COMPARISON OF THE UGA MICRO GIN, A LABORATORY GIN, AND A COMMERCIAL GIN IN GEORGIA

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Abstract

The University of Georgia Micro Gin located on the Tifton Campus provides an opportunity for researchers to gin research size cotton samples. Since its completion in 2004, UGA researchers at the Tifton campus as well as other researchers across the cotton belt have used the UGA Micro Gin as a tool for various research projects. However, some questions regarding the performance and the proper ginning protocol of the UGA Micro Gin still remain. The overall goal of this study is to compare the UGA Micro Gin with a commercial gin located in southwest Georgia based on fiber quality and turn out rate. The laboratory gin was used as a standard to compare them. In total, five different cotton varieties grown in southwest Georgia with five replicates were tested.

Introduction

Cotton researchers generally use small research plot trials to evaluate the fiber quality from certain varieties, various treatments, as well as other growing methods (Brown et al., 2004). These small research plots cannot generate enough cotton for a commercial gin to separate the lint from seeds, which is a necessary step for fiber lint quality evaluation (Boykin et al., 2008). Researchers have been using the laboratory gin to gin the small amount of cotton samples for many years. However, the hand gin also has several drawbacks for fiber quality evaluation: first, it usually has a totally different design from the commercial gin: it does not have seed cotton cleaning and lint cleaning steps, which are standard procedures in any commercial gin. This different design typically contributes to the overestimation of the cotton fiber quality such as staple, strength, and uniformity; second, the lab gin can only gin a small amount of cotton from the plot, not the complete research plot. This leads to the large variation due to different methods used to draw cotton samples from the research plot. For instance, fiber quality of cotton samples drawn from the end of a row might be quite different from that of cotton samples drawn from the middle of the row.

The Micro Gin at The University of Georgia Tifton Campus provides an opportunity for researchers to gin research size cotton samples and enable the ginning of cotton samples from a whole research plot. By using the Micro Gin, researchers can gin small size (e.g. 30 lbs) cotton samples and evaluate new cotton varieties or treatments in a quick manner. Since its completion in 2004, UGA researchers at the Tifton campus as

well as other institutions across the cotton belt have used it to do numerous research projects. However, several questions still remain unanswered, such as how well the UGA Micro Gin performs compared to a commercial gin? Can the UGA Micro Gin be used as a substitute of a commercial gin to accurately predict the cotton fiber quality and lint yield? Although one previous study was made to fill this knowledge gap (Brown et al., 2004), due to lack of replicates, this study could not compare different ginning methods statistically. This study is a continuation of the previous study in order to answer the fundamental question raised above.

Objectives

The overall goal of this study was to compare the UGA Micro Gin and a commercial gin based on the fiber quality and turnout rate over several cotton varieties. The laboratory gin was used as a standard to compare them. Specific objectives were:

- To compare the UGA Micro Gin, commercial gin, and laboratory gin regarding their ginning turnout rate;
- To compare the UGA Micro Gin, commercial gin and laboratory gin in terms of the cotton fiber quality based on the HVI data.

Materials and Methods

Cotton was grown in Colquitt County in Georgia and harvested in October, 2008. Five cotton varieties, ST 4554, PHY 375, PHY 480, ST 5327, and DPL 555, were used for the ginning turnout portion of the study. Three cotton varieties, PHY 480, DPL 555, and FM 1735, were used for fiber quality comparison. Five replicates were used for each cotton variety. In order to compare the performance of the three gins, cotton samples were collected in the field from the picker as the cotton was unloaded into the module builder and the same cotton samples from the same field were ginned across all three gins.

Three gins were compared in this study: the UGA Micro Gin (Lummus Inc., Savannah, GA and Cherokee Inc., Salem, Alabama), a commercial gin (due to the mutual agreement, the name of the commercial gin was not released), and a laboratory gin (Continental Eagle 10 saw laboratory gin). The UGA Micro Gin uses the same equipment used in commercial gin but in one foot wide versions. The equipment is arranged in the standard configuration for spindle picked cotton. Unlike the laboratory gin, the UGA Micro Gin provides full drying as well as seed cotton and lint cleaning. Seed cotton cleaning is accomplished in two stages. Stage one includes a six cylinder incline cleaner dropping into a stick machine. Cleaning in stage two is accomplished with the use of another six cylinder incline cleaner feeding into a Trashmaster cleaner. If the research calls for it, either of the seed cotton cleaning stages may be bypassed. Once the seed cotton leaves the first two stages of cleaning it enters the extractor feeder and gin stand. The gin stand is a 24 saw version of a Lummus gin stand. Once the lint is removed from the seed in the gin stand the lint cleaning portion of the process

begins. The first stage of lint cleaning is done with an air jet type cleaner. The second stage consists of two saw type lint cleaners manufactured by Cherokee Fabrication. Just like the seed cotton cleaning process, there is an option to use one, two, or even no lint cleaners depending on how the researcher wants the cotton processed.

All samples ginned at the UGA Micro Gin are processed using a set standard operating procedure. This standard operating procedure consists of conditioning, weighing, ginning, and fiber sample collection. The conditioning portion of the process begins by lining the bags up inside the gin and allowing them to sit for at least a 24 hour period. This gives time for each bag to come to equilibrium as far as moisture is concerned. Once the bags have conditioned, the incoming weights are taken just before ginning begins. The ginning procedure is set forth by the researcher. The final step of the process is to collect fiber samples. Once the lint has been cleaned it is collected in bags, this allows the lint to be weighted to determine lint turn out. As the lint is entering the bag three fiber samples are taken at the beginning, middle, and end of the run. These three sub samples are then combined to make one fiber sample for each replication of the study being ginned. The fiber samples are then sent to the USDA Classing Office for testing.

For both the ginning turnout and fiber quality comparison study, cotton samples were roughly 30 lbs for the UGA Micro Gin, and 1 lb for the laboratory gin. Cotton samples were put into mesh bags (for Micro Gin) and paper bags (for laboratory gin), and laid out in the UGA Micro Gin facility for at least 24 hours to condition them before ginning.

The turnout rate for the UGA Micro Gin and the laboratory gin was calculated by dividing the lint weight by the total seed cotton weight from each cotton sample. As a result, five turnout rates were obtained from five replications of each variety. However, for the commercial gin, the turnout rate was calculated by dividing the lint weight of a module (the smallest ginning unit) by the total weight of the seed cotton in that module. Therefore, only one turnout rate was obtained from each variety for the commercial gin. No statistics were calculated for the commercial gin turnout rate for a certain variety.

Fiber quality was evaluated by HVI (Uster Technologies, Knoxville, TN) at the USDA Cotton Classing Office in Macon, GA. Five fiber quality parameters were selected for the purpose of comparison: staple length, micronaire, strength, leaf grade, and uniformity.

The t-test statistical analysis was performed using Data Analysis Module of Excel 2007 (Microsoft Inc., Redmond, WA). For gin turnout comparison, since there was only one module for each variety from the commercial gin, no statistical analysis was made for the turnout rate of the commercial gin. For fiber quality comparison, t-test was performed to test the “equal means” of cotton fiber quality parameters between the UGA Micro Gin vs. commercial gin, and the UGA Micro Gin vs. laboratory gin, respectively.

The null hypothesis was that the mean values of a certain fiber quality parameter from two treatments were equal. All tests were conducted under the significant level of 95%.

Results and Discussion

As shown in Figure 1, ginning turnout rate of the laboratory gin was consistently higher than that of the other two gins across 5 varieties. This is reasonable because the lab gin does not have seed cotton cleaning and lint cleaning procedures, so more trash ends up going into the final lint product, which contributes to the higher turnout rate. The error bars in the figure show the standard deviation of each measurement. It was observed that variances of the turnout rate were relatively small for most of the varieties except for PHY 375 and PHY 480 for lab gin treatment. The turnout rate of the UGA Micro Gin was slightly higher than that of the commercial gin for 3 varieties (ST 4554, PHY 375, PHY 480), but lower than that of the commercial gin for the other 2 varieties (ST 5327, DPL 555). The performance of the UGA Micro Gin is much closer to the commercial gin regarding the turnout rate. For three out of the five varieties, the UGA Micro Gin had slightly higher turnout rates, while the commercial gin had slightly higher turnout rates than the UGA Micro Gin for the remaining two varieties. The UGA Micro Gin had higher variation for two varieties: ST 4554 and PHY 375, while the variation for the other three varieties were relatively small.

As indicated in Figure 2 and Table 1, no significant differences were observed between the UGA Micro Gin and laboratory gin regarding four quality parameters: staple, micronaire, strength, and uniformity across all three tested cotton varieties. However, leaf grade from the lab gin was much worse than that of the UGA Micro Gin, because no seed cotton cleaning or lint cleaning was performed during ginning of lab gin. This indicates that the UGA Micro Gin performs very closely to the lab gin in terms of the damage to the cotton fiber.

The significant differences were observed between the UGA Micro Gin and the commercial gin regarding staple, strength, and uniformity. Lint fiber quality (staple, strength, and uniformity) from UGA Micro Gin was consistently better than that from the commercial gin (this suggests that the UGA Micro Gin is less aggressive than commercial gin with regard to fiber damage). However, for micronaire, no significant difference was observed among the three gins, which suggests that micronaire is not a quality parameter that can be affected by the ginning process. For leaf grade, the UGA Micro Gin and the commercial gin are significantly different (3 vs. 4) in two varieties (DPL 555 and FM 1735), but not significantly different (4 vs. 4) for variety PHY 480.

Conclusion

The UGA Micro Gin was compared with a commercial gin and a laboratory gin in terms of ginning turnout rate and the fiber quality of the ginned lint. Based on results obtained above, the turnout rate of the UGA Micro Gin is much closer to the commercial gin than

the lab gin. In five tested varieties, the turnout rate of the UGA Micro Gin was higher than that of the commercial gin in three varieties, but lower in two varieties. As for the damage to the cotton fiber, the UGA Micro Gin is less aggressive than the commercial gin with regard to staple, strength, and uniformity. No significant difference was observed for micronaire in all three tested varieties. The UGA Micro Gin gave a better leaf grade (lower leaf grade value) than the commercial gin did for two varieties, but the difference was not significant in one variety.

Although this study showed differences between a commercial gin and the UGA Micro Gin, the differences between these two gins were narrower than those between a lab gin and commercial gin. This study only chose one commercial gin as a comparison, which did not provide a good representation. More than one commercial gins should be selected for comparison and better control of sampling methods will be taken in the future study.

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Literature Cited

Boykin, J. C., D. P. Whitelock, M. D. Buser, C. B. Armijo, G. A. Holt, T. D. Valco, D. S. Findley, E. M. Barnes and M. D. Watson (2008). Comparison of five small-scale laboratory gins to seven commercial gins sampled across the cotton belt. 2008 Beltwide Cotton Conferences. Nashville, Tennessee.

Brown, S. M., S. Jones and S. Ragan (2004). Large block variety trials at southwest Georgia research and education center. Cotton Research-Extension Report 2004. P. H. Jost, P. M. Roberts and R. C. Kemerait, The University of Georgia College of Agricultural & Environmental Sciences Cooperative Extension Service.

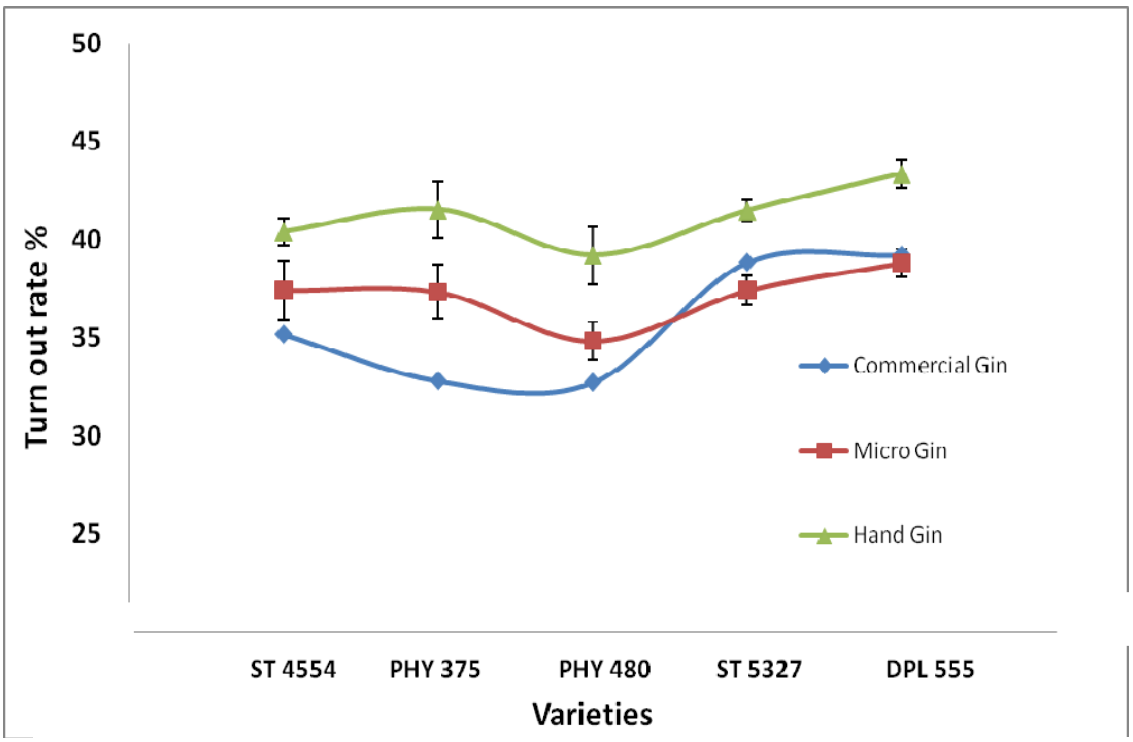

Figure 1. Turn out rate comparison of three gins.

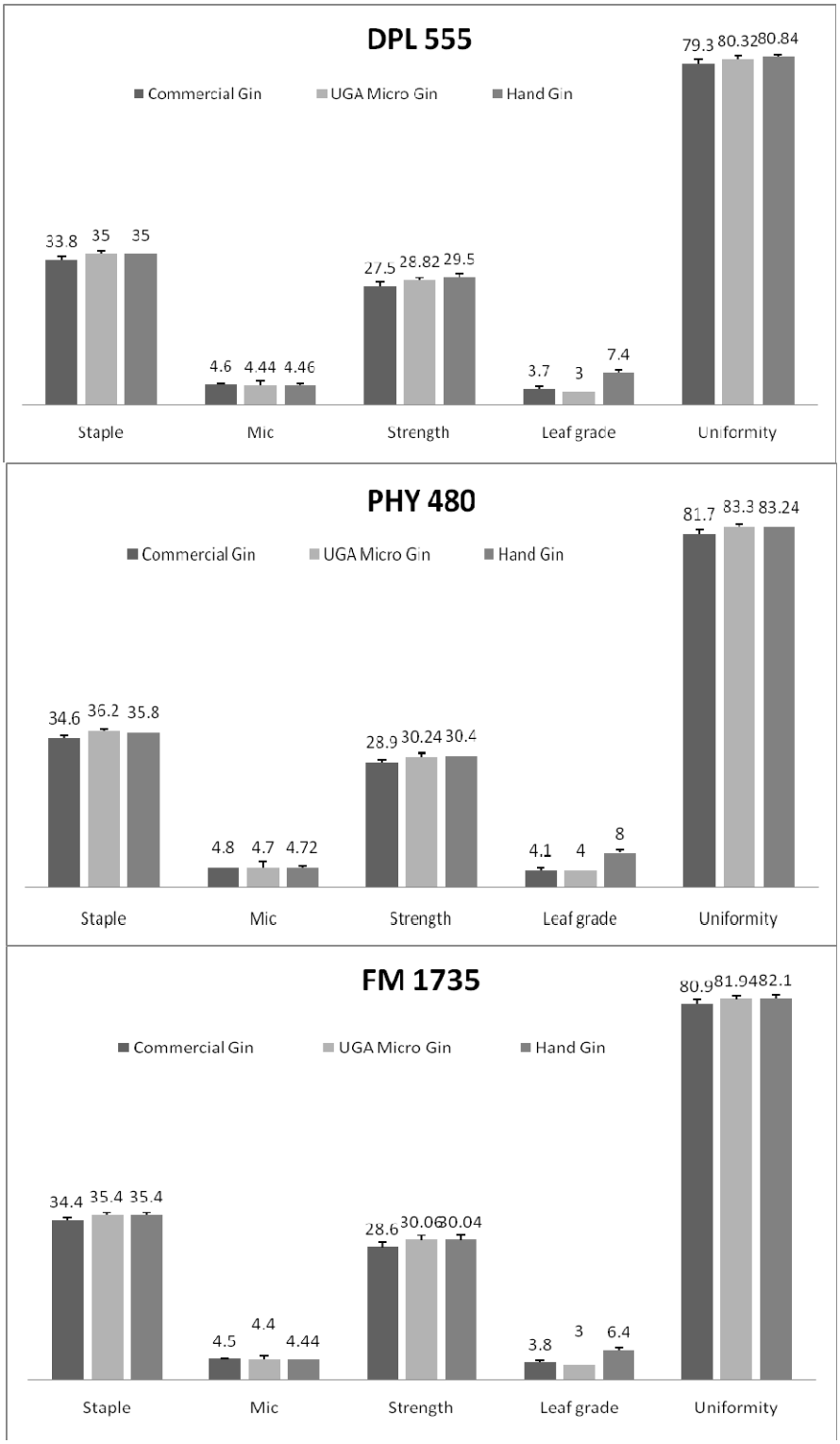

Figure 2. Comparison of three gins on five cotton fiber quality parameters across 3 cotton varieties.

Table 1. Performance comparison of three gins on the cotton fiber quality using the t-test (significant level 95%).

		Staple	Micronaire	Strength	Leaf grade	Uniformity
DPL 555	M vs. C	P=0.006	n.s.	P=0.003	P=0.0001	P=0.0135
	M vs. H	n.s.	n.s.	n.s.	P<0.0001	n.s.
PHY 480	M vs. C	P<0.0001	n.s.	P=0.01	n.s.	P=0.0016
	M vs. H	n.s.	n.s.	n.s.	P<0.0001	n.s.
FM 1735	M vs. C	P=0.005	n.s.	P=0.0129	P<0.0001	P=0.0038
	M vs. H	n.s.	n.s.	n.s.	P<0.0001	n.s.

M: UGA Micro Gin; C: Commercial Gin; H: laboratory gin;
n.s.: no significant difference