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A DETERMINATION OF COTTON MARKET PRICE PREMIUMS REQUIRED TO JUSTIFY MORE LINT CLEANING IN THE GIN PLANT

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Abstract

This study examines the effect of changes in net revenues at various levels of lint cleaning in the gin plant due to changes in market prices. Results of the study indicate that with higher levels of market price, increased levels of quality premiums become necessary to make successive levels of lint cleaning cost effective. This study concludes that optimal level of lint cleaning at the gin plant is influenced by market prices.

Introduction

With an objective of providing cotton to textile mills with an acceptable trash content and other fiber qualities, it is a common practice to clean stripper harvested cotton to a substantial extent during the ginning process. Prior studies have suggested that a combination of cotton ginning machinery for stripper harvested cotton and a gin process which includes two lint cleanings produce satisfactory lint grades and near-maximum bale value for most cotton (Baker 1994). Baker (1994) further suggests that modification of the recommendation (more cleaning) may be necessary in situations or areas that possess excessive amounts of foreign matter. A study by Baker et al. (1977) also found two stages of lint cleaning to be near optimum for bale value and fiber quality.

Several other studies have addressed the issue of the optimal level of lint cleaning in the gin plant with an objective of maximizing producer net returns. Specifically, Ethridge et al. (1995) found that two lint cleanings were the best general rule if the effects on prices, lint loss, and cost of lint cleaning are to be taken into consideration. Ethridge et al. (1995) considered only the energy costs of lint cleanings in their cost estimates and estimated price per pound of lint based on a pre-HVI market price structure that existed in 1992. Bennett et al. (1997) further addressed the consequences of successive stages of lint cleaning by considering the criteria of maximizing net revenue. The study found that net returns were consistently higher for one lint cleaning in the gin plant for all cultivars regardless of the time of harvest. It was concluded by Bennett et al. (1997) that the pricing structure for cotton had changed with the inception of the HVI measurements of fiber attributes in 1993. This change in the pricing structure was hypothesized to be primarily responsible for redefining the optimal level of lint cleaning at the gin plant as determined in this study.

Conflicts among the results of the studies regarding the number of times cotton should be lint cleaned in the gin plant raises the question of whether market prices do in fact alter the optimal number of lint cleanings. Both Ethridge et al. (1995) and Bennett et al. (1997) indicated that lint lost at each stage of cleaning in the gin plant is an important factor in determining the cost associated with ginning cotton from a producer's perspective. Since the value of lint lost at each stage of cleaning is directly influenced by the market price of cotton, this study analyzes the economic consequences of successive stages of lint cleaning at various base levels of cotton market prices. The economic criterion being used in this analysis is that of maximizing net revenues per bale of ginned cotton.

Methods and Procedures

For the purposes of this analysis, three irrigated cotton cultivars (Paymaster HS-26, Paymaster 145, and All-Tex Excess) were chosen based on their popularity of use in the Southern High Plains of Texas. The expected quality characteristics and gin turnout of each cultivar were averaged to provide the analysis with a typical cotton cultivar that might be ginned in the area.

Cotton Quality and Lint Loss

The GINQUAL (Barker et al., 1991), ginning simulator was used to determine changes in grade, staple length, strength, length uniformity, and micronaire of the cotton as it underwent 0, 1, 2, and 3 stages of lint cleanings. A lint turnout percentage, representing a ratio of the saleable lint weight to the weight of seed cotton entering the system, was also determined from the GINQUAL model.

The GINQUAL model simulated the processing of stripper harvested cotton at a rate of 15 bales per hour through a single 2.4 m (96 in.) wide overhead cleaning stream consisting of: (1) an airline cleaner, (2) first tower dryer, (3) first incline cleaner, (4) first stick machine, (5) second tower dryer, (6) second incline cleaner, (7) second stick machine, and (8) extractor feeder. The lint cleaning simulation used zero to three 2.2 m (88 in. wide) sequential lint cleaners. The simulated lint cleaners used a combing ratio of 30:1 with 0.4 m (16 in.) diameter saws operating at 1000 rpm. The first and second tower dryers' drying temperatures were held constant at 149 and 66 degrees Centigrade (300 and 150 degrees Fahrenheit), respectively, and the atmospheric temperature and relative humidity at 16 Centigrade (60 degrees Fahrenheit) and 30 percent humidity, respectively. Initial values for micronaire, length, strength, and uniformity ratio provided by tables included in the GINQUAL model were used in the simulation.

The lint loss in the gin plant due to precleaning and successive levels of lint cleaning were estimated from the GINQUAL output for the different cultivar categories and for different levels of lint cleaning. Lint loss for each level of lint cleaning was calculated by subtracting the current level of turnout in percent from lint turnout for one less lint cleaner. The resulting lint turnout difference was multiplied by 2,300 lbs. of initial seed cotton entering the gin plant and was further adjusted to a lint loss weight per bale.

Cost Estimates

A survey of ginners on the High Plains of Texas was taken and the survey results were used in the GINMODEL (Childers, 1995) to determine ginning costs. The GINMODEL calculates fixed and variable ginning costs for simulated gins at various processing utilization rates and gin capacities. Output from GINMODEL consists of total and per bale ginning costs separated into fixed and variable components. These costs are calculated for processing utilization levels ranging from one-hundred percent to ten percent. For the purpose of this analysis, per bale ginning cost was simulated for three categories of gins, owning and operating one, two, and three lint cleaners. Since no differences were observed from the results of gins operating between 50 and one-hundred percent utilization, it was assumed that gins were operating at one-hundred percent utilization. These gins ranged in size from: gins owning and operating one lint cleaner, gins owning and operating two lint cleaners, and gins owning and operating three lint cleaners.

The costs associated with lint loss in the gin plant due to precleaning and successive levels of lint cleaning were estimated by multiplying price of cotton after each stage of lint cleaning as discussed later and the lint loss calculated from the GINQUAL outputs for different levels of lint cleaning. Total ginning cost per bale and the cost of total lint loss per bale were added to obtain a total ginning cost to the producer for each of the configurations.

Effect of Market Price on Level of Lint Cleaning

The effects of changes in net revenues at various levels of lint cleaning in the gin plant due to changes in market prices for cotton was accomplished through the evaluation of market prices between $0.30 and $0.80 per pound of cotton lint at $0.05 per pound intervals. Specifically, it was first assumed that cotton cleaned with only one lint cleaning in the gin plant would have an associated market value of $0.30 per pound. Total revenues generated from lint cleaning cotton once in the gin plant was determined by the product of the market price $0.30 per pound and the resulting lint turnout in pounds. Net revenues were determined by subtracting the ginning cost from the total revenue generated from lint cleaning cotton once in the gin plant. Market prices were then adjusted until net revenues for cotton cleaned using two lint cleanings were greater than net revenues for cotton cleaned using only one lint cleaning. A similar approach was used for cotton cleaned using three lint cleanings in the gin plant. This process was repeated on $0.05 per pound intervals up to $0.80 per pound of cotton lint.

Findings

The results of this study are presented below in three different sections. The first section discusses the total revenues, cleaning costs, and net revenues associated with various market price levels. Price premiums required to justify more lint cleaning in the gin plant is presented in the second section. Finally, the quantity of lint lost during each stage of lint cleaning and the value of that lint loss is discussed in the last section.

Total Revenues, Cleaning Costs, and Net Revenues

Total revenues, cleaning costs, and net revenues generated from the adjustment of market prices required to make successive lint cleaning in the gin plant more profitable are presented in table 1. As described earlier, market prices were adjusted as to make the net revenues associated with the use of two lint cleanings greater than net revenues generated through the use of one lint cleaning, and net revenues associated with using three lint cleanings greater than those generated through the use of two lint cleanings. Given a constant cotton cleaning cost (ginning charge) of $41.72, $41.94, and $42.08 per bale for the use of one, two, and three lint cleaners, respectively, net revenues ranged from $103.87 to $346.52 per bale with an associated market price ranging from $0.30 to $0.80 per pound, respectively, after one lint cleaning. Likewise, net revenues associated with the use of two lint cleaners increased from $103.92 to $346.52 per bale given the market price range of cotton as described above. Finally, total revenues generated from using three lint cleaners increased from $103.94 to $346.53 per bale when the same cotton market price ranged from $0.30 to $0.80 per pound, respectively, after one lint cleaning.

Lint Loss and Lint Loss Value

The lint loss at various stages of lint cleaning demonstrates that successive stages of lint cleaning consistently increase lint loss, but that lint loss increases at a decreasing rate as the amount of lint cleaning increases (table 2). Cotton lint loss weights were 10.35 and 3.91 pounds per bale between one and two and two and three lint cleanings in the gin plant, respectively. These lint loss estimates translate into revenue loss of $3.11 per bale for cotton which was lint cleaned twice in the gin plant and possessed a market price of 30.00 cents per pound after one lint cleaning. An additional $0.95 per bale of revenue was observed to be lost under the same market price scenario when the cotton was lint cleaned three times.

The value of lint loss was observed to increase as the market price of cotton after one lint cleaning increased. As an example, the value of lint lost between one and two lint cleanings was observed to be $8.28 per bale when the associated market price of cotton after one lint cleaning is 80.00 cents per pound. Finally, an additional $2.54 per bale was observed to be lost when the cotton is lint cleaned three versus two times in the gin plant and when the market price for cotton equals 80.00 cents per pound for cotton lint cleaned once.

Price Premiums Required to Justify More Lint Cleaning

Successive lint cleaning in the gin plant necessitated higher cotton market prices to cover the additional cost of ginning and decreases in the quantity of salable cotton lint due to increases in the amount of cotton lint loss. Specifically, table 2 shows that if the price associated with one lint cleaning is equal to 30 cents per pound, the price premium required to justify one additional lint cleaning in the gin plant was equal to 0.71 cents per pound. Further cleaning (the use of three lint cleaners) would require a price premium of 1.00 cents per pound over one lint cleaning (0.29 cents per pound premium over two lint cleanings). In other words, if cotton that is cleaned once in the gin plant has an associated market value of 30 cents per pound, that same cotton would have to bring 30.71 cents per pound to justify two lint cleanings and 31.00 cents per pound to justify three lint cleanings.

As the price of cotton ginned using only one lint cleaner in the gin plant increases, the price premiums required to make more cleaning cost effective increases. Specifically, cotton that had an associated market price of $0.80 per pound after one lint cleaning would require a price premium of 1.79 cents per pound to justify the use of two lint cleaners over one lint cleaner. The use of three versus one lint cleaner would require a price premium of 2.50 cents per pound (an additional 0.71 cents per pound price premium over two lint cleanings). This suggests that the cotton that was worth 80.00 cents per pound after one lint cleaning must demand a market price of 81.79 cents per pound after two lint cleanings. Similarly, the market price must equal 82.50 cents per pound to justify lint cleaning this cotton three times. These findings suggest that as the market price for cotton increases, price premiums required to justify more lint cleaning also increase.

A summary of the findings of this study detailing the optimal number of lint cleanings depending on the market price for cotton are presented in table 3. For example, the table indicates that if the market price for cotton is 50 cents per pound, it should be lint cleaned once if a premium for two lint cleanings is less than 1.15 cents per pound. Similarly, it should be lint cleaned twice if the premium received in the market ranges between 1.15 and 1.55 cents per pound. If the premium received in the market exceeds 1.55 cents per pound, then it would be cost effective to clean that cotton three times.

Summary and Conclusions

This analysis simulated net returns per bale of cotton for irrigated stripper harvested cotton. Gin turnout and quality attributes for one, two, and three stages of lint cleaning in the gin plant were simulated for each case using the GINQUAL simulator. Ginning costs were estimated using the GINMODEL simulator which calculated variable, fixed, and total cost per bale for ginning cotton using one, two, and three lint cleaners. The effects of changes in net revenues at various levels of lint cleaning in the gin plant due to changes in market prices for cotton was accomplished through the evaluation of market prices between 30.00 and 80.00 cents per pound of cotton lint at 5.00 cents per pound intervals. Market prices were then adjusted until the net revenues generated from a higher level of lint cleaning were greater than the previous level's net revenues.

The study found that as the market price for cotton increases, premiums required to make successive levels of lint cleaning more profitable also increased. Specifically, price premiums must be 152.11 percent greater to justify two lint cleanings over one lint cleaning if the market price for cotton ginned using only one lint cleaning equals 80.00 cents per pound than if that same cotton's associated market price equals 30.00 cents per pound. Similarly, this study found that a 144.83 percent increase in price premiums was required to justify three lint cleanings over two lint cleanings in the gin plant for cotton possessing a market price that equals 80.00 versus 30.00 cents per pound after one lint cleaning.

The levels of price premiums required to justify more cleaning is directly related to the lint that is lost at each stage of lint cleaning. As the market price of cotton increases, the lint that is lost during lint cleaning becomes more valuable. Therefore, if net price premiums do not increase enough to offset revenue that is negated due to lint loss, less cleaning should be done in the gin plant.

Currently, existing practice calls for two lint cleanings in the gin plant. Previous research on machine-stripped cotton had also suggested that two lint cleanings were the best general rule. Ethridge et al. (1995) and Bennett et al. (1997), however, indicated that less lint cleaning at the gin plant could become optimal if lint cleaning technology or market pricing structures change. The results of this study suggest that the price level does alter the profit maximizing decision concerning the level of lint cleaning in the gin plant. Therefore, the cotton industry should be mindful of the current price level of cotton when making the decision of whether or not to utilize additional lint cleanings in the gin plant.

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Table 1. Total revenue, total cleaning cost, and net revenues generated from various levels of lint cleaning.

Market Price After One Lint Cleaning (Cents/lb)	Total Revenue (Dollars/bale)			Total Cleaning Cost (Do llars/bale)			Net Revenues (Dollars/bale)		
	1 Lint Cleaning	2 Lint Cleanings	3 Lint Cleanings	1 Lint Cleaning	2 Lint Cleanings	3 Lint Cleanings	1 Lint Cleaning	2 Lint Cleanings	3 Lint Cleanings
30	145.59	145.86	146.02	41.72	41.94	42.08	103.87	103.92	103.94
35	169.86	170.08	170.23	41.72	41.94	42.08	128.14	128.14	128.15
40	194.12	194.35	194.49	41.72	41.94	42.08	152.40	152.41	152.41
45	218.39	218.62	218.80	41.72	41.94	42.08	176.67	176.68	176.72
50	242.65	242.89	243.06	41.72	41.94	42.08	200.93	200.95	200.98
55	266.92	267.16	267.32	41.72	41.94	42.08	225.20	225.22	225.24
60	291.18	291.43	291.57	41.72	41.94	42.08	249.46	249.49	249.49
65	315.45	315.70	315.88	41.72	41.94	42.08	273.73	273.76	273.80
70	339.71	339.97	340.14	41.72	41.94	42.08	297.99	298.03	298.06
75	363.98	364.24	364.40	41.72	41.94	42.08	322.26	322.30	322.32
80	388.24	388.46	388.61	41.72	41.94	42.08	346.52	346.52	346.53

Table 2. Price premium required to make net revenues associated with higher levels of lint cleaning greater than lower levels of lint cleaning, lint loss and value of lint loss.

Market Price After One Lint Cleaning (Cents/lb)	Price Premium Required to Make Two Lint Cleanings Cost Effective (Cents/lb)	Price Premium Required to Make Three Lint Cleanings Cost Effective (Cents/lb)	Lint Loss (lb/bale)		Lint Loss Value (Dollars/bale)	
			2 Lint Cleanings	3 Lint Cleanings	2 Lint Cleanings	3 Lint Cleanings
30	0.71	1.00	10.35	3.91	3.11	4.06
35	0.81	1.14	10.35	3.91	3.62	4.74
40	0.92	1.29	10.35	3.91	4.14	5.41
45	1.03	1.45	10.35	3.91	4.66	6.09
50	1.14	1.60	10.35	3.91	5.18	6.77
55	1.25	1.75	10.35	3.91	5.69	7.44
60	1.36	1.90	10.35	3.91	6.21	8.12
65	1.47	2.06	10.35	3.91	6.73	8.79
70	1.58	2.21	10.35	3.91	7.25	9.47
75	1.69	2.36	10.35	3.91	7.76	10.15
80	1.79	2.50	10.35	3.91	8.28	10.82

Table 3. Optimal number of lint cleanings depending on the market price.

Market Price After One Lint Cleaning (Cents/lb)	Price Premium (Cents/lb)													
	0.50	0.55	0.60	0.65	0.70	0.75	0.80	0.85	0.90	0.95	1.00	1.05	1.10	1.15
	Optimal Number of Lint Cleanings													
30													Three Lint Cleanings	
35														
40												Two Lint Cleanings		
45														
50					One Lint Cleaning									
55														
60														
65														
70														
75														
80														

Table 3 (continued). Optimal number of lint cleanings depending on the market price.

Market Price After One Lint Cleaning (Cents/lb)	Price Premium(Cents/lb)													
	1.20	1.25	1.30	1.35	1.40	1.45	1.50	1.55	1.60	1.65	1.70	1.75	1.80	1.85
	Optimal Number of Lint Cleanings													
30														
35														
40										Three Lint Cleanings				
45														
50														
55							Two Lint Cleanings							
60														
65														
70			One Lint Cleaning											
75														
80														

Table 3 (continued). Optimal number of lint cleanings depending on the market price.

Market Price After One Lint Cleaning (Cents/lb)	**Price Premium(Cents/lb)**													
	1.90	**1.95**	**2.00**	**2.05**	**2.10**	**2.15**	**2.20**	**2.25**	**2.30**	**2.35**	**2.40**	**2.45**	**2.50**	**2.55**
	Optimal Number of Lint Cleanings													
30	Three	Three	Three	Three	Three	Three	Three	Three	Three	Three	Three	Three	Three	Three
35	Three	Three	Three	Three	Three	Three	Three	Three	Three	Three	Three	Three	Three	Three
40	Three	Three	Three	Three	Three	Three	Three	Three	Three	Three	Three	Three	Three	Three
45	Three	Three	Three	Three	Three	Three	Three	Three	Three	Three	Three	Three	Three	Three
50	Three	Three	Three	Three	Three	Three	Three	Three	Three	Three	Three	Three	Three	Three
55	Three	Three	Three	Three	Three	Three	Three	Three	Three	Three	Three	Three	Three	Three
60	Two	Three	Three	Three	Three	Three	Three	Three	Three	Three	Three	Three	Three	Three
65	Two	Two	Two	Two	Three	Three	Three	Three	Three	Three	Three	Three	Three	Three
70	Two	Two	Two	Two	Two	Two	Two	Three	Three	Three	Three	Three	Three	Three
75	Two	Two	Two	Two	Two	Two	Two	Two	Two	Two	Three	Three	Three	Three
80	Two	Two	Two	Two	Two	Two	Two	Two	Two	Two	Two	Two	Two	Three

Three Lint Cleanings

Two Lint Cleanings