

COMBINED EFFECTS OF FIELD CLEANING AND LINT CLEANING ON STRIPPER HARVESTED COTTON

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Abstract

Field cleaning of conventional stripper-type cottons during the brush stripping operation produced cleaner seed cotton and lint than did comparable cotton harvested without the field cleaner. Significant improvements in lint foreign matter levels were noted at each stage of lint cleaning, and these improvements in trash level resulted in somewhat higher color and leaf grades for field cleaned cotton. Field cleaning also tended slightly to increase some fiber maturity measurements and, in a few cases, to lower nep levels in fiber and yarn. Field cleaning did not affect any of the fiber length parameters, and its effects on the quality of ring and open-end yarns were minimal.

Introduction

Field cleaners are basically compact 2-saw stick machines similar to their larger cousins found in cotton gins. When combined with the stripper harvester, the field cleaner can remove a substantial amount foreign matter from the cotton during the harvesting operation (Brashears, 1991). Field cleaners (sometimes called bur extractors) have been employed to some extent for many years in the stripper harvesting areas of the Southwest (Kirk et al., 1972). In recent years, however, their popularity with producers appears to be on the increase. Most new brush-stripper harvesters are now equipped with a field cleaner when delivered from the factory, and most finger-type stripper harvesters used in UNR cotton are equipped with field cleaners. McPeck (1997) recently estimated that about 25% of the cotton in Texas was harvested using a field cleaner. Recent research documents the major advantages and disadvantages of field cleaning from both the producers' and the ginners' viewpoints (Sukant, et al., 1997 and Nelson, et al., 1998). These analyses were hampered to some extent, however, by a lack of detailed information on the effects of modern stripper harvesting and field cleaning practices on fiber quality and spinning performance. Consequently, ginning experiments were conducted at the USDA ARS ginning laboratory at Lubbock, TX during crop years 1997-98 and 1998-99 to obtain additional and more detailed information on the fiber quality effects of field cleaning during stripper harvesting.

Methods and Materials

Three conventional stripper varieties of cotton was evaluated in these studies, Table 1. One-half of each test cotton was processed through a standard two-saw field cleaner mounted on a 4-row brush stripper. The field cleaner was bypassed during the harvest of the other half of each test cotton. Each of the six combinations of test cotton and harvest method was processed through a standard array of seed cotton cleaning machinery consisting of an airline cleaner, two inclined cleaners, a combination bur and stick machine, a 3-saw stick machine, and an extractor feeder. After ginning, the lint was cleaned using two stages of saw-type lint cleaning.

Seed cotton samples collected before and after seed cotton cleaning were evaluated for foreign matter content using standard fractionation techniques. Lint samples were collected before and after each stage of lint cleaning and evaluated for foreign matter and quality using a Shirley analyzer, an HVI system, and an Automated Fiber Information System (AFIS). Test Cotton No. 2 was also subjected to spinning evaluations at the International Textile Research Center, Lubbock, TX.

Data for each test cotton was analyzed as a separate experiment with each experiment consisting of four replications of the two harvesting methods. Standard analysis of variance techniques were used to analyze the data at each stage of lint cleaning, and statistically significant differences between harvest methods were determined by Duncan's Multiple Range Test at the 0.05 level of significance.

Results

Seed Cotton Foreign Matter Levels

The initial foreign matter content of seed cotton was greatly affected by the field cleaning process, Table 2. Bur and stick contents were significantly reduced by field cleaning for all three test cottons, but fine trash levels were affected to a much lesser degree. The field cleaning process significantly reduced fine trash in only one of the three test cottons. The total trash content of each test cotton was influenced mostly by variations in the bur and stick contents, and consequently, was greatly reduced by field cleaning. The average reduction in total trash content across all three test cottons was 56%. Also, the removal of foreign matter in the field significantly improved lint turnout by 3.5 to 6.2 percentage points.

While the gin's seed cotton cleaning processes were highly effective in removing foreign matter from the seed cotton, differences in foreign matter levels between the regular and field cleaned cottons were still in evidence at the gin stand's feeder apron, Table 3. While the differences between regular and field cleaned cotton for the various types of foreign matter were not always statistically significant, a majority of

them were, and in all cases the total foreign matter levels were significantly lower for the field cleaned cotton.

Lint Foreign Matter Levels

After ginning, the foreign matter levels, measured by the Shirley Analyzer, in the ginned lint also reflected the extra cleaning provided by the field cleaner on the harvester, Table 4. This effect was most evident in samples taken before saw-type lint cleaning. In that case the lint from all field cleaned cotton was significantly cleaner than that from the regular harvested cotton. After lint cleaning, however, these differences were much smaller and only statistically significant for one test cotton.

HVI Data

HVI data for each test cotton, before and after each stage of lint cleaning, was obtained from the USDA AMS Classing Office in Lubbock, TX, Tables 5-7. The most consistent effect that field cleaning had on HVI properties was on percentage trash area. The field cleaner significantly lowered trash areas of all three test cottons at all three levels (0, 1 and 2 stages) of lint cleaning. These trash differences in turn tended to influence Rd color readings, classers' color grades, and leaf grades. While all of the differences due to field cleaning for these three measurements were not always statistically significant, a large number were and the data in general tended to indicate that field cleaning was in fact having a positive effect on HVI leaf and color grades. After two stages of lint cleaning, for example, both leaf and color grades were significantly improved by field cleaning for two of the three test cottons. Differences of this magnitude for leaf grade suggest that about one-half of the samples from the three test cottons were improved one leaf grade (from a "3" to a "2") by field cleaning. Similar results were also noted for samples taken before and after the first lint cleaner. While field cleaning had less effect on the classers' color grade, some significant differences were noted for the first digit in the color grade. Samples taken after two stages of lint cleaning indicated that field cleaning significantly improved the color grades of two of the three test cottons. Differences of this magnitude for color grade suggest that about one-fourth of the samples from the three test cottons were improved one color grade (from a "31" to a "21") by field cleaning. Field cleaning had no significant effect on the second digit (white, light spotted, or spotted color designations) of color grade.

The only other difference that was observed in the HVI data as a result of field cleaning was in the micronaire readings. The field cleaner tended to produce slightly higher micronaire readings (0.1 to 0.2 units) for the first two test cottons than did the regular stripper harvest method.

AFIS Data

Fiber property measurements from the AFIS were obtained from the International Textile Research Center, Lubbock, TX. A summary of these measurements for samples taken after two lint cleaners are presented in Table 8. Field cleaning had no significant effect on any of the fiber length parameters, but there was some evidence that field cleaning slightly affected fiber maturity measurements. Field cleaning significantly increased the fineness reading and reduced the immature fiber content of one of the three test cottons. This result tended to support the previously mentioned improvements in HVI micronaire readings that were attributed to the use of field cleaning. Field cleaning also produced slightly lower nep counts than did the regularly stripped cotton, especially for test cottons one and two. Dust, trash and total trash counts were also influenced by the field cleaner. These results also tended to support similar foreign matter findings mentioned earlier in this report.

Spinning Data

The spinning properties of one of the test cottons (No. 2) were evaluated at the International Textile Research Center, Lubbock, TX, Table 9. For ring spun yarn, field cleaning produced slightly fewer yarn neps than did the regular harvest. For open-end spun yarn, field cleaning produced a slightly higher evenness CV and a few more thin places than did the regular harvest. Otherwise, field cleaning had little effect on other properties of ring-spun or open-end spun yarns.

Summary

Ginning experiments were conducted during crop years 1997-98 and 1998-99 to obtain additional and more detailed information on the effects of field cleaning during stripper harvesting on seed cotton and lint trash levels, fiber quality, and spinning performance. Three conventional stripper varieties of cotton was evaluated in these studies. Field cleaning during stripper harvesting produced significantly cleaner seed cotton and lint than did comparable cotton harvested without the field cleaner. Improvements in lint cleanliness were evident before and after both saw-type lint cleaners employed in these studies, and these improvements in trash level resulted in somewhat higher color and leaf grades for field cleaned cotton. Field cleaning also tended slightly to increase some of the fiber maturity measurements and, in a few cases, to lower nep levels in fiber and yarn. Field cleaning had no significant effect on any of the fiber length parameters, and its effects on ring and open end yarns were minimal.

References

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Table 1. Test cotton identification and year of production.

Test Cotton	Cotton Variety	Production Year
Cotton #1	All-Tex Atlas	1997-98
Cotton #2	Paymaster HS 26	1997-98
Cotton #3	Paymaster 200	1998-99

Table 2. Initial foreign matter contents of test cottons.

Test Cotton	Regular Stripped	Field Cleaned
Initial Bur Content, %		
Cotton #1	26.1a*	11.1b
Cotton #2	20.6a	10.9b
Cotton #3	17.1a	5.5b
Initial Stick Content, %		
Cotton #1	4.8a	3.4b
Cotton #2	3.1a	2.5b
Cotton #3	1.4a	1.0b
Initial Fine Trash, %		
Cotton #1	4.7a	3.7b
Cotton #2	2.8a	2.4a
Cotton #3	3.9a	3.6a
Initial Total Trash, %		
Cotton #1	35.6a	18.2b
Cotton #2	26.5a	15.8b
Cotton #3	22.4a	10.1b
Avg. Turnout, %		
Cotton #1	21.6b	27.8a
Cotton #2	23.9b	27.4a
Cotton #3	25.3b	29.3a

* Means followed by the same letter are not significantly different at the 0.05 level.

Table 3. Seed cotton foreign matter contents at feeder apron.

Test Cotton	Regular Stripped	Field Cleaned
Bur Content, %		
Cotton #1	0.25a*	0.16b
Cotton #2	0.30a	0.20a
Cotton #3	0.39a	0.16b
Stick Content, %		
Cotton #1	0.38a	0.24b
Cotton #2	0.33a	0.22a
Cotton #3	0.13a	0.14a
Fine Trash, %		
Cotton #1	1.75a	1.39b
Cotton #2	1.07a	0.90b
Cotton #3	0.80a	0.68a
Total Trash, %		
Cotton #1	2.38a	1.79b
Cotton #2	1.70a	1.32b
Cotton #3	1.32a	0.98b

* Means followed by the same letter are not significantly different at the 0.05 level.

Table 4. Visible foreign matter (VFM) contents of ginned lint before and after lint cleaning.

Test Cotton	Regular Stripped	Field Cleaned
VFM Before Lint Cleaning, %		
Cotton #1	10.3a*	8.9b
Cotton #2	8.0a	7.4b
Cotton #3	7.0a	5.8b
VFM After One Lint Cleaner, %		
Cotton #1	2.8a	2.6a
Cotton #2	2.7a	2.3b
Cotton #3	2.1a	1.8a
VFM After Two Lint Cleaners, %		
Cotton #1	1.6a	1.5a
Cotton #2	1.9a	1.6b
Cotton #3	1.3a	1.1a

* Means followed by the same letter are not significantly different at the 0.05 level.

Table 5. HVI data for ginned lint samples taken before lint cleaning.

Test Cotton	Regular Stripped	Field Cleaned
Classers' Color Grade, 1st Digit*		
Cotton #1	3.35a**	3.15b
Cotton #2	4.00a	3.85a
Cotton #3	4.00a	4.00a
Micronaire Reading		
Cotton #1	3.44a	3.50a
Cotton #2	4.60b	4.83a
Cotton #3	4.55a	4.60a
Strength, g/tex		
Cotton #1	27.8a	27.6a
Cotton #2	28.7a	28.6a
Cotton #3	30.3a	29.9a
Rough Preparation, %		
Cotton #1	100.0a	100.0a
Cotton #2	95.0a	95.0a
Cotton #3	95.0a	100.0a
Rd Color Value		
Cotton #1	75.2b	76.7a
Cotton #2	75.6b	77.1a
Cotton #3	74.2b	75.1a
+b Color Value		
Cotton #1	8.3a	8.5a
Cotton #2	7.3a	7.2a
Cotton #3	7.3a	7.4a
Leaf Grade		
Cotton #1	5.25a	4.45b
Cotton #2	4.85a	4.55a
Cotton #3	4.85a	4.11b
Trash Area, %		
Cotton #1	1.32a	1.08b
Cotton #2	1.24a	1.07b
Cotton #3	0.86a	0.58b
UHM Length, in.		
Cotton #1	1.07a	1.07a
Cotton #2	1.07a	1.06a
Cotton #3	1.08a	1.08a
Uniformity, %		
Cotton #1	82.6a	82.5a
Cotton #2	83.3a	83.7a
Cotton #3	82.5a	82.4a

* The second digit of the color grade was not affected by field cleaning and averaged "2" for Cotton #1 and "1" for the other test cottons.

** Means followed by the same letter are not significantly different at the 0.05 level.

Table 6. HVI data for ginned lint samples taken after one lint cleaner.

Test Cotton	Regular Stripped	Field Cleaned
Classers' Color Grade, 1st Digit*		
Cotton #1	2.43a**	2.15b
Cotton #2	2.98a	2.93a
Cotton #3	2.86a	2.74a
Micronaire Reading		
Cotton #1	3.31b	3.44a
Cotton #2	4.54b	4.78a
Cotton #3	4.48a	4.54a
Strength, g/tex		
Cotton #1	27.0a	27.0a
Cotton #2	28.1a	28.1a
Cotton #3	29.8a	29.5a
Rough Preparation, %		
Cotton #1	0.00	0.00
Cotton #2	0.00	0.00
Cotton #3	0.00	0.00
Rd Color Value		
Cotton #1	79.2b	79.8a
Cotton #2	78.3b	79.2a
Cotton #3	77.0a	77.3a
+b Color Value		
Cotton #1	8.9a	9.0a
Cotton #2	7.6a	7.6a
Cotton #3	7.6a	7.6a
Leaf Grade		
Cotton #1	2.83a	2.35b
Cotton #2	3.23a	3.00b
Cotton #3	3.14a	2.95b
Trash Area, %		
Cotton #1	0.40a	0.36b
Cotton #2	0.61a	0.49b
Cotton #3	0.33a	0.24b
UHM Length, in.		
Cotton #1	1.04a	1.04a
Cotton #2	1.04a	1.04a
Cotton #3	1.06a	1.06a
Uniformity, %		
Cotton #1	81.5a	81.6a
Cotton #2	83.2a	83.0a
Cotton #3	81.8a	81.7a

* The second digit of the color grade was not affected by field cleaning and averaged "1" for all test cottons.

** Means followed by the same letter are not significantly different at the 0.05 level.

Table 7. HVI data for ginned lint samples taken after two lint cleaners.

Test Cotton	Regular Stripped	Field Cleaned
Classers' Color Grade, 1st Digit*		
Cotton #1	2.00a**	2.00a
Cotton #2	2.83a	2.40b
Cotton #3	2.49a	2.18b
Micronaire Reading		
Cotton #1	3.30b	3.43a
Cotton #2	4.54b	4.76a
Cotton #3	4.45a	4.54a
Strength, g/tex		
Cotton #1	27.1a	26.9a
Cotton #2	28.0a	27.9a
Cotton #3	29.3a	29.1a
Rough Preparation, %		
Cotton #1	0.00	0.00
Cotton #2	0.00	0.00
Cotton #3	0.00	0.00
Rd Color Value		
Cotton #1	80.0a	80.7a
Cotton #2	80.4a	79.8a
Cotton #3	77.6a	78.1a
+b Color Value		
Cotton #1	8.9a	9.1a
Cotton #2	7.7a	7.8a
Cotton #3	7.6a	7.6a
Leaf Grade		
Cotton #1	2.15a	2.00a
Cotton #2	2.75a	2.15b
Cotton #3	2.82a	2.10b
Trash Area, %		
Cotton #1	0.29a	0.24b
Cotton #2	0.42a	0.30b
Cotton #3	0.24a	0.19b
UHM Length, in.		
Cotton #1	1.03a	1.03a
Cotton #2	1.04a	1.04a
Cotton #3	1.06a	1.05a
Uniformity, %		
Cotton #1	81.5a	81.4a
Cotton #2	82.7a	82.8a
Cotton #3	81.5a	81.5a

* The second digit of the color grade was not affected by field cleaning and averaged "1" for all test cottons.

** Means followed by the same letter are not significantly different at the 0.05 level.

Table 8. Selected AFIS properties of ginned lint samples taken after two lint cleaners.

Test Cotton	Regular Stripped	Field Cleaned
Mean Length, in.		
Cotton #1	0.896a*	0.893a
Cotton #2	0.935a	0.933a
Cotton #3	0.900a	0.983a
Upper Quartile Length, in.		
Cotton #1	1.094a	1.092a
Cotton #2	1.124a	1.120a
Cotton #3	1.096a	1.090a
Short Fiber Content, %		
Cotton #1	10.92a	10.64a
Cotton #2	9.36a	9.38a
Cotton #3	10.53a	10.73a
Fineness, mtex		
Cotton #1	163.4b	165.3a
Cotton #2	178.9a	180.5a
Cotton #3	166.5a	166.5a
Immature Fiber Content, %		
Cotton #1	9.39a	9.10b
Cotton #2	5.29a	5.21a
Cotton #3	7.78a	7.83a
Nep Count, no/g		
Cotton #1	593.3a	541.0b
Cotton #2	265.6a	233.4b
Cotton #3	336.4a	320.3a
Seed Coat Neps, no/g		
Cotton #1	30.2a	29.8a
Cotton #2	28.4a	28.0b
Cotton #3	29.2a	28.0a
Dust Count, no/g		
Cotton #1	424.1a	358.5b
Cotton #2	372.1a	298.8a
Cotton #3	472.3a	418.0a
Trash Count, no/g		
Cotton #1	90.4a	77.5b
Cotton #2	101.8a	82.0b
Cotton #3	82.4a	64.7a
Total Trash Count, no/g		
Cotton #1	529.4a	436.1b
Cotton #2	473.9a	380.5b
Cotton #3	554.6a	482.7b

* Means followed by the same letter are not significantly different at the 0.05 level.

Table 9. Summary of spinning data for Cotton No. 2.

Yarn Property	Regular Stripped	Field Cleaned
	Ring Spun Yarn, 30 Ne	
Count Strength Product	2365a*	2340a
Yarn Grade	106a	102a
Tenacity, g/tex	14.4a	14.3a
Mean Strength, g	287a	285a
Yarn Elongation	6.6a	6.6a
Yarn Evenness CV, %	20.7a	20.8a
Thin Places/1000 yds	328a	327a
Thick Places/1000 yds	1048a	1039a
Neps/1000 yds	413a	372b
Hairiness	4.6a	4.5a
	Open-End Spun Yarn, 24 Ne	
Count Strength Product	2236a	2214a
Yarn Grade	115a	115a
Tenacity, g/tex	13.5a	13.4a
Mean Strength, g	338a	337a
Yarn Elongation	6.6a	6.7a
Yarn Evenness CV, %	14.6b	14.8a
Thin Places/1000 yds	30b	34a
Thick Places/1000 yds	66a	71a
Neps/1000 yds	6a	6a
Hairiness	3.2a	3.2a

* Means followed by the same letter are not significantly different at the 0.05 level.