Cotton Catchment Communities CRC

FINAL REPORT

(due within 3 months on completion of project)

Part 1 - Summary Details

Cotton CRC Project Number: 4.03.07

Project Title: Upgrade and evaluate modified lint cleaner

Project Commencement Date: 7/2010 **Project Completion Date:** 6/2011

Cotton CRC Program: Value Chain

Part 2 – Contact Details

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Background

The objective of the proposed project was to upgrade the modified lint cleaner (MLC) as per the conclusions of CRC Project No. 4.03.03, and evaluate the upgraded system in terms of fibre quality and trash removal.

Industrial trials as part of CRC Project No. 4.03.03 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 standard lint cleaners (SLC). The results also showed that whilst there was no significant difference in nep generation 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.

At the conclusion of the Project No. 4.03.03 it was proposed that upgrades to the MLC including reducing the diameter of the new draft rollers, reducing the draft distance between the condenser doffing rollers and the new draft rollers and revising the draft ratios between roller sets, would further improve fibre length and reduce the number of neps and trash.

These upgrades were implemented prior to the start of the 2010 ginning season and evaluation trials were completed by the end of July 2010. The evaluation trials also sought to separate effects associated with gin speed, lint cleaner combing ratio and feed bar settings.

Overall the results indicated statistically significant improvements in fibre properties using the upgraded MLC for cotton ranging in length from $35/32^{nd}$ (1.095) inches through to $39/32^{nd}$ (1.195) inches. Length (UHML), length uniformity (ML/UHML %), short fibre index (SFI), USDA leaf grade and neps (AFIS) all improved through the MLC, although the improvements were minor in terms of fibre value. Effects on fibre length were more muted for cotton in excess of 1.17 inches, although like the shorter cotton this cotton was cleaner in terms of leaf grade.

Project Objectives

The objectives of the project and their achievement status are listed in Table I below.

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

Objective	No.	Milestone	Performance Indicator	Achieved
Successfully upgrade modified lint cleaner (MLC) as per CRC Project 4.03.03	1	MLC successfully upgraded	New draft rollers fitted and draft distance shortened.	✓
Evaluate upgraded MLC	2	Effect of upgrades evaluated	Results show effect of upgrade on fibre quality. Results allow decisions to be made on MLC commercial potential.	✓

Methods

Versions of the MLC have been fitted to the first lint cleaner of gin stand 1 in Gin 8 at the Auscott Narrabri Gin since 2005. This lint cleaner was upgraded again according to CSIRO instructions in March/April 2010.

The invoice from Auscott to CSIRO for this work is attached as Appendix 1.

The upgrade included replacing the fluted draft rollers used by the MLC to date that had been 150 mm in diameter, with smaller fluted rollers of 100 mm diameter, and reducing the thickness of the roller chassis. Figure 1 shows the second version of the MLC rollers and chassis. The effect of reducing the roller size and distance means the drafting distances between the doffing rollers and the MLC draft rollers; and the feed rollers at the feed plate are reduced. Reducing this distance from 300 mm from roller nip-to-nip to around 200 mm allows the fibre batt drawn from the condenser doffer rollers to be drafted more evenly through the MLC draft and feed rollers, avoiding clumping of fibres and leading to a more open and even batt thereby reducing fibre loss and improving opening (cleaning).

Figure 1 – Photo showing draft rollers and chassis fitted to the first lint cleaner on gin stand one in Gin 8 Auscott Narrabri. In the upgraded version the 150 mm rollers are replaced with 100 mm rollers and the chassis is reduced in thickness.

Evaluation of the upgraded MLC was carried out on June 29th and 30th and July 14th 2010. Locally grown (lower Namoi Valley) cotton (var. Sicala 70BL and 71BRF) by three different growers was used in the evaluations. Field quality was kept constant throughout each evaluation day, i.e. gin and fibre comparisons were limited to one grower and one field.

Fibre quality comparisons were made between fibre ginned and sampled at the same time through the MLC and the adjacent standard lint cleaner (gin stand 2 of Gin 8), which like the MLC also had a toothed heel grid bar fitted to the second grid bar position. This grid bar helps break open fibre clumps and keeps fibre engaged in the saw teeth. Figure 2 shows the toothed heel grid bar.

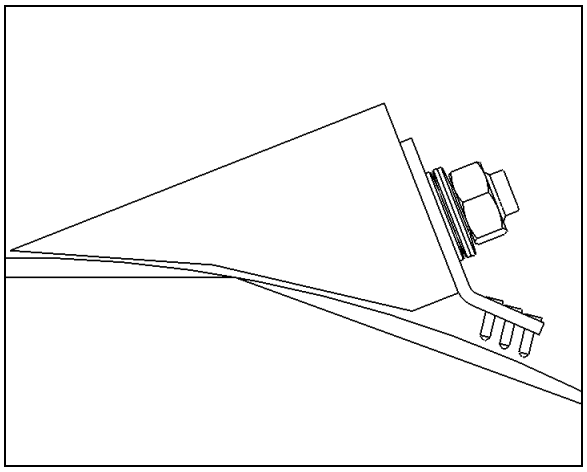

Figure 2 – Toothed heel grid bars fitted to the second grid bar position on the MLC and SLC evaluated in this study

A range of gin and lint cleaner settings were also tested including gin speed (2 treatments – limited to evaluations on June 29th and 30th), combing ratio (3 treatments) and feed plate settings (2 – limited to the last evaluation). To keep dependency of trash removal only on lint cleaner action the Super-J trash exit points were closed on gin stands one (MLC) and gin stand two (standard lint cleaner – SLC) of Gin 8. Gin production and seed fingers settings were also checked on both stands and adjusted so that they were the same. Table II below lists the gin/lint cleaner production treatments checked during the MLC evaluation.

Table II – Evaluation of the MLC; treatments applied

Treatment	Number and type of treatment applied
Variety (day)	3 (days/varieties/growers)
Lint Cleaner	2 (MLC vs. SLC)
Gin (motor) speed	2 (140 A vs. 170 A)
Lint cleaner combing ratio	3 (low, std. and high)
Lint cleaner feed plate	2 (out 1/8 inch vs. in 1/16 inch)

Fibre samples were collected from behind lint cleaners and subject to HVI and AFIS tests.

Trash was also collected from across the grid bars of lint cleaners during evaluation of feed plate settings on the MLC (trials on July 14th). The setting of the feed plate closer to the saw (1/16th vs. 1/8th inches) was undertaken to gauge what would happen when the lighter batt of the MLC was delivered more closely to the saw (teeth). It had been proposed previously that the lighter batt might not engage so well with the saw teeth if the feed plate was positioned higher to the saw. Figure 3 shows the feed plate to saw gap situation.

A perforated tray was fashioned to collect trash removed over the grid bars of both lint cleaners for given periods. Figure 4 shows photos of the trash collection point. Collected trash was weighed to determine cleaning rates for both lint cleaners, and then cleaned to determine percent fibre in the collected trash.

Figure 3 – Photo showing a high feed plate setting (> 1/8th inch) to saw (Lummus lint cleaner)

Figure 4 – (a) Top view of trash and fibre being removed by lint cleaner grid bars; and (b) bottom view, showing the access point where trash was collected beneath lint cleaner

Results and Outcomes

Table III and Figures 5 to 10 illustrate the measured affects of the MLC and other gin treatments on the quality of cotton ginned on June 29th and 30th. Fibre length through the MLC was statistically longer and more uniform and the fibre was cleaner in terms of particle count and USDA leaf grade. Although combing ratio and gin speed also had significant effects on fibre quality, the MLC effects were largest and most consistent. The MLC had no statistical affect on nep levels although as per previous work nep levels were slightly lower than the SLC, albeit still at a high level.

Table III – Grand average fibre property results (n = 60) from lint cleaner evaluations on June 29th and 30th 2010 at Auscott Gin 8

Property	MLC (1)	SLC (2)
UHML (inches)	1.155**	1.143
UNI (%)	80.72*	80.37
SFI (%)	8.92**	9.24
Leaf (USDA Grade)	2.23**	2.60
Neps (cnt/g)	421	429
Trash (cnt/g)	48**	75

** indicate statistical significance at $P \leq 0.001$

* indicate statistical significance at $P \leq 0.05$

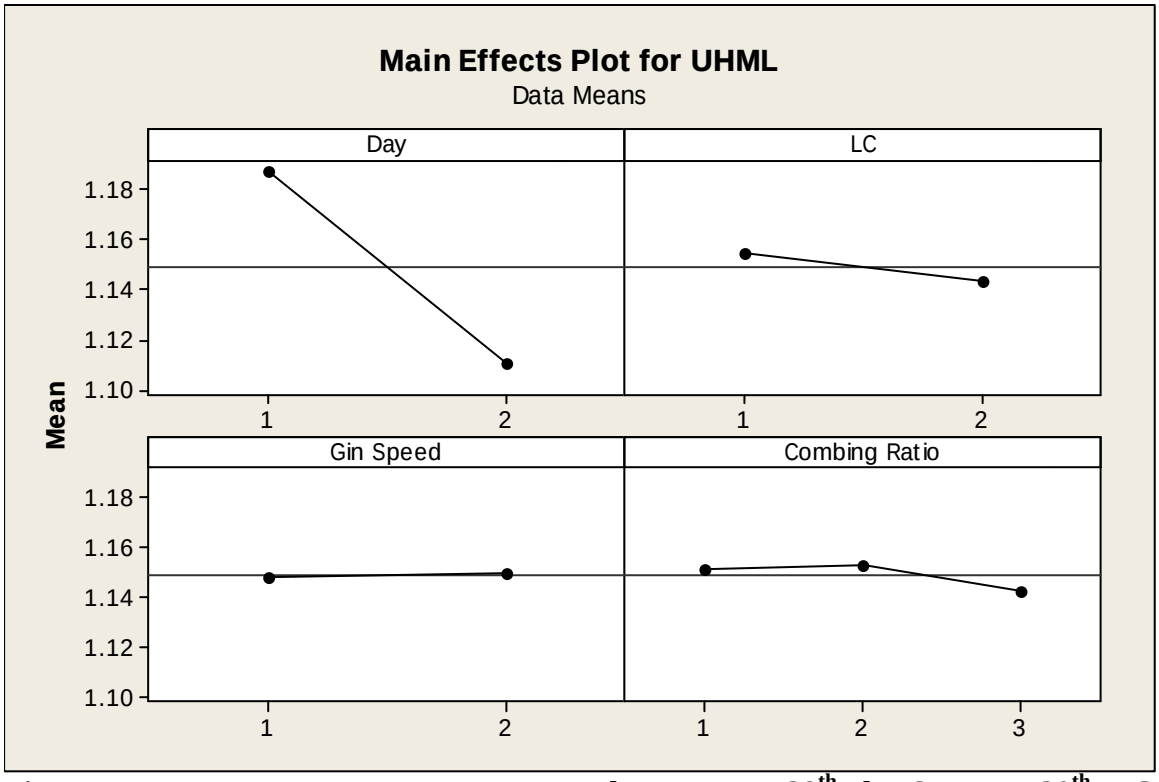

Figure 5 – UHML averages per treatment; day 1 = June 29th, day 2 = June 30th; LC 1 = MLC, LC 2 = SLC; gin speed 1 = fast, gin speed 2 = slow; combing ratio 1 = standard, 2 = low, 3 = high.

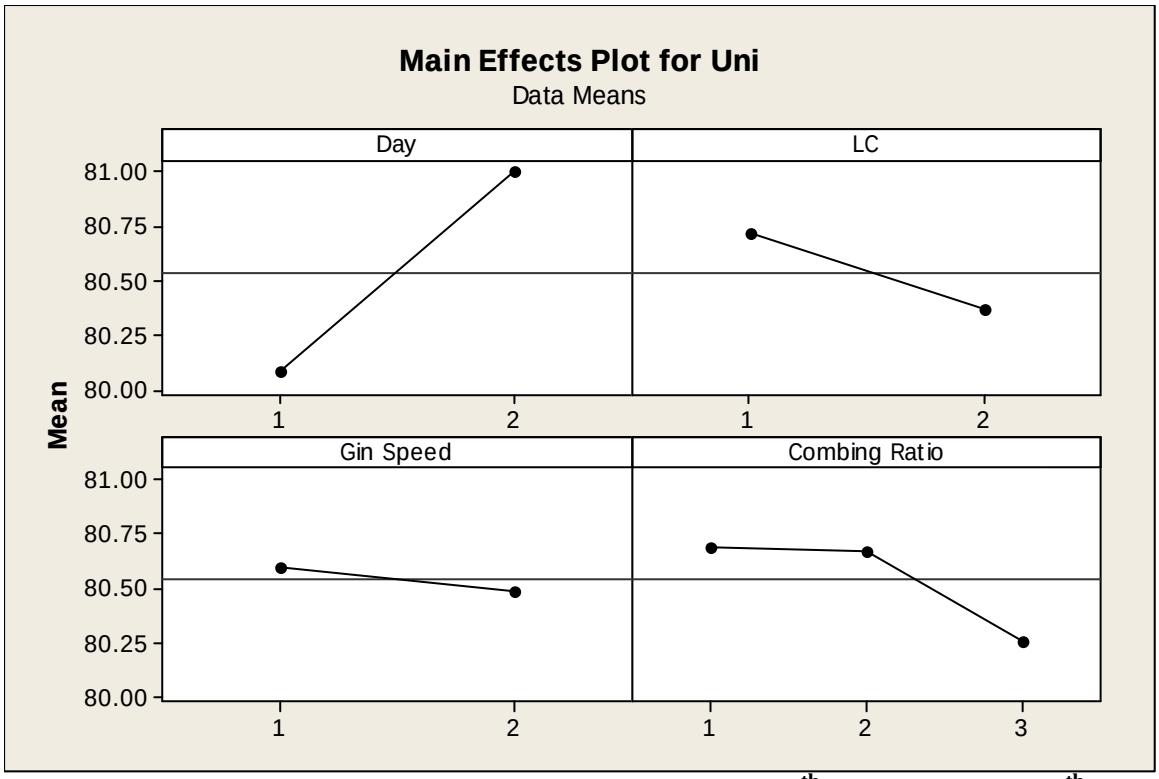

Figure 6 – UNI averages per treatment; day 1 = June 29th, day 2 = June 30th; LC 1 = MLC, LC 2 = SLC; gin speed 1 = fast, gin speed 2 = slow; combing ratio 1 = standard, 2 = low, 3 = high.

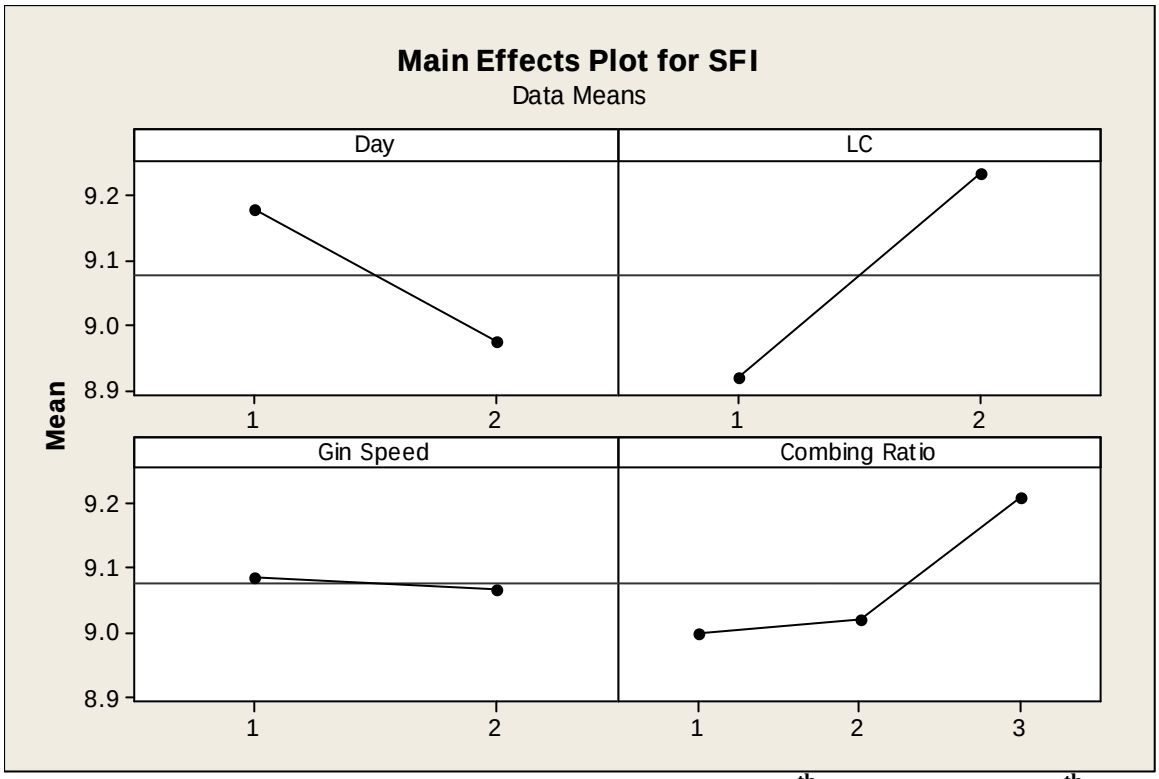

Figure 7 – SFI averages per treatment; day 1 = June 29th, day 2 = June 30th; LC 1 = MLC, LC 2 = SLC; gin speed 1 = fast, gin speed 2 = slow; combing ratio 1 = standard, 2 = low, 3 = high.

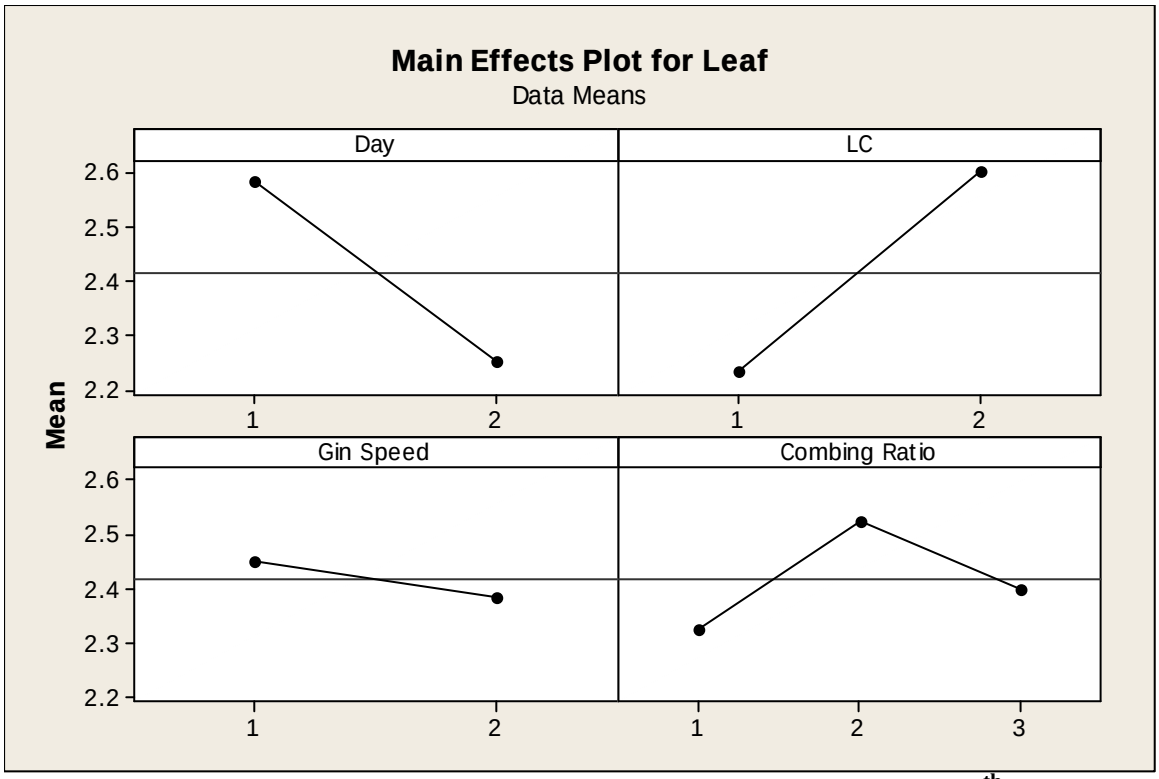

Figure 8 – HVI Leaf Grade averages per treatment; day 1 = June 29th, day 2 = June 30th; LC 1 = MLC, LC 2 = SLC; gin speed 1 = fast, gin speed 2 = slow; combing ratio 1 = standard, 2 = low, 3 = high.

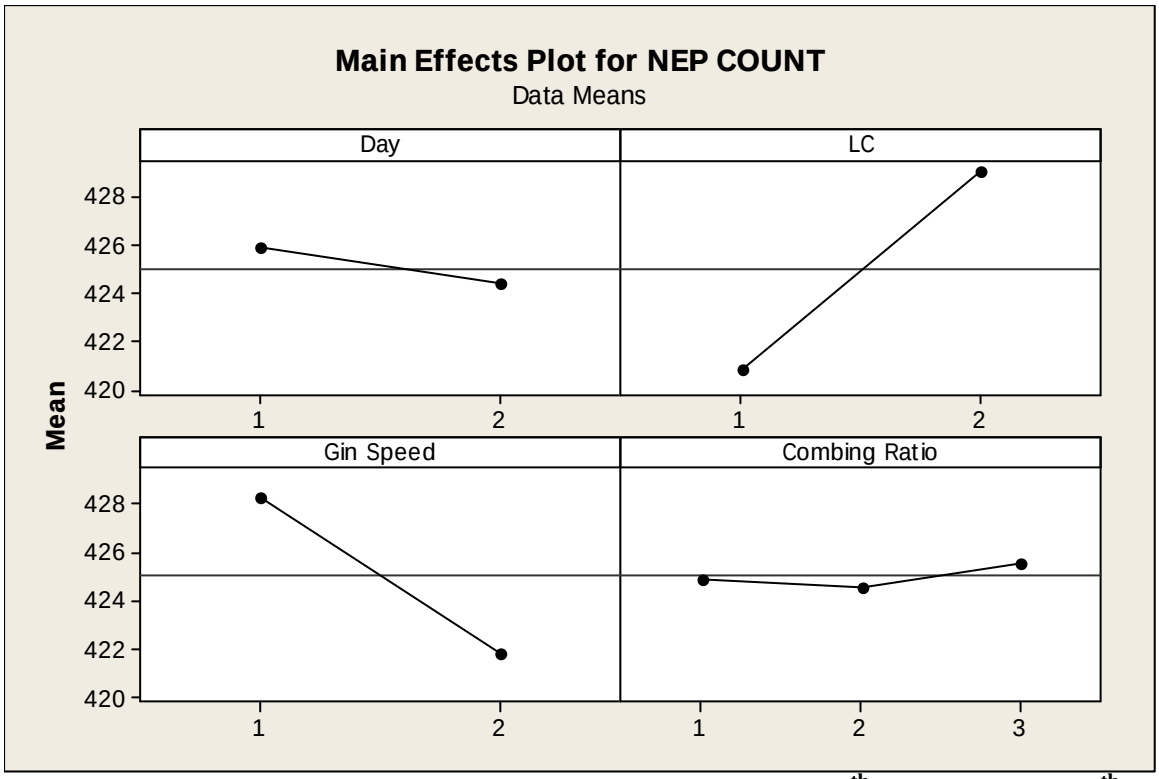

Figure 9 – Nep count averages per treatment; day 1 = June 29th, day 2 = June 30th; LC 1 = MLC, LC 2 = SLC; gin speed 1 = fast, gin speed 2 = slow; combing ratio 1 = standard, 2 = low, 3 = high.

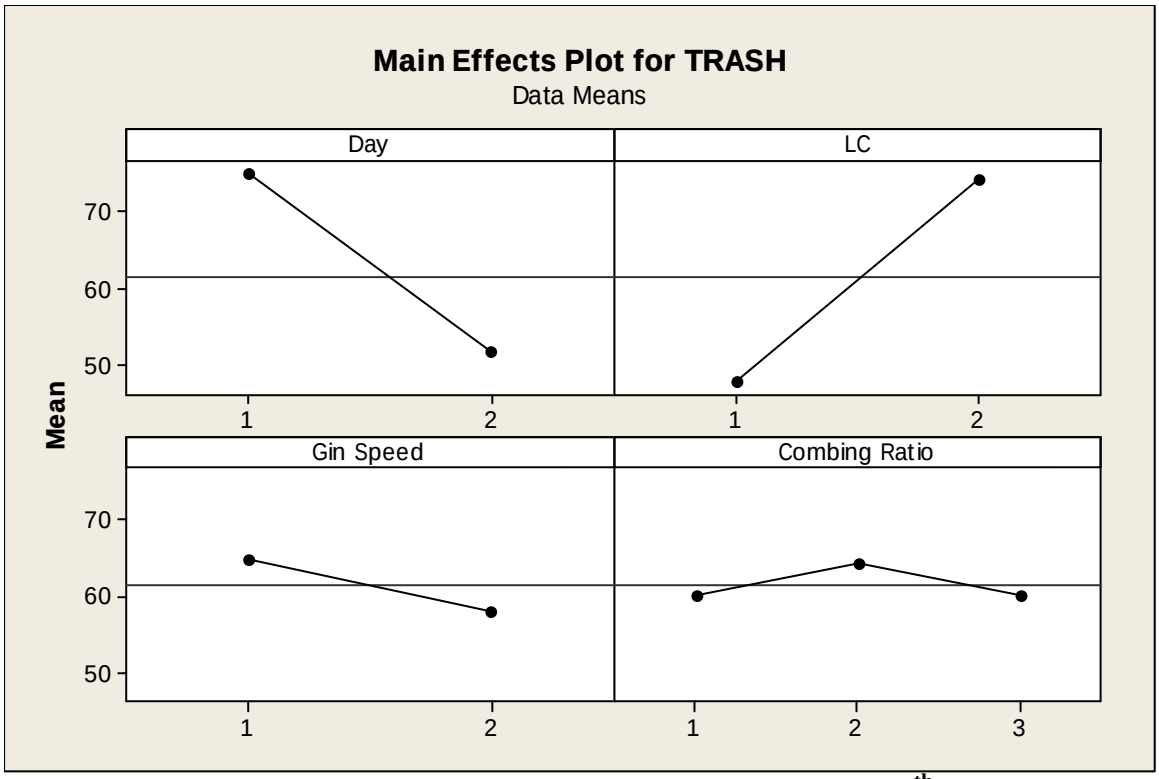

Figure 10 –Trash count averages per treatment; day 1 = June 29th, day 2 = June 30th; LC 1 = MLC, LC 2 = SLC; gin speed 1 = fast, gin speed 2 = slow; combing ratio 1 = standard, 2 = low, 3 = high.

Table IV and Figures 11 and 12 illustrate the affects of the MLC on longer staple cotton (> 38/32nd) tested on July 14th. These results reflect previous work on the effects of lint cleaner elements and settings on fibre quality – see Appendix 2. In this work the length of longer cotton was not improved as much when combing ratio was reduced, particularly if batt density remained high. Trash levels in the MLC processed longer cotton were however lower than the same cotton processed through the SLC.

Table IV – Fibre property results from lint cleaner evaluations July 14th 2010

Property	**MLC**	**SLC**
UHML (inches)	1.1975*	1.2101
UNI (%)	80.457*	81.013
SFI (%)	8.7833	8.6167
Leaf (USDA Grade)	2.70**	2.97

** indicate statistical significance at $P \leq 0.001$

* indicate statistical significance at $P \leq 0.05$

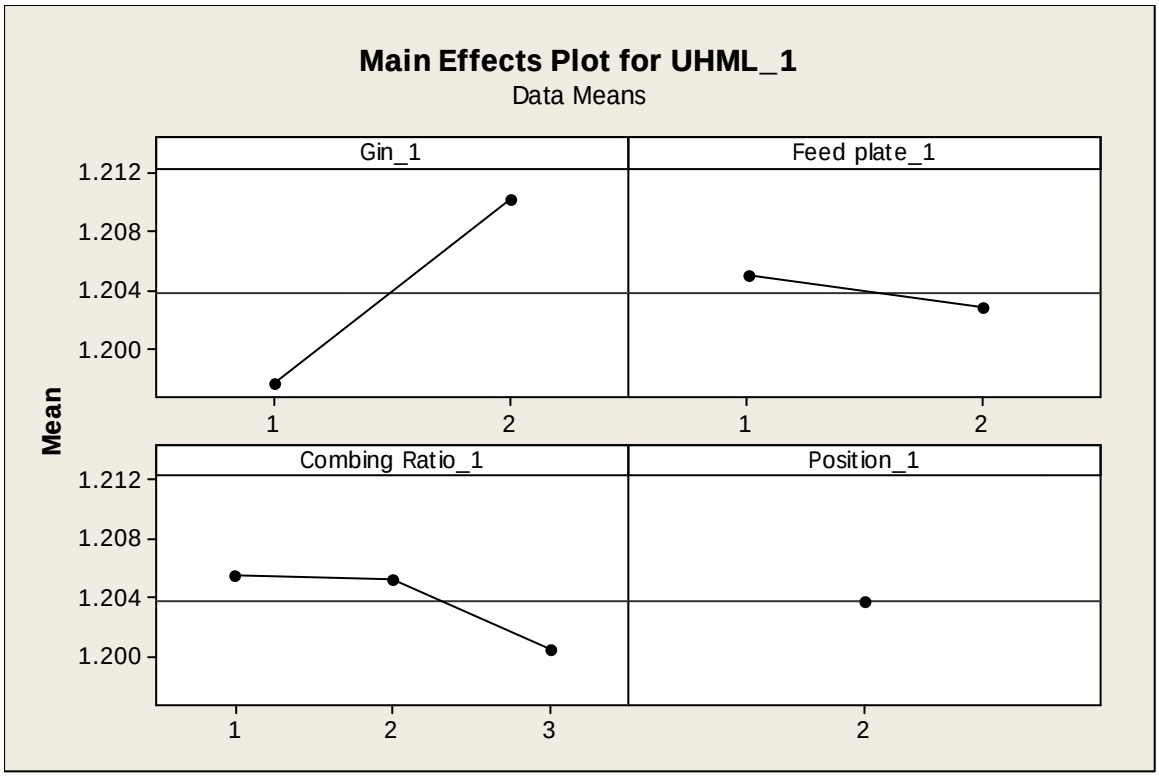

Figure 11 – UHML averages per treatment; Gin 1 = MLC, Gin 2 = SLC; feed plate 1 = out, feed plate 2 = in; combing ratio 1 = standard, 2 = low, 3 = high.

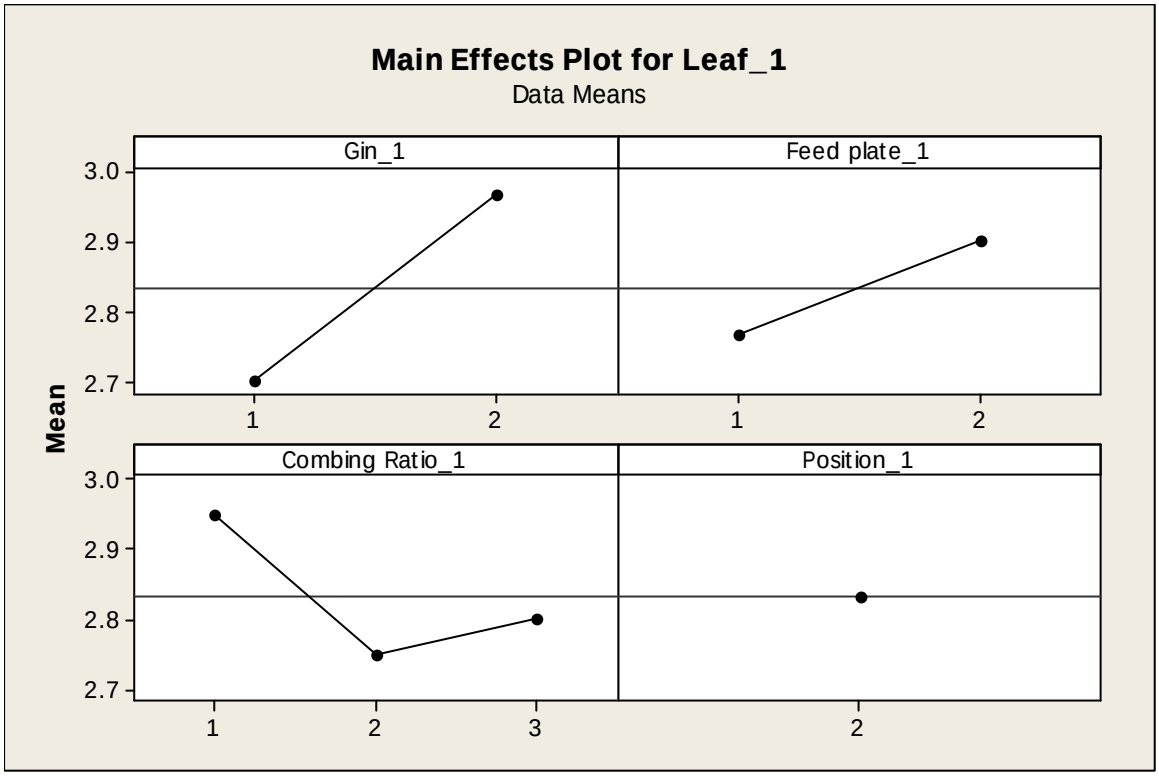

Figure 12 – HVI Leaf Grade averages per treatment; Gin 1 = MLC, Gin 2 = SLC; feed plate 1 = out, feed plate 2 = in; combing ratio 1 = standard, 2 = low, 3 = high.

Trash removal by the MLC was investigated in more detail during the July 14th evaluation. As described a perforated tray was fashioned to fit the duct collecting trash air-washed at the grid bars. Trash was collected for set periods, usually 5 minutes and weighed. Fibre in the trash was removed at CSIRO in order to assess fibre loss by each lint cleaner system.

Figure 13 shows the average results for trash removal rates and percent fibre in trash at the two different feed plate settings. The Figure shows the feed plate position has a large effect on fibre loss through the MLC. When the feed plate position is closed (to 1/16th inches) trash removal is enhanced while fibre loss is reduced. This result corresponds well with the fibre leaf grade effects measured by HVI; the MLC cleaned fibre more thoroughly when the feed plate was set closer to the saw, confirming previous ideas on the behaviour of MLC's delivery of its lighter batt onto the saw. Fibre length properties did not change significantly when the feed plate was set closer. These results confirm the MLC's superior performance in cleaning standard and longer grade cottons.

The closeness of the feed plate to the saw maybe of concern to some ginners who fear clumps could force the feed plate onto the saw when set at 1/16th inches. However, the author notes that within the Continental Eagle manual for the 24D lint cleaners used in this study a 1/16th gap is included in the setting range of the feed plate. It is also noted that the MLC applies a larger draft to the condenser batt and delivers a lighter batt through the feed plate; feed roller gap thereby reducing chances of large clumps through the lint cleaner.

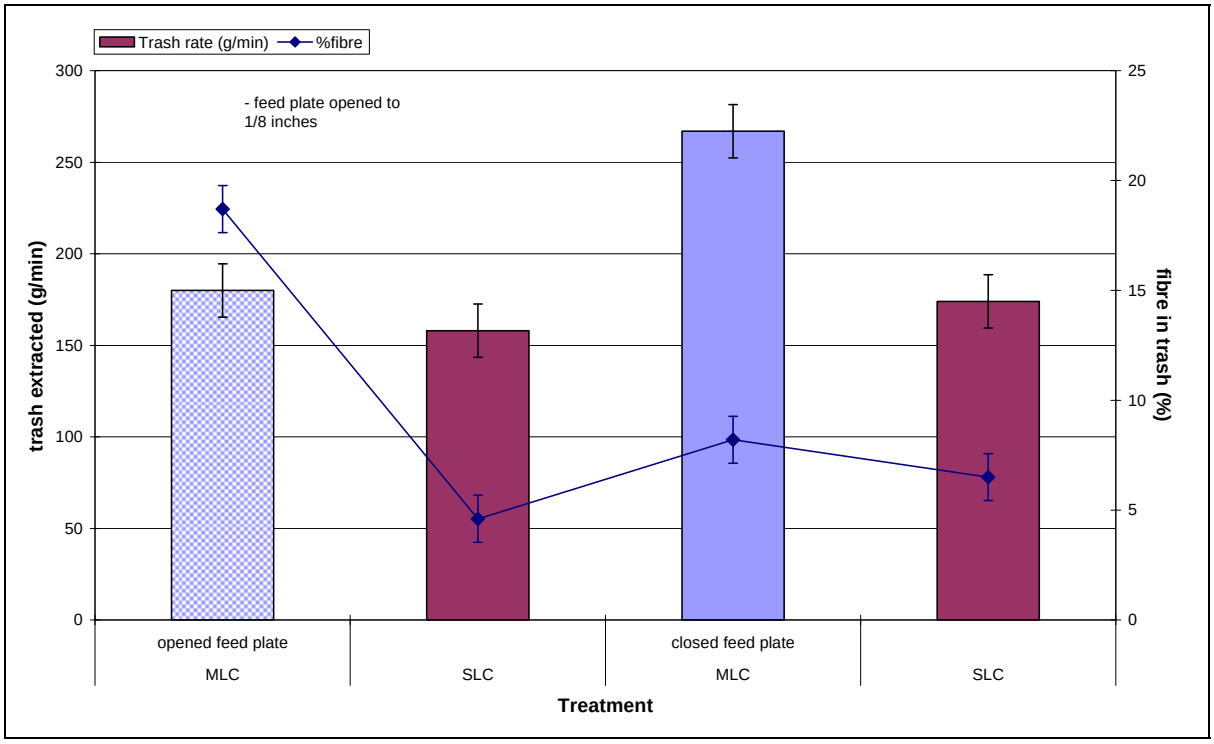

Figure 13 – Effect of feed plate setting on cleaning performance of the MLC

Conclusion

At the conclusion of the Project No. 4.03.03 it was proposed that upgrades to the MLC including reducing the diameter of the new draft rollers, reducing the draft distance between the condenser doffing rollers and the new draft rollers and revising the draft ratios between roller sets, would further improve fibre length and reduce the number of neps and trash.

These upgrades were implemented prior to the start of the 2010 ginning season and evaluation trials were completed by the end of July 2010. The evaluation trials also sought to separate effects associated with gin speed, lint cleaner combing ratio and feed bar settings.

Overall the results indicated statistically significant improvements in fibre properties using the upgraded MLC for cotton that ranged in length from 1.095 inches through to in excess of 1.20 inches. Length (UHML), length uniformity (ML/UHML %), short fibre index (SFI), USDA leaf grade and neps (AFIS) all improved when processed through the MLC, although the improvements were minor in terms of fibre value. The effect of the upgraded MLC was more muted on longer cottons e.g., UHML > 1.17 inches, although like the shorter cottons produced cleaner cotton in terms of leaf grade.

The efficiency of the MLC in removing trash was confirmed by directly measuring the rate of trash removal by the MLC and comparing the rate of the adjacent SLC. These tests showed the MLC was as much as 65% more efficient in removing trash than the SLC without causing damage to cotton with UHML > 1.18 inches.

Publications

Refereed (peer review)

1. Gordon, S. G., Bagshaw, K. M. and Horne F. A., The effect of lint cleaner elements, settings and fibre moisture on fibre quality, *Trans. ASABE* (accepted for publication February 2011)
2. Gordon, S. G., Bagshaw, K. M. and Horne F. A., Reports on a new fixed-batt saw lint cleaner, for *Trans. ASABE* (in preparation).

Others

3. Gordon, S. G., Bagshaw, K. M. and Horne F. A., The effect of lint cleaning on fibre quality, *Australian Cottongrower*, Oct-Nov 2010

Industrial trials as part of CRC Project No. 4.03.03 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 standard lint cleaners (SLC). The results also showed that whilst there was no significant difference in nep generation 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.

At the conclusion of this project it was proposed that upgrades to the MLC including reducing the diameter of the new draft rollers, reducing the draft distance between the condenser doffing rollers and the new draft rollers and revising the draft ratios between roller sets, would further improve fibre length and reduce the number of neps and trash.

Overall the results from samples processed through the upgraded MLC indicated statistically significant improvements in fibre properties for cotton with fibre lengths ranging from 1.095 inches to 1.20 inches. Length (UHML), length uniformity (ML/UHML %), short fibre index (SFI), USDA leaf grade and neps (AFIS) all improved when this type of cotton was processed through the MLC, although the improvements were minor in terms of fibre value. The effect of the upgraded MLC was more muted on longer cottons e.g., UHML > 1.17 inches, although like the shorter cottons produced cleaner cotton in terms of leaf grade.