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ENGINEERING AND GINNING

Harvesting and Ginning a Cotton with a Fragile Seed Coat

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ABSTRACT

Seed coat fragments that remain in fiber after the ginning process cause problems during the spinning process and ultimately affect the quality of finished goods. An experiment was conducted to determine the effect of harvesting and saw ginning methods on an upland cultivar known to have fragile seed coats. Three harvester (picker) treatments examined the effects of spindle diameter and spindle speed. Four saw ginning treatments examined the affects of the type of seed roll box and seed roll density on seed coat fragments in the ginned fiber. When compared with a commercial cultivar, the cultivar with a fragile seed coat contained many favorable fiber properties, but seed coat nep count and visible foreign matter content were higher. Fiber length was longest and short fiber content and seed coat nep count were lowest with the 13-mm (1/2-in) spindle compared with the other harvesting treatments. Increasing spindle diameter to 16-mm (5/8-in) and spindle speed of the 16-mm spindle by 45% increased seed coat nep count. In addition, fiber length was longer with the traditional and conveyor-tube seed roll boxes than with the paddle-roll box. Ginning with the conveyor-tube box at 40% of the normal conveyor-tube box rate produced the lowest short fiber content and the best HVI color grade. The paddle-roll box had the fewest seed coat neps and lowest total trash and visible foreign matter content, but it also had the lowest AFIS fiber length and the highest short fiber content.

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Research efforts continue toward finding processes that alleviate seed coat fragments in lint from high-quality, high-yielding cultivars that contain a fragile seed coat. Seed coat fragments that remain in the fiber after gin processing cause problems during the spinning process (Pilsbury, 1992) and ultimately affect the quality of finished goods. Seed coat fragments have been defined as bits of seed-coat tissue with attached lint (Brown and Ware, 1958). Ginning research by 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 because the fragments broke into smaller pieces.

Recent ginning research that centered on a particular cultivar with a fragile seed coat affirmed that the cultivar had many favorable fiber properties, such as turnout, cottonseed grade, immature fiber content, nep count, micronaire, strength, and uniformity, but seed coat nep count and visible foreign matter content were not favorable (Armijo et al., 2006). Seed coat neps are identified by the Advanced Fiber Information System (AFIS) as fibers with attached seed coat fragments (Baldwin et al., 1995). Seed coat nep count was about three times higher in the cultivar with the fragile seed coat. Armijo et al. (2006) also showed that neither saw ginning with auxiliary rib guides developed by Hughs (2002) nor roller ginning reduced seed coat nep count when compared with a conventional saw gin stand.

In addition to the contributions of ginning to seed coat nep formation, Armijo et al. (2006) observed seed meats from a fragile seed coat cultivar as early as the first 6-cylinder cleaner during seed cotton conditioning. This raised speculation about whether some damage had already occurred during the harvesting operation, although no seed meats were seen in the wagon (Armijo et al., 2006). If harvesting was damaging the seed, it might be possible to make changes to the picker to reduce seed coat fragments. The preliminary study also led to the formation of a hypothesis that using a less dense seed roll may reduce fragments in the fiber (Armijo et al., 2006).

Newer technology, such as the Power Roll Gin Stand (Laird et al., 2002) that has a paddle in the seed roll, also decreased seed coat neps in a preliminary study conducted at the USDA-ARS Cotton Production and Processing Research Unit in Lubbock, TX (Holt, unpublished data, 2004).

The objective of this research was to determine the interactions of spindle diameter and spindle speed on the picker and type of seed roll box and density of the seed roll on the saw gin stand in harvesting and processing lint from an upland cultivar that has a fragile seed coat. Conventional spindles and saw gin stands were used. The harvesting treatments included using two spindle diameters and two spindle speeds. The ginning treatments included varying the density of the seed roll on saw gin stands by using different seed roll box designs and changing the processing rate. Seed coat nep count in the fiber was used to evaluate harvesting and ginning treatments.

MATERIALS AND METHODS

Figure 1 shows the 13-mm and 16-mm (1/2-in and 5/8-in) diameter spindles used in the experiment with a 14-mm (9/16-in) diameter spindle for comparison. The 13-mm (1/2-in) spindle, the most common size currently used, extends a shorter distance into the plant, but weighs less and results in a lighter picker head. The 16-mm (5/8-in) spindle is not very common and weighs more, but the extension into the plant is greater than the 13-mm (1/2-in) spindle and may do less plant damage (i.e. less trash in the seed cotton) during picking, because the wider picking zone does not compress the plants as much.

Figure 1. View of 13-mm (1/2-in), 14-mm (9/16-in), and 16-mm (5/8-in) diameter spindles.

Figures 2, 3, and 4 are schematic drawings of a traditional seed roll box (USDA, 1994), a conveyor-tube seed roll box (USDA, 1994), and a paddle-roll seed roll box (Laird et al., 2002), respectively. The seed roll in a gin stand with the traditional seed roll box is turned solely by the gin saws. The seed roll in a conveyor-tube and paddle-roll seed roll box is turned with the assistance of the conveyor tube and paddle roll, respectively. More detail of the traditional and conveyor tube seed roll boxes can be found in the Cotton Ginners Handbook (USDA, 1994). More information on the paddle roll seed roll box is documented by Laird et al. (2002).

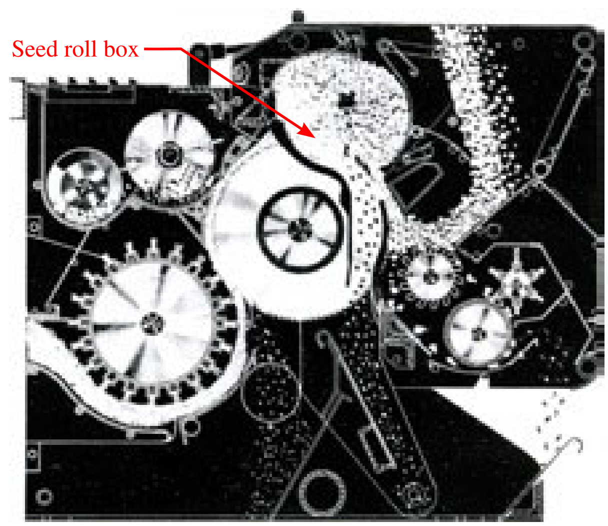

Figure 2. Side view of saw gin stand with traditional seed roll box (USDA, 1994)

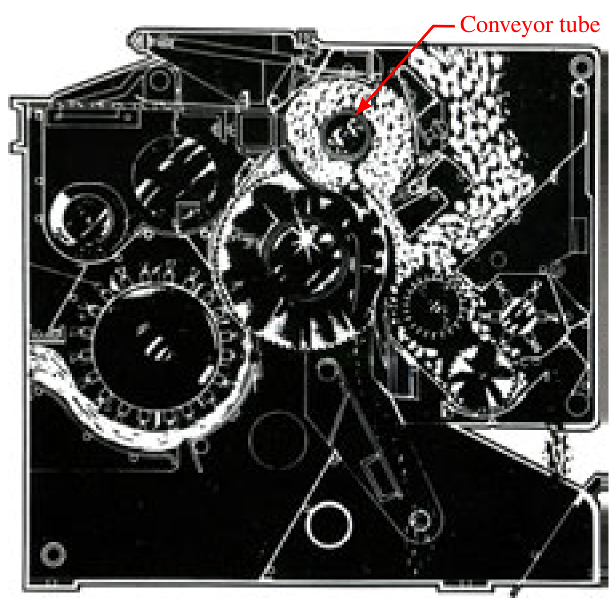

Figure 3. Side view of saw gin stand with conveyor-tube seed roll box (USDA, 1994).

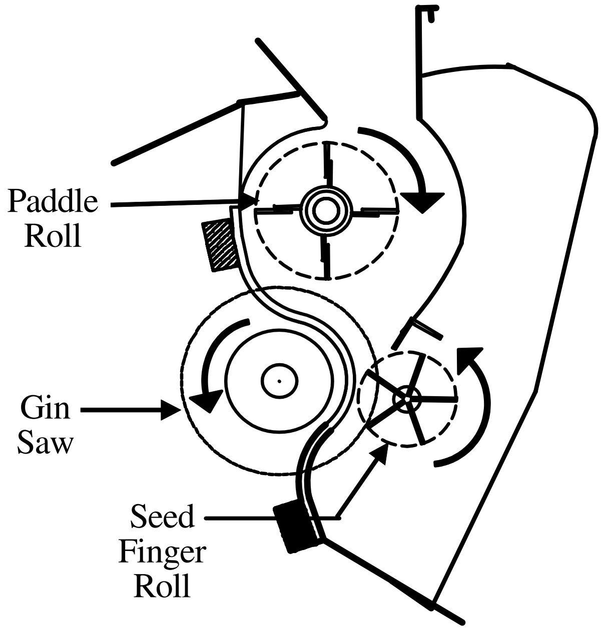

Figure 4. Side view of saw gin stand with paddle-roll seed roll box (Laird et al., 2002).

The fragile seed coat cotton was harvested in January 2005. The cotton was grown in the Mesilla Valley of Southern New Mexico. The three harvesting treatments were as follows: 1) a Case International Harvester Model 1822 two-row picker equipped with 13-mm (1/2-in) spindles turning at 2000 rpm, 2) an International Harvester Model M-12-H one-row picker equipped with 16-mm (5/8-in) spindles turning at 2000 rpm, and 3) an International Harvester Model M-12-H one-row picker equipped with 16-mm (5/8-in) spindles turning at 2900 rpm (45% faster) (all International Harvester; Racine, WI).

The ginning test was conducted in August 2005 using seed cotton from the harvesting treatments with four saw ginning treatments as follows: 1) a traditional seed roll box with no mechanism to assist turning the seed roll, 2) a seed roll box with a conveyor tube installed to assist turning the seed roll and pushing the cottonseed out the side of the stand, 3) a seed roll box with a conveyor tube installed to assist turning the seed roll and pushing the cottonseed out the side of the stand running at a reduced ginning rate, and 4) a seed roll box with a paddle roll installed to assist turning the seed roll. The settings used on the paddle roll were based on preliminary data from 2004 and were selected to minimize seed coat nep count. With the exception of the paddle roll ginning treatment, all of the ginning treatments were conducted at the USDA-ARS Southwestern Cotton Ginning Research Laboratory located in Mesilla Park, NM. The paddle roll ginning treatment was conducted at the USDA-ARS Cotton Production and Processing Research Unit in Lubbock, TX.

All of the seed cotton (including the cotton ginned with the paddle roll ginning treatment) was cleaned and conditioned at the New Mexico Laboratory using two 6-cylinder incline cleaners, one stick machine, and no drying. Lint cleaning at both laboratories consisted of one saw-type lint cleaner.

The ginning test consisted of three harvester treatments and four ginning treatments replicated three times for a total of 36 lots. The experimental design was a randomized complete block with replications serving as blocks. Analysis of variance was performed with the General Linear Model procedure 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.

Sampling included seed cotton before and after cleaning in the gin plant overhead, lint before and after cleaning, and cottonseed at the seed belt. 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 were used to determine the fiber properties. The 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).

RESULTS AND DISCUSSION

The interaction between harvesting and ginning treatment was not significant, so the data was analyzed and is presented in the tables by harvesting and ginning treatments. Although not a part of the experiment, properties of a commercial cultivar (Deltapine 33; Delta Pine and Land Co.; Scott, MS) were compared with the fragile cultivar. Table 1 shows gin process rate, turnout, trash and moisture content at the wagon and feeder, and conditions in the gin plant. As intended, gin process rate was significantly different among the ginning treatments. The seed roll boxes containing the conveyor tube had the highest and lowest rates, 2446 and 976 kg/m/h, respectively. As described, one of the conveyor-tube box treatments was purposely ginned at a slower-than-normal rate ("conveyor, slow" in the tables) to achieve a lower seed roll box density. The traditional, conveyor tube, and paddle roll seed roll boxes were run at their respective normal processing rate.

Turnout was available only for cotton ginned with the paddle-roll box (final lint weights were not available on the other ginning treatments). A higher turnout on the fragile seed coat cotton is one of the attractions of this cultivar, and this is evident with an average turnout of 42.2% (Table 1). Initial seed cotton foreign matter averaged 4.6%. Seed cotton foreign matter content at the wagon was different among harvesting treatments with the 13-mm (1/2-in) spindle having the highest trash content (5.1%). This agrees with the hypothesis stated earlier that the 16-mm (5-8-in) spindle may have less trash in the seed cotton, because the spindle extends further into the plant than the shorter spindle, and the plants do not need to be compressed as much because of a wider picking zone. Differences in seed cotton foreign matter at the feeder among ginning treatments reflected the different types of feeders, and not the type of seed roll box. Seed cotton moisture content (dry basis) was not different among harvesting or ginning treatments and averaged about 5.8% and 6.5% at the wagon and feeder (after seed cotton conditioning), respectively. Room temperature and relative humidity were different among ginning treatments, but this was because the paddle roll treatment was conducted in Lubbock, TX, and the other ginning treatments were performed in Mesilla Park, NM.

Table 2 shows the cottonseed properties. Linters content and foreign matter content of the cottonseed were not different among harvesting or ginning treatments and averaged 10.9% and 0.5%, respectively. Linters content on the commercial cultivar was 12.0%. Although not significantly different, the conveyor-tube seed roll box appeared to allow less foreign matter into the cottonseed. Moisture content of the cottonseed was different among ginning treatments, because the paddle-roll box treatments were ginned in Lubbock and the remaining treatments being ginned in Mesilla Park. Cottonseed grade, which is determined from most of the items in Table 2, was not different among harvesting or ginning treatments and averaged 115 (commercial cultivar was about 98).

To illustrate the magnitude of the fragile seed coat issue, cottonseed from a commercial cultivar and the fragile cultivar that was ginned using traditional and paddle-roll seed roll boxes (there was no particular reason for choosing these boxes) are shown in Figure 5. The seed meats (missing seed coats) are evident in the cultivar with a fragile seed coat. The commercial

Table 1. Means and statistical analysis by harvesting and ginning treatments of ginning rate, turnout, trash and moisture content at the wagon and feeder, and gin plant conditions

	Gin process rate (kg/m/h)[z]	Turn out (%)	Trash content @ wagon (%)[z]	Trash content @ feeder (%)[z]	Moisture content @ wagon (%)	Moisture content @ feeder (%)	Room temp. (°C)[z]	Room r.h. (%)[z]
				Harvesting treatment[y]				
13-mm spindle	1719	41.9	5.12 a	1.66	5.71	6.53	29.4	38.0
16-mm spindle	1731	42.3	4.13 b	1.49	6.02	6.51	29.4	37.9
16-mm, fast	1729	42.3	4.58 ab	1.51	5.76	6.33	29.3	37.8
Seed roll box				Ginning treatment[x]				
Traditional	1393 c	-	4.68	1.67 a	6.29	6.41	28.2 b	39.1 a
Conveyor	2446 a	-	4.40	1.38 b	5.65	6.44	27.9 b	40.0 a
Conveyor, slow	976 d	-	4.58	1.27 b	5.99	6.47	27.4 b	40.7 a
Paddle roll	2089 b	42.2	4.78	1.88 a	5.40	6.49	34.0 a	31.9 b
				Observed significance level				
Harvest (HAR)	NS	NS	0.0145	NS	NS	NS	NS	NS
Gin (GIN)	<.0001	-	NS	<.0001	NS	NS	<.0001	0.0021
HAR x GIN	NS	-	NS	NS	NS	NS	NS	NS

[z] For harvesting or ginning treatments, means within a column followed by the same letter are not significantly different according to Tukey's studentized range test ($P \leq 0.05$).

[y] Fast spindle speed is 2900 rpm (45% faster) compared with the normal speed of 2000 rpm.

[x] The conveyor seed roll box designated slow was run at 40% of the normal conveyor seed roll box process rate (2446 kg/m/h).

cultivar had a higher amount of foreign matter content compared with the fragile cultivar (about 22% versus 5%), which is also evident in Figure 5.

Because the experiment focused on harvesting and ginning treatments and the influence of lint cleaning was not an objective, the results in Tables 3-5 presented fiber properties immediately after the gin stand without lint cleaning. Most of the AFIS fiber data presented in Tables 3 and 4 were significantly different among either harvesting or ginning treatments. The longest fiber length (25.4 mm, 1.00 in) was obtained with the 13-mm (1/2-in) spindle compared with an average fiber length of 25.1 mm (0.99 in) with the 16-mm (5/8-in) spindles. Ginning with the conveyor-tube seed roll box at a slow processing rate produced the longest fiber (25.7 mm, 1.01 in), and the paddle-roll box had the shortest fiber length (24.4 mm, 0.96 in). Fiber length of the commercial cultivar was 23.7 mm (0.93 in).

Short fiber content (Table 3) followed the same trend as fiber length with the 13-mm (1/2-in) spindle having the lowest amount of short fiber (6.9%) compared with the 16-mm spindles (7.5%). The conveyor-tube box ginning at a slow processing rate had the lowest amount of short fiber (5.9%) and the paddle-roll box had the highest (9.2%). Short fiber content of the commercial cultivar was 12.8%. Fineness was not different among harvesting or ginning treatments and averaged 160 m-tex (commercial cultivar was 159 m-tex). Immature fiber content was different among ginning treatments. The seed roll box with the conveyor tube ginning at a slow processing rate had the lowest immature fiber content (4.9%) and the paddle-roll box had the highest (5.8%). Immature fiber content in the commercial cultivar was 7.1%. Nep count in the fiber was not different among either harvesting or ginning treatments and averaged 212 neps per g. Nep count in the commercial cultivar was 360 neps per g.

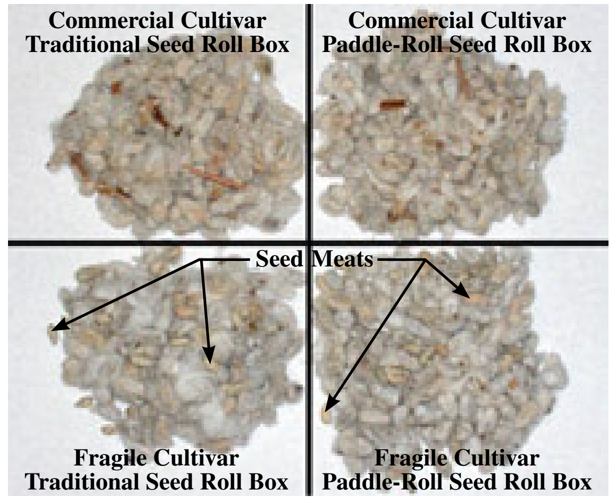

Figure 5. Cottonseed for the commercial cultivar (DPL 33) and the cultivar with a fragile seed coat from traditional and paddle-roll seed boxes. Cottonseed from the cultivar with the fragile seed coat contains seed meats.

Table 2. Means and statistical analysis by harvesting and ginning treatments of cottonseed properties

	Linters (%)	Total foreign matter (%)	Moisture (%)[z]	Free fatty acids (%)	Oil (%)	Ammonia (%)	Net quality index	Quantity index	Grade index
				Harvesting treatment[y]					
13-mm spindle	10.9	0.48	6.93	1.19	20.2	4.82	100	115	115
16-mm spindle	10.8	0.50	6.89	1.26	20.2	4.86	99.9	115	115
16-mm, fast	10.9	0.53	6.72	1.24	20.2	4.82	100	115	115
Seed roll box				Ginning treatment[x]					
Traditional	11.2	0.61	6.62 b	1.26	19.9	4.83	100	113	113
Conveyor	10.9	0.41	6.66 b	1.23	20.5	4.75	100	115	115
Conveyor, slow	10.9	0.38	6.63 b	1.28	20.3	4.91	99.9	116	115
Paddle roll	10.5	0.59	7.47 a	1.14	20.2	4.85	100	115	115
				Observed significance level					
Harvest (HAR)	NS	NS	NS	NS	NS	NS	NS	NS	NS
Gin (GIN)	NS	NS	<.0001	NS	NS	NS	NS	NS	NS
HAR x GIN	NS	NS	NS	NS	NS	NS	NS	NS	NS

[z] For harvesting or ginning treatments, means within a column followed by the same letter are not significantly different according to Tukey's studentized range test ($P \leq 0.05$).

[y] Fast spindle speed is 2900 rpm (45% faster) compared with the normal speed of 2000 rpm.

[x] The conveyor seed roll box designated slow was run at 40% of the normal conveyor seed roll box process rate (2446 kg/m/h).

It is interesting that nep count was not different among treatments, because seed coat nep count was different among harvesting and ginning treatments (Table 4). The 13-mm (1/2-in) spindle had the lowest amount of seed coat neps (58.3 neps per g), and the 16-mm (5/8-in) spindle running at the faster rate had the highest amount of seed coat neps (69.8 neps per g). The paddle-roll box had the lowest amount of seed coat neps at about 49 neps per g. There were no differences in seed coat nep count between the three other types of seed roll boxes, which averaged about 68 seed coat neps per g. Seed coat nep count in the commercial cultivar was 44.7 neps per g. As mentioned earlier, AFIS seed coat nep count was the main variable used to identify treatments that may help cultivars that have tendencies for fragile seed coats. It appeared that harvesting at a higher spindle speed was not beneficial in reducing nep count, but ginning with a paddle-roll box was effective in reducing nep count.

Total trash count and visible foreign matter were different among ginning treatments (Table 4). The seed roll box containing the paddle roll had the lowest total trash count (698 counts per g) and visible foreign matter (4.2%), and the conveyor-tube seed roll box operating at normal speed had the highest total trash count (1008 counts per g) and visible foreign matter content (7.3%). Ginning with the conveyor-tube box at the slower than normal process rate lowered total trash count about 27% and visible foreign matter about 20%. Total trash count and visible foreign matter in a commercial cultivar was 1049 counts per g and 4.0%, respectively.

HVI results for micronaire, upper half mean, strength, and elongation were not different among harvesting or ginning treatments and averaged 4.2, 28.6 mm (1.13 in), 28.6 cN/tex (29.2 g/tex), and 6.86%, respectively (Table 5). These properties with the commercial cultivar were 3.6, 28.6 mm (1.13 in), 26.5 cN/tex (27.0 g/tex), and 6.52%, respectively. Uniformity ranged from 83.3% to 83.7%, and was different among harvesting treatments with the 16-mm (5/8-in) spindle at the normal speed had the lowest uniformity. Uniformity in the commercial cultivar was 80.3%.

Color reflectance, color grade, and short fiber content were the only properties significantly different among ginning treatments (Table 5). Reflectance averaged 74.8 for the traditional and conveyor seed roll boxes, and 76.4 for the conveyor-tube ginning at the slower speed and paddle-roll seed roll boxes. Most of the color grades were reduced because stains

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

	Length (mm)[z]	Length CV (%)[z]	Upper quartile length (mm)[z]	Short fiber content (%)[z]	Fineness (m-tex)	Immature fiber content (%)[z]	Maturity ratio[z]	Nep count (per g)	Nep size (µm)[z]
				Harvesting treatment[y]					
13-mm spindle	25.4 a	32.6 b	30.0	6.89 b	161	5.08	0.90	203	794
16-mm spindle	25.1 b	33.4 a	29.8	7.60 a	159	5.39	0.89	211	805
16-mm, fast	25.0 b	33.0 ab	29.8	7.48 a	159	5.44	0.88	222	805
Seed roll box				Ginning treatment[x]					
Traditional	25.3 b	32.6 b	29.9 a	7.02 b	160	5.19 b	0.89 ab	208	812 ab
Conveyor	25.3 b	33.1 b	30.0 a	7.09 b	160	5.36 ab	0.89 ab	208	822 a
Conveyor, slow	25.7 a	31.6 c	30.2 a	5.94 c	161	4.88 b	0.90 a	206	799 b
Paddle roll	24.4 c	34.9 a	29.5 b	9.23 a	158	5.79 a	0.88 b	226	773 c
				Observed significance level					
Harvest (HAR)	0.0033	0.0500	NS	0.0013	NS	NS	NS	NS	NS
Gin (GIN)	<.0001	<.0001	<.0001	<.0001	NS	0.0026	0.0318	NS	<.0001
HAR x GIN	NS	NS	NS	NS	NS	NS	NS	NS	NS

[z] For harvesting or ginning treatments, means within a column followed by the same letter are not significantly different according to Tukey's studentized range test ($P \leq 0.05$).

[y] Fast spindle speed is 2900 rpm (45% faster) compared with the normal speed of 2000 rpm.

[x] The conveyor seed roll box designated slow was run at 40% of the normal conveyor seed roll box process rate (2446 kg/m/h).

Table 4. Means and statistical analysis by harvesting and ginning treatments of fiber properties measured by the Advanced Fiber Information System (AFIS) on samples taken before lint cleaning (just after ginning)

	Seed coat nep count (per g)[z]	Seed coat nep size (mm)	Dust count (per g)[z]	Trash count (per g)[z]	Total trash count (per g)[z]	Trash size (µm)[z]	Visible foreign matter (%)[z]
				Harvesting treatment[y]			
13-mm spindle	58.3 b	1156	700	193	894	413	5.89
16-mm spindle	61.7 ab	1175	664	191	855	423	6.08
16-mm, fast	69.8 a	1136	645	189	834	429	6.24
Seed box roll				Ginning treatment[x]			
Traditional	64.2 a	1177	790 a	215 a	1005 a	411 b	6.85 ab
Conveyor	71.6 a	1155	794 a	213 a	1008 a	415 b	7.34 a
Conveyor, slow	68.0 a	1110	548 b	184 ab	733 b	454 a	5.86 b
Paddle roll	49.3 b	1170	547 b	151 b	698 b	406 b	4.24 c
				Observed significance level			
Harvest (HAR)	0.0145	NS	NS	NS	NS	NS	NS
Gin (GIN)	0.0002	NS	<.0001	0.0008	<.0001	0.0022	<.0001
HAR x GIN	NS	NS	NS	NS	NS	NS	NS

[z] For harvesting or ginning treatments, means within a column followed by the same letter are not significantly different according to Tukey's studentized range test ($P \leq 0.05$).

[y] Fast spindle speed is 2900 rpm (45% faster) compared with the normal speed of 2000 rpm.

[x] The conveyor seed roll box designated slow was run at 40% of the normal conveyor seed roll box process rate (2446 kg/m/h).

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

	Micronaire	Upper half mean length (mm)	Uniformity (%)[z]	Strength (cN/tex)	Elongation (%)	Reflectance Rd[z]	Yellowness +b	Color grade[z,y]	Short fiber content (%)[z]
					Harvesting treatment[x]				
13-mm spindle	4.20	28.7	83.7 ab	28.9	6.86	75.9	11.2	104	3.51
16-mm spindle	4.21	28.6	83.3 b	28.7	6.90	75.2	10.9	101	3.95
16-mm, fast	4.16	28.6	83.7 a	28.2	6.83	75.4	11.0	102	3.77
Seed box roll					Ginning treatment[w]				
Traditional	4.24	28.8	83.7	28.4	6.84	74.8 b	10.9	101 b	3.27 b
Conveyor	4.30	28.7	83.6	28.6	6.96	74.7 b	10.9	100 b	3.63 ab
Conveyor, slow	4.23	28.5	83.6	28.4	6.82	76.4 a	11.1	105 a	3.74 ab
Paddle roll	3.99	28.6	83.3	29.1	6.84	76.3 a	11.2	103 ab	4.31 a
					Observed significance level				
Harvest (HAR)	NS	NS	0.0287	NS	NS	NS	NS	NS	NS
Gin (GIN)	NS	NS	NS	NS	NS	0.0002	NS	0.0046	0.0065
HAR x GIN	NS	NS	NS	NS	NS	NS	NS	NS	NS

[z] For harvesting or ginning treatments, means within a column followed by the same letter are not significantly different according to Tukey's studentized range test ($P \leq 0.05$).

[y] Old color grade code, where 100=31, 104=21, and 105=11.

[x] Fast spindle speed is 2900 rpm (45% faster) compared with the normal speed of 2000 rpm.

[w] The conveyor seed roll box designated slow was run at 40% of the normal conveyor seed roll box process rate (2446 kg/m/h).

that resulted from excessive rain during the 2004/05 season, but overall, grades were better than middling. The conveyor-tube box ginning at a slow processing rate and the paddle-roll box had the highest color grade (105 and 103, respectively). Color grade in the commercial cultivar averaged 100. Short fiber content ranged from 3.3% to 4.3%. The traditional seed roll box had the lowest amount of short fiber, and the paddle-roll box had the highest. Short fiber content in the commercial cultivar was 8.6%.

CONCLUSIONS

Compared with a commercial cultivar, the cultivar with a fragile seed coat had many favorable features, such as turnout, linters content, cottonseed grade, length, short fiber content, immature fiber content, nep count, uniformity, strength, and elongation. The fragile cultivar also had unfavorable traits, such as higher seed coat nep count and visible foreign matter content.

With respect to harvesting treatments, AFIS fiber length, short fiber content, and seed coat nep count were better with the 13-mm (1/2-in) spindle, and increasing spindle diameter to 16-mm (5/8-in) and increasing spindle speed by 45% for the 16-mm spindle increased seed coat nep count. Although the 16-mm (5/8-in) spindle had less plant damage and less trash in the seed cotton, seed coat nep count (fiber damage) was worse than with the 13-mm (1/2-in) spindle possibly because of the higher centrifugal force and surface velocity of the 16-mm (5/8-in) spindle.

With respect to ginning treatments, AFIS fiber length was better with the traditional and conveyor-tube seed roll boxes, and ginning with the conveyor-tube box at 40% the normal rate produced the lowest short fiber content and best HVI color grade but did not reduce seed-coat neps as predicted. The paddle-roll seed roll box had the fewest seed coat neps, total trash count, and visible foreign matter content, but had the shortest AFIS fiber length and the highest short fiber content.

Future research will add a harvester treatment that uses variable speed 14-mm (9/16-in) diameter spindles. Like the 13-mm (1/2-in) spindle, the 14-mm (9/16-in) spindle is a common spindle, but it has a lower centrifugal force and surface velocity than the 16-mm (5/8-in) spindle, which might result in less fiber and cottonseed damage. The 14-mm (9/16-in) spindle also extends further into the plant than the 13-mm (1/2-in) spindle, which might result in less trash in the seed cotton. Research will continue to evaluate different ginning treatments.

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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. 2006. Ginning a cotton with a fragile seed coat. J. Cotton Sci. 10:46-52 [Online]. Available at http://www.cotton.org/journal/2006-10/1/46.cfm

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.

Brown, H. B., and J. O. Ware. 1958. Cotton. 3rd ed. McGraw-Hill Book Company, Inc., New York, NY.

Hughs, S. E. 2002. Ginning rib modifications to reduce seed-coat fragments. Appl. Engineering Agric. 18(1): 13-16.

Laird, J. W., G. A. Holt, T. C. Wedegaertner, and W. F. Lalor. 2002. Powered paddle roll gin stands. *In* Proc. Beltwide Cotton Conf., Atlanta, GA. 8-13 Jan. 2002. Natl. Cotton Counc. Am., Memphis, TN.

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. Natl. Cottonseed Products Assoc., Inc., Memphis, TN.

Pilsbury, G. R. 1992. Eliminating bark and seed coat fragments from cotton card sliver. p. 1258-1263. *In* Proc. Beltwide Cotton Conf., Nashville, TN. 6-10 Jan. 1992. Natl. Cotton Counc. Am., Memphis, TN.

Shepherd, J. V. 1972. Standard procedures for foreign matter and moisture analytical tests used in cotton ginning research. Stock No. 0100-1509. U.S. Gov. Print. Office, Washington, DC.

USDA. 1994. Cotton Ginners Handbook. Agric. Res. Serv. Agric. Handb. No. 503. U.S. Gov. Print. Office, Washington, DC.