QUALITY AND LENGTH UNIFORMITY PANEL

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Abstract

A panel discussion of ongoing research to increase fiber uniformity and the importance of improving fiber characteristics and addressing the quality needs of the textile industry. The discussion will include perspectives from Cotton Incorporated, private and coop merchants, a representative from the textile industry, and USDA-ARS scientists. The individual presentations will be followed by a question and answer session where the audience can address the members of the panel.

Introduction

The panel is moderated by Vikki Martin of Cotton Incorporated, who will also present the perspective of Cotton Incorporated as well as introduce Cotton Incorporated's initiatives to address the needs of the textile industry. Chuck Ward of Gildan, one of the largest users of U.S. cotton, will present the perspectives of not only Gildan but the textile industry. Frederick Barrier of Staplcotn will present the perspective and challenges that coop merchants hear from the textile industry. Similarly, Jeffery Johnson of the Louis Dreyfus Company will present the views of a private cotton merchant. Christopher Delhom of USDA-ARS will present the research initiatives being carried out across the Agricultural Research Service to help the cotton industry address the challenges.

Cotton Incorporated Perspective

At Cotton Incorporated, there is an initiative known as Fiber of the Future. This initiative intends to push forward continuous improvement in cotton fiber quality beyond those attributes commonly focused on in cotton breeding programs. The reason to strive for continuous improvement is to ensure that cotton has an opportunity to compete against synthetic products in the future.

In recent years, cotton has struggled with market share due to a variety of factors. One of those factors has been the trend towards athleisure, where yoga pants have taken the place of denim jeans for running errands, having lunch, and other social activities. Many of the athleisure products are synthetic materials and are often lightweight and thin. Thinner and lighter weight fabrics require thinner yarns.

Of the three types of spinning systems in existence today, ring spinning is the predominant spinning system (Figure 1).

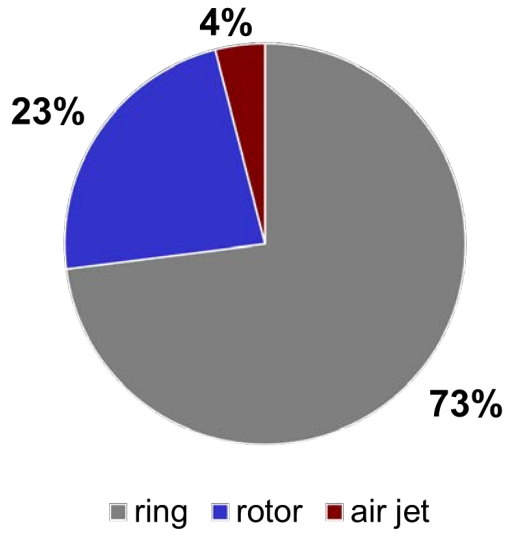

Figure 1. 2016 ITMF Data on global spinning system market share

For each spinning system, the relative importance of each fiber property changes based on the mechanical structure of the yarn formed by the spinning system. In the case of ring spinning length and length uniformity index (UI) are critical to structural integrity. Limitations in UI will result in more waste in textile spinning processes, potential efficiency issues with a higher likelihood of greater ends down during spinning, and will limit the range of yarn size, notably smaller or thinner yarn sizes.

Cotton is competing against synthetic and man-made fibers (MMF) that are cut to any desired length with all the fibers in a bale cut to the same lengths. These materials essentially have a UI of 100. As a natural material, cotton will always have a range of properties based on how the fiber develops in the boll and across the plant. But if we can reduce that variability in properties, it will improve spinning efficiencies and help make cotton more competitive. Through breeding and improved production management, we have seen fiber length and strength increase over the last 15 years (Figures 2 and 3).

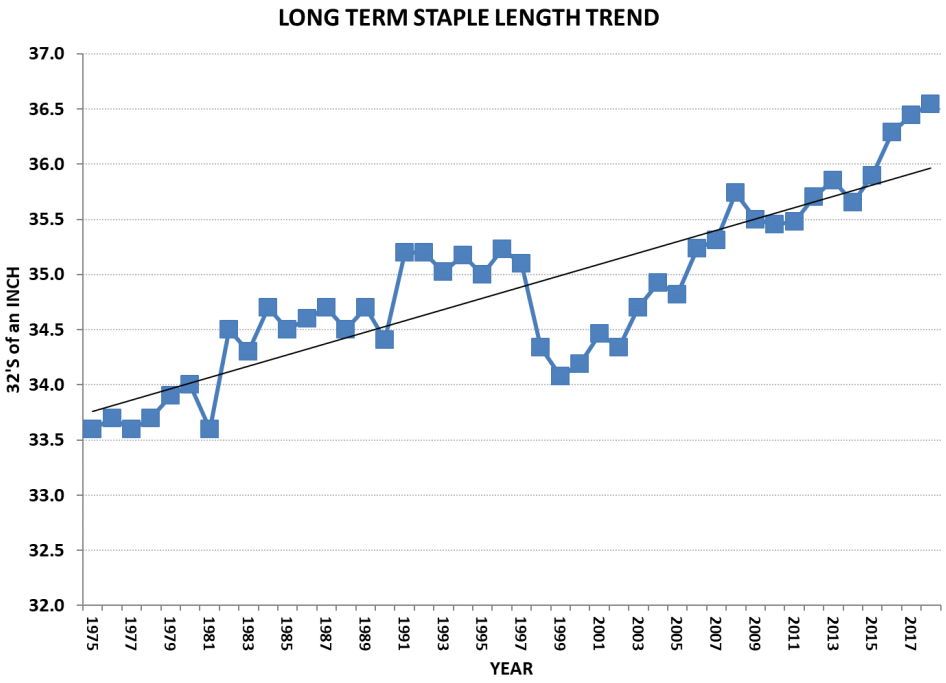

Figure 2. Long-term trend of U.S. cotton staple length

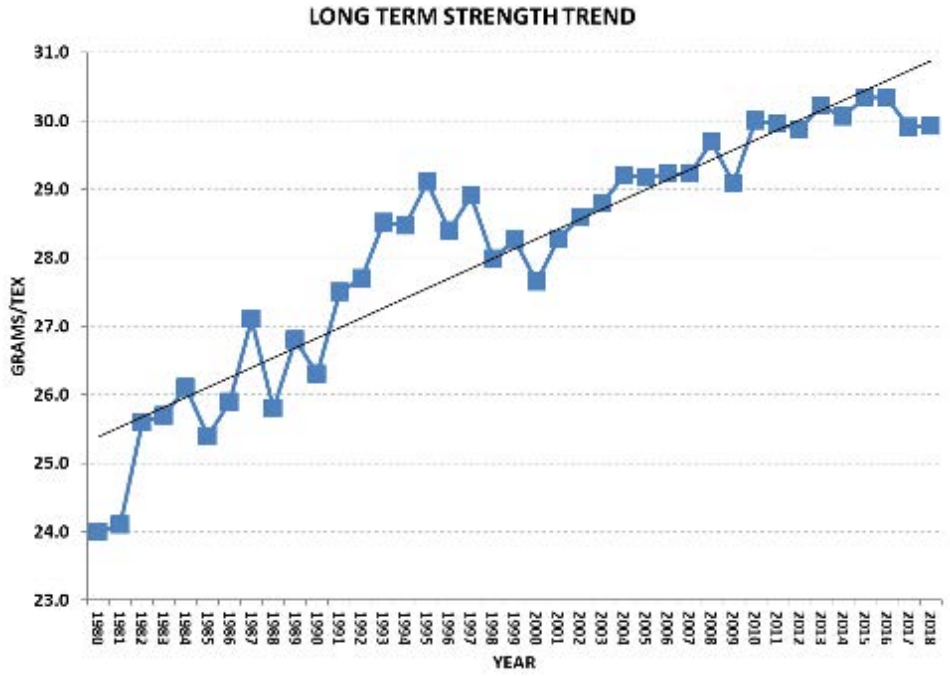

Figure 3. Long-term trend of U.S. cotton strength

However, over the same period, UI has not improved (Figure 4).

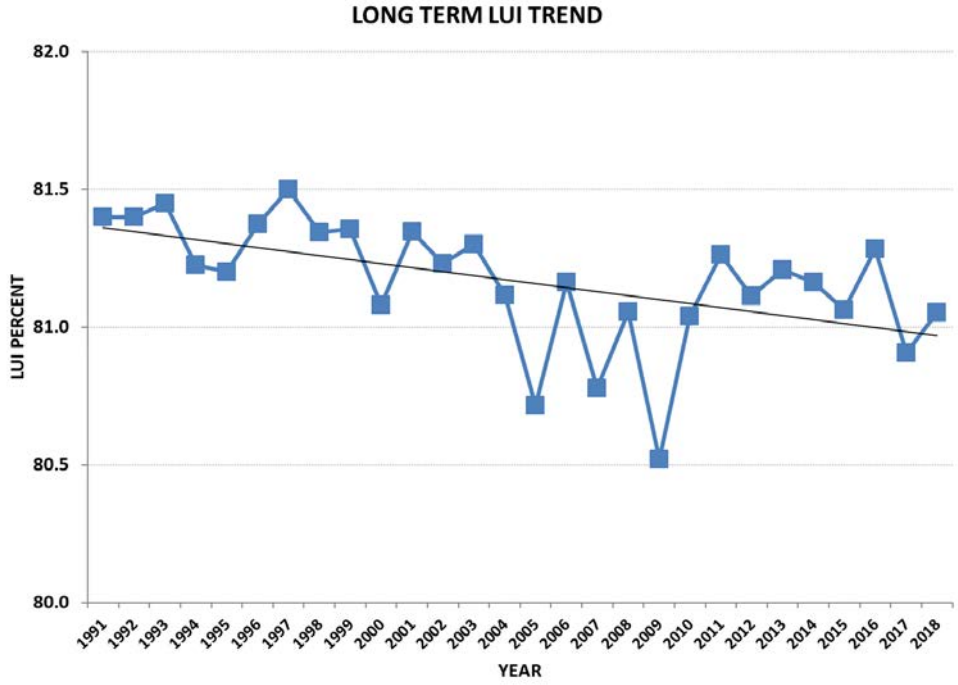

Figure 4. Long-term trend of U.S. cotton length uniformity index

This lack of uniformity makes it more challenging to process cotton compared to other materials and limits the types of yarns and fabrics that we can make with cotton. Textile mills will convey this back to suppliers as “the cotton doesn’t process as well; we have more ends down,” etc.

There is a wide range of research activities currently underway designed to focus on improving UI. The first efforts involve looking at whether the current UI is the correct measurement to focus on if the goal is for breeding programs to improve overall uniformity or length distribution. With the potential of different measurements from existing instrumentation efforts will then evolve into future breeding initiatives. And while varieties are an important part of what determines length uniformity or distribution, what happens during production, differences in environment and weather determines the condition of that fiber, which will also determine how much ginning could help or harm length uniformity/distribution. With this in mind, there are also research efforts underway to evaluate potential options to minimize damage to length uniformity/distribution in ginning.

Textile Mill & Merchant Perspective

The conversion of raw fiber to yarn and textile products requires a number of attributes. Fiber length, length uniformity, and strength are critically important. UI and specifically the distribution of UI in bales within a laydown complicates the predictability of how cotton will perform during spinning. Understanding and handling of UI during processing is a major challenge for the textile industry. The natural variation of cotton is one of the most compelling attributes of cotton that MMF is unable to match; however, this variation can be problematic when the variation is in the wrong properties or is unknown to the spinner. Strong fibers are required to maintain length and length distribution during processing. However, in general, U.S. cotton is strong cotton. Cotton fiber fineness is an important attribute that allows cotton to be spun into fine yarns; however, MMF has been able to replicate the fineness of cotton in recent years.

In addition to UI and length distribution issues, the cotton industry recognizes other challenges that cotton faces in light of competition with MMF. The color of baled lint is not always stable, and this presents both a perception problem in the marketing of cotton and the potential for defects in finished goods. Foreign matter, both contamination from plastics and litter as well as natural material such as bark, grass, and leaf matter, is something unique to cotton and does not exist in MMF that is produced in a chemical factory.

The process of converting raw bales of cotton into finished textile goods largely consists of sliding and arranging fiber against each other into parallel strands. Cotton contains natural waxes and lubricants which aid in this process. However, weathering and other unknown factors sometimes result in fibers which do not process consistently and predictably.

Cotton is marketed on an individual bale basis that necessitates many movements of individual bales between the gin, warehouse, and mill floor. This excess handling of bales results in damage to the bale packaging and potential contamination of the lint within the bale. This handling and damage are unique to cotton and another challenge that cotton must overcome to compete with MMF.

One of the biggest fundamental challenges the cotton industry currently faces is the push to improve sustainability. While the cotton industry has improved its environmental footprint and continues to become more sustainable, this is a story that must be conveyed beyond the industry. Consumers and retailers are calling for sustainable textiles, and the cotton industry must respond.

Fiber Quality Researcher Perspective

As shown earlier (Figures 2 and 4), the length of cotton fiber has been increasing, while the UI has not. Concentrating on the last 20 years shows that the decrease in UI may have halted, but it is at best flat compared to the increase in length (Figure 5). However, if examined in depth by grouping the results by upper half mean length then a general decrease in UI is observed (Figure 6). More troubling is that analysis by length group reveals an increase in short fiber index (SFI) (Figure 7). As previously stated, MMF has a UI of 100 and no short fiber essentially. The rise in SFI while maintaining no increase in UI will cause increased ends-down during spinning and increase waste in the opening and carding process. These losses in efficiency make the decision to replace cotton with MMF easier for the mill manager.

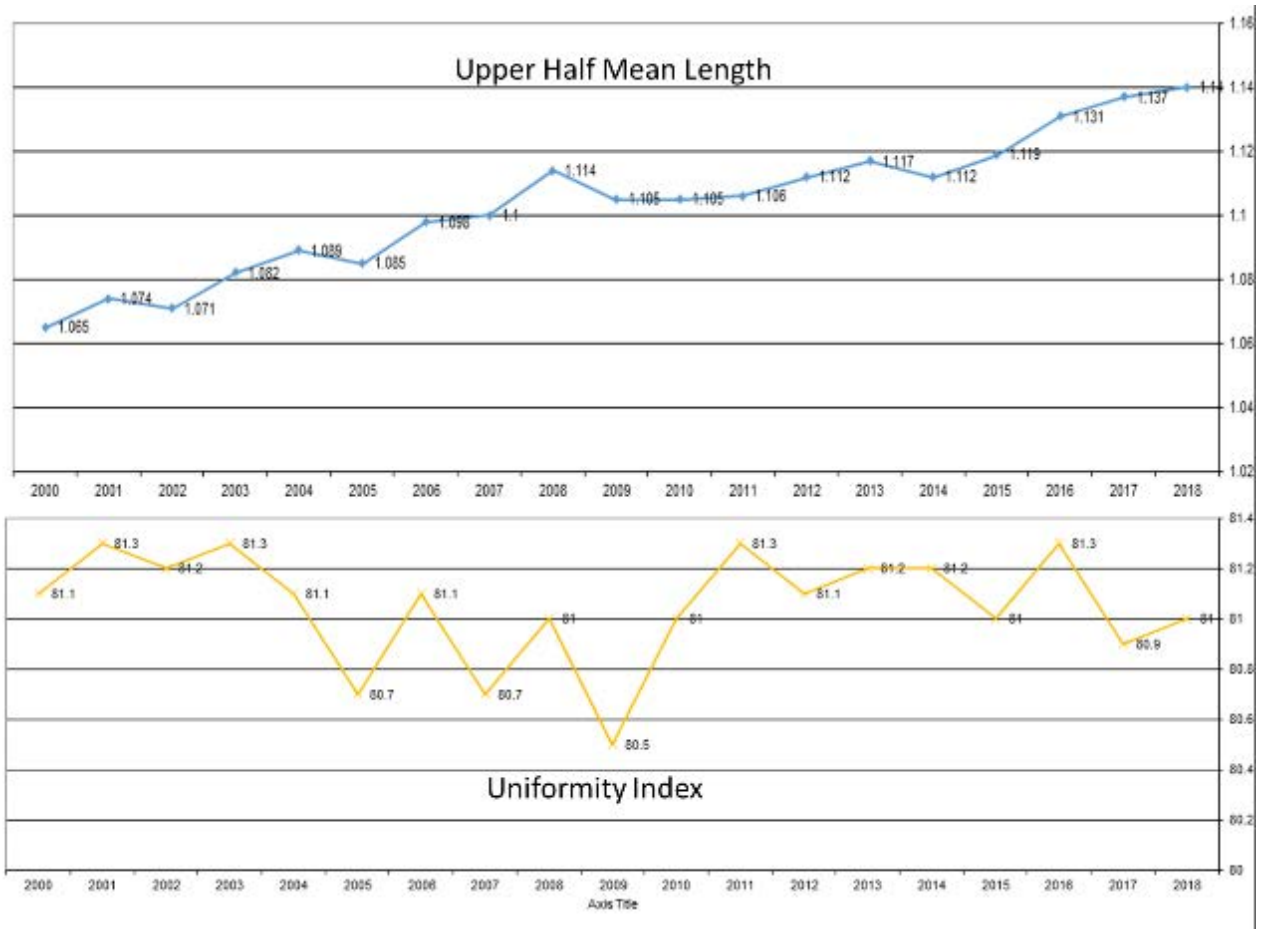

Figure 5. Upper half mean length and uniformity index over the last 20 years.

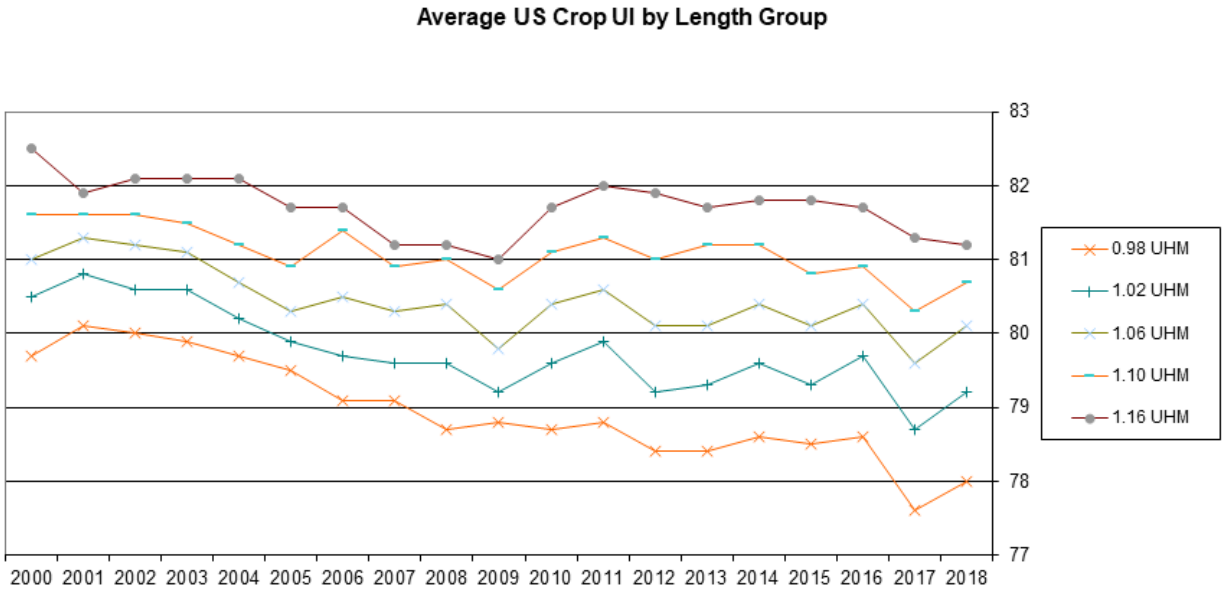

Figure 6. Uniformity index by length group.

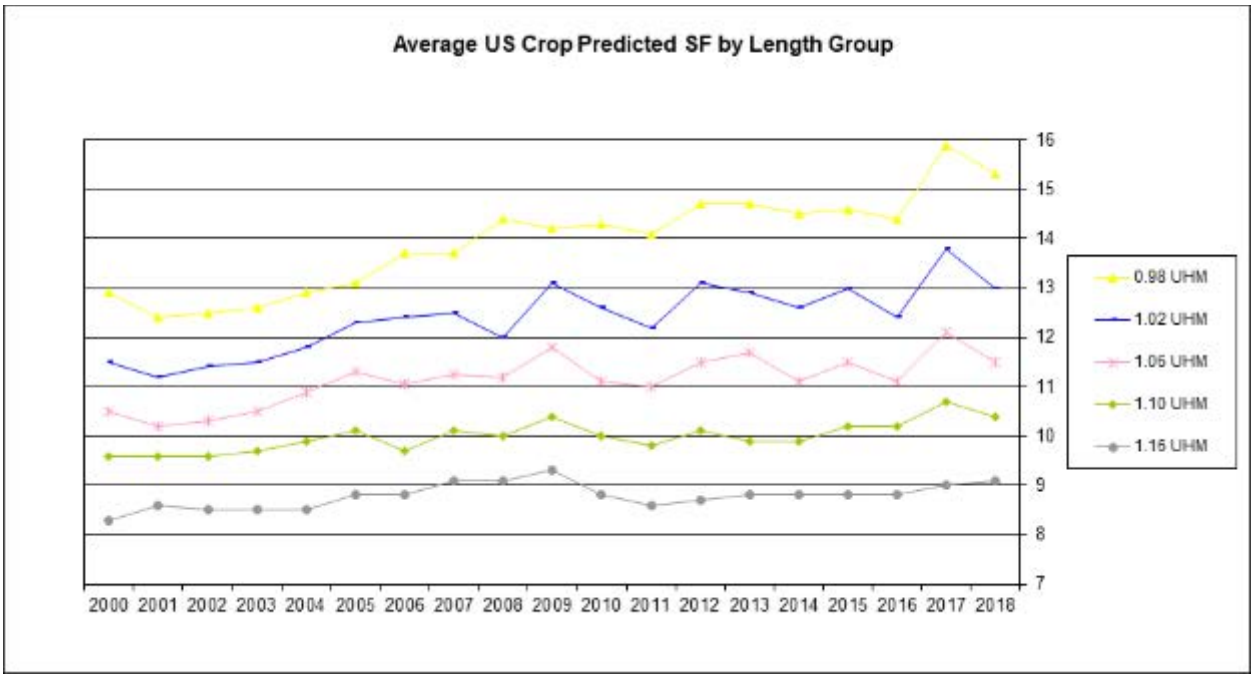

Figure 7. Predicted short fiber index by length group.

The trends in UI also follow regional patterns (Figure 8). Classing office results for the Texas High Plains consistently have the lowest UI in the country, while mid-south and southeastern growths tend to have higher UI.

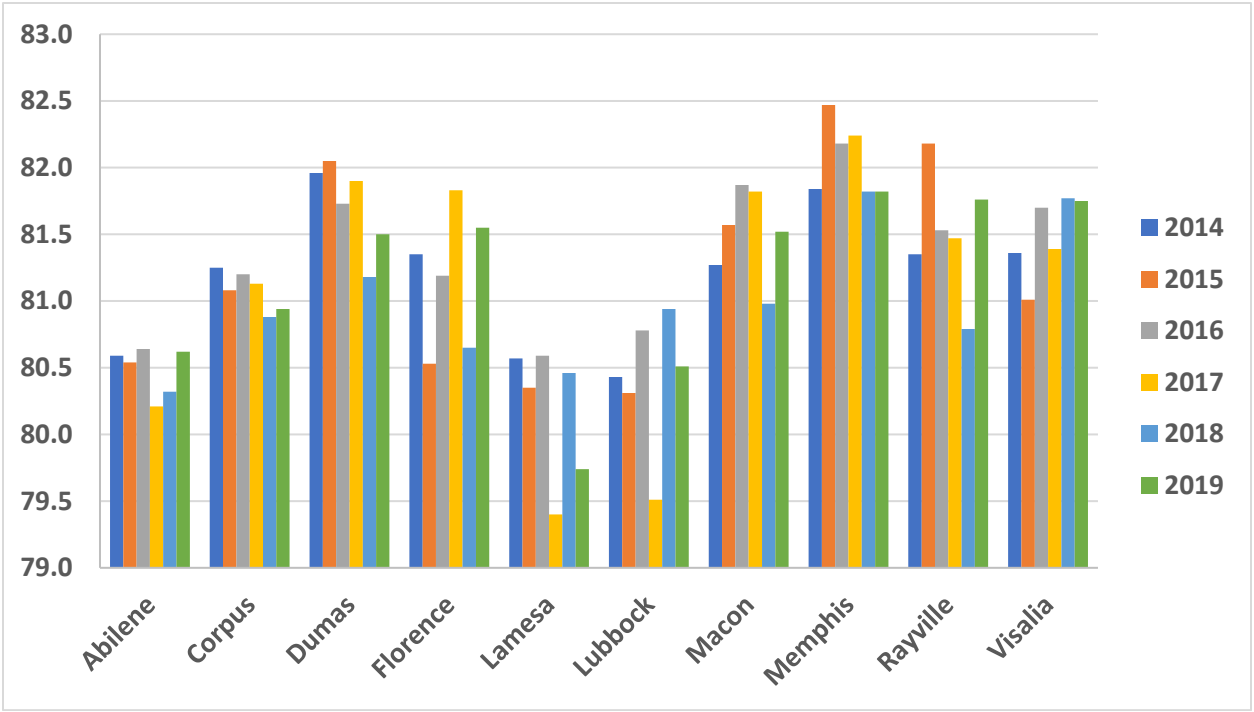

Figure 8. Regional trends of UI

The research community is actively addressing many of the concerns raised by the textile mills and merchants. Improved measurement and understanding of UI is a priority with ARS and is being addressed at the ARS cotton ginning and fiber quality laboratories. Work is ongoing to understand cotton fiber color and its stability. The surface properties of cotton, such as wax, have an impact on fiber friction and are being studied to understand the genetic and

environmental components better as well as how it impacts the ginning and textile processing of cotton. Research is also on-going to examine ways to improve the logistics of the cotton industry to both reduce costs and reduce the potential for bales to be damaged.

Lint cleaning is a necessary evil in the cotton industry. In order to remove foreign matter, some fiber will be damaged. A large-scale research project is underway under the jurisdiction of the Mesilla Park, NM cotton ginning laboratory to examine the interaction of various lint cleaner technology with UI.

The research community also recognizes that contamination of ginned lint by plastic materials is an immediate concern of the entire industry. The entire post-harvest cotton research community, not only ARS but also university and industry researchers, have come together to make addressing contamination a top priority and significant progress is being made on methods to prevent the contaminants from entering the material supply chain and removing the contaminants which do enter the material flow.

Summary

The panel unanimously agreed that length uniformity is a major challenge for cotton and that improving the UI will better enable cotton to compete with MMF and potentially open new markets for the cotton industry. The textile merchants and mill representatives also brought up numerous other fiber quality challenges for the cotton industry to consider.

A question and answer session was held with the audience after panel members presented their perspectives. Audience members questioned the economic return of improving the UI of cotton and whether or not contracts would reward producers for bales with improved UI. Panel members acknowledged that the current loan chart does not demonstrate that reward; however, the price paid for cotton on a contract is a function of the quality of the lint in the bale and the textile mill needs. The textile mill must purchase cotton which meets their needs and if cotton does not meet their quality needs, it will not be purchased. Audience members also asked about contamination in bales and the effect on the textile industry and price of cotton. Similarly, audience members asked about the role of leaf grade and that mills want high UI but also low leaf grade which is often in conflict. The panel members acknowledged that contamination is a rising concern and while equipment exists to remove plastic contaminants and foreign matter, not all mills have the equipment, due to cost, and that the equipment is not perfect.

References

EFS®-USCROP™ software from Cotton Incorporated. 2020. Cary, NC.

ITMF. 2016. International cotton industry statistics. Vol. 58.