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REPORTS

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Part 2 – Contact Details

Administrator: Allan Williams
Organisation: A & A Williams Pty Ltd
Postal Address: "Kia-Ora"
NARRABRI NSW 2390
Ph: 02 6793 5301 **Fx:** 02 6793 5302 **E-mail:** allanw@mpx.com.au

Principal Researcher: Allan Williams
Organisation: A & A Williams Pty Ltd
Postal Address: c/- Cotton Australia
2/490 Crown Street
SURRY HILLS NSW 2010
Ph: 02 9360 8500 **Fx:** 02 93608555 **E-mail:** allanw@mpx.com.au

Supervisor: Allan Williams
Organisation: A & A Williams Pty Ltd
Postal Address: "Kia-Ora"
NARRABRI NSW 2390
Ph: 02 6793 5301 **Fx:** 02 6793 5302 **E-mail:** allanw@mpx.com.au

Researcher 2

Organisation:
Postal Address:
Ph: **Fx:** **E-mail:**

Signature of Research Provider Representative:

FIBRE QUALITY MANAGEMENT

Maintaining Australia's Premium Markets

A discussion paper for the
Cotton Research and Development Corporation

August 2002

"Luck is what happens when preparation meets opportunity"

Prepared by A & A Williams Pty Ltd
DRAFT FOR CRDC CONSIDERATION ONLY
Version 1.1

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Executive Summary

Fibre quality management includes on-farm and post-farm gate practices. Variety selection, irrigation management, crop nutrition management, disease management, pest management, climatic and weather conditions, harvesting, transport and ginning practices can all affect fibre quality. Management practices and environmental conditions up to the point of harvest determine whether the valuable attributes of the selected variety are realised. Practices from harvest onwards determine whether these fibre qualities are maintained.

The overall quality of the Australian cotton crop is high and continually improving. While each year's crop generally has one or two quality aspects that would ideally be better, Australia has a well-deserved reputation for producing and delivering a consistent, high quality product well suited to the needs of spinners. Thus there is no over-riding quality concern that cries out for immediate attention, or which a failure to address would cause immediate marketing problems. Nonetheless, a coordinated, formal approach to fibre quality management will help ensure that at a minimum, Australian cotton will continue to occupy its current market position.

Four potential drivers for developing industry guidelines for fibre quality management have been identified. These are:

1) A need to address quality issues that are **currently affecting** the ability to sell the Australian cotton crop; while Australian cotton is generally of high quality, complaints from spinners about the high short fibre content and levels of neps in Australian cotton are not uncommon; also, price discounts for Australian cotton are certainly not unheard of
2) A need to address quality issues that **may in the future** affect the ability to sell the Australian cotton crop; for example, it is almost certain that spinners will continue to demand increasingly high fibre quality, due to the use of faster and faster spinning methods, the ongoing need to improve mill efficiency and reduce costs, and to meet their customers' needs; the industry should also ensure that it is well positioned to meet competition from other growths, or other fibres
3) A need to ensure that any move to BMP branding be supported by a fibre quality management program to ensure the integrity and credibility of the brand
4) A desire to formally prove the quality of Australian cotton; industry guidelines could be used to publicise the high quality of Australian cotton, and the industry's commitment to continual improvement.

It is recommended that the Australian cotton industry undertake to address quality management issues in a coordinated way, through a formal industry program. In particular, the following recommendations are made.

1. That existing information relating to managing fibre quality be collated and codified with a view to developing an information package for cotton growers that will help enable them to respond to market signals
2. That the information package, as well as addressing the specific points noted under "Potential Areas for Development of Information", include a brief description of how cotton fibre is formed, and of each relevant fibre characteristic, including information on why it is important, and what management practices and/or environmental factors can affect it
3. That consideration be given to instituting a formal extension/education program to deliver the information developed
4. That an appropriate industry body be given the responsibility to oversee the development of the information package and extension/education program, with either membership drawn from, or strong linkages to, the Cotton Evaluation and Advancement Committee, and the Raw Cotton Marketing Advisory Committee
5. That any planned introduction of the information package be trialled extensively before widespread introduction
6. That the appropriate industry body with the responsibility of overseeing the development of the information package also determine whether any of the issues identified as being outside of the scope of this discussion paper need further investigation to ensure that the fibre quality information package is as useful as possible.

It is difficult to be precise as to when such a formal approach may become necessary. Thus, the decision as to whether a formal approach to managing the quality aspects of Australian cotton should be developed rests on whether the industry wants to be well-prepared in advance of likely market or technological changes, or whether action is considered necessary only if and when these pressures become impossible to ignore. Whatever the timing, a low-key approach, based on trialling a set of materials developed from existing information is suggested. Such an approach allows for more consideration to be given to the potential threats facing the industry, but is at the same time beginning the preparation necessary to deal with these threats should they eventuate.

Twenty-five years ago, Australian cotton did not have the reputation it currently enjoys in the market place. A conscious decision was made around that time to improve the length, strength and fineness of Australian cotton. The benefits of that forethought are now being reaped; is it now time to sow some more seeds?

Notes on Terminology

- A broad definition of "fibre quality" is used in this report, covering each of the characteristics of cotton fibre that affect its value and marketability: for example, fibre strength, length, fineness, colour, and levels of trash and contaminants. The factors responsible for a given fibre's characteristics are similarly broad. These factors include variety selection, climate and weather conditions, agronomic practices, harvesting practices, and ginning practices. Management of these factors should aim to maximise the potential value of the fibre up to the point of harvest, and to minimise any depreciation in this value through harvesting or ginning.

- At this stage it is not considered appropriate to use the term "Best Management Practices" ("BMP") to describe any management guidelines that might be developed to help cotton growers produce the highest quality fibre. The reasons for this are twofold. First, Cotton Australia considers that the BMP Program should be limited to addressing environmental issues. Maintaining clarity of focus in the BMP Program will help ensure its success. To ensure consistency with current industry policy, any direct association of the BMP Program with quality management should be avoided. Second, investigations are being conducted by Cotton Australia to determine the potential to establish a brand for Australian cotton based on compliance with the BMP Program (i.e. a brand based on the method of production, rather than the quality of the product). Using "BMP" for fibre quality could create the misleading impression that a warrant was being made as to the product's high quality.

Introduction

The Cotton Research and Development Corporation (CRDC) has maintained a small but significant investment in post-farm gate issues relating to cotton fibre quality and in particular in those issues that are critical to Australian cotton maintaining its place as one of the premium growths of cotton on the world market. This investment has increased in recent years with CRDC's collaboration with CSIRO Textile and Fibre Technology. This discussion paper on the potential to develop industry fibre quality management guidelines reflects this ongoing commitment. The Australian Cotton Growers Research Association, through its Post Farm Gate sub-committee has also highlighted the need to develop formal management guidelines to help Australian cotton growers meet increasing market demands for higher and higher quality cotton.

Although Australia only produces 3-5% of the world's cotton, it is the third largest exporter of cotton in the world, and competes in the high medium/medium count segment of the market where it accounts for 15-20% of world production (Cherry 2000). The high medium/medium count segment of the market is a more profitable segment than the coarser count market, and increased competition is therefore inevitable as new technologies better enable other growths to match the high quality attributes of Australian cotton.

The Australian cotton industry has a well-deserved reputation for producing consistent, high quality cotton, with each year's crop able to be sold without the need to carry stocks into the succeeding production year. However, there are no formal management guidelines covering all aspects of fibre quality management that can be used to help ensure that this high quality is maintained. While it could be argued that the history of production of good quality fibre demonstrates the adequacy of past and present arrangements, recent issues have highlighted the need to at least consider whether the development of management guidelines for on-farm and/or 'post-farm gate' aspects of quality management is required. The following point to a need to investigate this issue:

- The increasingly tight fibre quality specifications being requested by spinners and therefore by purchasers of Australian cotton
- Concerns about the level of neps and short fibres in Australian cotton
- Increased competition from other growths, commodities and products
- The slip in the contamination rankings for some parameters of Australian cotton per the ITMF contamination survey
- Whether 'BMP' branding (based on method of production) should be supported by a quality management program to help ensure the credibility of the BMP brand.

The purpose of this discussion paper is to help the industry determine whether a formal approach to managing fibre quality is necessary, and if so, to provide some suggestions as to what form this might take.

Overview of Current Situation & Emerging Trends

Australian cotton quality

Australian cotton enjoys a reputation for being a high-quality consistent product[i]. It has good staple length, a small micronaire range, good strength and uniformity and low levels of contamination. Furthermore, a reliable forward market, together with geographic proximity to expanding Asian markets, gives Australian cotton an edge over many of its competitors, especially the United States. However, as Cherry quotes "[w]e can expect our customers will increase their quality demands year on year... the pressure on the Australian cotton industry to improve quality will not relax" (Cherry 2000).

This reputation for high quality cotton has been built on scientific research, technological innovation, and a commitment to improving management techniques. In relation to scientific research, Faerber notes that "[c]ontinuing efforts to improve the quality of Australian cotton varieties and to develop new traits and germplasm [have] culminated in fibre descriptions which appear most desirable for high-speed fine-count spinning-a segment which is occupied by few of the world's best cottons"(Faerber 2000). Faerber also notes however, that the industry cannot rest on its laurels: "[c]onsidering the continuous technological and engineering advance in all segments of the textile industry and the fierce and truly global competition amongst textile producers, the Australian cotton community is encouraged to continue focusing on and striving for further fibre quality improvements to adjust to the future and perhaps even more challenging demands of their customers" (ibid).

One threat facing the Australian cotton industry is the successful use of Australian-bred varieties in other countries. This has significantly improved the ability of foreign competitors to compete with Australian cotton on the basis of quality (Morrison 2002). Thus, even though Australian varieties will always be available to Australian growers first, the advantage conferred by the superior fibre characteristics of these varieties is being eroded, meaning that other qualities may be necessary to differentiate Australian cotton so that it can maintain its market position.

While the quality of the Australian crop is generally high and improving, there are areas of concern, especially in those quality parameters that are yet to have an economic testing protocol developed: for example, neps and short fibre content (e.g. see CSIRO TFT 2001, Cherry 2000, Morrison 2002).

Current Information

While there is a large amount of information available on issues affecting the quality of cotton fibre, no formal or coordinated program to deliver this information to growers exists. Educating growers about fibre quality management issues is currently ad-hoc, relying on the extension efforts of seed companies (largely through written materials) and ginning companies (generally through pre-season meetings with growers). It was outside the scope of this discussion paper to attempt to establish the level of knowledge amongst growers on issues of fibre quality. Anecdotal evidence suggests that there is a large variance in levels of knowledge amongst growers, with the depth or extent of this knowledge dependent on a grower's personal interest in quality management issues. Unfortunately fibre quality is most likely to be discussed by a grower with their consultant agronomist, ginner or merchant once the cotton had been classed, and a problem identified as a result of on-farm practices cannot be rectified for that season.

Tighter specifications

"Base levels for many fibre properties have narrowed" (Constable 2002). Australian cotton is increasingly becoming a niche market product, with the ability to forward sell dependent on producing high-quality fibre within an increasingly narrow set of specifications. According to Morrison, the base grade increasingly being requested by spinners is a 21 quality, 2 leaf, 36 length staple with a micronaire between 3.8 and 4.5 and strength of 29 grams/tex. One critical effect of strict specifications is that cotton falling outside those specifications attracts increasingly significant discounts ("cliff-face pricing"), due to the difficulty in selling 'non-conforming' fibre. For example, Morrison notes that cotton with a staple length shorter than an inch and an eighth receives no forward sales enquiries.

Spinning mills are becoming increasingly specialized, and are therefore less able to cope with cotton outside their specifications. Whereas previously different quality cotton would be used in different parts of the spinning mill, mills now will reject cotton falling outside their specifications. As noted by Yankey (1997), "[z]ero defects in fabric is quickly becoming the standard as worldwide competition pushes quality requirements higher". The introduction of Murata Vortex Spinning (MVS), with its especially high fibre-quality requirements, can be viewed as the next step in this trend and is a natural progression in the increasing quality marketing of Australian cotton, initially sold to open-end spinning mills, then into ring-spinning mills, with MVS the next logical step.

The micronaire range now expected provides a good example of the tightening of specifications; as noted above, 3.8-4.5 is now the standard purchaser specification, compared to the G5 range of 3.5-4.9 (Cherry 2000).

A related issue is that of the inability to measure, in a commercially viable way, some of the fibre quality characteristics of most interest to spinners. The principal qualities not susceptible to quick and easy commercial measurement are short fibre content and neps. It has often been noted that once a commercial measuring system is devised, then discounts for these issues will quickly follow.

Increased competition

A number of merchants have noted that competition from foreign producers has increased over time, both in terms of matching the quality of Australian cotton, and undercutting on price (Morrison, Prendegast). Just as Australian cotton has closed the gap on the premium afforded San Joaquin Valley cotton through improving aspects of its quality, so too will other growths seek to aggressively compete against the Australian premium.

Improvements in spinning mill technology (see below) that help overcome some of the advantages held by Australian cotton over hand-picked cotton will mean that these cottons will be better placed to compete against Australian cotton on some of the weaknesses of Australian cotton, especially those that result from the highly mechanized nature of the Australian cotton production system, average maturity, short fibre content and neps.

New spinning technology

According to Yankey (1997), "[r]aw material, by far, has the greatest impact on the cost and profitability of a spinning mill". Raw cotton accounts for around 50% of total manufacturing cost (Galmes 2000), and accordingly, mills are placing increasing emphasis on the geographic origin and ginning history of cotton fibre, especially with regards to managing neps, short fibre content and trash. For example, some mills specify the use of only one lint cleaner during ginning in order to reduce the number of neps and short fibres.

Improvements in spinning methods since the 1970s have significantly increased the speed, efficiency and productivity of spinning mills. For example, in 1970 carding doffer productivity in a typical mill was in the order of 14kg/hr: in 2000 carding doffer productivity was in the order of 60kg/hr. Similarly, ring spinning spindle speed for combed yarn has increased over this time from 11,000rpm to 20,000rpm (Husodo 2002). These and other improvements in spinning technology have created increasing demands for high quality fibre. In particular, attributes such as high fibre strength and uniformity, good length, and low neps are vital to maximize the productivity of modern, high-output mills.

Two new technologies in the spinning industry have the potential to cause this trend to continue: Murata Vortex Spinning and infrared trash management systems.

Murata Vortex Spinning ("MVS")
MVS is a relatively new, high speed spinning system that requires reasonably good fibre properties to achieve its potential for high volume output. In particular, the fibre needs to be clean, strong (30 g/tex or better) and uniform, with a staple length of at least 28 mm (Gordon 2001), and a small micronaire range. Cotton fibre with a high proportion of short fibres has a direct negative affect on mill productivity and therefore profitability, and the current level of short fibres in Australian cotton is holding this market opportunity back (Anthony pers. comm).

Infra-Red Trash Handling
Spinning mills are becoming better able to deal with contamination, traditionally a relatively insignificant issue in mechanically harvested Australian cotton. The premium available for low-contamination cotton may therefore be gradually eroded as the external contaminants associated with handpicked cotton become less of an issue for spinning mills (Cherry 2000).

The improved spinning mill technology that allows for better detection and removal of contaminants associated with hand harvesting is leading to a switch in focus to contaminants introduced by mechanical harvesting that are more difficult to remove, such as bark, leaf, rubber (from the doffers), oil and grease (Cherry 2000).

If Australia is to compete with other growths of cotton, it will need to ensure that growers are well informed about the specific market being targeted, and that they have the capacity to adapt quickly to increased competition or changes in market specifications brought about by advances in spinning technology. As Galmes (2000) notes, "[n]ew spinning systems ... will definitely require a different set of fibre parameters to the current technologies where the emphasis is on length, cleanliness, fineness and strength".

European ecolabels

The European Commission has developed guidelines for the eco-labeling of textiles (e.g. clothing and accessories and fibres, yarn and fabric intended for use in textile clothing and accessories). The professed primary purpose of the eco-label is to help European manufacturers deal with the challenges of globalisation. In particular, use of the label is intended to help European manufacturers respond to "the competition of fast-growing Asian markets. In order to stay in the business, companies have to look for differentiating factors by designing high value textiles and clothing." (European Commission web site, 2002).

The eco-label guidelines are a mix of environmental considerations (e.g. reduction of water and air pollution during fibre production) and quality considerations (e.g. guarantees of shrink resistance and colour fastness). The guidelines also claim that the "[w]hole production chain [is] covered", although no guidelines relating to production methods (other than the residue limits noted below) appear. The issue of requiring integrated crop management, although not defined, is included in the guidelines.

Cotton is included in the guidelines for residue limits. A limit of 0.05ppm is set for a range of chemicals, including some still used in Australia□. Exemptions from the need to comply with residue limits apply to certified organic cotton, or where documentary evidence, including a declaration by the farmer, is provided stating that the substances listed have not been applied to the fields or cotton plants producing the cotton, or to the cotton itself. Interestingly the limits for wool vary depending on the chemical in question, and wool has limits set for a number of compounds used in cotton production (e.g. chlorpyriphos and a number of the pyrethroids) that are not noted for cotton.

Variety

Different cotton varieties vary in their fibre characteristics, and variety is a significant factor in determining fibre quality. The Australian cotton industry has a proud history of plant breeding research that has developed varieties to meet the fibre quality demands of the market: i.e. for long, strong, mature fibre. This research effort continues today. Information on the fibre qualities of different varieties is regularly published by seed companies.

Plant breeding is an exercise in patience: Constable notes that it takes in the order of ten years to produce a new variety, and that breeding for quality is complicated by the number of different, desirable quality traits, as well as the need to breed for yield (Constable 2002). In addition to plant breeding research, considerable work is being undertaken towards the improvement of fibre quality through transgenics. As yet, this work has yielded little success. Nonetheless, it seems likely that in future transgenic varieties will be available to provide particular fibre characteristics.

Crop Management

Crop management practices that can significantly affect fibre quality include choice of variety (micronaire, maturity, fibre length and strength, and fineness), nutrition management, irrigation management, disease management, insect management, and weed management. For example, moisture stress, rank growth (typically caused by too much water and nitrogen), potassium deficiency and verticilium wilt can all contribute to fibre immaturity and low micronaire. Defoliation management is also critical for managing fibre quality. For example, poor defoliation can result in excessive trash, and defoliation that is carried out too early can contribute to low micronaire. In relation to picking, excessive moisture at harvest can cause a significant reduction in fibre quality.

Harvester set-up and module placement and construction are also important considerations. Practices should ensure that contamination from grease, rubbish, or dirty cotton is avoided. Proper tarping of modules is important to reduce colour deterioration. Seasonal or environmental factors outside the control of the grower can also significantly affect fibre quality. For example, low temperatures or stress in late boll fill adversely affect fibre maturity, and therefore micronaire.

A summary of factors affecting fibre quality is contained in the table on the following page.

Table: Factors affecting fibre quality

	Variety	Excess N	Nutrient Stress	Row setup	Water Stress	Late water or rain	Insects	Disease	Weather	Defoliation	Harvest	Ginning
Micronaire	√√	√√			√√	√√		√√	√√	√√	√√	
Strength	√√											√√
Length	√√		√	√	√				√			√√
Uniformity	√√							√	√			√√
Stickiness	√						√√					
SFC	√		√							√√	√√	√√
Neps	√	√√		√√		√√		√√	√√	√√	√√	√√
Contamination	√	√			√	√			√	√√	√	√√
Colour/grade						√√	√	√√	√√	√√	√	√√

Notes:

√ √ = major influence

√ = minor influence

Harvest includes module management and transport

Ginning and Transport

"A ginner cannot turn poor quality seed cotton into high quality raw cotton. However a competent ginner can modify or fine tune the process to minimize further deterioration" (Curran 1998). Ginning is a critical step in the maintenance of the inherent qualities of the fibre, with the challenge being to balance the amount of cotton pressed (i.e. turn out) against the effect that use of the various components of the gin machinery has on the fibre quality. Cotton quality after ginning is a function of the initial quality of the cotton, and the degree of cleaning and drying it receives during the gin process (Stanley 1996). The exact balance between turn-out and grade (i.e. what delivers the highest return to the cotton grower) will depend on the particular premium and discount ("P&D") sheet being applied to the cotton in question. Nevertheless, irrespective of which P&D sheet is used, there will always be a point between grade and turn-out that optimises the return to the grower.

"Inappropriate equipment or equipment settings, speeds, heat, drying etc can exacerbate problems such as neppiness, short fibre content and poor preparation" (Curran 1998). For example, the use of lint cleaners to remove trash can be contentious. While they improve the grade of the cotton, lint cleaners are also responsible for most of the fibre breakage, and hence the presence of short fibres (Gordon undated).

Moisture content and drying temperatures are important considerations in the treatment of seed cotton: high heat on dry seed cotton is a damaging combination, leading to high short fibre content, reduced staple length, increased neps and decreased strength (Gordon 2001).

Growers need to be aware of the affect that gin settings can have on their cotton. Growers should discuss this issue with the gin operator **before** their ginning season commences.

The major effects that ginning can have on fibre quality are as follows:

- Length
- Strength
- Trash content
- Neps.

"Country damage" was not raised as an issue in any of the interviews or written materials, and little formal information on appropriate transport and storage practices was available. The general consensus was that the primary concern is the protection of bales from dirt/dust during transport, and weather during storage, and that commercial interests provided sufficient incentive to ensure that bales were treated in an appropriate manner. It was highlighted that recent years have seen a move to enclosed bale transport, and that this has provided an effective means of protecting bales during transport from the gin to the warehouse.

Discussion

"While the overall report card from local and international spinners is good, survey and anecdotal reports over the last decade suggest that Australian fibre has a number of problems that need resolving" (Gordon 2001). The combination of the factors noted in the previous section may result in Australian cotton growers having to continue to improve quality, but without the expectation that a premium will continue to be available (Cherry 2000). As competition and expectations increase, the challenge becomes disposing of the entire crop year-in and year-out without any significant carry-over stocks (Prendegast 2002), and the 'premium' may well be the ability to sell the entire crop without incurring significant warehousing costs. To meet this challenge, Australian cotton may have to develop new ways of differentiating itself on the world market, especially in light of increased competition from other cotton-growing countries, and synthetic fibres which do not have the consistency problems inherent with a naturally grown fibre (and which, hopefully will continue to be unable to provide the inherent comfort qualities of cotton!).

One option for differentiating Australian product, by labeling the cotton based on its method of production - a BMP brand - is currently being investigated. A second option is to "[f]ocus on quality [as it] represents a good investment for Australian cotton exports. Further, by establishing a reputation as an industry that responds quickly to problems in an objective manner, the cotton industry enhances the good name that its product already has in its markets" (Gordon 2001).

Recent seasons have highlighted the inherent quality issues that arise from growing an organic fibre. In 1997, low micronaire, and neps and short fibre content were major issues affecting the cotton (Curran 1998), whereas in 2001 and 2002, high micronaire was the focus of attention, with neps and short fibre not receiving the same attention.

Thus there are two very distinct, almost contradictory, messages concerning the quality of Australian production:

1. Australian quality is excellent, and improving, BUT
2. There are some significant problems with the quality of Australian cotton that need addressing, and that if not addressed, could lead to a serious deterioration in the ability to sell the Australian crop.

It is difficult to separate out the noise of commercial positioning and negotiating; however, there is a sufficient consistency of opinion from a range of sources to suggest that perceived quality-related threats to the industry should be taken seriously (see for example the recent American Cotton Shippers Association press release for an illustration of the potential impact of fibre quality characteristics[iii]). In order to ensure that growers are not overloaded with more management system requirements, a low-key approach, based on trialing a set of materials codified from existing information is suggested. Such an approach allows for more consideration to be given to the potential threats facing the industry, but is at the same time beginning the preparation necessary to deal with these threats should they eventuate.

Relationship to BMP Program

Cotton Australia and the Australian Cotton Shippers Association are investigating the potential of developing a BMP brand, based on the environmental production methods of BMP growers, and using the BMP brand as a marketing tool to help ensure that Australian cotton remains the cotton of choice for purchasers.

The fundamental premise of the proposal is that by promoting an aspect that is unique to Australian cotton, it (Australian cotton) will be differentiated in the market place. It is hoped that the following two objectives would thereby be achieved:

- The positioning of Australian cotton ahead of its competitors
- The delivery of tangible benefits to growers involved in the BMP Program.

One of the most important benefits envisaged is the ability to continue to sell Australian cotton to the same customers year-in and year-out in the face of increased competition.

The proposal is still in its investigatory stage. Nevertheless, the following points can be made about the relationship between any fibre quality management program and the proposed BMP brand:

- There is no clear signal that fibre quality issues need to be addressed at the same time to ensure the credibility of the BMP brand
- Separation of environmental and quality issues is consistent with Cotton Australia's position regarding the BMP Program being solely an environmental program
- Over time, the distinction between environmental management and quality management issues may become an artificial one, as it is likely that farm management systems will become increasingly integrated
- It is important to ensure that customers clearly understand that the BMP brand is not a warrant as to fibre quality, and that any quality of cotton can be BMP cotton; it is therefore important that BMP cotton be accurately described as to its quality, otherwise the BMP brand could be associated with cotton that does not meet market specifications.

As the concept is still being developed, a number of issues are still to be resolved. These include:

- Where does quality fit in? Is there a need for 'BMP' for all steps of the production chain?
- How is BMP-branded cotton tracked from the farm gate all the way to the end-user?
- What constitutes a BMP cotton product? This is pertinent given recent examples of yarn sourced from India containing Australian cotton despite limited exports
- What is the potential impact of BMP branding on growers not involved in the BMP program? (the balance between carrot and stick perhaps)
- How is demand for the BMP brand to be developed, assuming it ultimately has to come from customers of the spinners (and even their customers)—how is such a 'pull-through' effect created?

Summary of Fibre Quality Parameters

The main quality parameters of cotton fibre are:

- Micronaire and maturity
- Strength
- Staple length
- Length uniformity
- Short fibre content
- Neps
- Colour
- Trash
- Contamination
- Stickiness

Each of these parameters is described briefly below.

Micronaire and Maturity

Micronaire is a combined measure of two different fibre attributes:

1) The thickness (fineness) of the fibre itself (i.e. its diameter); and
2) The thickness (maturity) of the fibre wall (the cotton fibre being a hollow tube)

Fibre diameter is largely determined by the genetic characteristics of the plant (i.e. is variety dependent), while fibre wall thickness is determined by environmental factors (for example, late season stress adversely affects fibre wall thickness). The 'premium' micronaire range is 3.8-4.5. Fibre with a micronaire value outside this range (low or high) is penalised. Fine cotton allows more fibres per given cross-section of yarn, making for a stronger yarn. Low micronaire fibre creates problems in spinning and drying at the mill. Immature fibres contribute to low length uniformity, neps and high short fibre content, each of which has a detrimental impact on the efficiency of the spinning mill, and the quality of yarn and fabric.

A fibre sample's micronaire value is derived from two independent variables. Two very different types of fibre can therefore give the same micronaire value. For example, a fine, mature cotton and a coarse immature fibre can have a similar micronaire value. Micronaire is used as a default measurement for maturity, but as it is an aggregate measure of both maturity and fineness, it is not a direct measurement of maturity. In recent years the micronaire of the bulk of Australian cotton has been within the 'premium' range, with very little low micronaire fibre.

Strength

Fibre strength is a measure of a fibre sample's resistance to longitudinal stress. The stronger the fibre the better. There is a direct correlation between fibre strength and yarn/fabric strength and quality. Strong fibre is required to allow today's high speed spinning mills to operate at maximum capacity and efficiency. The units of fibre strength are grams per tex (g/tex). Minimum fibre strength is 28g/tex. The average fibre strength of Australian cotton has been improving, but has not yet reached the strength of SJV cotton.

Staple length

The longer the staple length the better. Measured in inches, staple length is primarily determined by variety. For a given variety, factors that can adversely affect fibre length include high temperatures, severe moisture stress and potassium deficiency. The ever-improving staple length of Australian cotton has been of the success stories of the domestic breeding program. In recent years Australian cotton has been classified at the high end of staple length: 1 5/32 inches and 1 3/16 inches.

Length uniformity

Length uniformity is the ratio of the mean fibre length and the upper half mean fibre length; the lower the value of this ratio the higher the percentage of short fibres. The more uniform fibre length, the better: low fibre uniformity increases the amount of 'waste' fibre lost during processing at the spinning mill Length uniformity for a 'premium' cotton is 83 and above. Factors that adversely affect fibre length can also decrease length uniformity.

Short fibre content

Short fibre content is an indication of the number of fibres below 0.5 inches in length. A reduction in short fibre content increases the efficiency of the spinning mill by reducing the fibre lost or wasted during the combing process (Galmes 2000). Low short fibre content increases yarn quality. It is generally considered that mechanically harvested content is more susceptible to having unacceptable levels of short fibre. Short fibre content of less than 5.4% is desirable (Husodo 2002).

MVS requires low levels of short fibres, meaning that this aspect of fibre quality must be managed if Australian cotton is to supply a future market using this technology.

Neps

Neps are clusters or entanglements of fibres, and can be classified as biological neps, mechanical neps, and white specks. Neps are caused by environmental factors, processing, or are inherent to the variety, and are one of the major quality negatives affecting the marketability of Australian cotton – "[c]urrently the single biggest complaint area in respect to Australian cotton" (Cherry 2000).

While the exact level of contribution of each of the causes of neps is not known, with the list of potential causes being extensive—immature fibre, poor staple length, fineness, moisture content, mechanical handling (harvesting, ginning), once-over harvesting, early frost, disease and premature defoliation (Bel-Berger 2000)—the impact of neps on the fabric manufacturer are severe, as they generally only become apparent once the fabric has been dyed, i.e. once most of the money has been invested in the production of the fabric.

The management of neps is complex, and requires managing all the contributing causes of neps (such as agronomic and harvest management), and ensuring that cotton prone to neps is identified before it is ginned, and then ginned appropriately to minimise the number of neps produced.

The recent press release from the American Cotton Shippers Association, discussed above and in the endnotes, highlights the potential use of neps (and short fibre content) as both a quality issue, and a trade-barrier.

Colour/grade

Colour is a measure of the whiteness and brightness of cotton fibre. Cotton fibre is at its best colour when the boll first opens, and colour then deteriorates in response to weathering (moisture and light). Other factors adversely affecting colour include pests, the presence of green leaf at harvest, high moisture content in modules, incorrect module tarping, and module transport on dusty roads.

Trash content

Trash content refers to the level of leaf and branch in the ginned cotton. As noted above, a balance needs to be struck between the level of trash removed by the ginning process, and the subsequent adverse affect on fibre quality of increased cleaning. Poor defoliation can result in excessive trash levels in seed cotton at harvest, potentially increasing the cleaning requirement. A number of agronomic practices can also affect the amount of trash in seed cotton. For example, a crop with rank growth is likely to have a high trash content.

Contamination

Contamination can refer to either man-made contaminants (such as grease, or plastic), or natural contamination, especially bark. Australian cotton has a good reputation for having low levels of man-made contaminants, however, recent harvests have seen an increase in natural contaminants, specifically bark (Cherry 2000). Bark contamination is likely due to a combination of seasonal conditions and cotton picker set-up.

Stickiness

Stickiness is produced by sugary or other deposits in the fibre, produced by insects or the cotton plant itself. Stickiness has not generally been a significant issue for Australian cotton, although recent cases of increased whitefly numbers in central Queensland have brought this issue potentially to the fore.

There is nearly zero tolerance for stickiness by spinners due to the significant impact stickiness has on the operation of the mill (Cherry 2000).

Potential Areas for Development of Information

There are three main and distinct areas that would need to be covered under a comprehensive industry program for managing cotton fibre quality. In order of decreasing grower ability to control how the cotton is managed, they are:

1. Crop and harvest management, including transport to the gin
2. Ginning, including module and bale storage
3. Transport and storage of bales.

Broadly, the responsibility for these areas is with the grower, the grower and ginner, and the merchant/shipper respectively. Given these multiple responsibilities, one of the most important considerations in developing guidelines for these areas will be to ensure a collaborative effort between these sectors. Collaboration will help:

- Ensure consistency between the sectors on common issues
- Promote agreement as to the actual causes of fibre quality issues, and the options for managing them
- Manage any issues arising as a result of interaction between management practices aimed at ensuring quality and premium and discount sheets
- Ensure a coordinated approach to ensuring that 'BMP' branded cotton is in reality BMP along the entire supply chain, and to managing product and brand integrity.

It is suggested that a steering committee would be necessary to oversee the development of the guidelines and to provide a forum to facilitate the above-mentioned collaboration. The following areas of expertise should be represented on any steering committee formed:

- Cotton growing, including consultant agronomists
- Cotton ginning
- Cotton shipping/transport and warehousing
- Cotton spinning
- Cotton research
- Cotton marketing.

Crop and harvest management, including transport to the gin

This 'module' would seek to ensure the highest possible fibre quality by outlining practices to manage the following issues:

a) Preparation of cotton
b) Neps
c) Short fibre content
d) Length uniformity
e) Maturity
f) Cavitoma
g) Colour degradation
h) Contamination, including bark and foreign matter

These would probably be best addressed in a temporal manner, matching the management of the crop, so that the module would outline practices under the following headings:

a) Crop management, including fertiliser and defoliation management
b) Cotton harvest, including harvest timing, picker set-up
c) Module building (site selection, tarping etc.)
d) Module transport, including loading and unloading

Ginning, including module and bale storage

It is recommended that any guidelines developed for cotton ginning should be focused on educating growers on the effects of different ginning practices and parameters on fibre quality, and **not** on how to run a cotton gin. This educative approach would enable growers to be able to discuss with their ginner appropriate methods for ginning their cotton.

Transport and storage

The aim of this module would be to ensure that cotton is stored and transported in an appropriate manner, and (although not in itself something that affects fibre quality) help ensure that BMP-branded cotton can be tracked from the field to the fabric.

Issues that need addressing

- Recognition that a number of quality parameters are affected by a number of factors, and that more than one cause for a particular fibre characteristic may be possible. For example, Curran (1998) lists the following broad categories of factors that can affect fibre quality: plant genetics (variety), environmental, agronomic, harvesting, ginning, handling and storage, spinning and post-spinning. Within each of these categories a number of specific issues could be relevant. For example, agronomics could include irrigation, nutrition, weeds and pest management.
- Agreement on the controllable factors that affect, or contribute most significantly to particular fibre characteristics. As suggested above, a number of factors can contribute to a particular aspect of fibre quality. It is important that the issues included in industry quality management guidelines be *significant* and *controllable*. For example, a number of environmental factors (seasonal temperatures, rainfall) can significantly affect fibre quality, but are not able to be controlled by growers. Such factors could be noted in industry guidelines but they could not form the basis of meaningful practical suggestions for farm management. On the other hand, agronomic practices that affect quality such as crop nutrition, pest management and defoliation timing are obviously controlled by the grower and so should be included in any proposed guidelines.

Issues outside scope of discussion paper

- Whether or not the current pricing structure (for example as reflected in merchants' premium and discount sheets) allows for clear market signals regarding the requirements of spinners to effectively reach cotton growers (e.g. Galmes 2000) "I am firmly convinced that the only hope for a major change in the farming, ginning and marketing of raw cotton is a full transformation of the current marketing system into one that fully recognizes the true utility value of a given fibre profile and [that provides incentives to] growers, ginners and marketers to deliver the fibre quality and characteristics that their customer, the spinner, wants and needs"). No evidence was found to suggest that the divergence of opinion between growers and spinners in regards to fibre quality management had substantially changed.
- Supply chain issues, especially those relating to product identification and traceability
- Whether or not the current classing system, based on the United States Department of Agriculture grading system is appropriate for the Australian crop
- Quantitative information on the level of knowledge and understanding amongst cotton growers about factors that affect fibre quality, and the requirements of end-users of their product
- Competition from synthetic fibres
- Product segregation, especially with respect to genetically modified cotton.

Recommendations

1. That existing information relating to managing fibre quality be collated and codified with a view to developing an information package for cotton growers that will help enable them to respond to market signals
2. That the information package, as well as addressing the specific points noted under "Potential Areas for Development of Information", include a brief description of how cotton fibre is formed, and of each relevant fibre characteristic, including information on why it is important, and what management practices and/or environmental factors can affect it
3. That consideration be given to instituting an extension/education program to deliver the information developed
4. That an appropriate industry body be given the responsibility to oversee the development of the information package and extension/education program, with either membership drawn from, or strong linkages to, the Cotton Evaluation and Advancement Committee, and the Raw Cotton Marketing Advisory Committee
5. That any planned introduction of the information package be trialled extensively before widespread introduction
6. That the appropriate industry body with the responsibility of overseeing the development of the information package also determine whether any of the issues identified above as being outside of the scope of this discussion paper need further investigation to ensure that the fibre quality information package is as useful as possible.

Appendix 1
Australian Cotton Growers Research Association Research Priorities for Post-Farm gate Research

COMMUNITY & ECONOMICS and PROCESSING & MARKETING

Goal

To facilitate and promote research into growing, ginning, marketing (including transportation) and spinning of Australian Cotton, in order to continually enhance the competitiveness of Australian Cotton

Committee Members

Gordon Cherry (Chairman), Mitchell Abbo, Glenn Fresser, Hamish Millar, Stefan Mulligan

Research Priorities

1. Development of "Best Management Practices" for cotton post farm gate (could include the following sections):
   a. Module haulage
   b. Ginning
   c. Storage of cotton at the gin yard and warehouse
   d. Transport of baled cotton
   e. Shipping of cotton, container packing
   f. Transport of fuzzy seed
   g. Transport and/or treatment and disposal of gin trash

2. Ensuring the highest possible fibre quality by developing best practices to manage the following issues (some of these could be included in the relevant section above):
   a. Preparation and ginning of cotton
   b. Neps
   c. Short fibre content
   d. Maturity
   e. Cavitoma
   f. Colour degradation
   g. Bark contamination

3. The development of fully objective classing instrumentation

Appendix 2
Current Cotton Research & Development Corporation Research and Cotton CRC projects relating to fibre quality

CSIRO Textile and Fibre Technology

Australian Cotton CRC – Innovative Bleaching Technology for Cotton and Cotton Blends, (Project No. 5.1.0 AC)

Australian Cotton CRC – Continuous Dyeing of Cotton/Wool Blends, (Project No. 5.2.0 AC)

Australian Cotton CRC – Benchmarking Australian Cotton Fibre Quality (Project No. 5.2.3 AC)
Independently benchmark the fibre quality of Australian cotton. The exercise is proposed in order for the Australian cotton industry to more accurately benchmark Australian fibre quality so that it can act more decisively with regards to R&D needs and so it can back marketing activities with objective results. Project activities will involve two benchmarking exercises. One, conducting a 'fibre to fabric' trial in an overseas spinning mill and in the process establishing best practice benchmarks with regards to growing, harvesting, ginning and spinning preparation and two, surveying overseas spinning mills and testing samples gathered from surveyed mills to accurately assess the extent of problems associated with adverse fibre quality issues including neps, short fibre, length uniformity, contamination and microbial infection.

CWT6C Measuring Cotton Fibre Maturity Using Polarised Light Microscopy
Develop a simple, reference method for measuring cotton fibre maturity. This is to be achieved by making the polarised light method, as described in ASTM Standard D1442 - 93, an automated, objective and reproducible test. The aim is to design and fabricate an instrument that will be simple to use and give an accurate and precise measurement of fibre maturity. It is envisaged these measurements would become reference measurements against which faster, indirect methods could be calibrated. The speed of the proposed instrument would also mean that it has potential for use as a stand alone instrument in mill and merchant laboratories, replacing indirect methods such as the FMT and the AFIS maturity tester.

CTFT1C A Survey of Cotton Wax Contents in Australian Cotton
Understand the variation in cotton wax content in Australian cotton; whether it is due to varietal or regional effects, and whether the chemical composition of cotton waxes also varies. Information from the survey will help in reducing dye uptake variability in fabric made from Australian cotton.

CTFT2C Cotton Fineness and Maturity Measurement Using the Sirolan-Laserscan

Develop an instrument for measuring cotton fibre fineness and maturity. The aim is to adapt the CSIRO Laserscan instrument/concept for HVI lines so that it can measure cotton fibre fineness directly and in combination with the Micronaire value deduce fibre maturity.

CTFT3C Participation in an interlaboratory trial to develop standard reference cotton samples for fibre fineness and maturity

CTFT is participating in an interlaboratory trial involving the USDA SRRC laboratories in New Orleans and the ITC Texas Tech laboratories in Lubbock. The aim is to establish and ratify a reference method of directly measuring cotton fibre maturity. The method itself is laborious and time consuming however the results are considered by the USDA to be essential for the calibration of other technologies to measure fibre maturity. CTFT involvement means that Australia gains direct access to important reference data for its own initiatives in this area.

TFT5C Development of a whites speck analysis system for dyed yarn, To develop a prototype system (yarn detector and software) that measures the number of white specks (undyed neps) in a length of dyed yarn. The system is being developed to measure more accurately the outcomes of the 1999 and 2000 trials of the field to fabric project (NEC7C).

CRDC Improved Quality of Ginned Australian Cotton (Project No.)

Reduce nepping and breakage of Australian cotton fibre during lint cleaning at the gin. The project will survey a range of lint cleaner settings, including number of cleaners used, feed rate, saw speed, combing ratios, number of grid bars and feed bar and grid bar (toe and heel) settings, in an attempt to find settings and conditions that significantly reduce nepping and fibre breakage of Australian cotton. The interaction between the fibre batt and the leading edge profiles of the grid bars and saw tooth wire will be examined with a view to deriving new or adapting current profiles that would reduce fibre damage.

Other Research Providers

CRDC 38C Production factors impacting neps prior to ginning

CRDC 163C Examination of available commercial data on neps, and trace-back to field management

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Dave Anthony, Auscott Ltd

Gordon Cherry, Dunavant Enterprises

Stefan Henggeler, Auscott Ltd

Michael Logan, Oakville Pastoral Company

Brooke Lewis, Cotton Australia

Gerald McInnes, McInnes Transport

Jim Prendegast, Namoi Cotton Cooperative

Nick Mahoney, Namoi Cotton Cooperative

Urs Rierderer, Sunrise Resources

Cotton Australia Cotton Growers Forum, May 2002

Raw Cotton Marketing Advisory Committee

Cotton Evaluation and Advancement Committee

End Notes

[i] For example, the 2000 crop had the following quality characteristics:

- 87 % exceeded 28g/tex for strength
- 75 % exceeded an inch and an eighth staple length
- 68 % was Middling or better
- 95% was within the G5 micronaire range (Gordon 2001).

[ii] Aldrin, captafol, chlordane, DDT, dieldrin, endrin, heptachlor, hexachlorobenzene, heptachlorocyclohexane, 2,4,5-T, chlordimeform, chlorobenzilate, dinoseb, monocrotophos, pentachlorophenol, toxaphene, methamidophos, methylparathion, parathion, and phosphamidon.

[iii] The American Shippers Association ("ACSA") claim that the Chinese are using tight short fibre content and nep count parameters to restrict the importation of foreign cotton. The Chinese justification for the testing requirement for all imported cotton is that the two characteristics have "played a key role in affecting the cloth or yarn output… what we want to do is protect the interest of the tumbling textile industry". Further, "The national standard is revised in order to improve the quality of cotton, to satisfy the needs of textile enterprises for high quality cotton, to prevent fake and bad quality cotton from flowing into the market and to fight deceptive practices in trade" (ACSA 2002).