COMPARISON OF SAW GINNING AND HIGH-SPEED ROLLER GINNING WITH DIFFERENT LINT CLEANERS OF MID-SOUTH GROWN COTTON

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ABSTRACT. Four cotton cultivars were ginned with a saw gin equipment line and also with a high-speed roller-gin line. The saw gin line using an air-jet and controlled-batt saw-type lint cleaner was compared to the high-speed roller-gin line including one of three designs of lint cleaner; either of two versions of an experimental lint cleaner, of a basic design not used with commercial roller ginning, one design with a lint reclaimer and the other without the lint reclaimer or a commercially available mill-type lint cleaner. The high-speed roller-gin processed the seed cotton at the same rate as the saw gin stand per m of machine width; however, the roller-gin stand is narrower than the saw gin stand. The roller-gin line produced lint with better fiber length properties than the saw gin line. The roller-gin stand did less damage to the fiber than the saw gin stand and each of the three lint cleaners following the roller gin stand did less damage to the lint than the controlled-batt saw-type lint cleaner. Fewer neps were created in the roller-gin line than the saw gin line. The experimental lint cleaner did not remove as much non-lint material as the traditional controlled-batt lint cleaner but the measurements of the negative effects of the experimental lint cleaner were significantly lower than for the controlled-batt lint cleaner. The mill-type cleaner removed even less material but added still fewer neps than the experimental lint cleaner and did little damage to the lint. The fiber processed with the lint cleaner with the reclaimer had lower quality than the fiber processed with the same lint cleaner without the reclaimer; also, the lint cleaner with the reclaimer removed nearly as much material as without the reclaimer. Therefore, the reclaimer will not be included in further testing.

Keywords. AFIS, Cotton, Gin, HVI, Lint cleaner, Roller, Saw.

Two basic types of gin stands exist for separating lint from cotton seed, the roller gin stand and the saw gin stand. Historically the saw gin processed the cotton faster but was recognized to produce lint of lower quality, especially related to fiber length and nep content. Roller gins have traditionally been used in the United States for the longer staple and higher value cottons, mainly Pima, and saw gins have generally been used for the much more prevalent upland cottons. Design improvements have been made to roller gins over the years primarily to increase the throughput. Important improvements include optimization of feed to the roller gin (Leonard, 1970); high speed roller ginning and microcomputer control (Gillum; 1983, 1985); computer aided roller ginning and frequency optimization of the rotary knife (Gillum and Armijo; 1991, 2000); high speed roller ginning including upland varieties and commercial applications (Armijo and Gillum; 2005, 2007, 2010); and variable speed high-speed roller ginning (Thomas and Beeland, 2008). These along with a few other design modifications have resulted in the current high-speed roller gin stand (HSRG). Thomas et al. (2008) and Armijo and Gillum (2010) described the HSRG. Some gins in the Southwest have installed these gin stands and ginned upland cotton resulting in fiber with improved qualities (Thomas et al., 2008).

The Mid-south has grown upland varieties almost exclusively although a pilot program was conducted in 1989-1991 to grow Upland and Pima cotton and gin it with roller gins (Mangialardi, 1995). Mangialardi conducted his study of a (traditional speed) roller gin plant located in the Mississippi Delta. He included data for one extra-long staple and several Upland smooth-leaf cultivars. He found that non-lint content was higher when using the roller ginning system than the traditional saw gin system because of less aggressive lint cleaning resulting in lower grades (at the time color and leaf were combined in the grade determination). He found that the roller ginned cotton had greater fiber length and fewer neps, both desirable traits for mills. However, because of the increased non-lint content the commercial value of the cotton was lower when roller ginned than when saw ginned. The spinning tests showed that the roller ginned Upland cottons performed better than when they were saw ginned and potentially could be used for finer quality fabrics. However, the lint pricing at the time eliminated interest in continuing the study.
The pricing schedule has changed since 1991 by using High Volume Instrument (HVI) data and separating the color and leaf grades. New Upland cultivars now exist for producing fiber with improved properties with increased yield (Wanjura et al., 2010; Wheeler and Woodward, 2011).

Research conducted by Armijo and Gillum (2007) documented the improvement in roller ginning compared to saw ginning upland cotton in the Southwest. They were able to gin cotton at a speed comparable to saw ginning, 4.1 bales/m/h, with the same power requirement for the gin stand motor, approximately 7.5 kW/bale/h (10 hp/bale/h) total. Advanced Fiber Information System (AFIS) fiber length (by weight) was 5% greater and AFIS upper quartile length was 3% longer when using the HSRG. AFIS short fiber (by weight) was two percentage points lower and nep count was 27% lower when using the roller gin. AFIS non-lint content was somewhat higher with the roller gin stand and appropriate lint cleaning, two Aldrich mill-type cleaners with air-jet cleaners, but the difference was not statistically significant. HVI length and length uniformity were better when using the roller gin and the other measurements were not significantly different. Armijo and Gillum (2010) examined roller ginning in commercial gins and found the ginning rate to be as high as 4.8 bales/m/h for the HSRG compared to a maximum of 0.5 bales/m/h for a traditional roller gin.

In saw ginning of upland cotton the lint cleaning equipment is fairly standard with one air-jet lint cleaner (sometimes none) followed by one saw-type lint cleaner (occasionally two). With roller ginning the design is less standardized with a considerable variety of lint cleaners in use at different installations (Gillum et al., 1994). Anthony (2006) described an experimental lint cleaner which had cleaning cylinders and a saw cleaning section, but not the traditional feed works found on saw-type lint cleaners. Although a variety of lint cleaner designs are found in the industry following the roller gin stand, lint cleaners including a saw section such as was employed in this machine is not a design used by the roller ginning industry. The original design by Anthony (2006) included a reclaimer section, which returned some of the lint material removed by the cleaning saw to the processing stream, and thus into the bale. This lint cleaner has been used with the HSRG installed at the Cotton Ginning Research Unit in Stoneville, Mississippi since 2009.

The purpose of this study was to compare saw ginning and high-speed roller ginning of several cotton cultivars grown in the mid-south and to compare the use of a nonstandard experimental lint cleaner design, with and without a reclaimer section, and a more traditional lint cleaner with the roller ginned cotton.

**PROCEDURES**

For each bale ginned with the HSRG line a bale of the same cultivar was ginned with the saw gin line immediately before or after. The entire test consisted of three sub-tests, each sub-test employed a different lint cleaner for the HSRG. Four cultivars of seed cotton grown at Stoneville, Mississippi during the crop year 2009 were used with each sub-test (table 1).

**EQUIPMENT**

All seed cotton was processed the same, after removal from a trailer with air, it was fed to a drying air stream with the burner control set to 93°C (200°F) and cleaned with a cylinder cleaner and stick machine. The seed cotton was then picked up with more warm air with the burner control set to 66°C (150°F) and cleaned with a second cylinder machine. One bale was ginned with the Lummus 116 saw Imperial III gin stand followed by a Lummus Air-Jet and single Lummus saw-type lint cleaner (Lummus Corporation, Savannah, Ga.) which was 1.422 m (56 in.) wide. Another bale from the same source of the same cultivar was ginned with the Lummus HSRG followed by one of three lint cleaners. The saw gin stand had an effective ginning width of 1.68 m (66.3 in) and the roller gin stand had an effective ginning width of 1.01 m (39.8 in.).

The lint cleaner used with the first two sub-tests with the HSRG consisted of six cylinders followed by a saw-type lint cleaner with no feed works (CCSLC1) (fig. 1), an experimental lint cleaner described by Anthony (2006). The cleaning cylinders had 18 rows of spikes with 40 and 41 spikes in alternating rows and the grid bars were 9.5-mm (3/8-in.) square rods installed with 25.4-mm (1-in.) gaps. The cleaning cylinders were 1,788 m (62.5 in.) wide. A saw-type lint reclaimer was installed as an integral part of the lint cleaner to intercept the material removed by the lint cleaning saw and a single brush doffed the lint from both saws. The lint cleaner used with the first sub-test included the reclaimer saw (referred to as CCSLC1) and for the second sub-test the reclaimer saw was removed (referred to as CCSLC2). Two trash portions were collected when these cleaners were used, portion A included the material removed by the cylinder cleaning portion of the cleaner and portion B included the material removed by the saw cleaner portion.

The lint cleaner used with the third sub-test was a modified Aldrich textile type lint cleaner (ALC). The modification consisted of replacing the original cleaning

![Figure 1. Schematic of the experimental lint cleaner used with the HSRG, not to scale.](image-url)
cylinder with a Kirschner mill-type beater (Dueck, 2000). The beater was followed by an Air-jet cleaner (Lummus Corporation Savannah, Ga.). There were two trash portions collected from the ALC, portion A was the material removed by the Kirschner beater of the cleaner and portion B was the material removed by the air-jet cleaner. The active portion of the ALC was 1.346 m (53 in.) wide. Because the ALC was narrower than the CCSL1 or CCSLC2 and was installed behind the same gin stand, ginning at the same rate the fiber loading during the test was somewhat higher, 18%, which may have affected the results. Thus the three sub-tests compared the same two gin stands and the saw gin stand was always followed by the same lint cleaner, however, the lint cleaner following the HSRG was different for each sub-test.

COTTON

For sub-test 1 one bale of each of the cultivars was ginned with the saw gin line and one bale was ginned with the HSRG followed by the lint cleaner including the reclamer (CCSL1) identified as GinID 1 through 8 (table 1). For sub-test 2 one bale of each of the same cultivars were ginned with the saw gin line and one with the HSRG with the reclamer removed (CCSL2), identified as GinID 11 through 18 and similarly for the third sub-test when the mill-type cleaner, ALC, was used following the HSRG, identified as 21 through 28. All cotton for each cultivar was planted on the same date, treated the same in the field following normal practices, defoliated on the same date, and harvested on the same date. Some variation would be expected within the seed cottons but they were as uniform as can be achieved with normal preparations. A total of 24 bales were ginned during the entire test.

MEASUREMENTS—SAMPLES

Three lint samples were obtained before and three additional after the lint cleaner while ginning each bale for analysis by the AFIS PRO (Uster, Charlotte, N.C.) resulting in 144 samples. Five sub-samples were measured with the AFIS of each sample for a total of 720 measurements of each AFIS parameter. The AFIS data for the samples taken before the lint cleaners was intended to compare the gin stands and the samples after the lint cleaner were added to be able to detect changes due to the lint cleaners. In addition, three lint samples were taken after the lint cleaner for HVI (Uster, Charlotte, N.C.) fiber measurement resulting in 72 samples and 5 additional samples were obtained for moisture content (mc) determination. The mc samples were stored in sealed metal paint cans until mc determination in less than 48 h (Byler, 2004) by the oven method (Shepherd, 1972). Five sub-samples were measured of each HVI sample resulting in 360 measurements of each HVI parameter. Each AFIS sample taken during ginning was typically more than 20 g, each HVI sample more than 400 g, and each mc sample more than 200 g. The AFIS and HVI samples were shipped to the USDA-ARS Southern Regional Research Center for testing. All of the material removed by the lint cleaners was weighed and retained.

ANALYSIS—STATISTICS

The various data were entered into files and analyzed using SAS version 9.2 (SAS Institute Inc., Cary N.C.) procedures, PROC MEANS and PROC MIXED. The lsmmeans statement was used in PROC MIXED to determine which means were significantly different. The cultivar was expected to affect many of the measurements but gins must process each lot of cotton brought to be processed regardless of cultivar. The lint quality resulting from ginning with the two different gin stands was of interest. In addition, the non-lint content of the lint, the damage done to the lint during processing, and the amount of material removed by the lint cleaners was of interest. Differences in HVI data were of interest primarily because of possible effects on the commercial value of the cotton to the producer. The cultivar, sub-test, gin stand type, lint cleaner, and whether the samples were obtained before or after the lint cleaner (if appropriate) were classification variables. The Model statement in PROC MIXED when analyzing the AFIS data included the measured moisture content, the gin stand type, lint cleaner within gin stand type, the cotton cultivar with interactions with gin stand type and whether the sample was obtained before or after the lint cleaner including interactions with cultivar and gin stand type. The Random statement included the cultivar, gin stand type, and lint cleaner within sub-test and repeated measurement. The HVI data were analyzed with the same Model and Random statements except that the HVI samples were only collected after the lint cleaner.

The test plan did not include changes in moisture content which was not controlled but was measured. The plan was for the variations in moisture content to not be significant. The cultivars were not random but were chosen from those available for analysis and were consistent across the data collection. All experimental treatments were applied to all cultivars.

The measurements of the seed cotton and gin operation were examined to determine if any major differences occurred within each cultivar. Then the lint mc data were examined for any unusual variation which may have affected the results. Finally the AFIS fiber quality and HVI data were examined to determine if any significant differences could be attributed to the type of gin stand or lint cleaner used in the processing.

<table>
<thead>
<tr>
<th>GinID</th>
<th>Gin</th>
<th>Cultivar</th>
</tr>
</thead>
<tbody>
<tr>
<td>1, 11, 21</td>
<td>Saw</td>
<td>Deltapine 164 (Monsanto Co.)</td>
</tr>
<tr>
<td>2, 12, 22</td>
<td>Saw</td>
<td>FiberMax 960 (Bayer CropScience)</td>
</tr>
<tr>
<td>3, 13, 23</td>
<td>Roller</td>
<td>FiberMax 960 (Bayer CropScience)</td>
</tr>
<tr>
<td>4, 14, 24</td>
<td>Roller</td>
<td>Stoneville 4554 (Stoneville Seed Co.)</td>
</tr>
<tr>
<td>5, 15, 25</td>
<td>Roller</td>
<td>Phytogen 485 (Mycogen Co.)</td>
</tr>
<tr>
<td>6, 16, 26</td>
<td>Roller</td>
<td>Deltapine 164 (Monsanto Co.)</td>
</tr>
<tr>
<td>7, 17, 27</td>
<td>Saw</td>
<td>Phytogen 485 (Mycogen Co.)</td>
</tr>
<tr>
<td>8, 18, 28</td>
<td>Saw</td>
<td>Stoneville 4554 (Stoneville Seed Co.)</td>
</tr>
</tbody>
</table>
RESULTS

GINNING DATA

The ginner felt that the HSRG was operating at maximum speed for each replication throughout the test. The ginning rate for the saw gin stand was 3.0 bales/m/h, the rate with the HSRG was 2.9 bales/m/h, and the difference was not significant. While the test was being conducted the operator felt that the Fibermax cotton ginned more smoothly, with less noticeable vibration, than the other cultivars and the Stoneville 4554 cultivar ginned at a rate numerically but not significantly slower than the FiberMax 960 (table 2). All of these ginning rates were lower than the 4.8 bales/m/h observed by Armijo and Gillum (2010) but much higher than the 0.5 bales/m/h they reported for a traditional roller gin stand. This relatively new HSRG was not ginning at what was considered to be full speed until this test. The ginning speed of a HSRG is limited by how effectively the fiber is pulled under the knife by the roll and the roll has to be properly warmed across its whole surface for optimum operation. Perhaps this HSRG can achieve higher ginning rates after further breaking-in of the roller.

The turnout (weight of lint after all gin processing per weight of seed cotton) was examined and did not vary significantly by type of gin stand including the specified lint cleaner, and the overall average was 36%. There was no significant difference in turnout between the lint cleaners used with the roller gin stand. When the gin stand type and cultivar interaction was examined there were no cultivars for which the turnout difference between the two gin stand types with specified lint cleaner was significant. There were differences in turnout related to cultivar with Fibermax 960 at 36.4% and Stoneville 4554 at 32.7% (table 2).

LINT MOISTURE CONTENT

The mc, wet basis, measurements of the lint after the lint cleaners behind the saw gin stand the average weight removed was 13.1 kg (29 lb) for the first sub-test, 15.9 kg (35 lb) for the second sub-test, and 15.1 kg (33 lb) for the third sub-test. For the lint cleaners behind the roller gin the average was 5.7 kg (12.6 lb) for the first sub-test (using the CCSLC1), 7.5 kg (16.5 lb) for the second sub-test (using the CCSLC2), and 2.4 kg (5.4 lb) for the third sub-test (using the ALC). The CCSLC1 removed less than half the amount removed by the traditional lint cleaners and the ALC removed about 16% as much. The CCSLC1 behind the roller gin removed 1.8 kg more material without the lint cleaner, and the overall average was 36%.

Table 2. Mean of ginning rate with the HSRG observed in the test.

<table>
<thead>
<tr>
<th>Date of Ginning</th>
<th>Roller Ginning Line</th>
<th>Saw Ginning Line</th>
</tr>
</thead>
<tbody>
<tr>
<td>31 March</td>
<td>3.3</td>
<td>4.2</td>
</tr>
<tr>
<td>1 April</td>
<td>4.7</td>
<td>4.9</td>
</tr>
<tr>
<td>18 May</td>
<td>5.2</td>
<td>5.4</td>
</tr>
</tbody>
</table>

LINT CLEANER WASTE

The weight of the seed cotton ginned, the material removed by the lint cleaners, and the final bale weight for each bale of the test is shown in table 4. For the lint cleaners behind the saw gin stand the average weight removed was 13.1 kg (29 lb) for the first sub-test, 15.9 kg (35 lb) for the second sub-test, and 15.1 kg (33 lb) for the third sub-test. For the lint cleaners behind the roller gin the average was 5.7 kg (12.6 lb) for the first sub-test (using the CCSLC1), 7.5 kg (16.5 lb) for the second sub-test (using the CCSLC2), and 2.4 kg (5.4 lb) for the third sub-test (using the ALC). The CCSLC1 removed less than half the amount removed by the traditional lint cleaners and the ALC removed about 16% as much. The CCSLC1 behind the roller gin removed 1.8 kg more material without the lint cleaner.
reclaimer (CCSLC2), but the lint cleaners behind the saw gin stand removed 2.7 kg more material on the second sub-
test. The ALC removed significantly less material than the saw-type cleaners leaving the remainder of the weight in the bale, about 12.3 kg (27.0 lb). Cotton is sold by weight so any material removed by the lint cleaners results in less weight in the cotton bale.

AFIS FIBER QUALITY DATA

All AFIS data were combined and were analyzed statistically with differences due to sampling location (before or after the lint cleaner), sub-test (the lint cleaner used behind the HSRG), cultivar, gin type (saw or roller), lint mc of samples taken after the lint cleaner, and interactions with gin type included in the model. For the AFIS measurement fiber length by weight each of the main factors was significant beyond the 0.0001 level except the sub-test which was not significant at the 0.1 level but none of the interactions were significant except for gin type*cultivar which was significant beyond the 0.02 level. The cultivar and gin type accounted for most of the variation, and the lint cleaners reduced the AFIS length by weight significantly. The AFIS length by weight was higher for every cultivar when processed by the roller gin stand but the difference in length after saw versus roller ginning was different between cultivars which explained the significance of the gin type*cultivar interaction. The FiberMax 960 had the largest difference due to gin stand type, 0.18 cm, and the difference in length due to gin stand type of the Stoneville 4554 was the least, 0.06 cm. Two facts stand out in these results, first, the fiber length was shorter before the lint cleaners ginned by the saw gin than ginned by the HSRG (P<0.0001) by 0.11 cm. Second, the lint cleaner further reduced the length for the saw ginned cotton using the controlled bat saw-type lint cleaner (P<0.0001) by 0.06 cm but the decrease was less, 0.04 cm, but still statistically significant (P=0.003) with any of the lint cleaners used with the HSRG (table 5). The standard error of the difference estimates in AFIS fiber length by weight was about 0.01 cm. The HSRG produced fiber length 0.13 cm longer and the lint cleaners used after the HSRG reduced the length 0.03 cm less than the traditional controlled bat saw-type lint cleaner (which were installed after the saw gin stand). The AFIS fiber length mean calculated by weight was 0.14 cm longer after processing with the HSRG equipment line than when processed with the saw ginning line. This difference compares well to the difference Armijo and Gillum (2007) found of 0.12 cm. The mc range had a significant (P<0.03) effect on the AFIS length calculated by weight with a slope of 0.02 cm/% mc.

The cultivar, gin stand type, and location relative to the lint cleaner each affected the AFIS short fiber content, calculated by weight, significantly (P<0.0001). The AFIS short fiber content, calculated by weight, after the lint cleaner was 10.9% after the saw gin line and 7.9% after the HSRG line and this difference was statistically significant (P<0.0001). Armijo and Gillum (2007) found that for their cotton processed with their saw gin line resulted in 10.0% short fiber while their HSRG line resulted in 8.18% short fiber. The difference they observed was somewhat lower than that observed in this study but this study showed that the short fiber levels vary by cultivar and Armijo and Gillum didn’t use any of the cultivars used in this study. Table 6 shows the AFIS short fiber content means by cultivar, gin stand, and location relative to the lint cleaner. There was a difference across the lint cleaner for the HSRG line of 0.6% (P=0.003) and the saw-type lint cleaner on the saw gin line resulted in an increase of 1.3% and was statistically significant (P<0.0001). There was no significant difference in the short fiber content related to the three lint cleaners used after the HSRG. For means by cultivar, the Phytogen fiber had the lowest short fiber content at 7.0% and the Stoneville fiber had the highest at 11.4%. Higher mc resulted in lower AFIS short fiber with a slope of -1.0% short fiber per % mc (P<0.03).

The AFIS nep count/g data were analyzed and the type of gin stand, the sampling location, the cultivar, and the type of gin stand within a cultivar were all highly significant (P<0.0001). Table 6 shows the mean nep count/g calculated by cultivar, gin stand type, and location relative to the lint cleaner. The overall mean nep count was 253 count/g, the mean nep count after lint cleaning was 353 for the saw gin line and 214 for the roller gin line. This compares with 316 and 241, respectively, reported by Armijo and Gillum (2007). The mean nep count after the saw gin stand but before the lint cleaner was 271 count/g and was 172 count/g after the HSRG but before the lint cleaner. The increase across the lint cleaner for the saw gin line was 82 count/g, the increase across the lint cleaner for the HSRG line was 42 count/g, and both differences were significantly greater than zero. So a similar relationship existed for nep count as for the fiber length, the HSRG produced lint of better quality than the saw gin stand and

<table>
<thead>
<tr>
<th>Gin stand Sampling Location</th>
<th>Mean Fiber Length by Weight (cm)</th>
<th>Upper Quartile Length by Weight (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Saw Before lint cleaner</td>
<td>2.51 c</td>
<td>3.071 c</td>
</tr>
<tr>
<td>Saw After lint cleaner</td>
<td>2.45 d</td>
<td>3.017 d</td>
</tr>
<tr>
<td>Roller Before lint cleaner</td>
<td>2.62 a</td>
<td>3.136 a</td>
</tr>
<tr>
<td>Roller After lint cleaner</td>
<td>2.59 b</td>
<td>3.110 b</td>
</tr>
</tbody>
</table>

[a] Means followed by the same letter within a column were not significantly different at the 0.05 level

[28(4): 475-482]
The overall mean difference in the levels between roller ginned by the HSRG had lower non-lint content (table 7). The trash levels after lint cleaning were numerically lower for the HSRG line, with a mean of 63 count/g, than for the saw ginning line, with a mean of 74 count/g but the difference was not significant (P=0.19).

The AFIS nep count after the CCLSC1 was significantly lower than the other two which were not significantly different from each other. Higher lint mc correlated with lower AFIS nep count with a slope of -0.43 count per % mc (P<0.01).

The AFIS trash, measured in count/g, was analyzed and the most important factor was whether the samples were taken before the lint cleaner or after (P<0.0001), followed by the cultivar, the type of gin stand, and the sub-test. The overall AFIS trash level was decreased from 104 to 68 count/g across the lint cleaners. The data for the type of gin stand and cultivar interaction are shown in table 7. The trash level differences between the type of gin stand were much larger for the Stoneville 4554 cultivar than for the FiberMax 960 cultivar. The trash levels after lint cleaning were numerically lower for the HSRG line, with a mean of 63 count/g, than for the saw ginning line, with a mean of 74 count/g but the difference was not significant (P=0.19). The CCLSC1 and CCLSC2 AFIS trash levels were not significantly different, at 61 count/g but the trash level for the ALC were higher at 83 count/g. There was no significant effect on the AFIS trash related to the lint mc.

The results from analysis of the AFIS Visible Foreign Matter measurement (VFM) was similar to the trash measurement. The difference in VFM between the saw ginned and HSRG ginned varied with cultivar and the lint ginned by the HSRG had lower non-lint content (table 7). The overall mean difference in the levels between roller and saw ginned measurements was 0.6 percentage points. The overall difference due to the lint cleaner with the saw gin line was 1.3 percentage points and the difference due to the lint cleaner used with the HSRG line was 0.5 percentage points. After lint cleaning the HSRG line using the ALC had significantly higher VFM, at 1.7%, than the CCLSC1, at 1.1% and CCLSC2, at 1.2% which may have been related to the 18% higher loading with the ALC. The VFM decreased with increasing mc with a slope of -0.4% VFM per % mc.

The AFIS maturity ratio was analyzed and significant differences were observed due to sub-test (P=0.004), gin stand type (P=0.01), and cultivar (P=0.04) but none of the interactions were significant. There was no significant difference across any of the lint cleaners but the first sub-test had a mean maturity ratio of 0.971, the second 0.954, and the third 0.914. The mean for the saw ginned lint was 0.934 and the mean for the HSRG was 0.958. There was no indication that any of the lint cleaners significantly affected the maturity ratio. The AFIS maturity ratio was not significantly correlated with the measured lint mc.

**HVI DATA**

The HVI data were for samples taken after the lint cleaner so the variations resulted from a combination of the gin stand and lint cleaner. The HVI data were modeled using the sub-test, cultivar, type of gin stand (with lint cleaner) measured lint mc, and gin stand*cultivar interaction. Least squares means of selected HVI data are presented in table 8. The micronaire varied by cultivar and gin stand and the gin stand by cultivar interaction was also significant. The micronaire was correlated with the measured mc (P=0.02) and the slope was 0.3 units per % mc. The micronaire measurements were different within the gin stand for the Fibermax and Stoneville cultivars but not for the other cultivars. Although these differences were statistically significant, they were small, a maximum of 0.6,
and they may be related to different gin stands removing different lint from the seed of some cultivars. Micronaire differences of this magnitude usually would not affect the price of the lint. Armijo and Gillum (2007) reported a numerically higher micronaire after the HSRG than the saw gin line, but the difference was not statistically significant.

The upper half mean length (UHML) was correlated with the gin stand, cultivar, and the lint cleaner but not the measured lint mc. The UHML was higher for the roller gin line than for the saw gin line (P<0.0001). The Fibermax cultivar had the highest UHML at 2.98 cm and the Stoneville cultivar was lowest at 2.83 cm. The uniformity index (UI) correlated with the cultivar and gin stand only with the roller gin stand line at 82.2% and the saw gin line at 80.9%. UI values from 80% to 82% have no premium but differences of this magnitude usually would not affect the price of the lint with higher UI resulting in higher prices. Armijo and Gillum (2007) reported a higher UI after their HSRG line, 83.5%, than after the saw gin line, 81.0%, and the difference was statistically significant.

The only significant correlation with HVI fiber strength was the cotton cultivar. The HVI fiber strength was numerically lower for the lint from the roller gin line at 27.8 than for the saw gin line at 28.3 but the difference was not statistically significant, similar to the result of Armijo and Gillum (2007) who also found the difference to not be statistically significant. The HVI strength variation was not significantly correlated with the measured lint mc. The Rd and +b measurements of color were not affected by the gin type and were only affected by the cultivar. The HVI trash percent area was significantly higher (P=0.004) for the roller gin line than for the saw gin line, but the difference was relatively small. Smaller differences with lower significance were related to the sub-test and cultivar.

**CONCLUSION**

Four cultivars of cotton were processed through a Lummus saw gin stand followed by an air-jet and controlled-batt saw-type lint cleaner and through a Lummus high-speed roller gin (HSRG) followed by one of three different lint cleaners. The HSRG processed the cotton at the same rate per m of width and the same turnout as the saw gin stand. The HSRG line produced fiber with better fiber length properties as measured by AFIS with longer fiber, less short fiber, and fewer neps. The non-lint content was lower with processing through the HSRG line but depended on the cultivar and the lint cleaner used with the HSRG.

The lint cleaners used with the HSRG produced less waste than the traditional lint cleaner while damaging the fiber measurably less, as shown by AFIS fiber length and short fiber, and while adding fewer neps. This work was not designed to examine the effects of moisture content (mc) variation; however, some variation occurred and in some cases lint quality differences which correlated with these differences were detected. The examination of these issues is planned for future study and only limited conclusions regarding mc effects should be made based on this study.

The data were examined for evidence of the effect of removing the lint reclaimer and the fiber length was found to be somewhat better without the reclaimer but the cleaning was not significantly different. There appears to be no reason to include the reclaimer on the experimental lint cleaner for use with the HSRG. The commercially available modified Aldrich mill-type lint cleaner resulted in less damage to the lint and added significantly fewer neps to the lint than the saw-type lint cleaner.

The HSRG operated well and produced fiber with more desirable properties that the saw gin stand. Work related to the use of the HSRG at different moisture content levels and mid-south cultivars will continue.

**REFERENCES**


