COST/BENEFIT ANALYSIS OF BUR-EXTRACTORS IN COTTON GINNING

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Abstract

This study provides estimates for costs and benefits to the gin when bur-extracted cotton is processed. Results indicate that gins incur a net loss of about $3 per bale of cotton by processing bur-extracted cotton.

Introduction

Harvested cotton contains a mixture of lint, seed, and foreign matter such as burs, sticks, leaves, hulls, and other non-plant materials such as sand and rocks. The cotton cleaning process to remove this foreign matter has been conventionally limited to the gin plant and textile mill. As the seed cotton is advanced through the cleaning process of the gin, it goes through an array of machinery, which could include a green boll trap, air line cleaner or combination air line cleaner/separator, feed control, tower dryer or equivalent, cylinder cleaner, combination bur and stick machine, tower dryer or equivalent, cylinder cleaner, stick machine, extractor-feeder, saw gin stand, saw-cylinder lint cleaner, saw-cylinder lint cleaner, and bale press (Baker, 1994). Baker (1994) states that the cleaning requirements of stripper harvested cottons may vary from year to year, but the array of machinery listed above is near optimum in most conditions. The textile mill removes any remaining foreign matter, such as seed-coat fragments.

Subsequently, this cleaning process has broadened to include more than the gin and textile mill cleaning equipments. Research to develop a bur-extractor that could be combined in the stripper harvesting process was initiated as early as 1927 (Kirk et al., 1970). Bur-extractors were designed to remove foreign matter in cotton during stripper harvesting. Bur-extractors are currently being adopted into the stripper harvesting of cotton by an increasing number of producers. Prior research indicates that the bur-extractor, when incorporated in the harvesting process, reduces bur and stick percent in cotton by about 70 percent and 29 percent, respectively (Bennett et al., 1995). This reduction in gin trash through the use of a bur-extractor has had a direct effect on the amount of trash that is removed during the ginning process.

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Eighty-five percent of the cotton produced in Texas is currently stripper harvested and is, therefore, available to be harvested using a portable, stripper mounted bur-extractor (Glade et al., 1996). Prior studies indicated that about twenty-five percent of cotton in Texas is currently bur-extracted (McPeek, 1997). Misra et al., (1996) suggested that the use of bur-extractors by producers may reduce ginning charges per bale of cotton lint by $7.00 to $10.00. This savings to the producer is a result of the current pricing structure of charging per hundred weight of seed cotton. The producer is currently being charged a uniform price to have bur-extracted or non-bur-extracted cotton processed. In other words, the producer can have bur-extracted cotton, which contains more lint cotton per hundred weight of seed cotton, ginned for the same price as non-bur-extracted cotton, which contains less lint cotton per hundred weight of seed cotton. This savings to the producer, according to Misra et al., is a cost to the ginner.

However, ginners may also be experiencing savings when a bur-extractor is used by producers. Since bur-extracted cotton contains less foreign matter, ginners providing transportation of modules from the field to the gin are likely to see savings in transportation cost. Further, bur-extractors may affect operating costs of gins by affecting the ginning rate, drying efficiency, and/or cleaning efficiency. The possibility of different equipment configurations in the gin plant due to the use of bur-extracted cotton may result in a further savings. The gin plant may also incur savings in trash disposal costs since with bur-extracted cotton there is less trash to collect and dispose of. The wear and tear on gin machinery and its components may possibly be reduced as a result of the gin plant processing bur-extracted cotton.

Currently, there is a lack of information regarding the costs and savings in the gin plant due to the use of bur-extracted cotton. The objective of this study is to provide estimates for costs and benefits of bur-extractors to gins and to analyze how these estimates counterbalance in their net effect. This knowledge should benefit the gins that process bur-extracted cotton.

Methods and Procedures

The determination of the costs and savings in the gin plant and the specific magnitudes of these costs and savings due to the use of bur-extracted cotton included several components. A survey questionnaire was administered to gin plants in the Southern High Plains of Texas in order to obtain information about the costs and savings and the magnitude of each that may be incurred by the gin due to processing bur-extracted cotton. A cost/benefit analysis was then undertaken to determine the net effect of processing bur-extracted cotton on ginners' revenue.

Gin Survey

In the first stage of this study, Southern High Plains gin managers were consulted to better understand the potential

effects of bur-extracted cotton on the ginning process and to identify areas of the gin plant that could be affected as a result of ginning bur-extracted cotton. Based on information gathered from industry participants, a survey questionnaire was developed to collect primary data from several local gins. The survey questionnaire was pre-tested by several gin managers and was revised accordingly. Twenty-three gins were selected to participate in the survey on the basis of two criteria: 1) those gin plants that gin at least some bur-extracted cotton, and 2) those gin plants that had participated in prior studies at Texas Tech University.

The survey was administered in person to a sample of twenty-three gins on the Southern High Plains of Texas during the spring of 1997. The participating gins were asked a variety of questions concerning: the number of bales of bur-extracted and non-bur-extracted cotton processed, the turnout percentages of both, the transportation costs associated with bur-extracted and non-bur-extracted cotton, trash disposal expenses, the costs or savings incurred due to the wear and tear on gin machinery and components as a result of ginning bur-extracted cotton, and the possibility of bypassing specific equipment(s) when processing bur-extracted cotton.

Cost/Benefit Analysis

In response to the survey questions, the participating gins provided estimates of costs and savings as a result of bur-extracted cotton. The costs and savings reported by gin participants were averaged and presented in the form of dollars per bale.

Ginning Charges

Since the producer is currently being charged a uniform price for ginning, it has been suggested that the use of bur-extractors may reduce the "effective" ginning charge per bale of cotton lint to the producer, resulting in a loss to the ginner. In order to estimate the magnitude of this loss to the ginner, survey participants were asked to provide information such as turnout percentage for bur-extracted and non-bur-extracted cotton and ginning charges in dollars per hundred weight of seed cotton. It was observed from the survey response that some gins practice an one price system, which combines additional charges, such as bagging and ties and classing fees, with the charge per hundred weight of seed cotton. Some others, however, practice a two pricing system that includes dollars per hundred weight of seed cotton plus additional charges, such as bagging and ties and classing fee.

The ginning charges (for bur-extracted and non-bur-extracted cotton) in a uniform unit of dollars per bale were calculated using the following equations:

$$NBEGC = (480 / NBETP) * GC + AC \quad (1)$$

$$BEGC = (480 / BETP) * GC + AC \quad (2)$$

where NBEGC is the non-bur-extracted ginning charge in dollars per bale, NBETP is the non-bur-extracted turnout percentage, GC is the ginning charge per hundred weight, AC is any additional charge, such as bagging and ties or classing fee per bale, BEGC is the bur-extracted ginning charge in dollars per bale, and BETP is the bur-extracted turnout percentage. The difference in ginning charges was calculated using equation 3:

$$GCD = NBEGC - BEGC \quad (3)$$

where GCD is the difference in ginning charges in dollars per bale between bur-extracted cotton and non-bur-extracted cotton. This difference in ginning charges is the net loss to the gin plant in ginning charges per bale of cotton lint.

Transportation Cost of Modules

A decrease in bur and stick percentage reduces the amount of trash that is transported by module from its point of origin to the gin plant. Since module transportation is a common practice in the Southern High Plains of Texas and the transportation cost is generally borne by the gin plant, it was hypothesized that the gin plant could possibly be incurring a savings in the transportation costs of seed cotton as a result of processing bur-extracted cotton. This is because the gin plant is incurring an equal cost when transporting bur-extracted seed cotton, which contains more lint cotton and less trash per hundred weight of seed cotton than non-bur-extracted cotton.

The difference in transportation cost of modules between bur-extracted and non-bur-extracted cotton was calculated using survey results concerning the average transportation cost per module from the producer's field to the gin plant and the average number of bales of bur-extracted and non-bur-extracted cotton that were transported per module of seed cotton:

$$MTD = TC * [(1/NBEB) - (1/BEB)] \quad (4)$$

where MTD is the difference in module transportation cost in dollars per bale between bur-extracted and non-bur-extracted cotton, TC is the transportation cost per module from the producer's field to the gin plant, and NBEB and BEB are the average number of non-bur-extracted and bur-extracted bales of cotton per module of seed cotton, respectively.

Energy and Labor Savings

It is possible that the gins may be able to shorten the ginning season due to processing bur-extracted cotton. This reduction in days is possible because the gin is processing

less foreign matter per hundred weight of seed cotton when ginning bur-extracted cotton, and therefore may be able to clean and process bur-extracted cotton more quickly than non-bur-extracted cotton. Further, it must also be assumed that there is a steady flow of cotton to the gins, enabling them to continue operation in a timely fashion. The possible savings in days in the ginning season if the gin plant were to process only bur-extracted cotton was determined using the following equation:

$$DS = (NBEB / 24) * [(1/NBER) – (1/BER)] \quad (5)$$

where DS is the savings in days per ginning season, NBEB is the total number of non-bur-extracted bales processed by the gin plant, and NBER and BER are the number of bales of non-bur-extracted and bur-extracted cotton that can be ginned in one hour, respectively.

If the gin plant experiences a reduction in days of the ginning season due to processing bur-extracted cotton, then the gin plant may incur a reduction in costs of labor and energy. The savings in labor was calculated by the following equation:

$$\text{Labor Savings} = LC * DS \quad (6)$$

where LC is the labor cost for one day and DS is the number of reduced days in the ginning season. The savings in energy per bale was calculated by applying the following equations:

$$BS = NBEB – [NBEB / (BER * 24) * (NBER * 24)] \quad (7)$$

$$\text{Energy Savings} = EC * BS \quad (8)$$

where BS is the number of non-bur-extracted bales that would be ginned in the saved days in the ginning season that results from processing bur-extracted cotton, NBEB is the total number of non-bur-extracted bales that were processed by the gin plant, BER and NBER are the number of bales of bur-extracted and non-bur-extracted cotton that can be ginned in one hour, and EC is the cost of energy per bale.

Gin Equipment and Equipment Components

It has been hypothesized that the gin plant may incur savings in maintenance and repair costs of gin equipment and equipment components due to processing bur-extracted cotton. Savings in maintenance and repair of gin equipment, such as the green boll trap, automatic feed control, dryers, incline machine, stick and bur machine, conveyor/distributor, extractor/feeder, gin stand, lint cleaners, bale press, module trucks, and trash disposal trucks was calculated by taking the summation of all individual savings that were incurred by each piece of equipment to determine a total savings. The total savings in maintenance and repair was then standardized to a per bale basis by dividing the total savings by the number of bur-extracted bales that were processed in each gin plant.

The total savings in the gin equipment components, including tinwork on pipes, elbows, and duct work, fans, cyclones, and saws, was calculated by taking the summation of all savings, in dollars per season, that were incurred by the gin plant by processing bur-extracted cotton. This total savings was then divided by the total number of bales ginned by the gin plant to arrive at a savings per bale in gin equipment components.

Bypassed Machinery

It was hypothesized that a savings in energy may be incurred by the gin as a result of bypassing some cleaning equipment in the ginning process of bur-extracted cotton. Less foreign matter in bur-extracted cotton may possibly decrease the amount of overhead cleaning that is required, thus it is possible that some cleaning equipment may be bypassed. When a piece of gin machinery is bypassed, savings in energy may be incurred by the gin plant. The savings in energy was determined with the following equations:

$$K = (A * V) / 100 \quad (9)$$

$$MC = K * KR \quad (10)$$

$$CS = MC / GR \quad (11)$$

where K is the number of kilowatts, A is the amps of the motor that runs that piece of machinery, V is the voltage of the specific machine, MC is the dollar per hour that is required to operate the motor of that specific piece of machinery, KR is the rate per kilowatt that is charged by the gin plant's electric company, CS is the per bale cost savings that is incurred by the gin due to ginning bur-extracted cotton, and GR is the number of bales per hour that can be ginned.

Trash Disposal

With bur-extracted cotton, there is less trash to collect and dispose of at the gin plant. Thus, a gin plant may incur savings in trash disposal costs when processing bur-extracted cotton. An estimate of potential trash disposal cost savings was calculated by the following equations:

$$NBETDC = [(480 / NBETP) * TTP * (TDC / 2000)] \quad (12)$$

$$BETDC = [(480 / BETP) * TTP * (TDC / 2000)] \quad (13)$$

$$TDS = NBETDC - BETDC \quad (14)$$

where NBETDC is the cost of trash disposal per bale for non-bur-extracted cotton, NBETP is the turnout percentage of non-bur-extracted cotton, TTP is the percentage of total

matter that is trash, TDC is the cost of trash disposal, BETDC is the cost of trash disposal per bale for bur-extracted cotton, BETP is the turnout percentage of bur-extracted cotton, and TDS is the trash disposal savings per bale that is incurred by the gin plant due to processing bur-extracted cotton.

Findings

Sample Characteristics

The operational characteristics of the responding gin plants varied. The sample included cooperatives and individually owned gin plants. All of the responding gin plants processed bur-extracted and non-bur-extracted cotton and irrigated and dry land seed cotton. The proportion of bur-extracted cotton processed by responding gins ranged between 4 and 89 percent. The average number of total bales processed by the responding gins was about 34,615 bales per season. The average number of bales of bur-extracted and non-bur-extracted cotton processed by the responding gin plants were about 14281 and 20334, respectively (Table 1). The average ginning rate for bur-extracted cotton was 28.5 bales per hour, while the non-bur-extracted ginning rate was 24.95 bales per hour. The average turnout percentage for bur-extracted and non-bur-extracted cotton were 28.12 percent and 22.13 percent, respectively (Table 1).

Savings

The gin plant incurred a savings due to ginning bur-extracted cotton in the areas of transportation of modules, equipment and equipment components, energy and labor, bypassed machinery, and trash disposal.

Transportation of Modules

Survey results indicated that the average transportation cost per module from the producer's field to the gin plant in 1996 was $41.44 per module (Table 2). The average distance that these modules were hauled in 1996 was approximately 22 miles (Table 2). There was an average of 11.13 bales and 8.37 bales of bur-extracted and non-bur-extracted cotton per module, respectively (Table 2). Thus, while it is costing ginners about $4.95 to transport a bale of non-bur-extracted cotton, the module transportation cost of a bale of bur-extracted cotton is about $3.72. This results in a transportation cost savings of about $1.23 per bale when a bur-extractor is used during harvesting (Table 2).

Gin Equipment and Equipment Components

About 83 percent of the participating gin managers reported savings in the maintenance and repair of gin equipment, which include the green boll trap, automatic feed control, dryers, incline machine, stick and bur machine, conveyor/distributor, extractor/feeder, gin stand, lint cleaners, and bale press due to ginning bur-extracted cotton. The reported savings for each piece of machinery was summed for each respondent to determine a total savings of all machinery per gin. An average of the maintenance and repair of gin equipments savings was calculated over all responding gins. Results indicate that gins save about $0.50 per bale in maintenance and repair of gin equipment due to processing bur-extracted cotton (Table 3).

About 91 percent of the participating gin managers reported savings in the repair and replacement of the gin equipment components as a result of ginning bur-extracted cotton. Results of the survey indicate that the gin is saving about $0.71 per bale in repair and replacement of gin equipment components due to ginning bur-extracted cotton (Table 3). These gin equipment components include tinwork on pipes, elbows, and ductwork, fans, cyclones, and saws.

Bypassed Machinery

About 57 percent of responding gin managers indicated that it is possible to bypass some cleaning equipment when ginning bur-extracted cotton, but a majority of them are not currently bypassing any equipment. If some cleaning equipment is bypassed, it is possible to save energy expenses due to the fact that the motor of that piece of equipment is not in operation. This study indicates that the gin plant can incur energy savings of about $0.09 per bale by bypassing some machinery (Table 3). The equipment that the surveyed gin managers proposed could be bypassed are the second stick and bur machine, incline cleaner, and the third lint cleaner. All gin plants are unique in that they have different configurations of gin equipment. Therefore, each gin must decide for itself what piece of equipment in its unique gin setup, if any, should be bypassed.

Energy and Labor

Sixty-five percent of participating gin plants indicated that they were able to process bur-extracted cotton at a faster rate than non-bur-extracted cotton. Results indicate that gin plants can process about 3.5 bales per hour more of bur-extracted cotton than non-bur-extracted cotton. This is mainly due to more lint cotton and less foreign matter being processed per hundred weight of seed cotton. Thus, if it is assumed that a gin plant is processing 100 percent of bur-extracted cotton, then the ginning season could potentially be shortened and savings in energy and labor could be experienced. Survey results indicate that the average reduction in days of the ginning season was 6.75 days (Table 4). Results indicate that gin plants could save an average of $1.09 per bale in energy costs and $1.89 per bale in labor costs (Table 4). These savings are incurred only when the gin plant processes 100 percent bur-extracted cotton.

Trash Disposal

Survey results indicated that 100 percent of the responding gin managers noticed a decrease in gin trash. Gin trash was reduced by about 459 pounds per bale as a result of ginning bur-extracted cotton (Table 5). Gins do not use a standard practice to dispose of gin trash. While some gins sell a portion or all of their gin trash, others pay to dispose of it. Thus, a net trash disposal cost was first calculated for each

responding gin and then an average was calculated over all gins. Results indicate that the responding gins incurred a net cost of about $2.15 per ton to dispose of gin trash. Given that gins generate about 459 pounds less of gin trash by processing bur-extracted cotton, it was estimated that gins could decrease gin trash disposal costs by $0.45 per bale (Table 5).

Costs

The average ginning charge of the responding gins was $1.95 per hundred weight of seed cotton. Results indicate that the average ginning rate for bur-extracted cotton was 28.50 bales per hour and 25 bales per hour for non-bur-extracted cotton. The average turnout percentage for bur-extracted and non-bur-extracted cotton was 28.12 and 22.13 percent, respectively. Because the gin is charging the producer a uniform price for processing bur-extracted and non-bur-extracted cotton, it has been suggested that the gin may be incurring a loss as a result of reducing the "effective" ginning charge per bale of cotton lint to the producer. After converting all survey ginning charges into dollars per bale, a loss to the gin of $8.93 per bale was indicated as a result of ginning bur-extracted cotton (Table 6). This supports the findings of Misra et al., (1996) which found that producers save between $7.00 and $10.00 per bale of cotton lint in ginning charges.

Net Costs/Saving

Results indicate that gins are incurring a net loss due to ginning bur-extracted cotton (Table 6). They are incurring a savings in the areas of transportation of modules ($1.23 per bale), trash disposal ($0.45 per bale), gin equipment ($0.50 per bale), gin equipment components ($0.71 per bale), energy ($1.09 per bale), labor ($1.89 per bale), and bypassed machinery ($0.09 per bale). They are incurring a loss of $8.93 per bale in ginning charges. Therefore, gins are incurring a net loss of $2.91 per bale as a result of ginning bur-extracted cotton (Table 6).

Some Other Observations

Many responding gin managers offered valuable comments during the survey. With regard to the current pricing system, about half of the participating gin managers indicated that they would change the ginning charges if they were to gin 100 percent bur-extracted cotton.

Although several responding gins expressed concern about increased fire hazard of bur-extracted cotton, it was discovered that this issue has been addressed by local insurance companies and producers. Many local producers are replacing the steel laydown bar in the bur-extractor with a brush. Gins processing cotton from these producers that have made this adjustment have noticed a considerable decrease in the number of fires related to bur-extracted cotton.

Summary and Conclusion

This study found that a savings was incurred by the gin plant in the areas of transportation of modules, trash disposal, gin equipment, gin equipment components, energy, labor, and bypassed machinery totaling about $6.00 per bale as a result of processing bur-extracted cotton. A loss of about $9.00 per bale was incurred in ginning charges by the gin plant. Thus, a net loss of about $3.00 was incurred by the gin due to processing bur-extracted cotton. From the cotton industry perspective, however, producers' savings due to the use of bur-extractors should be taken into consideration. It has been suggested that a producer with 600 acres of cotton that produces 1.5 bales per acre, is incurring a cost of about $2.00 per bale and a savings of about $9.00 per bale, resulting in a net savings of $7.00 per bale by using a bur-extractor during harvesting. This study indicates that the gin plant is incurring a cost of $9.00 per bale, a savings of $6.00 per bale, thus resulting in a net loss of about $3.00 per bale. This would imply that the industry is experiencing a net savings of about $4.00 per bale due to the introduction of the bur-extractor into stripper harvesting.

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Table 1. Sample Characteristics of Responding Gin Plants

Characteristics	Average	Standard Deviation	Maximum	Minimum
Total Bales	34615.39	19425.08	71329	5800
BE Bales*	14281.26	11409.29	41000	543
NBE Bales**	20334.17	14021.66	51329	2320
BE Ginning Rate (bales/hr.)	28.50	7.30	40	15
NBE Ginning Rate (bales/hr.)	24.95	6.09	36	13.5
BE Turnout Percentage	28.12	1.33	30	25
NBE Turnout Percentage	22.13	1.64	25	18

* BE indicates Bur-Extracted

** NBE indicates Non-Bur-Extracted

Table 2. Module Transportation Characteristics and Costs of Responding Gin Plants

Characteristics	Average	Standard Deviation	Maximum	Minimum
Transportation Cost ($/module)	41.44	15.38	66	7
Distance (miles)	22.12	15.13	80	6
No. BE Bales/Module	11.13	1.27	14.2	9
No. NBE Bales/Module	8.37	.69	9.3	7
Transportation Cost for BE Cotton ($/bale)	3.72			
Transportation Cost for NBE Cotton ($/bale)	4.95			
Transportation Cost Savings ($/bale)	1.23			

Note: BE indicates Bur-Extracted and NBE indicates Non-Bur-Extracted Cotton.

Table 3. Savings in Equipment, Equipment Components, and Bypassed Machinery Due to Processing Bur-Extracted Cotton.

Characteristic	Average	Standard Deviation	Maximum	Minimum
Equipment:				
Total Equipment Savings ($)	6737.27	12010.62	53600	0
Equipment Savings/Bale ($/bale)	0.50	0.65	2	0
Components:				
Savings in Tinwork ($)	7820	4485.05	15000	1750
Savings in Fans ($)	4954.56	3559.88	10000	1000
Savings in Cyclones ($)	7908.33	12684.23	33500	450
Savings in Saws ($)	3649.90	3283.30	10000	-1500
Total Equipment Components Savings ($)	18006.65	18928.87	70125	0
Equipment Components Saving/Bale ($/bale)	0.71	0.68	3	0
Bypassed Machinery:				
Energy Savings in Bypassed Machinery ($)	455.462	310.229	1096.48	201.89
Energy Saving in Bypassed Machinery ($/bale)	0.09	0.08	0.28	0.02

Table 4. Characteristics of Energy and Labor

Characteristics	Average	Standard Deviation	Maximum	Minimum
Ginning Rate for BE Cotton (Bales/hour)	28.5	7.31	40	15
Ginning Rate for NBE Cotton (Bales/hour)	24.95	6.09	36	13.5
Potential Reduction in Ginning Season Days	6.75	5.38	21.38	1.45
Energy Cost Savings($/bale)	1.09			
Labor Cost Savings ($/bale)	1.89			

Table 5. Trash Disposal Characteristics

Characteristics	Average	Standard Deviation	Maximum	Minimum
Trash per gin (tons)	11505.91	8845.33	32098	300
Trash from BE cotton (lbs/bale)	323.96	16.15	363.62	303.01
Trash from NBE cotton (lbs/bale)	782.55	58.87	959.49	690.84
Gin trash disposal cost ($/ton)	-2.15	2.16	0	-9.89
Gin trash disposal cost savings ($/bale)	0.45	0.44	1.95	0

Table 6. The Savings and Costs for Gin Charges and Gin Equipment Due to Bur-Extracted Cotton

	Savings ($/bale)		Costs ($/bale)	
		Standard		Standard
Ginning Charge			8.93	3.37
Module Transportation	1.23	0.79		
Trash Disposal	0.45	0.44		
Equipment	0.50	0.65		
Equipment Components	0.71	0.68		
Current Cost/Savings	2.89		8.93	
Current Net Cost/Savings			-6.04	
Energy	1.09			
Labor	1.89			
Possible Cost/Savings	5.87			
Possible Net Cost/Savings			-3.06	
Bypassed Machinery	0.09	0.20		
Total	5.96		8.93	
Net Total			-2.97	