HOW TEXTILE MANUFACTURERS DEALT WITH STICKY COTTON FROM THE 1995 CROP

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Abstract

Identifying and understanding sticky cotton has been the focus of extensive efforts in research, which has been directed primarily toward prevention, measurement, and treatment. There is no information about the effects of sticky cotton on processing costs. A survey of textile mills was used to collect information on processing adjustments and costs. Analysis of the data was limited by the inability of the textile mills to retrace origins of processing costs, firms' policies against releasing cost information, and the small sample size. Nevertheless, the results indicate that added costs of processing sticky cotton increased as the level of stickiness increased. The presence of stickiness, and not the level of stickiness, was the driving factor in deciding what strategies to use. This research, restricted by limited cost information, was not able to generate cost estimates for processing sticky cotton. Future research directed toward the estimation of added costs would provide better decision-making information for all market participants.

Introduction and Objectives

The cotton industry consists of many components, including textile processing which converts raw cotton fiber into finished consumer goods (apparel, home furnishings, etc.) and industrial products (tents, awnings, etc.). The quality of the yarn used in these products is directly related to the quality of the raw cotton (U.S. Department of Agriculture, 1996).

Attributes not measured in the grading standards of the U.S. Department of Agriculture may also affect processing performance and/or product quality (U.S. Department of Agriculture, 1995). For example, noncellulosic material included in the lint affects the processability of cotton, but it is not included in leaf measurements, bark content, or other extraneous matter (Perkins, 1991). Some extraneous materials are beneficial for processing. For example, uniform waxes and metal salts provide lubrication, cohesion, and static electricity control. Other materials, in particularly sugar residue, are detrimental.

Stickiness refers to sugar deposits or sugar residues on the fibers in a cotton boll. The sticky sugar residue has two origins: plant sugars and insect sugars. The cotton plant naturally produces a sugar which is left behind as a residue when the fibers are not completely developed. These sugars are generally uniform within the cotton boll (Carter, 1992). Problems from the plant sugars usually occur when the first cotton to be harvested of a new-crop reaches the mill. Cotton harvested and/or marketed later has generally appeared to have less or no plant stickiness (Carter, 1990; 1992). Plant sugars build up on the machinery and cause the cotton fibers to stick to the machinery (Carter, 1992), which requires cleaning to prevent the fibers from sticking to machines (Lalor, 1994).

Another source of stickiness is derived from insect sugars which are commonly caused by whiteflies (*Bemisia n. sp.*) and aphids (*Aphis spp.*) and are thought to cause more acute problems in processing than plant sugars (Carter, 1990). Insects withdraw plant fluid and excrete the excess nutrients (called honeydew) onto the open cotton bolls (Lalor, 1994). The randomness of the deposits makes it more difficult to detect stickiness in a bale of cotton because the sugars are not uniformly present in the boll. The honeydew sticks to the machinery and the fibers and may cause yarn unevenness or, in extreme cases, machine shut down (Carter, 1992).

Attention to the sticky cotton problem to date has been in the areas of prevention, measurement, and treatment (Wyatt and Ethridge, 1996). Prevention refers to the strategies producers can use to prevent, or at least control, an infestation of whiteflies or aphids (Nichols, 1994). Commercial development of a reliable measurement of stickiness is currently limited by time and cost constraints.

Current treatments consist of enzymes (chemical reduction of sugar), oversprays (lubricating spray for machine contact), and washing (washing away sugars), which are still being tested in the commercial environment.

While some knowledge exists about prevention, measurement, and treatment, there is no information about the economic losses from sticky cotton. That is, the costs incurred by textile mills due to sticky cotton have not been quantified. Knowledge of these costs is important to understand how stickiness affects cotton fiber prices and textile mills' operating costs. If processing costs can be identified, the information would provide all market participants with better understanding of the overall effects of sticky cotton. The objectives of this research were to identify procedural changes in processing for different levels of stickiness and the additional textile processing costs associated with different levels of stickiness.

Methods and Procedures

A survey was developed to address the objectives. Before compiling the list of possible survey participants, some criteria were considered to decide which textile mills to contact. The criteria were to target only those mills which 1) processed cotton yarn and 2) were thought or known to have experienced sticky cotton. The information needed to achieve the specific objectives of this research was obtained

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through the use of specifically designed groups of questions (Floeck and Ethridge, 1997).

Measuring Stickiness

One group of questions was used to obtain information on the range of stickiness that can be processed. A reliable and commonly used test for stickiness needed to be identified in order to be consistent in the definitions of each level of stickiness, but the industry does not have a standardized test. Therefore, textile mills were asked whether each tested for sticky cotton, what specific test was used, and what levels of stickiness were experienced (regardless of whether or not a test was used). Because, the specific tests used were not consistent throughout the industry, a more subjective approach could be used by allowing the textile mills to report a perceived level of stickiness, regardless of whether the cotton was tested or the type of test used.

Measuring Added Costs

The majority of the questionnaire was focused on identifying the strategies used to deal with sticky cotton and the associated costs. Three particular strategies were outlined in the questionnaire: blending, slowing processing, and adding labor (the respondents were also given the option to describe other strategies, if applicable). The respondents were asked to indicate which strategies were used and to estimate the corresponding cost so that the total added cost of processing sticky cotton could be estimated.

For blending, the respondents were asked to identify a blending ratio for each level of stickiness experienced. Respondents were asked to indicate whether the average price of the non-sticky cotton used specifically for blending was higher than the sticky cotton, and to indicate the price difference. The average price difference was used to calculate the added cost of blending.

To calculate the added cost of slowed processing, the change in average output rates (lbs. of yarn/hr.) and the normal average cost of production ($/lb. of yarn) were needed. The respondents were asked to indicate the average rate of processing in pounds per hour for each level of stickiness experienced and the normal average rate of output. From this information, a change in processing rates could be used to calculate the added cost of slowed processing.

The added labor cost (for cleaning, machine monitoring, etc.) was addressed by obtaining the number of workers added for each level of stickiness and the average hourly wage paid (including benefits) per worker. The added cost of labor was calculated as the product of the number of added workers and the average hourly wage.

Data Analysis

Data analysis was limited for two reasons: 1) the small sample size and 2) the limited information on production costs and output rates. There is the possibility that other textile mills experienced sticky cotton that were not included in this survey. The sample size to be analyzed also became restrained by the lack of information available on the changes in costs of production and the changes in output rates. For these reasons, the data analysis was limited to descriptive results.

Correlation Analysis

Of the nine responses, eight textile mills indicated that they had experienced sticky cotton. Thus, for purposes of analysis, survey responses of the eight reporting stickiness were used. The correlation analysis was performed on 44 variables (Floeck and Ethridge, 1997).

Chi-Squared Analysis

The chi-squared analysis was performed on five different relationships between two variables (Conover, 1980). These consisted of 1) the level of stickiness and whether the cotton was tested for stickiness, 2) type of test used and the level of stickiness, 3) the level of stickiness and the source, 4) the percentage of total bales that were sticky and the level of stickiness, and 5) the level of stickiness and the strategies used to run the sticky cotton (blending, slowed processing, and added labor). Relationships 1, 2 ,3, and 4 were tested for independence from the level of stickiness reported and factors that could have influenced the subjective perception of stickiness. Relationship 5 was tested for independence of blending, slowed processing, and added labor from the level of stickiness.

Cost and Output Analysis

The data for production costs and output rates were limited by the inability of the textile mills to retrace origins of costs, firms' policies against releasing cost information, and a small sample size. Cost and output information were not consistently provided by each firm; therefore, a total added cost for each level of stickiness could not be estimated. Due to these limitations, only the averages of the data provided were evaluated.

The data that were given for added cost and the change in output rates were evaluated using the limited data provided by two firms. The individual added cost of blending was calculated by multiplying the price differential of non-sticky cotton to sticky cotton and the blending ratio at different levels of stickiness.

The new production cost was calculated by multiplying the normal output rate (lbs. of yarn/hr.) by the normal production cost ($/lb. of yarn) and dividing that by the slowed output

rate. The new production cost was subtracted from the normal production cost to calculate the added cost of slowed processing at each level of stickiness. This differential was used to see how the added cost changed over the varying degrees of stickiness.

The cost of added labor ($/hr.) was calculated using the data from only two firms. This was obtained using the product of the average hourly wage rate (including benefits) and the number of workers added to process the sticky cotton. Then, the costs were averaged for the two firms.

Results

Survey Results

Nine of the eleven firms who originally agreed to participate returned the survey, representing a response rate of 81.8%. However, only one firm returned a complete survey; one did not experience sticky cotton; and the remaining seven did not provide information on changes in production costs and output levels.

Descriptive Statistics

Table 1 summarizes the responses to the descriptive information questions. All nine respondents tried to process the sticky cotton, but one respondent later found no stickiness present after testing for it. Eight respondents (89%) actually experienced sticky cotton from the 1995 crop year. Seven of the nine respondents (78%) used some method to test for stickiness with five different types of tests used to measure stickiness (see Appendix B in Floeck and Ethridge, 1997). Four of the eight respondents who experienced stickiness said they had knowledge of whether the source was plant or insect.

The average percentage of the total bales being sticky was 33%. About 88% of the firms that experienced sticky cotton used blending, 75% slowed processing, and 50% added workers to help deal with sticky cotton. Of those that blended, 25% paid a higher price for the cotton used for blending.

Table 2 summarizes the percentages of mills experiencing the various degrees of stickiness. Three textile mills indicated that they handled more than one level of stickiness. The textile mills were asked to define a level of stickiness, regardless of whether the cotton was tested or simply perceived to be sticky.

Data Analysis

Variable Correlation

Significant correlations were found in three instances (Table 3). First, the presence of moderate stickiness from plant sugars was positively correlated with the percentage of total bales that were sticky. Second, high insect stickiness was positively correlated to adding workers, indicating that adding workers was a strategy most often used when the stickiness level was high and from an insect source. Third, the percentage of sticky bales and the use of blending were negatively correlated. That is, as the proportion of sticky bales increased, the blending strategy was less likely to be used.

Chi-Squared Analysis

All tests were at the 95% confidence level. Eight out of the nine observations were used in the analysis; one was dropped because testing revealed no stickiness. The first test showed that there was a relationship between the level of stickiness reported and whether the cotton was tested. As expected, testing appears to increase recognition of stickiness. The second test (seven of the nine observations were used -- two were dropped because they did not test for stickiness and one was dropped because testing indicated no stickiness) showed that the level of stickiness reported was independent of the type of test used. The type of test used did not appear to have any influence on the level of stickiness reported. In the third test, only four out of the nine observations had knowledge of the source of stickiness. Those four observations experienced more than one level of stickiness. The chi-squared analysis showed that the level of stickiness reported and the type of source indicated were independent of one another at the 95% confidence level. The source of stickiness, plant or insect, did not appear to be categorically associated with the level of stickiness reported.

Seven observations were available to test for a relationship between the percentage of total bales that were sticky and the level of stickiness reported. Two observations were dropped because one did not experience sticky cotton and the other did not know the percentage of the total bales that were sticky. The percentages were put into categories of 25% intervals. The alternating rule of boundaries was used: start with the conservative choice and alternate thereafter. The test showed that the percentage of total bales that were sticky was independent of the level of stickiness reported. In other words, the percentage of bales that were sticky appeared to have no relationship to the level of stickiness.

Independence was also tested between the level of stickiness reported and the different strategies used to run the sticky cotton. The analysis showed that the strategies used to deal with running the sticky cotton were independent of the level of stickiness reported. This indicates that decisions made on how to deal with the sticky cotton were not made directly in reference to the level of stickiness. This is likely due to the lack of information available to textile mills. The sampled textile mills probably did not have sufficient information on the best strategy to use given their level of stickiness. Three tests were also done on the individual strategies and the levels of stickiness. Each strategy taken separately was also independent of the level of stickiness reported.

Cost and Output Analysis

Only one firm provided information on both costs and outputs, and only two firms provided information on

blending costs. Enough information on the slowed processing costs were not provided, and only two firms provided added labor cost information. As a result, only tentative conclusions can be made.

The blending in one case showed that as the level of stickiness increased, the blending ratios increased, and the cost per pound of cotton used to blend increased. In another case, the firm used the same blending ratio for all levels of stickiness; thus, the cost per pound of cotton used to blend remained constant. The average added blending costs were 2.5, 3.1, 3.6, and 3.9 cents per pound of cotton, respectively, for stickiness levels very low, low, moderate, and high. As Figure 1 demonstrates, the average added cost of blending increased slightly as the level of stickiness increased. The sample size used to calculate the average added cost of blending was not large enough to generate figures that are representative of the industry as a whole, but the averages do give an indication of what existed in these two cases.

The average added cost for slowed processing was calculated using the cost of production information, which was provided by only one mill. The average added cost for slowed processing was 1.1, 2.2, 3.3, and 4.4 cents per pound of yarn, respectively, for stickiness levels very low, low, moderate, and high. As shown in Figure 2, the added costs of slowed processing increase at a constant rate as the level of stickiness increase.

The average added labor costs were also figured for two firms at each level of stickiness. The added labor costs averaged $20.00 per hour for low and high levels of stickiness. This could be expected if wages are set by the firm's own policy, but that information was not solicited in the questionnaire. The inconsistent addition of labor for each level of stickiness may have been a result of firms having to make decisions without complete information. The lack of information likely influenced the firms' ability to choose the best amount of labor to add in relation to the level of stickiness experienced.

Conclusions

Information from the survey indicated that the added costs of processing sticky cotton increased as the level of stickiness increased. However, the limited cost information precluded quantification of added costs for different levels of stickiness.

The strategy used to deal with sticky cotton was expected to vary in response to the level of stickiness. The information gathered from the survey did not support this hypothesis. The conclusion offered is that there is not enough information on how to deal with different levels of stickiness for the textile mills to use when making processing decisions.

The processing of sticky cotton is a complex problem which has occurred randomly throughout history and is not likely to disappear. The basis for dealing with sticky cotton is accurate information. This research was not able to generate estimates of added costs because little cost information was provided, which leads to the question of how to estimate the added costs. Two options for estimating added costs are to improve working relationships with firms or to use a simulation of processing operations to estimate costs. The capacity to simulate operations and costs of processing sticky cotton does not exist at the present time.

The sample size for this research project was small; therefore, conclusions must be regarded as tentative. Furthermore, respondents had trouble answering specific cost and output questions. Two aspects must be considered in order to overcome these problems in future research: 1) establishing trust with respect to confidentiality on individual firm data and 2) the research approach should be reorganized.

A flow of correspondence between the textile mills and the researcher(s) should be established in order to establish a partnership focused on obtaining better information. Also, the design of the project needs to be organized in a categorical fashion. For example, similar plants should be grouped together according to capacities, operating parameters, output (e.g., yarn size), etc.. A record-keeping project, structured to reveal added costs associated with processing sticky cotton, seems necessary to help firms trace added costs as they are incurred. As each firm encounters sticky cotton, a central testing site of cotton suspected to be sticky could be used to ensure that the type of test used would be consistent.

The type of test used for stickiness is important in the usefulness of information that is available on processing sticky cotton. The literature search on the existing types of stickiness tests revealed there to be several tests available. This study revealed that various types of tests are used and that no effective standards for measuring stickiness exist currently. Thus, information that is available on processing different levels of stickiness may not be applicable if different tests are used. A standard, objective test for stickiness would facilitate useful information for processing sticky cotton.

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Table 1. Summary of Survey Question Results.

Question	**"Yes" Percentage**
Experienced stickiness	89%
Tried to run the sticky cotton	100%
Tested for stickiness	78%
Knowledge of the source (plant or insect)	50%
Average % of total bales that were sticky	33%
Used Blending	88%
Price of non-sticky cotton greater than sticky cotton	25%
Slowed processing	75%
Added workers	50%

Table 2. Levels of Stickiness Experienced by Mills

Level of Stickiness	Percentage of Mills
Very Low	25%
Low	38%
Moderate	50%
High	75%

Table 3. Summary of Significant Variable Correlation.

Variables	Correlation	Significance Level
% of sticky bales: moderate plant stickiness	0.77418	0.0241
high insect stickiness: added workers strategy	0.77460	0.0240
%of sticky bales: blending strategy	- 0.77418	0.0241

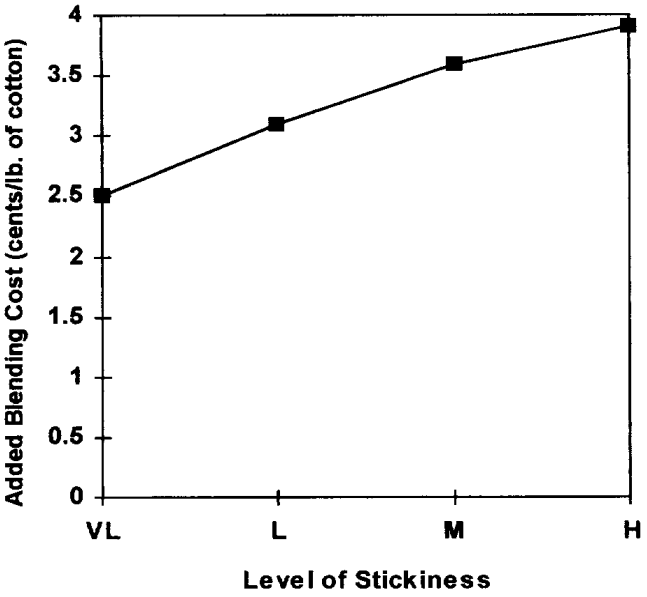

Figure 1. Average Added Blending Cost at Different Levels of Stickiness.

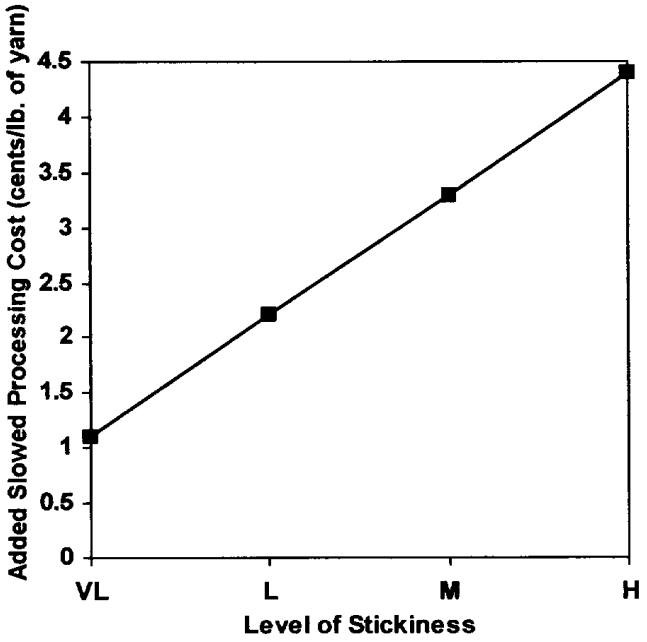

Figure 2. Average Added Slowed Processing Cost at Different Levels of Stickiness.