Blending could add value to long staple Upland varieties

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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 (such as Sicala 350B, produced by CSIRO Plant Industry) that approach the long and fine quality attributes of Pima-type cottons.

A blending trial at CSIRO Textile and Fibre Technology has shown that Pima cotton blends containing up to 30 per cent saw or roller ginned Sicala 350B can produce yarns and fabric almost as good as 100 per cent Pima. This could reduce the raw materials costs for spinners by up to 20 per cent while delivering a price premium of US15 cents per pound for growers.

In this study, Sicala 350B was roller and saw ginned, blended in increasing proportions with Pima A8 — an Extra Long Staple (ELS) Australian grown variety — and subjected to spinning trials. The aim of the investigation was to examine the degree to which Sicala 350B could be used as a substitute for Pima in fine count ring spun yarns.

Three blend ratios of the two cottons; 80:20, 70:30 and 60:40 (Pima A8 to Sicala 350B) were spun into 10 tex (Ne 60) ring spun combed yarns and examined against yarns spun from 100 per cent Pima A8 and Sicala 350B fibre. A comparison was also made between saw and roller-ginned Sicala 350B blended at the 70:30 ratio.

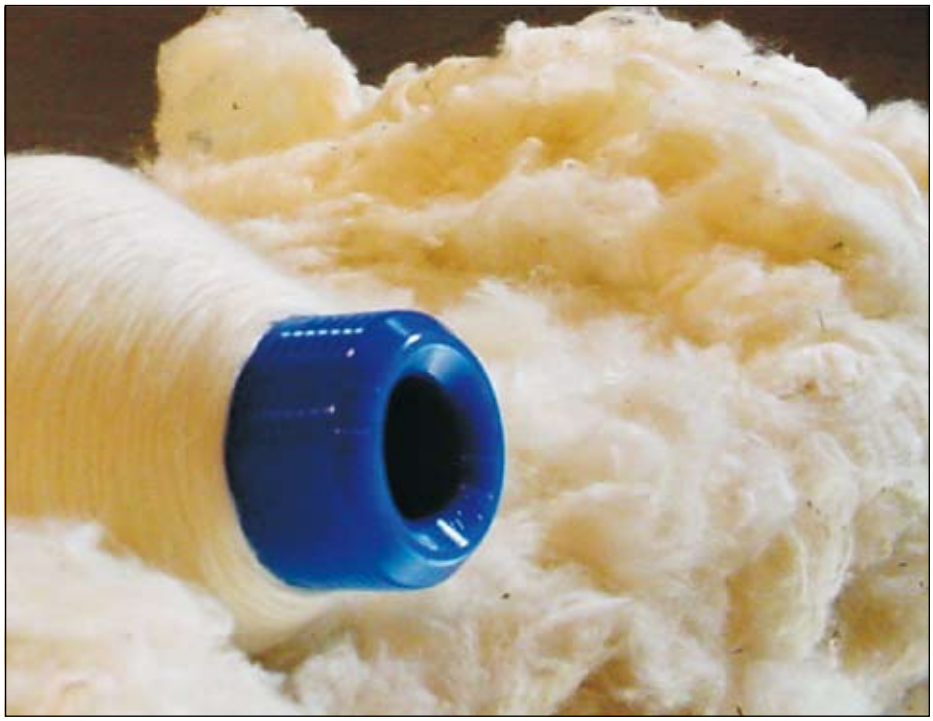

TABLE I: Spinner's cotton fibre property requirements for ELS

Fibre properties	Preferred value
Length	1 7/16 inch (46)
Uniformity	>85 per cent
Strength	>38 cN/tex
Micronaire	3.5–4.1
Maturity ratio	>0.85
Fineness	140–160 mtex
Neps	<250 neps/g
Ginning	Roller

Processing efficiency and yarn quality results were examined to judge the potential of Sicala 350B as a substitute for Pima cottons. Results indicated that a blend of 70:30 did not cause a practical deterioration in yarn quality and processing performance when compared to 100 per cent Pima. The primary advantage for the spinner is substantial savings on raw material costs.

FACING THE COMPETITION

Australian 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. But the Australian cotton industry faces increased competition in the premium market from cotton produced in the US, China, Brazil and West Africa. It is expected that the demand for ELS cottons, with fibre properties as listed in Table I, will increase by five to 10 per cent over the next five years and 10 to 20 per cent over the next 10 years.

Currently only 10 per cent of the Australian crop falls into the ELS category and new LS Upland cotton varieties from CSIRO Plant Industry are aimed at increasing this proportion of the market and gain the high premiums paid for fine, long and strong staple fibre.

Sicala 350B is a specialist high quality Bollgard II variety, with extremely long fibre lengths (>1 ¼ inches) compared with regular Upland varieties. Fibres are also

TABLE 2: Raw (bale) fibre quality results

Variety	Gin type	Tenacity[1] (cN/tex)	Elongation[1] (%)	Length[1] (mm)	Uniformity[1] Index (%)	SFI[1] (%)	Micronaire[1] (µg/inch)	Fineness[2] (mtex)	Maturity[2] ratio
Sicala 350B	Saw	32.0	2.4	31.2	81.3	12.5	4.2	192	0.82
Sicala 350B	Roller	33.0	5.5	33.8	85.1	6.5	4.2	198	0.79
Pima A8	Roller	48.1	5.8	34.0	86.8	6.7	4.2	173	0.91

[1]Using HVI 1000. Calibrated using HVI IIC Upland and Pima Calibration Cottons. Average of 10 tests.
[2]Using Cottonscan. Average of 5 tests.

typically finer and have excellent breaking tenacity (>32 grams per tex).

With Pima cotton commanding up to a 50 per cent price premium over the best Upland growths, one of the main advantages for the spinner in substituting an Upland variety for Pima cotton are savings in raw material costs, which typically amount to between 50 and 70 per cent of manufacturing costs in the spinning mill.

HOW THE WORK WAS DONE

Bales of commercially saw and roller ginned Sicala 350B cotton and roller ginned Pima A8 were supplied to CSIRO Textile and Fibre Technology (CTFT) by Auscott Limited and Macquarie Cotton. The Sicala 350B was grown at Auscott Midkin and the Pima A8 at Cubbie Station. Saw ginning was at Midkin while roller ginning was at North Bourke Ginning.

Roller ginning seed cotton from the same Sicala 350B module enabled comparisons to be made on the basis of gin treatment, and the potential for realising the fibre length premium length from Sicala 350B.

Fibre testing

Micronaire, staple length, uniformity, staple strength, elongation and short fibre index (SFI) were measured (Table 2).

Fibre fineness was determined using the CSIRO Cottonscan. The maturity ratio was also calculated using the fineness and maturity data (Table 2).

Bale and manually blended fibre samples were tested for nep, seed-coat neps (SCN) and short fibre content (SFC) by an Uster Technologies Advanced Fibre Information System (AFIS PRO) (Table 3).

Textile processing

Fibre from each of the treatments was processed into yarn and then knitted into

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TABLE 3: Nep, seed-coat nep and SFC results from the AFIS PRO

Variety	Gin type	Neps/ gram	SCN/ gram	SFC (W) %
Sicala 350B	Saw	376	44	12.9
Sicala 350B	Roller	193	43	8.0
Pima A8	Roller	190	22	3.7
80:20	Roller	185	35	4.4
70:30	Roller	176	20	4.4
60:40	Roller	182	36	7.9
70:30	Saw	372	44	12.6

Average of 5 tests

FIGURE 1: Evenness result for 10 tex yarns

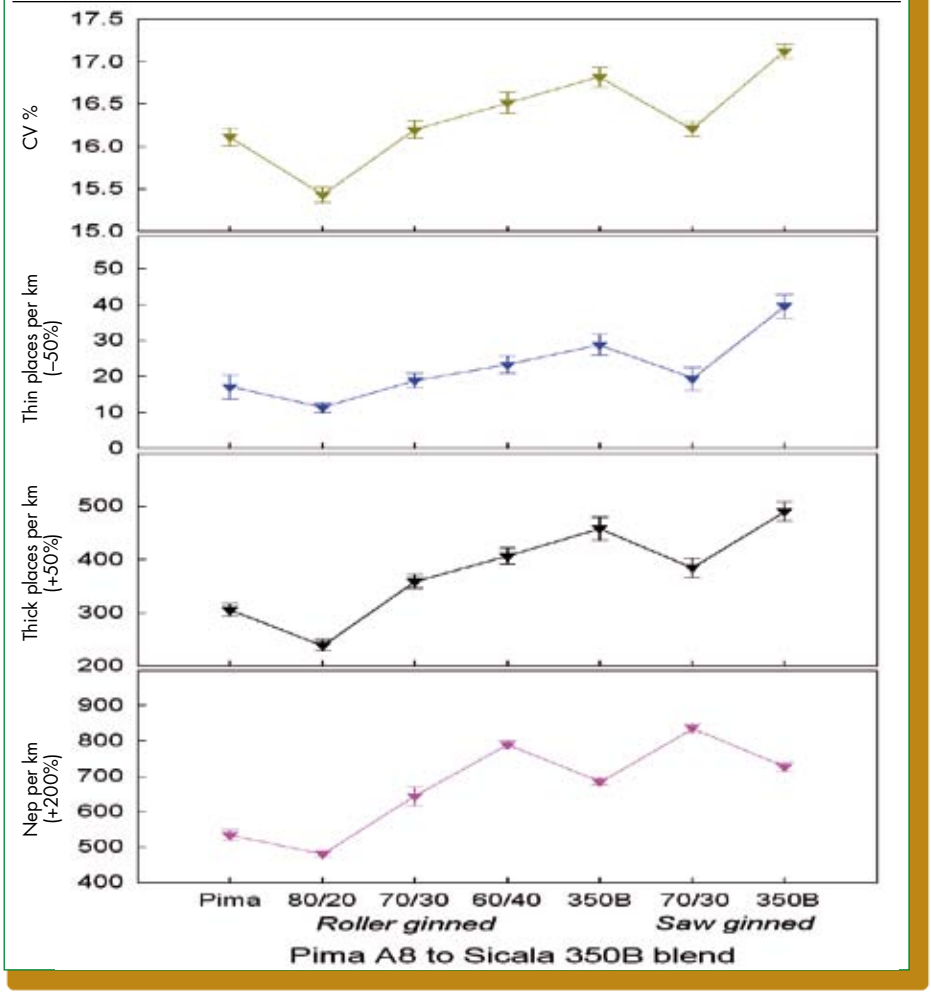
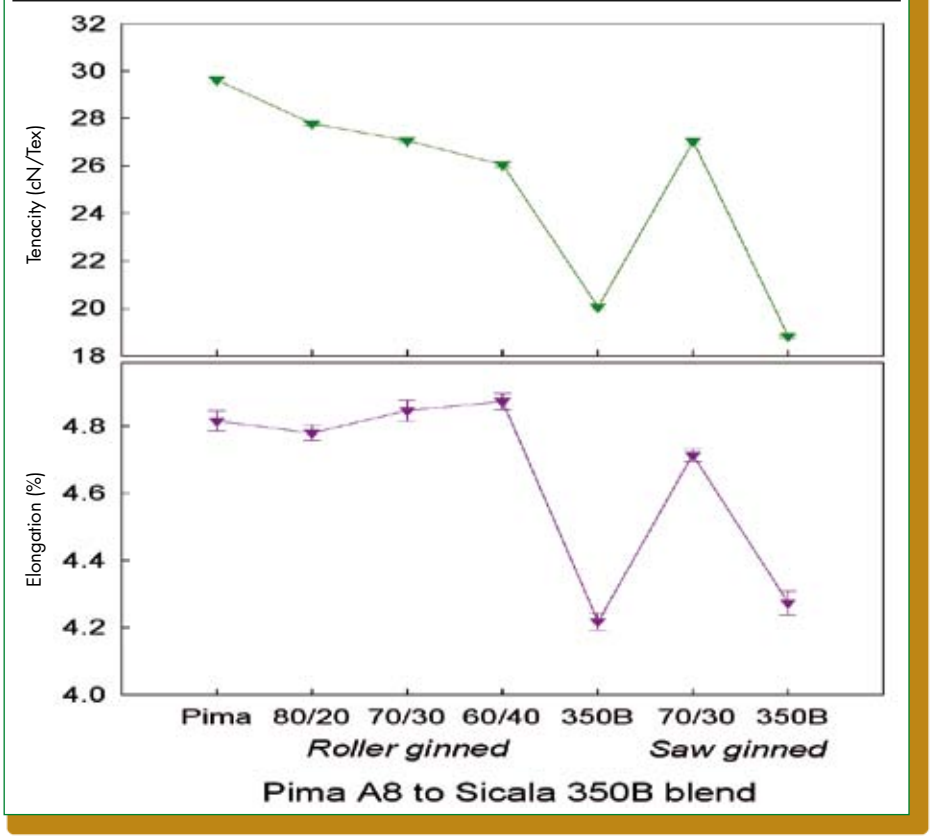
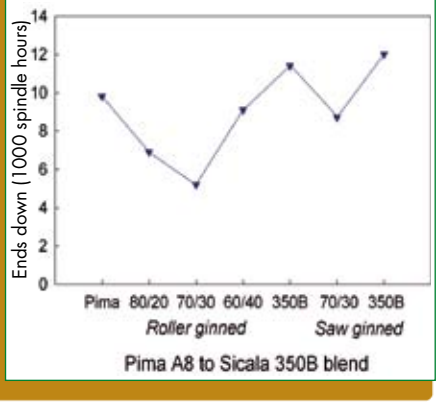


FIGURE 2: Strength and elongation results for 10 tex yarns



fabric using machines set to industry standard settings. Residual trash in each fibre treatment was measured during the opening, cleaning and carding processes. The amount of noil (that is, short fibre nep and residual trash) generated during combing of each treatment was also determined (Table 4).

FIGURE 3: Ends down for various treatments (spindle hours = 1508)



Yarn testing

Spun yarns were tested for linear density (count), twist, evenness, hairiness, imperfections and tensile properties (Figures 1 and 2).

Fabric testing

Greige (undyed) fabrics were tested for fabric mass and bursting strength (Table 5).

DISCUSSION OF RESULTS

By any measure, the fibre properties of all three cottons tested in this study were exceptional. While there were only small differences in fibre length properties between roller-ginned Sicala 350B and the Pima A8, which was also roller ginned (Table 2), the Pima cotton had much higher bundle tenacity, and was inherently finer. The inherent fineness of the Pima cotton would have positively affected the bundle tenacity result. The Sicala 350B had relatively high bundle tenacity for an Upland cotton.

Saw-ginning the Sicala 350B significantly reduced fibre length and length uniformity and increased SFC, seed-coat neps and neps. The nominal acceptable limit for neps is 250 counts per gram of fibre. In comparison to roller ginning (which has no lint cleaning) saw-ginning increased nep levels in the Sicala 350B cotton by nearly 100 per cent (from 193 to 376 neps per gram) and SFC by over 50 per cent (from 8.0 per cent to 12.9 per cent).

Trash and noil

The amount of trash extracted from each treatment during processing was generally low and similar across all treatments with only 0.5 per cent by weight separating treatments (Table 4). Trash levels appeared to be independent of ginning treatment and variety/blend.

The percentage of noil produced increased with the proportion of Sicala 350B in the blend (Table 4). Despite the measured differences in SFC between roller and saw-ginned Sicala 350B, both these treatments produced similarly higher levels of noil than the Pima cotton, which, reflecting its particularly good length properties, produced the lowest amount of noil.

Yarn tenacity

The Pima cotton alone produced the best yarn tenacity results although there was practically no difference between 100 per cent Pima A8 yarns, 70:30 saw and roller-ginned blends and 60:40 blended yarns (Figure 2).

There were significant differences in tenacity (>8 cN/tex) between 100 per cent Pima and 100 per cent Sicala 350B saw and roller-ginned yarns. Figure 2 shows some interaction between yarn count and blend for yarn tenacity and a strong influence of blend treatments. No difference was noted between 100 per cent Pima A8 and 80:20, 70:30 and 60:40 blends for elongation.

The tenacity and elongation of the 100 per cent Pima and all the blends, were considered excellent (between the 25 and five percentile lines of all yarns produced world-wide). Yarns within these percentiles are considered high quality and are typically destined for modern high speed weaving and knitting machines and high quality apparel end-uses.

FIGURE 4: Cost savings when blending 30% LS cotton with ELS cotton

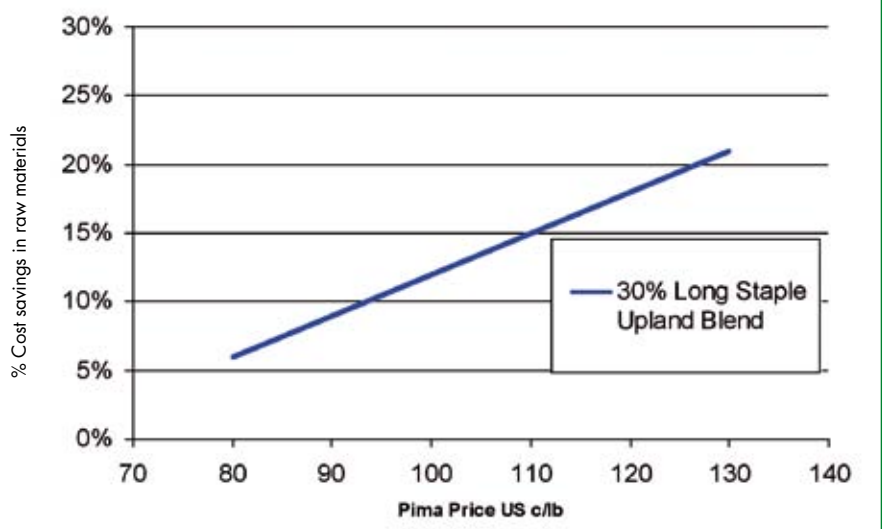


TABLE 4: Percent trash extracted in opening, cleaning and carding; and noil extracted in combing

Variety	Gin type	Opening & cleaning %	Carding %	Total trash %	Noil %
Sicala 350B	Saw	0.80	1.29	2.09	19.7
Sicala 350B	Roller	0.76	1.87	2.63	19.4
Pima A8	Roller	0.52	1.57	2.09	14.9
80:20	Roller	0.63	1.58	2.21	17.6
70:30	Roller	0.81	1.76	2.57	18.4
60:40	Roller	0.85	1.76	2.61	19.2
70:30	Saw	0.95	1.50	2.45	19.3

TABLE 5: Single Jersey (Griege) fabric test results

Fabric property	Sicala 350B saw	Sicala 350B roller	Pima A8 roller	80:20 roller	70:30 roller	60:40 roller	70/30 saw
Bursting pressure (KPa)	296	304	365	359	348	447	421
Fabric mass (g/m2)	96.2	103.5	97.6	98.4	99.9	101.2	98.3

Evenness

The most even yarns were produced from the 80:20 blend followed by the 100 per cent Pima, 70:30 and 60:40 blends, with the 100 per cent Sicala 350 B roller and saw-ginned fibre producing the most uneven yarns (Figure 1). The evenness values and total imperfections (the number of thin and thick places and neps) of the 100 per cent Pima A8 yarn were somewhat higher compared with the 80:20 blend, which may be due to the lower percentages of noil removed from the 100 per cent Pima treatment at the comb. The hairiness values for the 100 per cent Pima A8 and blends were similar and lower than those for the 100 per cent saw and roller-ginned Sicala 350B.

Processing performance

Another important measure of cotton lint quality is processing performance. The recording of end breakages in spinning is an important measure of processing performance because it indicates whether production levels and quality standards can be achieved. The processing performance of all yarns produced was excellent (see Figure 3) with most treatments and yarn counts recording end break rates at less than 20 breaks per 1000 Spindle Hours (SpH).

Fabric properties

The properties of fabrics knitted from the 10 tex yarn spun from each treatment tended to reflect yarn properties (Figure 2). Fabric burst pressure results, which indicate fabric strength, typically follow yarn tenacity results. So the fabrics knitted from 100 per cent Pima and blends had the highest burst test results, although it is interesting to note that blend treatments with the highest proportion of Sicala 350B (70:30 saw-ginned and 60:40) had the highest burst test results (Table 5).

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Financial benefits

Figure 4 gives the potential saving on raw material when a spinner is able to use 30 per cent of an LS Upland variety with ELS blend without jeopardising yarn and fabric quality and processing behaviour. The LS cotton in this model has been based on a price of 60USc/lb.

Table 6 gives suggested minimum fibre properties LS cotton will need to achieve to be attractive for a spinner to allow quality and processing performance standards to be met when blending LS Upland cottons with traditional ELS cottons.

CONCLUSION

The aim of this study was to determine the feasibility of blending LS cotton with ELS cotton without jeopardising processing performance and yarn quality of the resulting fine count yarn.

As expected cotton that is roller ginned produces a longer, stronger fibre with less neps and short fibre content than saw ginned cotton, which resulted in a more even and stronger yarn, although not significantly so.

Further trials conducted at CTFT have shown that as one produces finer yarns than 10 tex, differences in yarn quality between these same blend ratios become more acute.

TABLE 6: Minimum cotton fibre property requirements for LS cotton

Fibre properties	Preferred value
Length	>1 1/4 inch (40)
Uniformity	> 83%
Strength	>34 cN/tex
Micronaire	3.7 - 4.2
Maturity ratio	>0.85
Fineness	160–180 mtex
Neps	<200 neps/g
Ginning	Roller/saw

It must be also borne in mind that roller ginning is almost twice as expensive as saw ginning and that there are only three roller gins in Australia, and these will not be able to cope with large volumes. Roller ginning leads to lower gin turn out and at the same time Upland cottons are more difficult to gin and can cause extensive damage to roller gins.

The results from this investigation also show that Pima cotton blends containing up to 30 per cent saw or roller ginned Sicala 350B can produce fine count yarn which, while not statistically as strong as 100 per cent Pima yarn, do not significantly reduce the tensile properties of yarns. Yarn evenness and imperfections were not significantly affected at any blend ratio, with the level of noil (short fibre, trash and neps) removed during combing having a more pronounced affect on these properties than the blend ratio.

Although the blends do increase the amount of waste by 0.5 per cent this is offset by the savings on raw material costs, which according to Figure 5 can amount to as much as 20 per cent. A premium of 15USc/lb on regular Australian Upland is considered achievable, which should be sufficient to compensate for the current yield penalty.

In order to reproduce the quality of yarn spun in this investigation and produce even finer yarns it is paramount that the fibre properties of the Sicala 350B and other Long Staple Upland varieties like it, are not negatively influenced by the ginning process.

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