



Cotton Catchment Communities CRC

FINAL REPORT

(due within 3 months on completion of project)

Part 1 - Summary Details

Cotton CRC Project Number: 4.03.03

Project Title: Ginning (Modified Lint Cleaner)

Project Commencement Date: 7/2006

Project Completion Date: 6/2009

Cotton CRC Program: Value Chain

Part 2 – Contact Details

Administrator: Jo Cain

Organisation: CSIRO Plant Industry

Postal Address: Locked Bag 59, Narrabri NSW 2390

Ph: 02 6799 1513 **Fax:** 02 6793 1186 **E-mail:** jo.cain@csiro.au

Principal Researcher: Dr Stuart Gordon

Organisation: CSIRO Materials Science and Engineering

Postal Address: PO Box 21, Belmont VIC 3216

Ph: 03 5246 4000 **Fax:** 03 5246 4057 **E-mail:** stuart.gordon@csiro.au

Supervisor: Dr Geoff Naylor

Organisation: CSIRO Materials Science and Engineering

Postal Address: PO Box 21, Belmont VIC 3216

Ph: 03 5246 4000 **Fax:** 03 5246 4057 **E-mail:** geoff.naylor@csiro.au

Signature of Research Provider Representative: _____

Part 3 – Final Report Guide (due within 3 months on completion of project)

Background

There is evidence the nep and short fibre content of Australian cotton is too high compared with other growths of similar quality¹. These characteristics are a result of the productive and efficient harvest and ginning practices utilized by the Australian industry but the problem is exacerbated by current lint cleaner design. In particular, the combination of lint cleaner elements, i.e. the feed rollers and feed bar, grid bars and the doffing brush around the lint cleaner saw, and the transfer ratios between these elements affect fibre quality.

The broad aim of this project was to adapt and re-engineer the widely used fixed batt saw lint cleaner to reduce short fibre and nep content. The main adaptation proposed at the start of this project was an auto-levelling system for the lint cleaner feed such that the weight of fibre transferred onto the saw would always be constant. Typically the unit is powered by a single 30kW motor, which regardless of the rate of fibre flow runs at full speed.

Currently in lint cleaners there are no sensors to regulate fibre flow or draft settings. Excessive speed and large draft or combing ratios, i.e. a high saw surface speed to feed roller speed, increase damage to the lint. Implementing an auto-levelling system requires sensors and variable speed devices to maintain a consistent flow of material. It has been shown in previous work² that low combing ratios reduced short fibre content and improved fibre length and length uniformity. Introducing constancy to the batt weight requires a greater degree of control of this combing ratio effect. Thus, the initial focus in this project was to test the possibility of sensor control of mechanical elements, in particular the feed mechanism, in the standard fixed batt saw lint cleaner and CSIRO's Modified Lint Cleaner (MLC). As well as testing fibre and batt weight variation through the lint cleaner machine, work also concentrated on the application of additional mechanical elements, e.g. a combed grid bar heel, designed to even the transfer of fibre onto the saw.

Once achieved, the objective was then to link this mechanical control to moisture control systems being developed as part of New Ginning Technology for Australian Cotton: Part II (Moisture & Contamination) project.

However, observations from flow and mass sensors applied to a commercial gin in the first year of the project, showed the delivery of fibre from the gin by the current system was too fast and too uneven to be controlled. Work on the project subsequently defaulted to proving and extending the veracity of the MLC to industry, with a view to commercialising the MLC technology.

Alternate fibre conveyor designs to give a more even feed and allow time for the batt to be levelled and humidified were drawn up towards the end of this project. These designs require greater intervention to the ginning system than was originally foreseen in this project. A new project around these designs was proposed to the CRDC in a FRP in January 2009.

¹ Gordon, S. G., Van der Sluijs, M. H. J. and Prins, M. W., 'Quality Issues for Australian Cotton from the Mill Perspective', Report to Australian Cotton Industry, Australian Cotton CRC (pub), 55 pp, Jul 2004

² Gordon, S. G. and Bagshaw, K. M., Improved quality of ginned Australian cotton, Final Report to the CRDC for project no. CTFT9, 50 pp, Sep. 2006.

Project Objectives

The stated objectives of the project and whether they were achieved are listed in Table I below.

Table I – Project objectives, milestones, performance indicators and achievement

Objective	No.	Milestone	Performance Indicator	Achieved
Fit inverter control to current modified cleaner in order to facilitate a constant low combing ratio	1	Test displacement/proximity sensors to facilitate auto-sensing capabilities of lint cleaner feedworks	Demonstration that sensors accurately predict fibre weight through lint cleaner feed system	No – Fibre throughput is measured but inverter control not fitted because measured batt weight is too variable
		Design and retro-fit auto-levelling system to industrial lint cleaner that modulates feed rate according to weight of fibre in feedworks before combing	Successful trials of auto-levelling system in commercial gin. Success is ascribed when speed of feedworks automatically varies according to weight of fibre in the feedworks	No – see above. New fibre conveyor designs proposed.
Inverter control system is designed in modular form to allow addition of other gin production tools such as the proposed moisture replenishing system being investigated as part of project no. 4.03.04.	2	Moisture replenishing module is integrated with the modified lint cleaner control module	Successful implementation of moisture measurement and replenishing controls from same PC interface as the modified lint cleaner controls	New fibre conveyor designs produced. Addition of moisture gives improved fibre properties.
<i>Prove and extend the veracity of claims about moisture management and the MLC</i>	<i>2a</i>	<i>Controlled laboratory and industrial trials show MLC gives improved fibre properties</i>	<i>Results published in peer review journal and EOI document sent to US gin companies</i>	Yes
Reduce SFC and nep levels in Australian cotton through modification of ginning processes	3		SFC and nep levels are lowered on average by 25% and 15% respectively.	Yes – Length and SFC are significantly improved by the MLC. Nep levels are improved by the MLC and the addition of moisture.

Methods

Work on this project was conducted largely during the Narrabri gin seasons of 2007, 2008 and 2009. Gin seasons in these years were shorter than usual due to drought and typically ran from late April through to late June.

Proposed auto-levelling of a fixed batt saw lint cleaner

At the start of this project it was proposed that control of fibre input onto the lint cleaner saw would require monitoring of the input feed using a light switch on or around the lint cleaner condenser as per Figure 1, followed by a calibrated proximity sensor to measure the mass (density) of lint passing through the lint cleaner feed rollers as per Figure 2.

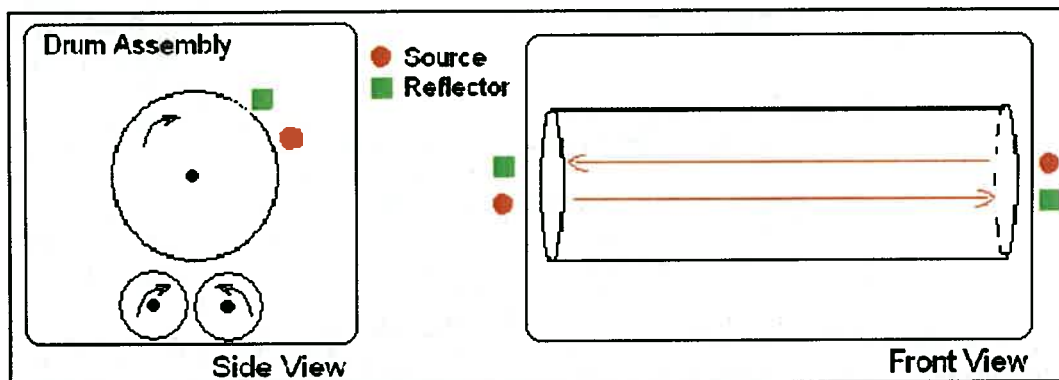


Figure 1 – Input feed monitoring with for example a photo-electric reflex switch fixed to the lint cleaner condenser.

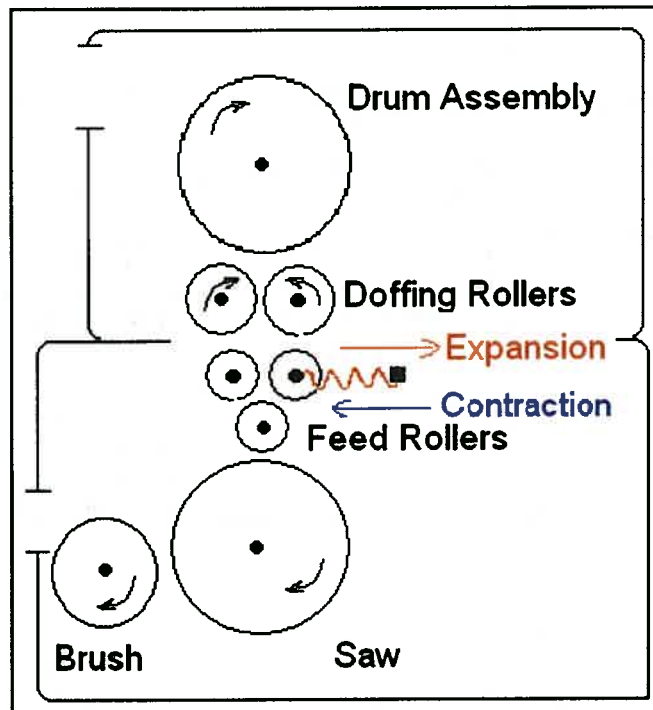


Figure 2 – lint flow (volume) measurement using for example a calibrated spring and proximity sensor fixed to the lint cleaner feed rollers.

According to this system when cotton is detected the variable speed system (the inverter) of the lint cleaner would operate. When lint is not detected for an extended period, perhaps seconds, the doffing and feed rollers would decelerate to an idle speed. Then, as the feed resumes the roller speed would accelerate back to processing speeds. To ensure constancy in

the batt mass or density and thereby combing ratio, a proximity sensor would be used to measure the displacement of a doffing or feed roller spring. A calibrated spring integrated with the sensor would allow the calculation of lint volumes passing between the rollers to be determined at any given moment (see Figure 3).



Figure 3 – Photo showing proposed location of calibrated spring to the feed roller (3).

Mass and air-flow measurements

Measurements of air flow and mass movement were made in 2007 in order to determine the mass variations in the lint cleaner batt weight or density to be corrected by the sensor-controlled inverter as per Figures 1 and 2. Measurements were made using a purpose made capacitor and an off-the-shelf hot wire anemometer fitted into the ducting of Auscott Narrabri's Gin Number 8 between the gin stand and lint cleaner. The capacitor forms the basis of the moisture meter built as part of New Ginning Technology for Australian Cotton: Part II (Moisture & Contamination) project. Mass and air-flow rates were monitored for week long periods during normal gin production.

Calibration of the capacitor mass value was conducted by setting different masses of equilibrated, static cotton between the capacitor plates and recording the capacitance values (in pico-Farads (pF)). Important in this calibration was the sensitivity of the sensor rather than its absolute accuracy.

Addition of new mechanical elements to the MLC

In addition to monitoring fibre mass and airflow new combing grid bars heels were designed, built and fitted to the first lint cleaner behind gin stand number 4 in Gin Number 8 at the Auscott Narrabri. The concept and initial laboratory trials of these grid bars are described in PART A in the Final Report to the CRDC for Project No. CTFT9.

The Auscott gin was visited in September 2006 to measure the lint cleaner dimensions and discuss with ginners the best method of fixing the new grid bars to the saw. Figures 4 and 5 show technical drawings of the combing grid bar heel and the method with which it is fixed relative to the saw. The grid bars were constructed in CMSE's workshop at Belmont and fitted by Auscott engineers to the second and third grid bar positions on the first lint cleaners

in Gin Number 8. Pin height to the saw was set at 1/16 inches in accordance with the stated grid bar heel setting (Continental Eagle 24D Manual).

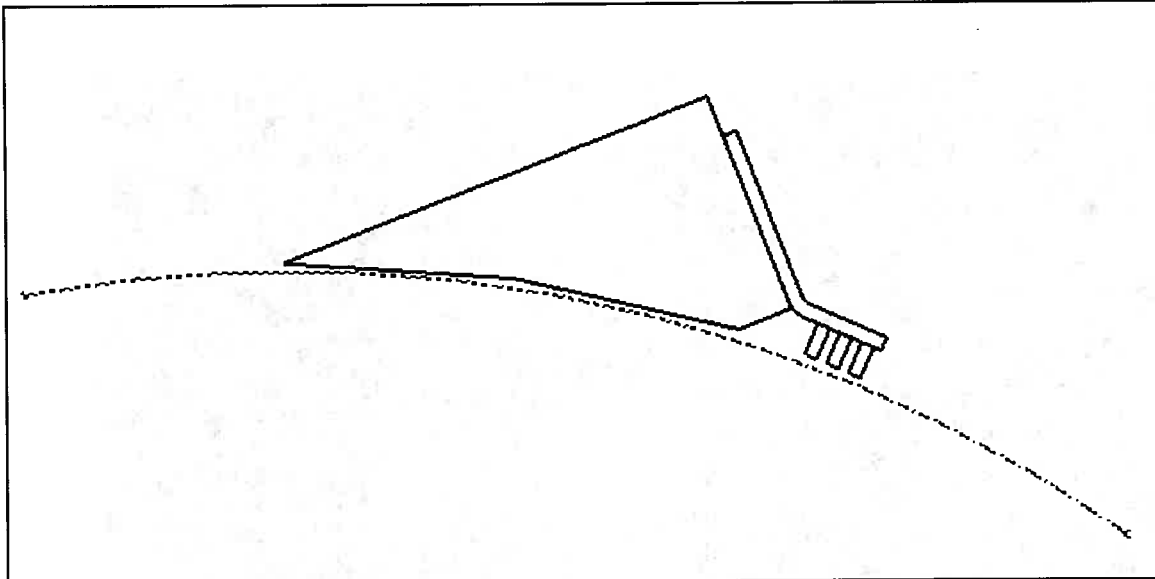


Figure 4 – Scale diagram showing side profile of CSIRO's combed heel grid bar and position to the saw. Combed heel grid bars were fitted to the second and third grid bar positions.

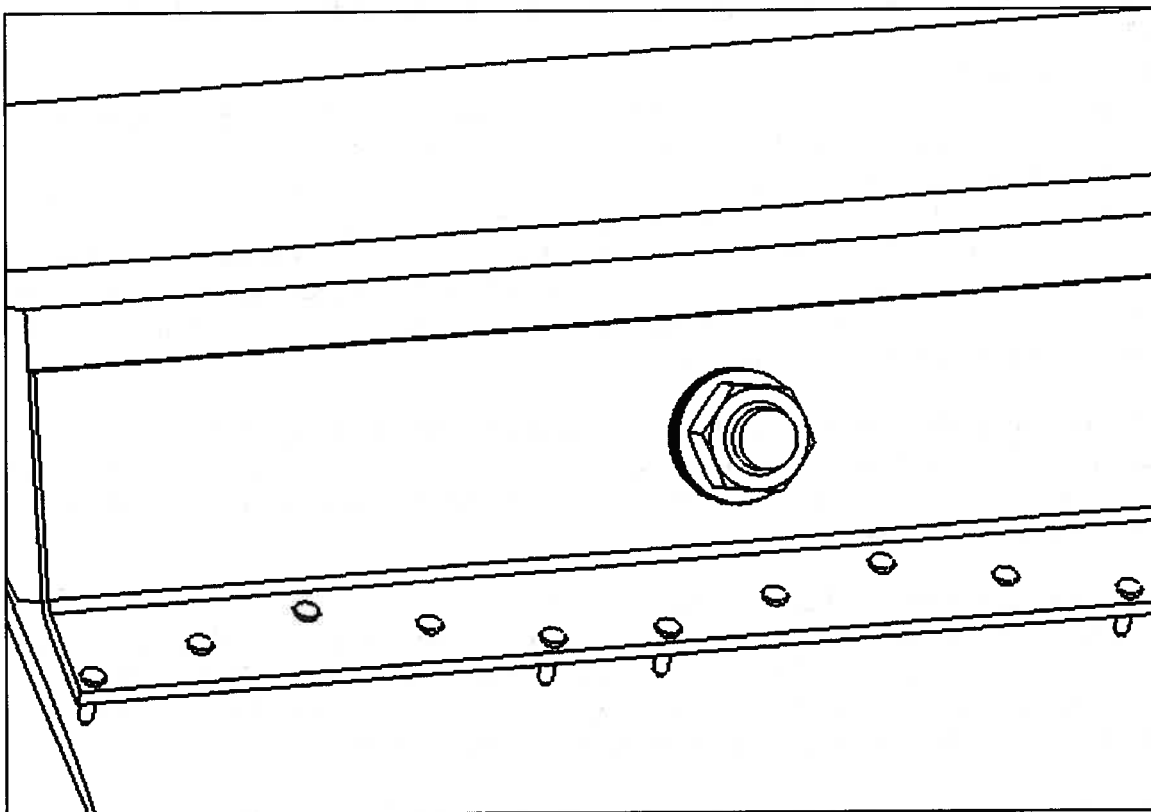


Figure 5 – Scale diagram showing combing heel pin profile and method of fastening grid bar to saw chassis.

Lint Cleaner and MLC Laboratory Trials

Laboratory trials are described in the paper entitled 'The effect of working elements in the fixed batt saw lint cleaner on ginned fibre properties' published in the Beltwide Cotton Conference proceedings of 2007. In this work the effects of lint cleaner elements, i.e. the feed roller, grid bars and brush, on three different Australian cottons; 'long & fine', 'standard' and 'short & coarse' were tested. A full copy of the paper appears in Appendix 1.

In further trials the MLC concept and the interaction of moisture with LC variables was tested on the same laboratory system used in these trials. Table II lists the variables tested in these trials.

Table II – Laboratory trials comparing fibre quality after treatments such as batt density, moisture equilibrium, saw speed, and combing ratio are applied

Variable		Settings
Cotton	3	Short & coarse, standard Australian and long & fine
Saw speeds	2	685 m/min (726 rpm) & 500 m/min (530 rpm)
Combing ratios	2 (5)	23 (95 rpm feed – 29.8 m/min) & 50 (44 rpm feed – 13.7 m/min)
Batt densities	2	100 gsm & 200 gsm – manually prepared
Conditions	2	wet (30° & > 70%RH) & dry (30°C & <30% RH)
Replicates	8	8 test replicates
Test replicates	5	5 AFIS replicates x 8 test replicates = 40 replicates/sample
Total tests (exc. test reps.)	>400	

Fibre samples were tested on an AFIS instrument using standard procedures. Simple statistics were calculated using MS Excel and analyses of variance to test the effect of each LC variable were performed using Minitab 15. Note comprehensive analyses of these test data will appear in a peer review paper currently in preparation. A brief overview of the results is given in the Results and Outcomes section of this report.

MLC Industrial Trials

Controlled industrial experiments testing the performance of the MLC at different combing ratios (CR) and the standard lint cleaner (SLC) with combing grid bar heels (GBH) were conducted during the ginning seasons of 2007 and 2008. During these trials gin feed and saw speed and lint cleaner saw speed were kept constant. Performance was measured in terms of fibre damage and efficiency in terms of running ability, i.e. ease of continuous operation with the MLC settings and elements in place.

The trials were conducted when large runs of the same cotton (same grower and paddock) were available. Trials in 2007 were limited to one grower and one variety. No pre LC samples were collected for these trials. Trials in 2008 were conducted over several days on a wide variety of cultivars. Tables III and IV list the time, date, the number of samples and the cotton used in trials during 2007 and 2008 respectively.

Table III – Treatments and samples tested during 2007 gin season

Date	Time	Cotton	Lint Cleaner treatments	Combing ratio	No. samples
Mid-June	12 hours	Sicot 71BR	MLC	19, 23, 27 & 30	10/CR = 40
			SLC	27	40
			SLC w/ GBH	27	40
					120 - total

Table IV – Treatments and samples tested during 2008 gin season

Date	Time	Cotton	Lint Cleaner treatments	Combing ratio	No. samples
Mid-May	12 hours	Sicot 71BR	MLC	19, 23, 27 & 30	
	6 days	Var. CSD	SLC	19 & 27	
			SLC w/ GBH	27	
June	12 hours	Var	MLC	19, 23, 27 & 30	
	2 days		SLC	19 & 27	
			SLC w/ GBH	27	

Fibre samples were tested on HVI and AFIS instruments using standard procedures. Simple statistics were calculated and plotted using MS Excel. Confidence intervals (95%) were calculated and applied to each mean to enable the significance of each treatment to be seen in each Figure.

Expression of Interest to commercialise the MLC

A targeted expression of interest (EOI) document has been drafted to provide parties interested in commercialising the MLC with information about the invention and the CSIRO commercialising process – see Appendix 2.

Results and Outcomes

Fit inverter control to current modified cleaner in order to facilitate a constant low combing ratio

Figure 6 below is given as evidence for not pursuing the application of an auto-levelling system to the standard fixed batt saw lint-cleaner. Short-term auto-levelling systems currently used within the textile processing industry, e.g. in the drawing process, contend with drafts in the range of 4 to 9, and thus short and long term mass variances largely within 20% of the input mass. Moreover, in these systems the inertial mass of the system and the mass of the input are relatively small compared to the inverter size.

Figure 6 shows the input fibre mass into the LC condenser and feed system can vary in excess of 50% within seconds, making application of a sensor controlled inverter without first condensing and mechanically balancing the feed problematic.

New conveyor

Plans for a buffer hopper and feed trunk capable of delivering a more even and thicker batt to the lint cleaner saw have been proposed to the CRDC. Aside from auto-levelling capabilities another advantage of collecting and evenly re-feeding fibre through a buffer hopper mechanically, rather than with air, is that it avoids large volumes of air being drawn through the fibre prior to cleaning which in turn provides the opportunity to condition the fibre, i.e. make it more resilient, before it is cleaned (and damaged) by the lint cleaner saw.

Further details of this proposal can be found in Appendices 3 and 4.

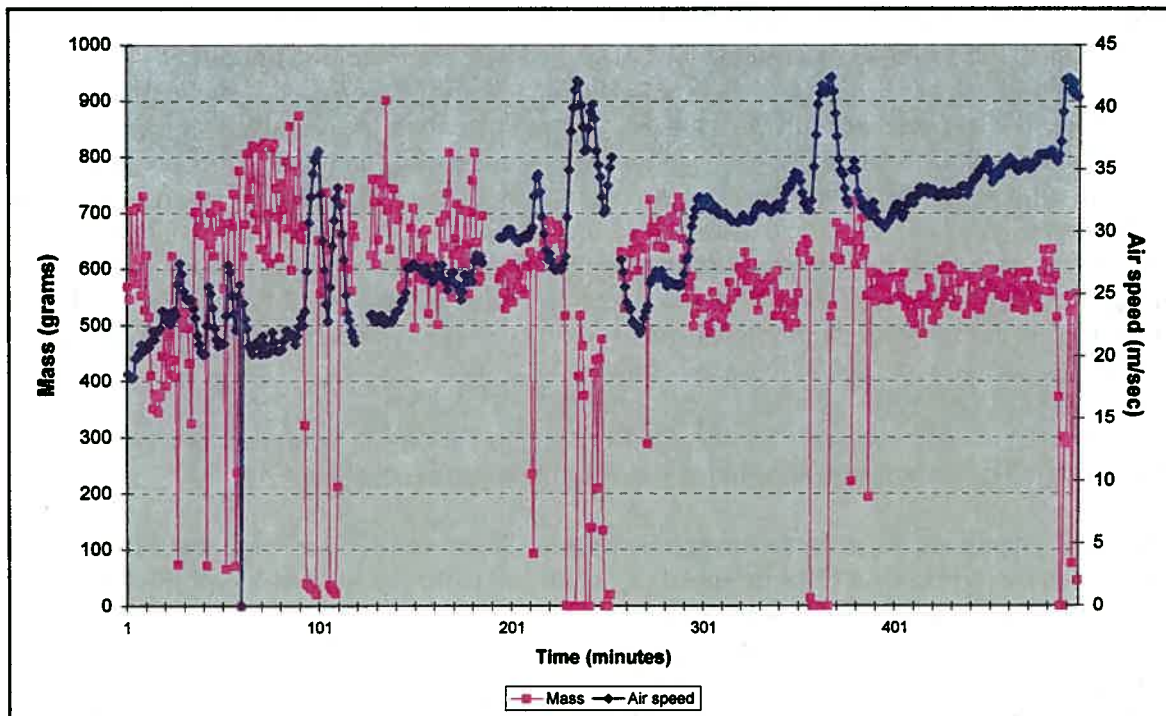


Figure 6 – Graph showing the uneven feed (in grams) and variable air speed through the duct connecting the gin stand to the first lint cleaner

Additional mechanical elements for the MLC

The effect of adding combing grid bar heels to grid bar positions two and three on fibre quality are described in the discussion on the MLC industrial trials.

MLC Laboratory Trials

The laboratory trial set-up used in these trials is largely described in the Beltwide Cotton Conference in Appendix 1. In these trials the effects from LC variables, e.g. batt density, combing ratio etc were partitioned from the large experimental error associated with the complex mechanical interactions at play in the LC. It is noted the three cottons used in these trials had all previously been subject to one or two standard lint cleaners before baling. The nep levels recorded in these trials are therefore higher than would normally be expected.

Figures 7 to 9 show the effects of cotton type, moisture, saw speed and combing ratio on nep levels. Figure 7 shows long, fine fibre will nep more than short, coarse fibre and that moisture provides some protection against nep formation in the lint cleaner. The protection given to fibre equilibrated at higher moisture contents is greater in long, fine fibre (~13% less neps in long, fine cotton conditioned to 6.5% w/w cf. with cotton conditioned to 5% w/w) than for shorter, coarser fibre (~3%). The largest interaction between these variables is associated with moisture content.

Figure 8 shows similar relative effects for saw speed, i.e. high saw speed creates more neps than a slow saw speed. Slow LC saw speeds produced around 10% less neps in long, fine cotton than high speeds. The effect was reduced for shorter, coarser fibre.

Figure 9 shows lower combing ratios create fewer neps. Long, fine cotton subject to low combing ratios (23) had around 6% fewer neps than cotton combed at a very high ratio (50).

The cumulative affect of these variables is much less than their individual contribution; the total reduction in nep count in long, fine cotton, as a result of subjecting moist cotton to low combing ratios and saw speeds, is around 20%. It is noted the batt density of the samples

tested here was 50% lighter than the batt density typically passed through a SLC. The responses to the variables and interactions measured here are therefore diminished.

Analyses of variance for these variables on nep creation (see Table V) confirm the significance of the visual results. Cotton-type, saw speed, combing ratio and moisture content all had significant effects on nep content. Significant interactions occurred between cotton-type and saw speed and cotton-type and moisture content. A significant three-way interaction also occurred between these variables. The interactions illustrate the potential of long, fine cotton to nep when it is subject to fast saw speeds and dry conditions. These interactions diminish for shorter, coarser cottons. The effect of combing ratio was muted by the lighter weight batt used in these experiments.

Similar effects were also seen for average fibre length and SFC. Trash results were affected by cotton-type, saw speed and combing ratio but not moisture content.

Table V - Analysis of variance for nep including select interactions. Sources of variation include cotton (3), saw speed (2), combing ratio (2), moisture equilibrium (condition) (2) and 40 (8 x 5) test replicates.

Source	DF	Seq. SS	Adj. SS	Adj. MS	F-value	Prob.
Cotton	2	19076741	19076741	9538370	6565.66	0.000
Saw speed	1	108588	108588	108588	74.75	0.000
Combing ratio	1	88897	88897	88897	61.19	0.000
Condition	1	200508	200508	200508	138.02	0.000
Physical replicates	7	9515	9515	1359	0.94	0.478
Test replicates	4	2514	2514	629	0.43	0.785
Cotton*Saw speed	2	65208	65208	32604	22.44	0.000
Cotton*Combing ratio	2	6605	6605	3303	2.27	0.104
Cotton*Condition	2	113051	113051	56526	38.91	0.000
Saw speed*Combing ratio	1	5463	5463	5463	3.76	0.053
Saw speed*Condition	1	17052	17052	17052	11.74	0.001
Combing ratio*Condition	1	3293	3293	3293	2.27	0.133
Cotton*SSpeed*CRatio	2	3246	3246	1623	1.12	0.328
Cotton*SSpeed*Condition	2	11860	11860	5930	4.08	0.017
Cotton*CRatio*Condition	2	8041	8041	4021	2.77	0.063
Error	928	1348167	1348167	1453		
Total	959	21068749				

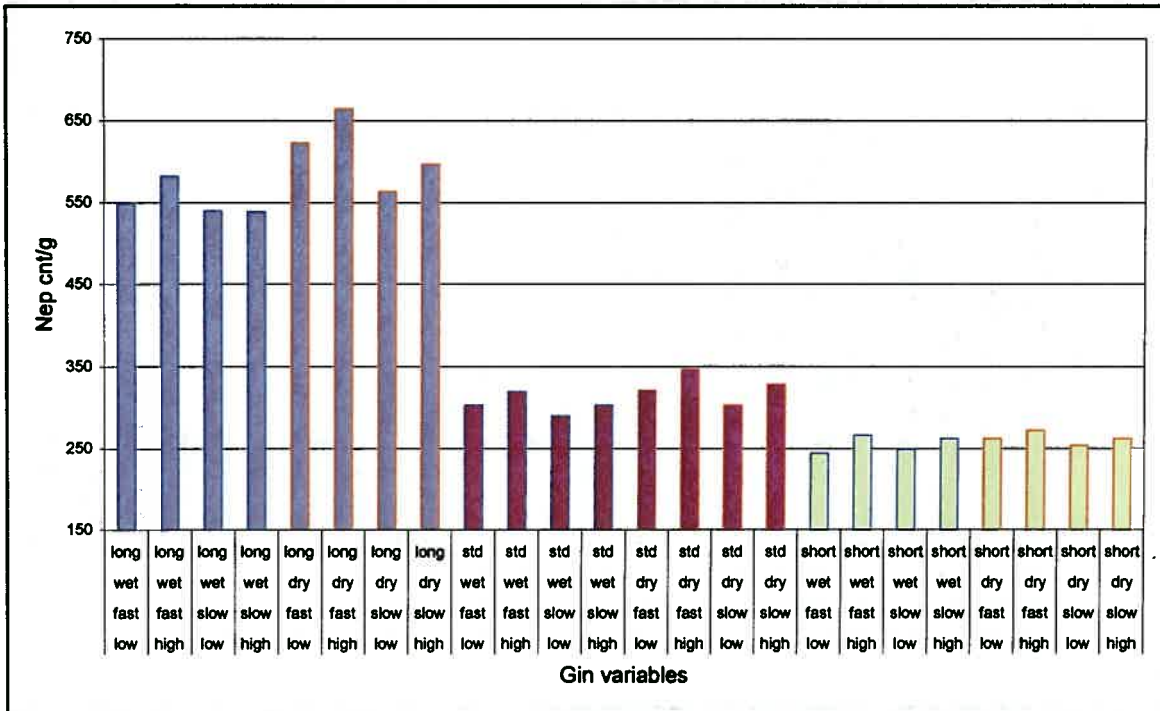


Figure 7 – Nep counts indicated on the basis of cotton type and wet or dry treatment; blue = ‘long & fine’ cotton, maroon = ‘standard’ cotton and beige = ‘short & coarse’ cotton. Blue outline indicates wet treatment, red outline indicates dry treatment. Other variables also listed on x-axis but not highlighted.

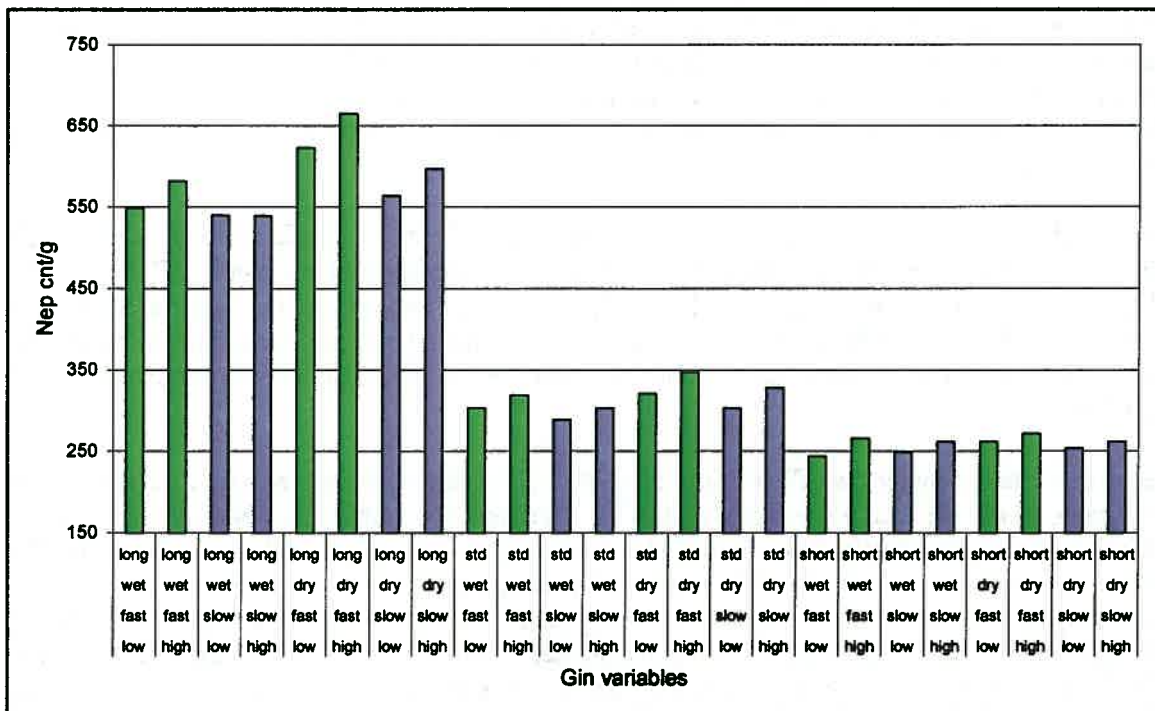


Figure 8 - Nep counts indicated on the basis of LC saw speed; green = fast, blue = slow. Other variables also listed on x-axis but not highlighted.

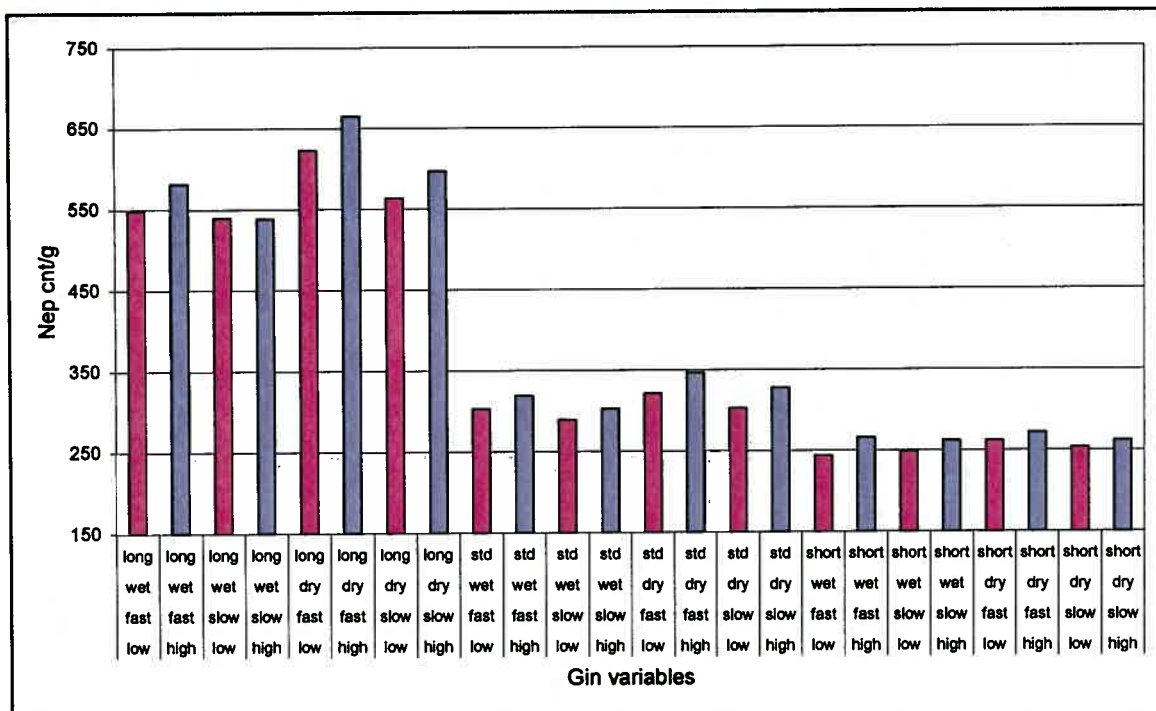


Figure 9 - Nep counts indicated on the basis of combing ratio; pink = low (23), blue = high (50). Other variables also listed on x-axis but not highlighted.

MLC Industrial Trials – Results

Trials of the MLC in industry were conducted over two years. The objective of the trials was to essentially apply the conclusions drawn from the laboratory trials above to industry, i.e. put a lower density batt onto the lint cleaner saw at a lower combing ratio. Moisture content, saw speed and cotton-type were not tested, and we note these did not vary widely during the trials. Trials were performed on the same machines in the same gin each season. No significant changes, other than batt density and combing ratio were made to the lint cleaners and gin stands used.

The trials allowed direct comparison of fibre property effects of standard lint cleaner (SLC) processing with the effects from a SLC fitted with combing grid bar heel (GBH) and the MLC. The effect of combing ratio (19, 23, 27 & 30) on fibre quality through the MLC was tested in 2007 and 2008, and the effect of combing ratio (19 & 27) on quality through the SLC with GBH was tested in 2008. The combing ratio of the SLC was kept constant at 27 for both years.

Except for batt density the effect of the SLC with GBH at a combing ratio of 19 is nominally the same as the MLC at a combing ratio of 19. We note that batt density whilst lighter in the MLC was not necessarily as well controlled as the SLC. Despite an adapted feed roller the extra distance between the MLC's additional drafting rollers was too wide (@ 300 mm) to properly control the batt. At lighter combing ratios the batt would pull apart before being gripped by the final feed rollers. The consequence of this was some unevenness in the MLC feed onto the saw. The likely effect of this was a reduction in the cleaning ability of the MLC, which was reflected in these comparisons, and a lessening of the ameliorating affects of the MLC on nep content. A shorter distance between these draft rollers and smaller roller diameter (from 150 mm to 100 mm) is required to further optimize the MLC performance.

Figures 10 to 15 illustrate comparisons made in 2007 and Figures 16 to 23 illustrate comparisons made in 2008. The 2008 data also compares the effect of each LC system on a before LC and after LC basis.

The trial results show that fibre through the MLC with a combing ratio of 19 was consistently and significantly better in UHML, uniformity and SFC than the SLC with a combing ratio of 27. Moreover the MLC with a combing ratio of 27 gave consistently although not significantly better fibre length properties than the SLC. Analysis of fibre properties before and after LC showed that the reduction in fibre length through the MLC was not statistically significant, whereas the reduction in fibre length through the SLC was consistently significant.

On average, cotton through the MLC with a combing ratio of 19 had 0.02 inches or 0.53 mm more length in terms of UHML (a 2% increase), a 1.34 increase in length uniformity (a 2% increase) and a 1.16% decrease in SFC (a 12% decrease) than the SLC. As per the laboratory trials it was noted the effects were better for longer cotton, with the industrial MLC typically saving 0.03 inches (1/32nd) in cotton with UHML values greater than 1.15 inches.

The results also showed that while there was no significant difference in nep content through each system, neps were consistently lower for the MLC at lower combing ratios and the SLC with GBH at a combing ratio of 19.

Although trash levels as measured by HVI and AFIS were consistently higher for LC systems with lower combing ratios including the MLC, the differences were not significant and not reflected in lower classing grades. It is proposed that further adapting the MLC to improve control of the batt and batt evenness the number of neps and trash could be reduced further.

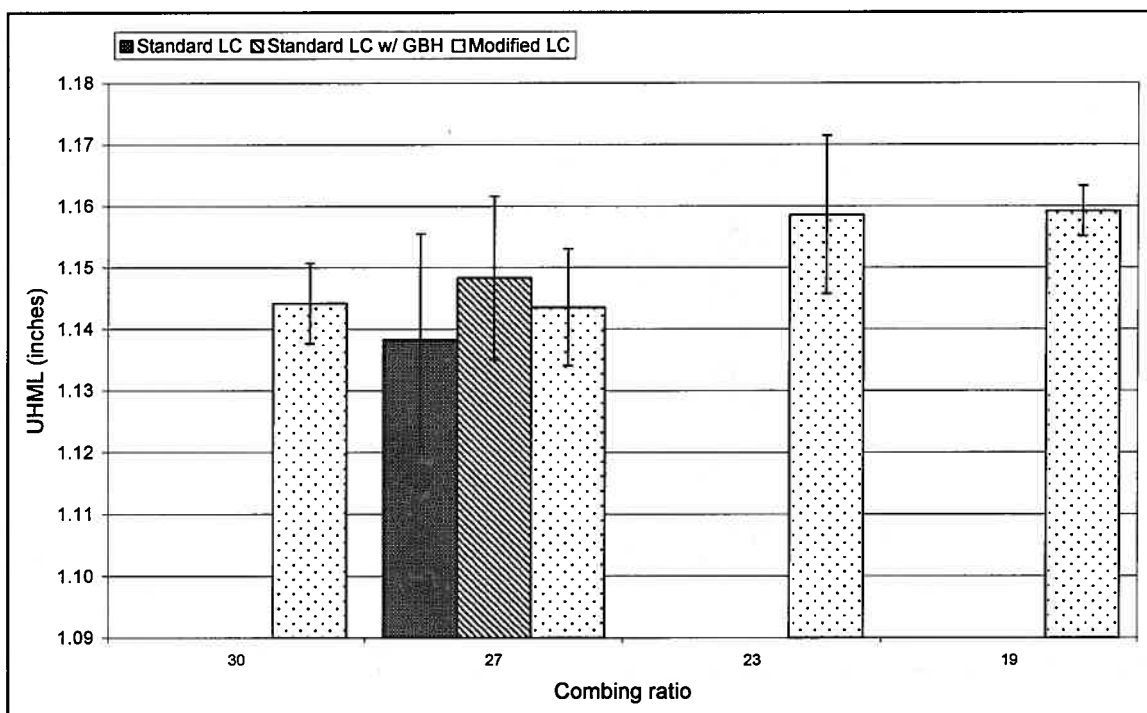


Figure 10 – UHML for combing ratio and LC treatments in 2007

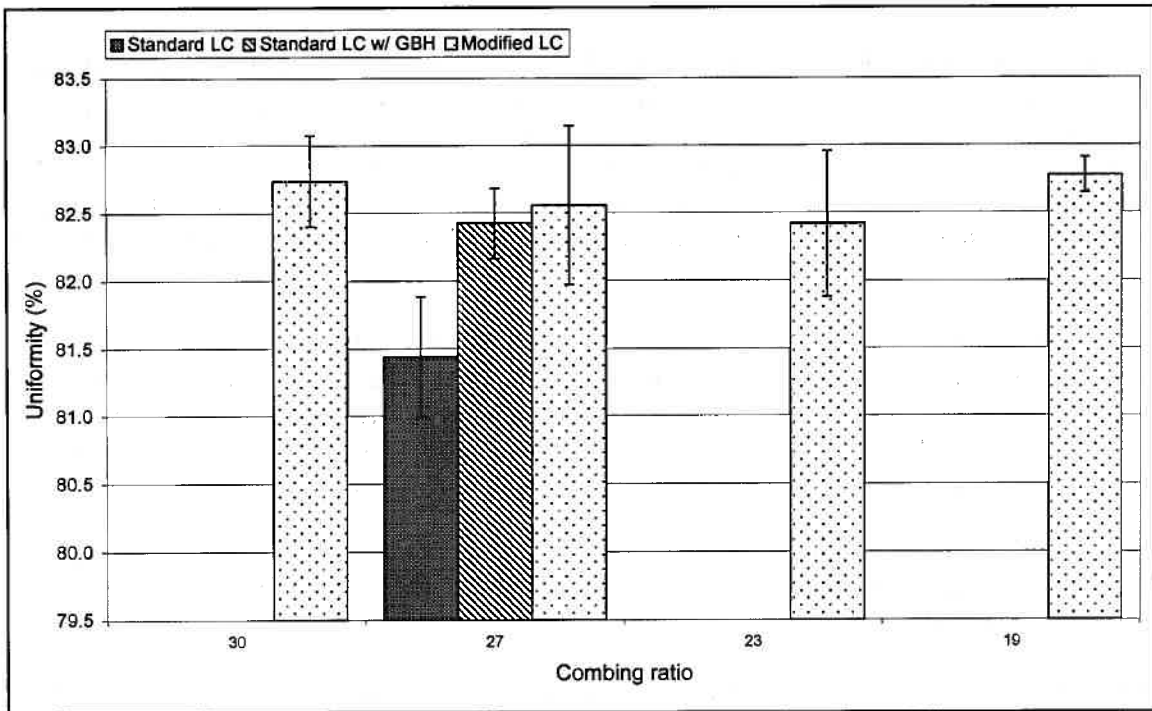


Figure 11 – Uniformity for combing ratio and LC treatments in 2007

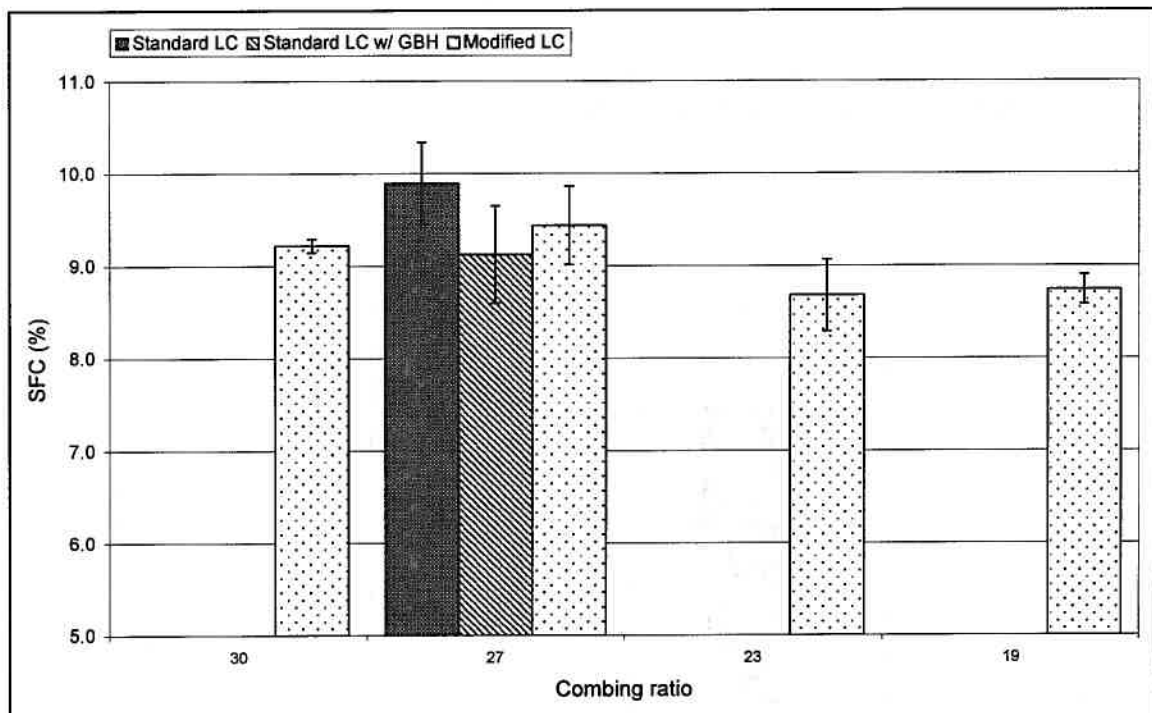


Figure 12 – SFC for combing ratio and LC treatments in 2007

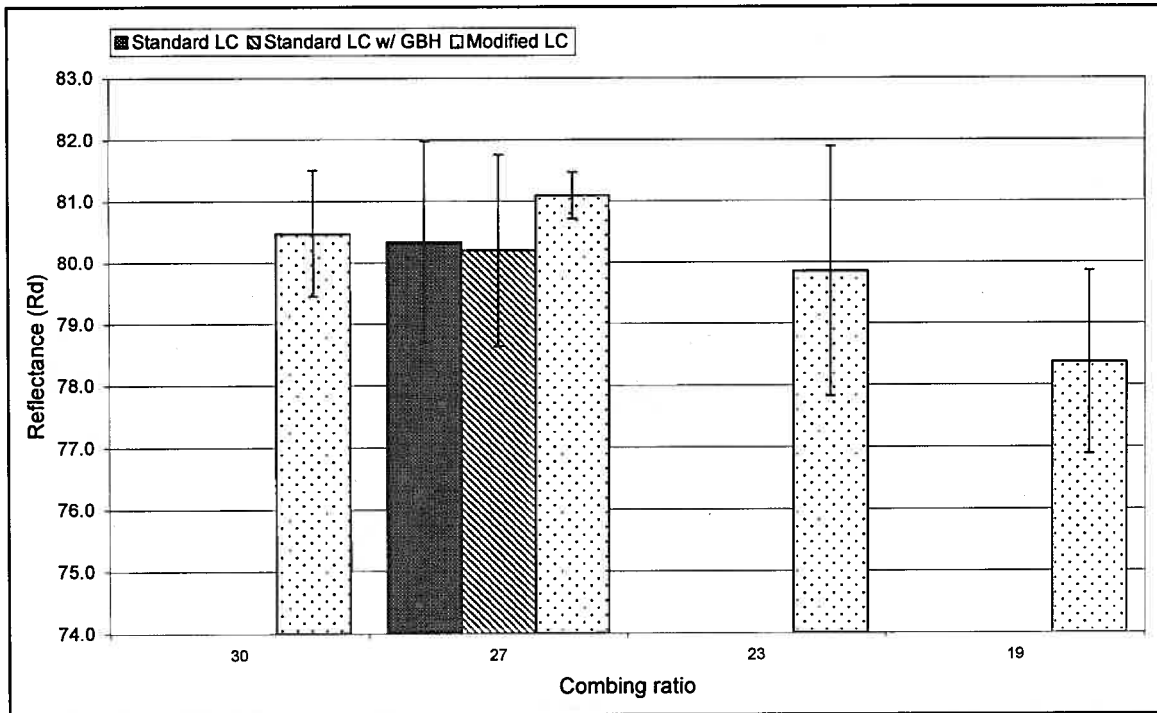


Figure 13 – Reflectance (Rd) for combing ratio and LC treatments in 2007

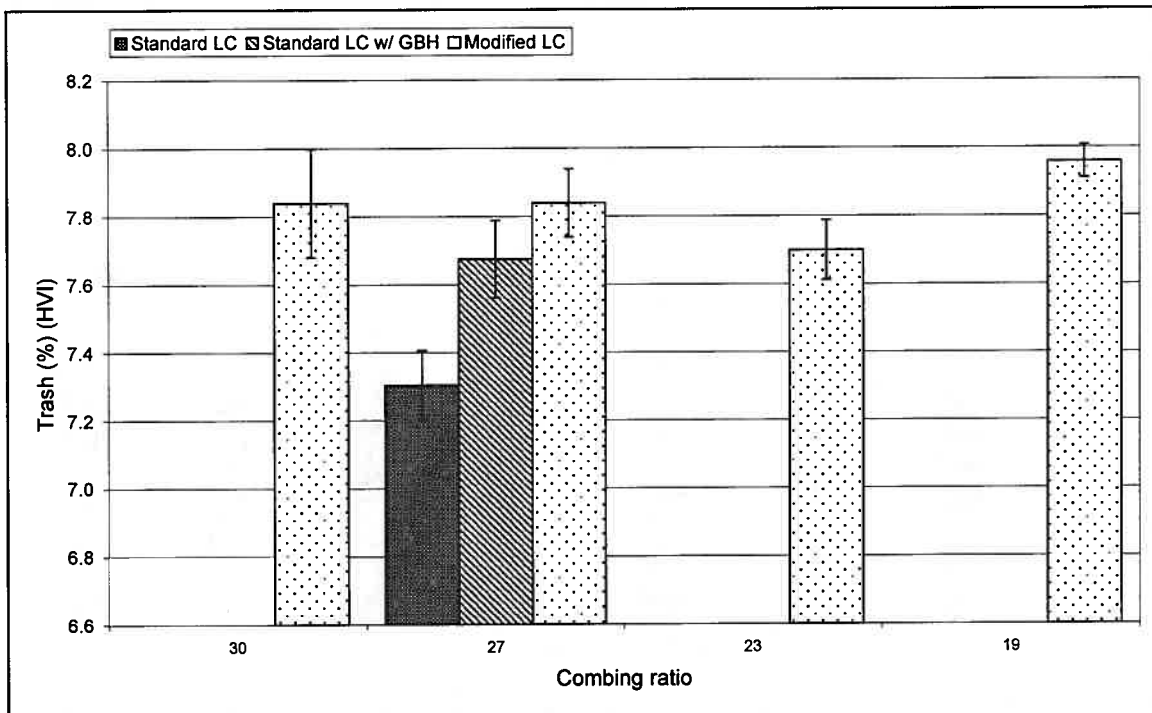


Figure 14 – HVI Trash (%) for combing ratio and LC treatments in 2007

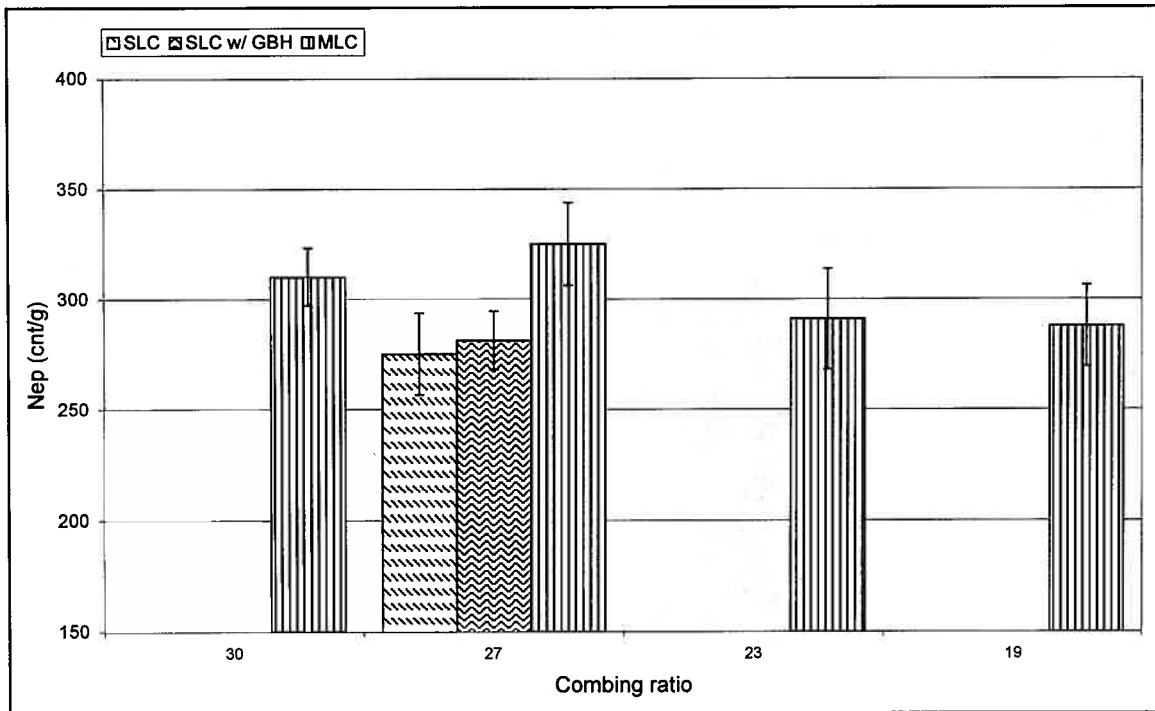


Figure 15 – AFIS Neps (count/g) for combing ratio and LC treatments in 2007

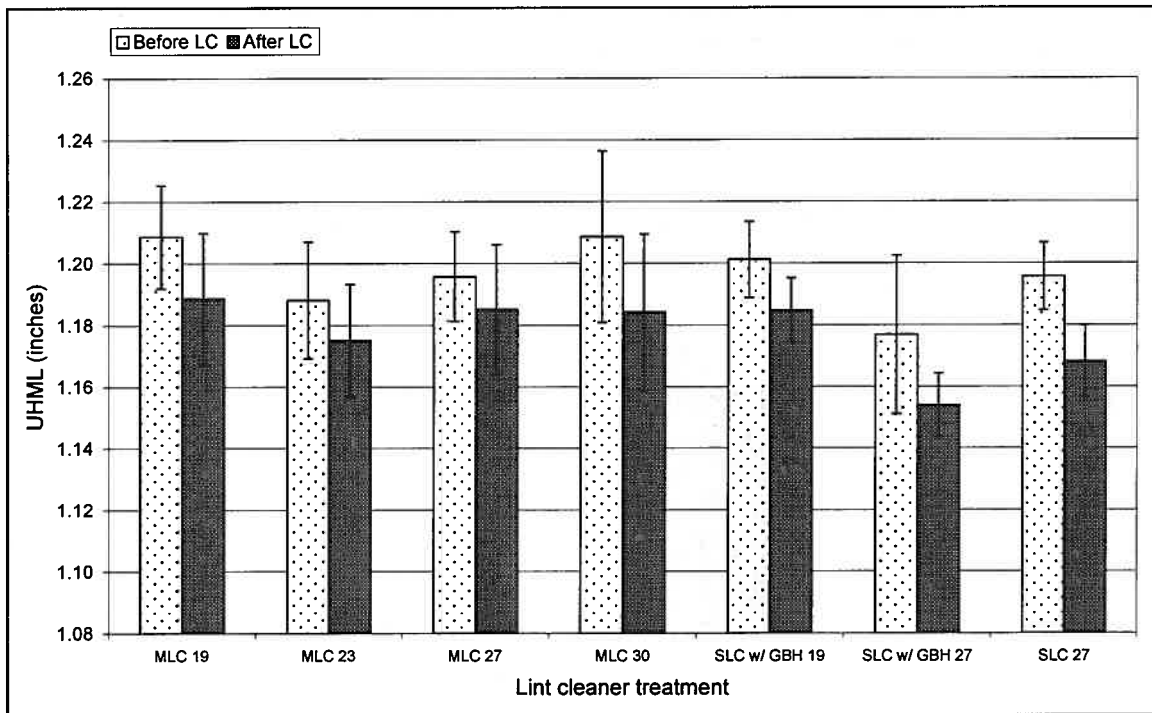


Figure 16 – Difference in UHML (inches) before and after combing ratio and LC treatments in 2008.

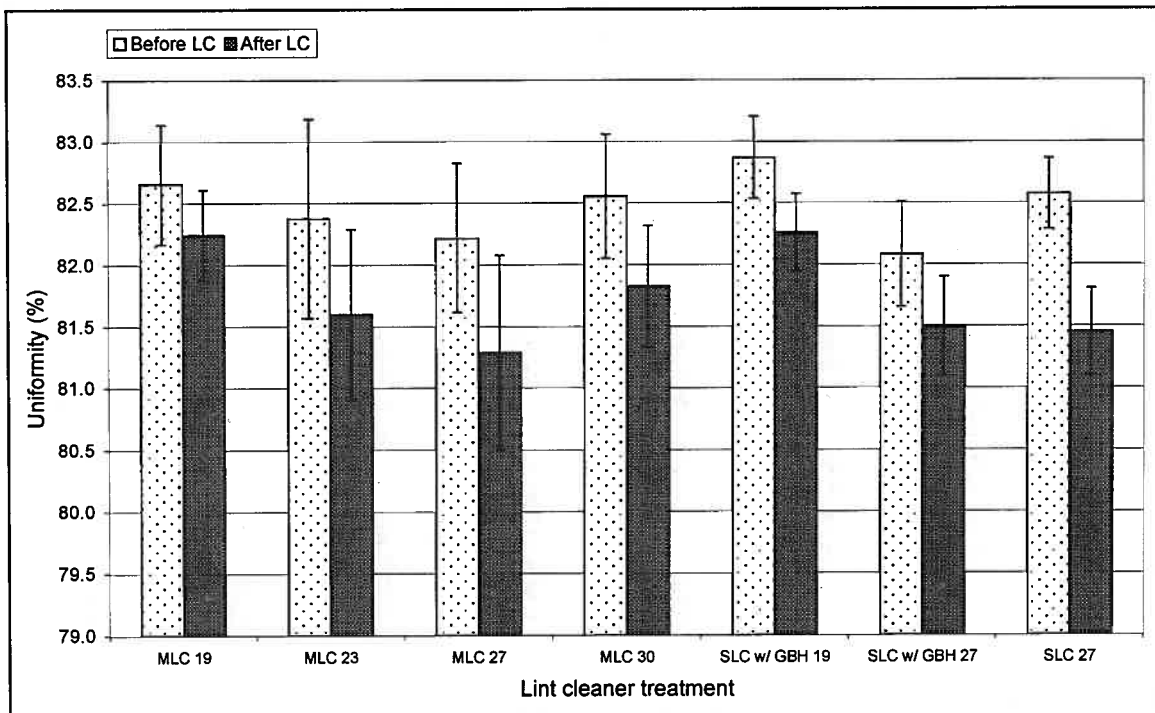


Figure 17 – Difference in Uniformity (%) before and after combing ratio and LC treatments in 2008.

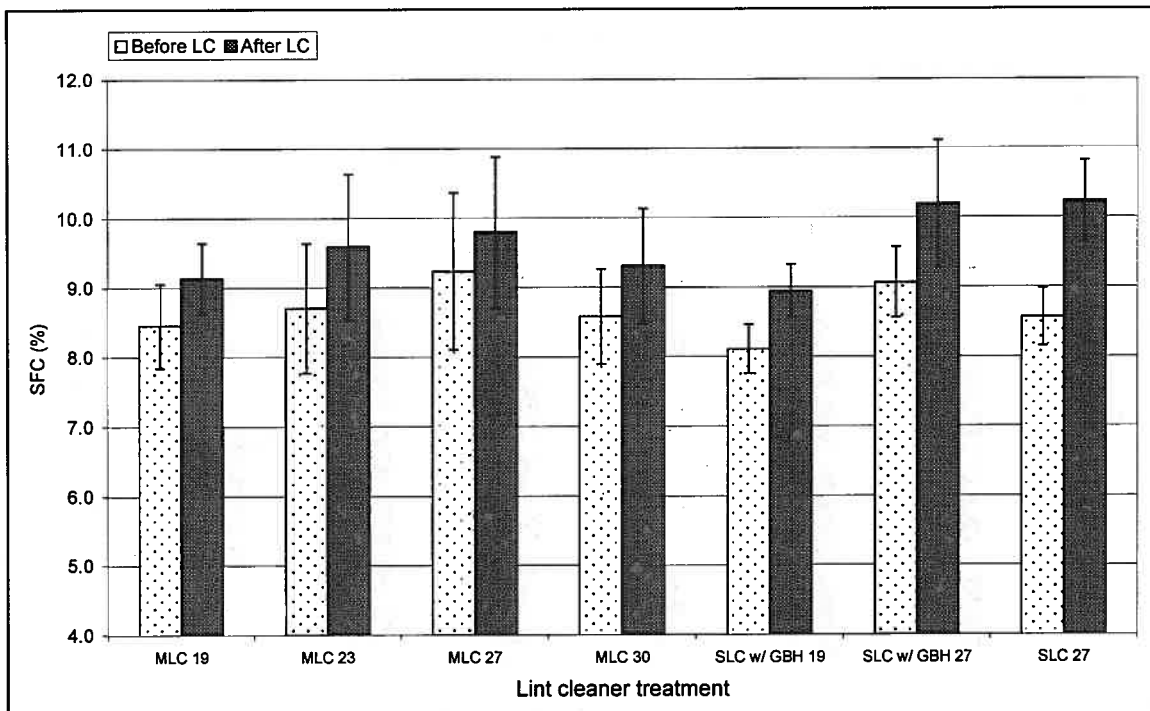


Figure 18 – Difference in SFC (%) before and after combing ratio and LC treatments in 2008.

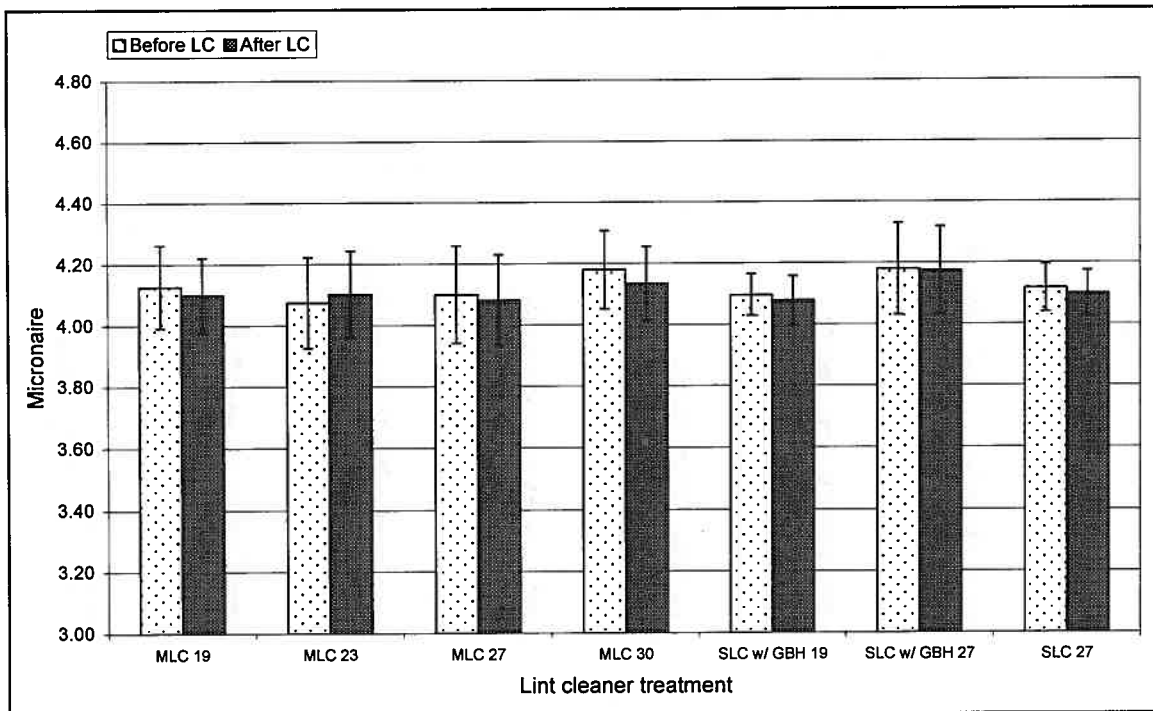


Figure 19 – Difference in Micronaire-value before and after combing ratio and LC treatments in 2008. This Figure is shown to illustrate the uniformity of Micronaire throughout the trial and the negligible effect of CR and LC treatments on its value.

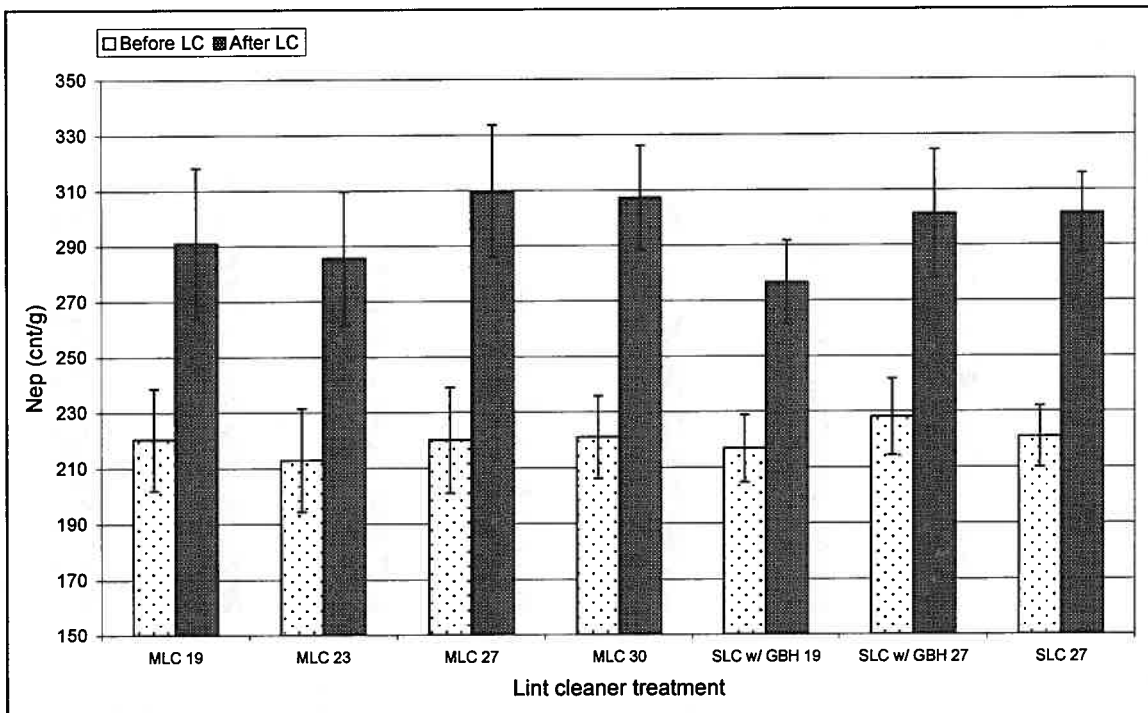


Figure 20 – Difference in Nep (count/g - AFIS) before and after combing ratio and LC treatments in 2008.

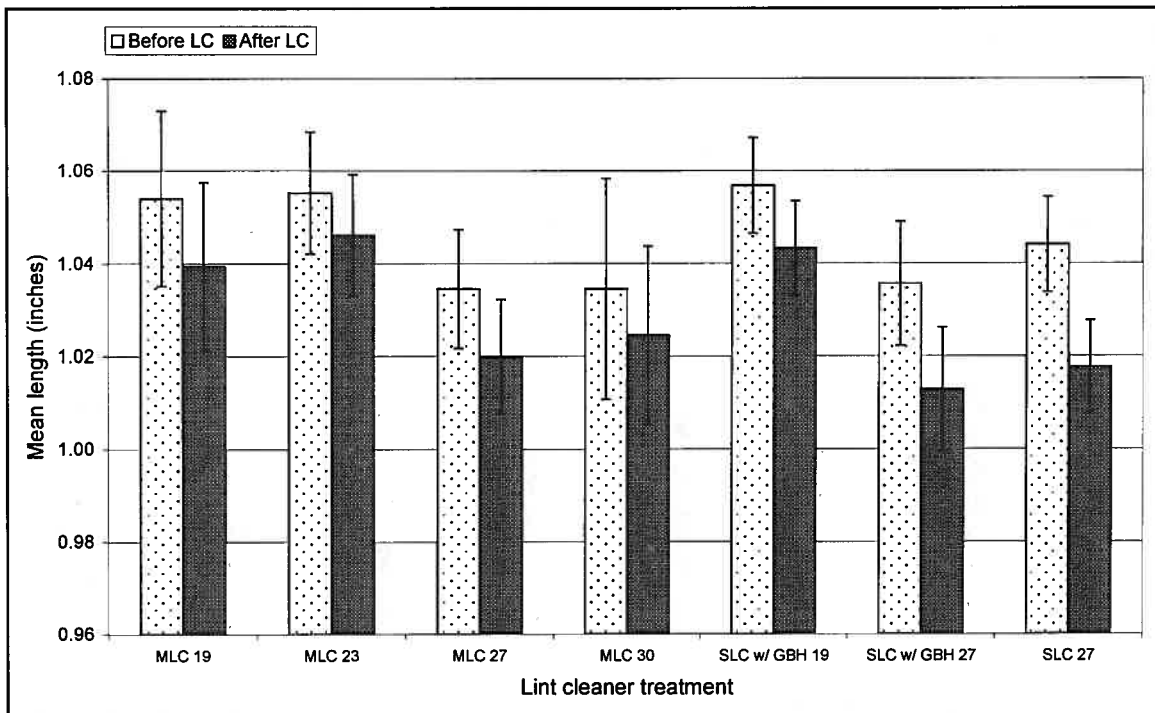


Figure 21 – Difference in average length (inches – AFIS) before and after combing ratio and LC treatments in 2008.

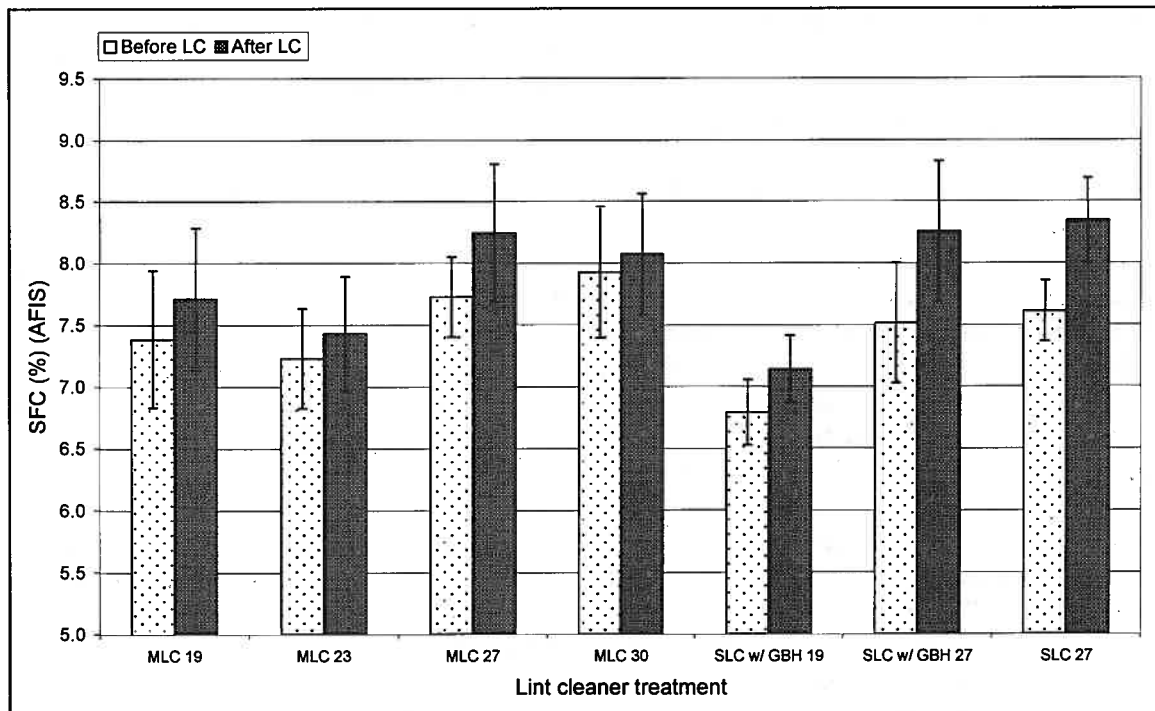


Figure 22 – Difference in SFC (%) (AFIS) before and after combing ratio and LC treatments in 2008.

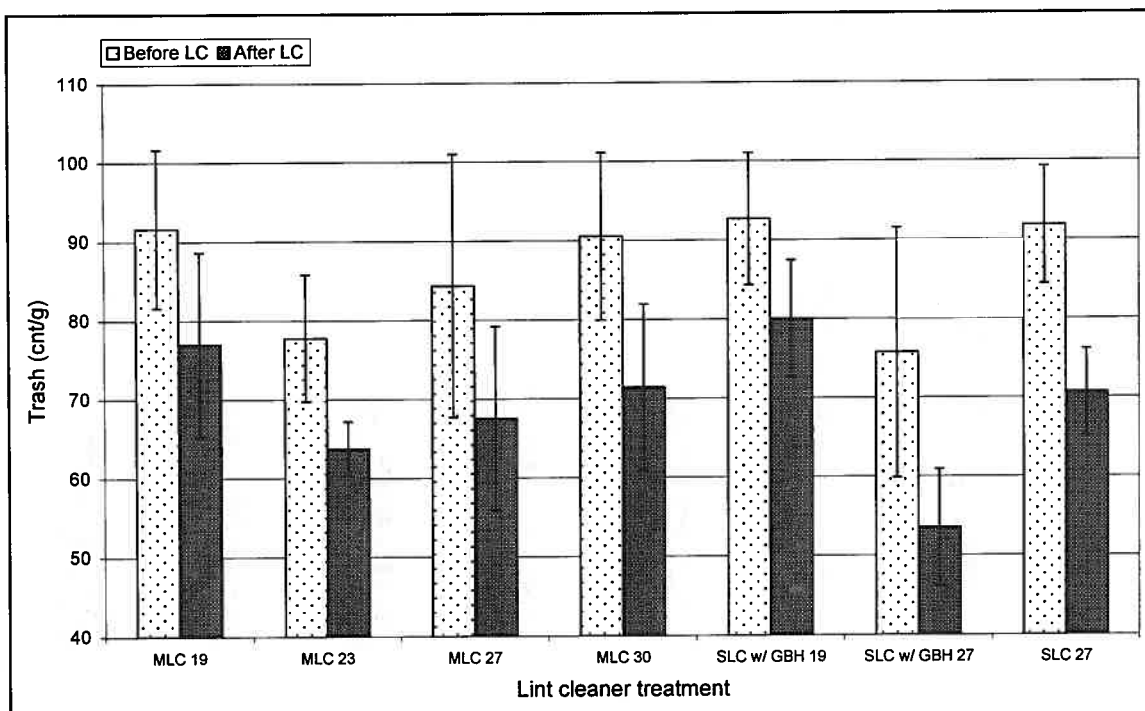


Figure 23 – Difference in Trash (count/g – AFIS) before and after combing ratio and LC treatments in 2008.

Conclusion

Observations from flow and mass sensors applied to a commercial gin in the first year of the project, showed the delivery of fibre from the gin by the current system was too fast and too uneven to be auto-levelled. Work on the project subsequently defaulted to proving and extending the veracity of the MLC to industry.

In laboratory and industrial trials the effects of LC set-up and the application of the MLC on fibre properties were examined. Laboratory trials that varied cotton type, moisture, saw speed, batt density and combing ratio showed the cumulative affect of these variables on nep reduction is much less than their individual contribution. The total reduction in nep count in long, fine cotton, as a result of subjecting moist cotton to low batt density and low combing ratios and saw speeds, was around 20%. Individually, cotton-type, saw speed, combing ratio and moisture content all had significant effects on nep content. Similar effects were seen for average fibre length and SFC. Trash results were affected by cotton-type, saw speed and combing ratio but not moisture content.

Industrial trials showed cotton through the MLC with a combing ratio of 19 had 0.02 inches or 0.53 mm more length in terms of UHML (a 2% increase), a 1.34 increase in length uniformity (a 2% increase) and a 1.16% decrease in SFC (a 12% decrease) than the SLC. It is noted the effects as per the laboratory trials were better for longer cotton, with the MLC typically saving 0.03 inches (1/32nd) in cotton with UHML values greater than 1.15 inches. The results also showed that while there was no significant difference in nep content of fibre through a SLC or MLC, neps were consistently lower for the MLC at lower combing ratios.

Although trash levels as measured by HVI and AFIS were consistently higher for LC systems with lower combing ratios including the MLC, the differences were not significant and not reflected in lower classing grades. It is proposed that further adapting the MLC to improve control of the batt and batt evenness the number of neps and trash could be reduced further.

Extension Opportunities

As per intentions of the EOI document – see Appendix 2.

Publications

1. Gordon, S. G. and Bagshaw, K. M., The effect of working elements in the fixed batt saw lint cleaner on ginned fibre properties, *proceed.* Beltwide Cotton Conference; New Orleans, LA. 2007
2. Bange, M., Long, R. L., Constable, G. and Gordon, S. G., Evaluation of in-field monitoring methods to reduce neps, *proceed.* Beltwide Cotton Conferences, National Cotton Council, San Antonio TX, Jan 2009
3. Apparatus and Process for Cleaning Cotton – Provisional patent application re-filed – March 2009 AU2007/901174
4. Gordon, S. G., Bagshaw, K. M. and Horne, F. A., The effect of lint cleaner elements, settings and humidification on cotton fibre quality: Laboratory trials – Part I, *Transactions of ASABE*, (in preparation)
5. Gordon, S. G., Bagshaw, K. M. and Horne, F. A., The effect of lint cleaner elements and settings on cotton fibre quality: Industrial trials – the modified lint cleaner – Part II, *Transactions of ASABE*, (in preparation)

Part 4 – Final Report Executive Summary

There is evidence the nep and short fibre content of Australian cotton is too high compared with other growths of similar quality. These characteristics are a result of the productive and efficient harvest and ginning practices utilized by the Australian industry but the problem is exacerbated by current lint cleaner design. In particular, the combination of lint cleaner elements, i.e. the feed rollers and feed bar, grid bars and the doffing brush around the lint cleaner saw, and the transfer ratios between these elements affect fibre quality.

The broad aim of this project was to adapt and re-engineer the existing fixed batt saw lint cleaner to reduce short fibre and nep content. The main adaptation proposed at the start of this project was an auto-levelling system for the lint cleaner feed such that the weight of fibre transferred onto the saw would always be constant. In addition to monitoring fibre mass and airflow, new combing grid bar heels were designed and fitted to the modified lint cleaner (MLC).

Unfortunately, the auto-levelling system could not be applied without significant changes to the lint cleaner feed. The changes required were beyond the scope of this project. Nevertheless, plans for a new feed system to deliver a more even and thicker batt to the lint cleaner were drawn up. Aside from auto-levelling capabilities another advantage of collecting and evenly feeding fibre through a buffer hopper is that it would avoid large volumes of air being drawn through the fibre prior to cleaning and provide the opportunity for the fibre to be conditioned before the fibre is cleaned by the lint cleaner saw.

Industrial trials showed that on average cotton through the MLC operated at lower combing ratios had 0.02 inches or 0.53 mm more length in terms of UHML (a 2% increase), a 1.34 increase in length uniformity (a 2% increase) and a 1.16% decrease in SFC (a 12% decrease) than the SLC. It is noted the effects as per the laboratory trials were better for longer cotton, with the MLC typically saving 0.03 inches (1/32nd) in cotton with UHML values greater than 1.15 inches.

The results also showed that while there was no significant difference in nep content through each system, neps were consistently lower for the MLC at lower combing ratios. Although trash levels as measured by HVI and AFIS were consistently higher for LC systems with lower combing ratios including the MLC, the differences were not significant and not reflected in lower classing grades. It is proposed that further adapting the MLC to improve control of the batt and batt evenness the number of neps and trash could be reduced further.

These results confirm the commercial potential of the MLC, which will be tested in the near future through the release of an EOI document outlining preferred commercialisation of the MLC.

Appendix 1

Gordon, S. G. and Bagshaw, K. M., The effect of working elements in the fixed batt saw lint cleaner on ginned fibre properties, *proceed.* Beltwide Cotton Conference; New Orleans, LA. 2007

Appendix 2

CSIRO Expression of Interest (EOI) call (November 2009)

Appendix 2a

Business rationale for patenting the MLC

Appendix 3

PRP – CRDC Investment for 2009/10, New fibre conveyance system for Australian cotton gins (Ginning I)

Appendix 4

Ginning conveyor – working doc

