Cotton
RESEARCH & DEVELOPMENT

Annual, Progress and Final Reports

Part 1 - Summary Details **REPORTS**

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

CRDC Project Number:

Annual Report:	☐	Due 30-Sep-03
Progress Report:	☐	Due 29-Jan-03
Final Report:	☒	Due 30-Sep-03
		(or within 3 months of completion of project)

Project Title:

Project Commencement Date: 1 July 2002 **Project Completion Date:** 30 June 2003

Research Program: Processing and Market

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Signature of Research Provider Representative: _____

Part 3.3 – Final Reports

1. Outline the background to the project.

This project addressed the issue of how to gin cotton in a way that maximized the quality of the lint. The need for it came from 'whispers' from the market that Australian cotton was prone to high levels of Neps and Short Fibre Content.

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

Initially it was planned to establish objectively where Australian cotton rated in a rigorous comparison with cotton from another cotton trading nation (*i.e.* USA). This was done, in 1998. Along the way, researchers developed methods and linkages to other agencies to collect, gin, sample, process and test cotton samples.

It was also planned to analyse the wide range of data from laboratory testing of lint, yarn, and fabric to determine which if any of the lint attributes could be used to predict yarn and fabric quality. This was done as part of the 1998 and 1999 studies.

It was then planned to investigate in detail the effect on lint, yarn, and fabric quality of varying both seedcotton moisture content and heating in a gin. This was done in 2000.

It was then planned to run field trials to determine the effects on cotton quality of growing cotton in the UNR format. UNR cotton has a reputation for low quality in some quarters. The trial was designed to establish whether this was deserved and what factors controlled the quality. This was done via a trial at Tandou in 2001. This study also enabled an add-on study into the effects of re-injecting moisture after cleaning and before the sawgin.

Also in 2001 there was an add-on to a trial at the ACRI research station in Narrabri. The ACRI trial was concerned with Insect Management and Variety with Nitrogen and water to suit. Once the agronomic data was collected and module weights recorded by other researchers, this project took the modules through the ginning stage. The trial was designed to establish whether and to what extent field treatments determined quality at the lint, and yarn forms. The aim was also to determine how to design future research into the issue of field effects on cotton quality postharvest.

The subtext was to highlight the issue of the current emphasis on yield at the expense of quality, and also to show how finer differences could be seen when using testing over and above that usually used in agronomic research.

This was done, and was the subject of a special report to CRDC in November 2002.

Also in 2001 there was a Base or Better study that looked at the quality effects at the lint, yarn and fabric stages of the three ginning treatments commonly referred to within the industry: Ginning Up (for premiums), Ginning for Base (as defined in standard selling contracts), and Ginning Down (an unorthodox list of equipment settings that de-emphasized cleanliness, and concentrated instead on removal of seed and gross trash to preserve the instrinsic quality of the incoming seedcotton).

3. How has your research addressed the Corporation's three outputs: Sustainability, profitability and international competitiveness, and/or people and community?

The research addressed profitability and competitiveness:

- increasing the value of the Australian crop by reducing the risk margin built into buyer's pricing decisions, caused by unpredictable quality;
- reducing the volatility in prices, by making it possible for Australian cotton to be sold into the higher end of the commodity market;
- reducing the incentive for industrial customers to subsitute synthetic chemical fibres for cotton, also caused by unpredictable quality.

4. Detail the methodology and justify the methodology used.

The methods used were based on the belief that 'external validity' is more important than 'internal validity' for this kind of research. That is, to show anything meaningful about the industry, the work had to be based on industrial conditions, even at the cost of some experimental rigour. Cotton with certain characteristics that was representative of the industry was harvested, and ginned in full sized commercial gins. Certain equipment settings, primarily cleaning and heating, were varied (unless field effects were being investigated). Samples were taken from the bale press, and sent for a wide range of laboratory tests, generally in overseas labs. Larger samples were also taken for further processing into yarn and fabric.

These extra steps were taken to ensure that the project was tied closely to the experience of buyers of raw cotton. It was felt that currently too much emphasis is placed on the quality of the lint because that is how the cotton growing industry sees cotton, and too little on yarn and fabric because that is in some way separate.

5. Detail results including the statistical analysis of results.

The extensive results are available from previous reports to CRDC. In particular, a summary of results, statistical analyses and conclusions drawn from them are contained in two special reports to the CRDC: 'Cotton Ginning with Emphasis on Quality', July 2002; and 'Field Effects on Cotton Quality', November 2002.

6. Discuss the results, and include an analysis of research outcomes compared with objectives. What are the "take home messages"?

The first take home message is that the Australian industry, like similar capital intensive cotton industries around the world, heats and cleans its cotton too much.

The 2001 Base or Better study had its origins in the question of whether it was best to (a) gin up for Premiums or (b) gin for Base grade. The answer turned out to be '(c) None Of The Above'. Several important quality attributes (including every length attribute plus Neps) was better for Ginning Down, and none were worse. Ginning Up and Ginning for Base were indistinguishable from each other in their effect on the quality, but were clearly worse than Ginning Down when quality in the hands of the industrial buyer was considered.

The second take home message is that the improvements on offer by Ginning Down cannot be realized under present conditions. An example of why this is so can be seen in another result in the 2001 Base of Better study. Most cleanliness attributes for the Ginning Down cotton were worse, and this would have caused severe price penalties. *Even though it was better cotton in the hands of the industrial buyer.*

So there is a paradox: One group of quality attributes (concerned with cleanliness and apprearance) has a positive effect on bale price but nil or a negative effect on quality as seen by the industrial buyer. Another group (concerned with length, length uniformity, short fibre, etc, plus Neps) has a positive effect on quality as seen by the industrial buyer but nil or a negative effect on bale price.

The former are emphasized in the current classing system, the latter are not. For financial reasons, ginning practice follows classing practice, and the former group are maximized at the expense of the latter group.

As a result, Australian cotton suffers unnecessary quality drops on the way through the gin. Neps (always present as a result of seed abortion under variable growing conditions) are multiplied, and several length attributes suffer. These attributes mean that the benefits of the other good attributes of Australian cotton cannot be realized. Less Australian cotton can be sold into the higher end of the commodity market, so prices are lower and more volatile. In addition, substitution by synthetic chemical fibres becomes more attractive, negatively affecting market share.

The situation appears to be frozen because of a demonstrated reluctance in the Australian raw cotton sector to acknowledge problems for fear of disturbing the reputation that they do have. This is amplified by the belief that the current classing system is tied closely to subsidy arrangements in a certain nation that grows and consumes large quantities of cotton.

This is why there is a lack of adption of the results from this project, and a gap between objectives and results. The research results are in but changes must take place elsewhere in the industry before the research can be adopted.

There is a third take home message also.

At first face growers don't have to be concerned about buyers getting higher levels of short fibre and Neps. Their selling contracts don't cater for adverse outcomes further along the production chain. Also, the classing results by which their bales are priced are affected little or not at all by the attributes that suffer as a result of current ginning practice. And modern varieties have enough fibre length that they can meet Base length requirements even with the reduction in the length attributes.

However, this project has shown that there are bad effects for growers, but they are obscured. Regardless of the shortcomings of the classing sytem, buyers of raw cotton get a very clear understanding of the quality of the cotton during processing. These effects must be passed back to growers in some way.

Firstly, the buyer will look at other options to the extent that he can. He can do this either by blending in more cotton that lacks the basic quality of the Australian cotton but has better Short Fibre and Neps attributes. Or he can do this by blending in more synthetic chemical fibre. Either of these options has the effect of making Australian cotton more substitutable, with an associated increase in price volatility. It will also make cotton in general more substitutable, with an associated decrease in its market share.

Secondly, when that buyer comes back to the market, he can be expected to hold something back in the price he offers, to pay for the periodic expensive surprises in the performance of Australian cotton. This causes a step downwards in prices that could have been avoided.

Therefore growers should be aware of the full range of effects of current classing and ginning practice, so that they can make informed decisions.

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 and future research needs.**

As a result of this research, there is now a better understanding of what Neps are, and how they are best managed in the gin. It is also better understood how erring on the side of 'bright white' cotton in the bale has a bad effect on several important quality attributes. Certain field effects on cotton quality have been demonstrated.

This research offers a way to bring about a step upwards in quality across the entire industry, for little cost or even for a nett reduction in operating expense. Properly implemented, this can bring about better prices and less volatile prices by being at the better end of the quality spectrum, and by having better control over the quality of the product. It also offers a means of competing better with synthetic chemical fibres, again by having better control over quality.

Putting a dollar figure on this step upwards in quality is difficult, but if the entire Australian industry produced 1.6 billion dollars worth of cotton, and the average increase in price was just 5% then eighty million dollars extra would flow into the industry p.a.

8. **A/a**

9. **Describe the project technology (eg. commercially significant developments, patents applied for or granted licenses etc).**

The commercially significant developments relate to new ways of using existing equipment, and pointers to how to develop new equipment.

10. **Provide a technical summary of any other information developed as part of the research project. Include discoveries in methodology, equipment design, etc.**

Methods have been developed to track cotton from field to fabric, using full sized industrial equipment and sample sizes but maintaining a high level of rigour in the analysis. Previous research has been tightly controlled trials involving small samples in plastic bags, or trials involving 16,000kg modules. This project combined the rigour of the former with the representative nature of the latter by using the smallest sample size that properly loads a full-sized gin. These methods attracted interest and cooperation from other researchers in the USA (SRRC New Orleans) and Australia (CSIRO Geelong) who had a need for these capabilities but no capacity.

11. **Detail a plan for the activities or other steps that may be taken;**

    (a) to further develop or to exploit the project technology.

To exploit the project results, changes need to take place elsewhere in the production chain. These changes relate to how cotton is classed:

Attributes relating to appearance and cleanliness need to be de-emphasized.

Other measures particularly the length attributes need to re-emphasized.

New attributes such as Immature Fibre Content, and direct Nep measurement, should be added as and when high throughput equipments becomes available. (There are several commercial prototypes using two different approaches under development.)

There are two options to achieve these changes: a 'big bang' approach, or a 'parallel' approach.

The author has observed that people in the ginning business understand most of the results of this project, as do many people further along the production chain. However, growers know these things least of all. This suggests that there needs to be an educational effort to let all growers know what they are missing out on. This will have the best chance of generating the impetus to bring about the necessary industry-wide changes.

The alternative is that one vertically integrated company (or group of companies in a supply chain) put these project results into commercial practice. Once it has been demonstrated using commercial quantities and under commercial operating constraints that a better, more consistent, and more valuable product results, the mighty dollar will speak and the rest of the industry will have to catch up or be left behind.

Part 4 – Final Report Executive Summary

Provide a half to one page Summary of your research that is not commercial in confidence, and that can be published on the World Wide Web. List the main outcomes and contact details for more information.

The main recommendation arising from six and a half years of research into how to gin cotton with an emphasis on quality relates to practices outside of ginning, rather than ginning itself.

The research in part produced a rigorous comparison of Australian cotton against cotton from a similar industry (USA). We lost. While Australian cotton had several good attributes, it was shown to be appreciably higher in Nep content.

Other individual studies showed the quality aspects of UNR cotton, of combinations of cotton moisture and heating levels, and the relevant importance of a wide range of quality attributes of lint in predicting a wide range of quality attributes of yarn and fabric. Initial work was also carried out into how much decisions taken during growing affect cotton quality postharvest.

The main outcome of this research is to show that there is a Ginner's Paradox.

There are two main groups of quality attributes for cotton lint. The first group is concerned with cleanliness and appearance (leaf, colour where weathering is not an issue, preparation, etc). The second group relate to performance in the hands of the industrial buyer (several length attributes, plus Neps and immature fibre content).

The former affect bale price strongly, but quality in the hands of the industrial buyer little or not at all, whereas the latter affect quality in the hands of the industrial buyer strongly but bale price little or not at all.

The paradox for the ginner is that he can gin for best results in one or other of these groups of attributes, but not both.

Current classing practice emphasizes the former, but punishes or ignores the latter. For pragmatic reasons, ginning practice follows classing practice. The end result is that an opportunity to produce a step upwards in quality across the Australian industry is going begging.

Those classing practices must change before the results of this research can be adopted.