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INVESTIGATION OF EXPERIMENTAL LINT CLEANER

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Abstract

The saw-type lint cleaner improves the appearance of ginned lint by removing foreign matter, motes, cottonseed, and other undesirable material. Unfortunately, it also removes about as much good fiber as it does undesirable material. One stage of lint cleaning typically removes about 20 pounds of material. An experimental lint cleaner was developed and patented to reduce the loss of good fiber and maintain fiber quality in the bale. Two studies were conducted to validate the operational characteristics of the experimental lint cleaner—one at a research facility and another at a commercial gin. Results at the research gin indicated that about 6 pounds of additional good fiber was retained by the experimental lint cleaner when compared to a standard lint cleaner with no significant difference in High Volume Instrument (HVI) or Advanced Fiber Information System (AFIS)-measured properties. The experimental lint cleaner operated for a full season at a commercial gin without operational problems. Measured HVI and AFIS-parameters of the baled lint from the experimental lint cleaner generally equaled or exceeded those of the standard lint cleaner.

Introduction

The saw-type lint cleaner has been used for many years in the ginning industry to comb and blend cotton fiber (lint), and to remove motes (aborted ovules), cottonseed, undesirable fiber, and plant parts. The lint from a gin stand or another lint cleaner is formed into a batt on a condenser screen drum and then fed into one or more sets of compression rollers, passed between very closely fitted feed rollers and a feed plate or bar, and then fed onto a saw cylinder. The teeth of the saw cylinder convey the fibers past several cleaning points commonly called grid bars that are spaced 1/32th to 1/16th in. away from the saw teeth. Good fiber as well as undesirable material is ejected at each of these grid bars or cleaning points, with the amount of good fiber increasing proportionately as the number of cleaning points increase (Anthony, 1999b; 2000). The amount of material removed by lint cleaning depends on the amount of foreign matter in the cotton as well as the percentage of motes and the fiber length characteristics. Typically, one stage of saw-type lint cleaning removes about 20 lbs of material that includes at least 50% good fiber (Mangialardi and Anthony, 1998). The percentage of fiber in the lint cleaner waste ejected by each successive grid bar increases as the number of grid bars increase.

The material ejected by lint cleaners is commonly, but erroneously, called "motes" by much of the cotton industry and "lint cleaner waste" by some (Anthony, 1999a). It is not unusual for the foreign matter in the lint cleaner waste to represent less than 50% of the total by weight. Lint cleaner waste is typically 1) placed into the waste pile along with materials removed by the seed cotton cleaners, 2) cleaned with a cylinder-type cleaner at the gin and sold to a mote processing facility, or 3) cleaned with cylinder-type cleaners and saw-type lint cleaners at the gin and sold as cleaned "motes". Much of the fiber in the lint cleaner waste is equal in quality to the fiber in the bale, and should remain in the bale.

Toward this end, a new machine was developed and patented (Anthony, 2003). The new lint cleaner consists of a standard lint cleaner modified to include a secondary saw to prevent loss of the longer fiber that is incorrectly ejected by the primary cleaning saw and grid bar arrangement (Figure 1). The new lint cleaner also includes either a steel brush or splined roller to guide the cotton onto the secondary saw (not shown). Material from the standard grid bar/saw cylinder falls on the second saw cylinder and is metered and compressed by a powered splined roller or brush. The roller or brush is positioned and operated such that only the longer fiber ejected by the primary saw cylinder is retained by the secondary saw.

The purposes of this study were to 1) determine the effectiveness of the new lint cleaner, and 2) determine the operational suitability of the new lint cleaner in a commercial gin.

Methodology

Study 1

A study was conducted in the full-scale gin at the Stoneville Ginning Lab involving three machine treatments, two cottons, and three replications for a total of 18 bales. The machine treatments included 1) the new machine as described earlier wherein the added section of the machine was bypassed to recreate a standard lint cleaner, 2) the machine described earlier equipped with a stationary brush for fiber retention, and 3) the new machine equipped with a powered roller for fiber retention. The cottons were Stoneville 747 and Stoneville BXN 47 harvested near Stoneville, MS, in 2001. The machine and cotton treatments were randomly assigned for the study. The sampling plan included 5 samples for wagon fractionation (module foreign matter), wagon (module) moisture, feeder fractionation (foreign matter before the gin stand), lint moisture before the bale press, seedcoat fragments before the bale press, and 10 samples before the bale press for Shirley Analyzer, High Volume Instrument (HVI) and Advance Fiber Information System (AFIS) analyses. A one-pound sample of the lint cleaner waste was taken from random locations in the lint cleaner waste after it was collected by a battery condenser. Weights for seed cotton, cottonseed, samples, lint and waste were also taken.

Study 2

The experimental lint cleaner (Figure 2) was removed from the full-scale gin at the Stoneville Lab, and installed in E. Ritter gin (Figure 3) at Marked Tree, AR, in August 2002. The Comet Extractor-feeder and a Continental Model 93 gin stand were also removed from the Stoneville Lab and installed in E. Ritter Gin to provide lint to the new lint cleaner. Since E. Ritter Gin was constructed as a "4-less-1" gin plant, the addition of the Stoneville machinery was simplified. The Stoneville equipment was installed for commercial operation during the 2002 season.

During the ginning season, the operational characteristics and the compatibility of the new lint cleaner to the commercial environment was observed on several occasions. In addition, 20 samples each were taken simultaneously 1) after the Continental Eagle 24D lint cleaner that followed a Continental Model 9000 Extractor-feeder, a Continental model 161 gin stand and a Continental Centrifugal Lint Cleaner, and 2) after the modified lint cleaner which followed a Continental Comet extractor-feeder and a Continental model 93 gin stand. Each of the 40 samples were divided into 5 sub-samples and analyzed by High Volume Instrument (HVI) at the Dumas Classing Office and the Advance Fiber Information System (AFIS) at Stoneville. At the same time, four samples were taken at each feeder apron for fractionation.

Results

Study 1

The data collected during ginning is shown in Table 1 with gin identifications and bale numbers in the order of the ginning treatments. Analyses of variance for the ginning related data is shown in Table 2. Ginning rate, wagon fractionation, feeder fractionation, wagon moisture, and lint moisture were not significant in the study. Wagon fractionation, feeder fractionation, wagon moisture, and lint moisture averaged 8.8%, 3.9%, 10.0%, and 5.3%, respectively (Table 3). The lint cleaner waste data was significant only for machines. The lint cleaner waste removed per 500-lb bale ranged from 14.5 lbs for the roller treatment to 20.5 lbs for the standard machine. Typical waste produced by the 16D and 28D lint cleaners are shown in Figures 4 and 5, respectively. The waste emitted by the 16D contained much more fiber than the waste emitted by the 28D.

None of the AFIS data was significant for machines (Table 4); however, several variables (short fiber content by weight, immature fiber content, fineness, neps per gram) were significant for cotton. Means for the AFIS data are shown in Table 5. The analyses of variance for HVI classing data is shown in Table 6 and means are in Table 7. None of the classing data was significant for machine or the interaction between machine and cotton. Leaf, micronaire, reflectance, yellowness, and uniformity were significant for cottons. The Shirley Analyzer waste, both total and visible, was significant for machines at the 5% level of probability for machines. The Shirley Analyzer visible waste was not significant between the standard (2.3%) or brush (2.5%) treatment but was different between the standard and roller treatment (2.7%).

Since the marketing parameters such as length, color, leaf, and micronaire were not different, then the value per pound of the cotton in the bale would be the same. The difference would be in the bale weight. For example, the bale would weigh 6 lbs more using the experimental machine treatments for a bale value increase for the farmer of over $4.00. For a typical 30,000 bale per year gin, this would be $120,000 annually.

Analyses of variance and means for seedcoat fragment data are in Tables 8 and 9, respectively. None of the treatments were significant.

It was apparent during the conduct of the experiment that different feed rates for the lint cleaner waste would be beneficial to improving the performance of the machine. Subsequent to this study, the rotational speed of the feed roller was changed from 31 to about 11 revolutions per minute and the amount of fiber recovered from the lint cleaner waste was dramatically increased. The initial test with the roller at different speeds, suggested that the 5 lbs of fiber recovered could be increased to at least 8 pounds. Further research is required in this area.

Study 2

Means for the feeder fractionation samples at E. Ritter Gin were 4.6% and 4.8% for the standard and modified lint cleaner treatments, respectively. Note that the "standard" lint cleaner for Study 2, was a commercial Continental Eagle Model 9000 extractor-feeder and 161 Model gin stand followed by a Continental Centrifugal Lint Cleaner and a model 24D lint cleaner operated in parallel with the Continental Model Comet extractor-feeder and 93-saw gin stand followed by the experimental lint cleaner. Analyses of variance and means for Study 2 are in Tables 10 and 11, respectively. A number of significant differences were evident for the AFIS data, primarily in favor of the modified lint cleaner. Several of the HVI variables were significant, mostly in favor of the 28D lint cleaner as follows:

Machine	Leaf	Length, in.	Uniformity	Staple
24D	3.50	1.069	82.4	34.2
28D	3.77	1.079	82.8	34.5

The differences in marketing parameters did not affect the price per pound. Thus, the difference in the two machines is in the bale weight. For example, the bale would weigh about 6 lbs more using the modified machine for an increase of about $4.00.

The modified cleaner processed about 5,000 bales during the season without any operational problems.

Acknowledgement

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Disclaimer

Mention of a trade name, proprietary product, or specific machinery does not constitute a guarantee or warranty by the U.S. Department of Agriculture and does not imply approval of the product to the exclusion of others that may be available.

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Table 1. Gin data for Study 1.

Gin ID	Cotton[1]	Treatment[2]	Gin time	Seed, weight lbs.	Bale weight lbs	Lint cleaner waste lbs	Moisture, %	
							Seed cotton	Lint
5	1	Brush	13:45	750	472	14.40	9.95	5.20
8	1	Brush	13:01	750	475	15.00	10.54	5.45
16	1	Brush	13:20	760	473	15.62	9.33	4.98
6	2	Brush	15:02	870	547	14.58	9.13	4.79
7	2	Brush	14:20	800	495	16.42	9.92	5.27
15	2	Brush	13:05	800	487	12.56	8.76	4.47
1	1	Roller	15:25	770	548	16.12	10.55	7.13
12	1	Roller	14:10	830	515	15.14	11.54	5.46
13	1	Roller	14:25	850	528	14.72	11.44	4.96
2	2	Roller	14:43	890	.	11.64	8.84	6.08
11	2	Roller	13:35	780	470	14.68	12.01	5.48
14	2	Roller	13:49	810	487	13.38	9.38	4.82
4	1	Standard	12:41	740	569	21.72	10.37	5.78
9	1	Standard	12:04	700	427	19.20	10.80	5.28
17	1	Standard	12:55	750	462	19.78	8.88	5.12
3	2	Standard	13:37	830	516	20.00	8.40	5.72
10	2	Standard	13:10	780	483	20.40	9.94	5.46
18	2	Standard	14:21	820	486	19.10	9.33	4.74

[1]STV 747 = cotton No. 1; BXN 47 = cotton No. 2

[2]Sixteen-D lint cleaner with secondary 12” diameter saw and 5 grid bars (Standard). Also equipped with either a feed roller (Roller) or a stationary brush (Brush) to feed waste on secondary saw.

Table 2. Analyses of variance for the ginning related data for Study 1.

Source of variation[1]	Ginning rate	Waste: Actual lbs	Waste: Percent	Waste: Per 500-lb bale, lbs	Seed cotton fractionation before processing	Seed cotton fractionation before gin stand	Seed cotton moisture	Lint moisture
	Mean Squares							
Machine	0.09 ns	61.11**	2.50 **	62.58**	0.39 ns	0.04 ns	2.06 ns	0.59 ns
Cotton	0.08 ns	4.44 ns	0.10 ns	2.43 ns	2.59 ns	0.45 ns	3.29 ns	0.36 ns
Machine * Cotton	0.06 ns	1.36 ns	0.04 ns	1.11 ns	0.05 ns	0.13 ns	0.07 ns	0.04 ns
Error	0.10	1.52	0.07	1.72	0.74	0.31	0.92	0.38
P>F	0.59	0.01	0.01	0.01	0.49	0.72	0.22	0.54
Mean	4.5	16.36	3.37	16.83	8.82	3.91	9.95	5.34
CV	6.9	7.54	7.78	7.78	9.74	14.21	9.63	11.54
MSE[2]	0.31	1.23	0.26	1.31	0.86	0.56	0.96	0.62

ns indicates not significant
*Indicates significance at the 5% probability level.
**Indicates significance at the 1% probability level.
[1]Degrees of freedom = 2, 1, 2 and 11, respectively.
[2]Root mean square error

Table 3. Means for ginning related data separated by Waller-Duncan for Study 1.

Variable	Ginning rate, bales/hr	Waste: Actual, lbs	Waste: Percent	Waste: Per 500-lb bale, lbs	Initial foreign matter %	Foreign matter before ginning %	Initial seed cotton moisture %	Lint moisture %
	Means for variable							
Machine								
Standard	4.6a	20.03a	4.10a	20.52a	8.67a	3.89a	9.62a	5.35a
Brush	4.4a	14.76a	3.01b	15.06b	8.68a	4.01a	9.61a	5.03a
Roller	4.4a	14.28b	2.91c	14.54b	9.12a	3.84a	10.63a	5.66a
Variety								
1–STV 747	4.56	16.86	3.42	17.10	9.20	4.11	10.38	5.48
2–STVBXN 47	4.44	15.86	3.31	16.54	8.45	3.75	9.52	5.20

Table 4. Analyses of variance for AFIS data for Study 1.

Source of Variation[1]	Short fiber content, %: Weight	Short fiber content, %: Number	IFC	L(w)	UQL (w)	L(n), in.	Length 5%, in.	Length 2.5%, in.	Fineness	Mat ratio	Nep/gm	Nep/size
Machine	0.01ns	0.62ns	0.01ns	0.01ns	0.01ns	0.01ns	0.01ns	0.01ns	1.40ns	0.01ns	344.04ns	8.00ns
Cotton	3.15**	11.22ns	1.18**	0.01ns	0.01ns	0.01ns	0.01ns	0.01ns	160.80**	0.01ns	6164.20**	26.40ns
Machine* Cotton	0.13ns	2.50ns	0.01ns	0.01ns	0.01ns	0.01ns	0.01ns	0.01ns	0.17ns	0.01**	22.81ns	43.64ns
Error	0.40	3.17	0.06	0.01	0.01	0.01	0.01	0.01	4.85	0.001	460.65	25.05
P>F	0.21	0.41	0.03	0.81	0.99	0.57	0.99	0.94	0.01	0.02	0.06	0.44
Mean	7.64	25.15	3.30	1.00	1.19	0.80	1.33	1.40	184.46	0.89	245.24	714.33
CV	8.25	7.08	7.57	1.68	1.43	2.61	1.25	1.10	1.19	0.91	8.75	0.70
MSE2	0.63	1.78	0.25	0.17	0.02	0.02	0.02	0.02	2.20	0.01	21.46	5.00

ns indicates not significant
**Indicates significance at the 1% probability level.
[1]Degrees of freedom = 2, 1, 2 and 11, respectively.
[2]Root mean square error

Table 4 (continued). Analyses of variance for AFIS data for Study.

Source of Variation[1]	SCN/gm	SCN/size	Total/gm[2]	Dust size[3]	Dust/gm[3]	Trash/gm[4]	Visible foreign matter, %
Machine	5.42ns	3157.59ns	8825.04ns	13.56ns	6269.67ns	242.05ns	0.10ns
Cotton	0.03ns	13.52ns	21204.27ns	24.73ns	14156.84ns	708.13ns	0.12ns
Machine*		3442.31ns	3404.50ns	97.62ns	2550.34ns	117.94ns	
Cotton	1.98ns						0.05ns
Error	2.98	922.29	6347.12	121.12	3995.30	324.07	0.10
P>F	0.46	0.06	0.28	0.83	0.24	0.52	0.56
Mean	19.95	1204.78	559.59	353.17	451.54	108.12	2.00
CV	8.66	2.52	14.24	3.12	14.00	16.65	15.87
MSE[5]	1.73	30.37	79.67	11.01	63.21	18.00	0.32

ns indicates not significant
**Indicates significance at the 1% probability level.
[1]Degrees of freedom = 2, 1, 2 and 11, respectively.
[2] Dust plus trash.
[3] Smaller than 500 microns but larger than 50 microns.
[4] Larger than 500 microns and smaller than 2000 microns.
[5]Root mean square error.

Table 5. Means for AFIS data separated by Waller-Duncan for Study 1.

Variable	Short fiber content, %		IFC	L(w), in	UQL (w), in.	L(n), in.	Length 5%, in.	Length 2.5%, in.	Fineness	Mat ratio	Nep/gm	Nep/size
	Weight	Number										
Machine												
Standard	7.65a	25.0a	3.30a	0.99a	1.19a	0.80a	1.33a	1.40a	184.77a	0.89a	238.50a	713.65a
Brush	7.67a	25.5a	3.33a	0.99a	1.19a	0.80a	1.32a	1.40a	183.90a	0.89a	253.43a	715.67a
Roller	7.60a	25.0a	3.27a	0.99a	1.19a	0.80a	1.33a	1.40a	184.70a	0.89a	243.78a	713.68a
Variety												
1-STV 747	7.22	24.36	3.04	1.00	1.19	0.81	1.32	1.40	187.44	0.90	226.73	715.54
2-STVBXN 47	8.05	25.94	3.56	0.99	1.19	0.79	1.33	1.40	181.47	0.88	263.74	713.12

Table 5 continued. Means for AFIS data separated by Waller-Duncan for Study 1.

Variable	SCN/ gm	SCN/ size	Total/ gm[1]	Dust size[2]	Dust/ gm[2]	Trash/ gm[3]	Visible foreign matter, %
Machine							
Standard	18.98a	1207.62ba	519.85a	354.62a	417.15a	102.80a	1.89a
Brush	19.98a	1226.17a	562.53a	351.62a	456.18a	106.40a	1.96a
Roller	20.88a	1180.55b	596.38a	353.28a	481.30a	115.15a	2.14a
Variety							
1- STV 747	19.91	1203.91	593.91	352.00	479.59	114.39	2.08
2-STVBXN 47	19.99	1205.64	525.27	354.34	423.50	101.84	1.92

[1] Dust plus trash
[2] Smaller than 500 microns but larger than 50 microns
[3] Larger than 500 microns and smaller than 2000 microns

Table 6. Analyses of variance for HVI classing data for Study 1.

Source of variance[1]	Staple	Leaf	Micronaire	Strength	Rd	Plusb
Machine	0.18 ns	0.12 ns	0.002 ns	0.10 ns	0.97 ns	0.01 ns
Cotton	0.03 ns	0.43 **	0.46 **	0.56 ns	5.93 **	0.45 **
Machine*cotton	0.03 ns	0.10 ns	0.002 ns	0.16 ns	0.23 ns	0.02 ns
Error	0.21	0.04	0.01	0.17	0.50	0.04
P>F	0.14	0.01	0.01	0.50	0.04	0.07
Mean	36.55	3.73	4.90	29.67	75.34	8.75
CV	1.25	5.11	2.37	1.41	0.94	2.20
MSE[2]	0.46	0.19	0.12	0.42	0.71	0.19

ns indicates not significant
*Indicates significance at the 5% probability level.
**Indicates significance at the 1% probability level.
[1]Degrees of freedom = 2, 1, 2 and 11, respectively.
[2]Root mean square error

Table 6 continued. Analyses of variance for HVI classing data for Study 1.

Source of variance[1]	Trash, % area	Length	Uniformity	Color grade index	Bark	Shirley Analyzer Total	Shirley Analyzer Visible
Machine	0.01 ns	0.01 ns	0.31 ns	3.15 ns	212.62 ns	0.36 *	0.27 *
Cotton	0.003 ns	0.01 ns	1.78 **	8.15 ns	27.43 ns	0.004 ns	0.09 ns
Machine*cotton	0.003 ns	0.01 ns	0.01 ns	0.49 ns	459.53 ns	0.04 ns	0.02 ns
Error	0.003	0.01	0.11	2.63	596.71	0.08	0.05
P>F	0.18	0.91	0.01	0.38	0.80	0.13	0.07
Mean	0.37	1.14	82.65	98.03	13.6	4.12	2.50
CV	14.03	1.36	0.39	1.66	179.88	6.69	8.96
MSE[2]	0.05	0.02	0.33	1.62	24.43	0.28	0.22

ns indicates not significant
*Indicates significance at the 5% probability level.
**Indicates significance at the 1% probability level.
[1]Degrees of freedom = 2, 1, 2 and 11, respectively.
[2]Root mean square error

Table 7. Means for HVI classing data separated by Waller-Duncan for Study 1.

Variable	Staple, 32[nd]	Leaf	Micronaire	Strength, g/tex	Rd	Plusb
Machine						
Standard	36.74a	3.69a	4.92a	29.81a	75.70a	8.72a
Brush	36.50a	3.74a	4.88a	29.55a	75.41a	8.78a
Roller	36.41a	3.87a	4.90a	29.67a	74.91a	8.76a
Variety						
1- STV 747	36.59	3.89	5.06	29.85	74.77	8.91
2-STVBXN 47	36.51	3.58	4.74	29.50	75.91	8.60

Table 7 continued. Means for HVI classing data separated by Waller-Duncan for Study 1.

Source of variance	Trash, % area	Length, in.	Uniformity	Color grade index	Color mode	Bark	Shirley Analyzer, % Total	Shirley Analyzer, % Visible
Machine								
Standard	0.35a	1.14a	82.91a	98.56a	31a	9.3a	3.88b	2.30b
Brush	0.34a	1.14a	82.56a	98.33a	31a	11.1a	4.11ab	2.48ba
Roller	0.41a	1.14a	82.48a	97.20a	31a	20.4a	4.38a	2.73a
Variety								
1- STV 747	0.38	1.14	82.96	97.36	31	14.81	4.14	2.57
2-STVBXN 47	0.35	1.14	82.33	98.70	31	12.35	4.10	2.43

Table 8. Analyses of variance for seedcoat fragments per gram of lint for Study 1.

Source of variance[1]	Seedcoat Fragments		Motes		Funiculi	
	Count	Weight[2]	Count	Weight[2]	Count	Weight[2]
Machine	176.17 ns	29.92 ns	2.77 ns	92.26 ns	1.34 ns	0.05 ns
Cotton	54.54 ns	57.72 ns	0.10 ns	5.89 ns	3.86 ns	0.48 ns
Machine*cotton	18.71 ns	32.72 ns	2.24 ns	56.38 ns	1.12 ns	0.41 ns
Error	60.31	20.92	1.57	31.50	0.87	0.17
P>F	0.27	0.20	0.33	0.16	0.15	0.22
Mean	41.67	22.35	3.07	11.36	3.02	1.10
CV	18.64	20.46	40.81	49.40	30.90	37.61
MSE[3]	7.77	4.57	1.25	5.61	0.9.3	0.41

ns indicates not significant
*Indicates significance at the 5% probability level.
**Indicates significance at the 1% probability level.
[1]Degrees of freedom = 2, 1, 2 and 11, respectively.
[2]Milligrams per gram of lint
[3]Root mean square error

Table 9. Means for seedcoat fragments per gram of lint separated by Waller-Duncan for Study 1.

Variable	Seedcoat Fragments		Motes		Funiculi	
	Count	Weight[1]	Count	Weight[1]	Count	Weight[1]
Machine						
Standard	35.50a	21.53a	2.33a	9.13a	2.83a	1.03a
Brush	43.83a	20.64a	3.67a	15.89a	36.56a	1.21a
Roller	45.67a	24.88a	3.22a	9.06a	2.67a	1.06a
Variety						
1- STV 747	39.93	20.56	3.15	10.79	2.56	0.94
2-STVBXN 47	43.41	24.14	3.00	11.93	3.48	1.26

[1]Milligrams per gram of lint

Table 10. Analyses of variance for Study 2. See appendix A for abbreviations.

Variable	Mean squares: Machine	Mean squares: Error	F-Value	Pr > F	R-Square	Coefficient of variation	Root MSE	Mean
LW	0.01283	0.00080	16.03	0.0003*	0.3023	2.9741	0.0283	0.951
Lwcv	95.48908	11.06766	8.63	0.0057*	0.1891	10.4831	3.3268	31.73
UQLv	0.00301	0.00013	22.5	0.0001*	0.3781	1.0256	0.0116	1.129
SFCw	16.06251	0.41435	38.77	0.0001*	0.5117	9.3027	0.6437	6.92
Ln	0.03692	0.00275	13.4	0.0008*	0.2659	6.6648	0.0525	0.788
Lncv	340.80411	39.54585	8.62	0.0057*	0.1889	13.6976	6.2885	45.91
SFCn	85.57600	3.74450	22.85	0.0001*	0.3818	9.1848	1.9351	21.07
1pt5	0.00490	0.00030	16.47	0.0002*	0.3080	1.3570	0.0172	1.271
12pt5	0.00425	0.00019	21.89	0.0001*	0.3717	1.0285	0.0139	1.355
Fine	45.90385	10.98394	4.18	0.0481*	0.1015	1.8567	3.3142	178.50
IFC	2.90080	0.29119	9.96	0.0032*	0.2121	13.4663	0.5396	4.01
Matrat	0.00402	0.00043	9.38	0.0041*	0.2023	2.3739	0.0207	0.872
Nepsize	16.78822	2119.27537	0.29	0.5915	0.0079	1.0754	7.5682	703.8
Nepgm	1279.05361	647.95960	1.97	0.1684	0.0506	10.9944	25.4551	231.5
SCNsize	27155.44676	3227.31990	8.41	0.0062*	0.1853	4.5251	56.8095	1255.4
SCNgm	64.06581	5.83506	10.98	0.0021*	0.2288	15.9243	2.4156	15.2
Total	37617.32560	18840.61400	2	0.1660	0.0512	21.0127	137.2611	653.2
Meansize	111.17604	495.16428	0.22	0.6384	0.0060	6.4542	22.2523	344.8
Dustgm	25005.77600	14755.64490	1.69	0.2010	0.0438	22.5866	121.4728	537.8
Color	9.02500	11.82184	0.76	0.3877	0.0197	9.0067	3.4383	38.2
Mike	0.00961	0.03435	0.28	0.5999	0.0073	4.1189	0.1853	4.5
Strength	0.66564	0.63974	1.04	0.3142	0.0267	2.7554	0.7998	29.03
Rd	0.08100	0.78837	0.1	0.7503	0.0027	1.2156	0.8879	73.0
Plusb	0.00196	0.06247	0.03	0.8603	0.0008	2.7593	0.2499	9.06
Leaf	0.72900	0.10058	7.25	0.0105*	0.1602	8.7247	0.3171	3.6
Pctarea	0.00004	0.00007	0.52	0.4767	0.0134	17.9978	0.0084	0.047
Length	0.00088	0.00010	8.79	0.0052*	0.1878	0.9336	0.1003	1.074
Uniform	2.20900	0.13847	15.95	0.0030*	0.2957	0.4506	0.3721	82.58

*Indicates significance at the 5% level of probability.

Table 11. Overall means for the two machine treatments for AFIS and HVI data for Study 2. See Appendix A for description of abbreviations.

Machine	L(w), in.	L(w), CV	UQL(w), in.	SFC(w), in.	L(n) in.	L(n), CV	SFC(n), %	Length 5%, in.
24D	0.93	33.26	1.12	7.55	0.76	48.79	22.51	1.26
28D	0.97	30.13	1.14	6.26	0.82	42.88	19.55	1.28

Table 11 continued. Overall means for the two machine treatments for AFIS and HVI data for Study 2. See Appendix A for description of abbreviations.

Length 2.5%, in.	Fine	IFC	Maturity ratio	Nep/size, um	Nep/gm	SCN/size, um	SCN/gm	Total dust
1.34	177.44	4.27	0.86	703.14	237.11	1281.15	13.92	623.0
1.37	179.61	3.73	0.88	704.45	225.65	1228.36	16.48	685.1

Table 11 continued. Overall means for the two machine treatments for AFIS and HVI data for Study 2. See Appendix A for description of abbreviations.

Dust/gm	Mike	Strength, g/tex	Rd	Plusb	Leaf	Trash, % area	Length, in.	Uniform
513.13	4.48	28.90	73.00	9.07	3.50	0.05	1.07	82.35
563.79	4.52	29.16	73.09	9.05	3.77	0.05	1.08	82.82

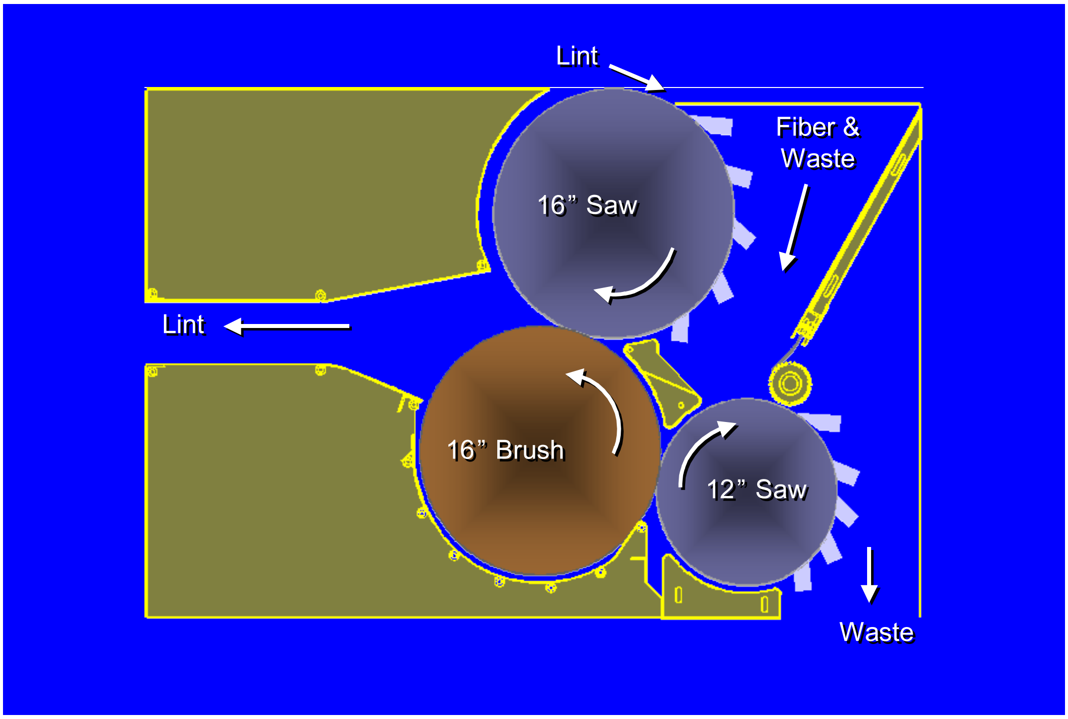

Figure 1. Cross-sectional view of the modified lint cleaner.

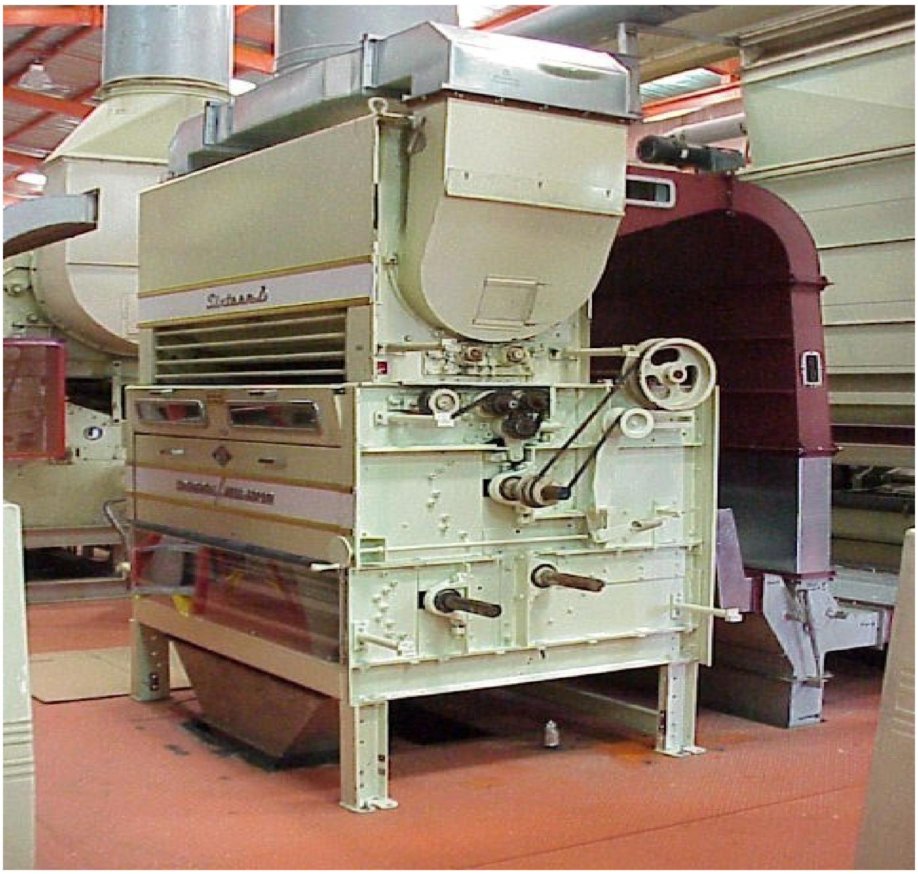

Figure 2. Side view of the experimental lint cleaner installed at Stoneville lab.

Figure 3. Side view of modified lint cleaner installed at E. Ritter Gin.

Figure 4. Typical lint cleaner waste from 16D lint cleaner.

Figure 5. Typical lint cleaner waste from 28D lint cleaner.

Appendix A. Abbreviations for AFIS and HVI variables.

Nep size [mm]	Mean size of all neps (both fiber and seed coat neps) in the sample.
Neps per gram	Total nep count normalized per gram. This includes both fiber and seed coat neps.
L(w) [in]	Average length of all the fibers in the sample computed on a weight basis.
L(w) CV [%]	Percentage of the coefficient of variation of the length by weight.
UQL(w) [in]	Upper Quartile Length by weight. This is the length which is exceeded by 25% of the fibers by weight.
SFC(w) [%]	Short fiber content of the sample (calculated by weight).
L(n) [in]	Average length of all the fibers in the sample computed on a number basis.
L(n) CV [%]	Percentage of the coefficient of variation of the length by number.
SFC(n) [%]	Short fiber content of the sample (actual fibers counted by number).
L5%(n) [in]	Length, calculated by number, that is exceeded by five percent of the fibers.
L2.5%(n) [in]	Length, calculated by number, that is exceeded by 2.5 percent of the fibers.
Total trash [count/gra	Total trash consists of Trash and Dust; this is the total of the trash and dust count per gram of the sample.
Trash Size [mm]	Mean size of all the trash in the sample.
Dust [count/gram]	Particles measured by the Trash Module that are below the size defined as Dust on the trash Report Type setup screen.
Trash [count/gram]	All foreign matter in cotton that is above the size defined as Dust is considered trash. This is the amount of trash per gram of the sample.
VFM [%]	Percentage of Visible Foreign Matter (dust and trash) in the sample.
SCN size [mm]	Mean size of all seed coat neps in the sample.
SCN per gram	Seed coat nep count normalized per gram.
Fine [mTex]	Fineness - Mean fiber fineness (weight per unit length) in millitex. One thousand meters of fibers with a mass of 1 milligram equals 1 millitex.
IFC [%]	Immature Fiber Content is the percentage of fibers with less than 0.25 maturity. The lower the IFC%, the more suitable the fiber is for dyeing.
Mat Ratio	Maturity Ratio - The ratio of fibers with a 0.5 (or more) circularity ratio divided by the amount of fibers with a 0.25 (or less) circularity. The higher the maturity ratio, the more mature the fibers are and the better the fibers are for dyeing.
Micronaire	Micronaire is a measure of fiber fineness and maturity.
Strength	Strength measurements are reported in terms of grams per tex. A tex unit is equal to the weight in grams of 1,000 meters of fiber.
Rd and Plusb	Color of cotton is determined by the degree of reflectance (Rd) and yellowness (+b). Reflectance indicates how bright or dull a sample is, and yellowness indicates the degree of color pigmentation.
Percent area	Trash is a measure of the amount of non-lint materials in the cotton, such as leaf and bark from the cotton plant. The surface of the cotton sample is scanned by a video camera and the percentage of the surface area occupied by trash particles is calculated.
Length	Fiber length is the average length of the longer one-half of the fibers (upper half mean length).
Uniform	Length uniformity is the ratio between the mean length and the upper half mean length of the fibers and is expressed as a percentage.