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GENETIC TRAITS ASSOCIATED WITH SEED COAT FRAGMENTS, MOTES, AND NEPS

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Abstract

Nep and seed coat fragment (SCF) contamination in cotton lint causes problems in textile mills during spinning and dyeing operations. Cotton cultivars grown in three test groups of the Mississippi Regional Cotton Variety Trial (RCVT) were processed through a typical sequence of gin machinery, and the lint was analyzed manually for SCF and motes. The Advanced Fiber Information System (AFIS) was also used to analyze neps and seed coat neps (SCN) in lint. These results were used to characterize cultivars, identify interactions between cultivar and test group, and identify trends between measurements. Statistically, the most discernable difference between cultivars was found for AFIS neps, ranging from 140 to 292 neps/g lint. Differences were also found between cultivars in each test for the number of SCF and AFIS SCN, and differences were seen between cultivars in two tests for the number of motes. Across cultivars in all test groups, the number of manually counted SCF ranged from 6 to 35 and averaged 13.1 SCF/g lint. The SCN counted by the AFIS ranged from 6 to 22 and averaged 11.1 SCN/g lint. The correlation coefficient between manual SCF and AFIS SCN was as high as 0.84 in one test but only 0.59 in another, so these measurements were similar but different. Only one measurement, AFIS nep count, revealed a significant interaction between cultivar and test group. For other measurements, cultivar differences were consistent between test groups.

Introduction

As cotton is harvested and processed through a gin, the coat of the cottonseed may be damaged and pulled off with the lint. Some of these SCFs are not removed during gin processing and remain in the baled lint. Problems due to SCF contamination in ginned lint occur in textile mills during spinning and dyeing.

Three of the most important factors contributing to the occurrence of SCFs have been shown to be cotton cultivar, environmental factors, and harvest timing. Anthony, et al. (1988) found that the SCF content after 1 lint cleaner varied between 5 cultivars from 14 to 19 SCF/g lint and from 12 to 21 mg/g lint. The test was repeated in two years with large differences in SCF content between years, but there was no interaction found between cultivar and year. Mangialardi and Meredith (1990) analyzed 9 cotton cultivars and found that SCF counts ranged from 13 to 20 SCF/g lint and weights ranged from 11 to 18 mg/g lint. They showed that SCF content tended to increase across 6 weekly harvest intervals. The test was repeated in two years, and an interaction was found between cultivar and year for the weight of SCF but not the number.

Mangialardi and Meredith (1990) also reported that the number of motes found in lint varied from 2.0 to 3.7 motes/g lint between cultivars and weighed 17 to 30 mg/g lint. Mote contents also increased across harvest intervals, and there was an interaction between variety and year for mote content. Davidonis et al. (2000) found discrepancies between reports relating mote frequency and boll location. They concluded from their study that long fiber motes were related to the timing and intensity of environmental stress, not harvest date or boll location. They also concluded that these effects on short fiber motes were more complicated. Environmental stresses may also impact SCF and neps, especially those created from motes.

The objectives of this study were to analyze genetic differences seen in seed coat fragments, motes, AFIS neps, and AFIS seed coat neps, and to relate these changes to other fiber properties. This study included modern cultivars grown in three of Mississippi's RCVT. For cultivars common to each test, interactions with environment were also analyzed.

Methodology

This study included the 2002 and 2003 Mississippi RCVT. In 2002, there were 38 cultivars grown in the Stoneville early maturity group (Stoneville'02), and in 2003 there were 38 cultivars grown in the Stoneville (Stoneville'03) and Tribbett (Tribbett'03) early maturity groups. Both tests in 2003 contained the same

cotton cultivars, but only 19 cultivars were common to all tests. The cultivars grown in 2002 are listed in table 1, and those grown in 2003 are listed in table 2. Cultivars common to all 3 tests are noted. 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 (Anthony and McCaskill, 1974). Cotton was stored for at least three days to equilibrate the moisture content. 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 within each test. The microgin contained all the machines of a typical gin including a shelf type dryer, Lummus 6 cylinder cleaner, Continental Little David stick machine, Lummus Trashmaster cylinder cleaner, Continental Commander extractor-feeder, Continental 93 (reduced to 20 saws) gin stand, and a Continental 16-D lint cleaner. The test grown in 2002 utilized two lint cleaners. Settings on the feed controls for cotton entering the dryer and the gin stand were adjusted before ginning and maintained within each test. Deviations in ambient conditions within each test were minimized by cooling the air within the gin to 75 +/- 5ºF (24 +/- 3ºC). This minimized heat buildup in the gin as the machinery warmed up. The relative humidity was not controlled, but controlling temperature helped to minimize fluctuations in relative humidity. For each lot, three samples were taken for lint measurements by AFIS and for manual determination of SCF and motes (USDA Cotton Testing Lab in Stoneville, MS). Statistical analysis was performed using the general linear model procedure (Proc GLM, SAS v8.2, 2001).

Results

Cultivar Differences for SCF, Motes, Neps and SCN

Results for measurements of SCF, motes, neps and SCN were reported for Stoneville'02 in table 3, Stoneville'03 in table 4, and Tribbett'03 in table 5.

SCF

Averaged across all test groups, there were 13 SCF/g lint weighing 6.4 mg and averaging 0.52 mg. The most SCF by number and least SCF by weight were found in Stoneville'02. The average fragment weight was 50% less in this test due to using two lint cleaners. Only one lint cleaner was used in Stoneville'03 and Tribbett'03. Between cultivars, differences were most significant for the number of SCF ranging from 5.8 SCF/g lint for DPXW99R (Stoneville'03) and FM966 (Tribbett'03) to 35.5 SCF/g lint for DES810 (Stoneville'02). The weight of SCF ranged from 2.3 mg/g lint for DP458BR (Stoneville'02) to 14.2 mg/g lint for DES810 (Tribbett'03). The average SCF weight did not vary between cultivars. There were 19 cultivars common to each test group analyzed for SCF, but no interaction was found between cultivar and test group for any SCF measurement (table 6). This indicated that cultivar differences in number and weight of SCF in ginned lint were consistent in each test.

Motes

The average mote content of ginned lint was 1.9 motes/g lint weighing 9.0mg and averaging 4.5mg. Like SCF, motes were also lighter in Stoneville'02 due to the additional lint cleaner, and they were also less numerous. The fewest motes were found for MIS8806 (0.3/g lint), FM958BG (0.4/g lint), and DES810 (0.4/g lint) in Stoneville'02; and the least motes by weight was also found for MIS8806 (1.0mg/g lint) in Stoneville'02. The most numerous motes were found for DPXW99R and SG215BR (3.9/g lint) in Stoneville'03, and the most motes by weight were found for PSC355 (25.6mg/g lint) also in Stoneville'03. Cultivar differences in average mote weight were only significant in Stoneville'03 where they ranged from 2.3mg/mote for FM958BG and BCG295 to 9.2mg/mote for PSC355. For the 19 cultivars common between test groups, interactions were not significant for the number or weight of motes (table 6). This interaction was almost significant ($p = 0.06$) for average mote weight.

AFIS SCN

The average SCN content over all groups and cultivars was 11 SCN/g lint averaging 1135µm. The number of SCN was greater in Stoneville'03 than in other tests. The fewest SCN were found for DP555BR in Stoneville'02 (6.4/g lint) and OAX303 in Tribbett'03 (6.3/g lint). The most SCN was found for DES810 in

Stoneville'03 (21.7/g lint). Cultivar differences were found for SCN size in Stoneville'02 and Stoneville'03 but not Tribbett'03. For the 19 cultivars common between tests, no interactions were found between cultivar and test group (table 6).

AFIS Neps

Neps averaged 200/g lint and 687µm. More neps were found in Stoneville'02 than in other tests, but neps were largest in Stoneville'03. The fewest neps (140/g lint) were found for PM1199RR in Tribbett'03, and the most neps (292/g lint) were found for DP555BR in Stoneville'02. The size of neps ranged from 661µm for DPX00W12 in Tribbett'03 to 719µm for DES810 in Stonneville'03. For the 19 cultivars common between tests, there was a significant interaction between cultivar and test for the number of neps but not nep size (table 6). For the number of neps, the F value for cultivar was 24.3 and for the interaction was 3.6, so the overall differences in cultivars was much more important than the interaction.

Relationship between SCF, Motes, Neps and SCN

As mentioned earlier, SCF ranged from 5.8 to 35.5 and averaged 13 SCF/g lint; and SCN ranged from 6.3 to 21.7 and averaged 11 SCN/g lint. In each test, there was a significant positive correlation between the number of SCF counted by hand and the number of SCN counted by the AFIS (table 7, table 8, and table 9). The highest correlation ($r = 0.84$) was too low to suggest these measured the same property, and the correlation was lower in another test ($r = 0.59$). Further evidence that SCF differ from SCN was the lack of any trend between average SCF weight and average SCN size. An interesting observation was that both SCF and SCN increased in each test with Nep size. This was possibly an indication that the poor correlation between SCF and SCN was related to the classification criteria distinguishing neps from SCN. Since SCF and SCN were determined from different sub-samples of the same sample, an alternate explanation of the poor correlation between SCF and SCN was that differences were due to the high variability of SCF in lint. To test the latter explanation, a statistical model was developed to determine cultivar differences in SCF using both measurements (table 10). The model included all three test groups and the 19 cultivars common to each test. Differences were found between tests, measurements, and cultivars. The most important finding was the significant interaction between cultivar and measurement, which indicated that cultivar differences depended on the method used to measure seed coat fragments. This indicated that the lack of correlation between SCF and AFIS SCN was not related to high sample variability. The F value for the interaction ($F = 2.80$) was less than cultivar ($F = 21.24$), so cultivar differences were similar with each method.

Summary and Discussion

This study analyzed 38 cultivars from 3 test groups of the Mississippi RCVT. There were 19 cultivars that were the same in each group. The cotton was machine picked and processed with a typically sequence of gin machinery, and samples were analyzed after the lint cleaner for SCF, motes, AFIS neps, and AFIS SCN. Cultivars were found to be different for each of these measurements. When values were averaged across tests for the 19 common cultivars, SCF ranged from 8.9 to 27.4/g lint and SCN ranged from 7.2 to 19.6/g lint. The interaction between cultivar and test group was not significant for SCF or AFIS SCN. Of the 19 common cultivars, 9 were statistically equal to the minimum value for SCF content, and 4 were statistically equal to the minimum for SCN content. Three cultivars (SG215BR, BCG28R, and SG105) were statistically equal to the minimum for both SCF and SCN content. Differences in cultivars with high SCN or SCF were more easily observed. The cultivar DES810 had the highest number of both, and it was statistically higher than all other cultivars.

In each test, there was a significant positive correlation between AFIS SCN and SCF ranging from 0.84 to 0.59. This correlation suggested the measurements were similar but different. This was confirmed when both measurements were used to model seed coat fragment content. A significant interaction was found between cultivar and the method used to measure seed coat fragments, so cultivar differences depended on which method was used. One explanation for the difference was that neps may have been incorrectly categorized between neps and SCN. Since, in general, SCN were fewer than SCF, it seems that SCN were

incorrectly classified as neps. This was supported by the finding that nep size increased for cultivars having more SCF or SCN. It was also unclear how the AFIS categorized motes.

Conclusion

Seed coat fragments in lint varied between cotton cultivars, and differences were consistent between tests. Since these fragments are not easily removed during ginning, progress made by cotton breeders could be a critical step to reducing problems associated with SCF contamination at cotton mills. The AFIS measurement of SCN was a fair predictor of SCF contamination, but cultivar differences changed between these measurements. Therefore, caution should be used when predicting SCF in ginned lint with AFIS SCN.

Disclaimer

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

References

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Table 1. Early maturing cultivars grown in 2002.

Cultivar	Abbreviation[z]
Bayer FM958	FM958*
Bayer FM958BG	FM958BG*
Bayer FM966	FM966*
Beltwide Cotton Genetics BCG28R	BCG28R*
Delta and Pine Land Company DP436RR	DP436RR*
Delta and Pine Land Company DP451BR	DP451BR*
Delta and Pine Land Company PM1199RR	PM1199RR*
Delta and Pine Land Company PM1218BR	PM1218BR*
Delta and Pine Land Company SG105	SG105*
Delta and Pine Land Company SG215BR	SG215BR*
Delta and Pine Land Company SG521R	SG521R*
Delta and Pine Land Company SG747	SG747*
Delta Research and Extension Center DES810	DES810*
Delta Research and Extension Center DES816	DES816*
Phytogen Seed Company PSC355	PSC355*
Stoneville Pedigreed Seed Company BXN49B	BXN49B*
Stoneville Pedigreed Seed Company ST4793R	ST4793R*
Stoneville Pedigreed Seed Company ST4892BR	ST4892BR*
Syngenta NX2429	NX2429*
ACALA1517-99	AC1517-99
Agri ProAP7115	AP7115
Alltex Atlas	ATAtlas
Delta and Pine Land Company DP20B	DP20B
Delta and Pine Land Company DP458BR	DP458BR
Delta and Pine Land Company DP555BR	DP555BR
Delta and Pine Land Company DPLX99X35	DPLX99X35
Delta and Pine Land Company SG2501BR	SG2501BR
Delta Research and Extension Center DES607	DES607
Mississippi State University MISCOT8806	MIS8806
Mississippi State University MISCOT8839	MIS8839
Olvey and Associates OA87	OA87
Olvey and Associates OA89	OA89
Olvey and Associates OA90	OA90
Phytogen Seed Company PH98M-2983	PH98M2983
RGC2001	RGC2001
RGC2002	RGC2002
Stoneville Pedigreed Seed Company BXN47	BXN47
Stoneville Pedigreed Seed Company ST457	ST457

[z] Cultivars followed by "*" common to both crop years.

Table 2. Early maturing cultivars grown in 2003.

Cultivar	Abbreviation[z]
Bayer FM958	FM958*
Bayer FM958BG	FM958BG*
Bayer FM966	FM966*
Beltwide Cotton Genetics BCG28R	BCG28R*
Delta and Pine Land Company DP436RR	DP436RR*
Delta and Pine Land Company DP451BR	DP451BR*
Delta and Pine Land Company PM1199RR	PM1199RR*
Delta and Pine Land Company PM1218BR	PM1218BR*
Delta and Pine Land Company SG105	SG105*
Delta and Pine Land Company SG215BR	SG215BR*
Delta and Pine Land Company SG521R	SG521R*
Delta and Pine Land Company SG747	SG747*
Delta Research and Extension Center DES810	DES810*
Delta Research and Extension Center DES816	DES816*
Phytogen Seed Company PSC355	PSC355*
Stoneville Pedigreed Seed Company BXN49B	BXN49B*
Stoneville Pedigreed Seed Company ST4793R	ST4793R*
Stoneville Pedigreed Seed Company ST4892BR	ST4892BR*
Syngenta NX2429	NX2429*
BayerFM 958LL(FM989R)	FM958LL
BayerFM 960BR	FM960BR
BayerFM 966LL(FM819RR)	FM966LL
Beltwide Cotton Genetics BCG 28RBCG295	BCG295
Delta and Pine Land Company DP449BR	DP449BR
Delta and Pine Land Company DPLX00W12	DPX00W12
Delta and Pine Land Company DPLX01W99R	DPXW99R
Delta and Pine Land Company DPLX01X99R	DPX99R
Delta and Pine Land Company DPLX02X71R	DPX02X71R
Delta and Pine Land Company SG215BR	SG215BR
Olvey and Associates OAX300BR	OAX300BR
Olvey and Associates OAX302BR	OAX302BR
Olvey and Associates OAX303	OAX303
Olvey and Associates OAX304BR	OAX304BR
Phytogen Seed Company PHY410RR	PHY410RR
Stoneville Pedigreed Seed Company ST4563B2	ST4563B2
Stoneville Pedigreed Seed Company ST474	ST474
Stoneville Pedigreed Seed Company STX0202B2R	STX202B2R
Stoneville Pedigreed Seed Company STX0204BR	STX0204BR

[z] Cultivars followed by "*" common to both crop years.

Table 3. Average AFIS neps, mote, and seed coat fragment data for early maturing cultivars tested in Stoneville'02.

	AFIS neps		AFIS seed coat neps		SCFs per 1g lint			Motes per 1g lint		
Cultivar[z]	Size, um	Per 1g lint	Size, um	Per 1g lint	No.	mg	mg / SCF	No.	mg	mg / mote
DP458BR	687H	244	1282H	8.7L	7.4L	2.3L	0.30L	2.1	9.5H	4.5HL
DES607	687H	269H	1103L	9.7	11.2L	4.3L	0.38H	1.4L	6.8	4.2HL
OA87	666L	205L	1080L	7.0L	11.3L	3.2L	0.30L	2.0	7.7H	4.2HL
AP7115	683	252	1128L	10.9	11.6L	3.7L	0.30L	1.1L	4.3L	3.6L
SG747*	677L	177L	1085L	8.2L	12.4L	3.9L	0.32L	0.7L	2.9L	4.4HL
SG215BR*	665L	208	1113L	6.9L	12.6L	4.4L	0.35H	2.1	9.4H	4.3HL
BXN47	681L	210	1067L	7.8L	12.8L	4.4L	0.33HL	1.3L	4.9L	3.3L
PM1199RR*	678L	196L	1185H	10.3	12.9L	4.1L	0.32L	2.0	10.7H	5.8H
SG2501BR	673L	184L	1122L	9.8	13.0L	4.3L	0.34HL	1.1L	2.9L	2.8L
FM966*	693H	243	1050L	9.9	13.1L	3.6L	0.28L	1.3L	6.4L	4.6HL
RGC2002	676L	230	1086L	9.3L	13.8L	4.3L	0.31L	0.9L	3.2L	4.3HL
DP555BR	685	292H	1062L	6.4L	14.2L	5.9	0.43H	0.9L	2.6L	2.9L
SG521R*	686	208	1098L	11.6	14.2L	5.4	0.37H	2.1	12.9H	6.2H
DP20B	684	265H	1115L	10.1	14.6	5.8	0.41H	1.4L	4.8L	4.3HL
SG105*	677L	225	1107L	8.7L	15.4	4.6L	0.30L	1.9	6.9	3.6L
RGC2001	686	210	1119L	11.6	15.4	4.4L	0.27L	0.7L	1.6L	2.7L
OA90	684	209	1148L	9.3L	15.6	4.1L	0.26L	1.4L	5.1L	3.0L
ST4892BR*	686H	185L	1196H	10.8	15.7	4.9L	0.33HL	1.8	7.5H	4.3HL
BCG28R*	682	254	1166HL	9.7	15.8	4.0L	0.26L	2.0	7.0	3.7L
DPLX99X35	686	236	1076L	11.0	16.1	4.3L	0.27L	0.8L	2.2L	3.1L
DP451BR*	676L	262	1118L	9.7	16.3	5.1L	0.31L	2.4H	9.9H	3.6L
MIS8806	690H	217	1145L	11.3	16.3	4.7L	0.29L	0.3L	1.0L	3.1L
DP436RR*	682	251	1201H	10.6	16.4	5.6	0.34HL	1.9	8.7H	4.5HL
OA89	692H	246	1211H	12.2	17.8	5.5	0.31L	3.3H	11.8H	3.5L
PH98M2983	679L	216	1121L	10.1	18.1	5.6	0.30L	0.9L	2.5L	2.9L
ST457	683	285H	1215H	11.0	18.1	5.5	0.31L	1.6	5.1L	3.7L
ATAtlas	688H	243	1081L	13.7	18.6	5.6	0.30L	0.8L	2.5L	3.3L
FM958BG*	685	284H	1054L	11.7	18.8	6.0H	0.32L	0.4L	1.8L	3.7L
ST4793R*	685	192L	1227H	11.3	18.9	8.1H	0.40H	2.7H	12.0H	4.4HL
BXN49B*	681L	276H	1042L	11.4	19.3	8.0H	0.41H	0.7L	2.3L	3.8L
MIS8839	685	241	1138L	11.9	19.3	5.2	0.27L	1.6	6.2L	4.0L
DES816*	686	229	1154L	12.6	20.7	5.3	0.26L	1.0L	4.8L	4.8H
NX2429*	691H	233	1117L	13.3	21.0	7.1H	0.34HL	0.9L	3.3L	3.8L
FM958*	688H	241	1112L	12.1	21.6	6.4H	0.29L	0.8L	2.7L	3.5L
AC1517-99	697H	288H	1278H	13.2	23.1	7.3H	0.32L	1.9	7.8H	4.3HL
PM1218BR*	677L	239	1056L	10.9	24.2	7.2H	0.29L	2.1	7.0	3.5L
PSC355*	696H	211	1156HL	14.8	26.8	6.8H	0.24L	1.2L	4.2L	3.5L
DES810*	703H	285H	1178H	19.3H	35.1H	8.9H	0.25L	0.4L	2.2L	5.3H
Replication F-value[x]	4.95**	9.86**	0.28	10.0**	0.14	4.41*	11.9**	0.70	0.59	6.25**
Cultivar F-value[x]	1.7 *	8.76**	1.81 *	4.97**	4.04**	1.96**	1.48	2.56**	2.76**	1.15
Mean	684	235	1,131	10.8	16.8	5.3	0.32	1.4	5.7	3.9
LSD	16	30	127	3.0	7.0	2.9	0.11	1.2	5.5	2.1

[z] Cultivars followed by "*" common to both crop years.
[y] Values statistically equal to maximum followed by "H" and minimum followed by "L".
[x] F-values corresponding to p-values under 0.05 followed by "*" and under 0.01 followed by "**".

Table 4. Average AFIS neps, mote, and seed coat fragment data for early maturing cultivars tested in Stoneville'03.

	AFIS neps		AFIS seed coat neps		SCFs per 1g lint			Motes per 1g lint		
Cultivar[z]	Size, um	Per 1g lint	Size, um	Per 1g lint	No.	mg	mg / SCF	No.	mg	mg / mote
DPXW99R	692L	195	1134L	9.8L	5.8L	4.7L	0.89H	3.9H	16.4H	4.2L
SG215BR*	679L	162L	1219	7.6L	6.6L	4.6L	0.69HL	3.9H	23.1H	6.6H
SG747*	697L	156L	1166L	10.2L	6.8L	3.4L	0.51L	1.9L	12.6L	6.3
STX0204BR	696L	226H	1151L	14.7	6.8L	4.2L	0.62HL	2.9H	15.9H	5.4
DP449BR	695L	174L	1126L	11.3L	7.1L	4.6L	0.68HL	3.3H	19.2H	5.7
FM966*	699	182	1119L	11.7	7.9L	5.4L	0.67HL	1.8L	8.3L	4.6L
DP451BR*	691L	186	1184	9.9L	7.9L	5.2L	0.67HL	3.4H	19.8H	5.7
FM958LL	686L	178	1098L	10.6L	8.1L	4.6L	0.55L	1.2L	5.7L	4.5L
OAX300BR	678L	179	1203	9.3L	8.3L	5.1L	0.59HL	3.3H	15.9H	4.7L
BCG28R*	696L	203	1230H	9.6L	8.7L	6.9L	0.79H	2.9H	16.7H	5.8
SG105*	693L	170L	1300H	9.9L	8.7L	4.3L	0.51L	3.0H	13.3	4.1L
FM966LL	689L	179	1147L	10.1L	8.8L	4.7L	0.56L	2.2HL	10.8L	4.7L
FM958BG*	712H	223	1109L	15.2	8.9L	6.8L	0.77HL	2.4HL	4.8L	2.3L
DES816*	712H	196	1220	14.9	8.9L	4.6L	0.50L	1.6L	5.7L	3.0L
OAX304BR	688L	192	1127L	12.6	9.0L	5.6L	0.64HL	3.9H	15.9H	4.4L
FM960BR	698L	180	1123L	13.6	9.1L	4.7L	0.54L	1.9L	4.7L	2.4L
SG521R*	678L	164L	1153L	11.1L	9.1L	4.8L	0.50L	2.2HL	12.9L	5.6
ST474	696L	163L	1039L	13.1	9.2L	5.6L	0.59HL	2.1L	9.2L	4.3L
FM958*	682L	159L	1056L	7.8L	9.4L	7.4L	0.80H	1.9L	6.9L	2.7L
DP436RR*	699H	209	1168L	13.0	10.1L	8.6	0.79HL	1.7L	8.1L	4.3L
DPX00W12	702H	172L	1268H	12.3	10.4	7.3L	0.72HL	3.9H	23.7H	6.0
PHY410RR	701H	192	1148L	16.0	10.4	5.9L	0.54L	1.8L	8.1L	5.9
NX2429*	708H	212	1031L	20.4H	10.7	8.3	0.79HL	3.3H	16.4H	5.4
ST4793R*	695L	164L	1172L	12.6	10.9	6.2L	0.56L	1.8L	9.2L	5.2
OAX302BR	692L	192	1371H	9.4L	11.1	7.9	0.72HL	2.9H	13.4	4.7L
SG215BR	684L	215	1098L	13.2	11.2	7.3L	0.66HL	2.4HL	15.8H	6.8H
OAX303	697L	179	1168L	11.6	11.4	8.3	0.72HL	2.1L	13.2L	5.7
BCG295	689L	205	1084L	9.7L	11.9	6.9L	0.58L	0.8L	2.3L	2.3L
PM1199RR*	709H	173L	1233H	13.1	12.4	9.6H	0.77HL	2.2HL	17.4H	8.2H
DPX02X71R	687L	193	1126L	11.3L	13.0	8.3	0.64HL	2.6H	14.3	5.7
STX202B2R	702H	208	1112L	15.7	13.3H	10.6H	0.79H	3.1H	11.1L	3.7L
ST4892BR*	690L	164L	1190	12.7	13.7H	9.4H	0.67HL	2.7H	12.8L	4.7L
ST4563B2	698	244H	1110L	14.0	14.0H	6.8L	0.49L	2.7H	15.2H	5.9
PSC355*	704H	187	1132L	18.8H	14.3H	8.2	0.58L	3.0H	25.6H	9.2H
BXN49B*	702H	228H	1179	14.0	15.6H	13.0H	0.86H	2.0L	7.4L	3.7L
DPX99R	703H	195	1139L	15.4	15.8H	12.7H	0.78HL	3.4H	13.4	3.5L
PM1218BR*	712H	203	1254H	15.4	17.0H	12.9H	0.76HL	2.8H	13.2L	4.7L
DES810*	719H	231H	1247H	21.7H	17.7H	10.6H	0.60HL	2.3HL	12.4L	5.5
Replication F-value[x]	1.95	14.7**	0.53	0.4	13.41**	6.89**	0.09	9.56**	7.05**	0.80
Cultivar F-value[x]	1.92**	9.94**	1.92**	5.3**	3.67**	2.97**	1.06	1.61*	1.94**	2.52**
Mean	696	190	1161	12.7	10.5	7.0	0.66	2.6	12.9	4.9
LSD	20	20	144	3.9	4.4	4.2	0.30	1.7	11.0	2.6

[z] Cultivars followed by "*" common to both crop years.
[y] Values statistically equal to maximum followed by "H" and minimum followed by "L".
[x] F-values corresponding to p-values under 0.05 followed by "*" and under 0.01 followed by "**".

Table 5. Average AFIS neps, mote, and seed coat fragment data for early maturing cultivars tested in Tribbett'03.

	AFIS neps		AFIS seed coat neps		SCFs per 1g lint			Motes per 1g lint		
Cultivar[z]	Size, um	Per 1g lint	Size, um	Per 1g lint	No.	mg	mg / SCF	No.	mg	mg / mote
FM966*	685	146L	1051L	9.3L	5.8L	3.0L	0.51HL	0.6L	4.1HL	8.2H
SG215BR*	665L	171	1205HL	7.7L	7.8L	3.9L	0.54HL	1.4HL	6.4HL	5.7HL
DP436RR*	682	169	1150HL	9.0L	7.9L	4.9L	0.65HL	1.2HL	7.3HL	5.3HL
SG747*	684	170	1300H	10.1	8.2L	4.0L	0.50HL	1.8HL	8.3HL	3.6L
SG521R*	678L	157L	1120HL	8.7L	8.6L	5.2L	0.65HL	2.3H	7.3HL	4.0L
FM958*	679	145L	1204HL	7.3L	9.7L	5.8L	0.57HL	0.6L	1.3L	2.6L
DP451BR*	697H	195	1233H	11.4	10.4L	6.7	0.64HL	1.3HL	6.9HL	4.8HL
DES816*	693H	173	1194HL	13.7	11.8	7.4	0.63HL	2.0HL	6.8HL	3.4L
ST4793R*	687	152L	1164HL	10.9	12.0	8.3	0.67HL	1.9HL	10.6HL	6.0HL
ST4892BR*	685	155L	1103L	11.6	12.1	8.1	0.68HL	2.8H	10.8HL	3.8L
PM1199RR*	684	140L	1203HL	9.1L	12.3	6.9	0.56HL	1.7HL	5.7HL	3.4L
BXN49B*	690H	231H	1193HL	13.6	12.4	6.3L	0.51HL	2.1HL	8.3HL	4.5HL
NX2429*	698H	160L	1146HL	14.9H	12.8	7.0	0.57HL	2.1HL	13.6H	6.0HL
SG105*	676L	156L	1074L	8.1L	13.2	6.8	0.52HL	1.9HL	8.3HL	3.9L
PSC355*	694H	157L	1170HL	13.4	13.3	9.0	0.69HL	2.1HL	14.3H	6.2HL
PM1218BR*	689	182	1199HL	10.8	17.6	8.8	0.51HL	2.1HL	12.7H	5.3HL
DES810*	708H	181	1202HL	17.7H	29.3H	14.2H	0.48HL	2.6H	10.8HL	4.2HL
OAX303	679L	165	1119HL	6.3L	n.a.[w]	n.a.	n.a.	n.a.	n.a.	n.a.
BCG28R*	677L	186	1173HL	6.7L	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
OAX302BR	666L	180	1206HL	6.9L	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
DPX00W12	661L	154L	1185HL	7.3L	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
OAX300BR	675L	168	1257H	7.7L	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
OAX304BR	679	186	1265H	7.7L	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
STX0204BR	666L	188	1097L	8.0L	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
DPX99R	672L	176	1110L	8.0L	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
DP449BR	679	178	1076L	8.2L	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
FM960BR	685	176	1232H	8.7L	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
FM966LL	679L	152L	1106L	9.2L	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
ST4563B2	687	235H	1085L	9.2L	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
ST474	689	153L	1255H	9.2L	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
SG215BR	669L	203	1107L	9.7L	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
DPXW99R	685	215H	1236H	9.8	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
DPX02X71R	674L	164	1218H	10.2	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
FM958LL	689	161L	1144HL	10.3	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
FM958BG*	679L	175	1026L	10.4	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
BCG295	690H	201	1219H	10.6	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
STX202B2R	691H	224H	1146HL	11.6	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
PHY410RR	682	177	1110L	12.8	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Replication F-value[x]	4.49 *	3.53 *	0.06	4.78 *	2.97	0.13	1.93	1.05	0.19	0.20
Cultivar F-value[x]	2.27**	8.67**	0.96	4.33**	9.98**	4.5**	0.80	1.15	0.88	0.98
Mean	682	175	1165	9.9	12.1	6.8	0.58	1.8	8.4	4.8
LSD	18	23	189	3.3	4.8	3.5	0.23	1.7	10.4	4.0

[z] Cultivars followed by "*" common to both crop years.
[y] Values statistically equal to maximum followed by "H" and minimum followed by "L".
[x] F-values corresponding to p-values under 0.05 followed by "*" and under 0.01 followed by "**".
[w] Data not available.

Table 6. Least square means and statistical analysis of AFIS neps, seed coat fragments, and motes for cultivars common to the three test groups.

	AFIS neps		AFIS seed coat neps		SCFs per 1g lint			Motes per 1g lint		
Cultivar	Size, um	Per 1g lint	Size, um	Per 1g lint	No.	mg	mg / SCF	No.	mg	mg / mote
FM966	692	190	1073L	10.3	8.9L	4.0L	0.49HL	1.2L	6.3L	5.8H
SG215BR	669L	178L	1175H	7.2L	9.0L	4.3L	0.53HL	2.5H	13.0H	5.5H
SG747	686	168L	1184H	9.5	9.1L	3.8L	0.44L	1.4L	7.9L	4.8H
SG521R	681	176L	1124HL	10.4	10.6L	5.1L	0.51HL	2.2H	11.0H	5.3H
BCG28R	685	214	1189H	8.6L	11.3L	5.5L	0.56HL	2.4H	11.3H	4.7HL
DP436RR	688	209	1173H	10.9	11.5L	6.4	0.59H	1.6HL	8.0L	4.7HL
DP451BR	688	214	1178H	10.3	11.6L	5.7L	0.54HL	2.4H	12.2H	4.7HL
SG105	682	184L	1160H	8.9L	12.4L	5.3L	0.44L	2.3H	9.5H	3.9L
PM1199RR	691	169L	1207H	10.9	12.6L	6.8	0.55HL	2.0HL	11.3H	5.8H
FM958BG	692	227	1063L	12.4	12.9	6.5	0.57HL	1.4L	2.8L	3.0L
FM958	683	182L	1124HL	9.1L	13.6	6.6	0.55HL	1.1L	3.6L	3.0L
DES816	697	199	1189H	13.7	13.8	5.8L	0.46HL	1.5HL	5.7L	3.7L
ST4892BR	687	168L	1163H	11.7	13.8	7.5	0.56HL	2.4H	10.4H	4.3L
ST4793R	689	169L	1187H	11.6	13.9	7.6	0.54HL	2.1H	10.6H	5.2H
NX2429	699H	202	1098L	16.2	14.8	7.5	0.57HL	2.1H	11.1H	5.0H
BXN49B	691	245H	1138HL	13.0	15.8	9.1H	0.59H	1.6HL	6.0L	4.0L
PSC355	698	185	1153H	15.7	18.1	8.0	0.50HL	2.1H	14.7H	6.3H
PM1218BR	693	208	1169H	12.4	19.6	9.6H	0.52HL	2.3H	11.0H	4.5L
DES810	710H	232H	1209H	19.6H	27.4H	11.2H	0.45L	1.8HL	8.5L	4.9H
Test										
Stoneville'02	684	231	1127	11.2	18.5	5.8	0.32	1.5	6.5	4.3
Stoneville'03	699	188	1177	13.1	10.8	7.4	0.67	2.5	13.0	5.1
Tribbett'03	686	168	1163	10.7	11.9	6.8	0.59	1.8	8.2	4.7
Test group F-value	24.9**	291**	4.33*	17.2**	66.8**	6.67**	90**	14.1**	18.7**	3.25*
Replication F-value	1.91	5.02**	0.21	1.98	2.23*	3.58**	1.6	2.3*	1.97	1.41
Cultivar F-value	4.14**	24.3**	1.84*	15.2**	11.64**	5.98**	0.97	1.75*	2.4**	2.14**
Test group *cultivar F-value	0.88	3.59**	1.15	1.27	1.3	1.4	1.01	1.16	1.28	1.52
Mean	690	196	1156	11.7	13.7	6.6	0.53	1.9	9.2	4.7
LSD	11	17	89	2.2	3.8	2.4	0.14	1.0	5.8	1.8

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

Table 7. Pearson correlations (r) between AFIS seed coat neps, AFIS neps, manual SCF, and manual motes in Stoneville'02.

	Nep size, µm	Neps/ g	SCN size, µm	SCN/g	SCF/g	SCF mg/g	mg/ SCF	Mote/ g	Mote mg/g	mg/ mote
Nep size, µm	1.00**	0.38*	0.34*	0.75**	0.56**	0.44**	-0.22	-0.22	-0.16	0.09
Neps/g		1.00**	0.02	0.26	0.31	0.35*	0.14	-0.12	-0.17	-0.05
SCN size, µm			1.00**	0.27	0.13	0.06	-0.15	0.46**	0.45**	0.24
SCN/g				1.00**	0.84**	0.66**	-0.36*	-0.25	-0.20	0.18
SCF/g					1.00**	0.84**	-0.32	-0.21	-0.24	0.02
SCF mg/g						1.00**	0.22	-0.11	-0.11	0.06
mg/SCF							1.00**	0.14	0.20	0.14
Mote/g								1.00**	0.93**	0.27
Mote mg/g									1.00**	0.54**
mg/mote										1.00**

[z] Values corresponding to p-values under 0.05 followed by "*" and under 0.01 followed by "**".

Table 8. Pearson correlations (r) between AFIS seed coat neps, AFIS neps, manual SCF, and manual motes in Stoneville'03.

	Nep size, µm	Neps/ g	SCN size, µm	SCN/g	SCF/g	SCF mg/g	mg/ SCF	Mote/ g	Mote mg/g	mg/ mote
Nep size, µm	1.00**	0.45**	0.14	0.77**	0.48**	0.46**	0.17	-0.09	-0.10	0.00
Neps/g		1.00**	-0.08	0.54**	0.42**	0.40*	0.22	0.01	-0.11	-0.13
SCN size, µm			1.00**	-0.15	0.13	0.12	0.01	0.23	0.28	0.19
SCN/g				1.00**	0.59**	0.48**	0.01	0.00	0.01	0.14
SCF/g					1.00**	0.89**	0.15	-0.09	-0.03	0.08
SCF mg/g						1.00**	0.56**	0.04	-0.01	-0.01
mg/SCF							1.00**	0.36*	0.15	-0.11
Mote/g								1.00**	0.80**	0.28
Mote mg/g									1.00**	0.76**
mg/mote										1.00**

[z] Values corresponding to p-values under 0.05 followed by "*" and under 0.01 followed by "**".

Table 9. Pearson correlations (r) between AFIS seed coat neps, AFIS neps, manual SCF, and manual motes in Tribbett'03.

	Nep size, µm	Neps/ g	SCN size, µm	SCN/g	SCF/g	SCF mg/g	mg/ SCF	Mote/ g	Mote mg/g	mg/ mote
Nep size, µm	1.00**	0.14	0.17	0.78**	0.66**	0.70**	0.00	0.35	0.47*	0.08
Neps/g		1.00**	0.05	0.16	0.24	0.15	-0.26	0.24	0.17	-0.05
SCN size, µm			1.00**	0.04	0.15	0.10	-0.19	0.01	-0.02	-0.41*
SCN/g				1.00**	0.71**	0.73**	-0.04	0.58**	0.62**	0.08
SCF/g					1.00**	0.94**	-0.29	0.57**	0.49*	-0.18
SCF mg/g						1.00**	0.02	0.62**	0.56**	-0.17
mg/SCF							1.00**	0.15	0.18	0.04

Mote/g	1.00**	0.74**	-0.23
Mote mg/g		1.00**	0.29
mg/mote			1.00**

[z] Values corresponding to p-values under 0.05 followed by "*" and under 0.01 followed by "**".

Table 10. Model predicting seed coat fragments in ginned lint with 2 measurement techniques: "manual SCF" and "AFIS SCN".

Effect	Degrees of Freedom	F value	P value
Test	2	17.23	0.0028
Measurement	1	17.93	0.0055
Test*measurement	2	34.97	0.0005
Cultivar	18	21.24	<.0001
Cultivar*measurement	18	2.80	0.0002
Cultivar*test	34	1.37	0.0939
Cultivar*measurement*test	34	1.24	0.1813