The *Journal of Cotton Science 12:16–32 (2008)*
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ENGINEERING AND GINNING

Small Sample Techniques to Evaluate Cotton Variety Trials

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ABSTRACT

Selection of cotton cultivars for production or in breeding programs are often based on data from small samples of cotton collected from small research trials, so it is important to understand how these results compare with conventional processing. The objective of this manuscript was to determine if differences in gin turnout and High Volume Instrument (HVI) fiber properties after conventional processing were predictable with two small sample techniques. Three research trials, each including 65 cultivars, were evaluated with two small sampling techniques (hand-picked boll samples and machine-picked grab samples) and with the microgin, which represented conventional processing. Boll samples overestimated gin turnout and underestimated leaf. Grab samples overestimated gin turnout, micronaire, and leaf and underestimated reflectance. Boll and grab samples predicted cultivar differences in strength, micronaire, yellowness, gin turnout, and length. Grab samples predicted cultivar differences in reflectance and leaf, but boll samples did not predict these differences. Neither grab samples nor boll samples correlated well with uniformity from the microgin. For most properties, cultivar *F*-values were higher for the microgin data, so small differences in cultivars may only be revealed after conventional processing. These small sample methods should continue to be a practical tool to predict cultivar differences in gin turnout and most fiber properties.

Small sample techniques used to evaluate cotton cultivars for gin turnout and fiber quality can be used to predict actual values expected in full scale operation. Bolls harvested manually from the plant or grabbed from the machine harvester can be ginned on small laboratory gins to determine fiber properties. These are useful techniques, since experimental trials often consist of numerous small plots. These small sample methods are different from standard production practices, and these differences should be considered when interpreting results of the trials. Small laboratory gins typically consist of one machine, the gin stand, which removes seed from lint. Standard ginning equipment consists of additional equipment, such as dryers, seed cotton cleaners, and lint cleaners, which tend to change fiber properties. These changes may not be revealed by boll samples picked manually from the plant (boll samples) or grab samples taken from the picker (grab samples). In addition, boll samples are not influenced by the machine cotton picker, which may collect additional plant material and be more aggressive than hand picking. Boll samples also have the potential to be biased if a good sampling protocol is not followed, and samples are not representative of the entire plant. Because of these differences, experiments are needed to determine the importance of these factors in cultivar trials.

In one experiment, Calhoun et al. (1996) found that gin turnout was overestimated by 4% or more with grab samples and boll samples compared with conventional processing, and the interaction between sample method and cultivar was significant. For HVI length, strength, and micronaire, the interaction between sample method and cultivar was not significant, but length and micronaire were both overestimated with the small sample methods. Boykin and Creech (2004) compared boll samples with conventional processing, and the interactions between cultivar and sample method for HVI length, strength, uniformity, reflectance, and leaf was significant. This interaction for gin turnout, micronaire, or yellowness was not significant. Overall, boll samples had higher values for gin turnout, length, micronaire, strength, and uniformity and lower values for reflectance, yellowness, and leaf. In these two reports, the differences shown in the grab samples were due to ginning methods, and differences in boll samples were due to harvesting and ginning methods. Part of the differences due to harvesting could include boll samples that don't represent the whole plant.

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Meredith et al. (1975) compared boll samples randomly picked from small plots (selective) with boll samples picked from whole plants within the same plots (nonselective). Selective sampling resulted in larger bolls and seeds, as well as increased yield, lint percentage, length, length uniformity, reflectance, and micronaire. Interactions between cultivar and sample method were significant for yield, boll size, seed size, and yellowness.

In a related study, Gannaway et al. (2004) compared the results of large plots that were conventionally planted, harvested, and ginned with small grab samples that were ginned on a small gin stand with pre-cleaning and lint cleaning. Pre-cleaning and lint cleaning in the commercial gin was much more rigorous and included additional machinery. The grab samples resulted in increased loan value, net value, yield, turnout, length, strength, and uniformity. The commercial gin had increased reflectance.

In this experiment, cultivar differences in gin turnout and High Volume Instrument (HVI) parameters based on boll samples and grab samples were compared with conventionally processed samples. This research was conducted to validate conclusions drawn from previous research and to address additional parameters, such as uniformity, reflectance, yellowness, and leaf, which had previously not been compared among all three sample methods. The primary purpose of this paper was not to determine if fiber properties determined with small sample methods were different from commercial gins. This information was interesting, but it may not be repeatable when comparing other laboratory gins to other commercial gins. Consider that identical cotton ginned on different commercial gins will likely have different properties. The purpose of this paper was to determine if cultivar differences found using small sample methods were the same as differences between cultivars processed in a conventional gin.

MATERIALS AND METHODS

Small plots from the Mississippi Regional Cotton Variety Trials were machine picked and ginned in a small scale cotton gin (microgin) using a typical machine sequence of dryer, cylinder cleaner, stick machine, cylinder cleaner, extractor-feeder/gin stand, and saw-type lint cleaner (Anthony and McCaskill, 1974). There were 65 cultivars grown in 2003 at Stoneville and Tribbett, MS, and 65 cultivars grown in 2004 at Stoneville. In each field, cultivars were separated into early- and medium-maturing groups and grown in separate parts of the field. Cultivars were replicated six times within each test. There were 24 early-maturing and 11 medium-maturing cultivars in common between 2003 and 2004. In the microgin, cotton harvested from adjacent field reps (Reps 1 and 2, Reps 3 and 4, and Reps 5 and 6) were paired and ginned as one lot. The paired reps (2 bags) were fed one after the other into the gin with minimal mixing. Gin turnout and fiber quality was determined for each lot. Gin turnout was the total weight of lint as a percentage of the total weight of seed cotton for each lot. Fiber quality was determined by High Volume Instrumentation (HVI) for three samples per lot. In an effort to avoid mixed plot data, data from only the first sample for each lot was included in this test. Therefore, HVI data was collected from Reps 1 or 2, 3 or 4, and 5 or 6, depending on which bag (rep) was fed into the microgin first. Gin turnout included both bags from each lot. Results obtained from the microgin samples reflected actual values expected in bales of conventionally processed cotton (Anthony and McCaskill, 1974). In addition, small samples of seed cotton (about 200 g) were collected, either from the picker (grab samples) or from the plant (boll samples), and ginned on a small, 10-saw laboratory gin (Continental Eagle; Prattville, AL). The boll samples were collected in the field from Reps 1, 3, and 5. The grab samples were collected in the microgin from one bag in each lot, so these samples came from Reps 1 or 2, 3 or 4, and 5 or 6. Gin turnout and fiber quality were also obtained from these samples for comparison with conventional (microgin sample) results.

Boll and grab samples were compared with samples conventionally picked and ginned (microgin) from the same plots. For each property, a statistical model (Proc Mixed, ver. 8.2; SAS Institute; Cary, NC) was developed that included the dependent fixed variables maturity, cultivar (within maturity), sample, sample by maturity, and sample by cultivar (within maturity) and the random variables crop-year by field, crop-year by field by maturity, crop-year by field by cultivar (within maturity), and crop-year by field by sample. This model was also used to determine the least significant difference (LSD) between cultivars within an individual maturity group, field, and crop-year. Models were developed to separately analyze boll and grab sample data with microgin data. When each cotton property was analyzed, the most important factor in consideration was the sample by cultivar in-

teraction. A significant interaction indicated that some cultivars compared differently depending on which sample method was used, and the LSD was used to identify these cultivars. When the interaction was not significant, differences between any two cultivars in the microgin data set were either the same or were different by less than twice the LSD when small sample methods were used. With the use of plots, this analysis helped to visualize the importance of the sample by cultivar interactions.

RESULTS

Gin turnout and fiber properties determined for microgin samples were reported for each cultivar grown in the 2003 Stoneville early maturity test (Table 1), 2003 Tribbett early maturity test (Table 2), 2003 Stoneville medium maturity test (Table 3), 2003 Tribbett medium maturity test (Table 4), 2004 Stoneville early maturity test (Table 5), and 2004 Stoneville medium maturity test (Table 6). This large pool of cultivars grown in different environments provided an ideal opportunity to study small sample methods used to evaluate cultivars.

Fiber properties (strength, micronaire, and yellowness) without a significant cultivar by sample interaction. Small samples accurately predicted microgin fiber strength. Strength was higher for the boll samples and lower for the grab samples than for the microgin (Fig. 1a, Table 10), but differences among sampling methods were not significant (Table 7 and Table 8). The cultivar by sample interaction was not significant when either small sample data was included with the microgin data (Table 7 and Table 8). Figure 1a illustrates the correlation between fiber strength with the microgin data and fiber strength determined with the boll sample and grab sample data. In Figure 1b, cultivars were sorted by microgin strength, so the slope of the line connecting microgin values from one cultivar to the next was always zero or positive. Since the cultivar by sample interaction was not significant, the slope of the line connecting boll and grab values from one cultivar to the next was usually zero or positive with some exceptions. The most obvious exception was that fiber strength was lowest for 'SG521R' in the microgin data set, but this was not observed for the boll sample or grab sample data. Also, 'DES810' had higher fiber strength relative to several other cultivars, such as DP449BR and DES816, in the microgin data set, but DES810 had reduced fiber strength compared with these cultivars within the boll sample and grab sample data sets. Even though SG521R and DES810 appeared to behave differently between sampling methods, the differences were not statistically significant.

Small sample micronaire was higher than microgin values (Fig. 2a, Table 10), but only the grab samples were significantly different from microgen samples (Table 7 and Table 8). The cultivar by sample interaction was not significant when either small sample data set was included with the microgin data set. Figures 2a and 2b illustrate micronaire determined with the boll, grab, and microgin sample data. Trends between cultivars for micronaire based on small samples were not different from trends between cultivars based on microgin data. Compared with the plots of fiber strength, these trends were not as obvious, because overall cultivar differences were less significant (lower *F*-values) for micronaire than strength (Table 9).

Yellowness was also accurately predicted with the small sample data. Yellowness was lowest for the grab samples and highest for the boll samples (Table 10, Fig. 3a). Boll or grab samples were not significantly different from the microgin samples, and the interactions between cultivar and sample method were not significantly different (Table 7 and Table 8).

For properties, such as strength, micronaire, and yellowness, with no significant cultivar by sample interaction, it is important to note that properties may have been different statistically between two cultivars with one sample method but not the other. When strength, micronaire, and yellowness were analyzed separately with data from each sample method, *F*-values were larger using the microgin data (Table 9). This was especially true for micronaire. For these properties, differences between cultivars were more discernable with the microgin data than with the data obtained from the other sample methods, yet cultivar differences were not significant between methods.

Fiber properties (length, uniformity, reflectance, and leaf) with a significant cultivar by sample interaction. When the boll sample data set was included with the microgin data set, the cultivar by sample interaction was significant for length, uniformity, reflectance, and leaf (Table 7). When the grab sample data set was included with the microgin data set, the cultivar by sample interaction was significant only for turnout, reflectance, and leaf (Table 8). These interactions indicated that cultivars behaved differently depending on the sample method.

Table 1. Mean gin turnout and HVI values for microgin samples from the early maturing cultivars grown in Stoneville in 2003

Cultivar	Gin turnout (%)[z]	HVI fiber property[z]						
		Length (mm)	Length uniformity (%)	Micronaire	Strength (cN/tex)	Reflectance (Rd)	Yellowness (+b)	Leaf
FM958	36.85	29.2	82.8	4.60	32.19	79.3	7.69 L	3.0 L
FM958BG	35.56	28.6	82.9	4.16 L	33.25 H	79.2	7.54 L	3.3 L
FM966	36.42	29.2	83.3 H	4.44	33.55 H	80.0 H	7.68 L	3.1 L
FM958LL	35.67	29.7 H	82.3 L	4.38	33.06 H	79.4	7.37 L	3.1 L
FM960BR	34.85	28.4	83.3 H	4.40	33.91 H	79.0	7.54 L	3.6
FM966LL	35.88	28.5	83.6 H	4.54	32.44 H	79.0	7.83	3.1 L
BCG295	33.83	29.8 H	82.4 L	4.31	31.24	79.3	7.84	3.0 L
BCG28R	37.69	28.7	82.3 L	4.66	28.87	78.7	8.19	3.0 L
DP436RR	32.51	28.8	83.3 H	4.58	28.68	79.6	8.00	3.0 L
DP444BR	36.56	28.4	83.2	4.08 L	28.50	79.0	7.71 L	3.7
DP449BR	35.14	28.5	83.0	4.60	31.47	80.0 H	7.68 L	3.0 L
DP451BR	33.00	28.8	83.2	4.59	28.93	80.0 H	7.49 L	3.0 L
DPX00W12	36.89	29.3	83.7 H	4.63	29.98	77.9	8.48 H	3.0 L
DPXW99R	37.62	29.6 H	83.1	4.31	28.76	80.0 H	7.70 L	3.1 L
DPX99R	35.93	28.5	83.3 H	4.57	29.01	78.0	8.27	3.8 H
DPX02X71R	35.83	28.6	83.4 H	4.50	29.24	78.4	8.46 H	3.0 L
PM1199RR	35.76	28.3	83.9 H	4.60	29.93	77.7	7.90	3.3 L
PM1218BR	36.94	27.5	82.9	4.67	28.56	78.7	8.20	3.0 L
SG105	35.43	28.6	83.4 H	4.83 H	30.00	78.7	7.99	3.0 L
SG215BR	35.69	27.5	83.3 H	4.84 H	26.91 L	79.4	8.33 H	3.0 L
SG521R	35.31	27.7	83.4 H	4.64	26.90 L	78.0	8.16	3.3 L
SG747	37.08	28.5	83.6 H	4.97 H	27.16 L	77.9	8.62 H	3.0 L
DES810	32.65	28.1	83.0	4.26	30.67	76.9 L	7.78	3.9 H
DES816	35.03	28.5	82.9	4.44	29.97	77.4	7.74	4.0 H
OAX300BR	37.06	26.7 L	83.0	4.70	26.63 L	79.9	7.92	3.0 L
OAX302BR	31.38 L	28.2	82.9	4.73	27.29 L	80.8 H	7.69 L	3.0 L
OAX303	39.61 H	28.1	82.9	4.73	28.89	79.9	7.53 L	3.0 L
OAX304BR	34.49	27.8	82.9	4.58	30.14	79.1	7.89	3.2 L
PHY410RR	34.94	28.3	83.1	4.41	29.73	76.7 L	7.91	4.0 H
PSC355	35.52	28.4	83.6 H	4.70	29.64	76.2 L	7.87	4.1 H
BXN49B	35.38	29.0	82.4 L	4.51	29.25	78.2	8.23	3.8 H
ST4563B2	35.51	29.1	82.1 L	4.31	29.38	79.6	7.97	3.7
ST474	36.86	28.2	83.3 H	4.88 H	28.41	77.2	8.32 H	3.8
ST4793R	36.01	27.9	83.3 H	4.84 H	28.72	77.6	8.42 H	3.9
ST4892BR	36.35	28.3	83.6 H	4.82 H	29.76	78.1	8.36 H	3.6
STX202B2R	34.89	28.4	82.6 L	4.38	29.43	77.8	8.17	3.7
STX0204BR	33.23	27.4	82.9	4.06 L	27.30 L	79.3	7.73	3.7
NX2429	35.05	28.6	83.7 H	4.53	29.81	76.6 L	7.70 L	4.1
Replication *F*-value	0.19	2.08	2.05	7.79**	1.61	26.03**	4.57 *	0.12
Cultivar *F*-value	26.37**	20.31**	3.98**	12.44**	10.07**	14.91**	6.47**	8.27**
Mean	35.54	28.5	83.1	4.55	29.67	78.6	7.94	3.4
LSD (P = 0.05)	0.87	0.4	0.6	0.18	1.67	0.8	0.35	0.4

[z] Values followed by H and L are statistically equal to the maximum and minimum, respectively. Values followed by * and ** are significant at $P \leq 0.05$ and 0.01, respectively.

Table 2. Mean gin turnout and HVI values for microgin samples from the early maturing cultivars grown in Tribbett in 2003

Cultivar	Gin turnout (%)[z]	HVI fiber property[z]						
		Length (mm)	Length uniformity (%)	Micronaire	Strength (cN/tex)	Reflectance (Rd)	Yellowness (+b)	Leaf
FM958	37.64	28.1	82.0	4.71 H	30.29	78.2 H	7.64	3.0 L
FM958BG	36.51	27.7	82.8 H	4.21 L	30.63	77.1 H	7.48 L	2.9 L
FM966	37.66	28.2	82.9 H	4.64	32.30 H	78.1 H	7.46 L	3.0 L
FM958LL	36.52	28.9 H	82.2	4.54	31.41 H	77.4 H	7.48 L	3.3
FM960BR	35.59	27.3	82.0	4.22 L	31.94 H	77.4 H	7.66	3.0 L
FM966LL	36.53	27.9	82.9 H	4.61	32.41 H	77.9 H	7.28 L	3.1
BCG295	34.81	27.8	81.6	4.24 L	27.97	76.7	8.11	2.7 L
BCG28R	37.85	27.2	81.6	4.79 H	27.29	77.4 H	7.83	2.8 L
DP436RR	33.59 L	27.2	82.1	4.80 H	26.36 L	76.6	7.47 L	2.7 L
DP444BR	38.06	27.0	82.0	4.11 L	27.29	75.4	8.00	3.0 L
DP449BR	35.48	27.0	81.9	4.42	29.21	77.1 H	7.46 L	3.0 L
DP451BR	33.98 L	27.3	81.9	4.59	26.38 L	76.4	7.72	3.0 L
DPX00W12	38.11	27.7	82.4	4.64	28.72	75.6	8.20	3.0 L
DPXW99R	39.11	27.8	81.2	4.14 L	25.77 L	77.9 H	7.78	3.0 L
DPX99R	35.49	26.6	82.0	4.59	27.22	74.6	8.47 H	3.4
DPX02X71R	36.02	26.6	82.1	4.64	26.24 L	75.9	8.48 H	3.0 L
PM1199RR	36.72	26.9	82.9 H	4.92 H	28.23	75.1	8.40 H	3.0 L
PM1218BR	37.84	26.6	81.9	4.62	27.12	76.8	7.96	2.8 L
SG105	36.78	27.1	83.3H	4.89 H	26.99	76.2	7.90	3.0 L
SG215BR	36.43	26.2	81.6	4.71 H	25.18 L	75.7	8.52 H	3.0 L
SG521R	36.08	26.4	82.7	4.74 H	26.39 L	75.7	8.22	3.0 L
SG747	38.35	27.1	82.3	4.83 H	26.38 L	75.3	8.57 H	3.0 L
DES810	33.39 L	27.1	82.8 H	4.61	29.28	72.3 L	7.73	3.9 H
DES816	35.42	27.1	82.2	4.61	28.40	74.8	7.83	3.3
OAX300BR	37.75	25.4 L	82.1	4.72 H	25.48 L	75.6	8.49 H	2.8 L
OAX302BR	33.93 L	27.2	82.1	4.77 H	26.29 L	77.9 H	7.40 L	2.9 L
OAX303	41.20 H	26.4	82.3	4.67	25.84 L	76.9 H	7.52 L	2.7 L
OAX304BR	35.76	26.6	82.1	4.56	26.87	77.6 H	8.29 H	2.8 L
PHY410RR	35.58	27.6	82.7	4.35	28.27	74.7	7.70	4.0 H
PSC355	36.06	27.3	83.0 H	4.88 H	28.99	72.4 L	7.99	3.6
BXN49B	35.95	27.9	81.8	4.29 L	27.39	76.6	7.99	3.6
ST4563B2	36.02	27.1	80.2 L	4.29 L	25.84 L	77.3 H	7.93	3.1
ST474	37.28	26.9	81.9	4.90 H	27.39	74.3	8.24 H	3.4
ST4793R	37.17	26.6	82.4	4.76 H	27.53	76.1	8.17	3.2
ST4892BR	37.25	26.7	82.0	4.67	27.35	76.3	8.46 H	3.1
STX202B2R	35.16	26.6	81.1	4.23 L	26.92	75.4	8.38 H	3.2
STX0204BR	34.04 L	26.2	82.1	4.12 L	26.00 L	77.4 H	7.73	3.0 L
NX2429	35.67	27.7	83.6 H	4.79 H	29.44	72.4 L	7.86	3.7 H
Replication *F*-value	0.61	18.84**	3.5 *	9.61**	8.82**	3.64 *	6.23**	3.35 *
Cultivar *F*-value	35.76**	11.26**	5.05**	8.08**	16.44**	11.09**	9.63**	4.27**
Mean	36.39	27.1	82.2	4.58	27.87	76.1	7.94	3.1
LSD (P = 0.05)	0.76	0.6	0.8	0.24	1.36	1.3	0.34	0.4

[z] Values followed by H and L are statistically equal to the maximum and minimum, respectively. Values followed by * and ** are significant at $P \leq 0.05$ and 0.01, respectively.

The sample by cultivar interaction was significant for leaf and reflectance when either the boll sample data set or the grab sample data set was included with the microgin data set (Tables 7 and 8). This was not surprising since only the microgin method included seed cotton and lint cleaners that improve both leaf and reflectance. There was no relationship between microgin and boll sample leaf grade data (Fig. 4a), but there was some relationship between microgin and grab sample data. Figure 4b illustrates differences in leaf grade with cultivars sorted by microgin results. Leaf grade was lowest for boll samples with very little variation between cultivars. These samples were picked manually, which collected less leaf tissue than the machine picker. Cultivar differences in leaf based on grab sample data (without cleaning) gave some indication which cultivars picked cleaner, but the sample by cultivar interaction was significant. Some differences observed without cleaning (grab sample data) persisted through ginning (microgin data), but some cultivars that were exceptionally easy or difficult to clean changed disproportionately causing the interaction between cultivar and sample method.

Table 3. Mean gin turnout and HVI values for microgin samples from the medium maturing cultivars grown in Stoneville in 2003

Cultivar	Gin turnout (%)[z]	HVI fiber property[z]						
		Length (mm)	Length uniformity (%)	Micronaire	Strength (cN/tex)	Reflectance (Rd)	Yellowness (+b)	Leaf
FM800BR	35.38	29.9 H	82.7	3.63 L	32.46 H	80.8	6.82 L	3.7
FM989BR	34.89	28.9	82.8	4.50	31.19	80.3	7.63	3.0 L
FM991BR	35.16	28.5	83.0	4.91 H	32.63 H	78.6 L	8.07 H	3.0 L
BCG24R	36.46	27.5 L	82.9	4.48	27.86 L	80.1	7.41	3.0 L
BCG28R	37.43	28.3	82.3	4.69	28.09	79.2	7.71	3.0 L
CS31	35.83	27.9 L	82.8	4.62	28.79	79.1	8.23 H	3.0 L
CS32	34.63	28.0	82.4	4.62	29.12	79.7	7.46	3.0 L
CS33	32.46 L	29.4	82.8	4.00	31.38	77.7 L	7.29	4.2 H
CS34	35.92	28.6	82.9	4.58	30.66	78.7	8.16 H	3.0 L
CS35	36.23	28.4	82.0	4.19	30.26	82.0 H	7.70	3.0 L
CS36	34.54	29.2	82.7	4.60	30.77	78.7	7.88	3.3
DP448B	35.61	28.2	81.9 L	4.47	28.58	81.1 H	7.54	2.9 L
DP449BR	36.29	28.4	82.6	4.56	31.02	81.1 H	7.43	3.0 L
DP458BR	35.96	28.3	82.1	4.78	29.26	81.7 H	7.63	2.9 L
DP491	38.71	30.3 H	82.0	4.51	30.65	78.0 L	8.11 H	3.9
DP493	40.21 H	28.1	81.8 L	4.69	30.33	80.7	7.61	3.0 L
DP5415RR	37.51	28.1	82.7	4.94 H	28.45	81.6 H	7.44	3.0 L
DP555BR	40.36 H	27.9 L	81.3 L	4.46	28.70	81.9 H	7.01 L	2.9 L
DPX25R	38.05	28.9	83.2	4.88 H	31.22	80.2	7.94	2.9 L
DPX176BR	38.07	29.9 H	82.0	4.57	30.86	79.0	8.02 H	3.0 L
DPX177RR	37.97	29.5	82.8	4.63	31.73 H	78.0 L	8.10 H	3.4
SG747	37.48	28.4	83.6 H	5.01 H	26.86 L	78.2 L	8.36 H	3.0 L
OAX301R	34.59	27.9 L	83.8 H	4.62	26.88 L	79.0	7.60	3.0 L
ST5303R	35.58	27.9 L	84.0 H	4.59	30.67	79.2	7.70	3.0 L
ST5599BR	37.25	28.2	81.9 L	4.48	29.23	78.1 L	7.53	3.8
ST5222B2	33.66	28.9	83.2	4.53	32.20 H	80.7	7.58	3.0 L
STX0203BR	37.59	28.2	83.0	4.29	27.90 L	80.1	7.84	3.0 L
Replication *F*-value	5.57**	5.27**	5.11**	3.73 *	3.35 *	1.57	8.5**	6.63**
Cultivar *F*-value	31.32**	20.4**	7.02**	35.18**	15.52**	15.43**	7.61**	14.7**
Mean	36.44	28.6	82.6	4.55	29.92	79.8	7.70	3.1
LSD	0.93	0.4	0.7	0.14	1.17	0.9	0.37	0.3

[z] Values followed by H and L are statistically equal to the maximum and minimum, respectively. Values followed by * and ** are significant at $P \leq 0.05$ and 0.01, respectively.

Overall, reflectance was lower in the grab sample data than the microgin data, and the microgin data and boll sample data were similar (Table 10 and Fig. 5a). The microgin data was correlated more with the grab sample data than the boll sample data (Fig. 5a). Figure 5b illustrates differences in reflectance with cultivars sorted by microgin results. Cultivar differences in reflectance based on small sample methods (without cleaning) gave an indication which cultivars had higher reflectance in the field. As with leaf grade, some cultivars that were easy or difficult to clean probably changed disproportionately causing the interaction between cultivar and sample method.

Table 4. Mean gin turnout and HVI values for microgin samples from the medium maturing cultivars grown in Tribbett in 2003

Cultivar	Gin turnout (%)[z]	HVI fiber property[z]						
		Length (mm)	Length uniformity (%)	Micronaire	Strength (cN/tex)	Reflectance (Rd)	Yellowness (+b)	Leaf
FM800BR	35.49	29.9 H	82.2	3.80 L	32.13 H	79.7 H	7.27	3.1 H
FM989BR	34.95	27.7	81.9	4.53	29.36	79.9 H	7.54	2.8
FM991BR	35.57	28.3	81.9	4.63	31.02 H	78.6	7.47	2.8
BCG24R	36.81	27.1 L	82.1	4.60	27.17 L	79.4 H	7.10 L	3.0 H
BCG28R	37.57	27.9	81.9	4.96	28.08	77.8 L	7.51	3.0 H
CS31	36.51	27.0 L	82.2	4.68	28.58	78.2	7.56	2.8
CS32	33.68 L	27.5	82.0	4.81	27.68	77.6 L	7.30	3.0 H
CS33	33.11 L	28.4	82.4	4.21	30.03	77.9 L	6.96 L	3.4 H
CS34	36.17	28.1	82.7 H	4.66	31.32 H	77.7 L	7.98 H	2.7 L
CS35	37.02	27.7	80.7 L	4.28	28.21	80.2 H	7.07 L	3.0 H
CS36	34.57	28.6	81.9	4.52	30.37	77.8 L	7.44	3.1 H
DP448B	35.85	27.6	81.9	4.64	28.30	79.2	7.47	2.8
DP449BR	35.82	27.2 L	81.6	4.78	28.46	79.6 H	7.34	2.7 L
DP458BR	35.90	27.3 L	81.4	4.82	28.66	79.8 H	7.39	2.6 L
DP491	39.26	29.1	80.9	4.72	30.02	77.6 L	7.87	3.1 H
DP493	41.32 H	27.7	80.6 L	4.88	28.86	79.5 H	6.83 L	2.8
DP5415RR	37.90	27.5	82.2	4.92	27.37 L	80.1 H	7.28	2.8
DP555BR	41.44 H	27.2 L	80.1 L	4.64	27.78	80.2 H	7.06 L	3.0 H
DPX25R	38.60	27.9	82.4	4.96	29.12	78.6	7.60	2.7 L
DPX176BR	37.73	29.3	81.8	4.68	29.32	77.6 L	7.79	3.1 H
DPX177RR	38.71	28.7	82.2	4.92	30.25	78.0 L	7.80	3.0 H
SG747	38.37	27.3 L	82.4	5.14 H	26.21 L	77.1 L	8.24 H	2.8
OAX301R	34.85	27.3 L	83.2 H	4.84	26.04 L	78.2	7.39	2.9
ST5303R	37.06	27.2 L	83.1 H	4.80	29.97	79.0	7.91	2.2 L
ST5599BR	38.24	27.4 L	80.9	4.69	27.96	77.6 L	7.60	3.2 H
ST5222B2	34.44	27.6	82.7 H	4.92	30.89 H	79.2	7.84	3.0 H
STX0203BR	38.48	27.5	82.6 H	4.53	26.86 L	78.6	7.77	2.7 L
Replication *F*-value	12.63**	0.82	1.08	29.78**	1.74	11.75**	3.77 *	2.05
Cultivar *F*-value	56.81**	23.11**	8.07**	18.79**	9.19**	7.93**	9.41**	2.23**
Mean	36.87	27.9	81.9	4.69	28.89	78.7	7.49	2.9
LSD	0.78	0.4	0.7	0.18	1.47	1.0	0.31	0.5

[z] Values followed by H and L are statistically equal to the maximum and minimum, respectively. Values followed by * and ** are significant at $P \leq 0.05$ and 0.01, respectively.

Table 5. Mean gin turnout and HVI values for microgin samples from the early maturing cultivars grown in Stoneville in 2004

Cultivar	Gin turnout (%)[z]	HVI fiber property[z]						
		Length (mm)	Length uniformity (%)	Micronaire	Strength (cN/tex)	Reflectance (Rd)	Yellowness (+b)	Leaf
FM 958 LL	35.78	28.6	82.56	4.28	30.60	82.11 H	7.68 L	3.00 H
FM 960 B2R	35.60	29.5 H	81.89 L	4.48	31.75	81.78 H	7.74 L	2.56
FM 960 BR	35.53	28.0	82.56	4.34	32.74 H	81.78 H	7.94	2.44
FM 960 RR	36.51	28.5	82.00	3.94 L	30.77	82.44 H	7.99	2.78
FM 966 LL	35.46	28.5	82.44	4.30	33.10 H	81.89 H	7.71 L	2.89 H
BCG 28 R	37.22	28.0	81.67 L	4.66 H	27.23	81.56	8.14	2.67
BCG 295	35.09	29.4 H	81.89 L	4.23	29.66	82.00 H	8.16	2.44
DP 424 BGII/RR	33.56 L	27.4	82.56	4.43	26.46 L	81.67 H	8.39	2.22 L
DP 432 RR	36.10	27.8	82.89	4.30	27.06	80.00	8.56	3.33 H
DP 434 RR	37.64	29.0	82.00	4.16	25.76 L	81.67 H	7.90	3.00 H
DP 436 RR	32.66 L	28.3	82.56	4.28	25.57 L	82.00 H	8.07	2.11 L
DP 444 BG/RR	36.59	28.2	82.44	3.92 L	26.53 L	80.89	8.19	2.78
DP 449 BG/RR	36.10	27.9	82.33	4.40	29.48	82.11 H	7.92	2.22 L
DP 451 BG/RR	33.73	28.4	82.00	4.33	26.65 L	81.67 H	7.97	2.44
DPLX00W12	36.84	28.1	82.67	4.39	28.19	80.22	8.76	2.56
DPLX01W93BR	37.98	28.1	82.67	4.33	29.14	80.67	8.33	2.56
DPLX02X39BR	37.59	28.6	81.89 L	4.00 L	29.91	79.78	8.88 H	2.89 H
PM 1218 BG/RR	36.74	27.2 L	82.89	4.71 H	25.98 L	81.00	8.47	2.00 L
SG 105	35.23	28.3	83.22 H	4.33	28.66	81.56	8.28	2.56
SG 215 BG/RR	36.09	26.9 L	82.33	4.56	25.55 L	81.22	8.68	1.89 L
SG 521 R	35.33	26.9 L	82.89	4.46	25.41 L	80.11	8.58	3.00 H
SG 747	37.28	28.2	82.78	4.69 H	25.75 L	79.89	9.01 H	2.44
DES 810	35.17	27.5	82.22	4.16	29.32	79.11 L	8.41	3.33 H
DES 816	34.61	28.5	82.67	4.40	29.45	79.89	8.18	3.33 H
OAX 303	39.22 H	27.8	82.78	4.63 H	26.81	82.11 H	8.10	2.33 L
PHY 410 R	35.11	28.4	83.67 H	4.42	27.43	79.44 L	8.43	3.11 H
PSC 355	35.69	27.9	83.22 H	4.64 H	28.39	78.78 L	8.81	3.22 H
ST 4646 B2R	34.87	27.5	81.89 L	4.42	26.76	79.67	8.66	3.00 H
ST 4793 R	36.68	27.0 L	82.11	4.73 H	26.59 L	79.78	8.86 H	3.11 H
ST 4892 BR	36.84	27.3 L	83.11 H	4.76 H	27.13	79.78	8.69	3.11 H
ST 5242 BR	36.86	27.7	82.33	4.41	26.56 L	81.22	8.30	2.67
ST 5599 BR	36.93	28.0	81.33 L	4.41	29.46	79.56 L	8.31	3.00 H
STX 3636 B2R	35.61	27.8	81.33 L	4.39	26.17 L	80.22	8.28	3.22 H
STX 4575 BR	36.75	27.5	83.00	4.37	27.91	80.11	8.79	3.00 H
STX 4686 R	37.36	28.0	81.78 L	4.22	26.99	81.44	8.51	2.56
DX 241203	37.19	28.7	82.78	4.26	28.96	81.78 H	8.23	2.44
DX 25105N	38.35 H	28.6	82.22	4.53	27.29	80.33	8.38	3.00 H
Replication *F*-value	3.77 *	8.66**	0.97	10.04**	17.85**	3.19 *	3.86 *	0.23
Cultivar *F*-value	16.12**	11.8**	5.91**	18.53**	18.53**	12.78**	27.66**	5.54**
Mean	36.16	28.06	82.42	4.39	28.03	80.84	8.33	2.74
LSD	0.95	0.5	0.62	0.13	1.328	0.81	0.19	0.47

[z] Values followed by H and L are statistically equal to the maximum and minimum, respectively. Values followed by * and ** are significant at $P \leq 0.05$ and 0.01, respectively.

For gin turnout, only the grab sample data set showed a significant cultivar by sample interaction when included with the microgin data set (Table 8). Grab and boll sample data for gin turnout were highly correlated with the microgin data (Fig. 6a). This was expected since cultivar *F*-values were much larger than cultivar by sample *F*-values. Figure 6b illustrates differences in turnout with cultivars sorted by microgin results. Gin turnout was increased for grab and boll samples. The most obvious examples of cultivars within the grab sample data contributing to the interaction were DES810, PHY410R, and SG105, which increased turnout compared with the other cultivars relative to their performance within the microgin data set. Differences were probably related to seed cotton and lint cleaning. If considerably more trash was removed from one cultivar than another in the microgin, considerably less lint (including trash) was yielded from the sample. The interaction was not significant when the boll sample data set was included with the microgin data set (Table 7). These samples were picked clean and had little trash to remove. The gin turnout was higher for boll samples (Table 10) since the clean boll samples weighed less compared with the lint, but this difference affected cultivars equally. These results showed that both small sample methods predicted differences in gin turnout.

Table 6. Mean gin turnout and HVI values for microgin samples from the medium maturing cultivars grown in Stoneville in 2004

Cultivar	Gin turnout (%)[z]	HVI fiber property[z]						
		Length (mm)	Length uniformity (%)	Micronaire	Strength (cN/tex)	Reflectance (Rd)	Yellowness (+b)	Leaf
FM 800 B2R	35.25	29.9 H	82.78	4.00	31.75 H	82.89 H	7.86	2.44
FM 800 BR	36.08	29.7	83.11 H	3.81 L	31.63 H	82.56 H	7.79 L	1.89 L
FM 800 RR	36.54	29.2	83.67 H	4.39	31.93 H	81.78	8.19	2.00 L
FM 832 LL	35.07	30.2 H	82.56	3.88 L	31.73 H	81.33	7.64 L	3.11 H
FM 991 B2R	33.00 L	29.2	82.56	4.27	31.28 H	81.33	8.22	2.22
BCG 24 R	36.80	27.5 L	82.00	4.23	27.59	83.11 H	7.84	2.11
DP 449 BG/RR	35.77	28.0	82.56	4.31	30.62	81.78	8.09	1.89 L
DP 458 B/RR	36.00	27.4 L	81.67	4.47	29.39	81.89	8.19	1.44 L
DP 488 BG/RR	37.74	29.4	82.44	4.40	30.38	80.44	8.57	2.00 L
DP 491	38.71	29.8 H	82.44	4.20	31.53 H	80.56	8.40	2.67 H
DP 493	39.84 H	27.8	81.11 L	4.54	29.67	81.89	7.99	2.11
DP 494 RR	38.36	28.9	82.22	4.51	30.67	81.44	8.21	2.44
DP 5415 RR	36.77	27.8	82.33	4.33	28.78	82.11	8.14	1.78 L
DP 555 BG/RR	39.64 H	27.4 L	80.89 L	4.51	28.70	83.00 H	7.74 L	1.78 L
DPLX01W93BR	37.43	28.5	82.89	4.32	29.69	80.44	8.43	2.56 H
DPLX02T57R	34.74	27.6 L	82.22	4.41	28.56	80.56	8.03	3.11 H
DPLX02X39BR	37.04	28.4	81.67	4.03	30.76	78.33 L	9.04 H	2.89 H
DPLX03Q301BR	35.24	28.2	81.78	4.49	29.77	81.22	8.09	1.89 L
SG 747	36.83	28.0	82.78	4.71 H	25.84 L	80.56	9.16 H	1.78 L
PSC 355	35.18	28.1	83.11 H	4.54	28.92	78.67 L	8.93	3.11 H
ST 5242 BR	36.64	27.5 L	82.67	4.39	26.50 L	81.44	8.64	2.33
ST 5303 R	35.65	27.2 L	83.33 H	4.54	29.68	81.33	8.31	1.67 L
ST 5599 BR	37.17	27.7	81.44 L	4.39	29.15	80.33	8.49	2.78 H
STX 5454 B2R	33.94 L	28.0	82.00	4.59 H	28.80	81.11	8.72	1.78 L
STX 6636 BR	34.35	28.8	82.67	4.49	30.14	80.33	8.81	2.22
STX 6848 R	33.86 L	28.3	83.56 H	4.67 H	31.23 H	79.56	8.63	2.67 H
Replication *F*-value	6.06**	9.42**	1.31	11.35**	4.43 *	0.63	2.45	3.11
Cultivar *F*-value	24.28**	40.6**	7.99**	15.31**	17.9**	12.72**	42.66**	5.63**
Mean	36.29	28.40	82.40	4.36	29.80	81.15	8.31	2.26
LSD	0.99	0.4	0.70	0.17	1.07	0.95	0.18	0.58

[z] Values followed by H and L are statistically equal to the maximum and minimum, respectively. Values followed by * and ** are significant at $P \leq 0.05$ and 0.01, respectively.

When included with the microgin data, only the boll sample data showed a significant cultivar by sample interaction for length and uniformity. Overall, boll samples had higher length and uniformity (Table 10), though the differences were not significant (Table 7). The interaction between maturity group and sampling method was highly significant for length and uniformity (Table 7), because values were significantly higher in the medium maturity group (Table 10). Boll sample and grab sample fiber length data were highly correlated with microgin data (Fig. 7a). Figure 7b illustrates differences in fiber length with cultivars sorted by microgin results. The cultivar DP434RR had a shorter fiber length than 'FM958LL' and 'DPLX00W12' when the boll sample data was compared with the microgin data.

Uniformity with the microgin data showed low correlation with grab sample data and no correlation with boll sample data (Fig. 8a). The cultivars DPLX00W12, DP432RR, FM958LL, and DP434RR had higher length uniformity compared with the other cultivars when the boll sample data was analyzed (Fig. 8b) but not for the microgin data. The two causes suspected for these differences were boll sample location within the plant and cleaning processes in the gin. If the boll samples included select bolls with higher length and uniformity than the plant average, this could have been a source of the cultivar by sample interaction. In this case, the interaction would indicate not only that the bolls were different from the plant average, but that this difference was inconsistent between cultivars. For other properties, such as strength and micronaire that showed no interaction, values were higher for boll samples, but cultivar differences were consistent (Table 10). Cleaning in the gin reduces fiber length and length uniformity. If cultivars were affected differently, this was a source of the cultivar by sample interaction, since boll samples were not cleaned and subjected to this damage.

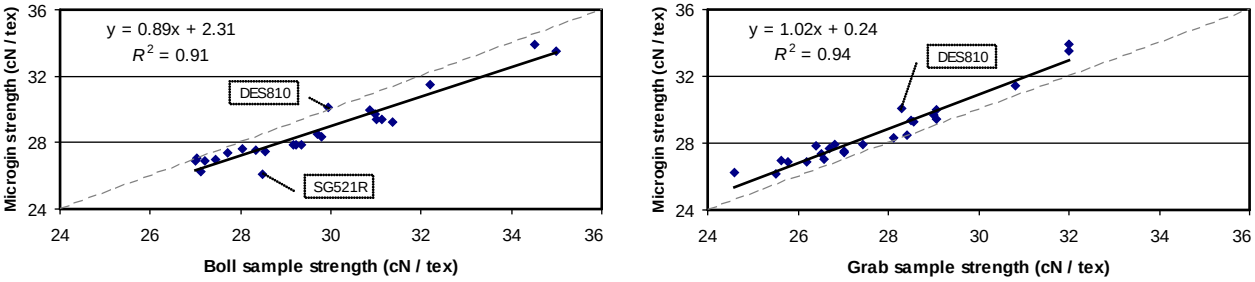

Figure 1a. Relationships between the microgin and the boll or grab sample fiber strength for cultivars in the early maturity group. Only cultivars grown in all three tests (Stoneville and Tribbett in 2003 and Stoneville in 2004) were included, and values for each cultivar are the means for all three tests. The R^2 was significant ($P < 0.001$) when comparing the microgin data with either the boll sample data or grab sample data.

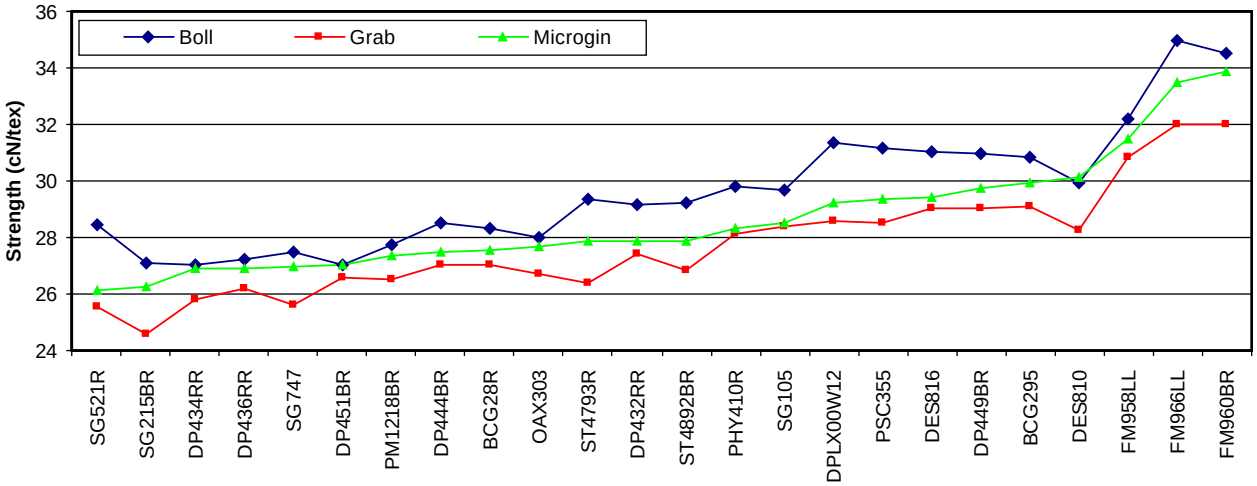

Figure 1b. Fiber strength determined with boll, grab, and microgin samples for early maturing cultivars sorted by the microgin results. Only cultivars grown in all three tests (Stoneville and Tribbett in 2003 and Stoneville in 2004) were included, and values for each cultivar are the means from all three tests. Between cultivars within each sample group, the least significant difference was 1.25 cN/tex.

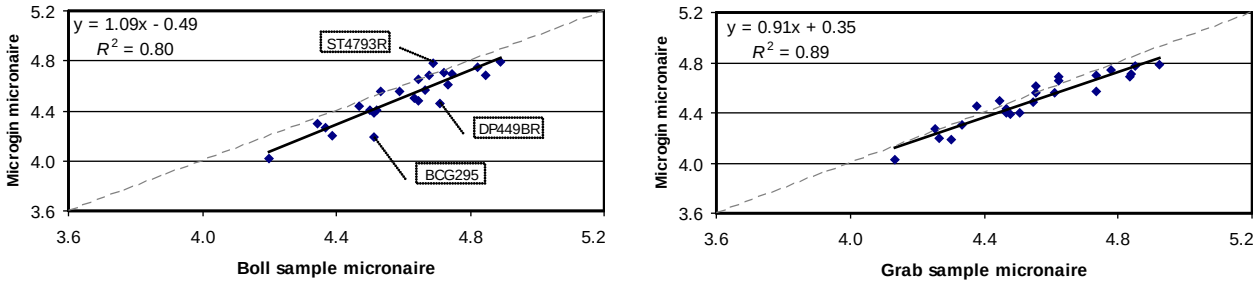

Figure 2a. Relationships between the microgin and the boll or grab sample micronaire for cultivars in the early maturity group. Only cultivars grown in all three tests (Stoneville and Tribbett in 2003 and Stoneville in 2004) were included, and values for each cultivar are the means from all three tests. The R^2 was significant ($P < 0.001$) when comparing the microgin data with either the boll sample data or grab sample data.

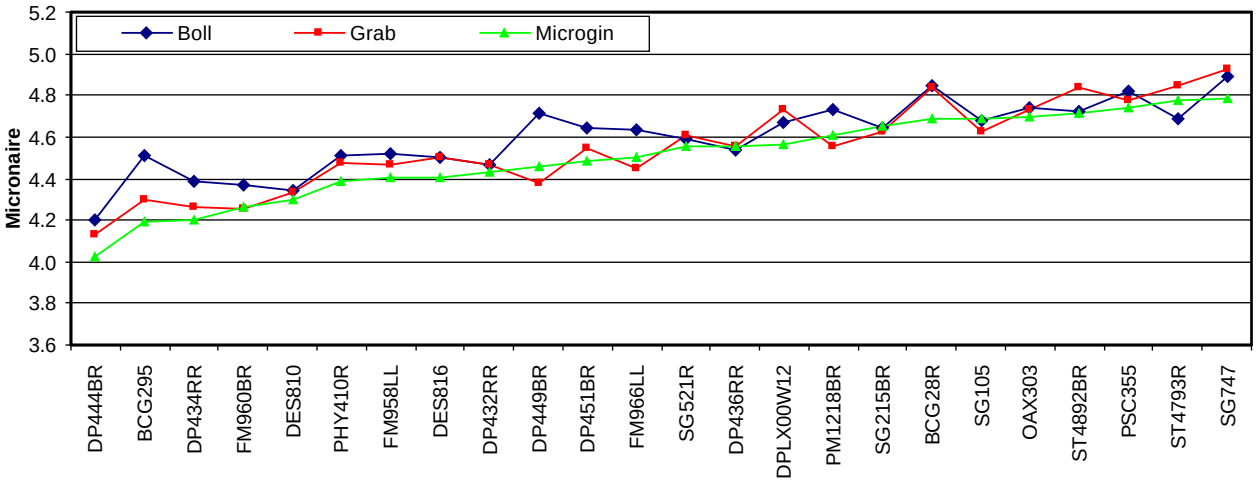

Figure 2b. Micronaire determined with boll, grab, and microgin samples for early maturing cultivars sorted by the microgin results. Only cultivars grown in all three tests (Stoneville and Tribbett in 2003 and Stoneville in 2004) were included, and values for each cultivar are the means from three tests. Between cultivars within each sample group, the least significant difference was 0.24.

Table 7. *F*-values for fiber qualities based on boll and microgin samples

Parameter[z]	Gin Turnout	Length	Length uniformity	Strength	Micronaire	Reflectance (Rd)	Yellowness (+b)	Leaf
Maturity	0.05	7.93	0.00	21.35*	1.29	2.08	1.93	33.40**
Cultivar (within maturity)	17.06**	10.03**	4.53**	5.54**	6.67**	7.01**	6.10**	2.80**
Sample method	45.98*	2.04	9.92	2.47	6.12	0.09	13.30	27.43**
Maturity*sample	7.01**	42.56**	19.82**	0.58	0.96	23.67**	1.61	7.15**
Sample*cultivar	1.08	2.08**	1.53*	1.33	1.22	1.46*	1.23	2.57**

[z] Values followed by * and ** are significant at $P \leq 0.05$ and 0.01, respectively.

Table 8. *F* -values for fiber qualities based on grab and microgin samples

Parameter[z]	Gin Turnout	Length	Length uniformity	Strength	Micronaire	Reflectance (Rd)	Yellowness (+b)	Leaf
Maturity	3.61	6.88	0.89	12.11	1.26	4.08	3.49	1.63
Cultivar (within maturity)	20.89**	10.42**	5.95**	20.11**	6.67**	8.49**	6.99**	6.76**
Sample method	124.89**	0.66	14.79	1.80	40.58**	169.09**	2.36	36.71**
Maturity*sample	11.46**	6.32*	1.66	2.27	0.53	0.36	2.98	22.78**
Sample*cultivar	1.41*	1.33	0.92	0.75	0.92	2.01**	0.90	1.74**

[z] Values followed by * and ** are significant at $P \leq 0.05$ and 0.01, respectively.

Table 9. ***F*-values for cultivar differences in fiber qualities among the three sample methods**

	Sample method		
	Microgin	Boll	Grab
Gin Turnout	**21.93**	**7.55**	**11.83**
Length	**9.03**	**8.18**	**6.69**
Length uniformity	**3.18**	**3.57**	**3.93**
Strength	**14.22**	**13.74**	**9.36**
Micronaire	**7.50**	**3.93**	**4.45**
Reflectance (Rd)	**8.02**	**2.30**	**5.96**
Yellowness (+b)	**5.42**	**3.58**	**4.40**
Leaf	**4.80**	**1.99**	**4.94**

SUMMARY AND CONCLUSIONS

Boll samples and grab samples were ginned on a small 10-saw gin and results were compared with samples ginned in the microgin. The objective was to determine differences in fiber properties between sample methods and analyze cultivar by sample interactions. Boll samples tended to overestimate gin turnout and underestimate leaf. Grab samples overestimated gin turnout, micronaire, and leaf, while they underestimated reflectance. Other differences were observed between sample methods, but they were not significant or consistent between fields and years. Boll samples and grab samples predicted differences in cultivars for strength, micronaire, yellowness, gin turnout, and length. For these properties, strong correlations were observed between sample methods, and the cultivar by sample interaction was either insignificant or small compared with cultivar differences. Grab samples gave good estimates of reflectance and leaf, but boll samples did not. Neither grab samples nor boll samples correlated well with uniformity. For most properties, cultivar *F*-values were higher for the microgin data, so small cultivar differences may only be revealed after more conventional processing methods like those used in the microgin.

Whether the cultivar by sample interactions were related to boll sample location within the plant or damage due to cleaning in the gin, the implications of the results are the same. For precise cultivar comparisons, it is important to consider the quality impact of harvesting and ginning. It should not be a surprise when some quality attributes of a top performing cultivar in a small sample test are surpassed by a moderately high performer when entered into full-scale production. These small sample methods should continue to be a useful tool to predict fiber quality and gin turnout when conventional machinery is not practical or unavailable.

ACKNOWLEDGEMENT

The author thanks Dr. John B. Creech at the Delta Research and Extension Center in Stoneville, MS, for providing the cotton studied in this experiment.

DISCLAIMER

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

Table 10. Mean values for gin turnout and HVI properties by sample method for each maturity group

Sample	Gin turnout (%)	Length (mm)	Length uniformity (%)	Strength (cN/tex)	Micronaire	Reflectance (Rd)	Yellowness (+b)	Leaf
Early maturity								
Boll	**39.4**	**28.3**	**83.7**	**29.66**	**4.57**	**78.7**	**8.12**	**1.67**
Grab	**38.7**	**28.0**	**82.9**	**27.88**	**4.53**	**74.5**	**7.73**	**5.20**
Microgin	**36.1**	**28.0**	**82.6**	**28.69**	**4.47**	**78.5**	**8.00**	**3.12**
Medium maturity								
Boll	**39.3**	**29.1**	**83.9**	**31.01**	**4.63**	**79.0**	**7.97**	**1.57**
Grab	**39.2**	**28.6**	**82.8**	**28.94**	**4.57**	**75.6**	**7.45**	**5.14**
Microgin	**36.4**	**28.4**	**82.4**	**29.81**	**4.51**	**79.8**	**7.77**	**2.83**

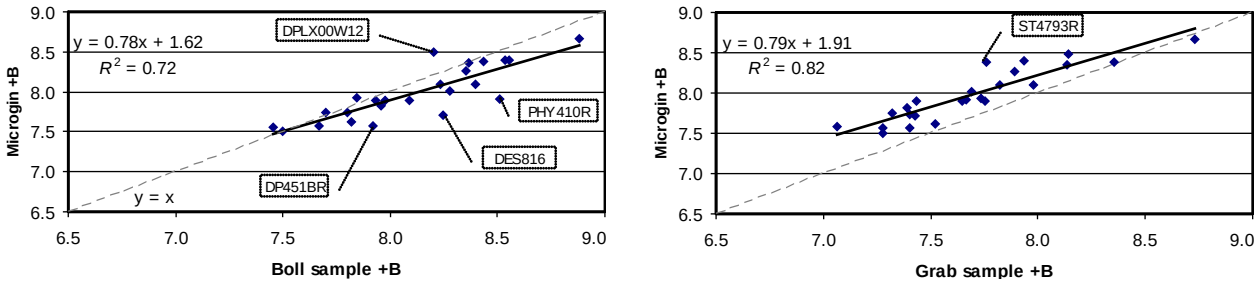

Figure 3a. Relationships between the microgin and the boll or grab sample yellowness (+B) for cultivars in the early maturity group. Only cultivars grown in all three tests (Stoneville and Tribbett in 2003 and Stoneville in 2004) were included, and values or each cultivar are the means from all three tests. The R^2 was significant ($P < 0.001$) when comparing the microgin data with either the boll sample data or grab sample data.

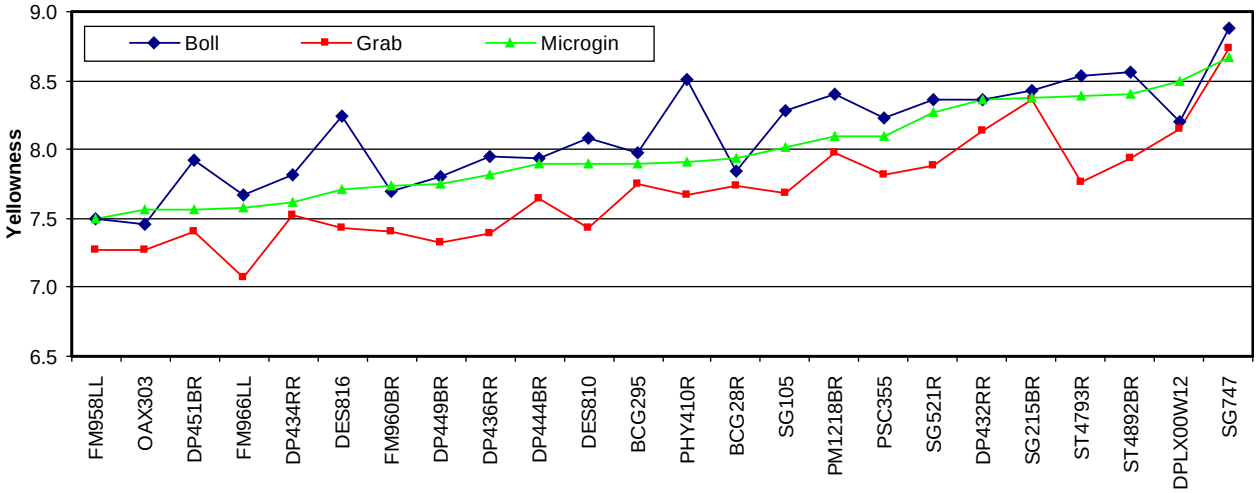

Figure 3b. Yellowness determined with boll, grab, and microgin samples for early maturing cultivars sorted by the microgin results. Only cultivars grown in all three tests (Stoneville and Tribbett in 2003 and Stoneville in 2004) were included, and values for each cultivar are the means from all three tests. Between cultivars within each sample group, the least significance difference was 0.39.

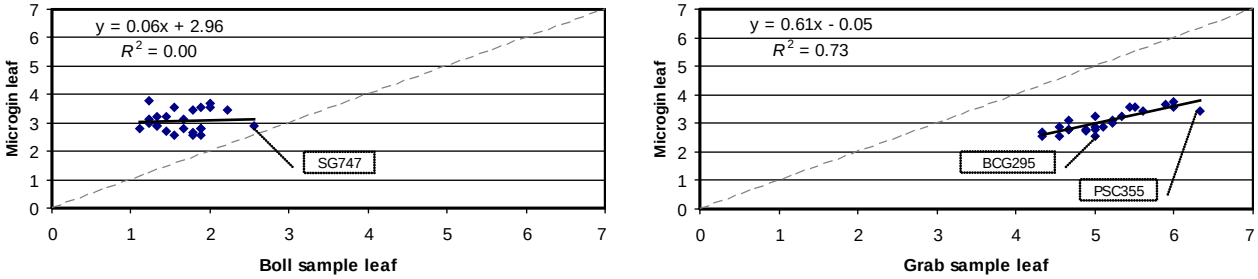

Figure 4a. Relationships between the microgin leaf grade data and the boll or grab sample leaf grade data for cultivars in the early maturity group. Only cultivars grown in all three tests (Stoneville and Tribbett in 2003 and Stoneville in 2004) were included, and values for each cultivar are the means from all three tests. The R^2 was not significant ($P = 0.78$) when comparing the microgin data with the boll sample data but was significant ($P < 0.001$) when comparing with the grab sample data.

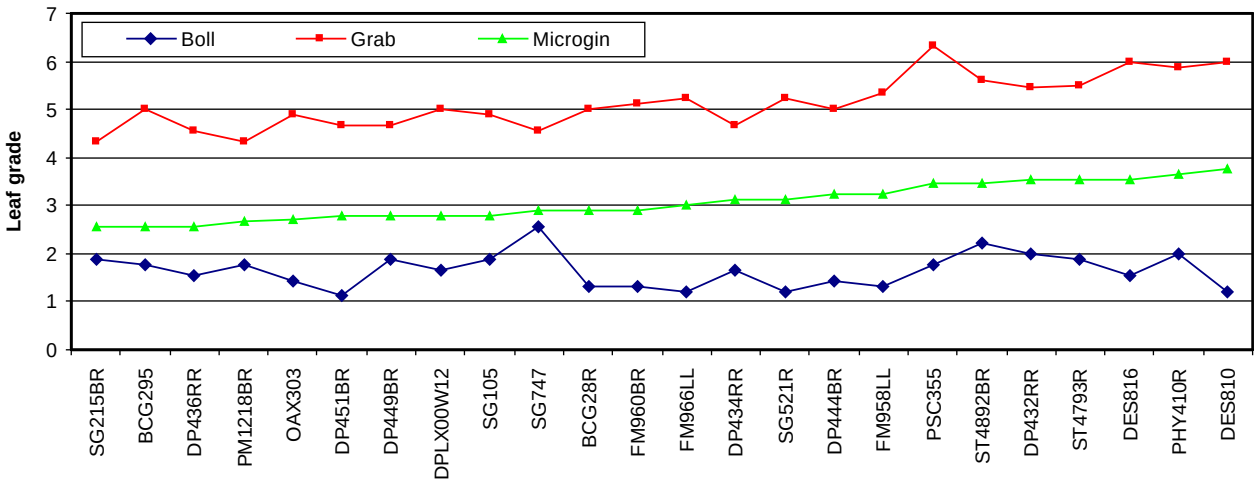

Figure 4b. Leaf grade determined with boll, grab, and microgin samples for early maturing cultivars sorted by the microgin results. Only cultivars grown in all three tests (Stoneville and Tribbett in 2003 and Stoneville in 2004) were included, and values for each cultivar are the means from all three tests. Between cultivars within each sample group, the least significant difference was 0.52.

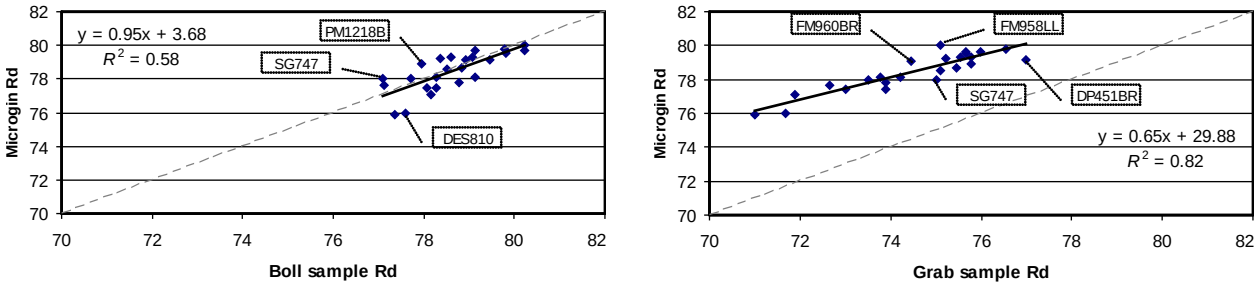

Figure 5a. Relationships between the microgin and the boll or grab sample reflectance (Rd) for cultivars in the early maturity group. Only cultivars grown in all three tests (Stoneville and Tribbett in 2003 and Stoneville in 2004) were included, and values for each cultivar are the means from all three tests. The R^2 was significant ($P < 0.001$) when comparing the microgin data with either the boll sample data or grab sample data.

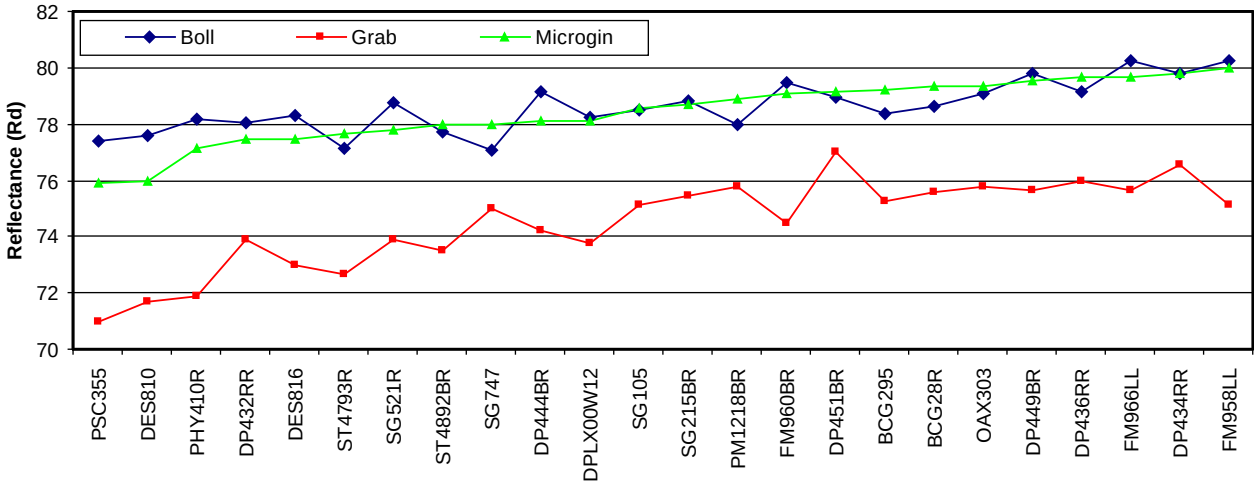

Figure 5b. Reflectance determined with boll, grab, and microgin samples for early maturing cultivars sorted by the microgin results. Only cultivars grown in all three tests (Stoneville and Tribbett in 2003 and Stoneville in 2004) were included, and values for each cultivar are the means from all three tests. Between cultivars within each sample group, the least significant difference was 1.22.

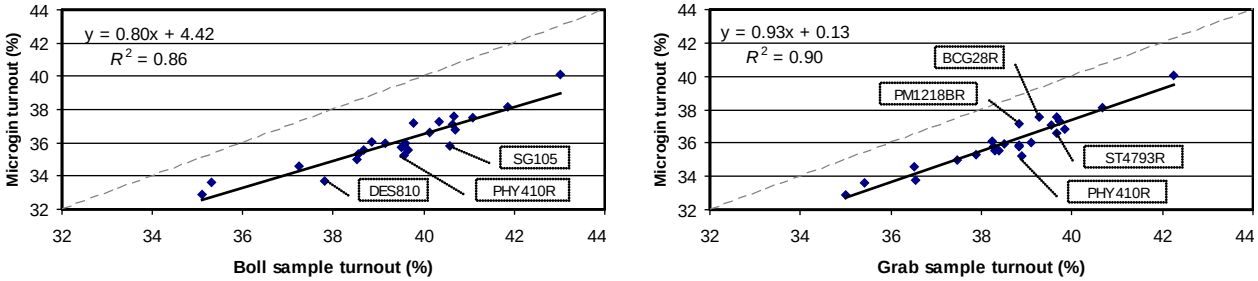

Figure 6a. Relationships between the microgin and the boll or grab sample turnout for cultivars in the early maturity group. Only cultivars grown in all three tests (Stoneville and Tribbett in 2003 and Stoneville in 2004) were included, and values given for each cultivar was the mean value across all three tests. The R^2 was significant ($P < 0.001$) when comparing the microgin data with either the boll sample data or grab sample data.

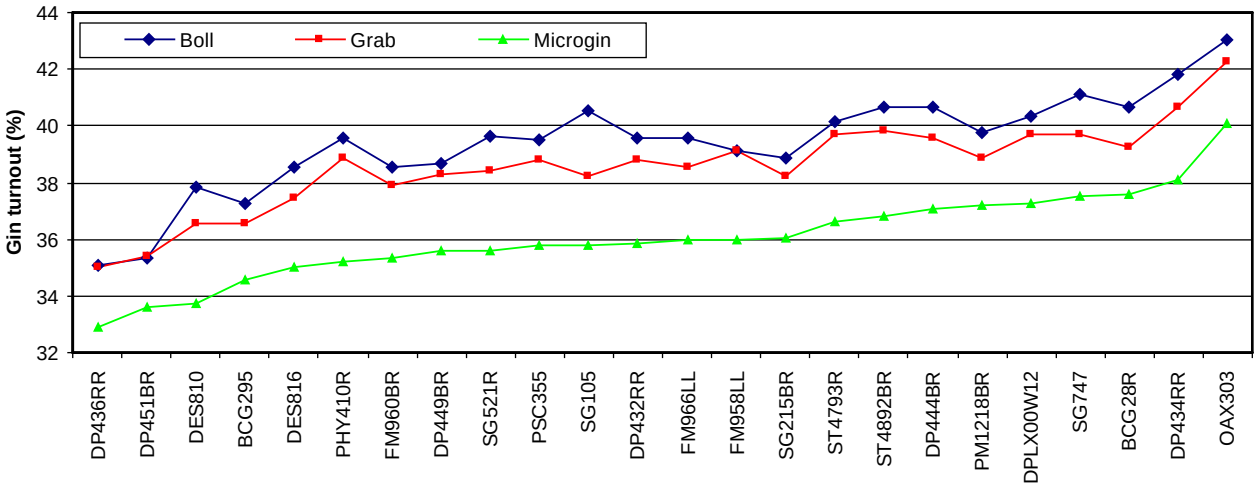

Figure 6b. Gin turnout determined with boll, grab, and microgin samples for early maturing cultivars sorted by the microgin results. Only cultivars grown in all three tests (Stoneville and Tribbett in 2003 and Stoneville in 2004) were included, and values for each cultivar are the means from all three tests. Between cultivars within each sample group, the least significant difference was 1.21.

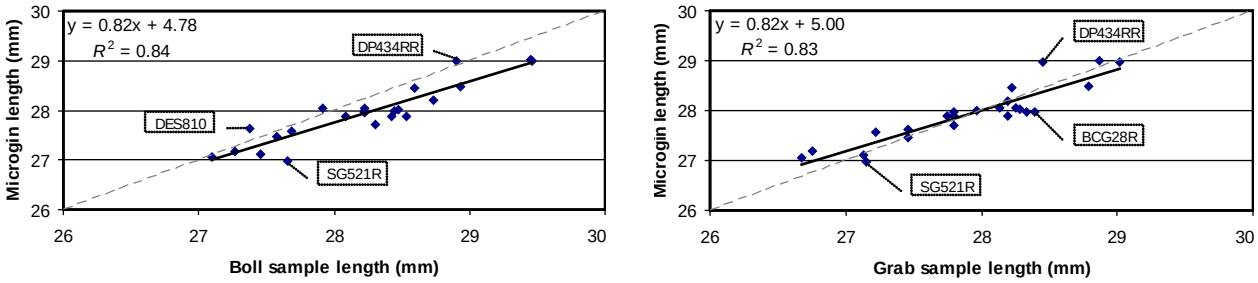

Figure 7a. Relationships between the microgin and the boll or grab sample fiber length for cultivars in the early maturity group. Only cultivars grown in all three tests (Stoneville and Tribbett in 2003 and Stoneville in 2004) were included, and values for each cultivar are the means from all three tests. The R^2 was significant ($P < 0.001$) when comparing the microgin data with either the boll sample data or grab sample data.

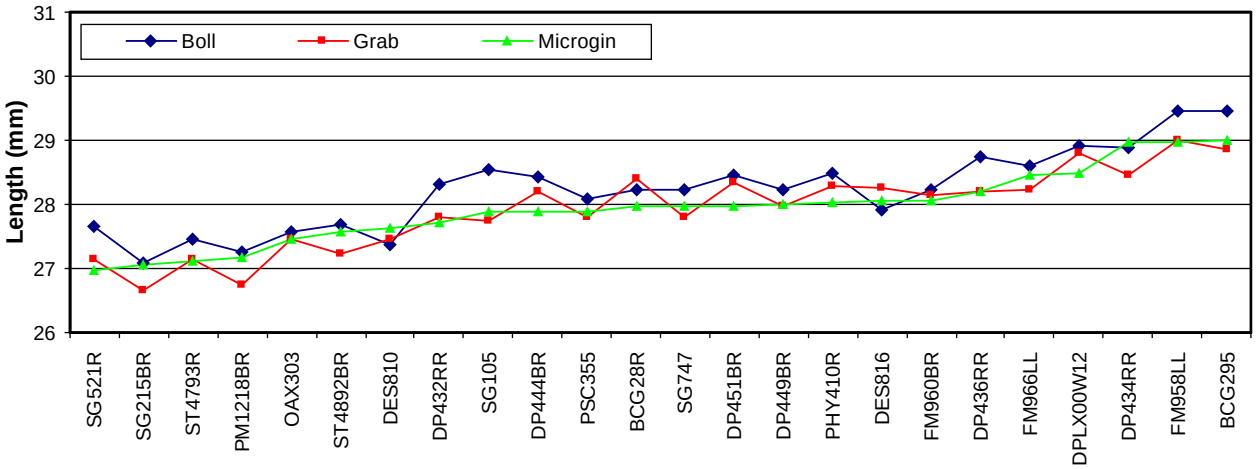

Figure 7b. Fiber length determined with boll, grab, and microgin samples for early maturing cultivars sorted by the microgin results. Only cultivars grown in all three tests (Stoneville and Tribbett in 2003 and Stoneville in 2004) were included, and values for each cultivar are the means from all three tests. Between cultivars within each sample group, the least significant difference was 0.61mm.

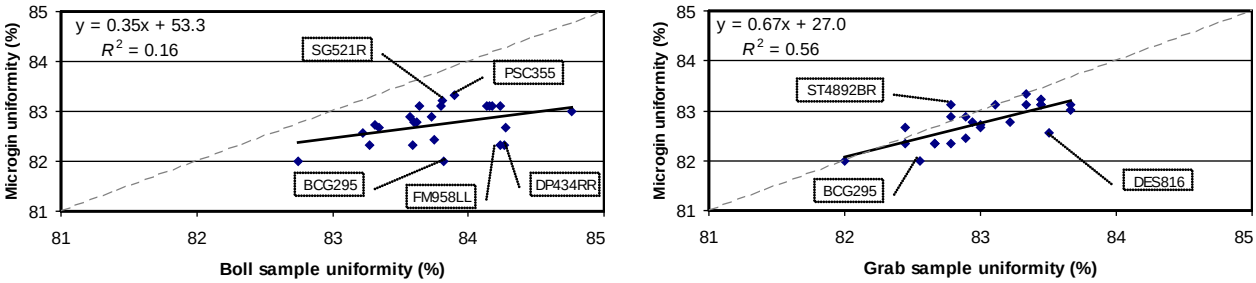

Figure 8a. Relationships between the microgin and the boll or grab sample length uniformity for cultivars in the early maturity group. Only cultivars grown in all three tests (Stoneville and Tribbett in 2003 and Stoneville in 2004) were included, and values for each cultivar are the means from all three tests. The R^2 was significant when comparing the microgin data with the boll sample data ($P = 0.05$) or grab sample data ($P < 0.001$).

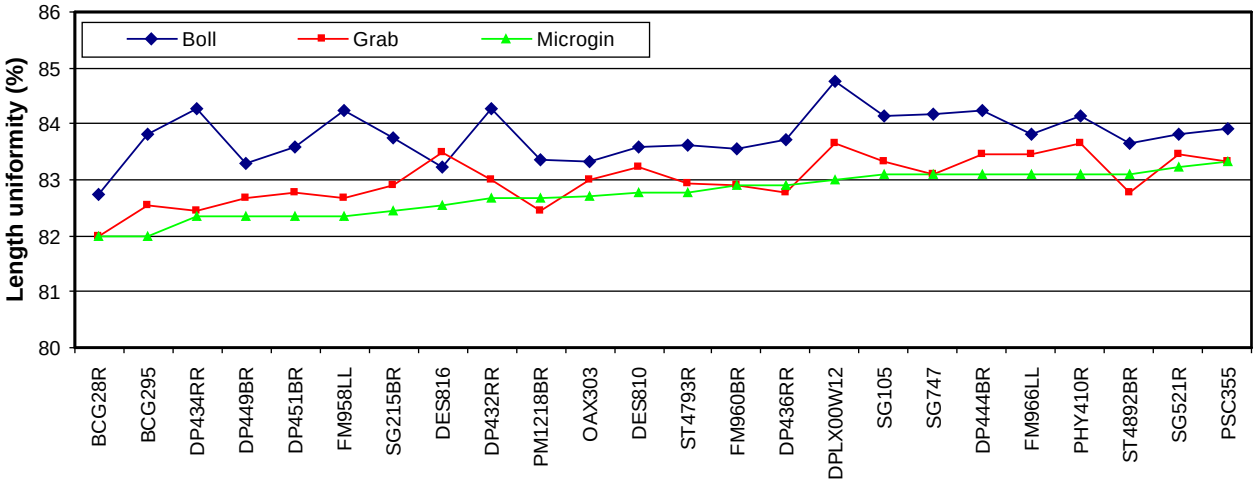

Figure 8b. Fiber length uniformity determined with boll, grab, and microgin samplesfor early maturing cultivars sorted by the microgin results. Only cultivars grown in all three tests (Stoneville and Tribbett in 2003 and Stoneville in 2004) were included, and values for each cultivar are the means from all three tests. Between cultivars within each sample group, the least significant difference was 0.76.

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