breaking Elongation %	5.5	4.9	4.6	4.4
CV % Elongation	7.2	8.8	10.0	12.2

Another important measure of cotton lint quality is processing performance. The recording of end breakages in spinning is an important measure of processing performance because it indicates whether production levels and quality standards can be achieved. The processing performance of the 40 -60 Ne yarns produced was excellent (see Table XI) recording end break rates at less than 35 breaks per 1000 Spindle Hours (SpH). The processing performance of the 74 Ne yarns was poor.

Table XI – Ends down*

Yarn Count	Ends down
40 Ne	4.3
50 Ne	9.0
60 Ne	18.1

**per 1000 Spindle Hours (SpH).*

Outcomes

5. Describe how the project's outputs will contribute to the planned outcomes identified in the project application. Describe the planned outcomes achieved to date.

This initial study has shown that it is extremely important for fibre that is to be marketed and sold as Premium Upland Long Staple cotton to be fully described. The fibre properties reported by the HVI such as length, strength and Micronaire are not enough. The cotton for this trial was selected as the HVI fibre properties were within the contracted specifications, however due to the fact that the cotton was immature we were unable to produce fine count yarns that were even and strong which is needed for weaving.

As a result of this trial the fibre for the commercial mill trial to be conducted in 2013 will be fully described. Only lint bales whose fibre quality falls within the contracted and uncontracted fibre specifications will be used during this trial.

6. Please describe any:-
   a) technical advances achieved (eg commercially significant developments, patents applied for or granted licenses, etc.);
   b) other information developed from research (eg discoveries in methodology, equipment design, etc.); and
   c) required changes to the Intellectual Property register.

N/A

Conclusion

7. Provide an assessment of the likely impact of the results and conclusions of the research project for the cotton industry. What are the take home messages?

The aim of this study was to conduct processing trials at the CMSE Cotton Mill, with Long Staple Upland cotton with fibre properties that fall within stipulated specifications. Fine count combed ringspun yarns were produced to determine the quality and processing performance of these yarns, with information from these trials assisting in the commercial mill trials planned for 2013.

The trial showed that although the fibre properties reported by the HVI such as length, strength and Micronaire were within the contracted specifications we were unable to produce even strong yarns needed for weaving. The reason for this was due to the fact that the fibre was immature resulting in higher than expected nep and short fibre content which affected the evenness and strength of the yarns.

The message is clear we will need to fully describe the cotton, adding fibre properties such as maturity, fineness and nep content to HVI measurements, to ensure that spinners can produce quality 40-80 Ne yarns without any processing performance problems. This will increase the demand for this cotton and ultimately lead to more growers growing the cotton due to the premiums spinners are prepared to pay for this cotton.

Extension Opportunities

8. Detail a plan for the activities or other steps that may be taken:
   (a) to further develop or to exploit the project technology.
   (b) for the future presentation and dissemination of the project outcomes.
   (c) for future research.
8. A. List the publications arising from the research project and/or a publication plan.
   (NB: Where possible, please provide a copy of any publication/s)

   It is envisaged that presentations on this work will be made to industry bodies such as the Australian Cotton Shippers Association, Australian Cotton Ginners Association, Cotton Classers Association of Australia and Cotton Australia.

B. Have you developed any online resources and what is the website address?

N/A

Part 4 – Final Report Executive Summary

Provide a one page Summary of your research that is not commercial in confidence, and that can be published on the World Wide Web. Explain the main outcomes of the research and provide contact details for more information. It is important that the Executive Summary highlights concisely the key outputs from the project and, when they are adopted, what this will mean to the cotton industry.

The aim of this study was to conduct processing trials at the CMSE Cotton Mill, with a bale of the current Australian Long Staple Upland variety (Sicala 340BRF) with fibre properties that fall into stipulated specifications. Fine count combed ringspun yarns were produced to determine the quality and processing performance of these yarns, with information from these trials assisting in the commercial mill trials planned for 2013.

We were able to spin 40-60 Ne combed ringspun yarns without any processing performance issues; we were however not able to spin 74 Ne yarns successfully. The quality of the yarns produced was uneven and not strong enough for the weaving process.

The trial showed that although the fibre properties reported by the HVI such as length, strength and Micronaire were within the contracted specifications we were unable to produce even strong yarns needed for weaving. The reason for this was due to the fact that the fibre was immature resulting in higher than expected nep and short fibre content which affected the evenness and strength of the yarns.

The message is clear; we will need to fully describe the cotton; adding fibre properties such as maturity, fineness and nep content to HVI measurements to ensure that spinners can produce quality 40-80 Ne yarns without any processing performance problems. This will increase the demand for this cotton and ultimately lead to more growers growing the cotton due to the premiums spinners are prepared to pay for this cotton.