Abstract

A two year, belt-wide commercial cotton gin sampling project was initiated in 2005 for the 2005-06 and 2006-07 ginning seasons to assess the changes in upland cotton quality throughout the ginning process and the ginning season. This report discusses preliminary analysis of the first year data. In order to compare fiber quality of seed-cotton samples ginned on a small-scale ten-saw laboratory gin with ginned lint samplers from a commercial gin, hand ginning/lab ginning relationships were developed and used to correct the fiber quality data for lab ginned seed-cotton samples back to near pre-ginning values. Trash content analyses showed that cleaning machines were on average reducing foreign matter content per lint basis from as high as 50% to about 4% from the module to the lint slide. Short fiber content (SFC) values after ginning were double those at the feeder and were increased at a lesser rate by the 1st lint cleaning. Nep counts were nearly tripled by the gin stand, then increased steadily as the lint passed through the first and second stage of lint cleaning, but the increases associated with the lint cleaners was much less than that at the gin stand. More in-depth data analyses will continue after the 2nd year data are complete. This future work will focus on within ginning process changes, changes as the ginning season progressed, and interactions among fiber properties (i.e. SFC and micronaire or neps and length) and effects of cleaning.

Introduction

There has been more concern recently about the short fiber content (SFC) and neppiness of US cotton. Also, there has been discussion to consider leaf grade 4 as a discount cotton in international cotton markets although it is the base grade for the U.S. loan chart (Laws, 2006). Foreign matter removal at the modern saw gin is accomplished with seed-cotton cleaning machines (i.e. inclined cleaners and stick machines) prior to ginning (Baker et al., 1994) and lint cleaners (i.e. air-type and saw-type lint cleaners) after lint cleaning (Mangialardi et al., 1994). Prior lint cleaning research has concentrated on saw-type cleaners with grid bars (Mangialardi and Anthony, 2003). It is well documented that this type of lint cleaning, while excellent at removing foreign material, reduces fiber length,
increases SFC and nep. More recent research has continued with saw-type lint cleaners and has concentrated on reducing fiber wastage. There is some debate as to whether this actually affects overall fiber quality in the bale. Based on discussion at a recent summit held at Cotton Incorporated to address lint cleaning issues, researchers from Cotton Incorporated, the USDA-ARS Ginning Labs, and Texas A&M University developed the “dream”:

To clean fiber and maintain fiber quality as well as or better than current technology, and reduce neps and short fiber content.

It was decided that to realize the “dream” some basic knowledge of lint cleaning needed to be confirmed and established with some of the better fiber quality measurement techniques used today. To that goal, a two year, commercial cotton gin sampling project was planned for the 2005-06 and 2006-07 ginning seasons. The Beltwide Gin Sampling Project was initiated to assess the changes in upland cotton quality during the ginning process and throughout the ginning season across the entire cotton belt.

**Procedure**

During the 2005-06 ginning season, three gins were targeted in each cotton growing region: Far-west, Southwest, Mid-south, and Southeast (Fig. 1). Seed-cotton samples were taken at the module and at the feeder apron of a selected gin stand at each gin. Lint samples were taken before lint cleaning behind the selected gin stand, and after each coinciding lint cleaner. The sampling intervals were early in the season around 1000 total bales ginned and then at 5000 bales per gin stand intervals throughout the season. The same gin stand/lint cleaner lines were sampled each time a gin was visited.

All samples were processed and analyzed at Cotton Incorporated. Seed cotton samples were ginned on a small-scale ten-saw, laboratory gin stand and a subset of samples was hand ginned in an attempt to account for fiber quality changes produced by the lab gin. The purpose of ginning the seed-cotton samples in this manner was to provide a method for adjusting the fiber quality values to pre-ginning levels. High Volume Instrument (HVI), Advance Fiber Information System (AFIS), and Micro Dust and Trash Analyzer III (MDTA3) analyses were performed on the lint samples obtained from the commercial gins and lint samples from the laboratory and hand ginned cotton samples. Results were analyzed to evaluate changes in fiber quality, especially trash content, SFC content and neps, at each step in the ginning process and as the ginning season progressed.

**Results**

Although complete HVI and AFIS analyses were conducted on the fiber sampled for this project, this paper details only preliminary analyses; focusing on MDTA3 trash and AFIS SFC and neps. Regression analyses of the fiber properties for hand ginned versus laboratory ginned cotton showed there were relationships that could likely be used to adjust the laboratory ginned data back to values closer to those prior to lab ginning (Fig. 2). Though the data
were somewhat scattered, \( R^2 \) values were above 0.50. An example of the impact of these adjustments on the data is shown in Figure 3. SFC after ginning on the laboratory gin averaged about 9\% for seed-cotton collected from the module and feeder apron. After adjusting with the hand ginned/lab ginned relationship in Figure 2, the average SFC was nearer to 4 or 5\%, closer to expected values before ginning.

![Figure 2](image)

Figure 2. Relationship between hand ginned fiber and fiber ginned on a ten-saw lab gin for (a) AFIS short fiber content (%) by weight, (b) AFIS nep count per gram. Solid line represents regression line and dashed line represents a one to one relationship.

![Figure 3](image)

Figure 3. Short fiber content adjustment effect: (a) laboratory ginned (before adjustment) and (b) hand ginned (after adjustment). The circle indicates the data that were adjusted.

Percentage trash content was calculated as the ratio of the weight of trash to the weight of cleaned lint in a cotton sample as determined by the MDTA3 process. Analysis of trash content at the various points in the gin showed that trash levels decreased as the material moved through the ginning process, which was expected (Fig. 4). Starting between 10\% and 50\% of the lint at the module (the highest value being stripper cotton from the Southwest) trash content steadily decreased to about 2.5\% after one lint cleaner and less than 2\% after the second lint cleaner. These results indicate that the seed cotton and lint machinery at the gins across the cotton belt are doing the job they were intended to do.
Figure 4. Average trash content (weight of trash to weight of cleaned lint determined from MDTA3 analysis) of cotton as it proceeds through gins in the four cotton growing regions.

Results from the AFIS SFC and nep count measurements are shown in Figure 5. There was very little increase in SFC or neps from the module to the feeder, which was expected since the fiber was still attached to the seed. Through the gin stand (0 LC), SFC about doubled and nep count nearly tripled. The increase in SFC due to lint cleaning was less than expected with an average increase of about 10% from the gin stand to one lint cleaner. Also, there was an unexpected trend for SFC to decrease after the second stage of lint cleaning. Typically, it is held that additional lint cleaning will reduce length and increase SFC (Mangialardi et al., 1994). This anomaly will have to be explored with further data analysis and the second year of sampling. Nep count continued to rise with lint cleaning, but at a lesser rate than the increase at the gin stand. Both SFC and neps increased much more at the gin stand than at the lint cleaners, as shown by the steeper slope of the lines from feeder to 0 LC than from 0 LC to 1 LC and 2 LC in Figure 5.

Figure 5. Percentage change from values at the module in average values for (a) AFIS short fiber content and (b) nep count per gram as cotton proceeds through gins in the four cotton growing regions.
Another interesting anomaly, not shown in Figure 5, was an apparent reduction in SFC from the gin stand to after an air-type cleaner for a particular gin included in the study (Figure 6). It was found that AFIS nep count also decreased and length by weight increased at the air-type cleaner. This gin was the only gin where samples were taken between the gin stand and the air-type cleaner, so this occurrence could not be substantiated or contradicted with data from the other gins. It is known that this type of lint cleaner is less effective at cleaning and improving grade than saw-type lint cleaners, but it is considered not to have an effect on fiber length and neps (Mangialardi et al., 1994). In the second year of sampling, greater effort will be made to obtain lint sample before the air-type lint cleaner to further investigate this anomaly.

![Figure 6](image_url)

Figure 6. Average AFIS short fiber content for lint samples collected behind the gin stand (0 LC), after an air-type cleaner (AJet), and after one stage of saw-type lint cleaning (1LC) for a particular gin participating in the study.

**Conclusions**

A two year, belt-wide commercial cotton gin sampling project was initiated in 2005 for the 2005-06 and 2006-07 ginning seasons to assess the changes in upland cotton quality during the ginning process and throughout the ginning season across the entire cotton belt. The first year of sampling and sample analysis was completed in 2006 and the second year sampling has begun.

Preliminary analysis showed that the ten-saw laboratory gin altered fiber properties enough that hand ginning/lab ginning relationships were needed to correct the fiber data for ginned cotton samples back to near pre-ginning values. The relationships developed for SFC and nep count fit the data with $R^2 > 0.50$.

Trash content analyses showed that cleaning machines were removing foreign matter fairly well. Average trash content, per lint basis, changed from as high as 50% to about 4% from the module to the lint slide. SFC doubled at the gin stand, increased at a lesser rate at the 1st lint cleaner, and unexpectedly decreased at the 2nd lint cleaner. Nep count nearly tripled at the gin stand, then increased steadily for one and two lint cleaners, but again at a decreased rate than at the gin stand.

Some unexpected findings, like a decrease in SFC and neps at the air-type cleaner and declining SFC at the 2nd lint cleaner, led to more directed sampling in the second year of the study. After the second year sample collection and fiber analyses are complete, more in-depth data analyses will continue focusing on within ginning process changes,
changes as the ginning season progressed, and interaction among fiber properties (i.e. SFC and micronaire or nep length) and effects of cleanings. Two other efforts have been proposed due to discussion of the preliminary results from this project. One will explore the effects of lint cleaning on the trash/dust particle size distribution in the ginned lint. The other will compare the effects of hand, laboratory, and commercial ginning on fiber quality.

Disclaimer

Mention of trade names or commercial products in this publication is solely for the purpose of providing specific information and does not imply recommendation or endorsement by the U.S. Department of Agriculture.

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References


