# INFLUENCE OF GINNING ON SPINNING PERFORMANCE AND YARN QUALITY

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## Abstract

All fiber quality measurements are important to the yarn spinner. With a knowledge of all fiber properties a spinner can work to optimize technical and economic efficiencies. However, all fiber quality information is not available to the spinner. One of the most important properties missing is short fiber content. Numerous studies have shown the importance of fiber length, especially short fiber, on processibility and quality. Short fiber content can be influenced by vigorous mechanical processing, especially at the gin. Therefore, textile firms have begun to look at gin location as a means for controlling short fiber content in cottons purchased.

## Introduction

During the past few decades the characteristics used in the marketing of cotton have changed significantly. We have moved from the human classification system to an almost complete instrument classification system. With the human classification system subjective indicators for grade and staple were given. Later an instrument measure for micronaire was included in the classification system. With the instrument classification system, High Volume Instrument (HVI) measurements are given for micronaire, reflectance, yellowness, trash, length, length uniformity, strength and elongation. These HVI measures are widely accepted/used in all segments of the cotton/textile industry. Widely accepted/used because they give the textile manufacturer a more complete description of the fibers in a bale of cotton. All information that describes cotton quality characteristics is very, very important. Important because it providing him, the ultimate user, the customer, with an opportunity to select and use bales to optimize technical and economic efficiencies in his plants.

Textile manufacturers must be able to optimize spinning performance and yarn quality, and at the same time reduce cost. They are always in the continuous improvement mode, searching/studying for ways to become more competitive in the global market place. New and improved processing machinery has replaced older less efficient machines. Management systems have changed and employees are more involved at every level. Fiber utilization systems are becoming more direct and focused on meeting specified requirements of the customer. These are just a few of the areas where significant work/changes have taken place. More must be done. We must focus on other fiber characteristics that influence performance, quality and cost at the textile manufacturer --- the customer of cotton producers.

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## Customer-Supplier Relationships

Have you ever purchased anything from Land's End, a mail order company? I have and I consider myself a customer of Land's End. I enjoy ordering from Land's End because I know exactly what I will be getting. Their pinpoint oxford shirts meet my requirements in every way. If they don't, I send them back, postage paid, and get new a shirts or a refund. The same relationship exist between a textile manufacturers and their customers. If the product they ship to their customer does not perform or meet customer specifications, the product comes back to the textile manufacturer. These products are the property of the textile manufacturer and they must decide how these products will be marketed. Products that do not meet the specifications of the customer are not the customers problem, they are the suppliers problem. I think that this same relationship exist between the cotton seed supplier and the cotton producer. If the seeds purchased do not germinate, whose seed are they?

This customer/supplier comparison takes on a different set of meanings when we focus on the cotton farmer, ginner and textile manufacturer. Clearly, the textile manufacturer is the customer of the cotton farmer. And there should be a direct linkage or partnership type relationship between the cotton farmer and textile manufacturer.

## Cotton Classification/Marketing/Utilization Data

Until recently, textile manufacturers were forced to purchase most of their cotton from U. S. cotton producers. In most cases, purchases were based on USDA classification data. That is, fiber properties for each bale as determined in USDA classing offices on HVI systems. These HVI measurements are for micronaire, reflectance, yellowness, trash, length, length uniformity, strength and elongation. However, missing from all of this data is a very important fiber measurement - SHORT FIBER CONTENT. This is one of the most important fiber measurements in textile manufacturing where the focus is directed toward improving performance, quality and reducing cost. Zeidman, M. I., Batra, S. K. and Sasser, P. E. stated that a knowledge of short fiber content is indispensable in obtaining high quality yarns.

Short fiber content is not recorded on a bale of cotton as it begins its journey through the U. S. cotton marketing channel. Therefore, bales arrive at the textile plant and are carefully placed in a mix laydown according to a set of specified parameters and/or HVI measurements. Short fiber content is not included in these data. Therefore, the influence of short fiber content is not recognized by the

plant until it is in downstream processes, where it can create numerous problems. This is the main focus of this report - short fiber content and its impact in manufacturing.

First, let's review what the cotton farmers customer must do with a bale of cotton with high short fiber content. At present, it is very simple. The customer, which is the textile manufacturer, owns the bale of cotton and he is solely responsible for determining how to use or dispose of this bale containing high short fiber content. There is no mechanism in the system for returning this unsatisfactory bale, or bale that doesn't meet customer specifications, back to the supplier. As I did with Land's End or the yarn buyer did with the yarn supplier or the cotton producer did with the seed supplier.

It is essential that a measurement for short fiber content be a part of bale classification data and used in the marketing of cotton.

## Sources of Short Fiber Content

Perkins and Bargeron reported that cotton varieties, growing conditions, harvesting, ginning and lint retrievers affect fiber length and the short fiber content of cotton. Cotton variety is directly related to fiber strength and therefore is indirectly related to short fiber content. The strength of fiber contributes to its ability to withstand mechanical stresses during harvesting and ginning. Weak fibers are prong to break during processing. Stronger fiber reduce the potential for breakage during harvesting and ginning, thus the existence of fewer short fiber in the bale. However, even with stronger fiber we have the potential to create a higher short fiber content because of increasing stresses on the fiber that are caused by changes in harvesting and ginning.

Growing conditions have an affect on short fiber content. Short fiber content is influenced by fiber maturity and maturity is directly related to growing conditions. Immature fibers have underdeveloped, weak, thin walls that are prong to break during harvesting and ginning. Fully mature fibers are less likely to be damaged or broken. Thus, a growing season that has an early frost, water stress or disease has a bearing on the percent of short fiber in a bale.

Harvesting involves the removal of locks of cotton from the open bolls. Bolls from the same plant do not develop evenly from the bottom of the plant to the top of the plant. Nor does bolls near the stalk develop evenly to the end of the limbs. Hence, there exist varying degrees of fiber development from bottom-to-top of the plant and from inside-to-outside of the plant. This development is directly related to harvesting mature and immature fibers. This means that we can expect variation in the levels of micronaire from a particular plant. Thus, wide micronaire variations might exist within and between picker baskets and modules. As mentioned above, immature fibers a more prong to be damaged/broken during harvesting and ginning than fully mature fibers. Therefore, short fiber content in a bale would be higher as a result of harvesting immature/low micronaire cotton.

Ginning has always been considered as an area that contributes to increasing the level of short fiber content in a bale of cotton. Seed cotton moves through a heated drying tower to attain a workable level of moisture in the lint. A moisture content that is to high or to low is detrimental to fiber quality. If it is to high, foreign matter is more difficult to remove from the fiber and grade is affected. If moisture content is to low, the fibers become more brittle and are prong to break at downstream processes in ginning. Downstream processes, i. e., lint cleaners, severely affect the level of short fiber content in ginned lint. However, low moisture content (dryer lint) facilitates removal of foreign matter during lint cleaning. Thus an improvement in classer grade. Typically one, two or three lint cleaners may be used in ginning to remove foreign matter. As the number of lint cleaners increase from zero to three, an increase in short fiber content would be expected (Perkins and Bargeron). Figure 1 shows the effects of gin lint cleaners on short fiber content. Clearly, as the number of lint cleaners increase the percent of short fibers increase, from 9.7% to 12.9%.

Lint retrievers might be used in some gins to clean lint cleaner waste and return it to the system for inclusion in the bale. A lint cleaner imposes an aggressive cleaning action on the cotton lint during processing. During this process some fibers are removed. Any fiber that is subjected to this cleaning action and removed at the lint cleaner probably undergoes a negative change in its length distribution. More specifically, the removed fiber will have a poorer length distribution and higher short fiber content. Since this has been thoroughly studied and shown to be true, it would seem reasonable to expect that feeding this fiber back into the bale would have a negative affect on the length distribution of fiber in the bale. And the inclusion of these fiber would increase the percent of short fiber in the bale.

In an earlier study, Rogers and Bargeron reported that fiber length and length distribution contribute significantly to spinning performance and yarn quality. In this study different length cottons were blended in different mixes. And the fiber characteristics of the mixes were evaluated to determine their affect on spinning performance and yarn quality. Results showed that the percentage of short fiber in each mix was one of the most important factors. Thus, the fiber characteristics of fibers being mixed/blended must be carefully studied/understood. Blending or combining fibers of a different length and length distribution may result in a different length and length distribution. The fiber length and percent of short fiber in the resulting blend/mix will be negatively affected if shorter fibers are fed back into the fiber flow. Clearly, lint retrievers would have a negative affect on the percent of short fiber in a bale of cotton.

## Comparison of Short Fiber Content by Gin Location

This past summer, 1996, bale samples were collected from cotton mix laydowns to study differences in short fiber content between gin locations. Seventeen gins were identified. For each gin, ten bales were sampled. These 170 samples were tested for short fiber content on the Advanced Fiber Information System (AFIS). Results from these tests are shown in Figure 2.

Shown for each gin is the average of the ten AFIS short fiber content measurements. These data show that gins numbered 3, 4, 6 and 12 have short fiber content greater than 10 percent. Gin 3 has an average short fiber content greater than 12 percent. Clearly, most textile firms would prefer a minimum amount of cotton, if any at all, from a gin locations that perform as gin number 3. In fact most textile firms would prefer not to use bales having 10 percent or greater in their mix laydowns. The current thrust is to work toward 9 percent or less.

## Manufacturing Performance and Quality

Numerous studies have been conducted investigating the negative influences of length and short fiber content on performance and quality measures in textile manufacturing. A summary of these include the following:

1. More thick and thin places in finished fabric, uneven appearance
2. More stops in weaving, reduction in weaving efficiency
3. More stops in winding, reduction in winding efficiency
4. More stops in spinning, reduction in spinning efficiency
5. Lower yarn strength
6. Lower yarn appearance grade
7. Higher level of fiber removed at combing
8. Higher level of fiber removed at carding
9. Higher level of neps in the card web
10. Higher levels of lint or fly in air throughout the plant
11. Higher levels of fiber removed as waste during opening and cleaning
12. More frequent cleaning of floors and machinery

Experience has and continues to remind textile manufacturers that all of these are true. Therefore, to improve spinning performance, quality and lower cost textile manufacturers must determine the most effective way to manage short fiber content in bales of cotton received.

## Summary

Cotton producers, ginners and textile manufacturers should work together to determine the specific measurements that are necessary in the marketing and utilization of cotton. All HVI fiber measurements are important to the textile manufacturer. And a percent of short fiber measurement is one of the most important fiber characteristics to the yarn spinner. To manage short fiber content in selecting bales the textile manufacturers must have a measurement for short fiber content on every bale of cotton. This measurement is essential if a textile firm is to improve its competitive position in the global market place or in some cases remain in business. Since a measure of short fiber content is so important, why is it not on every bale and considered in the cotton marketing system?

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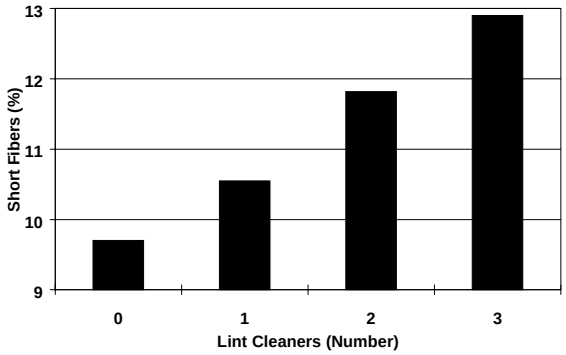


Figure 1. Effects of Gin Lint Cleaners on Short Fiber Content

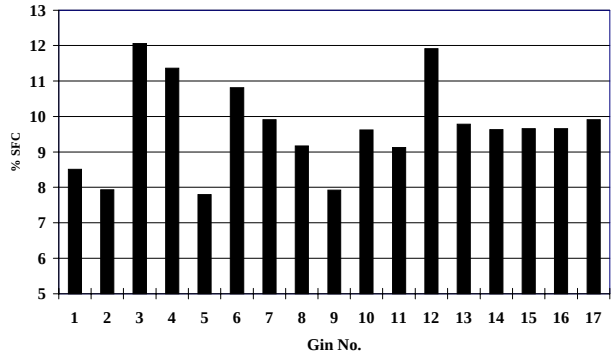


Figure 2. Short Fiber Content from Different Gin Locations