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ENGINEERING AND GINNING

Harvesting and Seed Cotton Cleaning of a Cotton Cultivar with a Fragile Seed Coat

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ABSTRACT

Seed coat fragments that remain in lint after the ginning process decrease spinning efficiency at the textile mill, and ultimately reduce the quality of finished goods. An experiment was conducted to determine the impact harvest and seed cotton cleaning treatments had on the fiber quality attributes of an upland cultivar known to have fragile seed coats. Three harvester treatments examined spindle size (diameter) and speed (rpm) on the picker: 13-mm (1/2-in) spindles operated at 2000 rpm; and 14-mm (9/16-in) spindles operated at either 1500 or 2400 rpm. Three seed cotton cleaning treatments varied the number of seed cotton cleaners from none to twice as many as customarily used. Seed coat nep count in the fiber as determined by AFIS was used as an indicator of seed coat fragment levels. Results showed that using a larger spindle diameter lowered seed cotton trash content at the wagon and feeder, produced less short fiber, and a higher color grade: however, seed coat nep count was not different. Increasing the number of seed cotton cleaners reduced trash content in the seed cotton (at the feeder), cottonseed, and fiber and improved color grade but not seed coat nep count. All other fiber and cottonseed properties were not different among harvesting or seed cotton cleaning treatments. It appeared that neither spindle size, spindle speed, nor increased seed cotton cleaning helped manage seed coat fragments. Future research is planned to examine possible methods to reduce seed coat fragments through modifications at the lint cleaner.

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Seed coat fragments have been defined as bits of seed coat tissue with attached lint (Brown and Ware, 1958), and those that remain in fiber after gin processing have caused problems at the textile mill for many years. Pearson (1955) reported that seed coat fragments affect not only the quality of the finished product but are also a factor while processing yarn, and are responsible for some of the ends down in spinning. These fiber "tufts" appear in dyed yarn or cloth as undesirable specks, and may lead to a hole or weakened spot in the yarn of fabric (Pearson, 1955).

Seed coat fragments are formed during the harvesting and ginning operations and may originate from undamaged mature cottonseeds, damaged cottonseeds, or immature cottonseeds (Bargeron and Garner, 1991). Past research has attempted to alleviate seed coat fragments in the ginning plant. Mangialardi and Shepherd (1968) found that lint cleaning did not reduce fragment number significantly, and a considerable number of fragments remained in the lint even after four stages of lint cleaning. Mangialardi (1987) concluded that lint cleaning was not a reliable method to reduce seed coat fragments, and in some cases, lint cleaning increased fragment counts due to existing fragments breaking into smaller pieces.

More recent research studies detail attempts to alleviate seed coat fragments at the gin stand using a high-quality, high-yielding fragile seed coat cultivar that contained a very large amount of seed coat fragments. Armijo et al. (2006a) showed that neither saw ginning with auxiliary rib guides, nor roller ginning, reduced seed coat nep count when compared to a conventional saw gin stand. Seed coat nep count was used as an indicator for seed coat fragments. Seed coat neps are identified by the Advanced Fiber Information System (AFIS) as fibers with attached seed coat fragments (Baldwin et al., 1995). Armijo et al. (2006b) showed that using a small diameter spindle during picker harvesting, or using a paddle roll to assist turning the seed roll in the saw gin stand may help alleviate seed coat fragments.

In the previous studies by Armijo et al. (2006a and 2006b), seed meats from the fragile seed coat cultivar were observed in the trash of the first six-cylinder cleaner during seed cotton conditioning. This observation led to including a harvester treatment in subsequent studies to determine if the diameter and/or speed of the spindle on the picker affected the presence of seed coat fragments. It also raised speculation as to whether the machinery used in seed cotton cleaning had an effect on the level of seed coat neps.

The objective of this study was to determine the interactions of picker spindle diameter/spindle speed and the amount of seed cotton cleaning in a ginning plant with an upland cultivar that has a fragile seed coat. As in previous studies by Armijo et al. (2006a and 2006b) that investigated methods of reducing seed coat fragments, AFIS seed coat nep count in the fiber was used to evaluate differences in harvesting and seed cotton cleaning treatments. In this study, a manual count of seed coat fragments was also used to evaluate differences in treatments.

MATERIALS AND METHODS

Figure 1 shows the 13- and 14-mm (1/2- and 9/16-in) diameter spindles used in the experiment. The 13-mm spindle, the most common size, has a shorter extension into the plant, and weighs less than the 14-mm spindle resulting in a lighter picker head. As reported by Armijo et al. (2006b), it is believed that because the 14-mm spindle extends further into the plant, the longer spindle may do less plant damage during picking since the cotton plant is not compressed as much due to a wider picking zone. The wider picking zone may lead to less trash in the seed cotton. The 13-mm spindle had 4.9 cm (1.9 in) of the spindle tip extending into the picking zone, whereas the 14-mm spindle had 6.1 cm (2.4 in) of the spindle tip extending into the picking zone. With the 13-mm spindle, the cotton plant is compressed through a picking zone that is 1.2 cm (0.5 in) narrower.

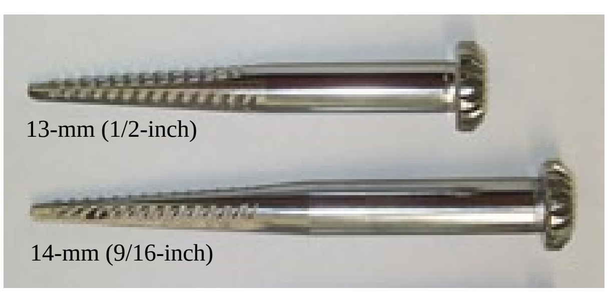

Figure 1. Picker spindles used in the study.

Three harvesting treatments were used to determine the effect of spindle diameter/speed on seed coat fragmentation: 1) a conventional Case International Harvester Model 1822 two-row picker equipped with 13-mm spindles turning at 2000 rpm, moving at a ground speed of 2.7 km/h (1.7 mi/h), 2) an experimental International Harvester Model 4M-120 one-row picker equipped with 14-mm spindles turning at 1500 rpm, moving at a ground speed of 3.0 km/h (1.9 mi/h), and 3) the same International Harvester Model 4M-120 one-row picker just mentioned, with the same sized spindles and the same ground speed, but its spindles turning at 2400 rpm (International Harvester; Racine, WI). Other than differences in picking zone between the 13-mm two-row picker and the 14-mm one-row picker discussed earlier, the geometry of the spindles in the picker cabinet for all harvesting treatments was the same.

There were three seed cotton cleaning treatments used to determine the effects of seed cotton cleaning on seed coat fragmentation: 1) no seed cotton cleaners (no pre-cleaning prior to the gin stand), 2) three seed cotton cleaners (a six-cylinder incline, a stick machine, and a six-cylinder incline in series), and 3) six seed cotton cleaners (a six-cylinder incline, a stick machine, a six-cylinder incline, a stick machine, a stick machine, and a six-cylinder incline in series). A ginning plant typically uses three seed cotton cleaners in its overhead. The fragile seed coat cotton was grown and harvested in the same field in the Mesilla Valley of Southern New Mexico during the 2005-06 season. The seed cotton was harvested at low moisture content so none of the treatments included drying. Figures 2 and 3 are schematic drawings of the type of inclined six-cylinder cleaners and three-saw stick machines used in the test (USDA, 1994). The six-cylinder cleaners used in the experiment were gravity-fed, 1.3-m (50-in) wide Continental/Moss Gordin inclines. The six-cylinder cleaners had 9.5-mm (3/8-in) diameter grids spaced 9.5 mm apart. The stick machines used in the experiment were gravity-fed 1.8-m (72-in) wide Continental/Moss Gordin Little David cleaners. The Little David's had one 0.349-m (13.75-in) diameter channel (sling off) saw and two reclaimer saws. Ginning was performed on a cut down Continental 46-saw Double Eagle saw gin stand with a Continental/Moss Gordin Galaxie feeder. For all treatments, lint cleaning consisted of one saw-type Continental/Moss Gordin Lodestar cleaner.

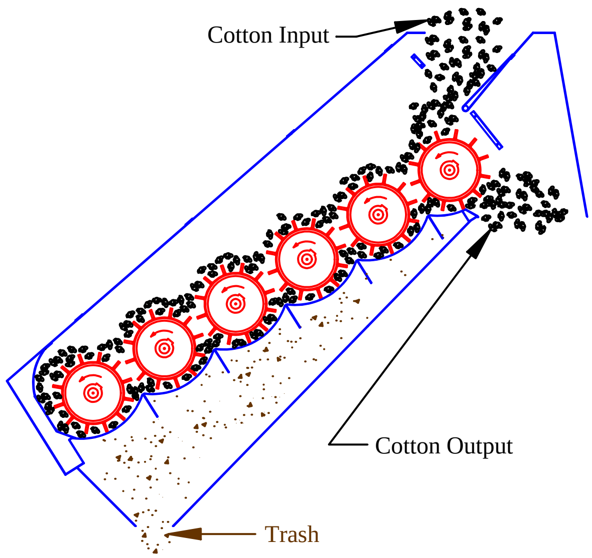

Figure 2. Six-cylinder seed cotton cleaner.

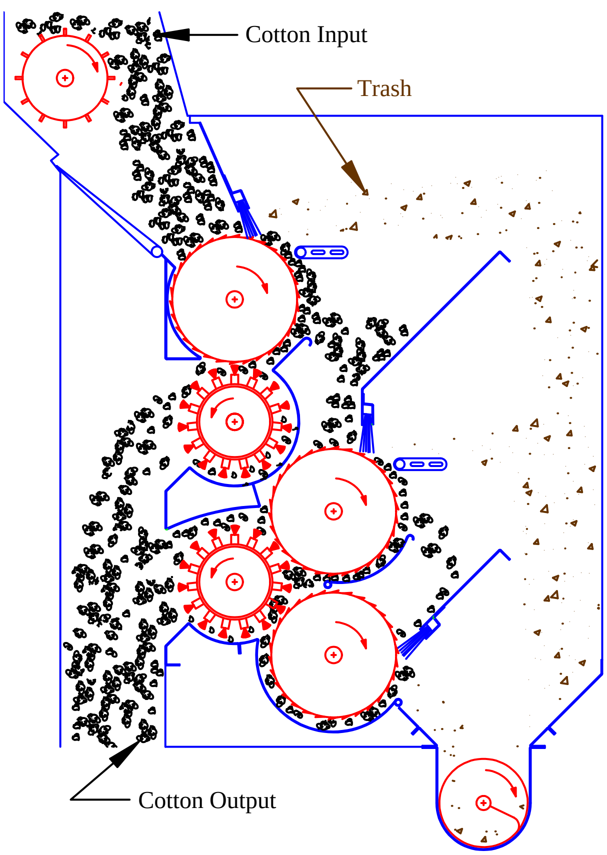

Figure 3. Three-saw stick machine.

The ginning test was conducted in the summer of 2006 at the USDA-ARS Southwestern Cotton Ginning Research Laboratory located in Mesilla Park, NM. The ginning test of three harvester treatments and three seed cotton cleaning treatments replicated three times resulted in a total of 27 ginning lots. The lots averaged 203 kg (447 lb) of seed cotton. The experimental design was a randomized complete block with replications serving as blocks. Analysis of variance was performed with the General Linear Model of SAS at the 5% level of significance (version 9.1; SAS Institute, Inc.; Cary, NC), and differences between main effect treatment means were tested with Tukey's studentized range test.

Seed cotton samples were collected before and after cleaning in the gin plant overhead. Lint samples were collected before and after cleaning. Cottonseed samples were collected at the seed belt. All sampling included two sub-samples per lot which were averaged together. The foreign matter content of the seed cotton samples was determined using the pneumatic fractionation method, and the moisture content of the seed cotton and lint samples was determined using the oven drying method (Shepherd, 1972). The USTER Advanced Fiber Information System (AFIS) and the High Volume Instrument (HVI) at Cotton Incorporated (Cary, NC) were used to determine the fiber properties of lint samples. Cottonseed analysis was performed at Mid-Continent Laboratories of Memphis, TN according to the Trading Rules of the National Cottonseed Products Association (National Cottonseed Products Association, 1997). A manual count of seed coat fragments was determined using the Standard Test Method for Seed Coat Fragments and Funiculi in Cotton Fiber Samples (ASTM, 1979).

RESULTS AND DISCUSSION

Because there was no significant interaction between harvesting and seed cotton cleaning treatments, the data was analyzed by harvesting and seed cotton cleaning treatments separately. Table 1 shows seed cotton cleaning process rate, trash and moisture content at the wagon and feeder, and ginning plant conditions during the experiment. Seed cotton cleaning process rate was significantly different among the seed cotton cleaning treatments. The seed cotton cleaning treatment with no cleaning had the highest process rate at 2239 kg/m/h (1504 lb/ft/h), and the seed cotton cleaning treatment with the most cleaning (six cleaners) had the lowest process rate at 2104 kg/m/h (1414 lb/ft/h). The difference in seed cotton cleaning process rate was probably due to recirculation of seed cotton in some of the cleaners. Seed cotton foreign matter content at the wagon was different among harvesting treatments with the 13-mm spindle having the highest trash content at 6.3%, and the treatments with the 14-mm spindle averaging 3.7%. This agrees with the hypothesis stated earlier that the 14-mm spindle may have less trash in the seed cotton because the spindle extends further into the cotton plant, and the plants do not need to be compressed as much due to a wider picking zone. These results were similar to those found by Armijo et al. (2006b) where the harvesting treatment with the 13-mm spindle contained more trash than the treatment with the 16-mm (5/8-in) spindle.

There were differences in seed cotton foreign matter content after the feeder among harvesting and seed cotton cleaning treatments (Table 1). Trash content after the feeder among harvesting treatments followed the same trend as trash content at the wagon: the treatment with the 13-mm spindle had the highest trash content at 1.3%, and the treatments with the 14-mm spindle averaged 1.0%. Trash content after the feeder among seed cotton cleaning treatments was highest on the treatment that contained no cleaning at 1.6%, and the remaining treatments (three and six cleaners) averaged 0.9%. Seed cotton moisture content (dry basis) at the wagon was different among harvesting treatments. The harvester with 13-mm spindles may have put a little more water on the spindles than the harvester with the 14-mm spindles, but the differences in moisture content are inconsequential. Seed cotton moisture content averaged 6.7 and 6.8% at the wagon and feeder (after seed cotton conditioning), respectively. Room temperature and relative humidity were not different among harvesting and seed cotton cleaning treatments and averaged 25.5 °C and 55.4%, respectively.

Table 2 shows the cottonseed properties. Total foreign matter content of the cottonseed was different among harvesting and seed cotton cleaning treatments. The harvesting treatment with the 14-mm spindle running fast had the lowest amount of foreign matter (0.28%) in the cottonseed; this is reasonable because the 14-mm spindle running fast had the lowest trash content at both the wagon and feeder, and some of the trash goes with the cottonseed. The seed cotton cleaning treatment with no cleaners had the largest amount of foreign matter in the cottonseed (0.41%), and as more cleaners were added in the remaining treatments, foreign matter content decreased. Linters content and cottonseed grade were not different among harvester or seed cotton cleaning treatments, and averaged 12.8% and 110.6, respectively. Moisture content, free fatty acids, oil content, and ammonia content of the cottonseed were not different among harvester or seed cotton cleaning treatments.

Table 1. Means and statistical analysis of seed cotton cleaning process rate, trash and moisture content after the wagon and feeder, and gin plant conditions, by harvesting and seed cotton cleaning treatment.

	S/C cleaning process rate[z]	Trash content wagon[z]	Trash content feeder[z]	Moisture content wagon[z]	Moisture content feeder	Room temp.	Room r.h.
	kg/m/h (lb/ft/h)	%	%	%	%	deg C	%
				Harvesting Treatment			
13-mm spindle	2158 (1450)	6.34 a	1.34 a	7.34 a	6.94	25.2	55.7
14-mm, slow	2134 (1434)	3.74 b	1.09 b	6.25 b	6.65	25.7	55.0
14-mm, fast	2196 (1476)	3.59 b	0.98 b	6.56 ab	6.65	25.6	55.5
				Seed Cotton Cleaning Treatment			
No cleaning	2239 (1504) a	4.62	1.63 a	6.51	6.67	25.7	54.5
Three cleaners	2145 (1441) b	4.78	0.99 b	6.81	6.73	25.6	55.7
Six cleaners	2104 (1414) b	4.27	0.81 b	6.86	6.84	25.2	56.0
				Observed Significance Level[y]			
Harvest Treat	NS	0.0001	0.0035	0.0327	NS	NS	NS
S/C Treatment	0.0009	NS	<.0001	NS	NS	NS	NS
HAR x S/C	NS	NS	NS	NS	NS	NS	NS

[z] Means followed by the same letter in each column are not different based on Tukey's studentized range test (P≤0.05).
[y] NS = not statistically significant at (P>0.05).

Table 2. Means and statistical analysis of cottonseed properties, by harvesting and seed cotton cleaning treatment.

	Linters	Total foreign matter[z]	Moisture	Free fatty acids	Oil	Ammonia	Net quality index	Quantity index	Grade
	%	%	%	%	%	%	Index	Index	Index
				Harvesting Treatment					
13-mm spindle	12.7	0.35 ab	7.13	1.02	19.3	4.70	100	110.5	110.6
14-mm, slow	12.8	0.36 a	6.71	0.89	19.4	4.70	100	110.8	110.8
14-mm, fast	12.9	0.28 b	6.73	1.04	19.4	4.65	100	110.4	110.4
				Seed Cotton Cleaning Treatment					
No cleaning	12.9	0.41a	6.81	0.97	19.4	4.68	100	110.5	110.5
Three cleaners	12.9	0.29 b	6.83	0.99	19.4	4.69	100	110.8	110.8
Six cleaners	12.7	0.28 b	6.93	0.98	19.3	4.68	100	110.4	110.4
				Observed Significance Level[y]					
Harvest Treat	NS	0.0222	NS	NS	NS	NS	NS	NS	NS
S/C Treatment	NS	0.0006	NS	NS	NS	NS	NS	NS	NS
HAR x S/C	NS	NS	NS	NS	NS	NS	NS	NS	NS

[z] Means followed by the same letter in each column are not different based on Tukey's studentized range test (P≤0.05).
[y] NS = not statistically significant at (P>0.05).

Because the study focused on harvesting and seed cotton cleaning treatments and the influence of lint cleaning was not an objective, the results in Tables 3 through 5 present fiber properties immediately after the gin stand without lint cleaning. Table 3 shows that AFIS length and upper quartile length were not different among harvesting and seed cotton cleaning treatments and averaged 24.4 (0.96 in) and 29.5 mm (1.16 in), respectively. Fineness, immature fiber content, and maturity ratio were not different among harvester or seed cotton cleaning treatments and averaged 168 m-tex, 7.7%, and 0.9%, respectively. Short fiber content (fiber less than 12.7 mm or 1/2 in) was different among harvesting treatments. The harvesting treatment with the 13-mm spindle had the highest short fiber content at 9.93%, and although the harvester treatment with the 14-mm running fast had the lowest short fiber content at 9.22%, the difference was only about 0.7%. Nep count and nep size were not different among harvesting and seed cotton cleaning treatments and averaged 234 counts per g and 770 µm, respectively. There was a significant interaction between harvesting and seed cotton cleaning treatment regarding nep size, but this appears to be an anomaly.

Table 4 shows that AFIS seed coat nep count and size were not different among harvester or seed cotton cleaning treatment. Seed coat nep count averaged 36.3 nep per g (considered in the "high" range of 31 to 40 counts per g as defined by Uster, 2004), and seed coat nep size averaged 1276 µm. As mentioned earlier, AFIS seed coat nep count was the main variable being used to screen for treatments that may help cultivars that have tendencies for fragile seed coats. Armijo et al. (2006b) found that the 13-mm spindle contained fewer seed coat neps per g compared to the 16-mm spindle, but in this study, the 13-mm spindle was not different from the 14-mm spindle (at either speed) with respect to seed coat nep count. Note that the seed coat nep counts were considered in the high range for all treatments. Dust count, trash count, and total trash count were different among seed cotton cleaning treatments with the no-cleaning treatment having higher counts than both the three- and six-cleaner treatments. Total trash count was 940 per g on the no-cleaner treatment, and averaged 661 counts on the three- and six-cleaner treatments. AFIS visible foreign matter was not different among harvester or seed cotton cleaning treatments and averaged 3.6%. Table 4 also shows the number of seed coat fragments in a 5 g sample of lint. A manual count of seed coat fragments was not different among harvester or seed cotton cleaning treatment and averaged 132 counts per g.

Table 3. Means and statistical analysis of fiber properties measured by the Advanced Fiber Information System (AFIS) on samples before lint cleaning (just after ginning), by harvesting and seed cotton cleaning treatment.

	Length	Length CV[z]	Upper quartile length	Short fiber content[z]	Fineness	Immature fiber content	Maturity ratio	Nep	
								count	size
	mm	%	mm	%	m-tex	%	-	per g	μm
				Harvesting Treatment					
13-mm spindle	24.3	36.1 a	29.5	9.93 a	166	7.81	0.89	241	769
14-mm, slow	24.4	36.2 a	29.6	9.79 ab	169	7.71	0.90	230	768
14-mm, fast	24.6	35.5 b	29.6	9.22 b	168	7.70	0.89	231	774
				Seed Cotton Cleaning Treatment					
No cleaning	24.4	36.0	29.5	9.76	168	7.71	0.90	224	773
Three cleaners	24.3	35.9	29.4	9.77	167	7.66	0.89	235	771
Six cleaners	24.5	35.8	29.7	9.43	167	7.84	0.89	243	766
				Observed Significance Level[y]					
Harvest Treat	NS	0.0242	NS	0.0149	NS	NS	NS	NS	NS
S/C Treatment	NS	NS	NS	NS	NS	NS	NS	NS	NS
HAR x S/C	NS	NS	NS	NS	NS	NS	NS	NS	0.0294

[z] Means followed by the same letter in each column are not different based on Tukey's studentized range test (P≤0.05).

[y] NS = not statistically significant at (P>0.05).

Table 4. Means and statistical analysis of fiber properties measured by the Advanced Fiber Information System (AFIS), and a manual count of seed coat fragments, on samples taken before lint cleaning (just after ginning), by harvesting and seed cotton cleaning treatment.

	Seed coat nep		Dust count[z]	Trash count[z]	Total trash count[z]	Trash size	Visible foreign matter	Seed coat fragment coat count
	count	size						
	per g	μm	per g	per g	per g	μm	%	per 5 g
				Harvesting Treatment				
13-mm spindle	35.8	1263	688	122	810	319	3.78	127.3
14-mm, slow	36.3	1281	635	103	738	311	3.45	132.9
14-mm, fast	36.7	1285	611	103	714	319	3.56	135.4
				Seed Cotton Cleaning Treatment				
No cleaning	37.3	1265	808 a	132 a	940 a	304	3.94	123.3
Three cleaners	35.4	1290	562 b	99.2 b	661 b	323	3.30	136.7
Six cleaners	36.1	1273	564 b	96.7 b	660 b	322	3.54	136.0
				Observed Significance Level[y]				
Harvest Treat	NS	NS	NS	NS	NS	NS	NS	NS
S/C Treatment	NS	NS	0.0020	0.0169	0.0026	NS	NS	NS
HAR x S/C	NS	NS	NS	NS	NS	NS	NS	NS

[z] Means followed by the same letter or group of letters in each column are not different based on Tukey's studentized range test (P≤0.05).

[y] NS = not statistically significant at (P>0.05).

Table 5. Means and statistical analysis of High Volume Instrument (HVI) results on samples taken just before lint cleaning (just after ginning), by harvesting and seed cotton cleaning treatment.

	Micronaire	Upper half mean length	Uniformity	Strength	Elongation	Reflectance[z]	Yellowness	Color grade[z]	Short fiber index
	Reading	mm	%	mN/tex	%	Rd	+b	Index	%
					Harvesting Treatment				
13-mm spindle	4.09	28.1	83.0	272	5.30	77.3 b	8.81	101	8.56
14-mm, slow	4.21	28.0	83.3	273	5.42	78.5 a	9.04	102	8.31
14-mm, fast	4.14	28.2	83.1	268	5.35	78.2 ab	8.86	103	8.50
					Seed Cotton Cleaning Teatment				
No cleaners	4.17	28.1	83.2	271	5.32	77.3 b	8.84	101 b	8.40
Three cleaners	4.06	28.2	83.3	271	5.42	78.4 a	9.04	103 a	8.46
Six cleaners	4.22	28.0	83.0	271	5.33	78.2 ab	8.82	102 ab	8.52
					Observed Significance Level[x]				
Harvest Treat	NS	NS	NS	NS	NS	0.0119	NS	0.0487	NS
S/C Treatment	NS	NS	NS	NS	NS	0.0151	NS	0.0264	NS
HAR x SC	NS	NS	NS	NS	NS	NS	NS	NS	NS

[z] Means followed by the same letter in each column are not different based on Tukey's studentized range test ($P \leq 0.05$).

[y] Old code=new code conversion: 94=41, 100=31, 104=21, 105=11

[x] NS = not statistically significant at ($P>0.05$).

Table 5 shows the HVI results. Micronaire, upper half mean, uniformity, strength, and elongation were not different among harvesting or seed cotton cleaning treatments and averaged 4.2, 28.1 mm (1.11 inch), 83.1%, 271 mN/tex (27.6 g/tex), and 5.4%, respectively. HVI short fiber index, which is calculated from the upper half mean length and the uniformity index, was not different among harvesting or seed cotton cleaning treatment and averaged 8.5%. Color reflectance and color grade were different among harvesting and seed cotton cleaning treatments (although the Observed Significance Level for color grade with the harvester treatment was close to being non-significant and the Tukey's studentized range test did not separate the means). Reflectance was about one point higher on both the 14-mm spindle (slow and fast) and three- and six-cleaner treatments (78.3 versus 77.3). Color grade followed the same pattern as reflectance with the 14-mm spindle treatments (slow and fast) and the three- and six-cleaner treatments having a higher color grade (102.5 versus 101, old code). A color grade of 102.5 and 101 (old code) is better than a middling grade of 31 (new code), but not high enough to make a strict middling grade of 21 (new code). Color grade must be analyzed using old code because the new code numbering system is not linear. Thomasson (1993) found that there is an association between trash particles in lint (color grade) and reflectance; less trash increased the reflectance. This study reaffirmed this association.

CONCLUSIONS

Seed cotton trash content at the wagon and feeder was different among harvesting treatment with the 13-mm spindle having more trash than the 14-mm spindle. This is consistent with the theory that longer spindles extend further into the plant and do not compress the plant as much due to a wider picking zone, resulting in less trash being harvested. Seed cotton trash content at the feeder was also different among seed cotton cleaning treatments. The treatment with no cleaners had the highest trash content, and the six-cleaner treatment had the lowest trash content. Trash content in the cottonseed was different among harvesting and seed cotton cleaning treatment with the 14-mm treatment running fast having the lowest amount of trash (the 14-mm harvesting treatment running fast also had the lowest amount of seed cotton trash), and the no-cleaner seed cotton treatment having the highest amount of trash. All other cottonseed properties, including linters content and grade, were not different among either harvesting or seed cotton cleaning treatment.

With respect to AFIS fiber properties on samples taken before lint cleaning, short fiber content was different among harvester treatments with the 13-mm spindle having the highest percentage, and the 14-mm spindle running fast having the lowest percentage, but the difference was small. Dust and trash counts were different among seed cotton cleaning treatments with the no-cleaner treatment having the highest trash counts. All other AFIS measurements, including seed coat nep count, were not different among harvesting or seed cotton cleaning treatments. Seed coat nep count was used as an indicator for levels of seed coat fragments. Also, a manual count of seed coat fragments agreed with the AFIS seed coat nep count results in that harvesting or seed cotton cleaning treatments were not different.

With respect to HVI fiber properties on samples taken before lint cleaning, reflectance and color grade were different among harvesting and seed cotton cleaning treatments. The harvester treatment with the 14-mm spindle running fast and the cleaning treatment with three seed cotton cleaners had the best color grade (less trash) and reflectance; both of these results may be related to the theory that longer spindles extend further into the plant and do not compress the plant as much due to a wider picking zone, and less trash is then harvested. All other HVI measurements were not different among harvesting or seed cotton cleaning treatments.

In this study, it appears that neither spindle diameter, spindle speed, nor increased levels of seed cotton cleaning affected the reduction of seed coat fragments. Future work will again examine harvester treatments that use other speeds with 14-mm diameter spindles. The 14-mm spindle extends further into the plant than the 13-mm spindle, and as seen in this test, resulted in less trash in the seed cotton. Future studies will also examine possible methods to reduce seed coat fragments through modifications at the lint cleaner.

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DISCLAIMER

Mention of trade names or commercial products in this publication is solely for the purpose of providing specific information and does not imply recommendation or endorsement by the U.S. Department of Agriculture.

REFERENCES

Armijo, C. B., S. E. Hughs, M. N. Gillum, and E. M. Barnes. 2006a. Ginning a cotton with a fragile seed coat. Journal of Cotton Science 10:46-52.

Armijo, C. B., G. A. Holt, K. D. Baker, S. E. Hughs, E. M. Barnes, and M. N. Gillum. 2006b. Harvesting and ginning a cotton with a fragile seed coat. Journal of Cotton Science 10:311-318.

ASTM Standards. 1979. Standard test method for seed coat fragments and funiculi in cotton fiber samples. p. 543-548. *In* 1979 Annual Book of ASTM Standards. Part 33. Textiles-Fibers and Zippers; High Modulus Fibers. American Society for Testing and Materials, Philadelphia, PA.

Baldwin, J. C., M. Quad, and A. C. Schleth. 1995. AFIS seed coat nep measurement. p. 1250-1253. *In* Proc. Beltwide Cotton Conf., San Antonio, TX. 4-7 Jan. 1995. Natl. Cotton Counc. Am., Memphis, TN.

Bargeron, J. D. and T. H. Garner. 1991. Cottonseed fragment contamination and fabric imperfections. Transactions of the ASAE 34(4): 1575-1582.

Brown, H. B., and J. O. Ware. 1958. Cotton. Third Edition. p. 411. McGraw-Hill Book Company, Inc., New York, NY.

Mangialardi, G. J. and J. V. Shepherd. 1968. Seed coat fragment and funiculus distribution in ginned lint as affected by lint cleaning. ARS Report 42-145, June 1968. United States Department of Agriculture, Agricultural Research Service, Beltsville, MD.

Mangialardi, G. J. 1987. Relationship of lint cleaning to seed coat fragments. p. 535-536. *In* Proc. Beltwide Cotton Prod. Res. Conf., Dallas, TX. 4-8 Jan. 1987. Natl. Cotton Counc. Am., Memphis, TN.

National Cottonseed Products Association. 1997. Methods of chemical analysis. p. 101-110. *In* Trading Rules. Chapter VII. National Cottonseed Products Association, Inc. Memphis, TN.

Pearson, N. L. 1955. Seedcoat fragments in cotton … an element of yarn quality. U.S. Department of Agriculture Technical Bulletin No. 1116. U.S. Government Printing Office, Washington, D.C.

Shepherd, J. V. 1972. Standard procedures for foreign matter and moisture analytical tests used in cotton ginning research. Stock No. 0100-1509. Issued February 1972. Washington, D.C.: GPO.

Thomasson, J. A. 1993. Foreign matter effects on cotton color measurement: determination and correction. Transactions of the ASAE 36(3): 663-669.

USDA. 1994. Cotton Ginners Handbook. Agricultural Research Service Agricultural Handbook No. 503. Washington, D.C.: GPO.

Uster. 2004. USTER AFIS PRO - What does the data mean? Common results in Upland cotton. Uster Technologies AG, Wilstrasse 11, CH-8610 Uster / Switzerland. 13 pp.