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: **CMSE 1102**

Project Title: Premium Cotton Spinning Trials

Project Commencement Date: 01/07/2010 **Project Completion Date:** 30/06/2012

CRDC Program: Value Chain

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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.

Australian Upland cotton is viewed world wide as a quality fibre and as such is usually purchased at a premium for producing high quality fine count, combed ring spun yarns. However, the Australian cotton industry faces increased competition in the premium market from cotton produced in the US, Brazil and West Africa. With advances in spinning technology and increased demand for higher quality products, it is expected that the demand for Extra Long Staple (ELS) cottons will increase by 5 to 10% over the next 5 years and 10 to 20% over the next 10 years[1].

The production of Extra Long Staple (ELS) cotton as compared to Upland cotton is relatively small making up just 3% of the world supply, is eratic and has been steadily decreasing since 1986. Current production is estimated to be 504 000 MT in 2010 [2]. As opposed to Upland cotton which is currently grown in 66 countries, the bulk of ELS cotton is mainly grown in four countries, namely China, US, India and Egypt. China is the largest consumer of ELS cotton followed by India[2]. This decrease in ELS production is mainly attributed to a reduction in US Pima acreage, a drop in Egyptian cotton production and a move in China from ELS cotton to Long Staple (LS) cotton[3]. Long Staple cotton is mostly made up of lower quality ELS cotton and accounts for about a third of ELS production and consumption.

ELS cotton is generally used for producing high quality yarns and fabrics. The most common yarns produced from ELS cottons are in the range of 50 Ne to +105 Ne, which are used for fine knit such as Polo's, woven apparel fabric for formal wear and shirts and woven fabric for home furnishing such as bed sheets and towels. In recent years there has been a move to coarser Pima yarns up to 30 Ne and even coarser for fabrics such as denim[1, 3, 4]. Substituting or blending ELS in various blending ratios, with less expensive LS cotton to reduce manufacturing costs, without jeopardising processing performance and product quality, is a growing and attractive trend to the spinning industry. This trend has been boosted with the

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[1] Technopak (2007), *Final Report on International Market Segmentation of Australian Cotton and Yarn and Assessment of Future Market Demand for High Quality Cotton and Cotton Development under Certified Best Practice Production System*,' Report for the Cotton Research and Development Corporation, 145pg.

[2] International Cotton Advisory Committee (September 2010),' *World Textile Demand*', 109 pg

[3] FC Stone Fibres & Textile (2010), *'The Future of High Quality and Branded Cotton'*, pg 163

[4] van der Sluijs, M. H. J. (2008), '*Blending premium quality Australian Cotton*', *proceed.* Bremen International Cotton Conference, Bremen Cotton Exchange, Bremen, Germany.

advent of compact spinning which has allowed mills to spin yarn counts with LS cotton normally associated exclusively with ELS cotton[2,4,5].

There is considerable interest within the Australian cotton industry for new varieties with improved fibre quality that attract a price premium. One option is Upland varieties that approach the long and fine quality attributes of ELS. Currently only 1% of the Australian crop falls into the ELS category and development of new LS Upland cotton varieties by CSIRO Plant Industry are aimed at increasing this proportion of the market to gain the high premiums paid for fine long and strong staple fibre.

In 2005, Australia produced its first commercial volumes of LS cotton, Sicala 350B, which is a specialist high quality Bollgard II variety, exhibiting extremely long fibre lengths (>1.26 inches) compared with regular Upland varieties. Fibres have breaking tenacity (> 32 cN/tex)[6].

Most of the Sicala 350B bales produced during four seasons (2007-2010) were fully described in the Premium Cotton Initiative (CMSE 1003) project as well in the reports of the three commercial trials conducted in India, China and Thailand. Sicala 350B was phased out in 2010 and replaced by Sicala 340BRF. Sicala 340BRF is the second commercial LS variety released in Australia (after Sicala 350B) and is also a specialist long fibre quality Bollgard II/RR Flex variety, exhibiting extremely long fibre lengths (>1.25 inches) compared with regular Upland varieties, with a breaking tenacity of> 32 cN/tex[7].

This report will provide feedback on the fibre properties of the Sicala 340BRF produced during the last three seasons as well as ELS cotton produced during the last four seasons. The results of the last processing trial conducted in 2010, in Vietnam using Sicala 350B, will also be reported.

Large scale trials, to determine the effect of ginning practices on the quality of Sicala 340 BRF, grown in St George, are still being conducted and will be reported separately. In the meantime other samples for the 2012 season are still being received and tested and the results will also be included in future project reports which are aligned to work in this area.

Objectives

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

The aims of the project are to:

1. Obtain comprehensive information and fibre data of all Sicala 340BRF and ELS commercially grown cotton.
2. Conduct commercial spinning trials at ACSA nominated spinning mills

[5] Morison, K. and Tomkins, R. (2008), *'Market Opportunities for Australian Long Staple Cotton'* Strategy Paper for CRDC, 10 pg.
[6] Stiller, W.N. (2005), *Sicala 350B*. Plant Var. J. 19:76–8
[7] Stiller, W.N.

Methods

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

Most of the Sicala 340BRF bales produced during the last three seasons and ELS (Pima) cotton produced during the last four seasons were fully described with the aid of HVI, AFIS PRO and Cottonscan instruments with the maturity calculated. This will provide spinners and the Australian cotton industry with an accurate picture of all the fibre properties tested with objective instruments.

A commercial trial was conducted at Mei Sheng Textiles (MST) in Vietnam during December 2010, with one hundred and ninety one bales supplied by Auscott Limited.

Results

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

4.1. Fibre Properties of Sicala 340BRF

The HVI results for a total of 7626 bales of Sicala 340BRF were received by CMSE which were commercially grown in 2010 to 2012. Three thousand two hundred and twenty nine bales were from the 2010 crop, 3403 were from the 2011 crop and 994 bales were from the 2012 crop.

Details of where the bales were grown is summarised in Table 1.

Table 1: Details of Sicala 340BRF bales

Valley	2010	2011	2012
Darling Downs	*	169	*
Bourke	1662	*	*
St George	*	1299	994
Macintyre	*	490	*
Namoi Valley	1195	*	*
Gwydir Valley	422	1445	*
Total	3279	3403	994

All the bales grown during 2010 were irrigated and spindle picked. Of the 1662 bales grown in Bourke in 2010, twenty two bales were roller ginned at Clyde Ag with the other 1640 saw ginned at Clyde Ag. One thousand one hundred and ninety five bales were grown and saw ginned in the Namoi Valley. Six hundred and twelve bales were grown in Wee Waa and ginned at Queensland Cotton (QC) gin in Wee Waa and classed at the QC classing facility in Brisbane. Five hundred and sixty four bales were grown in Narrabri and ginned at the Auscott gin in Narrabri and classed at the Auscott classing facility in Sydney. The remaining 19 bales are grown in Breeza and ginned at the Carroll Cotton gin in Carroll and classed at the QC classing facility. The 433 bales grown in the Gwydir Valley were grown in Carinda and ginned at the Namoi gin in Moomin and classed at Australian Classing Services in Wee Waa.

With the exception of the 169 bales grown on the Darling Downs, all the bales grown during 2011 were irrigated and spindle picked. The 169 bales grown on the Darling Downs were grown under dry land conditions and ginned at the QC gin in Dalby and classed at the QC classing facility. Of the 1445 bales grown in the Gwydir Valley in 2011, one thousand and sixty one bales were grown in Collarenebri and ginned at the QC Collymongle gin and classed at the QC classing facility. The other 384 bales were grown in Moree and ginned at North West ginning and classed at the QC classing facility. The 490 bales grown in the Macintyre Valley were grown in Boomi and ginned at Brighann ginning and classed at the Northern Rivers Independent Classing facility in Moree.

The 994 bales grown in St George in 2012 were ginned at the QC gin in St George and the QC classing facility.

As is normal practice, bale samples from all the Sicala 340BRF bales produced were collected and tested on the HVI, by the various classing facilities. Micronaire, staple length, length uniformity and staple strength were measured. Unfortunately, despite numerous reminders, not all the samples were retained after classing and forwarded to CMSE for further testing.

The number and size of nep and seed-coat neps (SCN), short fibre content (SFC) as well as trash and dust were determined by an Uster Technologies Advanced Fibre Information System (AFIS PRO). Fibre fineness was determined using the Cottonscan instrument, 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.

A summary of the overall results for the Sicala 340BRF bales is represented in Table 2 & 3.

Table 2. Overall results of principal fibre properties of Sicala 340BRF

	Length inches	UI %	Strength cN/tex	Mic µg/inch	TNep/ gram	SFC(w) %	Fineness mtex	Maturity Ratio
Avg	1.24	82	32.7	4.2	272	7.7	193	0.82
Min	1.12	78	26.9	3.3	145	3.7	166	0.54
Max	1.35	88	39.9	5.0	467	14.6	303	0.99
Std	0.03	1.42	1.65	1.70	53.0	1.94	13.61	0.08

Table 3. Overall results for secondary fibre properties of Sicala 340BRF

	Fibrous Nep	SCN/ gram	Nep size	SCN size	Dust/[1] gram	Trash/[2] gram	VFM[3] %
Avg	244	28	699	1092	349	59	1.21
Min	120	11	649	915	146	23	0.45
Max	433	59	761	1348	1559	149	2.87
Std	51.57	6.54	13.8	62.25	108	19.5	0.39

[1]. Refers to dust particles per gram of <500µm
[2]. Refers to trash particles per gram of >500µm
[3]. Visible Foreign Matter

CSIRO plant breeders (CPI) five year results for Sicala 340BRF fibre quality as measured by HVI and Shirley Fineness and Maturity Tester show the following averages[8]; length 1.28 inches, uniformity 84, strength 32.6 cN/tex, Micronaire 4.1, maturity ratio 0.92 and fineness 163 mtex. These results are similar to the three year results of CSIRO trials as detailed in the Cotton Seed Distributors Variety Guide for 2012, with the only difference being that the average fibre length of 1.24 inches is shorter than the average obtained by CPI.

Given the different instruments involved, scale of harvest and the various growing areas and conditions, the average results achieved by the commercially grown cotton varied somewhat from the results achieved by the CPI breeding trials.

In order to quantify these results we will compare these overall results to the minimum (or maximum) fibre properties of LS Upland cotton as suggested to the Premium Cotton Initiative (PCI) (Table 4).

Table 4. Minimum fibre properties for Long Staple Upland Cotton

Fibre Property	Value
Staple Length	≥1.26 inch; 32 mm (1 1/4 inch; 40/32)
Length Uniformity	≥ 83
Short Fibre Content	≤ 8.0
Strength	≥ 33 cN/tex
Micronaire	3.7 – 4.2
Maturity Ratio	> 0.85
Fineness	160 – 180 mtex
Neps	≤ 200 neps/gram
Stickiness	None
Contamination	None
Ginning	Saw/Roller

It is noted that on average the Sicala 340BRF produced fibre with a fibre length shorter than required (0.02 inches shorter than the minimum), with less length uniformity, with the strength slightly lower (32.7 as opposed to 33.0 cN/tex) than required. The Micronaire was within the range required, with the cotton being less mature (0.82 as opposed to 0.85) and slightly coarser (193 as opposed to 180 mtex). The nep content was higher (272 as opposed to 200 neps/gram), which is perhaps not surprising as the cotton was mechanical harvested by once over picking with the aid of applying chemical boll openers and defoliants, which increases the incidence of immature fibre, which bend and buckle during saw ginning.

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[8] Information supplied by Stiller, W.N.

We will now discuss the average results of the various fibre properties and provide figures with the average values with y-error bars of 1 standard deviation giving an indication of the variation.

Please note that the trash and dust results as well as nep and seed coat nep size have been included in this report for information only and will not be further discussed.

4.1.1. Fibre Length

When analysing the data further we note that 70% of the bales achieved <1.26 inches, with 12.5 % of the fibre ≥1.28 inches and 12% ≤1.19 inches. The 2011 crop produced the lowest fibre length with an average of 1.23 inches, followed by the 2012 crop with an average of 1.24 inches and the 2010 crop with an average fibre length of 1.25, all of which were below the required minimum length of 1.26 inches - See Figure 1.

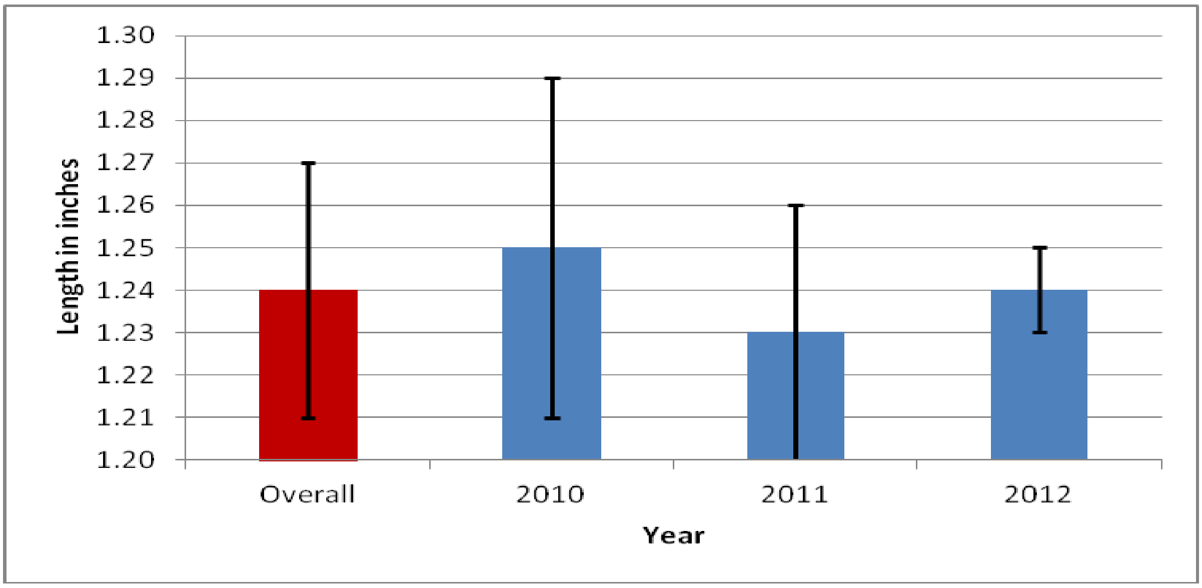

Figure 1. Average fibre length in inch per crop year.

Cotton grown in Bourke during 2010 produced the longest average length, with the saw ginned cotton averaging 1.26 inches and the roller ginned cotton averaging 1.33 inches. Cotton from St George averaged 1.25 inch, followed by cotton from the Namoi and the Macintyre Valley's at 1.23 inches, with cotton from the Gwydir valley averaging 1.22 inches and the dryland cotton produced during 2011 on the Darling Downs averaging 1.20 inches.

The cotton grown in 2012 in St George averaged 1.24 inches with the cotton grown in 2011 averaging 1.25 inches. Cotton from the Namoi Valley was grown during the 2010 season in Wee Waa, Breeza and Narrabri. The cotton grown in Wee Waa averaged only 1.19 inches, with the cotton grown in Breeza averaging 1.25 inches and at an average of 1. 27 inches the cotton grown in Narrabri produced the longest fibre in the Namoi Valley.

The cotton grown in 2010 in the Gwydir Valley was grown in Carinda and averaged 1.25 inches with the cotton grown in 2011 averaging 1.21 inches. The cotton grown in 2011 was grown in Moree and Collarenebri. The cotton grown in Collarenebri averaged only 1.20

inches, with the cotton grown in Moree achieving a slightly longer average fibre length of 1.22 inches.

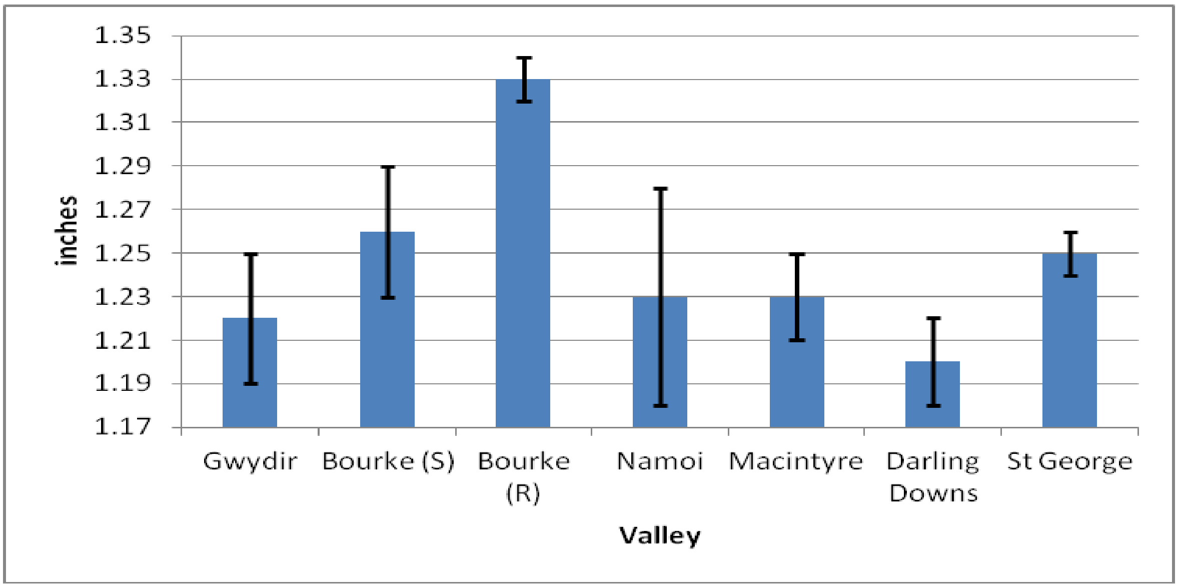

Figure 2. Average fibre length in inch per valley.

4.1.2. Strength

Although the average strength was close to the minimum required strength of 33cN/tex; further analysis of the data shows that 59% of the bales achieved <33 cN/tex with 41% achieving ≥33 cN/tex and 4 % achieving ≤29 cN/tex. The 2010 crop produced the lowest strength with an average of 31.5 cN/tex, followed by the 2012 crop with an average of 32.6 cN/tex. The 2011 crop produced an average fibre strength of 33.9 cN/tex which was above the required minimum strength of 33 cN/tex - See Figure 3.

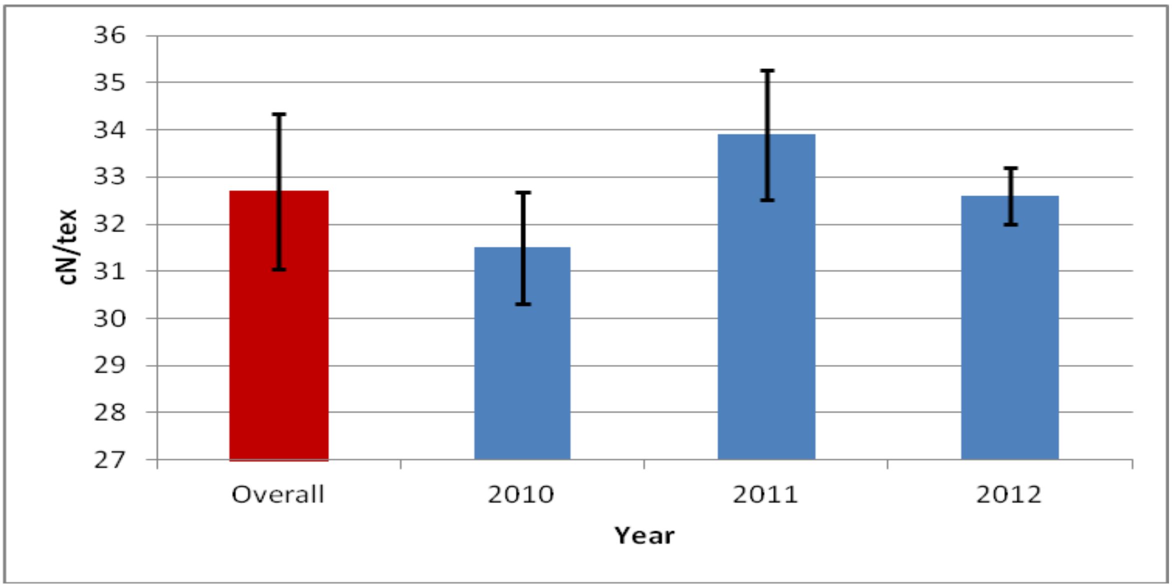

Figure 3. Average fibre strength per crop year.

As was the case with Sicala 350B grown on the Darling Downs in 2010, under dry land conditions, at an average fibre strength of 34.4 cN/tex, the Sicala 340BRF grown in 2011 also produced the strongest fibre, which seems an anomalous result and cannot be explained.

Cotton from the Gwydir Valley averaged 33.9 cN/tex, followed by cotton from St. George at 33.0 cN/tex, the Macintyre Valley which averaged 32.1 cN/tex, followed by cotton from the Namoi valley which averaged 31.6 cN/tex, with the cotton from Bourke averaging 31.3 cN/tex, irrespective of whether the cotton was saw or roller ginned.

Cotton from the Namoi Valley was grown during the 2010 season in Wee Waa, Breeza and Narrabri. The cotton grown in Breeza averaged 31.2 cN/tex, with the cotton grown in Narrabri averaging 31.3 cN/tex and the cotton grown in Wee Waa averaging 31.7 cN/tex, which produced the strongest fibre in the Namoi Valley.

The cotton grown in 2010 in the Gwydir Valley was grown in Carinda and averaged 32.1 cN/tex with the cotton grown in 2011 averaging 34.5 cN/tex. The cotton grown in 2011 was grown in Moree and Collarenebri. The cotton grown in Collarenebri averaged 34.5 cN/tex, with the cotton grown in Moree achieving a slightly lower average strength of 34.3 cN/tex- See Figure 4.

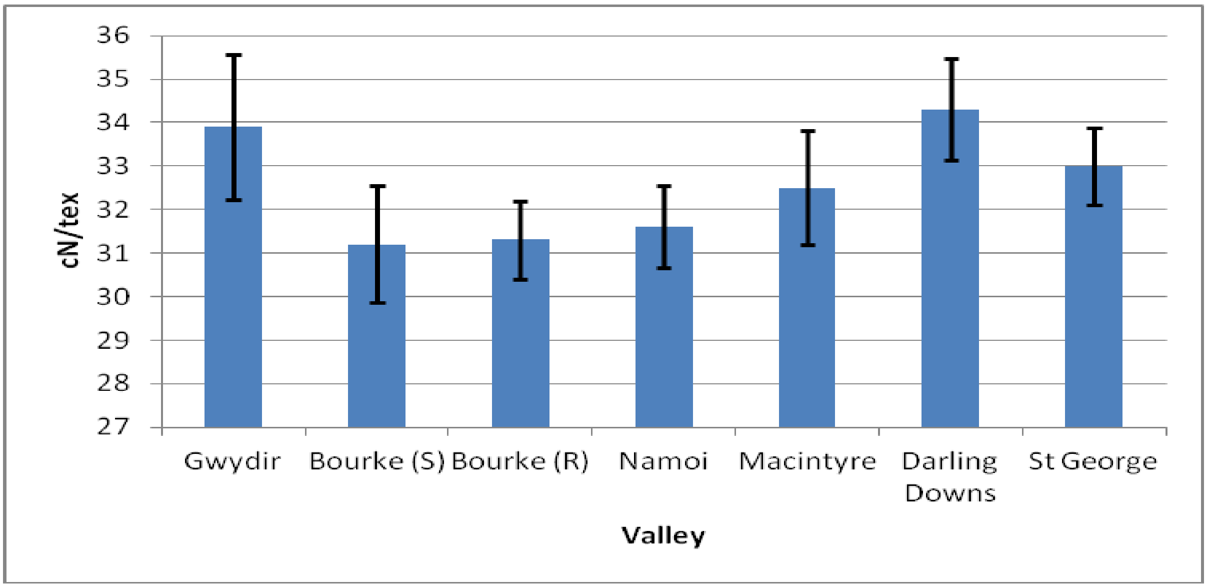

Figure 4. Average Strength per crop year.

4.1.3. Micronaire

Although the average Micronaire achieved was within the required Micronaire range of 4.2-3.7, there were large variations in the values achieved. Only 26% of the bales were in the required range, with 18% < 3.7 Micronaire and 56% > 4.2 Micronaire. At an average of 3.8, the 2010 crop produced the lowest Micronaire, followed by the 2012 crop at an average of 4.3 and the 2011 crop at an average of 4.5 - See Figure 5.

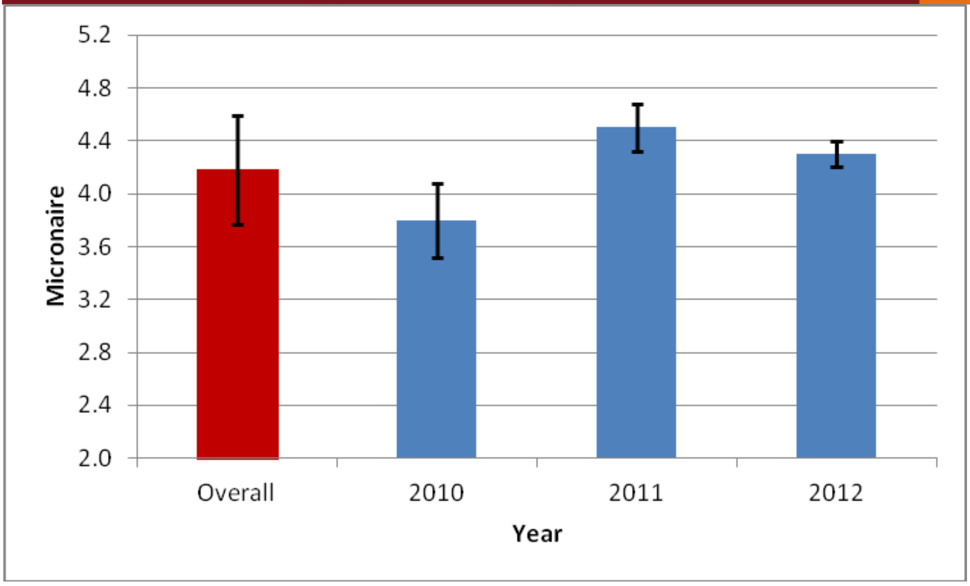

Figure 5. Average Micronaire per crop year.

The Sicala 340BRF grown on the Darling Downs in 2010, produced fibre with an average Micronaire of 4.7, which was the coarsest fibre produced over the past three years.

Cotton from the Gwydir, Macintyre and St George produced cotton with an average Micronaire of 4.4, followed by cotton from Bourke at 4.2 and 3.9 Micronaire. Cotton from the Namoi Valley had an average Micronaire of 3.7, which was the finest fibre produced.

Cotton from the Namoi Valley was grown during the 2010 season in Wee Waa, Breeza and Narrabri, which produced an average Micronaire of 3.7.

The cotton grown in 2010 in the Gwydir Valley was grown in Carinda and averaged 3.9 Micronaire with the cotton grown in 2011 averaging 4.6 Micronaire. The cotton grown in 2011 was grown in Moree and Collarenebri. The cotton grown in Collarenebri averaged 4.7 Micronaire, with the cotton grown in Moree achieving a slightly lower average Micronaire of 4.3 - See Figure 6.

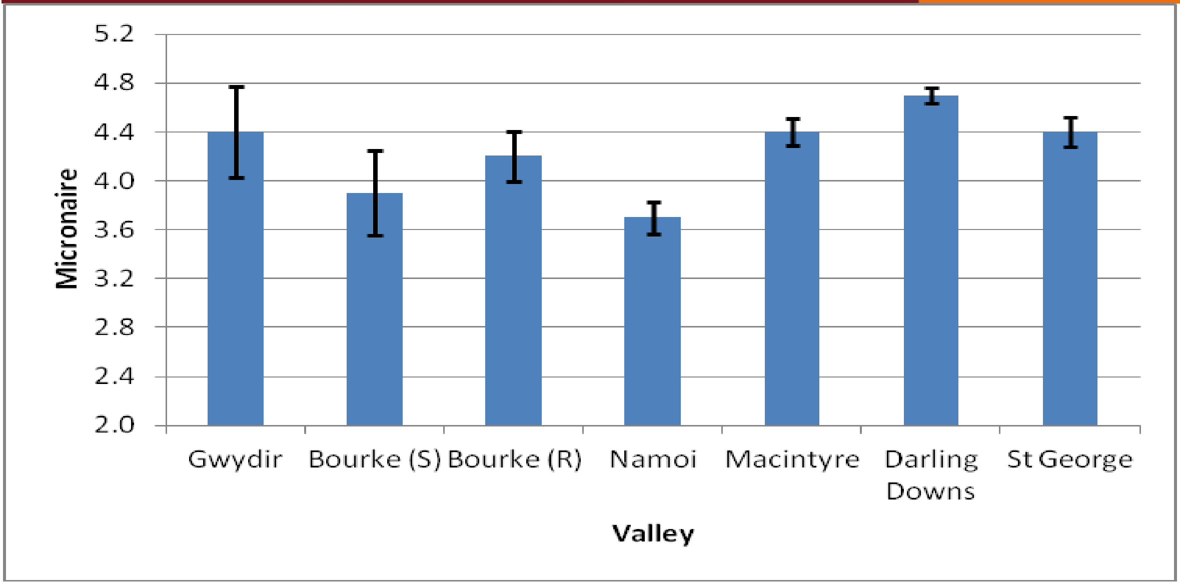

Figure 6. Average Micronaire per valley

4.1.4. Fineness

Eighty three percent of the Sicala 340BRF produced over the two year period was coarser than the maximum of 180 mtex required. At an average of 199 mtex the coarsest fibre was produced in 2011 and at 183 mtex the finest average fibre was produced in 2010 - See Figure 7.

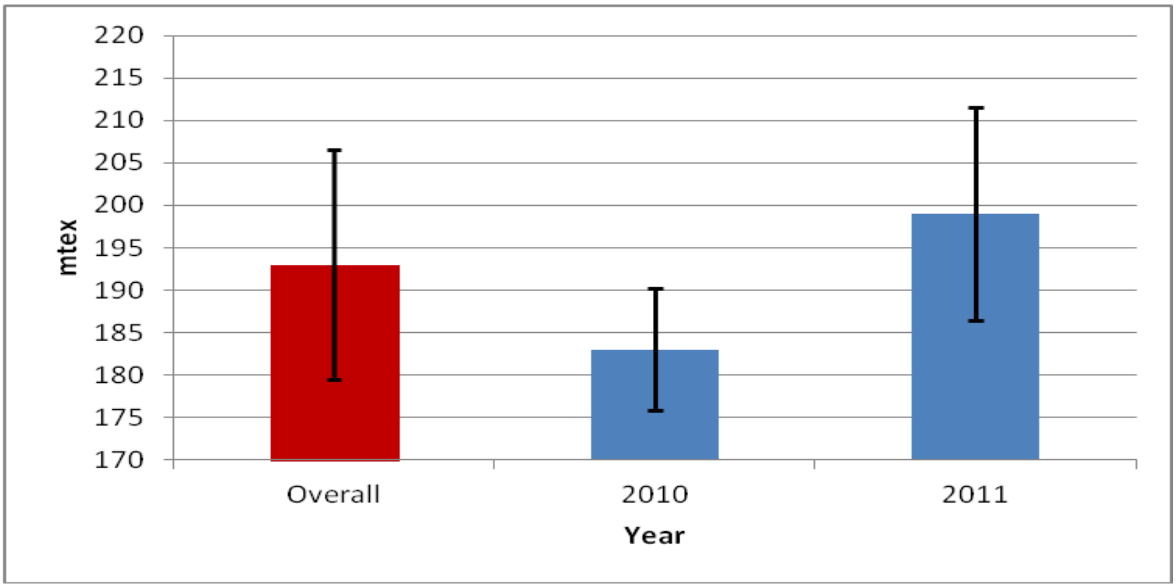

Figure 7. Average fineness per crop year.

The Sicala 340BRF grown on the Darling Downs in 2010, under dry land conditions, produced the coarsest fibre with an average 215 mtex which was slightly coarser than the fibre produced in the Macintyre Valley at 205 mtex. Cotton from the Gwydir Valley had an average of 195 mtex, with cotton from Bourke ranging from 196- 184 mtex, followed by cotton from St George at 188 mtex. The finest cotton was produced in the Namoi Valley which is not surprising as it also produced cotton with the lowest Micronaire. Unfortunately only cotton from Narrabri was received and tested.

The cotton grown in 2010 in the Gwydir Valley was grown in Carinda and had an average fineness of 177 mtex with the cotton grown in 2011 averaging 203 mtex. The cotton grown in 2011 was grown in Moree and Collarenebri. The cotton grown in Collarenebri averaged 202 mtex, with the cotton grown in Moree achieving a slightly coarser fibre at 204 mtex - See Figure 8.

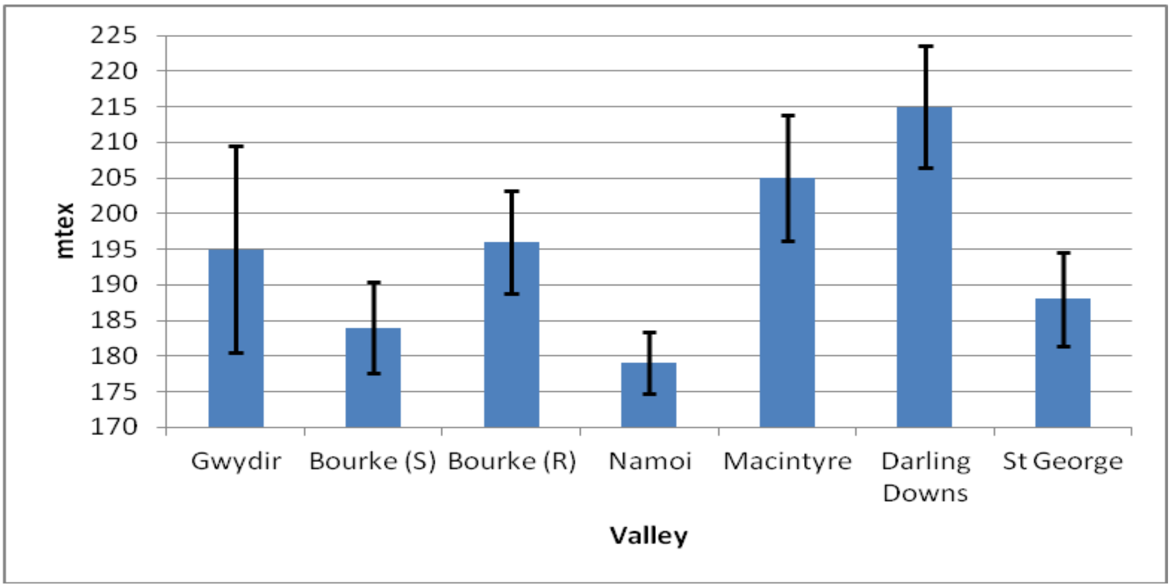

Figure 8. Average fineness per valley

4.1.5. Maturity

Overall the cotton produced over the two year period was immature, with only 41% of the fibre achieving an average maturity of ≥ 0.85. At an average maturity of 0.74, the cotton produced in 2010 can be considered to be immature, with the cotton produced in 2011 considered to be mature with an average of 0.87 - See Figure 9.

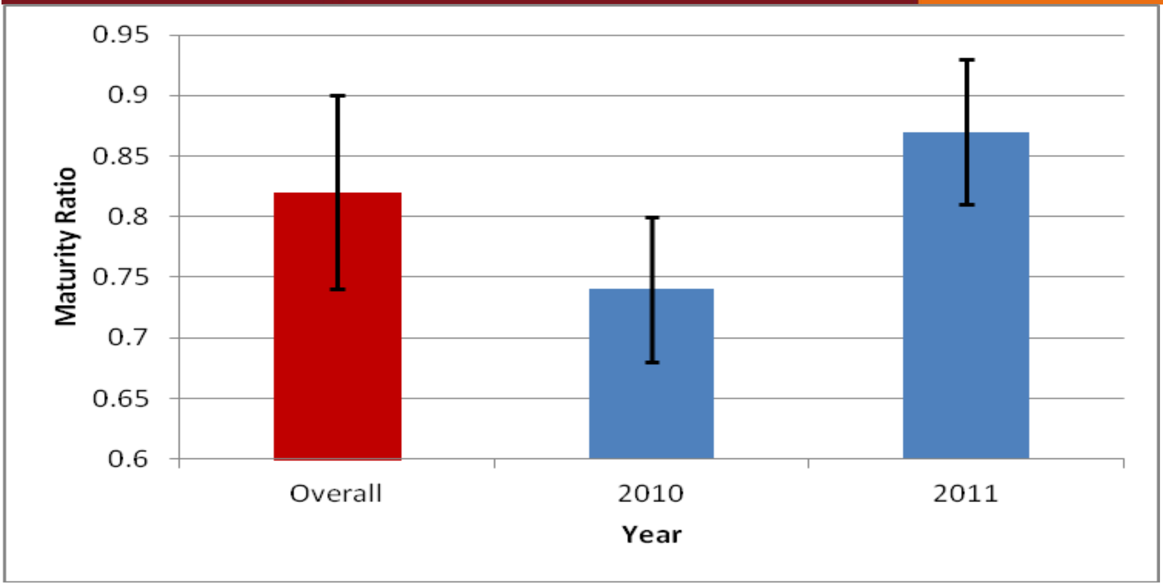

Figure 9. Average Maturity per crop year.

The Sicala 340BRF grown in St George in 2010 and 2011as well as on the Darling Downs in 2010, under dry land conditions, produced mature cotton with all the cotton from the other Valley's producing on average an immature fibre.The least mature cotton, at 0.72 was produced in the Namoi Valley, followed by cotton from Bourke, Gwydir and Macintyre Valley's.

The cotton grown in 2010 in the Gwydir Valley was grown in Carinda and had an average maturity of 0.79 with the cotton grown in 2011 averaging 0.85. The cotton grown in 2011 was grown in Moree and Collarenebri. The cotton grown in Collarenebri was mature at 0.92 with the cotton grown in Moree considered to be immature at 0.79 - See Figure 10.

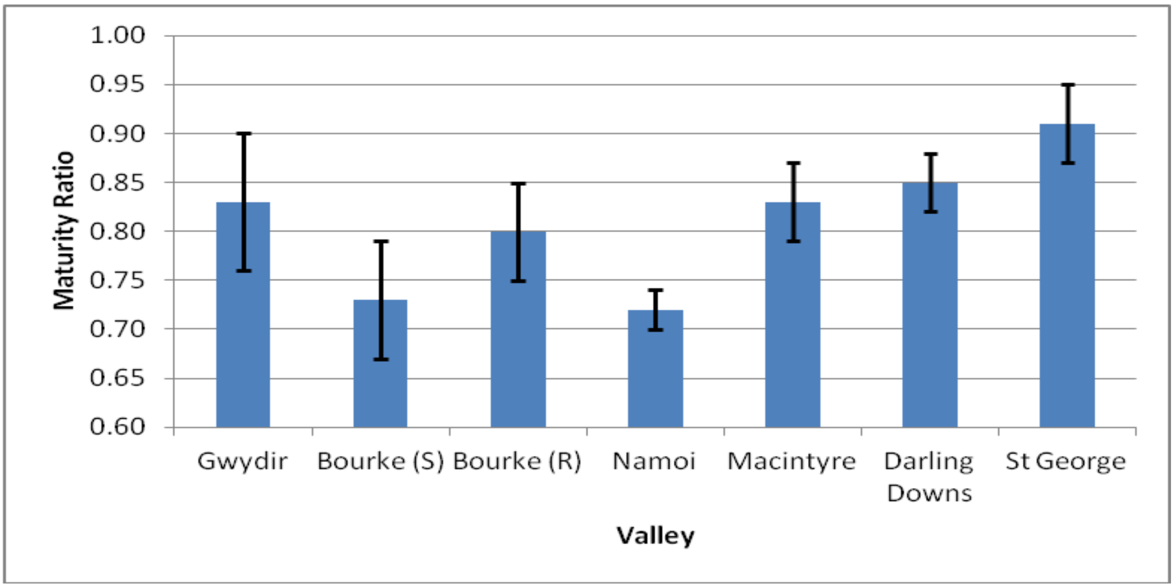

Figure 10. Average Maturity per valley.

4.1.6. Neps

The average Total nep content of the Sicala 340BRF bales was 272 neps/gram which is 72 neps/gram higher than required. When analysing the data further we note that only 16% of the bales ≤ 200 neps/gram, with 20% ≥ 300 neps/gram and 2% ≥ 400 neps/gram. At an average of 254 neps/gram, the 2011 crop had the least number of neps, followed by the 2010 crop with an average of 302 neps/gram - See Figure 11.

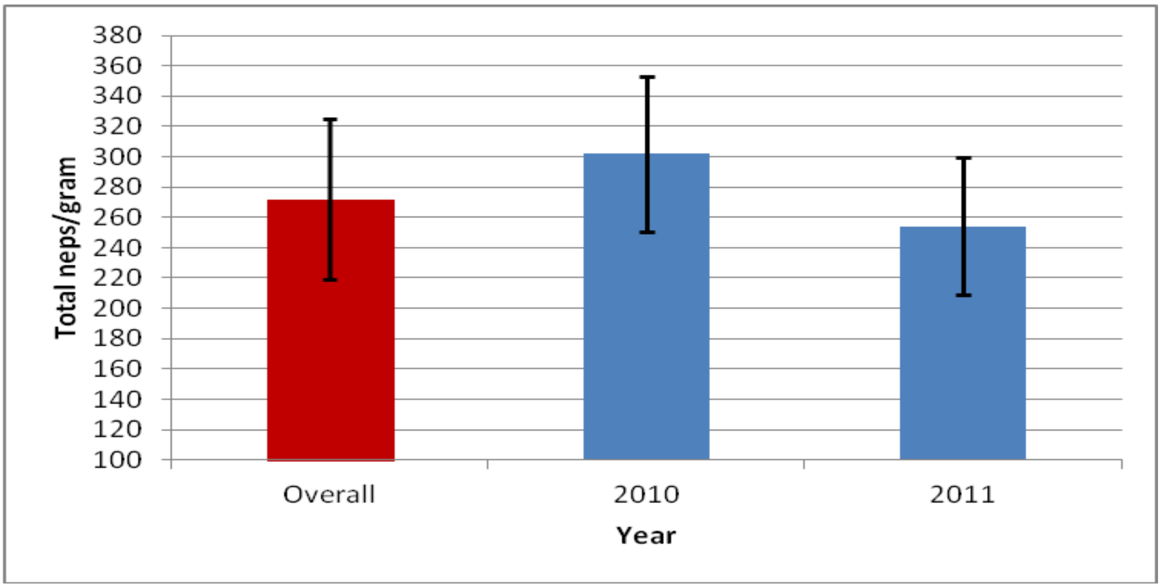

Figure 11. Average nep per crop year

At an average total nep content of 412 neps/gram, the cotton grown in the Namoi Valley produced the highest number of neps, which was not unexpected considering the low average Micronaire and Maturity values and the fact that the Sicala 350B produced in the Namoi Valley also had the highest average neps content and is in part due to the aggressive nature of the cotton gin where all of the cotton was ginned. At an average of 201 neps/gram, the cotton produced in Bourke, which was roller ginned, produced cotton with the lowest nep content. In contrast the cotton produced in Bourke that was saw ginned produced cotton with 28% more neps/gram.

The Sicala 340BRF grown on the Darling Downs in 2010, had an average total nep content of 216 neps/gram, followed by cotton from the Macintyre and Gwydir Valley's as well as St George which produced cotton with an average total nep content of 259, 267 and 279 neps/gram respectively- See Figure 12.

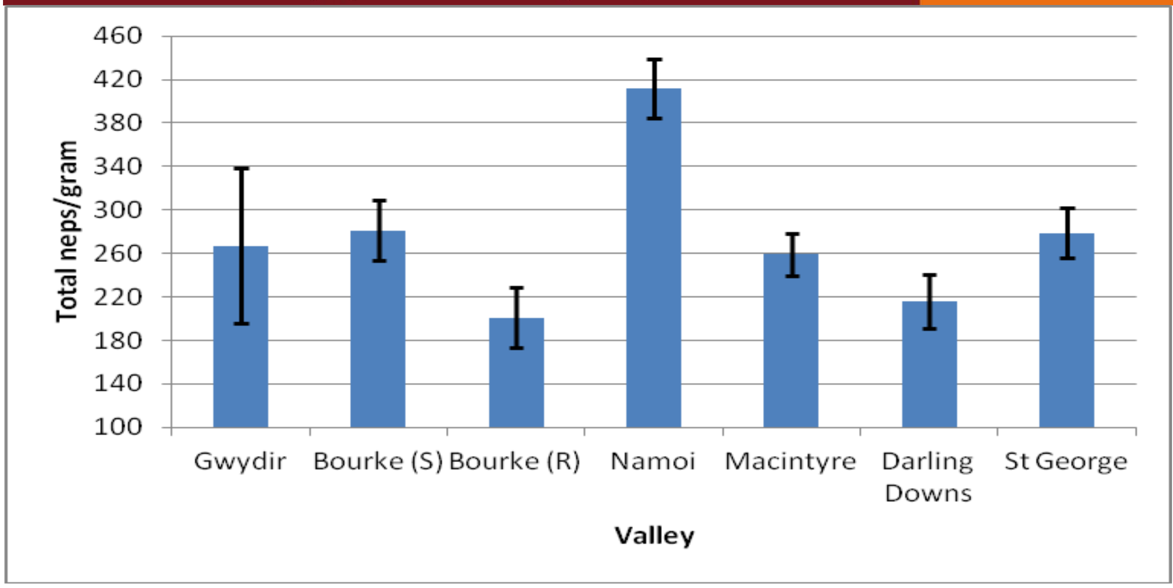

Figure 12. Average nep per valley

4.1.7. Short Fibre Content

The average short fibre content (SFC) of all the Sicala 340BRF bales was better than the required specification. The average SFC for the 2010 crop was 6.3% with the average SFC for the 2011 crop somewhat higher at 8.5%. There are however large variations –See Figure 13

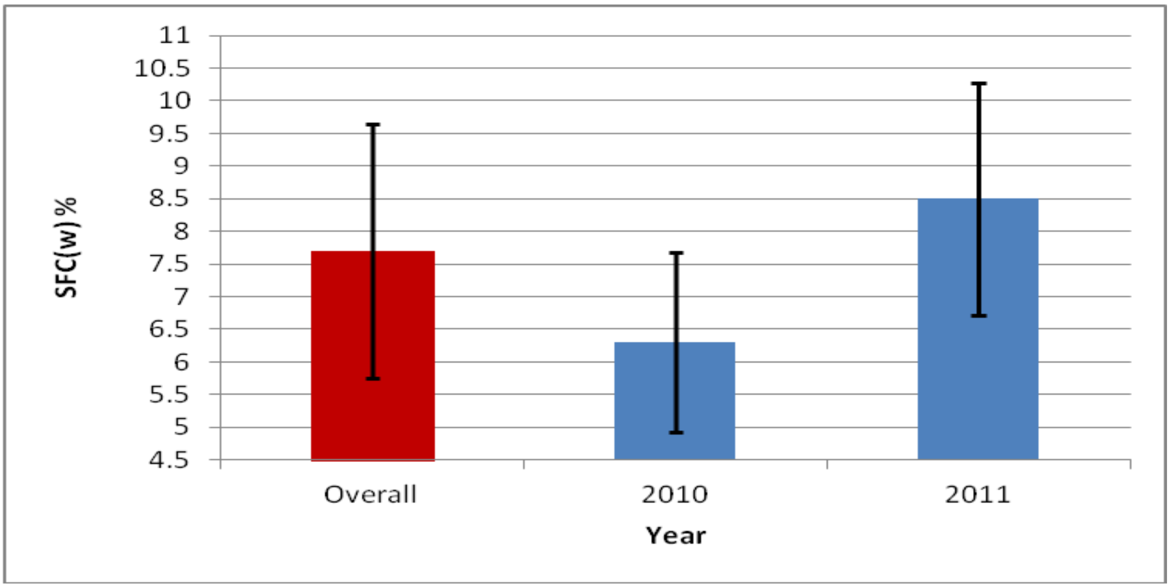

Figure 13. Average short fibre content per crop year

With the exception of cotton produced on the Darling Downs in 2010 and St George in 2011, the average short fibre content of all the Sicala 340BRF bales across all the valleys is within slightly above the required specification of 8.5%.

As expected, at an average total SFC of 4.7%, the cotton grown in Bourke and roller ginned produced the lowest SFC and at an average of 9.4% the cotton grown on the Darling Downs produced the highest SFC, followed by cotton from St George at 9.0% and the Namoi Valley at 8.7%.

The cotton grown in 2010 in the Gwydir Valley was grown in Carinda and had an average SFC of 8.2% with the cotton grown in 2011 averaging 8.6%. The cotton grown in 2011 was grown in Moree and Collarenebri. The cotton grown in Collarenebri had a SFC of 7.0%, with the cotton grown in Moree averaging 10% –See Figure 14.

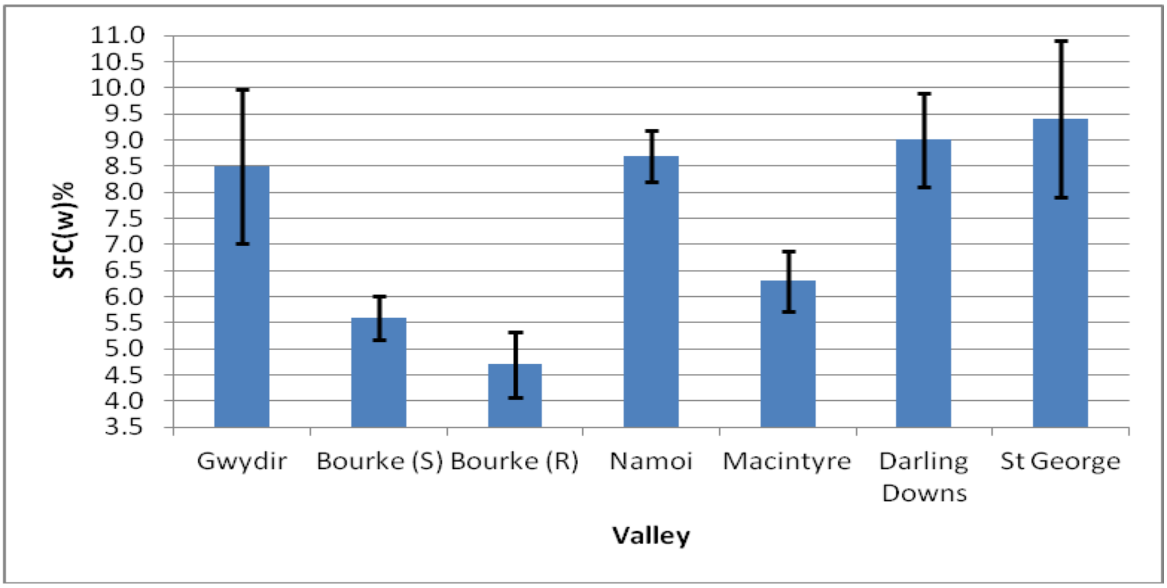

Figure 14. Average short fibre content per valley

4.1.8. Conclusion

A survey conducted by FC Stone[9] found that the six most important parameters when purchasing Long Staple cotton were;

- length (> 1.26 inch)
- strength
- Micronaire
- price
- availiability of supply
- reliability of supplier.

The Sicala 340BRF fibre grown over the last three seasons did not achieve the average length and strength required and there were large variations in the results.The average Micronaire was within the range required, however the fibre was coarser and less mature than required. The nep content was above the required nep content and varied significantly, due to aggressive saw ginning. In contrast roller ginning resulted in;

- fibre length 0.07 inches longer
- length uniformity 3 % better
- 100 less neps/gram
- 1 % less short fibre content

[9] FC Stone Fibres & Textile (2010), *'The Future of High Quality and Branded Cotton'*, pg 163

4.2. Fibre Properties of ELS

Over the last four seasons (2009-2012) there have been a total of 6516 bales of Pima cotton commercially grown in Australia. All the bales produced in 2009-2010 were grown using Supima 280. The bales produced in 2011-2012 were grown using both Supima 280 and Pima A8, with less than 20% of the cotton grown from Supima 280. Further details of the number and where the bales were grown is summarised in Table ~~6~~5.

Table ~~6~~5: Details of ELS bales

Valley	2009	2010	2011	2012
Gwydir Valley	61	1644	*	*
Boambee Valley	*	*	2169	2642
Total	61	1644	2169	2642

All the bales grown in 2009 and 2010 were grown in Moree and ginned at the Clyde AG in Bourke. All these bales were classed at the Northern Rivers Independent Classing facility in Moree. All the bales grown in 2011 and 2012 were grown in Menindee and ginned at Tandou, with all these bales classed at ProClass in Goondiwindi.

As is normal practice, all ELS bales produced were tested on the HVI, for Micronaire, staple length, length uniformity and staple strength. A large number of samples from the ELS cotton produced in 2009 and 2010 were collected and forwarded to CMSE for further testing. Samples from 200 bales from the 2011 crop were also forwarded for testing with no samples from the 2012 forwarded for testing.

At CMSE, the number and size of total, fibrous and seed coat nep (SCN), short fibre content (SFC) as well as dust, trash and Visible Foreign Matter (VFM) were determined by an Uster Technologies Advanced Fibre Information System (AFIS PRO). Fibre fineness was determined using the Cottonscan instrument, 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.

A summary of the overall results for the ELS bales is represented in Table ~~7~~ 6 & ~~8~~7.

Table ~~7~~6. Overall results of principal fibre properties of ELS

	Length inches	UI %	Strength cN/tex	Mic µg/inch	TNep/ gram	SFC(w) %	Fineness mtex	Maturity Ratio
Avg	1.35	85	44.8	3.9	234	4.0	176	0.77
Min	1.30	80	39.2	3.3	120	2.0	153	0.65
Max	1.44	88	54.3	4.6	371	7.4	207	0.96
Std	0.23	1.44	4.24	5.89	18.4	20.5	5.6	7.8

Table ~~8~~7. Overall results for secondary fibre properties of ELS

	Fibrous Nep	SCN/ gram	Nep size	SCN size	Dust/[1] gram	Trash/[2] gram	VFM[3] %
Avg	220	14	679	1088	454	32	0.78
Min	112	3	625	834	140	9	0.22
Max	355	38	740	1371	1818	86	2.25
Std	19.1	38.5	2.3	7.8	37.7	37.5	36.0

1. Refers to dust particles per gram of <500µm.
2. Refers to trash particles per gram of >500µm
3. Visible Foreign Matter

In order to quantify these results we will compare them to the minimum contracted quality specifications such as for Micronaire, length, length uniformity and strength as required by spinning companies to spin high quality yarn consistently. We have also added minimum fibre properties that are not contracted and suggested by the PCI.

In order to quantify the results of the ELS cotton we will compare the overall results to the minimum (or maximum) fibre properties for ELS as suggested by the PCI (Table 8).

Table 8. Minimum fibre properties for ELS Cotton

Fibre Property	Value
Staple Length	≥1.36 inch)
Length Uniformity	≥ 85
Short Fibre Content	≤ 6.0
Strength	≥ 33 cN/tex
Micronaire	3.5 – 4.1
Maturity Ratio	> 0.85
Fineness	140 – 160 mtex
Neps	≤ 180 neps/gram
Stickiness	None
Contamination	None
Ginning	Roller

We note that on average the ELS cotton produced fibre had good average fibre length, although slightly shorter than the minimum (0.01 inches shorter than the minimum) and length uniformity, with the average strength substantially higher (44.8 as opposed to 38 cN/tex) than required. At an average of 3.9, the Micronaire is in the required range of 3.5-4.1, with the cotton being less mature (0.77 as opposed to 0.85) and finer, which in all likelihood has resulted in the resulting high nep content (234 as opposed to 180 neps/gram).

We will now discuss the average results of the various fibre properties and provide figures with the average values with y-error bars of 1 standard deviation giving an indication of the variation.

As mentioned earlier, the trash and dust results as well as nep and seed coat nep size for ELS have been included in this report for information only and will not be further discussed.

4.2.1.Fibre Length

When analysing the data further we note that 55% of the bales <1.36 inch and that 45 % > 1.36 inch. The 2012 crop, which was all Pima A8 grown in Menindee, produced the lowest fibre length with an average of 1.34 inch. This is followed by the 2011 crop, which was also grown in Menindee using Supima 280 and Pima A8, with an average of 1.35 inch.

If the results are separated by variety it becomes apparent that the Supima 280 produced an average length of 1.36 inch with the Pima A8 producing an average length of 1.35 inch. The 2009 and 2010 crop, which was all Supima 280, grown in Moree produced an average length of 1.38 and 1.37 inch respectively - See Figure 15.

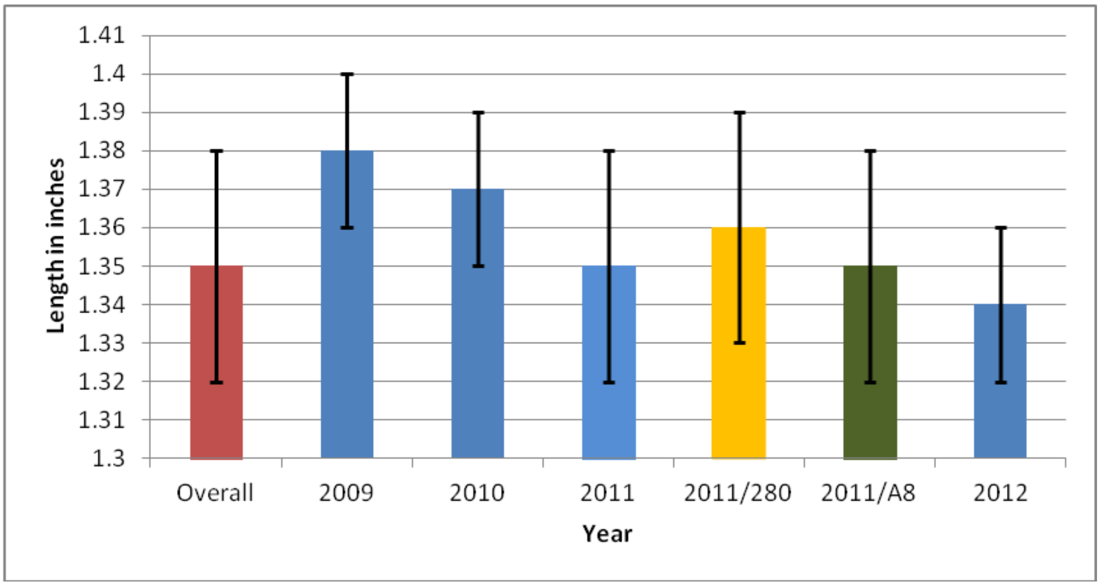

Figure 15. Average fibre length in inch per crop year.

4.2.2. Strength

When analysing the data further we note that 7% of the bales produced, achieved > 48 cN/tex, with 63% achieving < 43 cN/tex. At 44.1 cN/tex, the 2010 crop produced fibre with the lowest strength, followed by the 2009 crop with an average fibre strength of 44.5 cN/tex. The 2011 and 2012 crop achieved an average fibre strength of 46.1 and 45.2 cN/tex respectively. All the ELS produced fibre, which was above the required minimum fibre strength of 38 cN/tex.

If the results are separated by variety, the Pima A8 variety achieved an average strength of 45.3 cN/tex, ranging from 42 to 54.3 cN/tex with the Supima 280 achieving an average strength of 44.1 cN/tex, ranging from 39.2 to 51.6 cN/tex - See Figure 16

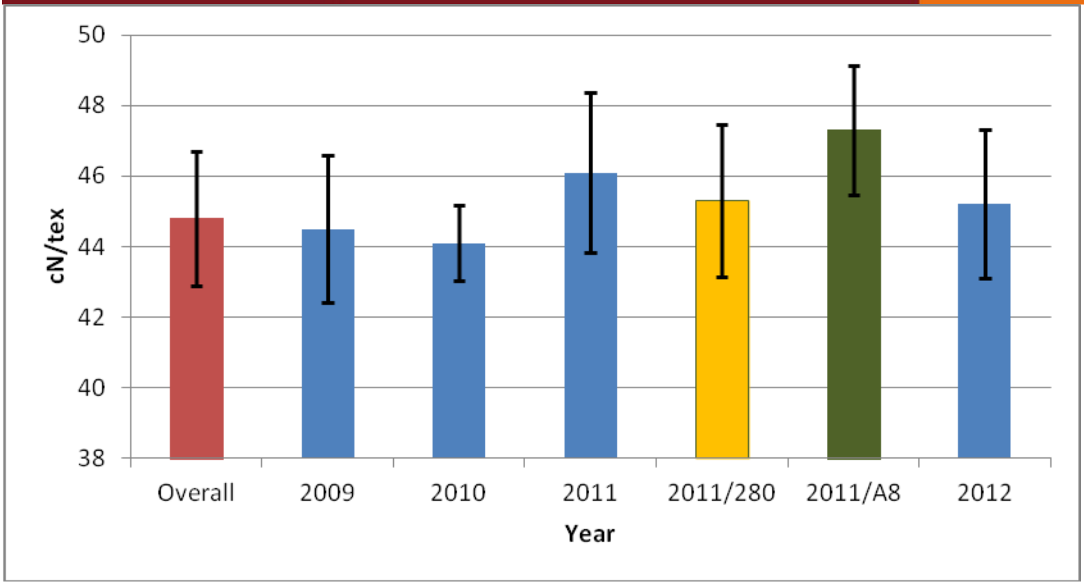

Figure 16. Average fibre strength per crop year.

4.2.3. Micronaire

The average Micronaire achieved was within the required Micronaire range of 3.5-4.1, with 89% of the bales within this range. Less than 1% of the bales produced, achieved < 3.5, with 10% achieving > 4.1. At an average of 4.1, the 20011 and 2012 crop produced the coarsest fibre. At an average of 3.7, the 2009 and 2010 crop produced the lowest Micronaire.

If the results are separated by variety, the Pima A8 variety had an average Micronaire of 4.1, ranging from 3.7 to 4.6 with the Supima 280 having an average Micronaire of 3.7, ranging from 3.3 to 4.3 - See Figure 17

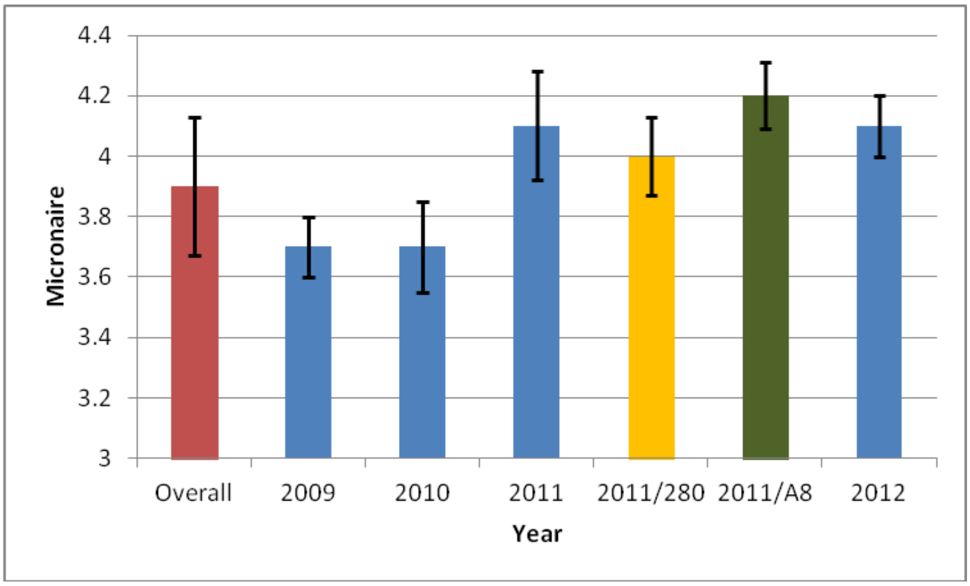

Figure 17. Average Micronaire per crop year.

4.2.4. Fineness

At an average fineness of 176 mtex, all the ELS, with the exception of two bales, produced over the three year period were coarser than the maximum of 155 mtex required. At an average of 187 mtex the coarsest fibre was produced in 2011 and at 161 mtex the finest average fibre was produced in 2009.

If the results are separated by variety, the Pima A8 variety, grown in 2011, had an average fineness of 183 mtex, ranging from 171 to 206 with the Supima 280 having an average fineness of 175 mtex ranging from 153 to 207 - See Figure 18

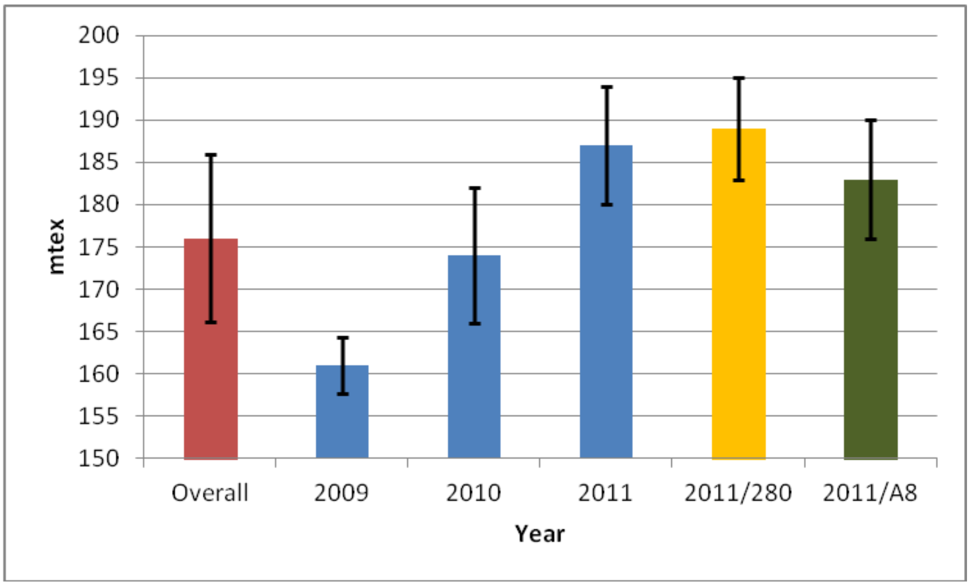

Figure 18. Average fineness per crop year.

4.2.5. Maturity

With an average maturity of 0.77 the ELS cotton produced over the three seasons was somewhat immature. Only 7% of the ELS produced had a maturity > 0.87, with 5% < 0.70. At an average of 0.81the ELS fibre produced in 2009 and 2011 was more mature than the ELS cotton produced in 2010.

If the results are separated by variety, the Pima A8, produced in 2011 achieved an average maturity 0.87, ranging from 0.75 to 0.96 with the Supima 280 achieving an average fineness of 0.76 ranging from 0.65 to 0.92 - See Figure 19.

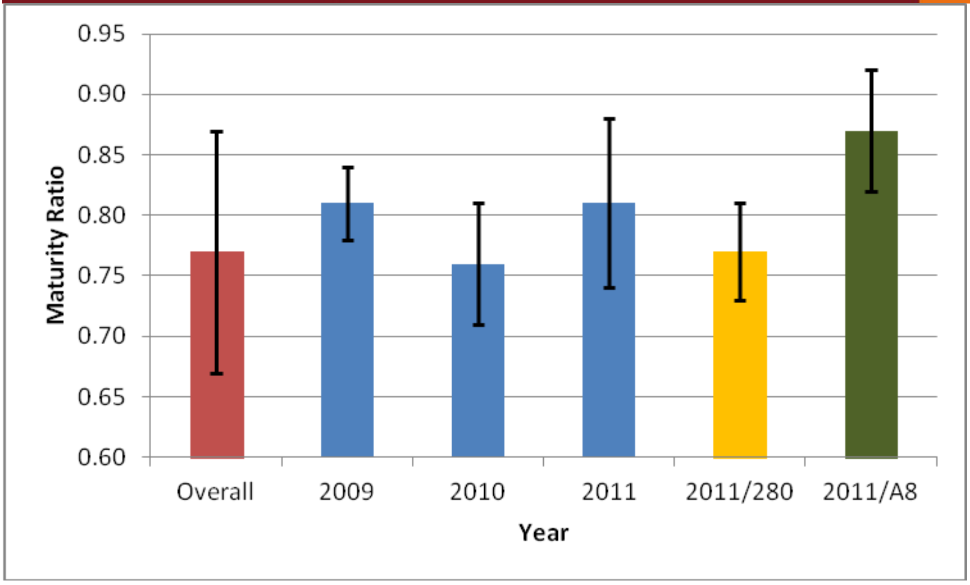

Figure 19. Average Maturity per crop year.

4.2.6. Neps

The average Total nep content of the ELS bales was 234 neps/gram which is 44 neps/gram higher than required. When analysing the data further we note that only 18% of the bales achieved < 190 neps/gram, with 6% of the bales > 300 neps/gram. At an average of 183 neps/gram, the 2011 crop had the least number of neps. This is followed by the 2010 crop with an average of 247 neps/gram; with the 2009 crop producing the highest average nep content of 249 neps/gram.

If the results are separated by variety, the Pima A8, produced in 2011 had an average Total nep content 162 neps/gram, ranging from 120 to 217 with the Supima 280 having an average total nep content of 240 neps/gram ranging from 144 to 371 - See Figure 20

These results are not unexpected as the Pima A8 produced a slightly coarser and more mature fibre as opposed to the Supima 280, which resulted in less fibres buckling and becoming entangled during the ginning process.

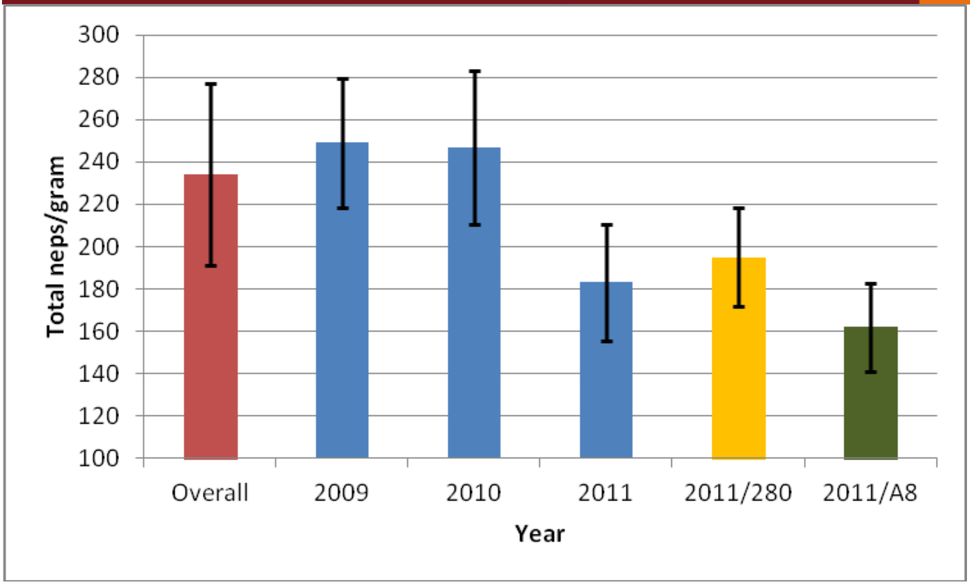

Figure 20. Average nep per crop year

4.2.7. Short Fibre Content

The average short fibre content of all the ELS bales was 4.0 which is better than the required specification of 6.0. When analysing the data further we note that 50% of the bales produced achieved a short fibre content of 4.0%, with 1% of the bales > 6.0%. At an average of 3.7%, the 2011 crop had the least short fibre content. This is followed by the 2010 and 2009 crop with an average of 4.1 and 4.2% respectively. If the results are separated by variety, the Pima A8, produced in 2011 had an average short fibre content of 4.1%, ranging from 3.7 to 4.6 with the Supima 280 having an average short fibre content of 4.1% ranging from 2.3 to 7.4 - See Figure 21

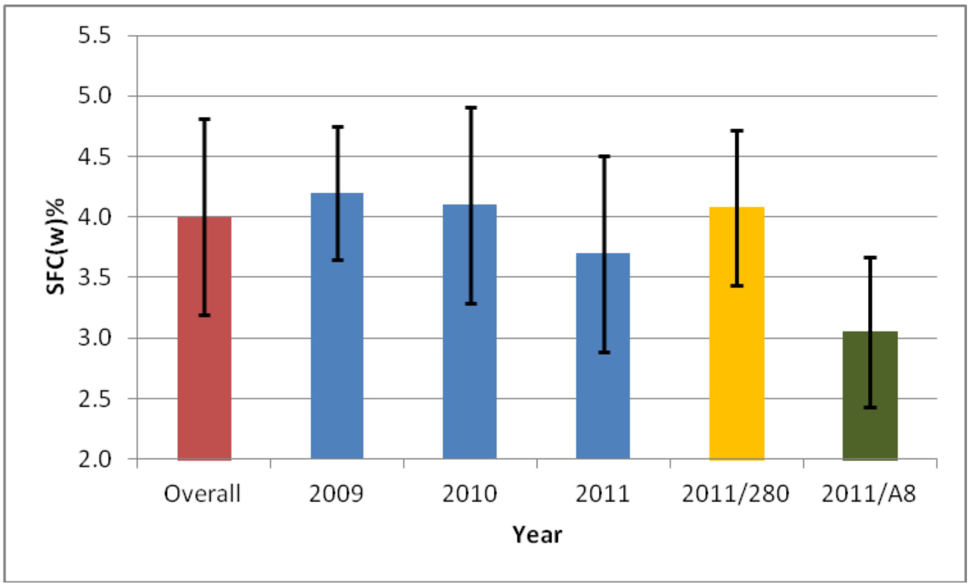

Figure 21. Average short fibre content per crop year

4.2.8. Conclusion

The ELS grown over the last four seasons almost achieved the average length, but did achieve length uniformity, with the average strength much higher with the required Micronaire. However the fibre was less mature, but finer which in all likelihood has resulted in a high nep content.

4.3. Commercial Spinning Trials

The 2009/10 Mill Survey [10]found that the majority of Australian Upland cotton is used in the 30 to 39 Ne count range, which is where the biggest demand is and can be considered as the commodity yarn market. Not surprising the usage of Australian cotton in the < 30 Ne count range was relatively low. It is encouraging to note that the Australian Upland makes up around a third of the fibre used in the 40-59 Ne count range of our survey participants – See Figure 22.

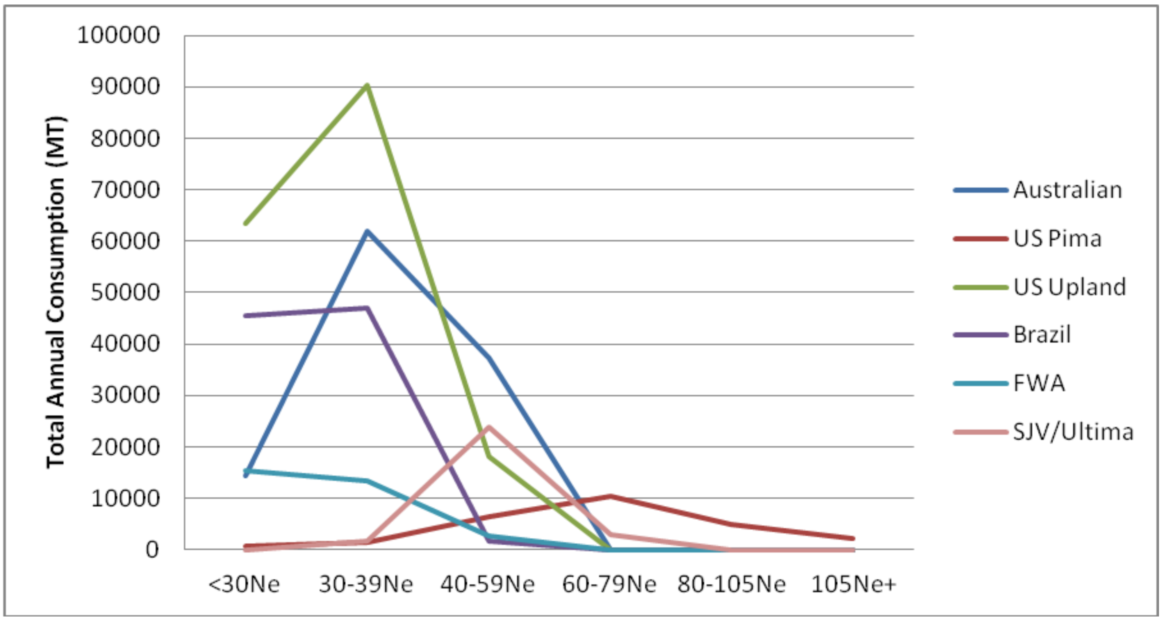

Figure 22 – Breakdown of growths used in various yarn count categories – Overall data.

Long Staple Upland cotton is predominately used for the production of 40 – 80 Ne yarns, with the 60 Ne market showing the highest growth potential of the medium/fine count markets surveyed and for this reason is the core focus of the commercial trials undertaken[10].

Spinning trials conducted at CMSE has highlighted the superior fibre properties of a Long Staple (LS) Upland variety called Sicala 350B, produced by breeders at CPI. Initial trials conducted in 2004 showed Sicala 350B fibre could produce superior quality Ne 42 and Ne 35 ring-spun carded and combed yarn and subsequently fabric (single jersey) knitted from it. Performance was measured in terms of process efficiency and quality relative to yarn and

[10] van der Sluijs, M.H.J and P.J. Johnson (2011)' *The Determination of the Perceptions and Needs of Mills that Purchase and Process Australian Cotton*', unpublished draft report

fabric produced from standard Australian Upland cotton (Sicot 71BR). Subsequent spin limit trials conducted in 2005 showed Sicala 350B could also be used to process high quality fine count carded and combed ring-spun yarns in the range of Ne 60 to 70. The Premium Blends project in 2007 further highlighted the fact that a 70/30 blend of Pima/Sicala 350B did not result in a practical deterioration in yarn quality and processing efficiency compared with yarn spun from 100% Pima. The primary advantage for the spinner using Sicala 350B fibre is a substantial savings in raw material costs[11].

The Premium Cotton Initiative (PCI) was formed after these trials to identify and create markets for these LS Upland variety types, by better understanding textile performance and developing predictive textile performance technologies tailored to high quality Australian raw cotton fibre. The PCI is a collaboration between the Australian Cotton Shippers Association, Cotton Australia, CSIRO, Cotton Seed Distributors and the Cotton Research and Development Corporation, who provide coordination for the initiative.

Although results from the trials conducted at CMSE were well received by the Australian cotton industry; the question remained whether these results could be replicated in industry. The aim of the commercial spinning trials is to introduce Australian Upland cotton to ACSA nominated mills. This will provide the Australian cotton industry with feedback on the performance of this cotton and potential market.

The first commercial trial was conducted in India in March 2009. These trials found that Sicala 350B can be successfully spun into high quality fine count 50-70 Ne combed, normal ring and compact spun yarns that performed well in high speed weaving, producing high quality fine shirting material[12,13].

The second commercial trial was conducted in China in November 2009. These trials also found that, with some attention to detail, Sicala 350B can be spun successfully into high quality 40-60 Ne combed yarns, in normal, compact and low twist yarns, in 100% and 70/30 Pima/Sicala 350B blends[14].

The third commercial trial was conducted in Thailand in March 2010. These trials also confirmed that Sicala 350B can be spun successfully in a 100% blend into high quality fine

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[11] van der Sluijs M.H.J (2008) *The Market for Australian Long Staple Upland Cotton*, Proceedings 29th Bremen International Cotton Conference, Bremen

[12] van der Sluijs M.H.J (March 2009) *Report on Commercial Processing Trials of Sicala 350B Long Staple Upland Cotton at Vardhman Textiles Limited.*

[13] van der Sluijs M.H.J (September 2009) *Fabric results of Sicala 350B Long Staple Upland Cotton produced at Vardhman Textiles Limited.*

[14] van der Sluijs M.H.J. (November 2009) *Report on Commercial Processing Trials of Sicala 350B Long Staple Upland Cotton at Central Textiles Limited.*

count, normal 50 Ne and 50-60 Ne compact ring-spun combed yarns, suitable for high speed air jet weaving[15].

The fourth commercial trial was conducted at Mei Sheng Textiles Vietnam Co. Ltd (MST), which is part of the Leading Textiles Group; a family of companies with over 40 years of experience in the textile industry annum. It currently uses around 40% Australian cotton in their 100% cotton yarns and in blends with other fibres.

These commercial trials were conducted during the second and third week of December 2010, with the complete report on the trials attached in Appendix 1.

4.3.1. Conclusion

The commercial processing trials conducted in 2009 and 2010 in India, China, Thailand and Vietnam with Sicala 350B proved that it is possible to produce a fine count ring spun yarn (up to 70 Ne). Unfortunately, the quality of the yarns produced by the mills was disappointing and varied considerably. As a result the Australian cotton industry has not really been able to determine the 'real' value of the fibre and what spinners would be prepared to pay for it. It is clear that if Australia wants to capitalise on these LS Upland varieties only cotton that meets all the suggested specifications is marketed and promoted as premium Upland cotton.

The project that has been recently approved by the CRDC will seek to determine what the Australian LS Upland cotton is capable of if fibre within suggested specifications is processed by a commercial spinning mill.

[15] van der Sluijs M.H.J. (March 2010) *Report on Commercial Processing Trials of Sicala 350B Long Staple Upland Cotton at TTI Textiles Limited.*

Appendix 1
Report on Commercial Processing Trials of Sicala 350B Long Staple Upland Cotton at Mei Sheng Textiles Vietnam Co. Ltd.

Background

Spinning trials conducted at CSIRO Materials Science and Engineering (CMSE) has highlighted the superior fibre properties of a Long Staple (LS) Upland variety called Sicala 350B, produced by breeders at CSIRO Plant Industry. Initial trials conducted in 2004 showed Sicala 350B fibre could produce superior quality Ne 42 and Ne 35 ring-spun carded and combed yarn and subsequently fabric (single jersey) knitted from it. Performance was measured in terms of process efficiency and quality relative to yarn and fabric produced from standard Australian Upland cotton (Sicot 71BR). Subsequent spin limit trials conducted in 2005 showed Sicala 350B could also be used to process high quality fine count carded and combed ring-spun yarns in the range of Ne 60 to 70. The Premium Blends project in 2007 further highlighted the fact that a 70/30 blend of Pima/Sicala 350B did not result in a practical deterioration in yarn quality and processing efficiency compared with yarn spun from 100% Pima. The primary advantage for the spinner using Sicala 350B fibre is a substantial savings in raw material costs[16].

The Premium Cotton Initiative (PCI) was formed after these trials to identify and create markets for these LS Upland variety types, by better understanding textile performance and developing predictive textile performance technologies tailored to high quality Australian raw cotton fibre. The PCI is a collaboration between the Australian Cotton Shippers Association, Cotton Australia, CSIRO, Cotton Seed Distributors and the Cotton Research and Development Corporation, who provide coordination for the initiative.

Although results from the trials conducted at CMSE were well received by the Australian cotton industry the question remained whether these results could be replicated in industry. The aim of the commercial spinning trials is to introduce Australian Upland cotton to ACSA nominated mills. This will provide the Australian cotton industry with feedback on the performance of this cotton and potential market. This report provides feedback on the spinning trials conducted in Vietnam.

Commercial Spinning Mills

The first commercial trial was conducted in India in March 2009. These trials found that Sicala 350B can be successfully spun into high quality fine count 50-70 Ne combed, normal ring and compact spun yarns that performed well in high speed weaving, producing high quality fine shirting material[17,18].

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[16] van der Sluijs M.H.J (2008) *The Market for Australian Long Staple Upland Cotton,* Proceedings 29th Bremen International Cotton Conference, Bremen

[17] van der Sluijs M.H.J (March 2009) *Report on Commercial Processing Trials of Sicala 350B Long Staple Upland Cotton at Vardhman Textiles Limited.*

The second commercial trial was conducted in China in November 2009. These trials also found that, with some attention to detail, Sicala 350B can be spun successfully into high quality 40-60 Ne combed yarns, in normal, compact and low twist yarns, in 100% and 70/30 Pima/Sicala 350B blends[19].

The third commercial trial was conducted in Thailand in March 2010. These trials also confirmed that Sicala 350B can be spun successfully in a 100% blend into high quality fine count, normal 50 Ne and 50-60 Ne compact ring-spun combed yarns, suitable for high speed air jet weaving[20].

The PCI actively sought to conduct more commercial trials with ACSA nominated mills to further demonstrate the concept. Mei Sheng Textiles Vietnam Co. Ltd was approached who agreed to participate in the trials.

Mei Sheng Textiles Vietnam Co. Ltd (MST) is part of the Leading Textiles Group; a family of companies with over 40 years of experience in the textile industry. The Leading Textiles Group was established in Australia and includes associate companies in Malaysia and Vietnam. MST was established in 2009 as a speciality spinning mill and employs around 1000 people. MST currently consists of 5 mills and is vertically integrated. Three of the mills have spinning installations with a combined spinning capacity of 34,000 compact spindles, 20,000 normal ring spindles, 4,800 air vortex spinning positions and 432 rotors. These mills have a capacity to produce 2,600 MT per month. Currently a further four spinning mills are either under construction or about to be constructed. The knitting mill has 64 circular knitting machines from 15 to 28 gauge capable of producing 1000 MT fabric a month. The yarn dyehouse commenced production this month and is capable of producing 900 MT of yarn per month.
MST produces yarns from a large range of staple fibres and in a range of yarn counts for their own knitting installation and for the export textile market. The Leading Group has had a long association with Australian cotton and MST uses around 8000 MT of Australian cotton per annum. It currently uses around 40% Australian cotton in their 100% cotton yarns and in blends with other fibres.

These commercial trials were conducted during the second and third week of December 2010. The cotton was processed in MST's Number 1 and 3 Factories due to scheduling, production pressures and mechanical issues. The fibre was carded and spun in Factory 3 with combing

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[18] van der Sluijs M.H.J (September 2009) *Fabric results of Sicala 350B Long Staple Upland Cotton produced at Vardhman Textiles Limited.*

[19] van der Sluijs M.H.J. (November 2009) *Report on Commercial Processing Trials of Sicala 350B Long Staple Upland Cotton at Central Textiles Limited.*

[20] van der Sluijs M.H.J. (March 2010) *Report on Commercial Processing Trials of Sicala 350B Long Staple Upland Cotton at TTI Textiles Limited.*

preparation, combing, drawing and roving produced in Factory 1. The spinning machinery installed is a mixture of European, Chinese, Taiwanese, Indian and Japanese machines.

There is small satellite Quality Assurance Departments (QAD) in each factory that conducts routine tests according to a laid down schedule. The laboratory in Factory 1 is the larger laboratory and is equipped with standard yarn testing instruments one would expect to find in a modern high quality spinning mill.

Materials

Two 40 foot containers (lots) containing a total of 191 bales of Sicala 350B were shipped to MST by Auscott Limited. All the bales were high density bales wrapped in cotton.

Fibre Testing

All bales in these shipments were extensively tested as per the Best Management Practice for Classing Handbook. Two replicates were tested per bale using an Uster Technologies 1000 HVI at the Auscott Classing facility to determine the Micronaire, staple length, length uniformity, staple strength and colour (Rd & +b).

Three replicates were tested per bale sample using the Cottonscan™ instrument by CMSE to determine fibre fineness. Combined with the HVI Micronaire value, the average fibre maturity was calculated using Lord’s empirical relationship between Micronaire, maturity ratio and fineness. Nep, seed-coat neps (SCN), percent short fibre content by weight (SFCw), trash and dust were also tested at CMSE on an AFIS PRO. Five replicates were tested per sample.

See Appendices 1& 2 for a complete breakdown of fibre properties.

Fibre and Yarn testing during Textile Processing

As MST only have a limited amount of fibre testing equipment, fibre samples were collected at MST in the blowroom and at each process through to roving for testing at CMSE. As these samples are currently being shipped to CMSE, only the MST results on fibre nep and trash levels by the Mesdan/Keisokki Nep and Trash Indicator (NATI) are presented. Sliver evenness from the carding, drawing, combing as well as the roving processes was monitored. The following yarn tests were also conducted: yarn count, twist, tenacity, evenness, number of imperfections and hairiness. Unfortunately accurate ends down figures were not measured.

Textile Processing

Due to a shortage of raw material and increased yarn orders MST had already used the majority of the bales in a blend with SJV (38% Sicala 350/62% SJV roller ginned) for the production of 60 Ne compact yarns for weaving. However, five bales from each lot were kept specifically for these trials. Two bales or 454 kg of Sicala 350B fibre was opened for each lot of which approximately 300 kg was processed. The bales chosen were considered to be representative of the two original shipments. See Table 1 for the bales that were selected with their relevant classing data.

Table 1 - Lot One and Two bales and fibre properties

	HVI				AFIS		
Bale Number	Length inch	Length Uniformity	Strength g/tex	Micronaire µg/inch	Neps/ gram	SCN/ gram	SFC/ (w)
Lot 1 80275031	1.27	84	32.7	4.3	284	21	6.7
Lot 1 80275076	1.28	84	33.9	4.5	278	25	6.7
Lot 2 90351598	1.30	83	33.6	4.1	289	11	7.1
Lot 2 90351670	1.31	83	33.5	4.0	311	18	8.2

It was agreed to produce enough 40, 50 and 60 Ne hosiery yarns for knitting trials and thereafter produce 40, 50, 60 Ne weaving twist yarns solely for testing purposes. One ringframe was used for spinning both lots with rovings from each lot creeled in either side of the ringframe for each yarn count and twist level. Two hundred and five roving bobbins from each lot were spun. Yarn samples for testing were collected from the same spindles to allow accurate comparison of the results.

For the trials the opening, cleaning, carding, combing, drawing, roving and spinning processes were conducted with the equipment set initially to MST standard specifications. These were then optimised to achieve the required quality as is accepted practice in high quality spinning mills. Production speeds were kept constant throughout the trial. Figure 1 summarises the processing steps, production speeds and other production related details used to convert the cotton into yarn.

For strength (tenacity) and elongation testing yarns were kept for a minimum of 12 hours in the laboratory before testing. This was not generally standard practice at MST as the laboratory conditions were not very stable.

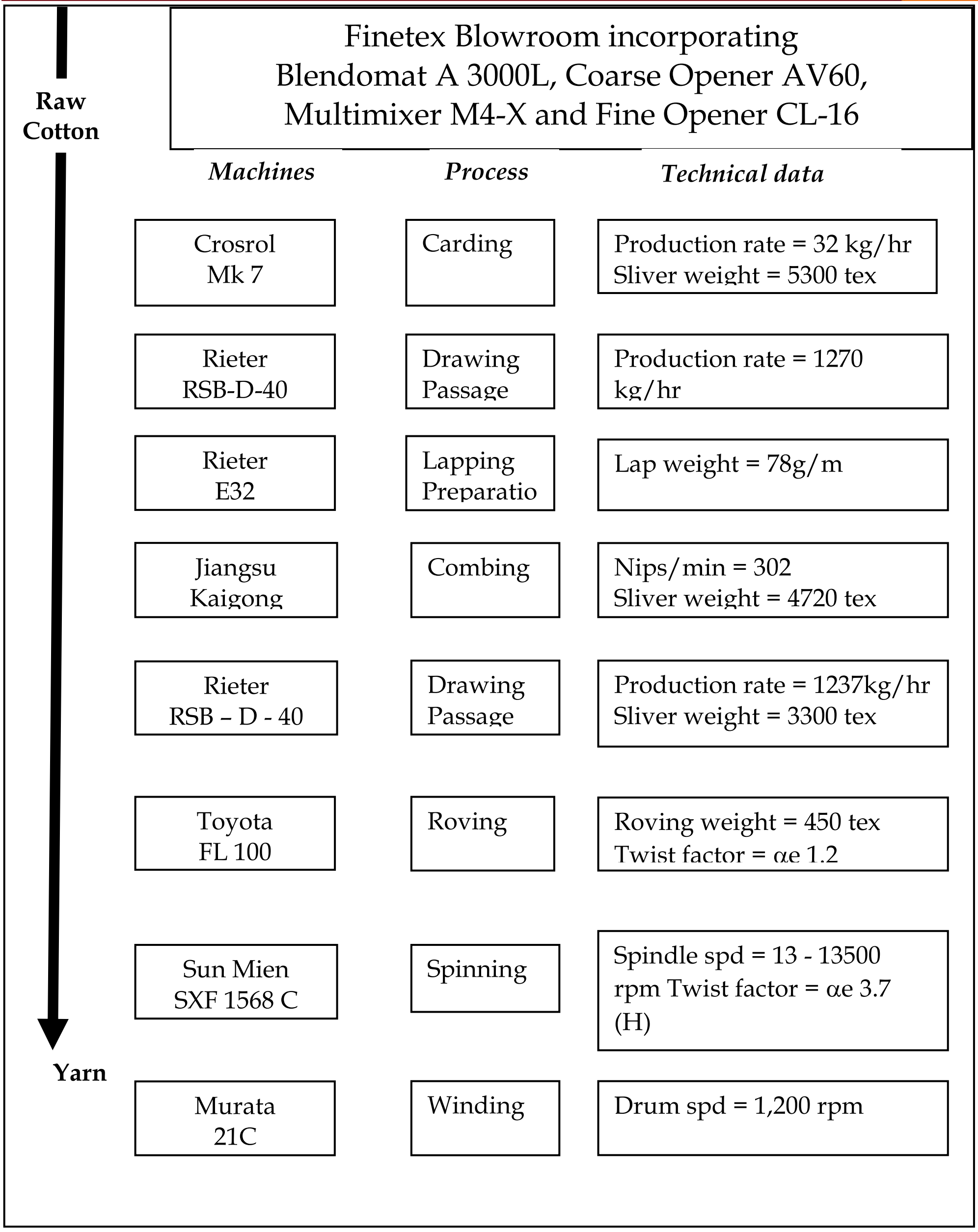

Figure 1 – Textile Processing Route for Lot One and Lot Two

Results and Discussion

Lot One processed well through the preparation stages easily meeting and even exceeding MST's standards. Lot Two also processed well through the preparation stages meeting most quality standards with the exception of nep content in the card sliver. Table 2 gives the results for the lots at the various processing stages as tested by NATI.

Table 2 - Lot One and Two Results for NATI

Process	Neps/gram > 0.5 mm	Trash/gram > 0.5 mm
Card Sliver Specification	**< 80**	
Card Lot 1	50	2.8
Card Lot 2	83	2.8
Combed Sliver Specification	**< 60**	
Comber Lot 1	29	0.5
Combed Lot 2	56	0.0

Four replicates were tested per sample.

Table 3 and 4 list the evenness results for the two lots at the various processing stages, as tested on an Uster Technologies Evenness Tester 3. The evenness results for all the stages were better than standards set by MST, with the exception of the evenness results of the roving produced from Lot Two, which was slightly above the standard.

Table 3 - Lot One Evenness Results

Process	Standard U%	Actual U%	CV% (1m)	CV% (3m)
Card #	4.0	3.91	2.97	2.50
Drawframe Passage	3.0	2.54	1.57	1.35
Comber	3.0	2.33	1.34	1.22
Drawframe Passage	3.0	2.01	0.51	*
Roving 470 tex	3.0	2.76	1.42	*

Average for 5 cards; * No result

Table 4 - Lot Two Evenness Results

Process	Standard U%	Actual U%	CV% (1m)	CV% (3m)
Card #	4.0	4.22	3.33	2.50
Drawframe Passage	3.0	2.79	2.08	1.93
Comber	3.0	2.20	0.96	1.09
Drawframe Passage	3.0	2.05	0.58	*
Roving 470 tex	3.0	3.12	1.67	*

Average for 5 cards,* No Result

The standard amount of waste (% noil) extracted during the combing process typically ranges between 18% and 20%. At 16.3% extraction the waste and nep levels in the combed sliver for Lot One were exceptional, and it was decided to process this lot with this comb setting. As the carded sliver of Lot Two contained somewhat higher nep content it is not surprising that the waste and nep extracted was 19.6%.

The yarns were tested on an Uster Technologies Evenness Tester 3, the Uster Tensorapid 3 Yarn Strength Tester and the Keisokki Laserspot Hairiness Tester.

The evenness, hairiness and strength results for the yarns produced for Lot One are given in Table 5. The results from Lot One were compared with the results obtained from previous trials conducted in India, China and Thailand. The strength results are benchmarked to the current 2007 Uster Statistics, which has been published by Uster Technologies Incorporated for close on fifty years. These statistics are widely used in the textile industry as a quality reference which allows for the classification and benchmarking of fibres and yarns produced world wide.

In the case of the 40 Ne hosiery yarns the evenness and imperfection results were generally better than previous results with the exception of neps, which was double previous results (60 as opposed to an average of 30). The yarn tenacity results, although suitable for knitting, were 2 to 3 cN/tex lower than previous trials. When comparing the results to the Uster Statistics we note that the results can be considered average. We have not conducted trials on 40 Ne weaving yarns before; however the tenacity results can also be considered to be average.

In the case of the 50 Ne hosiery yarns the evenness and imperfection results were generally similar to previous results again with the exception of neps which was almost four times higher than previous results (184 as opposed to 48). The yarn tenacity results, although suitable for knitting, were 1 cN/tex lower than previous trials. When comparing the results to the Uster Statistics, the results are below average. The 50 Ne weaving yarns had similar CV% and thin places than previous results with the thick places double (36 opposed to 17) and the neps almost four times (134 as opposed to 36) higher when compared to previous results. The tenacity results were 2 cN/tex lower than previous results and compared to the Uster Statistics, the results are below average.

In the case of the 60 Ne hosiery yarns the evenness and thin places results were generally similar to previous results with the thick places more than half of previous results (60 opposed to 137) but neps almost three times (194 as opposed to 72) to previous results. The tenacity results, although suitable for knitting, were 2.2 cN/tex lower than previous trials. When comparing the results to the Uster Statistics, the results are below average. The 60 Ne weaving yarns had similar CV% and imperfection results than previous results with the exception of neps which were almost seven times (220 as opposed to 31) higher than previous results. The tenacity results were 3 cN/tex lower than previous results and compared with the Uster Statistics, the results are below average.

The evenness, hairiness and strength results for the yarns produced for Lot Two are given in Table 6. As was the case with Lot One, the results from Lot Two were compared with the results obtained from previous trials conducted in India, China and Thailand.

In the case of the 40 Ne hosiery yarns the evenness and imperfection results were generally better than previous results with the exception of neps which was three times previous results (93 as opposed to an average of 30). The tenacity results were similar to previous results and when comparing the results to the Uster Statistics the results can be considered to be better than average. The elongation results were 2 % lower than previous results and compared to the Uster Statistics the results can be considered to be below average. As mentioned earlier, we have not conducted trials on 40 Ne weaving yarns; however the tenacity results can be considered to be average.

In the case of the 50 Ne hosiery yarns the evenness and imperfection results were generally similar to previous results again with the exception of neps which was almost six times previous results (274 as opposed to 48). The tenacity results, although suitable for knitting, were slightly lower than previous trials. When comparing the results to the Uster Statistics, the results can be considered average. The elongation results were 2 % lower than previous results and compared to the Uster Statistics the results can be considered to be below average. The 50 Ne weaving yarns had similar CV% and thin places than previous results with the thick places more than double (41 opposed to 17) and the neps almost five times (174 as opposed to 36) to previous results. The tenacity results are 1 cN/tex lower than previous results, with the elongation results also 2 % lower than previous results. Compared to the Uster Statistics, the results can be considered to be below average.

In the case of the 60 Ne hosiery yarns the evenness and thin places results were generally similar to previous results with the thick places more than half of previous results (66 opposed to 137) but neps almost four times higher (271as opposed to 72) than previous results. The tenacity results, although suitable for knitting, were 1.5 cN/tex lower than previous trials. When comparing the results to the Uster Statistics, the results can be considered average. The elongation results were 2 % lower than previous results and compared to the Uster Statistics the results can be considered to be below average. The 60 Ne weaving yarns had similar CV% and imperfection results than previous results, with the exception of thick places which were more than double (74 as opposed to 30) and neps which were almost ten times higher (313 as opposed to 31) than previous results. The strength results are 1.5 cN/tex lower than previous results and compared to the Uster Statistics, the results can be considered to be below average. The elongation results were 2 % lower than previous results and compared to the Uster Statistics the results can be considered to be below average.

Table 5 - Test Results for Yarns for Lot One

Instrument & Measurement	40 Ne Hos	50 Ne Hos	60 Ne Hos	40 Ne Weav	50 Ne Weav	60 Ne Weav
Uster Technologies 3						
Evenness[1]						
Coefficient of variation CV %	12.0	13.3	13.9	12.0	12.9	13.7
Thin places - 50 % /1000	1	9	11	1	2	8
Thick places + 50 % /1000	17	36	60	20	30	55
Neps + 200 % /1000	60	184	194	58	134	220
Hairiness						
Hairiness H	2.6	2.9	2.9	3.1	3.0	2.9
Uster Technologies Tensorapid 3						
Strength[2]						
Breaking Tenacity cN/tex	16.6	16.6	16.0	18.5	17.0	16.8
CV % Tenacity	8.7	10.7	10.5	7.3	10.5	9.7
Breaking Elongation %	3.9	3.6	4.0	4.8	3.8	3.8

[1] *Average of 12 tests* [2]*Average of 60 tests*

Table 6 - Test Results for Yarns for Lot Two

Instrument & Measurement	**40 Ne Hos**	**50 Ne Hos**	**60 Ne Hos**	**40 Ne Weav**	**50 Ne Weav**	**60 Ne Weav**
Uster Technologies 3						
Evenness[1]						
Coefficient of variation CV %	12.1	13.4	13.8	11.7	12.9	13.6
Thin places - 50 % /1000	0	22	6	0	1	11
Thick places + 50 % /1000	22	53	66	14	41	74
Neps + 200 % /1000	93	274	271	82	174	313
Hairiness						
Hairiness H	2.9	3.0	3.0	3.7	3.2	2.9
Uster Technologies Tensorapid 3						
Strength[2]						
Breaking Tenacity cN/tex	18.3	17.8	17.2	18.5	17.8	18.1
CV % Tenacity	9.3	9.2	13.13	9.91	9.5	9.0
Breaking Elongation %	4.3	3.8	3.9	4.8	3.9	4.0

[1] *Average of 12 tests* [2]*Average of 60 tests*

The yarn tenacity achieved during these trials was quite low as are the values achieved by MST in their general production. The CV% of tenacity was also quite high and it is thought that these low strength and elongation results and high CV% of tenacity measurements are in all likelihood due to the fact that samples are generally not conditioned before strength testing and that the conditions in the laboratories are not maintained at standard conditions. The evenness of the yarns and the number of thin places were similar to previous trials; however the thick places and neps were a lot higher than previously achieved.

These results may be improved to some degree by further fine tuning of the production process as these fine counts are generally not spun in factory 3. The cotton bales used for this trial generally had a higher nep content than the cotton used in previous trials. This high nep content in the cotton bales, especially Lot Two, could have been countered by increasing the noil % removal during the combing process, but this would have led to an unacceptable high waste percentage. The Micronaire values for Lot One (4.5) also made the production of high quality fine count yarns difficult.

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. Unfortunately ends down were not formally checked during the trial but feedback from the operators and supervisor suggests that end breaks during processing were not an issue.

Further Work

MST will knit the yarn into single jersey fabric for further analysis. CMSE will test samples collected at MST on the AFIS PRO and forward the results to MST.

Conclusion

The aim of work was to continue to work with commercial spinning mills and to introduce them to the Long Staple Upland cotton produced in Australia. A further aim was to determine whether the results that were obtained at the CMSE Cotton Mill and subsequent commercial trials in India, China and Thailand can be replicated by MST in Vietnam. The results confirm that 100% Sicala 350B can be spun into fine count 40 to 60 Ne combed ring-spun yarns suitable for knitting and weaving. The yarn tenacity and elongation results achieved were substantially lower than achieved previously and is of some concern. This may have been affected by a lack of adequate conditioning. Other issues, which need to be taken into account when producing fine count yarns suitable for further processing into quality fabrics include;

- Micronaire values must be below 4.5 to produce quality fine count yarns (40 Ne and finer), to ensure that the number of fibres in the cross section is sufficient to produce yarns with the required evenness and imperfections (thin, thick, neps).
- Nep content must be < 200 neps/gram to achieve acceptable nep values in fine count yarns.

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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.

A large number of Sicala 340BRF and ELS bales produced during the last three to four seasons have been fully described giving the Australian cotton industry a picture of the fibre properties of the current commercially grown Long Staple Upland and Extra Long Staple cotton as tested by objective instruments.

The Sicala 340BRF fibre grown over the last three seasons did not achieve the average length and strength required by international spinners, with the average Micronaire within the range required, however the fibre was coarser, less mature with high nep content. When we compare the average quality results achieved for the Sicala 340BRF with the Sicala 350B we note that the average length of the Sicala 340BRF was shorter, more variable coarser and less mature in higher nep content and that than the Sicala 350B. The ELS grown over the last four seasons almost achieved the average length, but did achieve length uniformity, significantly higher average strength with the required Micronaire. However the fibre was less mature and finer which in all likelihood has resulted in the high nep content.

The commercial spinning trial, has given the Australian industry a unique opportunity to determine what yarn counts can be achieved with this fibre. The fibre properties required to produce fine count yarns in the 40-70 Ne count range were reinforced during this trial. Any further trials and fibre marketed and promoted as Long Staple Upland cotton should meet all the specifications highlighted in Table 4.

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

6. 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 first commercially released Australian Long Staple Upland cotton, Sicala 350B grown during the 2007-2010 seasons generally produced a good quality fibre, with fibre quality very much dependant on growing conditions experienced during the season. The average length met the required length of 1.26 inch and the fibre achieved a reasonable average strength; although slightly below the minimum of 33 cN/tex preferred for genuine premium quality. Both fibre properties showing large variations. The average Micronaire was generally coarser than the required 4.2 Micronaire which will be an issue when producing yarns in the 50-70 Ne count range. The average nep content of the Sicala 350B was above the required nep content of 200 neps/gram and varied significantly.

In contrast the current Long Staple Upland cotton, Sicala 340BRF, grown during the 2010-2012 seasons generally produced a fibre with variable quality. The average fibre length of 1.24 inch was shorter than required, achieved a reasonable average strength; although slightly below the minimum of 33 cN/tex. The average Micronaire was within the range required, with the cotton being less mature, coarser with high nep content. This variable quality is due to the fact that Sicala 340BRF cotton is grown as dryland cotton with the sole intention of achieving the Upland base grade and due to different seasonal and environmental conditions experienced during the three years resulting in different management considerations.

The ELS cotton produced during the 2009 – 2012 seasons achieved good average fibre length and length uniformity, with high average strength and Micronaire within the required range. The fibre being generally immature, fine with high nep content.

The commercial trial conducted in Vietnam has once again shown that it is possible to produce fine count combed yarns for knitting or weaving, in the range of 40 -70 Ne with 100% Australian Long Staple cotton. The quality of the yarns produced varied considerably and was generally of average or below average quality. These results are mainly due to the fact that the quality of the fibre used for these trials was variable and in most cases not within the recommended specifications. Trials conducted with 340BRF during 2011, in conjunction with the Cottonspec project, made similar conclusions with a number of Chinese mills able to produce 40-60 Ne combed yarns.

Extension Opportunities

7. 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)

1. van der Sluijs M.H.J. (January 2011) *Report on Commercial Processing Trials of Sicala 350B Long Staple Upland Cotton at Mei Sheng Textiles Vietnam Co. Ltd, 20pg.*

Once the ‘Verification of Australian Long Staple Upland Cotton Spinning Performance’ project, which was recently approved by the CRDC, is completed an overview of the work in this area will be published in a forthcoming edition of the Australian Cotton Grower. It is also 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 Sicala 340BRF fibre grown commercially over the last three seasons generally produced a fibre with variable quality. The average fibre length of 1.24 inch was shorter than required and achieved a good average strength, although slightly below the minimum of 33 cN/tex, needed to attaract a genuine premium. The average Micronaire was within the required range for the production of fine count yarns in the 50-70 Ne count range. The fibre was generally immature, which is not unusual for mechanically picked defoliated cotton and coarse with the average nep content above 200 neps/gram and varied significantly, mainly due to aggressive saw ginning and immature cotton and possibly also due to differences between seasons, location and management. Roller ginning produced fibre which was 0.07 inches longer, with better length uniformity and less nep and short fibre content.

The ELS cotton produced over the last four seasons achieved good average fibre length, length uniformity and strength. The average Micronaire was within the required range, with the fibre being generally immature, fine with the average nep content above 180 neps/gram with large variations.

The fibre properties of commercially grown Sicala 340BRF is variable and does not achieve the length and strength required to be considered a genuine premium fibre. This is attruted to seasonal, management and ginning factors and may be the reason why the adoption by growers has been poor because of lack of confidence in achieving price premiums.

A commercial spinning trial was carried out in Vietnam, with Sicala 350B, showed that it is possible to produce a fine count combed yarns for knitting or weaving, in the range of 40 -70 Ne with Australian Long Staple cotton, although the quality of the yarns produced varied considerably. This was mainly due to the fact that the fibre provided for spinning did not meet the specifications for maturity which led to high nep content and short fibre content. This has once again highlighted that the quality of the fibre needs to be within the proposed specifications in order to produce acceptable 40-70 Ne yarns, without any subsequent processing performance issues in fabric formation.

This means that the Australian cotton industry still does not really know what this fibre is really capable. Further work in this area over the following year will involve conducting another commercial trial with Long Staple Upland cotton (both saw and roller ginned) which meets all the specifications required for a genuine premium fibre. It is hoped that this work will provide the Australian industry with information on the capability of the Long Staple Upland cotton which will assist in promoting the fibre to mills and encourage growers to grow this type of cotton.