Effect of Bur Extractor on Trash in Seed Cotton and Fiber Quality for Different Harvest Dates

Blake K. Bennett, Sukant K. Misra, Alan Brashears, and Tracy L. Dowty*

* Research Assistant and Assistant Professor Department of Agricultural Economics, Texas Tech University, Lubbock, TX, Agricultural Engineer, USDA-ARS, Lubbock, TX and Research Assistant, Oklahoma State University, Stillwater, OK.

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Introduction

Stripper harvesting is the most prominent means of harvesting cotton in Texas. Seventy-two percent of the cotton produced in Texas is stripper harvested, while the other 28 percent is machine picked (Glade et al., 1993). Stripper harvesting is faster than picker harvesting but removes more extraneous matter with the cotton lint and seed. Most of this extraneous matter (non lint and non seed) is composed of plant material such as burs, stems, leaf, and hulls, but could also contain non plant materials that include sand and rocks. These extraneous materials must be removed from cotton lint to improve lint grade and thus provide increased revenues to the producer. The presence of foreign material in cotton lint may also compromise the quality of the products coming out of the mills.

Research was initiated as early as 1927 to develop a field cleaner that can be used on stripper harvesters for removing some extraneous material at the time of harvesting (Kirk et al). Currently, field cleaners are commercially available to producers. Producers have a choice of buying a new stripper with a field cleaner (bur extractor) already attached to it or adding a field cleaner to their existing stripper harvesters.

Farmers may need to know the effect of a field cleaner on extraneous materials (fractionation attributes) in harvested cotton and quality attributes of lint (e.g., strength, color grade, trash grade, and micronaire). Previous studies have addressed the effect of field cleaners on fractionation attributes and found that cotton turnout can be improved (Richman et al.). However, estimates of

the effect of field cleaners on individual fractionation and quality attributes are unavailable.

Objectives

The general objective of this study was to estimate the effects of a field cleaner on fractionation and quality attributes of stripper harvested cotton. More specifically, the objectives were to determine the effects of field cleaning on:

1. fractionation attributes of cotton for different harvest dates.
2. quality attributes of cotton for different harvest dates.

Data and Methods

The data for this study were collected from the Agricultural Research Service office of the U.S. Department of Agriculture (ARS-USDA) in Lubbock, Texas. The cotton samples that were used for this analysis were of one cotton variety, HS26, and were all stripper harvested (some with the use of a field cleaner and some without). Samples were obtained from cotton that was harvested on October 28, November 6, November 14, December 5, December 13, and December 19, of 1990, and January 22 of 1991. Once harvested and dumped into trailers, 42 total samples were taken at random to obtain the trailer samples, which were ginned within two days of being harvested. During the ginning process, samples were taken at the feeder apron above the gin stand. For each of these samples, 200 grams of seed cotton were weighed and the burs and sticks were removed by hand. These 200 gram samples were then placed in a

pneumatic fractationator that separated the fine trash. Each foreign matter fraction and the seed cotton was then weighed.

The cotton was ginned using the standard sequence used for stripper harvested cotton, which included: airline cleaner, inclined cleaner, combination bur and stick machine, second incline cleaner, stick machine, 178 saw gin and two saw-type lint cleaners. Lint samples collected after the second lint cleaning were sent to the USDA classing office in Lubbock, Texas, where the quality attributes were measured. The data were compiled for all samples and an average was taken of the samples with similar treatments. This produced forty-two data points for final analysis.

Cross-tabulations were initially performed to analyze the effects of the field cleaner on fractionation and quality attributes of cotton for different harvest dates. These provided some insight on the effects of a field cleaner. To obtain more definitive statistical estimates, several regression models were run. Each of the fractionation and quality attributes was specified as a function of the field cleaner and the time of harvest. The field cleaner (FC) variable was specified as a dummy variable; FC = 1 if the field cleaner was used in harvesting and FC = 0 otherwise. The time of harvest variable was also incorporated into the model as dummy variables by collapsing into three categories representing early-harvest (EH), mid-harvest (MH), and late harvest (LH). Cotton that was harvested from October 28 through November 6 was classified as early harvest. Similarly, cotton that were harvested from November 14 through December 5 and

December 13 through January 22 were classified as mid and late harvest, respectively. Both linear and non-linear functional forms were attempted to identify a model that fits the data the best. Since the results from both non-linear and linear regressions were very similar, only the estimated linear regressions are reported in this study.

Results and Implications

Frequency analysis of the effects of the field cleaner on fractionation and quality attributes of cotton for different harvest dates are presented in Appendix Tables 1 through 12. Appendix Tables 1, 2 and 4, representing bur-percent, stick-percent, and seed cotton percent, respectively, exhibit definite patterns in their data distribution. The frequencies shown in Appendix Tables 1 and 2 demonstrate that field cleaned cotton is lower in bur and stick percent than cotton that is not field cleaned. Cotton that was field cleaned tended to possess a higher percentage of seed cotton than cotton that was not field cleaned, as shown in Appendix Table 4.

Frequency tables representing the effects of field cleaning on cotton quality attributes are presented in Appendix Tables 5 through 12. The use of a field cleaner does not appear to have any impact on cotton quality attributes such as strength, composite color grade, RD, +b, trash, length, uniformity, or micronaire. A similar observation can be made about the effect of a field cleaner on fine trash.

The effects of the field cleaner on fractionation and quality attributes of cotton for different harvest dates were further analyzed with regression procedures. The regression results presented in Appendix Table 13[1] indicate that the field cleaner has a statistically significant effect (significance level of 0.05 or less) on the majority of the fractionation attributes. More specifically, the use of a field cleaner was found to be statistically significant in explaining bur percent, stick percent, and seed cotton percent. The use of a field cleaner was not, however, statistically significant in explaining fine trash.

The results shown in Appendix Table 13 indicate that when a field cleaner was not used bur percent was 24.12, stick percent was 6.21, and seed cotton percent was 61.82 percent. However, when a field cleaner was employed during early harvest bur percent was found to decrease by 78.98 percent, stick percent decreased by 37.68 percent, and seed cotton increased by 36.28 percent. When a field cleaner was employed during mid-season harvest bur percent decreased by 81.88 percent, stick percent decreased by 28.82 percent, and seed cotton percent increased by 31.30 percent. Employment of a field cleaner during late season harvest yielded

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[1] Appendix Table 13 may also be expressed in equation form. An example would be: Bur Percent = 24.12 - 15.16(FC) - 3.89(EH) - 4.59(MH), with the effect of field cleaner being represented by the FC coefficient. All other regression results presented in Appendix Tables 13 and 14 can also be expressed in the same manner.

similar results with bur percent decreasing by 63.85 percent, stick percent decreasing by 28.66 percent, and seed cotton percent increasing by 27.56 percent.

The regression results presented in Appendix Table 14 do not reveal any statistically significant relationships between field cleaning and any of the quality attributes. This is consistent with the frequency analysis presented earlier. This implies that the effects of the field cleaner are offset as the cotton is further cleaned in the gin plant (cotton that is field cleaned possess the same quality attributes as cotton that is not field cleaned).

Summary and Conclusions

Experimental data on fractionation and quality attributes of cotton with and without the use of a field cleaner for the 1990-91 production year were collected and analyzed to assess the effects of field cleaning. Cross-tabulations and regression analyses found the field cleaner to have a significant effect on bur percent, stick percent, and seed cotton percent. Regression estimates suggest that bur percent in cotton can be reduced by about 63 to 82 percent with the use of a field cleaner. Similarly, field cleaning can potentially decrease stick percent in cotton by about 28 to 38 percent. Seed cotton percent was found to increase by 27 to 37 percent with the use of a field cleaner. With regard to the time of harvest, it was found that the field cleaner was most effective in reducing stick content and in increasing seed-cotton percent during early harvest. However, it appears that the field cleaner

was most effective in reducing bur percent during the mid-season harvest. Further, analyses suggested that the field cleaner does not have any statistically significant effect on the quality attributes of cotton.

These results imply that producers can decrease their bur and stick percent, and thus increase seed cotton percent by using a field cleaner. However, producers under most circumstances will not be able to influence the quality characteristics of their cotton with a field cleaner. This raises the question of the economic feasibility of a field cleaner. Though this is beyond the scope of this paper, further research is needed to determine if the benefits of improving bur percent, stick percent, and seed cotton percent outweigh the costs of the field cleaner itself.

References

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Appendix

Appendix Table 1. Frequency analysis for bur percent as affected by field cleaner for early harvest (EH), midseason harvest (MH), and late harvest (LH).

Field Clean	Bur Percent												Total
	3.0-8.0			10.1-10.7			15.7-22.2			24.9-29.1			
	EH	MH	LH	EH	MH	LH	EH	MH	LH	EH	MH	LH	
No	0	0	0	0	0	0	0	6	5	3	0	7	21
Yes	6	6	5	0	0	4	0	0	0	0	0	0	21
Total	6	6	5	0	0	4	0	6	5	3	0	7	42

Appendix Table 2. Frequency analysis for stick percent as affected by field cleaner for early harvest (EH), midseason harvest (MH), and late harvest (LH).

Field Clean	Stick Percent												Total
	2.1-3.1			3.3-5.3			5.5-6.9			7.3-9.2			
	EH	MH	LH	EH	MH	LH	EH	MH	LH	EH	MH	LH	
No	1	0	0	3	2	1	0	3	6	2	1	2	21
Yes	4	1	0	1	4	8	0	0	1	1	1	0	21
Total	5	1	0	4	6	9	0	3	7	3	2	2	42

Appendix Table 3. Frequency analysis for fine trash as affected by field cleaner for early harvest (EH), midseason harvest (MH) and late harvest (LH).

Field Clean	Fine Trash												Total
	3.9-5.6			6-7.9			8-9.2			9.5-12.7			
	EH	MH	LH	EH	MH	LH	EH	MH	LH	EH	MH	LH	
No	3	0	2	0	2	3	2	3	4	1	1	0	21
Yes	3	0	0	3	2	9	0	2	0	0	2	0	21
Total	6	0	2	3	4	12	2	5	4	1	3	0	42

Appendix Table 4. Frequency analysis for seed cotton percent as affected by field cleaner for early harvest (EH), midseason harvest (MH) and late harvest (LH).

Field Clean	Seed Cotton Percent												Total
	57-64			66.1-71.4			76.2-80.5			80.9-88.1			
	EH	MH	LH	EH	MH	LH	EH	MH	LH	EH	MH	LH	
No	2	2	9	4	4	0	0	0	0	0	0	0	21
Yes	0	0	0	0	0	0	1	3	9	5	3	0	21
Total	2	2	9	4	4	0	1	3	9	5	3	0	42

Appendix Table 5. Frequency analysis for composite color as affected by field cleaner for early harvest (EH), midseason harvest (MH) and late harvest (LH).

Field Clean	Composite Color									Total
	31-39			40-42			43-46			
	EH	MH	LH	EH	MH	LH	EH	MH	LH	
No	6	1	3	0	4	3	0	1	3	21
Yes	5	2	3	1	4	5	0	0	1	21
Total	11	3	6	1	8	8	0	1	4	42

Appendix Table 6. Frequency analysis for mike as affected by field cleaner for early harvest (EH), midseason harvest (MH) and late harvest (LH).

Field Clean	Mike									Total
	30-33			34-36			37-38			
	EH	MH	LH	EH	MH	LH	EH	MH	LH	
No	0	2	1	5	2	5	1	2	3	21
Yes	0	1	1	6	3	7	0	2	1	21
Total	0	3	2	11	5	12	1	4	4	42

Appendix Table 7. Frequency analysis for strength as affected by field cleaner for early harvest (EH), midseason harvest (MH) and late harvest (LH).

Field Clean	Strength									Total
	22-23			24-25			26			
	EH	MH	LH	EH	MH	LH	EH	MH	LH	
0	6	4	4	0	2	4	0	0	1	21
1	4	2	1	2	4	7	0	0	1	21
Total	10	6	5	2	6	11	0	0	2	42

Appendix Table 8. Frequency analysis for RD as affected by field cleaner for early harvest (EH), midseason harvest (MH) and late harvest (LH).

Field Clean	RD						Total
	3			4			
	EH	MH	LH	EH	MH	LH	
No	5	0	1	1	6	8	21
Yes	3	1	2	3	5	7	21
Total	8	1	3	4	11	15	42

Appendix Table 9. Frequency analysis for plus b as affected by field cleaner for early harvest (EH), midseason harvest (MH) and late harvest (LH).

Field Clean	Plus b									Total
	1			2			3			
	EH	MH	LH	EH	MH	LH	EH	MH	LH	
No	6	0	1	0	5	7	0	1	1	21
Yes	6	0	2	0	6	6	0	0	1	21
Total	12	0	3	0	11	13	0	1	2	42

Appendix Table 10. Frequency analysis for trash as affected by field cleaner for early harvest (EH), midseason harvest (MH) and late harvest (LH).

Field Clean	Trash									Total
	4			5			6			
	EH	MH	LH	EH	MH	LH	EH	MH	LH	
No	2	6	2	4	0	4	0	0	3	21
Yes	1	6	3	5	0	4	0	0	2	21
Total	3	12	5	9	0	8	0	0	5	42

Appendix Table 11. Frequency analysis for uniformity as affected by field cleaner for early harvest (EH), midseason harvest (MH) and late harvest (LH).

Field Clean	Uniformity									Total
	78-79			80-81			82			
	EH	MH	LH	EH	MH	LH	EH	MH	LH	
No	1	2	0	3	4	8	2	0	1	21
Yes	1	2	2	3	3	7	2	1	0	21
Total	2	4	2	6	7	15	4	1	1	42

Appendix Table 12. Frequency analysis for length as affected by field cleaner for early harvest (EH), midseason harvest (MH) and late harvest (LH).

Field Clean	Length									Total
	99-102			103-105			203-204			
	EH	MH	LH	EH	MH	LH	EH	MH	LH	
0	4	4	0	5	0	3	0	5	0	21
1	3	1	0	4	0	5	0	6	2	21
Total	7	5	0	9	0	8	0	11	2	42

Appendix Table 13. Regression Results of the Effects of Field Cleaning on Fractionation Attributes for Different Times of Harvest.

	Constant	FC	EH	MH	R^2
Bur %	24.12[2]	-15.16[2]	-3.89[2]	-4.59[2]	0.94
	(0.61)	(0.67)	(0.81)	(0.81)	
Stick %	6.21[2]	-1.78[2]	-0.56	-0.01	0.29
	(0.42)	(0.46)	(0.56)	(0.56)	
Fine Trash	7.02[2]	-0.09	-0.69	1.77[2]	0.32
	(0.42)	(0.46)	(0.56)	(0.56)	
Seed Cotton Percent	61.82[2]	17.04[2]	5.39[2]	2.31[1]	0.89
	(0.90)	(0.98)	(1.19)	(1.19)	

Note: Numbers in parenthesis are standard errors.

[1] - Significance level ranging from 0.05 to 0.10.
[2] - Significance level of less than 0.05.

Appendix Table 14. Regression Results of the Effects of Field Cleaners on Quality Attributes for Different Times of Harvest.

	Constant	FC	EH	MH	R^2
Strength	23.95[2]	0.43	-1.0[2]	-0.67[2]	0.26
	(0.24)	(0.26)	(0.32)	(0.32)	
Comp. Color	40.95[2]	-0.90	-5.67[2]	0.5	0.40
	(0.99)	(1.08)	(1.31)	(1.31)	
RD	3.83[2]	0.00	-0.50[2]	0.08	0.29
	(0.11)	(0.13)	(0.15)	(0.58)	
+b	1.99[2]	-0.10	-0.94[2]	0.14	0.60
	(0.11)	(0.12)	(0.15)	(0.15)	
Trash	5.02[2]	-0.05	-0.25	1.00	0.38
	(0.16)	(0.18)	(0.21)	(0.21)	
Length	107.37[2]	9.38	-9.56	-10.22	0.09
	(6.85)	(6.85)	(8.27)	(8.27)	
Uniformity	80.52[2]	-0.05	0.25	-0.58	0.11
	(0.28)	(0.31)	(0.37)	(0.37)	
Mike	35.29[2]	-0.48	0.28	0.19	0.03
	(0.44)	(0.48)	(0.58)	(0.58)	

Note: Numbers in parenthesis are standard errors.

[2] - Significance level of less than 0.05.