2004 BELTWIDE COTTON CONFERENCES, SAN ANTONIO, TX – JANUARY 5-9

COMPARISON OF CONVENTIONAL AND BREEDER SAMPLE METHODS FOR FIBER QUALITY PARAMETERS

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Abstract

Two methods for sampling cotton variety trial plots were compared in this test on 38 cultivars grown in an early maturing variety test and 27 cultivars grown in a medium maturing variety test in three replications. Hand picked samples, consisting of 25 randomly chosen bolls from each plot, were taken before picking the entire plot by machine. The samples picked by hand were ginned on a laboratory saw gin and the whole-plot samples were processed through the microgin. All properties were more precise for the microgin samples than for the hand-picked boll samples. Gin turnout, Micronaire, uniformity, fiber length, strength, and seed index were overestimated by hand-picked boll samples, while reflectance, yellowness, leaf, and price were underestimated by hand-picked boll samples. There were trends between the microgin and hand-picked boll sample data for gin turnout (lint percent), fiber length, micronaire, strength, reflectance, yellowness, and seed index, but relative differences in cultivars were consistent between sample methods only for gin turnout, micronaire, and seed index. There was very little comparison between the microgin and hand-picked boll samples for uniformity, leaf, or lint value. Conventional results may be better predicted by using an improved protocol for hand sampling.

Introduction

Cotton variety trials are conducted on different scales for different phases of cultivar development. Small-scale test plots may be used in the early phases, while larger trials are usually conducted on more developed cultivars or commercially available varieties to give producers information to use in cultivar selection. Smaller plots may be sampled by picking bolls randomly by hand or by picking all bolls from several plants. Larger plots can be picked by hand or machine. These samples are typically ginned on small laboratory gins without any pre-cleaning or lint cleaning.

Full-scale gins are too large to gin typical test plots. The microgin is a small-scale gin, less than two feet in width, which includes the standard ginning machine sequence and processes about twenty pounds of seed cotton per minute. This gin can be used to gin seed cotton lots under 50 pounds, and will produce fiber quality and gin turnout data consistent with full scale gins (Anthony and McCaskill, 1972).

Previous research compares sample methods for lint yield and fiber quality. One report included samples picked by hand (100 bolls per plot), samples grabbed from the cotton picker (400-600 g seed cotton per plot), and whole-plot samples (Calhoun *et al.*, 1996). The small samples were ginned on a laboratory gin, and the whole-plot samples were ginned through the microgin. Lint percent, length, strength, and Micronaire were reported in this test of 24 cultivars replicated three times in each of three locations. The author found that both small sample methods overestimated lint percent by at least 4%, and that there was a significant interaction between the sample methods and cultivars. For length, strength, and Micronaire, he found that all sample methods reflected relative differences similar among cultivars, but length and Micronaire were both overestimated by the small sample methods, more so for samples picked by hand.

Plant breeders often use hand-picked boll samples ginned on laboratory gins to estimate lint yield and fiber quality from small test plots, especially in the early stages of cultivar development. This experiment replicated the study by Calhoun *et* al. (1996) on current cotton cultivars and included additional fiber quality parameters, but this test did not include picker grab samples. In this experiment, yield and fiber quality data were collected for samples picked by hand and conventional samples. Samples picked by hand consisted of 25 bolls randomly chosen from each plot and ginned on a 10-saw laboratory gin. Conventional samples were picked by machine and ginned in the microgin. The purpose of the study was to determine if the breeder samples picked by hand using this method: 1) adequately represent fiber quality and gin turnout and 2) reflect relative differences in gin turnout and fiber quality among cultivars.

Methods

The Regional Cotton Variety Test (RCVT) was conducted with cultivars of cotton grown in two sections of field 7 of sandy loam soil near Stoneville, MS. There were 38 early maturing cultivars harvested from one section on October 16, 2002, and there were 27 medium maturing cultivars harvested from another section on October 22, 2002. The early maturing cultivars are listed in Table 1, and the medium maturing cultivars are listed in Table 2. Each cultivar was replicated in six plots, blocked by replication. Plots consisted of 2 rows 100 cm (40 in.) wide and were 12.2 m (40 ft.) long.

The cotton was spindle harvested and stored at the Cotton Ginning Lab in Stoneville, MS, until processed through the microgin. The amount of cotton available from each plot was insufficient for processing in the microgin, so plots replicated in adjacent blocks were combined for a total of three lots to be ginned for each cultivar. Samples taken from each lot included one from each block. The early maturing cultivars were moved into the microgin 17 days before ginning and were spread out for conditioning. The medium maturing cultivars were kept outdoors in a covered trailer. They were moved into the microgin two days before ginning and were spread out for conditioning the day before ginning.

The early maturing cultivars were ginned in the microgin during the period December 9-11, 2002, and the medium maturing cultivars were ginned December 11-12, 2002. Temperature was monitored in the microgin and was typically 20-21ºC (68-70ºF) initially and increased to 24.5ºC (76ºF) during the day. Similarly, relative humidity decreased from about 38-40% initially to 31-35% during the day.

Each lot was ginned and cleared from the gin machinery before ginning the next lot. The machine sequence used was dryer, cylinder cleaner, stick machine, cylinder cleaner (Trashmaster), extractor-feeder/gin stand, and two saw-type lint cleaners. The gin stand used was a Continental Eagle 93 saw gin that had been reduced to 20 saws. The seed cotton was weighed before ginning, and the lint was weighed after ginning. For each lot, three samples were taken for seed cotton moisture and lint moisture determined by the oven method (ASTM 1973), wagon fractionation, feeder fractionation, and High Volume Instrument (HVI). The weights of these samples were recorded. Also, one sample of seed was taken from the seed roll for determination of seed properties, and all gin stand motes were collected and weighed. The weight of lint cleaner waste produced was recorded.

In addition to the conventional spindle-harvesting and ginning, samples (25 bolls) were hand-picked from the first, third, and fifth blocks the day of machine harvesting and ginned with a 10-saw laboratory gin stand (Continental type 10 model A976336). No cleaning or drying was used on these samples. These samples were analyzed for HVI parameters, lint yield, and seed index, and results were compared to data from samples conventionally picked and ginned.

Results and Discussion

All data were analyzed with the SAS General Linear Model (GLM) procedure, and significant differences were reported with 95% confidence. The MEANS procedure was used to approximate the least significant difference (LSD) between cultivars. The MIXED procedure was used to model relationships between sample methods. The LSD was the 95% confidence interval about the sample mean and was used to compare the relative precision of each sample method. The LSD was based on both error due to sampling method and error across plots. Plot to plot error should be equal for each sampling method, so differences in LSD values can be attributed to sampling method error. For gin turnout and seed index, breeder samples were from single plots, but microgin samples were from combined plots, reducing plot-to-plot error. Comparisons of sample method precision for seed index and gin turnout were inaccurate.

Lint Percent and Gin Turnout

Gin turnout was the amount of lint recovered with the microgin from machine-harvested cotton. Lint percent was the amount of lint recovered with a laboratory gin from bolls harvested by hand. For the early maturity test, cultivars varied for both gin turnout, which averaged 34.7% and ranged from 31.2% to 39.1%, and lint percent, which averaged 38.8% and ranged from 34.2% to 43.1% (Table 1). For the medium maturity test, cultivars were also different for both gin turnout, which averaged 34.9% and ranged from 32.5% to 39.0%, and lint percent, which averaged 38.3% and ranged from 35.4% to 41.4% (Table 2).

Comparison statistics between the two methods are reported in Table 3 for the early maturity test and Table 4 for the medium maturity test. Lint percent overestimated gin turnout for both tests by 4.1 (early maturity test) and 3.4 (medium maturity test). Most of this difference was attributed to the trash contents of the samples which were almost 7% for the microgin samples and nearly 0% for the samples picked by hand. Also, gin turnout did not include lint lost during ginning. Gin stand motes and lint cleaner waste (including fiber, motes, and trash) totaled about 1.5% of the initial sample weight. For both tests, there were no significant interactions between cultivar and sample method, and for the early maturity test, there was a high correlation between average lint percent and average gin turnout, therefore, lint percent was an accurate prediction of relative differences in cultivars.

Calhoun *et al.* (1996) found breeder's lint percent to overestimate gin turnout by 4.6%. He found changes in the relative difference among cultivars for the two sample methods, but since the mean squares (MS) were fairly low for the interaction (MS=1.80) and error (MS=0.56) compared to the cultivar (MS=62.68), the interaction may not have been of practical importance.

Fiber Length

For the early maturing cultivars, the upper half mean fiber length of the microgin samples averaged 1.09 in. and ranged from 1.04 in. to 1.13 in. The fiber length of the breeder samples averaged 1.11 in. and ranged from 1.06 in. to 1.16 in. (Table 5). For the medium maturing cultivars, the upper half mean fiber length of the microgin samples averaged 1.11 in. and ranged from 1.04 in. to 1.18 in. The fiber length of the breeder samples averaged 1.13 in. and ranged from 1.07 in. to 1.21 in. (Table 6).

For both tests, the breeder samples overestimated fiber length by 0.02 in. This was likely the result of sampling in favor of the more mature bolls or fiber damage during ginning. Calhoun *et al.* (1996) showed breeder samples overestimated fiber length data by 0.05 in. Statistical results were different between the two tests for interactions between cultivar and sample method (Tables 3 and 4). Data from the medium maturity test showed that relative differences in cultivars for microgin length were reflected by breeder length data, but a significant interaction was found between cultivar and sample method for the early maturity test. The correlation between average breeder and microgin fiber lengths was also higher for the medium maturity test. The average lint moisture content of the cultivars in the early maturity test (4.16%) was lower than in the medium maturity test (5.10%), and more fiber damage during ginning or lint cleaning may have resulted from the lower moisture. The significant interaction between cultivars and sample method seen in the early maturity test could indicate a tendency of some cultivars to withstand fiber breakage better than others. Calhoun *et al.* (1996) found no interaction between sample method and cultivar for fiber length, but results of this test suggested that breeder samples might not have predicted values for fiber length accurately, especially when ginning cotton at low moisture contents.

Micronaire

For the early maturing cultivars, the microgin sample micronaire averaged 4.60 and ranged from 3.97 to 5.07, and the breeder sample micronaire averaged 5.07 and ranged from 4.37 to 5.40 (Table 5). For the medium maturing cultivars, the microgin sample micronaire averaged 4.50 and ranged from 3.82 to 4.95, and the breeder sample micronaire averaged 4.92 and ranged from 4.40 to 5.35 (Table 6).

Cultivars were found to be significantly different for micronaire with both microgin and breeder samples, but the microgin sample micronaire values were much more precise with a smaller LSD. The breeder sample LSD was twice as big as the microgin sample LSD. Microgin sample micronaire was over 0.4 less than breeder sample micronaire, but relative differences in cultivars were similar for both samples (Table 3 and 4). Calhoun *et al.* (1996) found similar relationships where breeder samples overestimated micronaire by 0.54. Ginning is not known to affect micronaire; so hand-picked boll samples likely included more mature bolls not representative of the whole plot.

Strength

For the early maturing cultivars, the microgin sample fiber strength averaged 29.28 g/tex and ranged from 26.93 to 32.80 g/tex, and the breeder sample fiber strength averaged 32.79 g/tex and ranged from 28.93 to 39.87 g/tex (Table 5). For the medium maturing cultivars, the microgin sample fiber strength averaged 30.45 g/tex and ranged from 27.42 to 34.47 g/tex, and the breeder sample fiber strength averaged 32.57 g/tex and ranged from 28.67 to 39.03 g/tex (Table 6).

Both the microgin and breeder samples showed significant differences in strength for different cultivars, but the microgin sample strength was more precise with lower LSD. Microgin strength was about 3.5 g/tex (early maturity test) and 2.1 g/tex (medium maturity test) less than breeder strength, and relative differences in cultivars were different for the two sample methods (Table 3 and 4). These results were different from those by Calhoun *et al.* (1996), who found little difference between the two methods for actual values of strength or relative differences in cultivars.

Uniformity

For the early maturing cultivars, the microgin sample uniformity averaged 82.5 and ranged from 80.5 to 83.3, and the breeder sample uniformity averaged 84.6 and ranged from 83.3 to 85.8 (Table 7). For the medium maturing cultivars, the microgin sample uniformity averaged 82.4 and ranged from 80.5 to 83.7, and the breeder sample uniformity averaged 84.9 and ranged from 83.7 to 86.1 (Table 8).

Both the microgin and breeder samples showed significant differences in uniformity for different cultivars, but the microgin sample uniformity was more precise with lower LSD values. Microgin uniformity was 2.1 (early maturity test) and 2.5 (medium maturity test) less than breeder uniformity, and relative differences in cultivars were different for the two samples methods (Table 3 and Table 4). Differences in uniformity could be attributed to hand picked bolls being more uniform before ginning, or more fiber damage occurring in the microgin.

Reflectance

For the early maturing cultivars, the microgin sample reflectance (Rd) averaged 74.9 and ranged from 72.3 to 78.0, and the breeder sample Rd averaged 70.5 and ranged from 66.6 to 74.3 (Table 7). For the medium maturing cultivars, the microgin sample Rd averaged 73.4 and ranged from 71.0 to 76.0, and the breeder sample Rd averaged 71.7 and ranged from 64.3 to 75.0 (Table 8).

Both microgin and breeder samples showed differences in cultivars for Rd, but the microgin samples were much more precise. The microgin data had lower LSD values. Microgin Rd was 4.4 (early maturity test) and 1.7 (medium maturity test) higher than breeder Rd, and relative differences in cultivars were different for different sample methods in the early maturity test (Table 3 and Table 4). Lint cleaning and blending samples in the microgin probably increased reflectance.

Yellowness

For the early maturing cultivars, the microgin sample yellowness (+B) averaged 8.2 and ranged from 7.6 to 8.8, and the breeder sample +B averaged 7.3 and ranged from 6.6 to 8.0 (Table 7). For the early maturing cultivars, the microgin sample yellowness (+B) averaged 8.5 and ranged from 7.7 to 9.0, and the breeder sample +B averaged 7.3 and ranged from 6.6 to 8.0 (Table 8).

Both microgin and breeder samples showed differences in cultivars for +B, but the microgin samples were more precise with smaller LSD values. Microgin +B was 0.9 (early maturity test) and 1.2 (medium maturity test) higher than breeder +B, but relative differences in cultivar +B were similar for each sample method (Table 3 and Table 4). There was very little correlation between average values for breeder and microgin samples, so breeder samples should not be used to predict yellowness.

Leaf

For the early maturing cultivars, the microgin sample leaf averaged 3.0 and the breeder sample leaf averaged 2.1 (Table 9). For the medium maturing cultivars, the microgin sample leaf averaged 3.4 and the breeder sample leaf averaged 2.0 (Table 10). Both microgin and breeder samples showed differences in cultivars for leaf, but there was almost no relationship between data for different sampling methods. The microgin samples were more precise with lower LSD values. Microgin leaf was 0.83 (early maturity test) and 1.43 (medium maturity test) higher than breeder leaf (Table 3 and Table 4). Breeder boll samples were collected with less leaf trash from the plots.

Seed Index

Seed index was the weight of 100 fuzzy seed. For the early maturing cultivars, the microgin sample seed index (SI) averaged 9.8 g/100 seed and ranged from 7.5 to 11.4, and the breeder sample SI averaged 10.0 g/100 seed and ranged from 8.2 to 11.5 (Table 9). For the medium maturing cultivars, the microgin sample seed index (SI) averaged 9.2 g/100 seed and ranged from 7.4 to 11.2, and the breeder sample SI averaged 9.7 g/100 seed and ranged from 8.1 to 11.9 (Table 10).

Both microgin and breeder samples showed differences in cultivars for SI. Microgin SI was 0.2 g/100 seed (early maturity test) and 0.5 g/100 seed (medium maturity test) lower than breeder SI, but the R^2 values between microgin and breeder SI were high.

Loan Value

For the early maturing cultivars, the microgin sample loan value averaged 54.00 cent/lb. and ranged from 50.73 to 55.90, and the breeder sample loan value averaged 49.13 cent/lb. and ranged from 46.05 to 55.68 (Table 9). For the medium maturing cultivars, the microgin sample loan value averaged 53.57 cent/lb. and ranged from 49.91 to 55.31, and the breeder sample loan value averaged 51.76 cent/lb. and ranged from 44.63 to 55.40 (Table 10).

Both microgin and breeder samples showed differences in cultivars for loan value, but the microgin samples were more precise with lower LSD values. For both the early and medium maturity variety tests, the lint loan value was underestimated by breeder boll samples by 4.87 (early maturity test) and 1.81 (medium maturity test) cent/lb. Relative differences in cultivars were different for microgin and breeder samples with little correlation between the two (Table 3 and Table 4). Differences in loan values were seen before applying discounts and premiums for micronaire, strength, and uniformity (Table 11.). These differences were due to color and leaf grade as well as fiber length. The breeder lint values were increased slightly by strength and uniformity premiums but were more dramatically decreased after micronaire discounts.

Conclusion

Breeder samples picked by hand were chosen randomly but still favored the more select bolls. These more mature bolls inaccurately estimated the whole plant and crop. For some fiber quality parameters, such as gin turnout, seed index, and micronaire, hand-picked boll samples can be used to predict differences in cultivars and their response to machine-harvesting and conventional ginning, though with less precision. For other quality parameters, such as length, strength, reflectance, and yellowness, trends can be expected between results from conventional and hand-picked boll samples, but relative differences

in cultivars change between sample methods. There was very little relationship between sample methods for uniformity, leaf, and lint value.

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Table 1. Average gin turnout (microgin samples machine harvested) and lint percent (breeder samples picked by hand) for cotton cultivars in the early maturity test.

Cultivar	Cultivar	Gin Turnout	Lint Percent
ACALA1517-99	ACALA1517-99	33.6	38.5
ALLTEXATLAS	ALLTEXATLAS	31.2	35.7
AgriPro AP7115	AP7115	35.4	39.1
Stoneville BXN49B(STX0001)	BXN49B(STX0001)	34.8	39.6
Delta Research and Extension Center DES607	DES607	35.4	39.8
Delta Research and Extension Center DES810	DES810	32.3	36.1
Delta Research and Extension Center DES816	DES816	33.8	37.6
Deltapine DP20B	DP20B	32.1	36.5
Deltapine DP436RR	DP436RR	31.5	34.2
Deltapine DP451B/RR	DP451B/RR	31.6	35.0
Deltapine DP458BR	DP458BR	35.4	39.3
Deltapine DP555BG/RR	DP555BG/RR	**39.1**	**42.0**
Deltapine DPLX99X35	DPLX99X35	**38.4**	**41.9**
Fibermax FM958	FM958	35.6	40.4
Fibermax FM958BG (E6478)	FM958BG(E6478)	35.0	38.8
Fibermax FM 966	FM966	34.6	39.2
Mississippi State University MISCOT 8806	MISCOT8806	33.6	38.3
Mississippi State University MISCOT 8839	MISCOT8839	33.4	37.8
NX2429	NX2429	34.0	38.1
Olvey and Assoc. OA-87	OA-87	36.7	40.1
Olvey and Assoc. OA-89	OA-89	33.9	38.1
Olvey and Assoc. OA-90	OA-90	**38.5**	**43.1**
PH98M-2983	PH98M-2983	36.9	41.3
Paymaster PM1199RR	PM1199RR	34.8	39.3
Paymaster PM1218BG/RR	PM1218BG/RR	35.6	39.4
PhytoGen PSC355	PSC355	35.0	38.9
RGC2001	RGC2001	33.9	38.8
RGC2002	RGC2002	33.5	37.9
Sure-Grow SG105	SG105	34.4	38.9
Sure-Grow SG215BG/RR	SG215BG/RR	34.4	38.8
Sure-Grow SG501BR	SG501BR	33.8	37.4
Sure-Grow SG521R	SG521R	34.1	38.4
Sure-Grow SG747	SG747	35.8	40.2
Stoneville ST457(STX8M007)	ST457(STX8M007)	35.1	38.4
Stoneville ST4793R	ST4793R	35.3	40.1
Stoneville ST4892BR	ST4892BR	35.7	39.8
Stoneville STBXN47	STBXN47	35.5	39.1
TEXAS28R	TEXAS28R	36.1	40.2
	max	39.1	43.1
	min	31.2	34.2
	avg	34.7	38.8
	LSD	1.0	1.5

Table 2. Average gin turnout (microgin samples machine harvested) and lint percent (breeder samples picked by hand) for cotton cultivars in the medium maturity test.

Cultivar	Cultivar	Gin Turnout	Lint Percent
Deltapine DP448B	DP448B	34.5	37.7
Deltapine DP458B/RR	DP458B/RR	35.6	38.1
Deltapine DP491	DP491	37.1	**40.6**
Deltapine DP5415RR	DP5415RR	35.9	39.0
Deltapine DP555BG/RR	DP555BG/RR	**39.0**	**41.2**
Deltapine DP565	DP565	35.6	37.9
Deltapine DP5690RR	DP5690RR	32.7	35.6
Deltapine DP655B/RR	DP655B/RR	33.4	35.4
Fibermax FM966	FM966	35.1	38.7
Fibermax FM989BR	FM989BR	33.7	38.5
Fibermax FM989R	FM989R	35.1	38.9
Germain's GC271	GC271	32.5	36.0
Deltapine NUCOTN35B	NUCOTN35B	33.9	35.5
Olvey and Assoc. OA-85	OA-85	37.1	**41.4**
Olvey and Assoc. OA-87	OA-87	35.0	**40.3**
Olvey and Assoc. OA-88	OA-88	37.1	39.0
PhytoGen PSC355	PSC355	34.0	38.0
Sure-Grow SG747	SG747	36.0	**39.7**
Stoneville ST580	ST580	34.8	38.7
Stoneville STX0003	STX0003	34.9	38.3
Stoneville STX9905	STX9905	35.5	39.3
TEXAS245	TEXAS245	33.8	36.7
TEXAS24R	TEXAS24R	35.4	38.2
USGEXP555	USGEXP555	33.4	37.0
USGEXP650	USGEXP650	33.4	35.4
USGEXP710	USGEXP710	34.2	38.3
	max	39.0	41.4
	min	32.5	35.4
	avg	34.9	38.3
	LSD	2.9	2.3

Table 3a. Comparison statistics of microgin (machine harvested) and breeder (picked by hand) sample parameters for the early maturity variety test.

Parameter	Turnout/Lint percent	Length, in.	Micronaire	Strength, g/tex	Uniformity, %
Average Microgin Value	34.7	1.09	4.61	29.28	82.5
Average Breeder Value	38.8	1.11	5.07	32.79	84.6
Difference	-4.11	-0.02	-0.46	-3.51	-2.1
Microgin F-value	38.43	9.30	11.70	12.73	3.65
Breeder F-value	13.99	3.71	2.76	9.70	1.87
P, sample	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
P, cultivar*sample	0.0637	0.0079	0.9076	<0.0001	0.0484
R^2	0.9088	0.5369	0.7790	0.7031	0.2081

Table 3b. Comparison statistics of microgin (machine harvested) and breeder (picked by hand) sample parameters for the early maturity variety test.

Parameter	Reflectance	Yellowness	Leaf	Seed Index, g/100	Loan Value, cent/lb.
Average Microgin Value	74.9	8.2	3.0	9.8	54.00
Average Breeder Value	70.5	7.3	2.1	10	49.13
Difference	4.4	0.9	0.9	-0.2	4.87
Microgin F-value	19.20	7.58	3.18	29.52	4.64
Breeder F-value	3.61	1.96	1.37	9.31	2.48
P, sample	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
P, cultivar*sample	0.0270	0.0711	<0.0001	0.2882	0.0002
R^2	0.7150	0.4418	0.0606	0.8466	0.3530

Table 4a. Comparison statistics of microgin (machine harvested) and breeder (picked by hand) sample parameters for the medium maturity variety test.

Parameter	Turnout or Lint percent	Length, in.	Micronaire	Strength, g/tex	Uniformity, %
Average Microgin Value	34.9	1.11	4.5	30.45	82.4
Average Breeder Value	38.3	1.13	4.92	32.57	84.9
Difference	-3.4	-0.02	-0.42	-2.12	-2.5
Microgin F-value	5.13	17.75	17.73	13.89	8.27
Breeder F-value	5.90	7.37	2.10	9.87	4.17
P, sample	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
P, cultivar*sample	0.3544	0.4616	0.1746	0.0001	0.0003
R^2	0.6928	0.8365	0.6879	0.7516	0.2943

Table 4b. Comparison statistics of microgin (machine harvested) and breeder (picked by hand) sample parameters for the medium maturity variety test.

Parameter	Reflectance	Yellowness	Leaf	Seed Index, g/100	Loan Value, cent/lb.
Average Microgin Value	73.4	8.5	3.4	9.2	53.57
Average Breeder Value	71.7	7.3	2.0	9.7	51.76
Difference	1.7	1.2	1.4	-0.5	1.81
Microgin F-value	5.85	2.34	3.00	23.01	3.23
Breeder F-value	3.34	1.58	1.70	6.56	2.01
P, sample	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
P, cultivar*sample	0.0901	0.1888	0.0001	0.648	0.0749
R^2	0.4651	0.1066	0.0251	0.8341	0.4181

Table 5. Average length, micronaire, and strength for microgin (machine harvest) and breeder (picked by hand) samples of cotton cultivars in the early maturity test.

	Length, in.		Micronaire		Strength, g/tex	
Cultivar	**Microgin**	**Breeder**	**Microgin**	**Breeder**	**Microgin**	**Breeder**
ACALA1517-99	**1.12**	**1.16**	3.97	**4.37**	**31.98**	37.80
ALLTEXATLAS	1.09	1.08	4.53	5.00	30.68	33.70
AP7115	1.08	1.11	4.43	**4.80**	27.78	30.83
BXN49B(STX0001)	**1.12**	**1.12**	4.42	5.10	29.18	30.80
DES607	**1.11**	**1.15**	4.35	**4.77**	28.87	31.23
DES810	1.09	1.08	4.37	**4.83**	30.35	33.77
DES816	1.10	1.11	4.62	**4.90**	30.82	35.80
DP20B	1.11	**1.16**	4.62	5.07	28.43	30.47
DP436RR	1.11	**1.13**	4.70	5.10	28.05	28.93
DP451B/RR	1.11	**1.13**	4.60	5.10	28.92	30.20
DP458BR	1.08	**1.13**	4.68	5.13	29.20	31.73
DP555BG/RR	1.07	**1.13**	4.25	**4.73**	29.63	32.70
DPLX99X35	1.08	1.11	4.70	5.13	27.93	31.60
FM958	**1.13**	**1.14**	4.48	**4.73**	31.52	34.37
FM958BG(E6478)	1.11	1.11	3.97	**4.67**	**32.22**	34.53
FM966	**1.11**	**1.13**	4.27	**4.80**	**32.80**	**39.87**
MISCOT8806	1.11	**1.12**	4.60	5.07	30.82	34.43
MISCOT8839	**1.13**	**1.14**	4.58	4.97	28.67	31.20
NX2429	1.11	**1.13**	4.63	5.37	31.08	34.87
OA-87	1.04	1.06	4.70	5.30	26.93	29.53
OA-89	1.06	1.09	4.62	5.20	28.68	32.40
OA-90	1.09	1.08	4.73	5.20	28.77	32.27
PH98M-2983	1.09	1.12	4.72	5.20	28.42	33.23
PM1199RR	1.10	**1.12**	4.82	5.27	29.53	34.70
PM1218BG/RR	1.07	1.07	4.87	5.17	28.50	30.97
PSC355	1.09	1.11	4.78	5.23	29.73	34.57
RGC2001	1.11	**1.12**	4.67	5.13	29.25	33.30
RGC2002	1.08	1.10	4.47	**4.93**	28.13	31.47
SG105	1.11	**1.12**	4.78	5.40	30.02	34.10
SG215BG/RR	1.05	1.09	4.78	5.33	27.12	30.00
SG501BR	1.07	1.09	4.77	5.03	29.50	34.40
SG521R	1.07	1.06	4.67	5.13	27.83	30.90
SG747	**1.12**	**1.12**	5.07	5.37	27.98	30.60
ST457(STX8M007)	1.08	**1.13**	4.55	**4.90**	29.15	32.73
ST4793R	1.08	1.09	4.87	5.40	29.18	34.23
ST4892BR	1.09	1.11	4.80	5.33	28.27	33.47
STBXN47	1.09	**1.13**	4.80	5.27	27.70	32.97
TEXAS28R	**1.11**	**1.15**	4.67	5.10	28.87	31.47
max	1.13	1.16	5.07	5.40	32.80	39.87
min	1.04	1.06	3.97	4.37	26.93	28.93
avg	1.09	1.11	4.60	5.07	29.28	32.79
LSD	0.02	0.04	0.19	0.40	1.10	2.04

Table 6. Average length, micronaire, and strength for microgin (machine harvest) and breeder (picked by hand) samples of cotton cultivars in the medium maturity test.

	Length, in.		Micronaire		Strength, g/tex	
Cultivar	**Microgin**	**Breeder**	**Microgin**	**Breeder**	**Microgin**	**Breeder**
DELTAPEARL	1.12	1.16	4.43	5.07	30.28	32.13
DP448B	1.11	1.14	4.35	5.00	29.95	30.80
DP458B/RR	1.11	1.13	4.67	5.00	31.17	33.27
DP491	**1.17**	**1.21**	4.18	**4.80**	32.75	33.37
DP5415RR	1.10	1.11	4.72	5.03	29.30	29.73
DP555BG/RR	1.10	1.12	4.28	**4.80**	29.97	30.70
DP565	1.12	1.16	4.55	**4.87**	29.42	32.07
DP5690RR	1.11	1.13	4.48	**4.83**	31.62	34.30
DP655B/RR	1.11	1.14	4.22	**4.53**	32.22	33.83
FM966	1.13	1.14	4.35	**4.93**	**34.47**	**39.03**
FM989BR	1.11	1.12	4.48	**4.87**	30.83	34.73
FM989R	1.10	1.13	4.35	**4.83**	32.38	**38.00**
GC271	1.15	1.17	4.75	**4.90**	31.77	35.17
NUCOTN35B	1.11	1.13	4.37	**4.83**	31.35	33.50
OA-85	1.08	1.11	4.70	**4.87**	28.37	31.90
OA-87	1.04	1.07	4.72	5.10	27.42	30.60
OA-88	1.09	1.13	4.72	5.00	27.88	28.90
PSC355	1.10	1.10	4.63	5.07	30.78	32.43
SG747	1.10	1.12	4.95	5.35	27.90	29.05
ST580	1.11	1.11	4.63	5.07	29.17	29.77
STX0003	1.08	1.11	4.73	5.23	31.23	36.27
STX9905	1.09	1.13	4.40	**4.90**	30.60	32.93
TEXAS245	**1.18**	**1.20**	3.82	**4.40**	**34.18**	36.03
TEXAS24R	1.08	1.10	4.50	**4.90**	29.98	31.53
USGEXP555	1.10	1.14	4.33	**4.73**	28.83	29.97
USGEXP650	1.12	1.15	4.47	**4.87**	28.93	28.67
USGEXP710	1.08	1.09	4.70	4.97	29.43	30.73
max	1.18	1.21	4.95	5.35	34.47	39.03
min	1.04	1.07	3.82	4.40	27.42	28.67
avg	1.11	1.13	4.50	4.92	30.45	32.57
LSD	0.02	0.03	0.16	0.36	1.36	2.47

Table 7. Average uniformity, reflectance, and yellowness for microgin (machine harvest) and breeder (picked by hand) samples of cotton cultivars in the early maturity test.

	Uniformity		Reflectance		Yellowness	
Cultivar	**Microgin**	**Breeder**	**Microgin**	**Breeder**	**Microgin**	**Breeder**
ACALA1517-99	82.5	**85.8**	75.5	**73.6**	8.5	7.6
ALLTEXATLAS	82.2	83.6	75.3	70.7	8.3	7.4
AP7115	81.8	84.2	76.7	**73.5**	**7.9**	**6.9**
BXN49B(STX0001)	82.3	**84.6**	74.8	68.8	8.4	7.9
DES607	82.5	**85.2**	75.0	71.2	8.7	7.7
DES810	**83.0**	84.2	73.2	68.8	**7.7**	**6.8**
DES816	82.2	**84.6**	74.0	70.4	8.0	**6.9**
DP20B	**82.7**	**85.5**	75.8	71.5	**7.9**	**7.0**
DP436RR	82.5	**84.9**	76.0	**72.1**	8.0	**7.2**
DP451B/RR	**82.7**	**85.0**	76.7	**72.0**	**7.9**	**7.2**
DP458BR	82.0	84.4	**77.7**	**74.3**	8.1	**7.2**
DP555BG/RR	80.5	83.3	**78.0**	**73.6**	**7.6**	**7.1**
DPLX99X35	82.3	**85.1**	76.3	**71.8**	**7.9**	**6.6**
FM958	82.0	**84.8**	76.7	71.2	8.2	7.6
FM958BG(E6478)	82.3	84.3	75.8	**71.8**	8.0	**7.4**
FM966	**82.7**	**85.1**	76.5	71.5	**7.9**	**7.3**
MISCOT8806	**83.2**	**84.7**	73.3	66.6	8.1	**6.7**
MISCOT8839	**83.0**	84.5	74.8	70.5	8.2	**7.3**
NX2429	**83.2**	**85.1**	72.3	69.5	8.2	7.6
OA-87	82.3	84.1	74.8	69.9	8.4	7.6
OA-89	82.5	83.8	75.2	**71.9**	8.7	7.8
OA-90	**82.7**	83.6	76.5	70.8	**7.9**	**6.6**
PH98M-2983	82.2	84.3	73.3	67.7	**7.8**	**6.8**
PM1199RR	**83.2**	**85.3**	73.7	69.3	8.2	**7.2**
PM1218BG/RR	**82.7**	83.9	75.0	69.3	8.2	7.6
PSC355	**83.0**	**84.9**	73.0	68.3	8.2	7.6
RGC2001	**82.7**	84.4	73.8	68.9	8.3	**7.1**
RGC2002	82.3	84.3	73.3	69.0	8.5	7.4
SG105	**82.8**	**85.7**	75.3	**72.1**	8.3	**7.3**
SG215BG/RR	82.3	**84.7**	75.0	70.3	8.7	7.6
SG501BR	**83.0**	**85.4**	74.8	70.8	8.5	8.0
SG521R	**83.0**	83.9	74.8	70.1	8.3	7.6
SG747	**83.3**	**84.9**	74.2	70.7	8.5	7.7
ST457(STX8M007)	82.5	**85.3**	72.8	68.7	8.8	**6.8**
ST4793R	82.5	**84.7**	74.0	68.9	8.8	7.7
ST4892BR	**83.0**	**85.2**	73.8	69.2	8.5	7.7
STBXN47	**82.8**	**84.8**	73.2	67.9	8.6	7.5
TEXAS28R	82.3	84.4	75.7	**72.2**	8.0	**7.2**
max	83.3	85.8	78.0	74.3	8.8	8.0
min	80.5	83.3	72.3	66.6	7.6	6.6
avg	82.5	84.6	74.9	70.5	8.2	7.3
LSD	0.7	1.2	0.9	2.7	0.3	0.7

Table 8. Average uniformity, reflectance, and yellowness for microgin (machine harvest) and breeder (picked by hand) samples of cotton cultivars in the medium maturity test.

	Uniformity		Reflectance		Yellowness	
Cultivar	**Microgin**	**Breeder**	**Microgin**	**Breeder**	**Microgin**	**Breeder**
DELTAPEARL	81.3	84.4	73.8	**72.9**	8.5	**6.8**
DP448B	82.2	85.0	**75.0**	**72.1**	8.5	7.7
DP458B/RR	82.5	84.4	**74.7**	**75.0**	8.5	7.7
DP491	81.5	**85.4**	73.7	**72.2**	8.6	8.0
DP5415RR	82.3	**85.2**	**74.8**	**73.0**	8.5	**7.2**
DP555BG/RR	80.5	83.7	**76.0**	**73.7**	**7.7**	**6.7**
DP565	82.5	**85.3**	**75.2**	**72.7**	**7.9**	**6.8**
DP5690RR	82.7	85.1	74.0	**72.6**	8.5	**6.8**
DP655B/RR	82.3	84.3	**74.7**	**73.7**	8.5	7.7
FM966	**83.7**	**85.6**	73.7	**72.5**	8.4	**7.3**
FM989BR	82.5	84.9	74.0	**72.1**	**8.2**	**7.3**
FM989R	82.8	84.9	72.0	**73.2**	9.0	**7.2**
GC271	**83.7**	**86.1**	71.8	**72.3**	8.2	**7.0**
NUCOTN35B	81.5	**85.5**	**74.5**	**72.0**	**8.2**	**7.2**
OA-85	82.0	83.9	73.5	71.4	8.3	**7.1**
OA-87	82.0	84.5	72.3	70.2	8.9	**7.2**
OA-88	82.7	**85.5**	73.2	**72.7**	8.6	7.5
PSC355	**83.5**	**85.2**	71.0	64.3	8.5	**7.2**
SG747	82.8	**85.9**	71.7	67.5	9.0	**7.5**
ST580	82.7	84.0	72.8	**71.9**	8.9	7.6
STX0003	**83.3**	**85.8**	73.5	71.1	8.4	7.8
STX9905	81.8	84.1	72.0	**73.3**	9.0	7.7
TEXAS245	82.7	**86.1**	74.3	**72.3**	8.5	**7.0**
TEXAS24R	82.7	84.2	**74.5**	**73.2**	8.6	**6.6**
USGEXP555	81.7	84.5	71.7	69.6	8.5	7.5
USGEXP650	81.5	84.6	72.3	70.5	8.6	**7.1**
USGEXP710	82.7	84.4	71.7	68.7	8.3	7.9
max	83.7	86.1	76.0	75.0	9.0	8.0
min	80.5	83.7	71.0	64.3	7.7	6.6
avg	82.4	84.9	73.4	71.7	8.5	7.3
LSD	0.7	1.0	1.5	3.3	0.6	0.9

Table 9. Average leaf, seed index, and loan value for microgin (machine harvest) and breeder (picked by hand) samples of cotton cultivars in the early maturity test.

	Leaf		Seed Index, g/100 seed		Loan Value, cent/lb.	
Cultivar	**Microgin**	**Breeder**	**Microgin**	**Breeder**	**Microgin**	**Breeder**
ACALA1517-99	3.3	**1.3**	10.8	11.1	**55.88**	**55.68**
ALLTEXATLAS	3.0	**2.0**	11.4	11.5	**54.77**	49.65
AP7115	3.0	**1.0**	9.6	9.8	54.18	**51.22**
BXN49B(STX0001)	3.0	2.7	10.0	10.1	**54.82**	47.88
DES607	2.8	**2.0**	9.3	9.7	**54.68**	**51.17**
DES810	3.5	**1.7**	9.8	9.9	54.28	49.72
DES816	3.0	**1.3**	10.2	10.4	**54.59**	48.97
DP20B	3.0	**1.3**	10.0	10.1	**54.78**	49.42
DP436RR	3.0	**1.7**	10.1	10.5	**54.63**	49.50
DP451B/RR	3.0	**1.7**	10.1	10.4	**55.45**	50.72
DP458BR	2.8	**1.7**	8.2	8.2	**55.00**	**50.85**
DP555BG/RR	3.0	**1.3**	7.5	8.4	53.53	**52.65**
DPLX99X35	2.8	**2.0**	9.0	8.9	54.09	49.35
FM958	3.0	**2.3**	10.3	10.7	**55.90**	**52.77**
FM958BG(E6478)	3.7	**2.3**	10.1	9.9	**54.88**	**52.62**
FM966	3.2	**1.3**	10.8	11.3	**55.58**	**51.60**
MISCOT8806	3.2	**2.3**	10.0	10.2	**54.83**	46.60
MISCOT8839	2.8	**1.7**	10.4	10.2	**54.77**	**51.35**
NX2429	3.3	**2.3**	10.1	10.5	**54.75**	46.05
OA-87	3.0	3.0	9.8	9.9	50.73	46.25
OA-89	3.0	3.0	9.4	9.5	53.89	49.23
OA-90	2.8	**1.3**	8.7	8.6	**54.54**	47.47
PH98M-2983	3.0	**1.3**	9.5	9.5	52.79	46.07
PM1199RR	3.0	**2.0**	10.0	11.0	53.86	46.65
PM1218BG/RR	**2.5**	**1.7**	10.8	11.2	51.77	46.28
PSC355	3.2	3.3	9.7	10.3	53.53	46.40
RGC2001	3.2	**1.3**	9.8	9.7	**54.39**	47.08
RGC2002	3.0	**2.0**	9.4	9.5	53.62	50.07
SG105	2.8	**2.3**	10.0	10.2	**55.16**	49.03
SG215BG/RR	**2.3**	**2.0**	9.8	9.9	51.45	47.03
SG501BR	**2.7**	3.0	9.9	10.2	53.31	**51.13**
SG521R	3.0	2.7	9.8	9.4	53.37	46.95
SG747	**2.7**	2.7	9.8	9.7	51.37	47.40
ST457(STX8M007)	2.8	**2.3**	9.3	9.7	53.67	50.10
ST4793R	**2.3**	3.7	10.3	10.3	52.33	46.92
ST4892BR	3.0	3.0	10.1	10.8	53.24	46.60
STBXN47	**2.7**	3.3	9.6	10.2	52.92	46.43
TEXAS28R	2.8	**2.0**	8.5	8.6	**54.53**	**52.18**
max	3.7	3.7	11.4	11.5	55.90	55.68
min	2.3	1.0	7.5	8.2	50.73	46.05
avg	3.0	2.1	9.8	10.0	54.00	49.13
LSD	0.4	1.6	0.4	0.7	1.61	4.32

Table 10. Average leaf, seed index, and loan value for microgin (machine harvest) and breeder (picked by hand) samples of cotton cultivars in the medium maturity test.

	Leaf		Seed Index, g/100 seed		Loan Value, cent/lb.	
Cultivar	**Microgin**	**Breeder**	**Microgin**	**Breeder**	**Microgin**	**Breeder**
DELTAPEARL	**3.2**	**1.7**	8.2	8.7	**53.31**	**50.87**
DP448B	**3.3**	**2.0**	8.8	9.2	**54.87**	**52.63**
DP458B/RR	**3.0**	**1.0**	8.1	8.7	**54.41**	**52.65**
DP491	4.0	3.0	8.8	9.6	**54.63**	**55.27**
DP5415RR	**3.2**	**2.0**	7.9	8.1	**54.27**	**52.33**
DP555BG/RR	**3.0**	**2.0**	7.4	8.1	**54.40**	**53.63**
DP565	**3.0**	**1.3**	8.5	9.2	**54.74**	**51.55**
DP5690RR	3.7	**1.7**	9.6	10.0	**54.78**	**52.87**
DP655B/RR	3.8	**1.7**	8.9	9.2	**54.76**	**55.40**
FM966	3.7	**2.0**	11.1	11.9	**55.04**	**53.65**
FM989BR	3.7	**2.3**	10.4	10.2	**54.53**	**51.35**
FM989R	**3.3**	**2.0**	9.2	10.6	51.77	**52.78**
GC271	3.7	**1.7**	9.7	9.8	**54.93**	**52.95**
NUCOTN35B	3.7	**1.0**	9.1	9.6	**54.41**	**52.90**
OA-85	3.5	**1.3**	9.0	9.1	**53.38**	**51.27**
OA-87	**3.2**	**1.7**	9.7	10.5	50.15	47.70
OA-88	3.5	**1.7**	9.2	10.0	52.76	**53.05**
PSC355	3.7	3.0	9.8	10.1	52.77	45.32
SG747	3.5	**2.0**	9.7	10.1	49.91	44.63
ST580	**3.0**	**2.3**	8.8	9.9	53.00	**50.73**
STX0003	**3.0**	3.0	9.8	10.3	**54.18**	50.35
STX9905	3.7	**1.7**	10.3	10.6	51.82	**54.02**
TEXAS245	3.8	**2.0**	10.0	10.8	**55.31**	**54.37**
TEXAS24R	**3.3**	**1.7**	8.5	8.7	**53.50**	**52.60**
USGEXP555	**3.2**	**2.3**	9.4	10.1	52.58	**52.32**
USGEXP650	**3.2**	**2.3**	8.9	10.0	**53.12**	**50.78**
USGEXP710	3.7	3.7	9.4	9.6	**53.12**	49.52
max	4.0	3.7	11.1	11.9	55.31	55.40
min	3.0	1.0	7.4	8.1	49.91	44.63
avg	3.4	2.0	9.2	9.7	53.57	51.76
LSD	0.5	1.4	0.5	0.9	2.21	4.92

Table 11. Loan values, premiums, and discounts for cultivars grown in the early and medium maturity cotton variety tests.

Average for Early Maturing Cultivars	**Conventional (Cent/lb.)**	**Breeder (Cent/lb.)**	**Diff.**
Price before discounts	53.95	51.44	-2.51
Micronaire Discount	0.29	3.37	3.08
Uniformity Premium	0.13	0.42	0.29
Strength Premium	0.20	0.62	0.42
Price with discounts	53.99	49.13	-4.86

Average for Medium Maturing Cultivars	**Conventional (Cent/lb.)**	**Breeder (Cent/lb.)**	**Diff.**
Price before discounts	53.09	52.04	-1.05
Micronaire Discount	0.03	1.82	1.79
Uniformity Premium	0.11	0.44	0.33
Strength Premium	0.38	0.54	0.17
Price with discounts	53.56	51.76	-1.80