UPDATE ON THE IMPACT OF MODERN GIN STANDS ON FIBER QUALITY

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Abstract

The purpose of this study was to determine the fiber length reductions, short fiber content, fiber neps, and cottonseed damage associated with modern gin stands. This two year study focused on five different gin stands of differing makes and models. The ginning rates of two of the super-high capacity gin stands were approximately 30% below the manufacturers recommended rates, so the achievable rates were used for these gin stands. The average seed cotton moisture content prior to ginning was between 5.5% and 6.7%. Generally, gin stand D (high capacity) produced fewer neps than the super-high capacity gin stands. Fiber length was typically longer in the high capacity gin stands as compared to the super-high capacity stands. There was characteristically less short fiber content in the cotton ginned in the high capacity gin stands as compared to the super-high capacity gin stands. Gin stand D routinely produced fiber with less trash in the lint than the other gin stands. It appears that the cottonseed exited the seed roll much more quickly in gin stand D, which had a high residual linters content and low seed damage, as compared to gin stand E (super-high capacity), which had low residual linters and high seed damage. Further studies will be conducted to narrow these results to specific or specific combinations of saw-type gin stand characteristics.

Introduction

Short fiber content (SFC) and neps have been a topic of concern since the days of the conventional saw-type gin stand. Neps are small knots of tangled fibers, which are created during boll development, harvesting, ginning, and yarn manufacturing (Mangialardi, 1985). Neps may affect manufacturing, cause non-uniform dyeing, and affect the appearance of woven fabrics. The percentage of fibers less than ½" in length by weight (ASTM D1440) defines SFC. The SFC in cotton lint is inversely related to yarn strength and can directly affect the quality of a finished product (Anthony, 1985).

Several studies have focused on the formation of neps and SFC in conventional and high-capacity gin stands. Pre-1958 gin stands (conventional) have about 90 saws set on ¾ -inch centers and turned at 700 rpm. These stands have an optimum ginning rate of 1 ½ to 2 bales per hour (Griffin, 1977). High-capacity gin stands became readily available in the early 1960's. Some of these stands incorporated either larger diameter saws (16- or 18-inch diameter), redesigned roll boxes, reciprocating seed roll actions, or dual saw cylinders and achieved ginning rates of 3½ to 7 bales per hour (Wilmot and Watson, 1966).

High-capacity gin stands have been compared to conventional gin stands in terms of SFC and fiber breakage and showed no significant difference between treatments (Griffin, 1979). Griffin (1977) suggests that high-capacity gin stands do not create an abnormal quantity of SFC or fiber breakage when ginning at manufacturers recommended rates (the recommend rate in his study was 5.2 bales per hour). It was further concluded that ginning at higher than recommended rates for a given gin stand (7.2 bales per hour) caused a significant increase in SFC or fiber breakage.

Studies from the 1950's to the 1970's indicate that nepping increases with increasing seed roll density, and can be affected by saw spacing, number of teeth per saw, and saw tooth condition. More recently, Mangialardi (1985) evaluated nep formation at the gin and determined that gin stands were a major contributor to nepping during gin processing. In another study, ginning rates from 1.4 to 6.4 bales per hour did not significantly affect nep count for a gin stand rated at 4.8 bales per hour (Mangialardi, et al., 1987).

Seed damage studies have focused on pneumatic damage, saw diameter size, and ginning rate to determine means of reducing seed damage during the ginning process. Anthony (1985) reviewed several studies, which related increased seed damage to increased saw diameter and increased ginning rates. Seed damage consisting of slits and cracks parallel to the minor axis of the seed have been characterized as conveying damage, while slits and cuts parallel to the major axis of the seed have been defined as damage due to the gin stand. Reducing seed damage is important in terms of increasing germination, as well as improving fiber quality. Seed damage typically results in seed coat fragments, which can result in additional neps and higher trash content.

Modern gin stands, often referred to as super-high-capacity gin stands, can process seed cotton at rates of 8½ to 15 bales per hour. The higher rates have been achieved by smaller saw spacing ($^{7}/_{16}$- to $^{9}/_{16}$- inches), improved seed roll agitators and seed tubes, and electronic feed controls. The very high rates have been achieved by also increasing the overall width of the gin stands. Limited information is available on how these modern gin stands affect nep formation and SFC.

The objectives of this study were to determine the cottonseed damage, short fiber content, length reductions, and neps

Reprinted from the *Proceedings of the Beltwide Cotton Conference*
Volume 2:1602-1609 (2000)
National Cotton Council, Memphis TN

caused by gin stands at their manufacturers recommended ginning rates. Information obtained from this study would be used in making gin stand modifications that reduce the occurrence of neps, seed damage, short fiber content and fiber breakage, and serve as a basis for new gin stand designs.

Materials and Methods

This project was divided up into three sections in order to fulfill the objectives of the study. These sections include: 1) a preliminary evaluation of the differences in fiber properties due to the overall ginning characteristics of different gin stands; 2) an evaluation of the differences in fiber and cottonseed properties due to the overall ginning characteristics of different gin stands, using two cotton varieties; 3) a confirmation of the differences in fiber and cottonseed properties due to the overall ginning characteristics of different gin stands, using one cotton variety.

The commercial-size ginning plant at the U. S. Cotton Ginning Laboratory (USCGL) in Stoneville, Mississippi was used in this study. The recommended seed cotton cleaning sequence for Midsouth spindle-picked cotton was used in this study (Baker, et al., 1994). The standard sequence consists of a 24-shelf tower drier, 6-cylinder cleaner, stick machine, 24-shelf tower drier, 6-cylinder cleaner, and extractor feeder. Five different gin stands were used in this study. A comparative list of the details of each gin stand, as supplied by the manufacturer, is shown in Table 1. Since the objective of this study was to determine the impact of gin stands on fiber and seed quality, the optimum ginning rates for each gin stand were the manufacturers recommended ginning rates.

This first experiment consisted of 3 replications involving 1 cotton variety and 5 gin stands (treatments), for a total of 15 test lots. Each test lot consisted of 350 pounds of seed cotton, requiring approximately 4 bales for the experiment. The cotton variety used in the experiment was Delta and Pine Land (DPL) 5409. The seed cotton was grown and spindle-harvested by the Delta Research and Extension Center, Mississippi Agricultural and Forestry Experiment Station (MAFES), and the Agricultural Research Service, USDA, Stoneville, MS. Harvesting was done during the week of September 20-25, 1997, and ginning was performed on June 3, 1998.

Test lot numbers were assigned to the gin stand treatments in a randomized arrangement to limit the effects of processing order. To avert the effects of gin stand “cool down”, 300 pounds of seed-cotton were ginned prior to each test lot thus, requiring a total of 8 bales of cotton for the first section of this study. Further, sample collection was performed after the gin stands reached the desired capacity and before the capacity declined to reduce the ginning “starting and stopping effects”.

During ginning, approximately 10 pounds of seed-cotton and 3 fractionation samples were collected from the feeder apron and 3 lint moisture and 3 Advanced Fiber Information System (AFIS) samples were collected behind the gin stand. The 10-pound seed-cotton samples were processed in the following manner: the entire sample was spread out approximately 4 inches deep on a plastic sheet; a sub-sample was collected by randomly taking 20 to 25 small handfuls; the sub-sample was ginned on a “bench-model” gin stand equipped with 6-inch diameter saws; the lint was collected for AFIS measurements; and the process was repeated 10 times.
The “bench-model” gin stand separates the lint from the seed and blends the fiber. This ginning method was used instead of hand ginning to produce representative samples for AFIS measurements. The alternative method, hand ginning, would require mechanical blending for a similar representative sample. Both mechanical blending and saw ginning increase neps in the fiber and can alter other fiber properties. Further, the feeder apron samples were collected to determine if there were significant differences in neps and short fiber content of the seed-cotton between gin stands prior to ginning. Based on this information, using the bench-model gin stand was the most efficient means of processing the seed cotton from the feeder apron samples.

The second section of this study consisted of 3 replications involving 2 cotton varieties and 5 gin stands (treatments), for a total of 30 test lots. Each test lot consisted of 500 pounds of seed cotton, requiring approximately 10 bales for the experiment. The cotton varieties used in this experiment were Suregrow 125 and 501. The seed cotton was grown, spindle-harvested, and moduled by the KLB Farms Partners near Leland, Mississippi.

Test lot numbers were assigned to the gin stand treatments in a randomized arrangement and blocked by variety, due to the limitations associated with module handling after the tarps are removed and part of the module is ginned. To avert the effects of gin stand “cool down”, approximately 500 pounds of seed-cotton were ginned prior to each test lot therefore, increasing the total number of bales required for this section to 20. Further, sample collection was performed after the gin stands reached the desired capacity and before the capacity declined to reduce the ginning “starting and stopping effects”.

During ginning, 11 seed cotton samples and 3 seed cotton moisture samples were collected from the feeder apron, 11 lint samples and 3 lint moisture samples were collected behind the gin stand, and 6 cottonseed samples and 3 cottonseed moisture samples were collected from the seed belt. Five of the lint samples collected behind the gin stands were used to generate AFIS measurements. Five of the lint samples collected behind the gin stand were used for HVI measurements and once the samples were returned from the classing office, the samples were processed on the Shirley Analyzer for trash content. Seed coat fragment analysis was performed on the final lint sample collected behind the gin stand. One of the cottonseed samples was used for residual linter measurements and the other five cottonseed samples were used for seed and damage classification.

The seed cotton samples collected from the feeder apron were ginned on a "bench-model" gin stand equipped with 6-inch diameter saws. The lint collected from five of the samples was used for AFIS measurements, five of the lint samples were used for HVI and Shirley Analyzer trash measurements, and one of the lint samples was used for seed coat fragment measurements. The cottonseed collected from five of the samples was used for seed and damage classification, one of the cottonseed samples was used for residual linters measurements, and the remaining five samples were stored for additional tests if required.

The third section of this study consisted of 3 replications involving one cotton variety and 5 gin stands (treatments), for a total of 15 test lots. Each test lot consisted of 1,500 pounds of seed cotton, requiring approximately 15 bales for the experiment. The cotton variety used in this experiment was Stoneville 747. The seed cotton was grown, spindle-harvested, and moduled by the KLB Farms Partners in Leland, Mississippi.

Test lot numbers were assigned to the gin stand treatments in a randomized arrangement. To avert the effects of gin stand "cool down", approximately 500 pounds of seed-cotton were ginned prior to each test lot thus, increasing the total number of bales to 20 for this section. Sample collection was performed after the gin stands reached the desired capacity and before the capacity declined to reduce the ginning "starting and stopping effects".

During ginning, 19 seed cotton samples and 3 seed cotton moisture samples were collected from the feeder apron, 16 lint samples and 3 lint moisture samples were collected behind the gin stand, and 8 cottonseed samples and three cottonseed moisture samples were collected from the seed belt. Five of the lint samples collected behind the gin stands were used to generate AFIS measurements. Five of the lint samples collected behind the gin stand were used for HVI measurements and five of the samples were processed on the Shirley Analyzer for trash content. Seed coat fragment analysis was performed on the final lint sample collected behind the gin stand. Three of the cottonseed samples from the seed-belt were used for residual linter measurements and the other five cottonseed samples were used for seed and damage classification.

Sixteen of the seed cotton samples collected from the feeder apron were ginned on a "bench-model" gin stand equipped with 6-inch diameter saws and the other three samples were used for fractionation measurements. The lint collected from five of the samples was used for AFIS measurements, five of the lint samples were used for HVI, five of the lint samples were used for Shirley Analyzer trash measurements, and one of the lint samples was used for seed coat fragment measurements. The cottonseed collected from five of the samples was used for seed and damage classification, three of the cottonseed samples were used for residual linters measurements, and the remaining eight samples were stored for additional tests if required.

AFIS measurements for the first two sections of this study were performed by Cotton Incorporated, Raleigh, North Carolina. The HVI sample measurements for all sections of this study were completed by the USDA Cotton Classing office in Dumas, Arkansas. Mid Continent Laboratory in Memphis, Tennessee, performed the linters measurements on the cottonseed samples of all sections of this study. The Fiber Testing Laboratory at the Cotton Ginning Research Unit in Stoneville, Mississippi completed the following measurements for this study: AFIS on lint samples from the third section, fractionation, Shirley Analyzer trash measurements, seed coat fragment, seed classification, and seed damage classification.

Results

This study compared five gin stand of which, three of the gin stands were super-high capacity saw-type gin stands (A, C, and E) and two of the gin stands were high capacity saw-type gin stands (B and D). The optimum ginning rates were the manufacturers recommended ginning rates for each individual gin stand; however, due to cotton variety and moisture content interaction, some deviation from the optimum rates was expected. During the first section of this study, gin stands A, C, and E were unable to achieve the expected ginning rates. Estimated ginning rates for stands A, C, and E were 30-, 35-, and 40% below manufacturers recommended rates, respectively. The lower than specified rates were attributed to insufficient horsepower. Even though the ginning rates were lower than expected, sample measurements were completed to obtain preliminary cotton fiber information relating to gin stand characteristics.

Prior to the second section of this study, the horsepower issues with gin stands A, C, and E were addressed and corrected. All five gin stands were checked for dull and or damaged saws, shaft speeds, etc., so that the gin stands were as close to manufacturers specifications as possible. Next, approximately two bales of DP&L seed cotton from the 1997 crop year were processed on each gin stand to evaluate their respective ginning rates. Gin Stands B, C, and D processed the seed cotton slightly higher than the manufacturers recommended rate, while stand A and E were approximately 10% below the manufacturers recommended rates. The stand specifications were re-checked and the recommended rates were confirmed by the manufacturer. Based on this information the second section of this study was completed to determine the effects of additional cotton varieties on the gin stands ginning rates in addition to the effects of gin stand characteristic on cotton fiber and cottonseed properties.

During the second section of this study, gin stands B, C, and D produced ginning rates, which were higher than the manufacturers recommended ginning rates, as shown in Table 2. The ginning rates achieved for the two super-high capacity gin stands were 24- and 35% lower than the recommended ginning rates for gin stands A and E, respectively based on average rates across varieties. The average gin stand electronic feed control rate for gin stand A was 61 with a 110 percent load (feed rate can range from 0 to 100, while percent load ranges from 0 to as high as 115 before disengaging the breast section of the gin stand). Gin stand E had a gin stand electronic feed control rate of 68 with a seed density of 74 (both the feed rate and seed density can range from 0 to 100), based on the digital readout. When either of these gin stands was pushed beyond these limits, the electronic controls of the gin stands would disengage the breast section of the gin stand. Although both of these gin stands ginning rates deviated from the manufacturers recommended rates, the tests were still completed while maintaining the ginning rates that could be achieved.

For the third section of this study, the actual ginning rates achieved were 6.0, 5.3, 7.1, 4.7, and 6.8 bales per hour for gin stands A, B, C, D, and E, respectively. The rates for gin stands B, C, and D were slightly higher than the recommended rates, while gin stands A and E were 30- and 32% lower than the manufacturers recommended ginning rates.

Dryer temperatures for the first and second sections of this study were 180°F at the top of the first dryer, while no heat was used in the second tower dryer. In the third section of this study, a temperature of 150°F at the top of the first dryer was used, while no heat was used in the second tower dryer. The average seed-cotton moisture content prior to ginning in the first study was 6.6% and was not significantly different between replications of gin stand treatments. The average moisture prior to ginning in the second study was 6.7% and 6.5% for Suregrow 125 and Suregrow 501, respectively. After ginning in the second study, the lint moisture content averaged 3.9%. During the third section of this study, the average seed-cotton moisture content was 5.5% prior to ginning and lint moisture content was 3.7% after ginning. These moisture contents were determined by the oven-drying method.

Mean AFIS measurements from the first section, mean fiber and cottonseed measurements from the second section, and mean fiber measurements from the third section of this study are shown in Table 3, Table 4, and Table 5, respectively. A list of the nomenclatures used in Tables 3, 4, and 5 are shown in Appendix A. Table 4 shows the means across varieties, although there are several significant interactions between gin stands and cotton varieties. These interactions will be discussed in a future publication. In addition, the fiber and cottonseed measurements from the samples ginned on the bench model gin stand and their potential uses as covariants to describe part of the error will be discussed in the future publication. Further the measurements for cottonseed and fiber properties of the samples ginned on the bench model gin stand of the third section will be completed for this future publication.

Cotton Fiber AFIS Measurements

In the first section of this study, the nep size was significantly smaller in lint processed with gin stand D with respect to gin stands A and B, while in the second section gin stand D produced significantly smaller neps than the other four gin stands. No significant differences in nep size were detected at the 0.05 level for the third section of this study. There were significantly fewer neps per gram in the lint ginned on gin stand D as compared to gin stands A and B in the first section. In the second study, gin stand B produced lint with significantly fewer neps per gram than gin stand D, which produced lint with significantly fewer nep than gin stand C. Gin stand A produced significantly more neps per gram than the other gin stands in section three of this study. Based on this information, gin stand D typically produced the fewer and smaller neps than the super-high capacity gin stands.

Fiber length by weight was significantly longer for cotton ginned on gin stands B and D as compared to gin stand E in the first section and gin stand D as compared to stands A, C, and E in sections two and three of this study. Gin stand D produced the longest fiber in terms of length by number in all sections of this study. In the first section of this study, gin stands B and D had a significantly higher length by number than gin stand E; in section two, gin stand D had a significantly higher length by number than gin stands A and C; in section three, gin stand D had a significantly higher length by number than the other gin stands. There were no significant differences in upper quartile length between gin stands in sections one and three; while in section two, gin stands B and D produced significantly longer upper quartile length than gin stands A, C, or E. In sections one and three of this study, there were no significant differences in length by number exceeded by 5 or 2.5 percent of the fibers; however in section two, gin stands B and D produced significantly higher values for length exceeded by 5 percent of the fibers than stands A or C and gin stand D produced significantly higher values for length exceeded by 2.5 percent of the fibers than stands A, C, or E. Based on the overall length information, the high-capacity gin stands tend to produce lint with longer fiber lengths than the super-high capacity gin stands.

In the first section of this study, short fiber content by weight was significantly less for gin stand D as compared to stand E. Short fiber content by weight in the second section was significantly lower for gin stands B and D as compared to stand C and in the third section, short fiber content by weight was significantly lower for gin stand D as compared gin stand B, which was significantly lower than gin stands A or C. Short fiber content by number was significantly lower for gin stand D as compared to stands A or E in the first section, while short fiber content by number was significantly lower for gin stand D as compared to stand C in the second section and short fiber content by number was significantly lower for gin stand D as compared to the other gin stands in section three of this study. Based on this information, the high capacity gin stands typically produced less short fiber content by weight and number than the super-high capacity gin stands.

There were no significant differences in total trash of the ginned lint between gin stand treatments in the first section of this study; however, gin stands B and D appeared to produce lint with less total trash than gin stands A or C. In the second section, the lint associated with gin stands A and D had significantly less total trash than gin stands B or E, which produced lint with less trash than gin stand B. In the third section, gin stand D had significantly less total trash in the ginned lint than gin stands A or B. The size of the trash associated with gin stand B was significantly larger than the trash size associated with gin stands B, D, and E in the first section of this study. In section two, gin stand A generated significantly larger trash than the other four gin stands and there were no significant differences in trash size in the third section of this study. There were no significant differences for dust in the ginned lint from the first section of this study. In the second section of this study, there was significantly less dust in the ginned lint associated with gin stands A and D as compared to the other three gin stands and dust associated with the lint from gin stand B was very high. The dust levels in the ginned lint of gin stands B, C, D, and E were significantly lower than gin stand A in the third section. There were no significant differences in trash content of section one. Gin stands A and D produced lint with significantly less trash than gin stands B, C, or E in the second section of this study while in the third section, gin stands B, C, D, and E produced lint with significantly less trash than gin stand A. The visible foreign matter in the lint produce by gin stand D was significantly less than the lint produced from gin stands A or B in the first section of this study. In the second section, the visible foreign matter was significantly less in the fiber from gin stand D as compared to the other four gin stands and in section three, gin stands B, C, D, and E produced lint with significantly less visible foreign matter than gin stand A. Based on this information, it appears that the trash content of the fiber from gin stand D had less trash than the fiber from the other four gin stands in this study.

There were no significant differences in the seed coat nep size in the first or third sections of this study; however, in section one and three, gin stand B appeared to generate smaller seed coat neps than the other gin stands. In the second section of this study, gin stand B generated significantly smaller seed coat neps than gin stand C. Gin stand D in the first section of this study produced significantly fewer seed coat neps than the other four gin stands. In section two, gin stands A, C, and D generated significantly fewer seed coat neps than gin stands B or E and in the third section, gin stand C produced significantly fewer seed coat neps than gin stands A, B, or E. Based on this information, it appears that gin stand B produced the smallest seed coat neps and gin stand D produced the fewest seed coat neps.

Fineness was significantly lower for the fiber associated with gin stand E in the first study and significantly higher for the fiber associated with gin stand D in the third section. Immature fiber content was significantly lower for the fiber associated with gin stand A and C as compared to gin stand E in the first section and significantly lower for the fiber associated with gin stand D as compared to the other four gin stands in section three of this study. There were no significant differences in immature fiber content in section two of this study. No significant differences were detected in maturity ratio in the second section of this study; however in the third section, the maturity ratio for the fiber associated with gin stand A and B were significantly lower than the fiber associated with gin stand D. Fineness, immature fiber content, and maturity ratio are more dependant on the cotton than on the gin stand treatment used, therefore the significant differences in these measurements are not a function of gin stand treatment but a function of the cotton prior to ginning.

Cotton Fiber HVI Measurements

No HVI measurements were made for the cotton fiber in the first section of this study. No significant difference in micronaire measurements were detected in sections two and three of this study. All micronaire measurements for the cotton used in this study were in the base range according to the classing offices market value estimates. There were no significant differences in fiber strength in section two; however, in section three, gin stands B and E had significantly higher fiber strength measurements than gin stands C and D. In the second section of this study, the cotton fibers degree of strength, according to the classing office definition, was in the very strong range, while the cotton fiber from the third section was in the strong range.

Gin stands normally do not affect fiber strength, so the differences noted are most probably due to small natural variation in the cotton.

The HVI color measurement Rd was significantly higher for the fiber produced from gin stand D as compared to other gin stands in section two, while Rd in the third section was significantly higher for fiber produced from gin stand D as compared to gin stand A. In the second study, the plus b measurement associated with gin stand D was significantly lower than the measurements associated with gin stand A. Plus b in section 3 was significantly lower in gin stands C, D, and E as compared to gin stand B. Based on Rd, plus B, and the HVI color diagram for American Upland Cotton, the fiber color associated with gin stands C, D, and E was 31, and was 41 for gin stands A and B in the second section. In the third section, the fiber associated with gin stands A and B had a HVI color of 31 and gin stands C, D, and E had a HVI color of 21. Trash percent area in the second study was significantly lower for gin stands B and E and compared to gin stands A and C, while in the third section the percent area was significantly lower for gin stand D as compared to gin stand A.

The HVI length was significantly higher for gin stand D as compared to gin stands A or B, in the second section. In the third section, there were no significant differences in HVI length; however, gin stand B appeared to have the longest fiber length. There were no significant differences in HVI uniformity for section two. In section three, gin stands A, C, and E had a lower uniformity than gin stands B and D. The uniformity of sections two and three were high according to the classing offices definition.

Seed Coat Fragment Measurements

Seed coat fragment measurements were not performed for section one of this study and to date the seed coat fragment measurements for section three of this study have not been completed. Seed coat fragments by number were significantly lower for gin stand D as compared to gin stands A and B. Seed coat fragments by weight were significantly lower for gin stand D as compared to gin stand A. The fiber samples from gin stand A had significantly more motes by number than the other gin stands, while in terms of motes by weight gin stand B had significantly less motes as compared to gin stands A, C, or E. Funiculi by number measurements were significantly lower for gin stands B and D as compared to gin stands A and E. The funiculi by weight measurements were significantly lower for gin stands B and D as compared to gin stand E. There were no significant differences in seed by number and seed by weight measurements. Based on this information it appears that gin stand D produced the cleanest lint in terms of seed coat fragments, funiculi, and seed, whereas gin stand A produced lint with the most seed material.

Shirley Analyzer Trash Measurements

Shirley Analyzer measurements were not performed for section one of this study and to date, the Shirley Analyzer measurements have not been completed for section three. In section two, visible trash for lint ginned on gin stands D and E was significantly less than lint from gin stand A. The total trash measurement was significantly lower for gin stands B and D as compared to gin stand A. Based on this information it appears the gin stand D produced fiber with the least amount of trash while gin stand A produced fiber with the greatest amount of trash. Fractionation samples were collected from the gin stand feeder aprons and the measurements have not been completed at this time. Information from these samples will be compared to the Shirley Analyzer measurements and AFIS trash measurements to determine if the differences in trash content were due the gin stands or due to the extractor feeders.

Cottonseed Measurements

Cottonseed measurements were not performed for section one of this study and to date, the cottonseed measurements have not been completed for section three. Several cottonseed properties were documented in section two of this study, including: minor axis diameter, major axis diameter, seed weight, seed coat weight ratio, and embryo weight ratio. Approximately 2,400 seeds from each variety were measured to determine the average minor and major axis diameters and approximately 100 seeds from each variety were used to determine the seed composition. The average minor axis diameter for Suregrow 125 was 0.195-inches with a standard deviation of 0.019 and a maximum and minimum diameter of 0.299- and 0.103-inches, respectively. The average minor axis diameter for Suregrow 501 was 0.185-inches with a standard deviation of 0.015 and a maximum and minimum diameter of 0.3- and 0.12-inches, respectively. The average major axis diameter of Suregrow 125 was 0.345-inches with a standard deviation of 0.009 and a maximum and minimum diameter of 0.498- and 0.171-inches, respectively. The average major axis diameter of Suregrow 501 was 0.344-inches with a standard deviation of 0.005 and a maximum and minimum diameter of 0.499- and 0.165-inches, respectively. The average seed weight for Suregrow 125 was 2.132-grams with a standard deviation of 0.158, in which the seed coat accounted for 40% of the weight and the embryo accounted for 60% of the weight. The average seed weight for Suregrow 501 was 2.072-grams with a standard deviation of 0.106, in which the seed coat accounted for 42% of the weight and the embryo accounted for 58% of the weight.

Gin stand E produced cottonseed with significantly less residual linters than gin stands C or D. The percent seed damage was significantly less in gin stand D as compared to the other stands and gin stands B and E generated significantly more seed damage than stands A, C, or D. Seed damage was further classified as major, minor, and pinhole damage. Minor and pinhole damage will be discussed in a future publication when the measurements for section three are completed. Major damage is defined as a percent of the damaged seed, which are missing portions of the seed coat or the embryo is exposed due to relatively large cuts or cracks in the seed coat. Major seed damage was significantly lower in gin stand D as compared to gin stands A and B. Based on this information, it appears that the cottonseed exited the seed roll much more quickly in gin stand D, which had a high residual linters content and low seed damage, as compared to gin stand E, which had slightly lower residual linters and slightly higher seed damage.

Conclusions

The objectives of this study were to determine the cottonseed damage, short fiber content, length reductions, and neps caused by gin stands at their manufacturers recommended ginning rates. Ginning rates for gin stands B, C, and D were slightly higher than the manufacturers recommended ginning rates, while gin stands A and E, super-high capacity gin stands, were approximately 30% below the manufacturers recommended ginning rates. Possible reasons for the below expected ginning rates include: a) the interaction of gin stand characteristic and cotton variety, since the ginning rates were within 10% of the manufacturers recommended ginning rates in a test run with cotton variety DP&L 5409; b) software calibration issues with the electronic feed control. The study was completed with the ginning rates that could be achieved with the selected cotton varieties and a future study will focus on the effects of ginning rate.

The average seed cotton moisture content prior to ginning was between 5.5% and 6.7%, while the after ginning average lint moisture content was between 3.7% and 3.9%. Generally, the high capacity gin stand D produced fewer neps than the super-high capacity gin stands. Fiber length was typically longer in the high capacity gin stands as compared to the super-high capacity gin stands. There was characteristically less short fiber content in cotton ginned on the high capacity gin stands as compared to the super-high capacity gin stands. Gin stand D routinely produced fiber with less trash in the lint than the other four gin stands, according to AFIS measurements. Fineness, immature fiber content, and maturity ratio were more dependent on cotton variety than on the gin stand treatment used.

Generally, the HVI measurements appeared to be more dependant on cotton variety than on the gin stand treatment and this issue will be discussed along with the gin stand and cotton variety interactions in a future publication.

The average minor and major axis diameters for Suregrow 125 seed were 0.195- and 0.345-inches, respectively. The average minor and major axis diameter for Suregrow 501 seed were 0.185- and 0.344-inches, respectively. The average seed weight for Suregrow 125 and Suregrow 501 were 2.132- and 2.072-grams, respectively. The average seed coat weight percentage was 41% of the total seed weight. It appears that the cottonseed exited the seed roll much more quickly in gin stand D, which had a higher residual linters content and low seed damage, as compared to gin stand E, which had low residual linters and high seed damage.

In summary, the fiber properties associated with the high capacity gin stands were slightly superior to the fiber properties associated with the super-high capacity gin stands; in terms of short fiber content, fiber breakage, and neps. The fiber and cottonseed quality of cotton processed with gin stands with wider saw spacings (B and D) tend to be better than the cotton processed in the other gin stands of this study.

Acknowledgements

The author wishes to express thanks to the KLB Farms Partners, Leland, Mississippi, USDA-ARS Application and Production Technology Unit, and the Mississippi Agricultural and Forestry Extension Service for supplying the cotton used in the project, Burdette Gin Company for providing the module transportation, and Cotton Incorporated for providing AFIS measurements.

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Table 1. Gin stand details as specified by the manufacturer (Columbus et al., 1994).

	Gin Stand				
Gin stand details	A[1]	B[2]	C[1]	D[2]	E[1]
Saw spacing (in.)	0.5	0.75	0.625	0.75	0.5
Saw diameter (in.)	12	16	16	11.75, 12	12
Number of saws	112	93	93	178	116
Number of saw cylinders	1	1	1	2	1
Recommended rate (bales/hour)	8.5	5	7.5	4-4.5	10
Agitator	Yes	No	Seed tube	No	Yes
Motor horsepower, hp	75	50	75	50	100

[1]Super-high capacity saw-type gin stand.
[2]High capacity saw-type gin stand.

Table 2. Manufacturers recommended ginning rates and actual ginning rates achieved for Suregrow 125 and Suregrow 501 cotton varieties, second section of the gin stand comparison study.

	Recommended	Actual Ginning Rates (Bales/Hour)		
Gin Stand	Ginning Rate (Bales/Hour)	Suregrow 125	Suregrow 501	Mean
A[1]	8.5	7.3	5.7	6.5
B[2]	5.0	6.3	5.5	5.9
C[1]	7.5	8.3	6.8	7.5
D[2]	4.0 to 4.5	5.0	4.6	4.8
E[1]	10.0	7.3	5.8	6.5

[1]Super-high capacity saw-type gin stand.
[2]High capacity saw-type gin stand.

Table 3. Mean AFIS measurements for the first section of the gin stand comparison study. All means represent samples taken directly behind the gin stand.

	Gin Stand*				
Measurement[1]	A[2]	B[3]	C[2]	D[3]	E[2]
Nep Size [µm]	763b	762b	759ab	**746a**	759ab
Neps per gram	179b	170ab	162ab	**153a**	171ab
L(w) [in]	1.02ab	**1.03a**	1.02ab	**1.03a**	1.01b
UQL(w) [in]	**1.24a**	**1.24a**	**1.24a**	**1.24a**	1.23a
SFC(w) [%]	7.61ab	7.27ab	7.57ab	**6.77a**	8.03b
L(n) [in]	0.85ab	0.86a	0.85ab	**0.87a**	0.84b
SFC(n) [%]	21.0b	20.4ab	20.8ab	**19.1a**	21.9b
L5%(n) [in]	1.39a	**1.40a**	**1.40a**	**1.40a**	1.39a
L2.5%(n) [in]	1.48a	**1.50a**	1.49a	1.49a	1.48a
Total Trash [Count/gram]	478a	406a	467a	**401a**	418a
Trash Size [µm]	354b	**390a**	365b	356b	361b
Dust[count/gram]	389a	**320a**	375a	325a	337a
Trash [count/gram]	89.8a	86.1a	91.4a	**75.8a**	80.8a
VFM [%]	1.84b	1.89b	1.76ab	**1.44a**	1.66ab
SCN size [µm]	998a	**968a**	1003a	1031a	1030a
SCN per gram	17.8b	22.9c	16.2b	**9.56a**	15.8b
Fine [mTex]	176b	177b	177b	177b	**173a**
IFC [%]	**5.01a**	5.23ab	5.13a	5.36ab	5.59b
Mat Ratio	**0.95a**	0.94a	**0.95a**	0.94a	0.93b

*Numbers not followed by the same lower case letter in each row are significantly different at the 0.05 level. Bold numbers in each row are more desirable
[1]Description of the measurements are shown in Appendix A
[2]Super-high capacity saw-type gin stand.
[3]High capacity saw-type gin stand.

Table 4. Mean cotton fiber and cottonseed measurements for Suregrow 125 and Suregrow 501 cotton varieties in the second section of the gin stand comparison study.

	Gin Stand*				
Measurement[1]	A[2]	B[3]	C[2]	D[3]	E[2]
Nep Size [µm]	753b	765c	752b	**744a**	763c
Neps per gram	278bc	**209a**	283c	246b	264bc
L(w) [in]	0.998dc	1.020ab	0.981d	**1.027a**	1.000bc
UQL(w) [in]	1.195bc	**1.213a**	1.185c	**1.213a**	1.199b
SFC(w) [%]	6.8ab	6.3a	7.7b	**5.6a**	6.8ab
L(n) [in]	0.850bc	0.872ab	0.826c	**0.886a**	0.853abc
SFC(n) [%]	18.4ab	17.6ab	20.7b	**16.0a**	18.5ab
L5%(n) [in]	1.357bc	1.374a	1.345c	**1.376a**	1.362ab
L2.5%(n) [in]	1.449c	1.468ab	1.435d	**1.469a**	1.455bc
Total Trash [count/gram]	169a	540c	224b	**164a**	235b
Trash Size [µm]	**436a**	379d	425ab	399cd	406bc
Dust [count/gram]	130a	435c	174b	**128a**	185b
Trash [count/gram]	39a	106c	50b	**36a**	50b
VFM [%]	1.0b	2.6d	1.3c	**0.8a**	1.2bc
SCN Size [µm]	1017ab	**1003a**	1048b	1014ab	1019ab
SCN per gram	20.2a	24.5b	16.6a	**13.1a**	25.4b
Fine [mTex]	**172ab**	173ab	173ab	**172a**	173b
IFC [%]	5.9a	**5.6a**	5.8a	5.7a	5.7a
Mat Ratio	0.929a	**0.940a**	0.926a	**0.940a**	0.937a
Micronaire	4.6a	4.6a	**4.5a**	**4.5a**	**4.5a**
Strength	31.4a	31.3a	31.5a	**31.8a**	31.4a
Rd	73.8a	73.8a	74.1a	74.9b	74.0a
Plusb	9.0b	8.9ab	8.9ab	8.8a	9.0ab
Area	4.5bc	3.9a	4.6c	4.0ab	**3.8a**
Length	113.5b	113.7b	114.0ab	**114.6a**	114.3ab
Uniform	83.7a	**83.8a**	**83.8a**	83.6a	**83.8a**
Seed coat fragment (n)	135b	125b	90ab	**72a**	117ab
Seed coat fragment (w) [mg]	92b	73ab	63ab	**39a**	74ab
Mote(n)	19a	**9b**	12b	13b	11b
Mote(w) [mg]	118d	**33a**	54ab	92cd	71bc
Funiculi(n)	40b	31a	33ab	**26a**	40b
Funiculi(w) [mg]	10ab	7a	9ab	**6a**	11b
Seed(n)	**0a**	**0a**	**0a**	**0a**	**0a**
Seed(w) [mg]	29a	16a	**0a**	**0a**	**0a**
Visible Trash [%]	4.19b	3.54ab	3.63ab	**3.35a**	3.52a
Total Trash [%]	5.9b	5.0a	5.3ab	**4.9a**	5.2ab
Seed damaged [%]	5.4b	8.0c	5.6b	**3.1a**	8.3c
Major seed damage [%]	68.3b	71.3b	61.7ab	**43.2a**	53.7ab
Linters	12.4ab	12.3ab	12.8b	13.7c	**11.9a**

*Numbers not followed by the same lower case letter in each row are significantly different at the 0.05 level. Bold numbers in each row are more desirable.

[1]Descriptions of measurements are shown in Appendix A.

[2]Super-high capacity saw-type gin stand.

[3]High capacity saw-type gin stand.

Table 5. Mean cotton fiber measurements for Stoneville 747 cotton variety in the third section of the gin stand comparison study.

	Gin Stand*				
Measurement[1]	A[2]	B[3]	C[2]	D[3]	E[2]
Nep Size [µm]	719a	727a	715a	**711a**	717a
Neps per gram	174b	159a	156a	**150a**	158a
L(w) [in]	0.985d	1.00ab	0.991cd	**1.011a**	0.997bc
UQL(w) [in]	1.191a	**1.201a**	1.191a	1.199a	1.197a
SFC(w) [%]	8.1d	7.1b	7.7cd	**6.3a**	7.5bc
L(n) [in]	0.801d	0.830b	0.812cd	**0.846a**	0.817c
SFC(n) [%]	24.5c	22.1b	23.5c	**20.0a**	23.0bc
L5%(n) [in]	1.331a	**1.341a**	1.328a	1.338a	1.340a
L2.5%(n) [in]	1.407a	**1.418a**	1.403a	1.415a	1.415
Total Trash [count/gram]	499c	391b	384ab	**304a**	367ab
Trash Size [µm]	311a	309a	305a	**318a**	303a
Dust [count/gram]	427b	337a	333a	**257a**	318a
Trash [count/gram]	73b	55a	51a	**47a**	48a
VFM [%]	1.5b	1.1a	1.1a	**1.0a**	1.1a
SCN Size [µm]	1102a	**1060a**	1143a	1151a	1122a
SCN per gram	22.7c	23.2c	**14.3a**	15.9ab	18.2b
Fine [mTex]	**180a**	181a	182a	185b	182a
IFC [%]	5.6b	5.4b	5.3b	**4.8a**	5.3b
Mat Ratio	0.903b	0.904b	0.908ab	**0.921a**	0.908ab
Micronaire	**4.7a**	**4.7a**	**4.7a**	**4.7a**	**4.7a**
Strength	29.5ab	**29.7a**	29.2b	29.2b	**29.7a**
Rd	76.9a	77.2ab	77.9ab	78.5b	78.0ab
Plusb	9.1ab	9.2b	9.0a	9.0a	9.0a
Area	3.1b	2.4ab	2.7ab	**2.3a**	2.6ab
Length	114.3a	**114.9a**	114.0a	114.2a	114.1a
Uniformity	84.3b	84.5a	83.3b	**84.8a**	84.4b

*Numbers not followed by the same lower case letter in each row are significantly different at the 0.05 level. Bold numbers in each row are more desirable.

[1]Description of measurement are shown in Appendix A.

[2]Super-high capacity gin stand.

[3]High capacity gin stand.

Appendix A. Definitions of measurements used in the gin stand comparison study.

Measurements	Definition
Nep size [µm]	The mean size of all neps (both fiber and seed coat neps) in the sample.
Neps per gram	The total nep count normalized per gram. This includes both fiber and seed coat neps.
L(w) [in]	The average length of all the fibers in the sample computed on a weight basis.
L(w) CV [%]	The percentage of the coefficient of variation of the length by weight.
UQL(w) [in]	Upper Quartile Length by weight. This is the length which is exceeded by 25% of the fibers by weight.
SFC(w) [%]	The short fiber content (< 0.5-inches) of the sample (calculated by weight).
L(n) [in]	The average length of all the fibers in the sample computed on a number basis.
L(n) CV [%]	The percentage of the coefficient of variation of the length by number.
SFC(n) [%]	The short fiber content (< 0.5-inches) of the sample (actual fibers counted by number).
L5%(n) [in]	Percent 1 - The length, calculated by number, that is exceeded by five percent of the fibers.
L2.5%(n) [in]	Percent 2 - The length, calculated by number, that is exceeded by 2.5 percent of the fibers.
Total trash [count/gram]	Total trash consists of Trash and Dust; this is the total of the trash and dust count per gram of the sample.
Trash Size [µm]	The mean size of all the trash in the sample.
Dust [count/gram]	The particles measured by the Trash Module that are below the size defined as Dust on the Trash Report Type setup screen.
Trash [count/gram]	All foreign matter in cotton that is above the size defined as Dust is considered trash. This is the amount of trash per gram of the sample.
VFM [%]	The percentage of Visible Foreign Matter (dust and trash) in the sample.
SCN size [µm]	The mean size of all seed coat neps in the sample.
SCN per gram	The seed coat nep count normalized per gram.
Fine [mTex]	Fineness - Mean fiber fineness (weight per unit length) in millitex. One thousand meters of fibers with a mass of 1 milligram equals 1 millitex.
IFC [%]	Immature Fiber Content is the percentage of fibers with less than 0.25 maturity. The lower the IFC%, the more suitable the fiber is for dyeing.
Mat Ratio	Maturity Ratio - The ratio of fibers with a 0.5 (or more) circularity ratio divided by the amount of fibers with a 0.25 (or less) circularity. The higher the maturity ratio, the more mature the fibers are and the better the fibers are for dyeing.
Micronaire	Micronaire is a measure of fiber fineness and maturity.
Strength	Strength measurements are reported in terms of grams per tex. A tex unit is equal to the weight in grams of 1,000 meters of fiber.
Rd and PlusB	The color of cotton is determined by the degree of reflectance (Rd) and yellowness (+b). Reflectance indicates how bright or dull a sample is, and yellowness indicates the degree of color pigmentation.
Area	Trash is a measure of the amount of non-lint materials in the cotton, such as leaf and bark from the cotton plant. The surface of the cotton sample is scanned by a video camera and the percentage of the surface area occupied by trash particles is calculated.
Length	Fiber length is the average length of the longer one-half of the fibers (upper half mean length). It is reported in 32nds of an inch.
Uniformity	Length uniformity is the ratio between the mean length and the upper half mean length of the fibers and is expressed as a percentage.
Linters	Measurement of the percent of lint, by weight, after ginning.
Seed Coat Fragment (n)	The number of seed coat fragments in a 5 gram sample of lint.
Seed Coat Fragment (w)	The weight of seed coat fragments in a 5 gram sample of lint.
Mote (n)	The number of motes in a 5 gram sample of lint.
Mote (w)	The weight of motes in a 5 gram sample of lint.
Funiculi (n)	The number of funiculi in a 5 gram sample of lint.
Funiculi (w)	The weight of funiculi in a 5 gram sample of lint.
Seed (n)	The number of cottonseed in a 5 gram sample of lint.
Seed (w)	The weight of cottonseed in a 5 gram sample of lint.
Visible Trash	Percent of visible trash by weight from the Shirley Analyzer.
Total Trash	Percent of non-lint by weight from the Shirley Analyzer.