Part 1 - Summary Details

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CRDC Project Number: **CSP184**

Project Title: CSIRO Fibre Quality Laboratory

Project Commencement Date: July 2006 **Project Completion Date:** June 2007

Research Program: Off Farm

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Part 3

1. Outline the background to the project.

Fibre quality has always been an important component of Australia's cotton. In the mid 1980's a conscious decision was made by the industry to raise the level of fibre quality to ensure ready demand on the export market from spinners. At that time, some varieties were withdrawn from use because of their reduced fibre length and strength. Since that time, CSIRO's fibre quality selection pressure has gradually increased fibre properties of breeding material and varieties. We made rapid increase in fibre length up to 1990 and continued increase in fibre strength to the present time, both through conventional plant breeding and with a dedicated HVI line to apply selection pressure to segregating populations.

Although it is difficult to estimate the financial benefit of those changes, there is no doubt that better fibre has been a key factor in the success of cotton over the past 20 years; Australia has been able to enter higher quality markets at better prices.

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

This project funded casual labour and the maintenance on a semi automatic HVI 900, a Shirley FMT3 and associated air conditioning equipment at Narrabri. The major **objectives** were providing fibre quality measurements for the CSIRO breeding program and other research projects at ACRI and the Cotton CRC. For 2006/07 one-year project:

a. Screen early generation breeding material for length, uniformity, extension, strength and micronaire by HVI.

b. Screen promising breeding lines for the above plus fibre fineness and maturity by FMT.

c. Provide HVI testing for other research projects. Collaborate with CSIRO TFT in Geelong in providing calibration samples and assessing instruments such as Cottonscan and SIROmat.

These objectives have been met. We have averaged 20,000 HVI samples and 10,000 FMT samples each season from CSIRO and DPI experiments, with measurements done in two shifts per day during the harvest period. Samples from Canberra and Katherine - Kununurra are processed throughout the year. CRDC funds supported casual staff (sometimes on after hours shifts) and maintenance of air-conditioning, HVI and FMT instruments. The Shirley FMT3 is old and requires constant maintenance. A new HVI was installed for 2004/05.

3. Detail the methodology and justify the methodology used.

Each year, fibre samples from experiments are tested for fibre properties on HVI. Up to 15% of these samples are from agronomy and other projects from ACRI or Industry Development Officers in all regions. In the last year, samples have been processed from experiments by Mick Bange, James Neilsen, Lewis Wilson, Ian Rochester, Sandra Deutscher, Steve Yeates, Dirk Richards, Yong-Ling Ruan, Yves Al-Ghazi (all CSIRO); Robert Mensah and Nilantha Hulugalle (NSW DPI); and Robert Eveleigh (CSD).

The rest of the samples are from CSIRO cotton breeding from experiments on ACRI and all district sites. For sites with fusarium wilt where samples cannot be bought back to ACRI because of our fusarium protocol, samples are ginned in the valley from where they came and fibre tested at a commercial laboratory in Moree or Goondiwindi.

A large proportion of breeding samples also have fineness and maturity tested by Shirley FMT3.
Measurements are done during April, May and June, often with two shifts each day. Samples are measured at other times in the year when necessary – for example from Kununurra and Katherine or from Canberra laboratories. About 30,000 samples are processed each year.

CSIRO Plant Industry participate in Australian and International round tests and that information is used to ensure calibration and instrument maintenance are maintained.

CSIRO Textiles in Geelong are developing new instruments to measure cotton fibre properties (Cottonscan for fineness and Siromat for maturity). We collaborate with that group to provide samples for calibration and in some instances to locate an instrument in our laboratory for evaluation and testing in parallel with our HVI and FMT3. Were commercial versions (or near commercial) of these instruments to become available we would consider replacing our old FMT3 with a Cottonscan.

4. Detail and discuss the results including the statistical analysis of results.

Note: this project supported the operation of a fibre quality laboratory at ACRI to service most research projects. Specific details on fibre quality results are listed in those project reports.

Full analysis of breeding data from 2006/07 is not yet complete, but overall the results have been pleasing. Good progress is being made in firstly increasing the fibre length of major varieties to ensure compliance with the increased base for fibre length in Australia. All breeding lines in our program have to be at least .03” (1/32”) greater than Sicot 71; secondly, in order to provide options for possible market requirements or opportunities for premium fibre quality, breeding has commenced in trying to develop premium fibre types (long, strong, fine) for Australia with satisfactory yield to be a viable commercial option. The following three tables give examples of these areas of breeding.

Table 1. Yield and fibre properties of advanced breeding lines from four sites in 2006/07. Fibre properties measured by HVI (length, uniformity, strength, elongation, micronaire) and FMT (percent maturity and fineness).

Entry	YIELD	LEN	UNI	STR	EL	MIC	PM	FIN
97215-86-348	3202	1.19	84.9	31.6	6.9	4.5	86.0	176
Sicot 71	3126	1.15	83.2	30.9	6.0	4.7	86.3	184
62222-379	3121	1.18	83.0	30.2	4.9	4.8	86.2	188
62213-142	3105	1.20	84.4	32.0	7.4	4.4	80.7	182
20019-366	3104	1.18	83.4	31.3	5.2	4.7	87.7	186
61234-233	3096	1.18	84.0	30.8	7.6	4.7	84.4	191
62213-282	3091	1.20	84.6	33.1	6.5	4.4	84.8	173
62213-114	3087	1.21	83.8	31.4	6.7	4.2	79.1	181
61233-310	3070	1.22	84.9	32.8	5.8	4.4	84.4	176
61234-303	3059	1.21	84.0	30.4	7.1	4.5	83.5	185
61233-376	3053	1.21	84.6	31.9	6.1	4.5	87.6	177
61212-305	3023	1.18	83.5	31.2	5.4	4.5	85.9	177
99209-242	3019	1.19	83.7	31.0	7.9	4.5	80.7	190
20019-247	3017	1.20	84.7	32.2	5.0	4.7	84.7	192
62222-121	3004	1.24	84.1	30.8	6.5	4.3	83.4	169
99209-284	3002	1.17	84.0	30.6	7.5	4.9	84.6	199
61212-247	2998	1.21	84.4	32.1	5.8	4.2	83.5	169
61234-140	2986	1.19	84.8	32.3	6.3	4.5	83.3	189
61234-273	2981	1.22	84.2	31.2	5.9	4.4	86.9	171
61210-179	2955	1.19	83.8	31.0	5.8	4.6	85.9	185
99216-513	2949	1.19	84.1	30.0	6.2	4.7	87.0	189
20228-190	2930	1.25	85.5	32.4	6.6	4.4	84.8	174
20228-64	2871	1.24	84.7	33.1	5.9	4.1	82.4	169
20231-457	2567	1.29	85.9	32.8	4.7	4.2	84.1	162

Table 2. Yield and fibre properties of preliminary high quality breeding lines from two sites in 2006/07. Fibre properties measured by HVI (length, uniformity, short fibre, strength, elongation, micronaire) and FMT (percent maturity and fineness).

Entry	Yield	LEN	UNI	SFI	STR	EL	MIC	PM	FIN
20229-652	3254	1.22	84.7	7.4	32.7	5.3	4.2	79.3	177
Sicot 71	3237	1.17	83.4	8.1	32.4	5.6	4.1	77.7	178
20229-314	3174	1.21	84.1	7.4	31.1	6.0	4.3	78.8	186
20229-772	3163	1.24	84.0	8.0	32.5	5.7	4.1	76.9	174
61232-590	3145	1.22	84.3	7.4	32.8	4.9	4.0	80.5	162
61211-178	3126	1.25	85.8	6.7	34.2	4.5	4.2	80.5	169
63219-621	3103	1.20	84.5	6.9	31.2	7.5	4.2	79.6	176
20027-199	3098	1.21	84.5	7.1	33.4	4.8	4.3	82.0	170
20229-274	3089	1.24	85.3	7.3	33.0	5.5	4.2	79.2	173
63942-65	3080	1.24	83.6	7.8	33.6	5.0	4.0	79.9	168
61232-358	3075	1.24	84.9	6.9	32.2	4.7	4.4	81.7	178
63219-474	3057	1.25	84.4	7.1	33.6	6.0	4.0	78.7	159
61232-422	3039	1.27	84.8	7.4	33.4	4.1	4.2	80.9	172
61219-354	3036	1.23	84.7	7.8	33.6	4.0	4.1	79.2	168
63219-307	2997	1.22	84.3	7.3	33.2	6.7	4.2	78.7	172
61211-34	2978	1.23	85.3	7.5	33.6	4.1	4.1	83.9	164
63224-232	2954	1.23	84.1	7.6	34.6	5.0	3.8	77.3	160
61211-272	2918	1.24	85.4	6.8	34.2	5.4	3.9	79.3	163
61219-325	2879	1.25	85.5	7.0	34.8	4.1	4.0	79.0	161
63955-193	2842	1.31	84.9	7.4	33.3	4.9	3.9	79.2	156
61220-377	2835	1.23	85.7	6.3	34.8	4.7	4.4	85.0	169
61211-389	2833	1.28	85.4	7.2	34.5	4.6	3.8	78.7	153
20231-397	2782	1.29	85.2	6.8	35.6	3.9	4.0	80.2	157

Table 3. Yield and fibre properties of Sicot 70BRF compared with Sicot 71BR at 12 sites in 2006/07. Fibre properties measured by HVI (length, strength, micronaire) and FMT (percent maturity and fineness).

	Yield	Len	Str	Mic	PM	Fin
Sicot 70BRF	98.0	1.19	30.9	4.2	81.5	179
Sicot 71BR	100.0	1.13	30.1	4.7	84.1	194

All data sets show good progress in combining improved fibre properties with high yield.

5. Provide a conclusion as to research outcomes compared with objectives. What are the "take home messages"?

Note: this project supported the operation of a fibre quality laboratory at ACRI to service most research projects. Specific details on fibre quality results are listed in those project reports.

For breeding, the take home message is that progress has been good, with improved fibre length achieved in high yielding varieties and breeding material with premium fibre has been identified.

6. Detail how your research has addressed the Corporation's three Outputs - Economic, Environmental and Social?

Note: this project supported the operation of a fibre quality laboratory at ACRI to service most research projects. Specific details on fibre quality results are listed in those project reports.

New varieties with better yield and fibre properties will increase gross margins of cotton growers directly, so economic benefits will accrue to them directly. Economic success by an industry in a region, in combination with environmental improvements will benefit the whole community. Economic benefit to growers and industry is through increased yield and fibre properties – a CIE report in 2002 calculated that CSIRO's cotton breeding program has added $4.9b in net present value to Australia's cotton industry.

7. Provide an assessment of the likely impact of the results and conclusions of the research project for the cotton industry. Where possible include a statement of the costs and potential benefits to the Australian cotton industry or the Australian community.

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Fibre quality has become even more important as criteria for marketing our cotton. This has arisen from dynamics in the spinning industry (less mills in US, more in China - so the US exports substantially more) and increased production and export from other countries. In order to keep a high reputation with spinners, Australia needs an improved fibre quality portfolio with improved uniformity and reliability. This project supports the operation of a dedicated fibre quality laboratory at ACRI to support all research programs - especially CSIRO's plant breeding, but also a range of agronomy projects.

Our breeding has always kept an active selection on fibre quality traits while breeding for pest and disease resistance and we have a high reputation internationally for fibre quality. It is difficult to put a dollar value on quality as there are few premiums paid for good quality, but many penalties (discounts) for poorer quality. In the past five years, 5% of the Australian cotton crop has been discounted for short fibre, 9% for low strength; 7% for high micronaire and 2% for low micronaire. This annual total cost (loss) to growers of these discounts is up to $21m, but the real value of breeding for fibre is maintaining market demand and possibly also adding some premium fibre types to our export portfolio. If 10% of our cotton was a premium type attracting a 15% price premium, the annual additional benefit could be $18m. Unfortunately, buyers of cotton are always raising the bar for what is acceptable in terms of quality parameters. Maintaining high quality, or preferably raising quality is therefore essential for us to keep our markets in the face of increasing competition and preferably to provide us with an edge in marketing.

Part 4 – Final Report Executive Summary

Note: this project supported the operation of a fibre quality laboratory at ACRI to service most research projects. Specific details on fibre quality results are listed in those project reports.

This project part funded operation and maintenance of HVI900 and FMT3 cotton fibre testing instruments and associated air conditioning in CSIRO's fibre testing laboratory at ACRI for the 2006/07 season. The laboratory supports measurements of fibre quality from cotton experiments in CSIRO's breeding program and research projects by other organisations and projects.

More than 20,000 samples were tested by HVI and 10,000 samples by FMT.

Global cotton production and market dynamics indicate Australia needs a future edge with fibre quality to ensure buyers will want our cotton in preference to our competitors. This means developing varieties, management and processing to ensure we deliver better fibre. There may be opportunities for premium fibre products in future. Thus the CSIRO cotton breeding program raised the emphasis on developing improved fibre varieties to address these needs.

Negative associations between yield and fibre quality present challenges for variety development. We have accurately measured these associations and developed breeding population sizes to ensure the rare combinations of high yield and quality can be identified. Accurate measurement of fibre quality is an important component of that work.

Progress has been good, with improved fibre length achieved in high yielding varieties and breeding material with premium fibre identified.