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# STUDY OF HVI MEASUREMENTS BY GIN THAT INFLUENCE TEXTILE MANUFACTURING

**Clarence D. Rogers**
**School of Materials Science and Engineering**
**Clemson University**
**Clemson, SC**
**David McAlister III**
**USDA, ARS, CQRS**
**Clemson, SC**

## Abstract

All fiber quality measurements are important to textile manufacturers. With knowledge of fiber properties/characteristics manufacturers can work to improve technical and economic efficiencies. Improvements can be made if sources of variation in quality characteristics can be identified and action taken to reduce or eliminate variation. Thus achieving more consistency in quality measurements. Textile manufacturers have determined that variation in HVI measurements exist within and between gin locations. With this information they have implemented strategies to purchase cottons more selectively. In fact textile firms have begun to look at gin location as a means for controlling variation in cottons purchased and this leads to less variation, more consistency, in cotton mix laydowns. Knowing this information about textile firms, cotton producers and ginners are working to improve variation in HVI measurements within and between bales of cotton. They are also evaluating differences between gin locations and causes for these differences. Twenty-five gins from the Southeast participated in this study. Results from this study show that there is a difference in HVI measurements between gin locations. This is not an unexpected finding. However, the importance of this work is that it lets each gin see how its HVI measurements stack up against the other twenty-four participating gins.

## Introduction

Textile manufacturers are continually searching for ways to improve manufacturing performance, product quality and at the same time lower costs. They have worked within their plant, at each stage in the manufacturing process, to determine the actual level of performance and compared that to the expected level. Within their plant they have worked to identify why actual and expected levels of performance are different. They understand that any number of factors might cause these differences, including raw materials (fibers), machines, environmental conditions, and people.

They have also worked with machinery suppliers to upgrade technologies, replacing older less efficient machines with newer and improved processing machinery. Fiber utilization systems have become more direct and focused on meeting the specific requirements of the textile manufacturer. At the same time management systems have been implemented to educate and involve employees at every level. During the past few years, manufacturers have begun to focus their efforts on environmental conditions and its influence on the processability of fiber as the fiber moves along its journey from the beginning-to-end of the manufacturing process.

More recently, textile manufacturers have begun focusing on ginning and cottons from different producers as a potential source for varying fiber quality characteristics. Perkins and Bargeron have reported that cotton varieties, growing conditions, harvesting, ginning and lint retrievers affect fiber quality characteristics. Rogers has also reported on the influence of ginning on spinning performance and yarn quality. Results from these and other studies clearly show that fiber property measurements on bales of cotton from ginning vary. Textile manufacturers know that fiber property measurements on bales vary and that some vary more than others. It is this variation in fiber property measurements that contributes to the concerns of textile manufacturers as they seek to optimize all textile systems.

To manage variation in fiber quality measurements in mix laydowns several systems have been developed and employed. Two such systems are the EFS system and direct shipment of mix laydowns according to pre-specified requirements. These systems have contributed to a reduction in the levels of variation in mix laydowns and they have provided for a more consistent utilization of cottons.

It is essential that all segments of the cotton-textile-apparel complex understand the influence of fiber quality measurements on each segment of the industry complex. That is, each segment is (or should be) working toward a system that optimizes technical and economic efficiencies for the entire cotton-textile-apparel complex.

The focus of this study is to further develop the body of information/knowledge on HVI measurements and how these measurements vary between twenty-five gins in the Southeast.

## Customer-Supplier Relationships

Have you ever purchased anything from Land's End 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 shirts or a refund. The same relationship exists between 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 customer's problem; they are the supplier's problem. This same relationship exists between the cottonseed supplier and the cotton producer. If the purchased seeds do not germinate, whose seeds 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 all segments of the pipeline – specifically, the cotton farmer and textile manufacturer.

## Sources of Variation in Fiber Properties

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 fibers reduce the potential for breakage during harvesting and ginning, thus the existence of fewer short fibers in the bale. However, even with a 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 fibers 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 exists 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 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 are 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 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 too high or too low is detrimental to fiber quality. If it is too high, foreign matter is more difficult to remove from the fiber and the grade is affected. If moisture content is too 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. 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 fibers 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

During 1996, a textile plant worked on a project to reduce variation in cotton mix laydowns. Samples were collected from bales in the cotton mix laydowns to evaluate differences in short fiber content (SFC) 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. Average short fiber content for gin 3 is greater than 12 percent. Clearly, most textile firms would prefer a minimum amount of cotton, if any at all, from 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. So improvements could be made in the performance of this plant by implementing a strategy to purchase cotton from those gins with the lower SFC.

Many factors influence cotton fiber properties. Cotton producers, ginners and textile manufacturers know many of these factors. Manufacturers are continually trying to identify and evaluate these factors. They have identified gins and gin locations as factors that contribute to variations in fiber properties. All factors that impact variation is important to yarn spinners since it influences manufacturing performance, product quality, and cost. Thus it makes sense for cotton selection and purchasing decisions to include data/information about gins/gin locations.

## Comparison of HVI Measurements by Gin Location

With this feedback information from the textile manufacturers it becomes natural to work with cotton producers and ginners in an effort to identify sources of variation and work to reduce/eliminate as much variation as possible. If sources of variation are found there becomes an opportunity to improve upstream in the system – toward the ginner, cotton producer and cotton breeder. If improvements can be made at the producer/ginner level, lint cotton quality characteristics in bales from the gin would be more consistent and therefore more valuable to textile manufacturers. Achieving consistency in HVI measurements must be a goal of each segment of the cotton/textile pipeline.

Figures 3 through 7 show HVI average measurements by gin location for UHM, UI, SFC, micronaire and strength. SFC is calculated using the USDA, AMS, Cotton Division formula. Figure 3 shows that the average UHM ranges from 1.028 inches for gin number 9 to 1.085 for gin number 2. Figure 4 shows that average UI ranges from a low of 80.46 for gin 24 to a high of 81.56 for gin 14. Figure 5 shows that SFC ranges from 10.7 percent for gin 14 to 11.9 percent at gin 17. Shown in Figure 6 are the average micronaire values for the twenty-five gins. Gin 8 has the lowest average micronaire value 4.32 compared to the highest value 4.74 for gin number 9. Figure 7 shows that the average strength ranges from 27.1 g/tex to 29.2 for gins number 4 and 18, respectively.

Data in these figures are averages. This alone does not tell the whole story. The major importance of this data is to show that there are differences. And recognizing this as an opportunity to improve, ginners and producers can take the next step to reduce variation at their location and maybe move toward the benchmark gin location. For each gin location there are a number of producers, varieties, environmental factors, ginning factors, attitudes, etc. Recognizing all factors that contribute to variations in fiber property measurements, systems may be developed/implemented to reduce variation both within and between gin locations.

## Conclusions

This study shows that there is a difference in the average of HVI measurements between gin locations. Results provide cotton producers, ginners and textile manufacturers an opportunity to work together in determining specific measurements (factors/variables) that are needed/necessary in the marketing and utilization of cotton. All HVI fiber measurements are important to cotton producers, ginners and textile manufacturers. In addition to the best possible average, consistency is a key. Collaboration between all segments of the industry complex (from genes-to-jeans or dirt-to-shirt) might lead to the development of strategies to improve fiber properties and at the same time improve consistency in measurements. Each segment should continually search for inputs or systems to optimize performance, quality and at the same time lower cost. Thus it seems that reducing variation should be an area of great interest to all segments of the industry complex.

## Disclaimer

Mention of a trade name, propriety product or specific equipment does not constitute a guarantee or warranty by Clemson University or the U. S. Department of Agriculture and does not imply approval of a product to the exclusion of others that may be suitable.

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Perkins, H. P. and Bargeron, J. D. III 1982. Factors Affecting Short Fiber Content of Cotton, Methods of Analysis, and Effects on Processing. Textilbetrieb. 100(9), 4pp.

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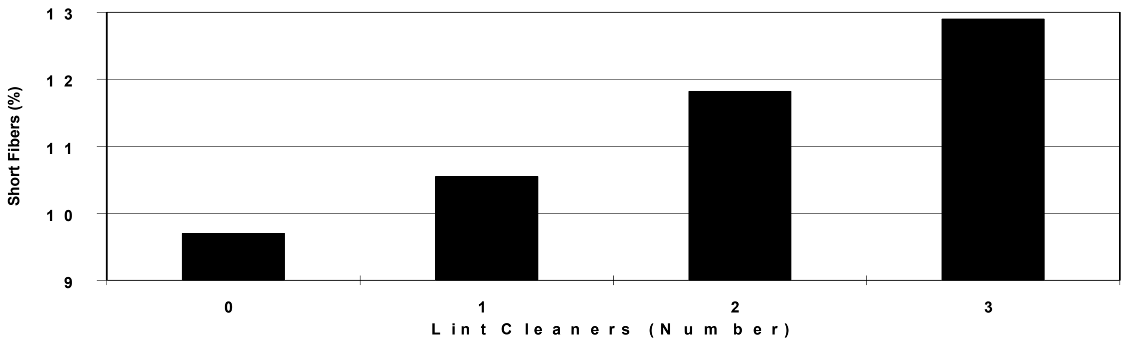


Figure 1. Effects of Gin Lint Cleaners on Short Fiber Content.

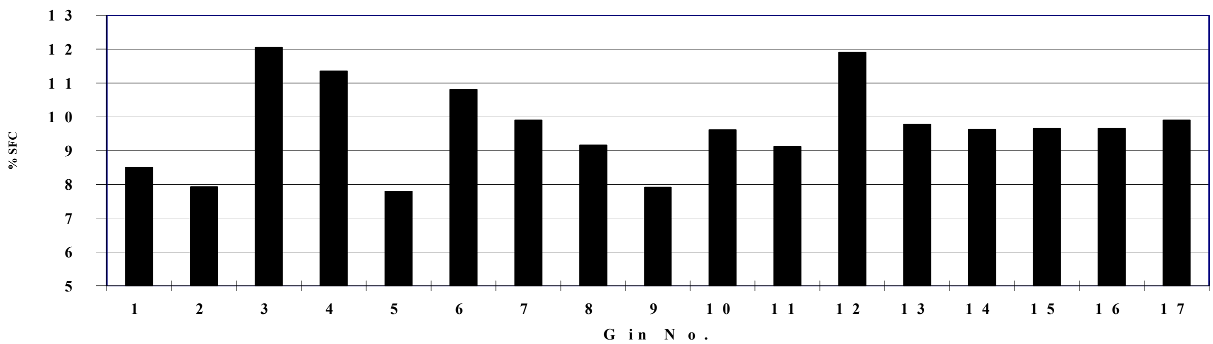


Figure 2. Short Fiber Content from Different Gin Locations.

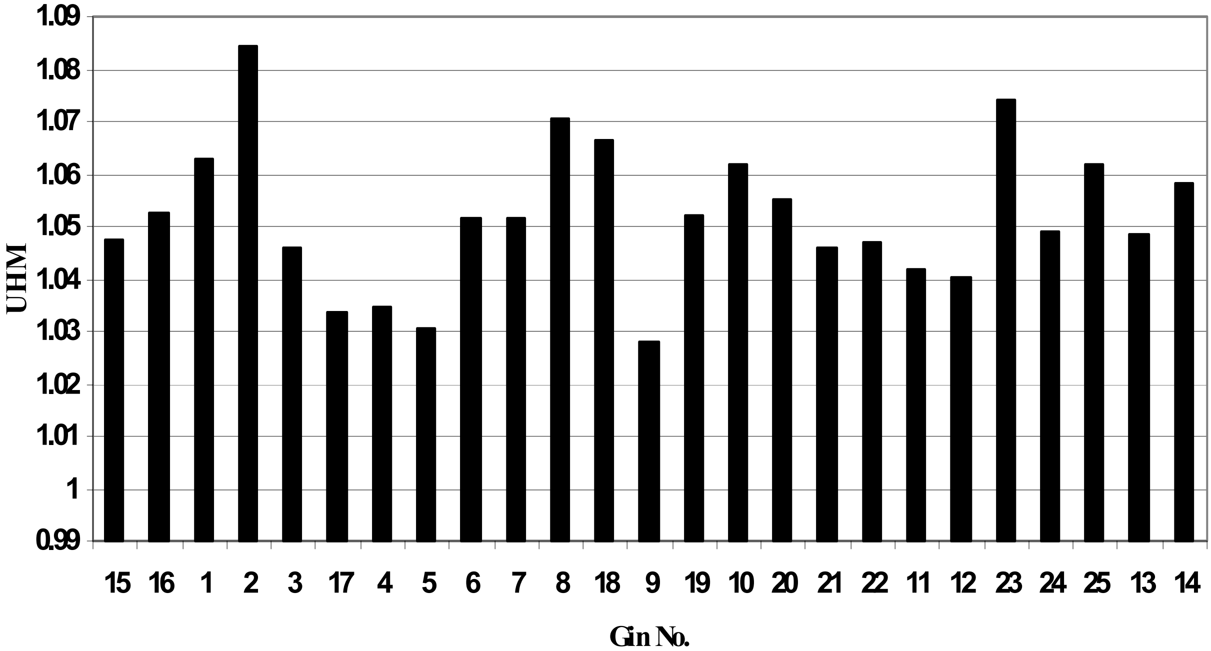


Figure 3. HVI Average UHM, By Gin Location, Southeast.

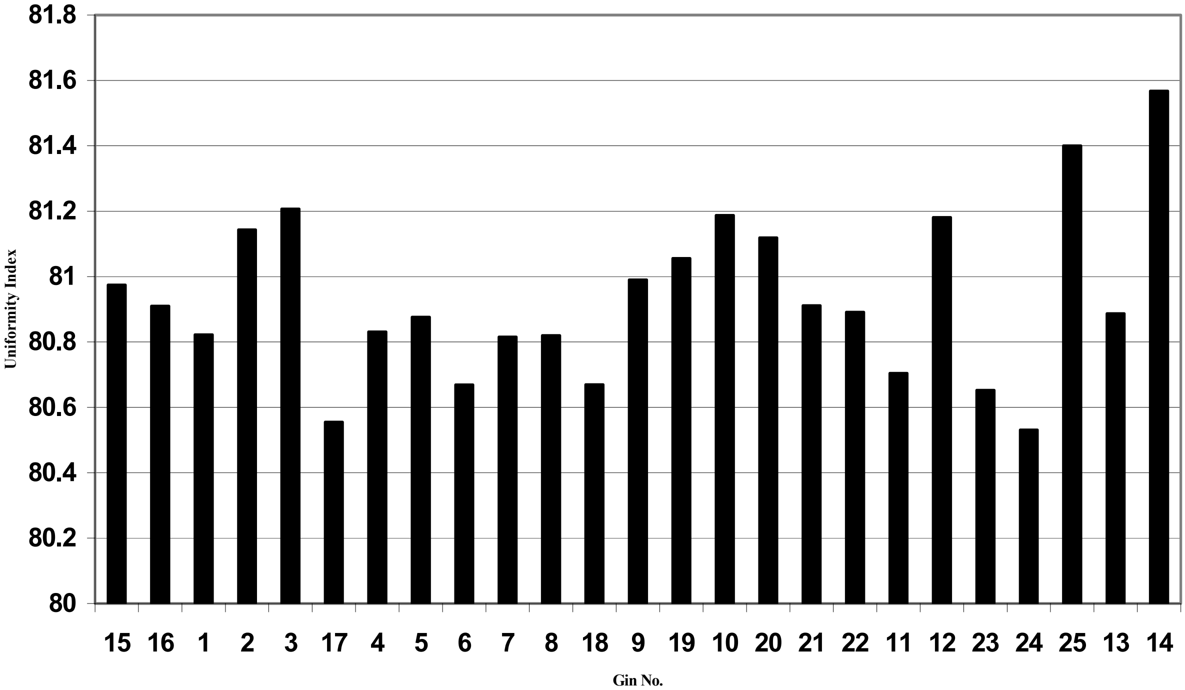


Figure 4. HVI Average Uniformity, By Gin Location, Southeast.

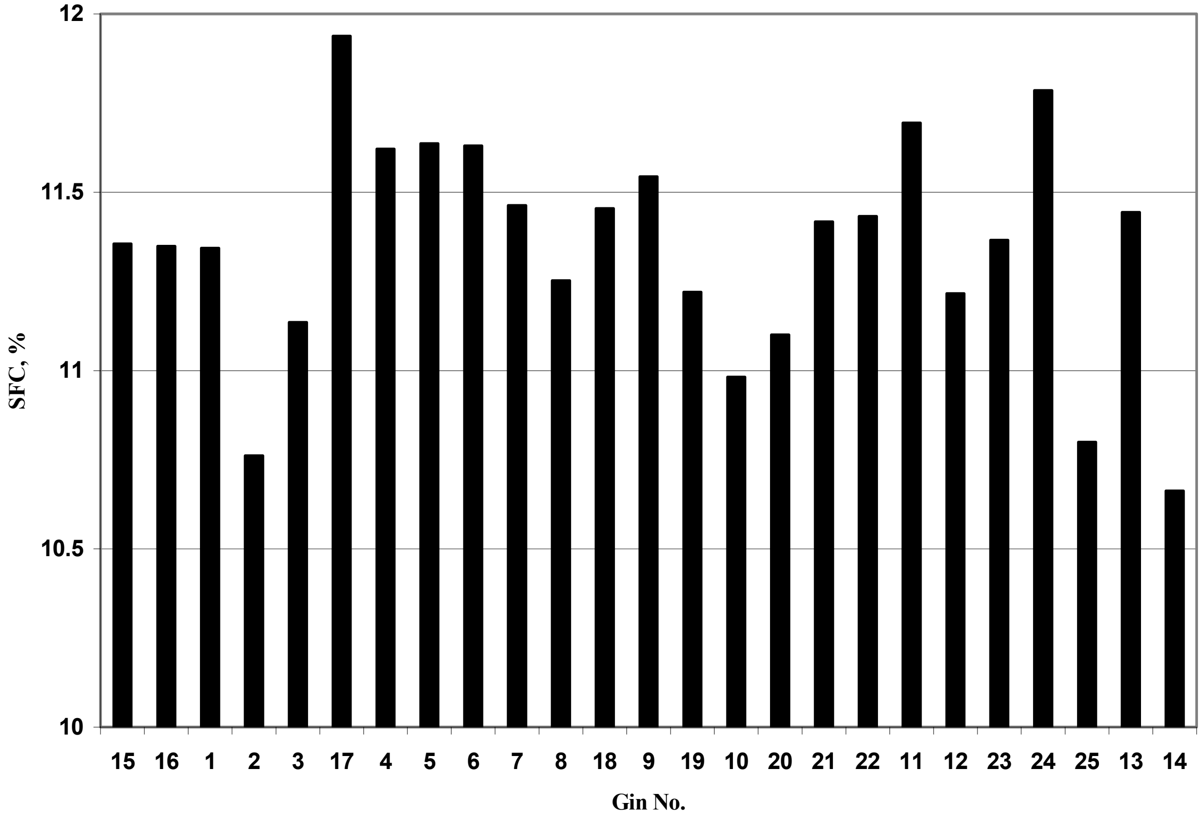


Figure 5. HVI Average SFC, By Gin Location, Southeast.

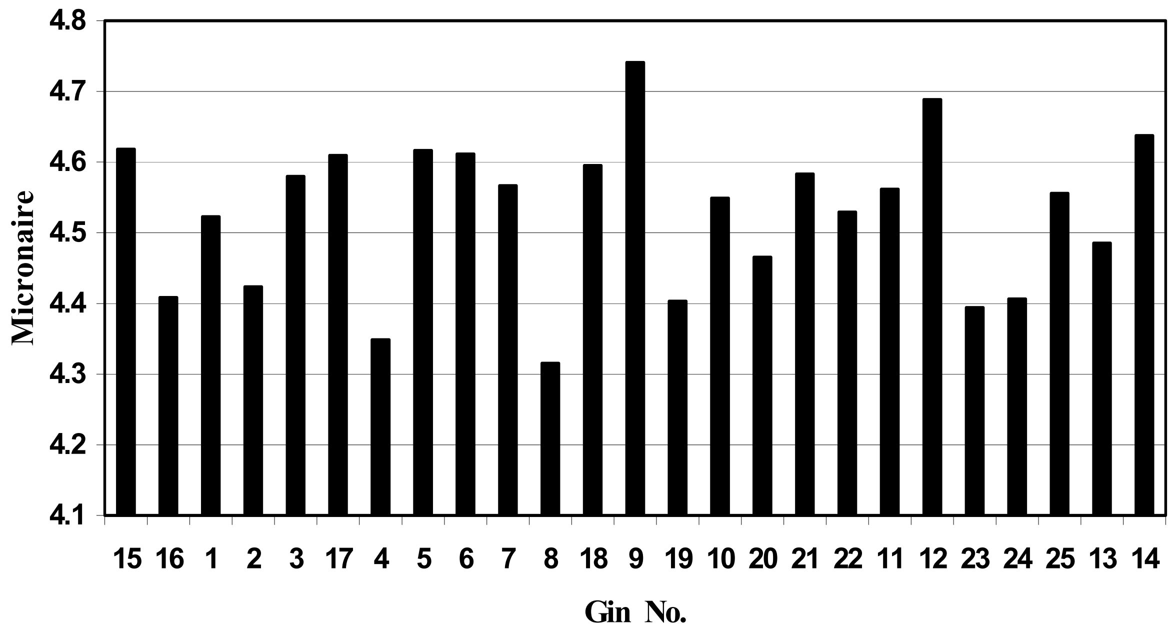


Figure 6. HVI Average Micronaire, By Gin Location, Southeast.

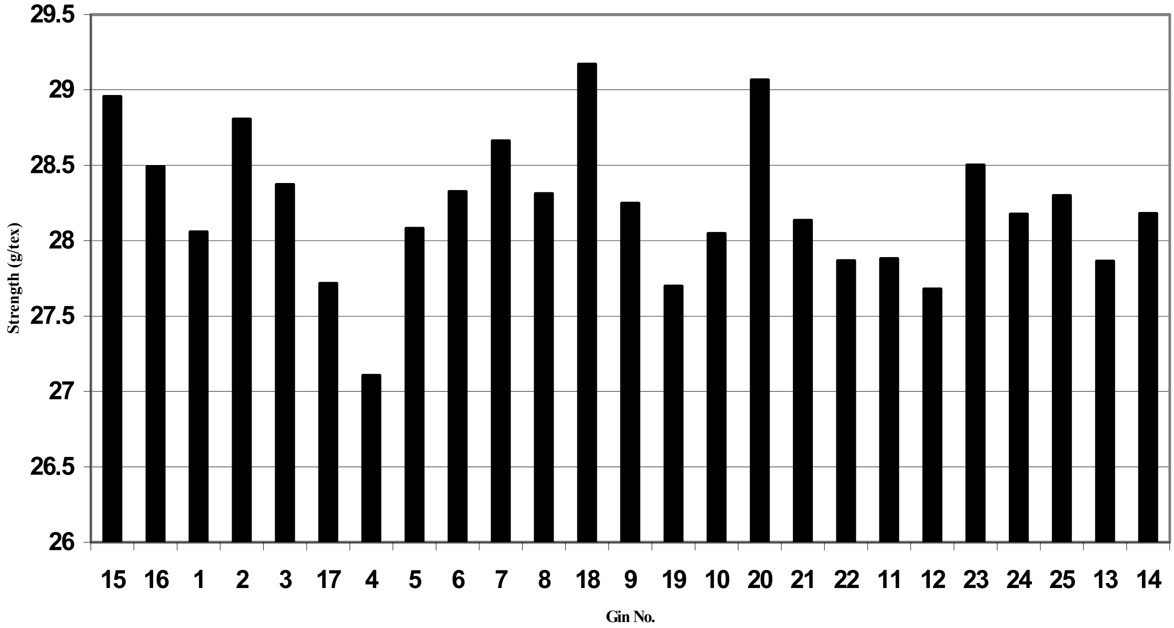


Figure 7. HVI Average Strength, By Gin Location, Southeast.