

INFLUENCE OF STICK MACHINES ON TURNOUT AND QUALITY OF STRIPPER COTTON

R. V. Baker, G. A. Holt and A. D. Brashears
USDA ARS South Plains Ginning Research Laboratory
Lubbock, TX

Abstract

Bypassing the second stick machine in the gin's seed cotton cleaning system when handling field cleaned cotton did not significantly affect HVI properties or lint turnout. For non-field cleaned cotton, however, the bypassing of a stick machine adversely affected Rd color (reflectance), HVI trash area, and leaf grade. Lint turnout was improved slightly for non-field cleaned cotton when the second stick machine was bypassed.

Introduction

Stick machines provide the extraction capabilities needed by cotton gins to remove burs and sticks from seed cotton prior to ginning. Consequently, these machines have been an essential part of a cotton gin's seed cotton cleaning system for many years (Baker et. al., 1977). Gins handling stripper cotton are typically equipped with two stages of extraction in the seed cotton cleaning system, and one stage at the extractor feeder (Baker et. al., 1990). These three extractors will generally provide the required level of bur and stick extraction needed to satisfactorily gin most stripper harvested cottons, even those containing excessive amounts of trash. Some stripper cottons, however, contain much less trash and do not require the maximum amount of extraction available at the cotton gin. Cleaner stripped cottons have become more commonplace in recent years due to greater use of field cleaners during harvest, and to cultural practices that permit an earlier, more timely harvest (Brashears et. al., 1997, Misra et. al., 1997).

Stick machines are equipped with bypass valves to enable the ginner to bypass one or more of these machines when processing relatively clean cotton that does not require the gin's full complement of extraction. Even though this bypass feature has been available for many years, it has not been used to any great extent in the past. In recent years, however, there has been an increased interest in bypassing the second stick machine in order to improve lint turnout. The actual impact of the second stick machine on turnout has not, however, been studied to any great degree. The purpose of this study was to investigate the impacts of stick machine usage at the cotton gin on lint turnout and HVI properties.

Methods

A conventional brush-roll stripper harvester was used to harvest twenty-four bales of cotton (Paymaster HS-26) produced in Lubbock County, Texas during the 1999-2000 crop year. Twelve of bales were pre-cleaned with a stripper-mounted field cleaner. The field cleaner was bypassed while harvesting the other twelve bales. One-half of the cotton from each harvest method was processed through a standard array of seed cotton cleaning and extracting equipment consisting of two inclined cleaners and two stick machines. The second stick machine was bypassed when cleaning the other half of cotton from each harvest method. All cotton was then further cleaned with an extractor-feeder, ginned using a 93-saw gin stand, and processed through two stages of saw-type lint cleaning.

Lint turnout was calculated for each ginning lot from initial seed cotton weights at the input suction and from the weights of the ginned lint after one and two stages of lint cleaning. Seed cotton samples were collected at the module and at the feeder apron for determination of moisture and

foreign matter contents. The trash removed from the seed cotton by the second stick machine was collected, weighed, and evaluated to determine the amount of seed cotton lost during this stage of extraction. Lint samples were collected after each stage of lint cleaning for HVI grading at the Lubbock Classing Office (USDA AMS). The samples were then evaluated at the International Textile Research Center, Lubbock, TX, for foreign matter content (Shirley Analyzer method) and fiber quality (AFIS). The waste removed by the lint cleaners was collected, weighed and evaluated to determine the amount of lint wasted by each stage of lint cleaning.

The four harvesting and ginning treatments were replicated four times in a randomized complete block experiment. Experimental results were evaluated by analysis of variance procedures and differences among treatment means separated by the Student-Newman-Keuls test at the 0.05 level of significance.

Results

The moisture contents of the seed cotton and lint were uniform and did not vary significantly from among the four treatments, Table 1. Processing rates were also controlled within a narrow range. The seed cotton was processed through the 6-foot wide cleaners and extractors at a rate of about 10 bale/h. Ginning and lint cleaning rate averaged about 5.5 bale/h for a 93-saw gin stand and two 66-in wide lint cleaners.

Field Cleaning

Field cleaning, as expected, had a large effect on the foreign matter of the seed cotton, Table 2. The field cleaner removed about 60% of the total foreign matter in the cotton. The field cleaner was much more effective in removing burs than it was in removing sticks and fine trash. The overall effects of field cleaning on foreign matter levels were still apparent after seed cotton cleaning and lint cleaning. As a result, field cleaning produced slightly better HVI leaf grades after one lint cleaner than did the harvest treatment without field cleaning, Table 4. After two lint cleaners, however, there was not a significant difference between the two harvest methods in leaf grade, Table 5. The Rd color values (reflectance) after one and two lint cleaners was slightly higher for field cleaned cotton, but these differences were too small to significantly affect the color grades, Tables 4 & 5. Field cleaning had no significant effect on micronaire value, fiber strength, fiber length, or length uniformity.

Field cleaned cotton, because of its lower trash levels, produced higher ginned lint turnouts than did non-field cleaned cotton, Table 3. These ginned lint turnouts, however, do not take into consideration the amount of cotton lost in the field by the field cleaner. Differences in yield data for plots harvested with and without the field cleaner were determined and compared to estimated seed cotton losses. Average lint yields with and without the field cleaner were 418 and 438 lbs/acre, respectively. This 20-lb/acre loss in yield was surprising, and suggests that this aspect of field cleaner performance needs to be evaluated more closely. It could not be determined in this study whether this high loss of cotton is typical of modern field cleaners, or whether it was due to unusual circumstances that occurred only in this study.

Second Stick Machine

The second stick machine significantly lowered bur, stick, and fine trash contents at the feeder apron for both field cleaned and non-field cleaned seed cottons, Table 2. All of the cotton, however, was relatively clean at this stage of processing. Even the treatment that produced the highest trash levels (no field cleaning and one stick machine) did not allow enough sticks to remain in the cotton to produce a bark problem. Past research has shown that the gin stand can add significant amounts of bark to the lint when stick contents exceed about 1.5% at the feeder apron (Laird and Baker, 1975). These differences in foreign matter levels due to second stick machine were still apparent after lint cleaning for the non-field cleaned

cotton, but not the field cleaned cotton, Table 2. For the non-field cleaned cotton, the visible foreign matter (VFM) contents after one and two stages of lint cleaning were significantly lower for cotton processed through the second stick machine. These differences in VFM, while relatively small, were never-the-less large enough to significantly affect Rd color, leaf grade, and trash area measurements of non-field cleaned cotton, Tables 4 & 5. The second stick machine did not significantly influence other HVI measurements for non-field cleaned cotton, nor did it significantly effect any of the HVI measurements for field cleaned cotton.

Even though lint turnout calculations were based on input seed cotton weights that were measured to the nearest 2-lb increment for each test lot and on lint weights that were measured to the nearest pound, numerical differences in turnout as high as 0.5 percentage point were not found to be statistically significant, Table 3. The natural variation in turnout within the modules were apparently high enough to mask any small differences in turnout such as those that might be created by the second stick machine. Despite the lack of conclusive statistical evidence, however, lint turnout probably did improve slightly when the second stick machine was bypassed, at least for the non-field cleaned cotton. It simply was not possible in this study to document exactly how many additional pounds were added to the bale as a result of bypassing the second stick machine. An estimate of this weight gain can, however, be made by considering the amount of seed cotton lost by the second stick machine and the increase in VFM in the lint when this machine is bypassed. In this study the second stick machine wasted very little seed cotton, Table 3. In fact, this loss was so small (0.004%) that it can be ignored. This situation may not, however, be true for all second stage stick machines. Cotton losses by a stick machine depend on machine design and condition, feed rate, and on the nature of the cotton itself. So, it cannot be ignored in all cases. Since the second stick machine in this study did not waste enough cotton to affect bale weight, any increases in weight would have had to accrue from additional foreign matter in the bale. The VFM of non-field cleaned cotton averaged 0.2 (after 2 lint cleaners) to 0.4 (after 1 lint cleaner) percentage points higher for cotton that had bypassed the second stick machine, Table 2. This increase in VFM is equivalent to weight increases in the bale of approximately 1 to 2 pounds. This increase in bale weight was accompanied by a small reduction in leaf grade which would, of course, further minimize the beneficial effects of the weight gain. For field cleaned cotton, there were no significant increases in VFM as a result of bypassing the second stick machine.

Summary

Field cleaned and non-field cleaned stripper harvested cotton from the 1999-2000 crop year was used to evaluate the impact of bypassing one of the stick machines in a cotton gin's seed cotton cleaning system on lint quality and turnout. Bypassing a stick machine at the gin when handling field cleaned cotton did not significantly affect HVI properties or lint turnout. For non-field cleaned cotton, the bypassing of a stick machine adversely affected Rd color (reflectance), trash area, and leaf grade. Estimates indicated, however, that lint turnout was improved slightly for non-field cleaned cotton when the second stick machine in the gin's seed cotton cleaning system was bypassed.

References

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Table 1. Average moisture levels and processing rates.

Measurement	Harvesting & Ginning Treatments			
	No Field Cleaning		Field Cleaned	
	1SM ¹	2SM	1SM	2SM
Moisture Content:				
At Feeder Apron, %	6.9	6.9	6.6	6.6
At Lint Slide, %	6.0	6.2	5.9	5.9
Processing Rates:				
Seed Cotton, bale/h	10.3	10.2	10.0	9.9
Lint, bale/h	5.5	5.4	5.5	5.5
Seed/Lint Ratio	1.63	1.62	1.63	1.58

¹ Number of stick machines employed at the gin.

Note: There were no significant differences (p=0.05) among the harvesting and ginning treatments for any of the above measurements.

Table 2. Effects of field cleaning and stick extraction at the gin on seed cotton and lint foreign matter levels.

Type of Foreign Matter	Harvesting & Ginning Treatments			
	No Field Cleaning		Field Cleaned	
	1SM ¹	2SM	1SM	2SM
After Harvest, Before Ginning				
Burs, %	19.7a ²	19.8a	5.2b	5.5b
Sticks, %	3.4a	3.4a	2.7b	2.7b
Fine Trash, %	9.5a	9.1a	6.9b	7.5b
Total Trash, %	32.6a	32.3a	14.8b	15.7b
After Seed Cotton Cleaning (Feeder Apron)				
Burs, %	1.6a	0.6b	0.5b	0.2c
Sticks, %	0.8a	0.4bc	0.5b	0.3c
Fine Trash, %	2.6a	2.1b	2.0b	1.7c
Total Trash, %	4.0a	3.1b	3.0b	2.2c
After One Lint Cleaner				
VFM ³ , %	3.7a	3.3b	3.0b	3.0b
After Two Lint Cleaners				
VFM, %	1.9a	1.7b	1.6b	1.5b

¹ Number of stick machines employed at the gin.

² Means for a given type of trash followed by the same letter are not significantly different at the 0.05 level of significance.

³ Visible foreign matter content as measured by the Shirley Analyzer.

Table 3. Effects of field cleaning and stick extraction at the gin on seed cotton and lint losses, lint cleaner waste, and lint turnout.

Measurement	Harvesting & Ginning Treatments			
	No Field Cleaning		Field Cleaned	
	1SM ¹	2SM	1SM	2SM
Trash Removed by 2 nd				
Stick Mach., lb/bale	0.0	63.5a ²	0.0	26.2b
Seed Cotton Loss at 2nd Stick Mach., %	0.000	0.004	0.000	0.004
Lint Cleaner Waste: ³				
1st Stage, lb/bale	63a	53b	49b	45c
2nd Stage, lb/bale	26a	23b	22bc	20c
Lint Lost at :				
1st L. C., lb/bale	9.1	9.3	9.5	8.9
2nd L. C., lb/bale	3.7	3.8	3.7	3.6
Lint Turnout:				
After 1 L. C., %	22.6b	22.2b	28.2a	28.4a
After 2 L. C., %	22.1b	21.8b	27.9a	28.0a

¹ Number of stick machines employed at the gin.

² Means for a given measurement followed by the same letter, or not followed by any letter, are not significantly different at the 0.05 level of significance.

³ Total weight of fiber, trash, and other debris removed by lint cleaning.

Table 4. Effects of field cleaning and stick extraction at the gin on HVI properties of samples collected after one lint cleaner.

Measurement	Harvesting & Ginning Treatments			
	No Field Cleaning		Field Cleaned	
	1SM ¹	2SM	1SM	2SM
Color Grade:				
Avg. of 1st Digit	3.07	3.02	2.85	2.88
Avg. of 2nd Digit	1.08	1.10	1.00	1.12
Staple L., 32nd in.	33.0	33.0	33.2	33.1
Micronaire Value	4.5	4.5	4.5	4.5
Strength, g/tex	28.9	28.7	28.7	28.7
Rd Color Value	77.4c ²	77.7b	78.2a	78.2a
+b Color Value	8.1a	8.1a	8.0b	8.0b
Leaf Grade, avg.	3.63a	3.45b	3.20c	3.20c
Trash Area, %	0.29a	0.24b	0.22b	0.23b
Length, in.	1.03	1.03	1.03	1.03
Uniformity Ratio	82.0	82.0	81.9	81.9

¹ Number of stick machines employed at the gin.

² Means for a given measurement followed by the same letter, or not followed by any letter, are not significantly different at the 0.05 level of significance.

Note: None of the samples were found to exhibit rough preparation or bark characteristics.

Table 5. Effects of field cleaning and stick extraction at the gin on HVI properties of samples collected after two lint cleaners.

Measurement	Harvesting & Ginning Treatments			
	No Field Cleaning		Field Cleaned	
	1SM ¹	2SM	1SM	2SM
Color Grade:				
Avg. of 1st Digit	2.48	2.43	2.37	2.42
Avg. of 2nd Digit	1.00	1.00	1.00	1.00
Staple L., 32nd in.	33.1	33.0	33.0	33.0
Micronaire Value	4.5	4.5	4.5	4.5
Strength, g/tex	29.0	29.0	28.7	28.9
Rd Color Value	79.0b ²	79.2b	79.6a	79.7a
+b Color Value	8.3a	8.2ab	8.2ab	8.1b
Leaf Grade, avg.	2.67	2.62	2.58	2.57
Trash Area, %	0.14	0.12	0.11	0.12
Length, in.	1.03	1.03	1.03	1.03
Uniformity Ratio	81.5	81.6	81.4	81.5

¹ Number of stick machines employed at the gin.

² Means for a given measurement followed by the same letter, or not followed by any letter, are not significantly different at the 0.05 level of significance.

Note: None of the samples were found to exhibit rough preparation or bark characteristics.

Table 6. Effects of field cleaning and stick extraction at the gin on AFIS measurements of samples collected after one lint cleaner.

Measurement	Harvesting & Ginning Treatments			
	No Field Cleaning		Field Cleaned	
	1SM ¹	2SM	1SM	2SM
Mean Length, in.	0.91	0.92	0.92	0.92
Upper Quartile L., in.	1.09	1.10	1.10	1.10
Short Fibers, %	8.7	8.4	8.7	8.4
Fineness, mtex	176	178	176	178
Immature Fiber, %	5.9	5.8	5.9	5.9
Maturity Ratio	0.90	0.91	0.90	0.91
Neps, cnt/g	275	284	267	270
Seed Coat Neps, cnt/g	25ab ²	27a	21b	23ab
Dust, cnt/g	903a	798b	712bc	675c
Trash, cnt/g	185a	176a	137b	139b
Mean Trash Size, um	329	332	324	326
VFM, %	3.11a	2.96a	2.40b	2.44b

¹ Number of stick machines employed at the gin.

² Means for a given measurement followed by the same letter, or not followed by any letter, are not significantly different at the 0.05 level of significance.

Table 7. Effects of field cleaning and stick extraction at the gin on AFIS measurements of samples collected after two lint cleaners.

Measurement	Harvesting & Ginning Treatments			
	No Field Cleaning		Field Cleaned	
	1SM ¹	2SM	1SM	2SM
Mean Length, in.	0.91	0.91	0.91	0.91
Upper Quartile L., in.	1.09	1.09	1.09	1.09
Short Fibers, %	8.7	8.7	8.7	8.7
Fineness, mtex	176	175	176	176
Immature Fiber, %	6.0	6.1	6.0	5.8
Maturity Ratio	0.90	0.89	0.90	0.90
Neps, cnt/g	328	349	321	310
Seed Coat Neps, cnt/g	20	20	22	20
Dust, cnt/g	424	433	351	358
Trash, cnt/g	91	91	83	83
Mean Trash Size, um	33	336	344	344
VFM, %	1.63	1.58	1.4	1.50

¹ Number of stick machines employed at the gin.

Note: There were no significant differences ($p = 0.05$) among the harvesting and ginning treatments for any of the above measurements.