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SMALL SAMPLE TECHNIQUES TO EVALUATE COTTON VARIETY TRIALS

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Abstract

Cotton cultivars were evaluated for differences in gin turnout and High Volume Instrument (HVI) fiber properties. The objective was to determine if cultivar differences after conventional processing were predicted with two small sample techniques. The microgin sample, which represented conventional processing, included entire plots of cotton spindle picked and processed through a typical sequence of gin machinery including drying and cleaning. The grab sample was collected by hand from the picker, and the boll sample was picked by hand from the plant. Grab samples and boll samples were ginned on a smaller 10-saw gin without cleaning machinery. For each cotton property, a statistical model was developed to explain variation due to cultivar, sample method, and other factors; and the interaction between cultivar and sample method was analyzed. The most important finding was that cultivars tended to compare differently, in some cases, depending on the sample method. This was revealed statistically when the interaction between cultivar and sample was significant. The interaction was significant for leaf and reflectance when grab or boll sample data sets were included with the microgin data set. The interaction was significant for length and uniformity when the boll sample data set was included with the microgin data set. The interaction was significant for gin turnout when the grab sample data set was included with the microgin data set. For micronaire, strength, and yellowness, the small sample methods revealed cultivar differences that were not statistically different from the microgin.

Introduction

Small sample techniques used to evaluate cotton cultivars for High Volume Instrument (HVI) and gin turnout measurements can be used to predict actual values expected in full scale operation. Bolls harvested by hand from the plant or grabbed from the machine harvester can be ginned on small laboratory gins to determine fiber properties. These are very useful techniques since experimental trials often consist of small plots. These small sample methods differ 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 by hand 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. Due to these differences, experiments are needed to determine the importance of these factors in cultivar comparison trials.

In one such experiment, Calhoun et al. (1996) found that gin turnout (lint percent) was overestimated by 4% or more by both grab samples and boll samples when compared to conventional processing, and an interaction was found between sample method and cultivar. For HVI length, strength, and micronaire, no interaction was found between sample method and cultivar, but length and micronaire were both overestimated with the small sample methods. Boykin and Creech (2004) compared hand picked boll samples (processed on a 10-saw gin) to machine picked samples processed through conventional ginning machinery (machine picked, dryer, cylinder cleaner, stick machine, cylinder cleaner, extractor-feeder/gin stand, and two saw-type lint cleaners) and found interactions between cultivar and sample method for HVI length, strength, uniformity, reflectance, and leaf. No interaction was found for gin turnout, micronaire, or yellowness. Overall, boll samples had higher values for gin turnout, length, micronaire, strength, and uniformity; and had lower values for reflectance, yellowness, and leaf.

In this experiment, boll samples and grab samples were compared to conventionally processed samples for gin turnout (lint percent) and High Volume Instrument (HVI) parameters. This research was conducted to support conclusions drawn from previous research and to address additional parameters; such as uniformity, reflectance, yellowness, and leaf; previously not compared between all three sample methods.

Materials and Methods

Small plots of cotton from the Mississippi Regional Cotton Variety Trials in 2003 and 2004 were machine picked and ginned in a small scale cotton gin (microgin) utilizing 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 38 early maturing cultivars and 27 medium maturing cultivars grown in two locations (Stoneville and Tribbett, MS) in 2003 and one location (Stoneville, MS) in 2004. Each cultivar was replicated 6 times across the field at each location. The same cultivars were grown at each location in 2003, and 24 early maturing and 11 medium maturing cultivars were the same in each year. In the microgin, bags of cotton 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 without mixing. Gin turnout and fiber quality was determined to study cultivar differences. 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 Instrument (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. Mixed plot gin turnout data could not be avoided. 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 200g) 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 after pairing reps, so these samples came from reps 1 or 2, 3 or 4, and 5 or 6. It was not certain which bag (rep) each grab sample was taken from, but since the sample came from only one bag it was not from mixed field plots. Gin turnout and fiber quality were also obtained from these samples to compare to conventional (microgin sample) results. The MIXED procedure was used to analyzed the factors maturity, cultivar (within maturity), sample method, and their interactions while considering the random effects of year and location (Proc Mixed, SAS v8.2, Cary N.C., 2001).

Results

Gin turnout and fiber properties based on 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 methods used to sample plots of cotton when evaluating differences in fiber properties.

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

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

[z] Values statistically equal to maximum followed by “H” and minimum followed by “L”.
[y] F-values corresponding to p-values under 0.05 followed by “*” and under 0.01 followed by “**”.
[x] LSD=least significant difference.

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

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

[z] Values statistically equal to maximum followed by “H” and minimum followed by “L”.
[y] F-values corresponding to p-values under 0.05 followed by “*” and under 0.01 followed by “**”.
[x] LSD=least significant difference.

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

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

[z] Values statistically equal to maximum followed by "H" and minimum followed by "L".
[y] F-values corresponding to p-values under 0.05 followed by "*" and under 0.01 followed by "**".
[x] LSD=least significant difference.

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

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

[z] Values statistically equal to maximum followed by "H" and minimum followed by "L".
[y] F-values corresponding to p-values under 0.05 followed by "*" and under 0.01 followed by "**".
[x] LSD=least significant difference.

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

Cultivar	% Gin turnout	Length, mm	Length uniformity, %	Mic-ronaire	Strength, cN/tex	Rd	+b	Leaf
FM 958 LL	35.78	28.6	82.56	4.28	30.60	82.11H	7.68L	3.00H
FM 960 B2R	35.60	29.5H	81.89L	4.48	31.75	81.78H	7.74L	2.56
FM 960 BR	35.53	28.0	82.56	4.34	32.74H	81.78H	7.94	2.44
FM 960 RR	36.51	28.5	82.00	3.94L	30.77	82.44H	7.99	2.78
FM 966 LL	35.46	28.5	82.44	4.30	33.10H	81.89H	7.71L	2.89H
BCG 28 R	37.22	28.0	81.67L	4.66H	27.23	81.56	8.14	2.67
BCG 295	35.09	29.4H	81.89L	4.23	29.66	82.00H	8.16	2.44
DP 424 BGII/RR	33.56L	27.4	82.56	4.43	26.46L	81.67H	8.39	2.22L
DP 432 RR	36.10	27.8	82.89	4.30	27.06	80.00	8.56	3.33H
DP 434 RR	37.64	29.0	82.00	4.16	25.76L	81.67H	7.90	3.00H
DP 436 RR	32.66L	28.3	82.56	4.28	25.57L	82.00H	8.07	2.11L
DP 444 BG/RR	36.59	28.2	82.44	3.92L	26.53L	80.89	8.19	2.78
DP 449 BG/RR	36.10	27.9	82.33	4.40	29.48	82.11H	7.92	2.22L
DP 451 BG/RR	33.73	28.4	82.00	4.33	26.65L	81.67H	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	81.89L	4.00L	29.91	79.78	8.88H	2.89H
PM 1218 BG/RR	36.74	27.2L	82.89	4.71H	25.98L	81.00	8.47	2.00L
SG 105	35.23	28.3	83.22H	4.33	28.66	81.56	8.28	2.56
SG 215 BG/RR	36.09	26.9L	82.33	4.56	25.55L	81.22	8.68	1.89L
SG 521 R	35.33	26.9L	82.89	4.46	25.41L	80.11	8.58	3.00H
SG 747	37.28	28.2	82.78	4.69H	25.75L	79.89	9.01H	2.44
DES 810	35.17	27.5	82.22	4.16	29.32	79.11L	8.41	3.33H
DES 816	34.61	28.5	82.67	4.40	29.45	79.89	8.18	3.33H
OAX 303	39.22H	27.8	82.78	4.63H	26.81	82.11H	8.10	2.33L
PHY 410 R	35.11	28.4	83.67H	4.42	27.43	79.44L	8.43	3.11H
PSC 355	35.69	27.9	83.22H	4.64H	28.39	78.78L	8.81	3.22H
ST 4646 B2R	34.87	27.5	81.89L	4.42	26.76	79.67	8.66	3.00H
ST 4793 R	36.68	27.0L	82.11	4.73H	26.59L	79.78	8.86H	3.11H
ST 4892 BR	36.84	27.3L	83.11H	4.76H	27.13	79.78	8.69	3.11H
ST 5242 BR	36.86	27.7	82.33	4.41	26.56L	81.22	8.30	2.67
ST 5599 BR	36.93	28.0	81.33L	4.41	29.46	79.56L	8.31	3.00H
STX 3636 B2R	35.61	27.8	81.33L	4.39	26.17L	80.22	8.28	3.22H
STX 4575 BR	36.75	27.5	83.00	4.37	27.91	80.11	8.79	3.00H
STX 4686 R	37.36	28.0	81.78L	4.22	26.99	81.44	8.51	2.56
DX 241203	37.19	28.7	82.78	4.26	28.96	81.78H	8.23	2.44
DX 25105N	38.35H	28.6	82.22	4.53	27.29	80.33	8.38	3.00H
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 [x]	0.95	0.5	0.62	0.13	1.32822	0.81	0.19	0.47

[z] Values statistically equal to maximum followed by “H” and minimum followed by “L”.
[y] F-values corresponding to p-values under 0.05 followed by “*” and under 0.01 followed by “**”.
[x] LSD=least significant difference.

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

Cultivar	% Gin turnout	Length, mm	Length uniformity, %	Mic-ronaire	Strength, cN/tex	Rd	+b	Leaf
FM 800 B2R	35.25	29.9H	82.78	4.00	31.75H	82.89H	7.86	2.44
FM 800 BR	36.08	29.7	83.11H	3.81L	31.63H	82.56H	7.79L	1.89L
FM 800 RR	36.54	29.2	83.67H	4.39	31.93H	81.78	8.19	2.00L
FM 832 LL	35.07	30.2H	82.56	3.88L	31.73H	81.33	7.64L	3.11H
FM 991 B2R	33.00L	29.2	82.56	4.27	31.28H	81.33	8.22	2.22
BCG 24 R	36.80	27.5L	82.00	4.23	27.59	83.11H	7.84	2.11
DP 449 BG/RR	35.77	28.0	82.56	4.31	30.62	81.78	8.09	1.89L
DP 458 B/RR	36.00	27.4L	81.67	4.47	29.39	81.89	8.19	1.44L
DP 488 BG/RR	37.74	29.4	82.44	4.40	30.38	80.44	8.57	2.00L
DP 491	38.71	29.8H	82.44	4.20	31.53H	80.56	8.40	2.67H
DP 493	39.84H	27.8	81.11L	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	1.78L
DP 555 BG/RR	39.64H	27.4L	80.89L	4.51	28.70	83.00H	7.74L	1.78L
DPLX01W93BR	37.43	28.5	82.89	4.32	29.69	80.44	8.43	2.56H
DPLX02T57R	34.74	27.6L	82.22	4.41	28.56	80.56	8.03	3.11H
DPLX02X39BR	37.04	28.4	81.67	4.03	30.76	78.33L	9.04H	2.89H
DPLX03Q301BR	35.24	28.2	81.78	4.49	29.77	81.22	8.09	1.89L
SG 747	36.83	28.0	82.78	4.71H	25.84L	80.56	9.16H	1.78L
PSC 355	35.18	28.1	83.11H	4.54	28.92	78.67L	8.93	3.11H
ST 5242 BR	36.64	27.5L	82.67	4.39	26.50L	81.44	8.64	2.33
ST 5303 R	35.65	27.2L	83.33H	4.54	29.68	81.33	8.31	1.67L
ST 5599 BR	37.17	27.7	81.44L	4.39	29.15	80.33	8.49	2.78H
STX 5454 B2R	33.94L	28.0	82.00	4.59H	28.80	81.11	8.72	1.78L
STX 6636 BR	34.35	28.8	82.67	4.49	30.14	80.33	8.81	2.22
STX 6848 R	33.86L	28.3	83.56H	4.67H	31.23H	79.56	8.63	2.67H
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 [x]	0.99	0.4	0.70	0.17	1.07	0.95	0.18	0.58

[z] Values statistically equal to maximum followed by "H" and minimum followed by "L".
[y] F-values corresponding to p-values under 0.05 followed by "*" and under 0.01 followed by "**".
[x] LSD=least significant difference.

Small sample methods (boll and grab) typically used to study cultivar differences in lint percent and HVI parameters were compared to samples that were conventionally picked and ginned (microgin) from the same plots. For each property, a statistical model was developed that included the dependent fixed variables maturity, cultivar (within maturity), sample, sample*maturity, and sample*cultivar (within maturity) and the random variables crop-year*field, crop-year*field*maturity, crop-year*field*cultivar (within maturity), and crop-year*field*sample. Separate models were developed to analyze boll and grab sample data with microgin data. When each cotton property was analyzed, the most important factor in consideration was the interaction between sample and cultivar. A significant interaction indicated that cultivars compared differently depending on which sample method was used. Another important factor was the significance of cultivar differences since variation between cultivars was required to reveal sampling differences.

There was no significant interaction between cultivar and sample method for strength, micronaire, and yellowness when either small sample data set was included with the microgin data set (table 7 and table 8). For these properties, differences between any two cultivars in the microgin data set were either the same or differed by no more than one level of significance when small sample methods were used. Figure 1a illustrates the high correlation between fiber strength determined 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 there was no interaction between cultivar and sample method, 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 based on microgin data, but this was not seen for boll and grab data. Also, DES810 had increased fiber strength relative to other cultivars when the microgin data was compared to the boll sample and grab sample data. Even though SG521R and DES810 appeared in the plots to behave differently between sampling methods, differences were statistically insignificant. Figures 2a and 2b are similar to figures 1a and 1b, but they illustrates micronaire determined with the boll, grab, and microgin sample data. Compared to the plots of fiber strength, it is not as obvious in figures 2a and 2b that trends between cultivars for micronaire based on the boll or grab sample data were not statistically different from trends between cultivars for microgin sample data. This was due to overall cultivar differences being less significant (lower F-values) for micronaire than strength (table 9). For properties such as strength, micronaire, and yellowness with no interaction between cultivar and sample method, it is important to note that properties may have differed 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 utilizing 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 data obtained from the other sample methods, yet there was no statistically significant interaction between cultivar and sample method.

Table 7. F-values based on boll and microgin samples.

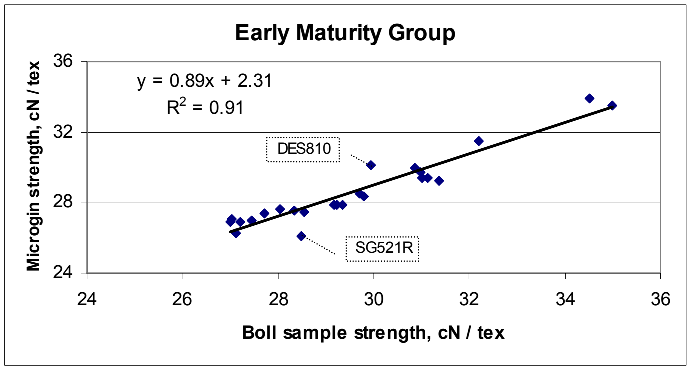
Parameter	Gin Turnout	Length	Length uniformity	Strength	Mic.	Rd	+b	Leaf
Maturity	0.05	7.93	0.00	*21.35	1.29	2.08	1.93	**33.40
Cultivar (within maturity)	**17.06	**10.03	**4.53	**25.54	**6.67	**7.01	**6.10	**2.80
Sample method	*45.98	2.04	9.92	2.47	6.12	0.09	13.30	**27.43
Maturity*sample	**7.01	**42.56	**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] F-values corresponding to p-values under 0.05 followed by "*" and under 0.01 followed by "**".

Table 8. F-values based on grab and microgin samples.

Parameter	Gin Turnout	Length	Length uniformity	Strength	Mic.	Rd	+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] F-values corresponding to p-values under 0.05 followed by "*" and under 0.01 followed by "**".



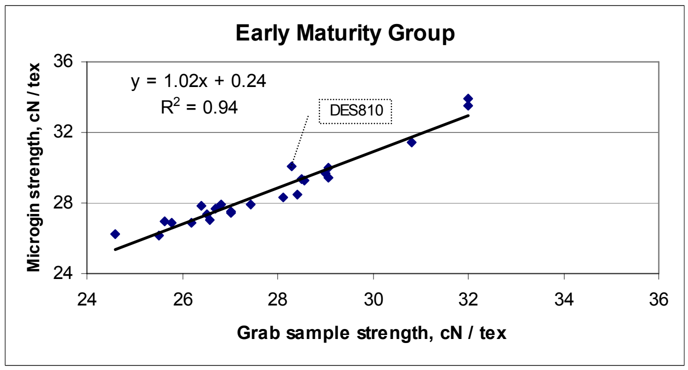


Figure 1a. Relationships between the microgin fiber strength data and the boll or grab sample fiber strength data for cultivars in the early maturity group. Only cultivars grown in all three tests (Stoneville and Tribbett in 2003 and Stoneville in 2004) were included, and values given for each cultivar was the mean value across all three tests.

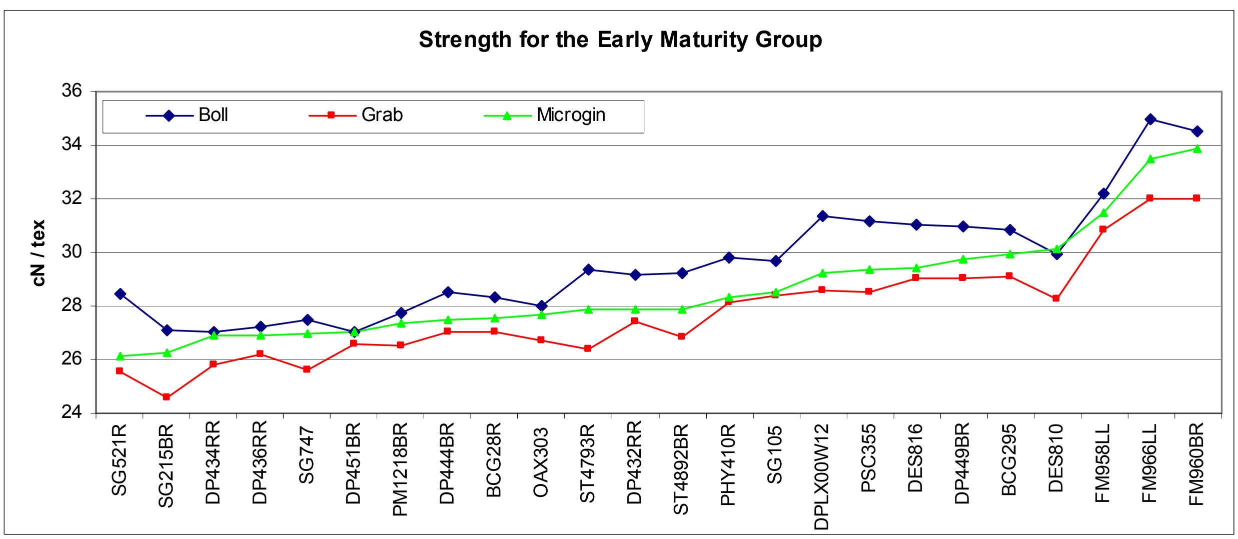
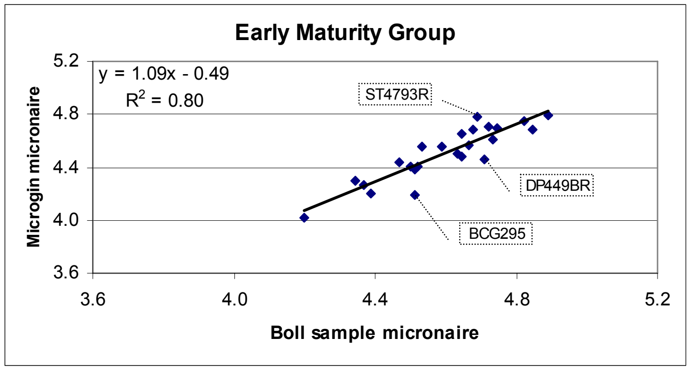


Figure 1b. This plot illustrates fiber strength determined with boll, grab, and microgin sample data for early maturing cultivars sorted by the microgin results. Only cultivars grown in all three tests (Stoneville and Tribbett in 2003 and Stoneville in 2004) were included, and values given for each cultivar was the mean value across all three tests.



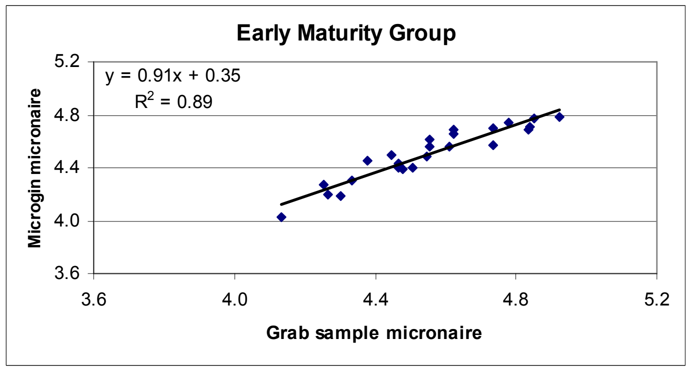


Figure 2a. Relationships between the microgin micronaire data and the boll or grab sample micronaire data for cultivars in the early maturity group. Only cultivars grown in all three tests (Stoneville and Tribbett in 2003 and Stoneville in 2004) were included, and values given for each cultivar was the mean value across all three tests.

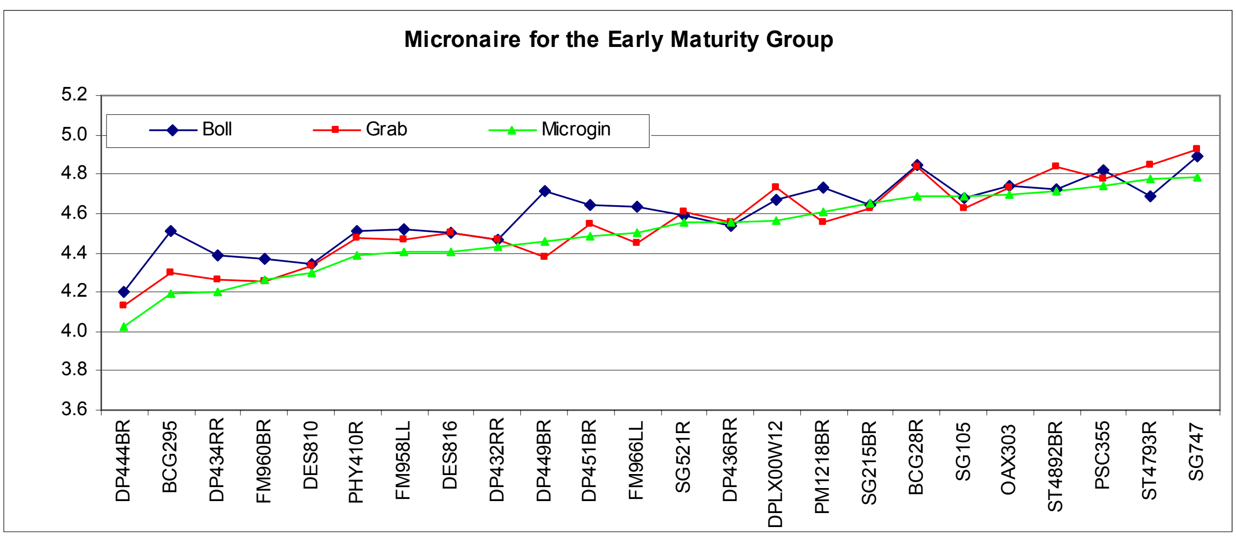


Figure 2b. This plot illustrates micronaire determined with boll, grab, and microgin sample data for early maturing cultivars sorted by the microgin results. Only cultivars grown in all three tests (Stoneville and Tribbett in 2003 and Stoneville in 2004) were included, and values given for each cultivar was the mean value across all three tests.

Table 9. F-values for cultivar differences in HVI properties using 3 sample methods.

	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
Rd	8.02	2.30	5.96
+b	5.42	3.58	4.40
Leaf	4.80	1.99	4.94

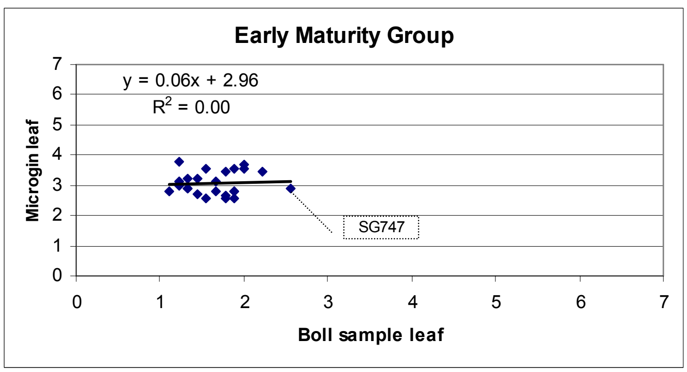
When the boll sample data set was included with the microgin data set, a significant interaction between cultivar and sample method was seen for length, uniformity, reflectance, and leaf (table 7). When the grab sample data set was included with the microgin data set, a significant interaction was found only for turnout, reflectance, and leaf (table 8). Notice that interactions between sample method and cultivar were 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. This was not surprising since only the microgin method included seed cotton and lint cleaners which improve both leaf and reflectance. Figure 3a shows there was no correlation between microgin and boll sample leaf grade data, but the correlation between microgin and grab sample data was much higher. Figure 3b 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 by hand which collected less leaf than the machine picker. Cultivar differences in leaf based on grab sample data (without cleaning) give an indication of which cultivars were cleaner. Some of these differences persisted through ginning. But, some cultivars that were exceptionally easy or difficult to clean changed disproportionately causing the interaction between cultivar and sample method. For reflectance, the microgin data was more strongly correlated with the grab sample data than the boll sample data (figure 4a). Figure 4b illustrates differences in reflectance with cultivars sorted by microgin results. Cultivar differences in reflectance based on small sample methods (without cleaning) give an indication of which cultivars were higher 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.

For gin turnout (or lint percent), only the grab sample data set showed a significant interaction between sample and cultivar when included with the microgin data set (table 8). Figure 6a shows that both the grab and boll sample data for gin turnout was highly correlated with the microgin data. Figure 6b illustrates differences in turnout with cultivars sorted by microgin results. Based on grab samples, turnout was increased for DES810, PHY410R, and SG105. Differences were probably related to seed cotton and lint cleaning. If considerably more trash is removed from one cultivar than another in the microgin, considerably less lint (including trash) will be yielded from the sample. There was no interaction seen when the boll sample data set was included with the microgin data set (table 7). These samples were picked clean with very little trash to remove. The lint percent was higher for boll samples (table 10) since the clean boll samples weighed less in comparison to the lint, but this difference affected cultivars equally.

When included with the microgin data set, only the boll sample data set showed significant interactions between sample and cultivar for length and uniformity. The boll samples, overall, had higher length and uniformity (table 10). Figure 7a shows that both boll sample and grab sample fiber length data were highly correlated with microgin data. Figure 7b illustrates differences in fiber length with cultivars sorted by microgin results. The cultivar DP434RR had a shorter fiber length relative to FM958LL and DPLX00W12 when the boll sample data was compared to the microgin data. Microgin uniformity data showed low correlation with grab sample data and no correlation with boll sample data (figure 8a). In figure 8b, the cultivars DPLX00W12, DP432RR, FM958LL, and DP434RR had higher length uniformity compared to other cultivars when the boll sample data was analyzed, but this was not found in 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 that were better than the plant average, this could have been a source of the interaction between sample and cultivar. In this case, the interaction would indicate not only that the bolls differed 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 interaction between cultivar and sample method since boll samples were not cleaned and subjected to this damage.

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

Sample	% Gin turnout	Length, mm	Length uniformity, %	Strength, cN/tex	Mic.	Rd	+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



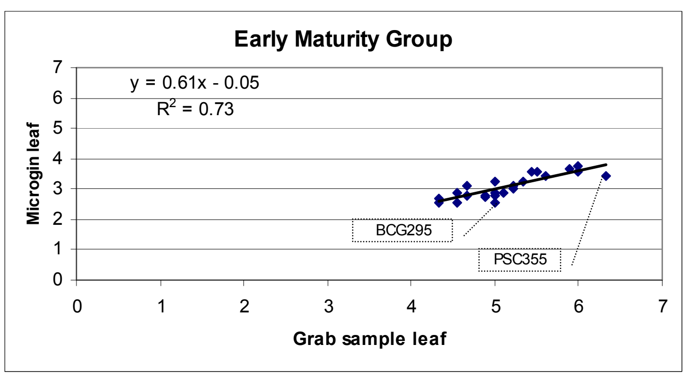


Figure 3a. Relationships between the microgin leaf grade data and the boll or grab sample leaf grade data for cultivars in the early maturity group. Only cultivars grown in all three tests (Stoneville and Tribbett in 2003 and Stoneville in 2004) were included, and values given for each cultivar was the mean value across all three tests.

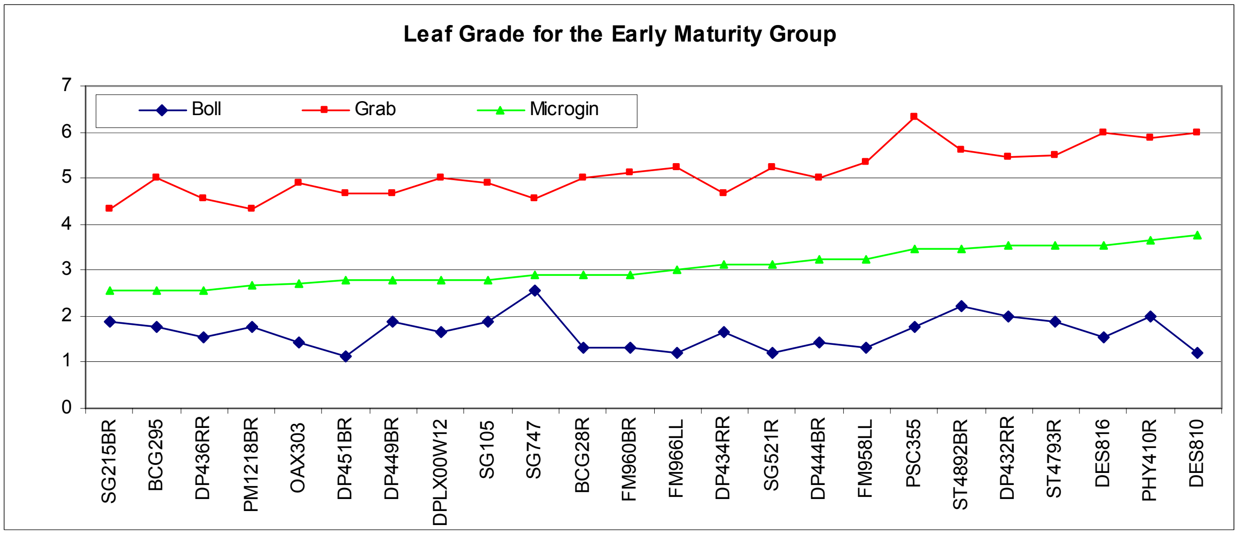
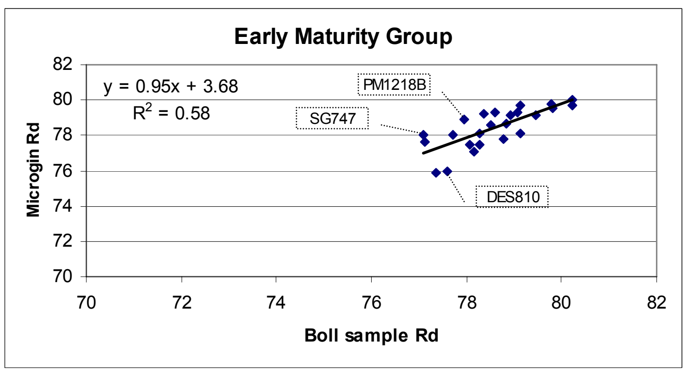


Figure 3b. This plot illustrates leaf grade determined with boll, grab, and microgin sample data for early maturing cultivars sorted by the microgin results. Only cultivars grown in all three tests (Stoneville and Tribbett in 2003 and Stoneville in 2004) were included, and values given for each cultivar was the mean value across all three tests.



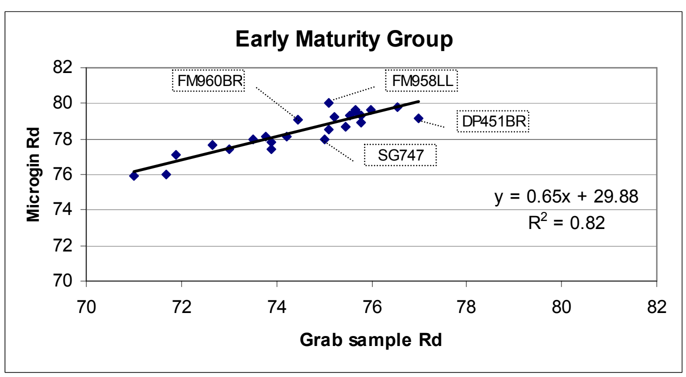


Figure 4a. Relationships between the microgin reflectance (Rd) data and the boll or grab sample reflectance (Rd) data for cultivars in the early maturity group. Only cultivars grown in all three tests (Stoneville and Tribbett in 2003 and Stoneville in 2004) were included, and values given for each cultivar was the mean value across all three tests.

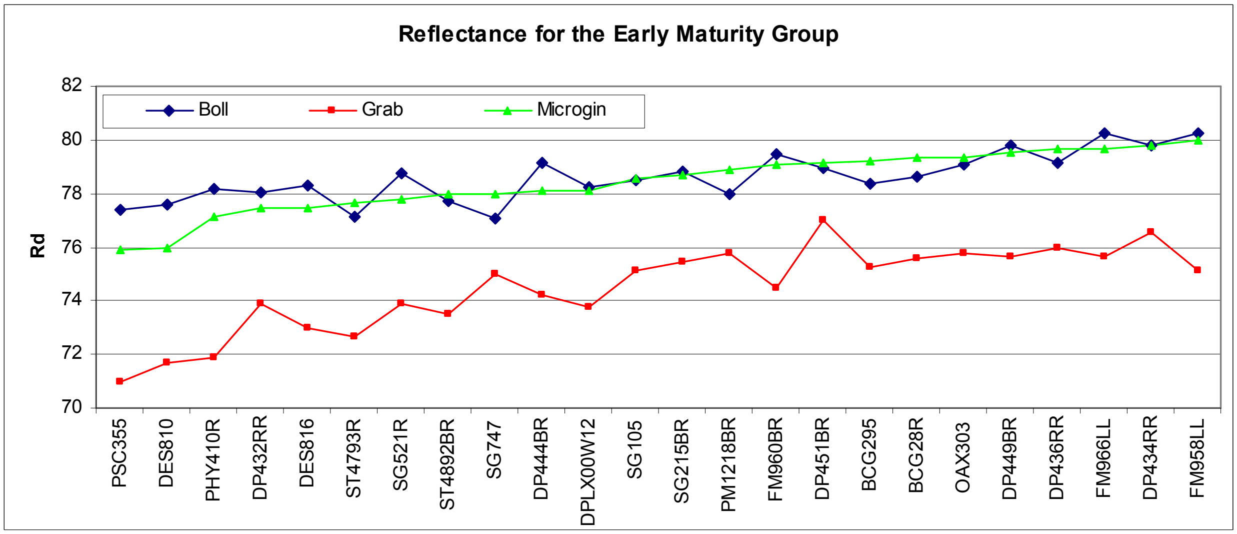
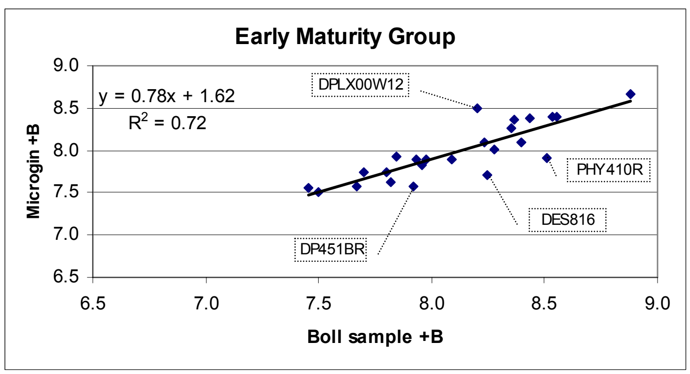


Figure 4b. This plot illustrates reflectance determined with boll, grab, and microgin sample data for early maturing cultivars sorted by the microgin results. Only cultivars grown in all three tests (Stoneville and Tribbett in 2003 and Stoneville in 2004) were included, and values given for each cultivar was the mean value across all three tests.



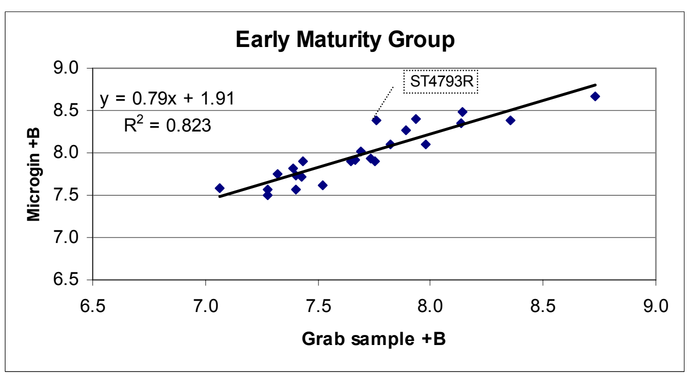


Figure 5a. Relationships between the microgin yellowness (+B) data and the boll or grab sample yellowness (+B) data for cultivars in the early maturity group. Only cultivars grown in all three tests (Stoneville and Tribbett in 2003 and Stoneville in 2004) were included, and values given for each cultivar was the mean value across all three tests.

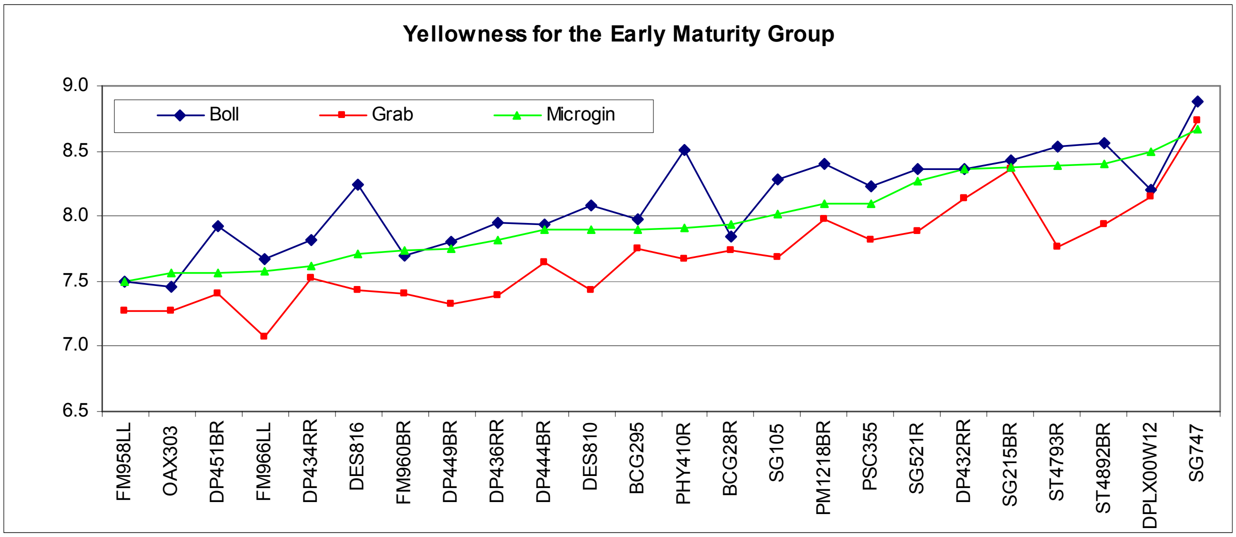
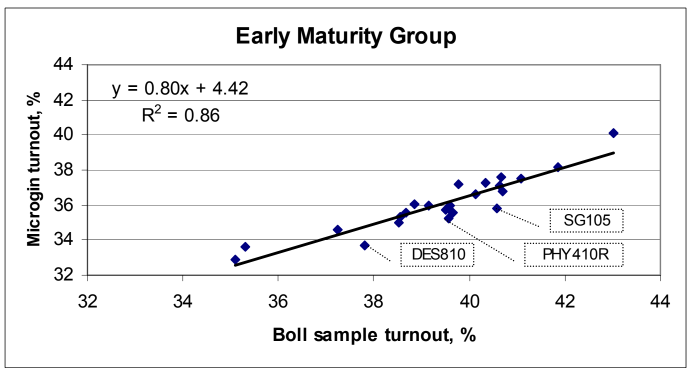


Figure 5b. This plot illustrates yellowness determined with boll, grab, and microgin sample data for early maturing cultivars sorted by the microgin results. Only cultivars grown in all three tests (Stoneville and Tribbett in 2003 and Stoneville in 2004) were included, and values given for each cultivar was the mean value across all three tests.



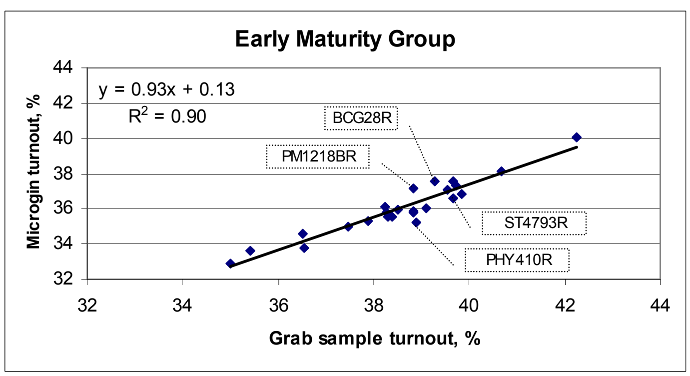


Figure 6a. Relationships between the microgin turnout data and the boll or grab sample turnout data for cultivars in the early maturity group. Only cultivars grown in all three tests (Stoneville and Tribbett in 2003 and Stoneville in 2004) were included, and values given for each cultivar was the mean value across all three tests.

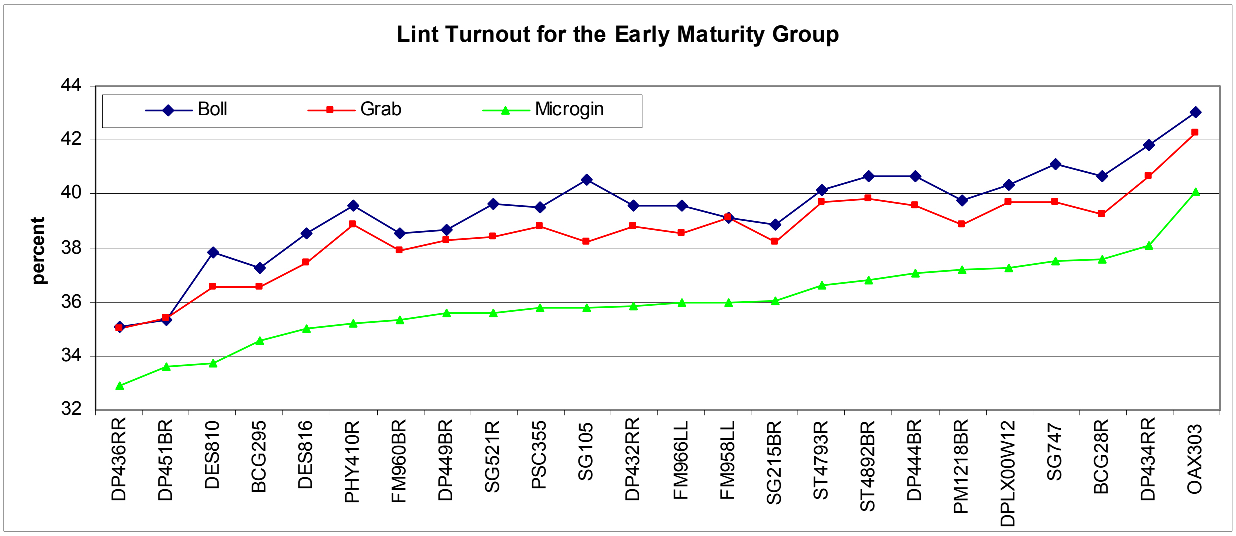
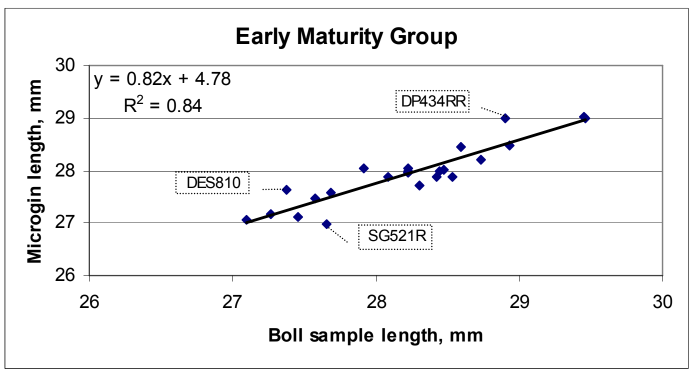


Figure 6b. This plot illustrates percent lint turnout (gin turnout) determined with boll, grab, and microgin sample data for early maturing cultivars sorted by the microgin results. Only cultivars grown in all three tests (Stoneville and Tribbett in 2003 and Stoneville in 2004) were included, and values given for each cultivar was the mean value across all three tests.



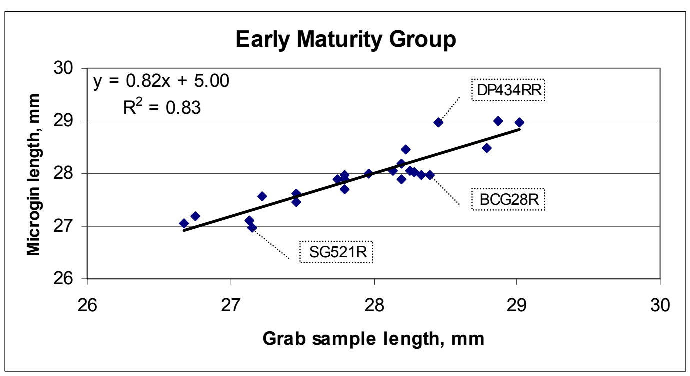


Figure 7a. Relationships between the microgin fiber length data and the boll or grab sample fiber length data for cultivars in the early maturity group. Only cultivars grown in all three tests (Stoneville and Tribbett in 2003 and Stoneville in 2004) were included, and values given for each cultivar was the mean value across all three tests.

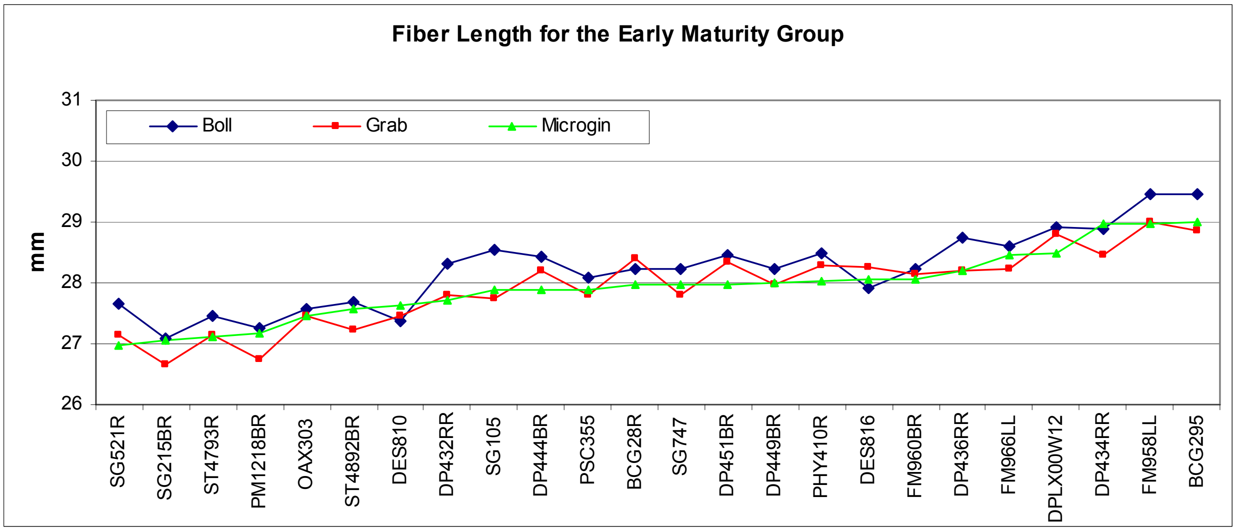
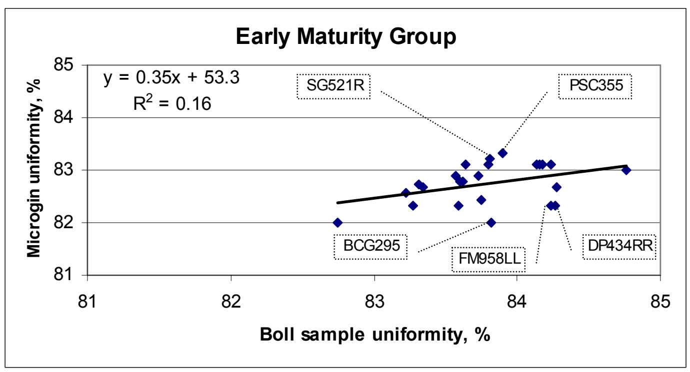


Figure 7b. This plot illustrates fiber length determined with boll, grab, and microgin sample data for early maturing cultivars sorted by the microgin results. Only cultivars grown in all three tests (Stoneville and Tribbett in 2003 and Stoneville in 2004) were included, and values given for each cultivar was the mean value across all three tests.



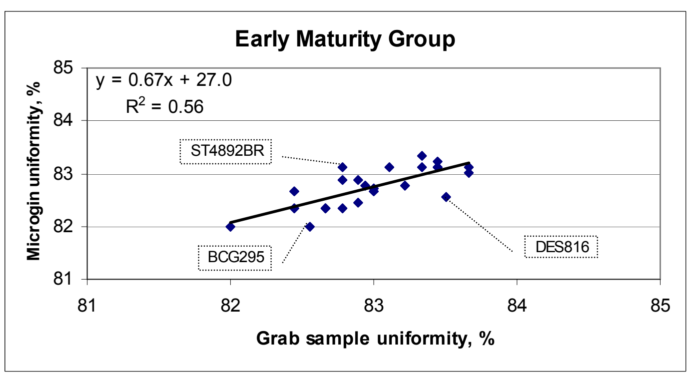


Figure 8a. Relationships between the microgin length uniformity data and the boll or grab sample length uniformity data for cultivars in the early maturity group. Only cultivars grown in all three tests (Stoneville and Tribbett in 2003 and Stoneville in 2004) were included, and values given for each cultivar was the mean value across all three tests.

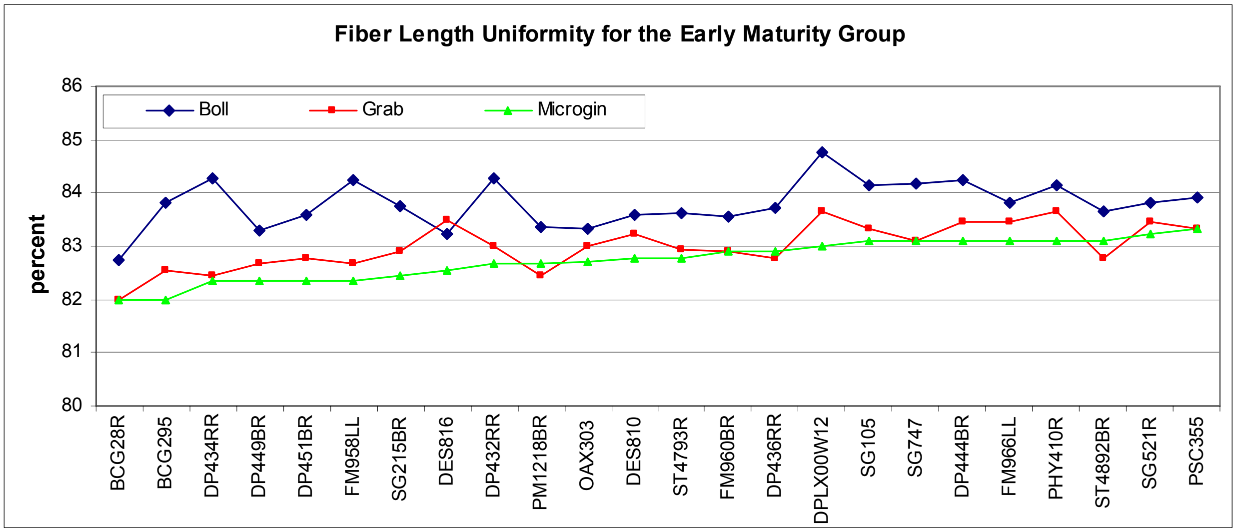


Figure 8b. This plot illustrates fiber length uniformity determined with boll, grab, and microgin sample data for early maturing cultivars sorted by the microgin results. Only cultivars grown in all three tests (Stoneville and Tribbett in 2003 and Stoneville in 2004) were included, and values given for each cultivar was the mean value across all three tests.

Whether the interactions between cultivar and sample method 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. For most properties, the interaction between cultivar and sample method is insignificant or small compared to the significance of cultivar differences. This means that in most cases there are no extreme changes in results when different sampling methods are utilized. But, it should be no 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.

Conclusions

The microgin data described gin turnout and fiber quality differences between cotton cultivars after conventional processing. Small sample (boll and grab) data were compared to microgin data. In most cases, properties differed most significantly between cultivars when the microgin data were analyzed. For strength, micronaire, or yellowness, relative differences in cultivars were similar when small sample (boll or grab) data were compared to the microgin data. Cultivar differences in reflectance and leaf determined with the microgin data were statistically different using boll or grab sample data, and only the grab sample leaf data was correlated with the microgin leaf data. Also, length and uniformity differences seen between cultivars changed when boll sample data were compared to microgin samples, but this was not found to be significant with grab sample data. Microgin turnout data was strongly correlated with both boll sample and grab sample data. In all cases, except leaf and uniformity boll sample data, the overall differences in cultivars were much stronger than the inconsistencies between sample methods, so 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.

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