GINNING PICKER AND STRIPPER HARVESTED HIGH PLAINS COTTON

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Abstract

Texas High Plains cotton has improved over the last ten years with regard to yield and HVI fiber quality. New harvesting and ginning practices are needed to preserve fiber quality and maximize return to the producer. The objective of this work is to investigate the influence of harvest method, number of seed cotton extractor cleaners (e.g. stick machines), and number of lint cleaners used during ginning on lint turnout, fiber quality, and lint value. Two varieties grown under irrigated conditions were harvested with a spindle picker, brush-roll stripper with field cleaner, and a brush-roll stripper bypassing the field cleaner. Differences in turnout, fiber quality, and lint value were observed by variety and harvest method. Turnout, fiber quality, and lint value were not influenced by the number of stick machines (extractors) used in the ginning process. Minor differences in fiber quality by the number of lint cleaners used were observed.

Introduction

Cotton produced in the Texas High Plains has exhibited substantial improvements in terms of yield and fiber quality over the last ten years. These benefits stem primarily from cultivar changes and improved irrigation practices. In an effort to better preserve fiber quality, some producers in the region have begun to look to spindle pickers to harvest the High Plains crop. Recent work by Faulkner et al. (2009 a and b) indicates that picker type harvesters can offer advantages with regard to harvesting productivity, gin turnout, and fiber and yarn quality, when compared to brush-roll stripper type harvesters.

Cotton grown in the Texas High Plains region is traditionally harvested with brush-roll stripper harvesters. These machines were developed to be a cost effective method for harvesting relatively low yielding cotton (0.5 – 1.5 bales/acre) grown on short plants with closed or "storm-proof" boll conformations. The spindle picker is not well suited to harvest cotton under these conditions. In contrast to spindle pickers, stripper harvesters indiscriminately harvest seed cotton from the plants. As a consequence of the indiscriminate harvesting action, foreign matter content of stripped cotton is often much higher than that of picked cotton. Subsequently, lint turnout values are typically in the range of 25%, 30%, and 35% for stripped - non-field cleaned, stripped - field cleaned, and picked cottons, respectively.

Ginning practices in the High Plains region have evolved to handle high trash levels contained in stripper harvested cotton. The recommended machinery sequence for processing stripper harvested cotton includes: green boll/rock trap, air-line cleaner, feed control, tower drier, inclined cleaner, stick machine, tower drier, inclined cleaner, stick machine, extractor-feeder, gin stand, and two lint cleaners (Baker et al., 1977). Anthony et al. (1986) recommend a similar sequence for processing machine picked cotton, but included only one stick machine prior to the gin stand. Differences in the recommended machinery sequences for ginning picked and stripped cotton reflect the difference in the amount of required seed cotton cleaning to affect efficient ginning and acceptable lint trash grades.

Research on seed cotton cleaning equipment over the years indicates that extractors (e.g. stick machines and burr machines) and cylinder cleaners (e.g. horizontal and inclined cleaners) have little influence on fiber length characteristics, while positively influencing color and leaf grades (Anthony, 1982; Anthony et al., 1986; Baker et al., 1977; Baker and Lalor, 1990, Holt et al., 2002). Cleaning efficiency of seed cotton cleaning equipment is influenced by many factors, including initial seed cotton foreign matter content, processing rate, moisture content, machine configuration/setting, and distribution of cotton across the machine (Baker et al., 1982; Baker et al., 1994). Additionally, compromises must be made to balance cleaning efficiency with processing rate and seed cotton loss.

Moreover, mechanical actions on cotton fibers in the harvesting and ginning process have been shown to increase the amount of neps and short fibers in the bale (Anthony et al., 1986). Short fiber and nep content influence spinning performance and mill waste, but neither are reported by the USDA – Agricultural Marketing Service (AMS), which uses the HVI (high volume instrument) classification system for Commodity Credit Corporation (CCC) loan value determination. Recent questions have arisen from the industry concerning appropriate methods for ginning picker harvested cotton from high-quality cultivars that preserve fiber quality and bale value. Thus, the objective of this work was to investigate the influence of harvest method, seed cotton extractor cleaners, and lint cleaning on turnout, and fiber quality for picked and stripped cotton produced in the Texas High Plains.

Materials and Methods

Two cotton varieties, Deltapine 143 B2F (DP 143 B2F) and FiberMax 9180 B2F (FM 9180 B2F), were grown in 2008, on a cooperating producer's irrigated field near Lubbock, TX. The varieties were chosen based on their expected growing season length to maturity: DP 143 B2F - mid-season maturing and FM 9180 B2F - early season maturing, to provide test cottons with a range in fiber maturity. Approximately 4000 lb of each variety was harvested using three harvest methods: stripper with field cleaner bypassed (stripped NFC), stripper with field cleaner (stripped w/FC), and spindle picker. The cotton from each variety/harvest method was stored in trailers prior to ginning at the USDA – ARS Cotton Production and Processing Research Unit, in Lubbock, TX.

During each test, a seed cotton lot of approximately 1/3 bale (600 lb seed cotton) was processed through one of two gin machinery sequences that included: green boll/rock trap, feed control, tower drier (no heat applied), inclined cleaner, combination burr/stick machine, tower drier (no heat applied), inclined cleaner, stick machine (bypassed in machine sequence 2), extractor-feeder, gin stand, and two lint cleaners (Figure 1). Thirty six total tests were conducted using three replications of each variety (2) x harvest method (3) x ginning sequence (2) combination. Samples of seed cotton were collected from the trailer and feeder apron for fractionation analysis described by Shepherd (1972). Samples of seed cotton and lint were collected at the extractor feeder apron and lint slide, respectively for gravimetric moisture content analysis. The trash removed by the first and second stage stick machines, extractor feeder, and first and second stage lint cleaners was weighed and sampled during each test. Trash samples from each of the seed cotton extractors were fractionated to determine the amount of seed cotton rejected in the trash. Samples of the lint cleaner trash were analyzed for lint and foreign matter content using the microdust and trash monitor (MTM) at the Fiber and Biopolymer Research Institute in Lubbock, TX. Lint samples were collected after each lint cleaner for HVI and advanced fiber information system (AFIS) fiber quality analyses performed by Cotton Incorporated, Cary, NC.

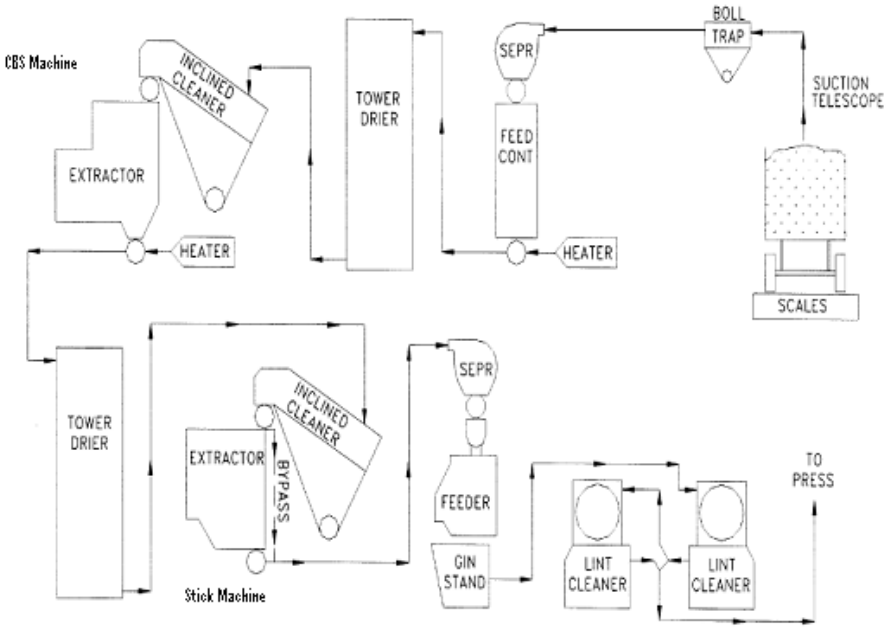

Figure 1. Machinery sequence used to gin seed cotton lots.

Lint turnout was calculated using the incoming seed cotton weight and lint weight after two lint cleaners. Total trash content in the seed cotton ginned per test was calculated as the incoming seed cotton weight less the final lint weight and seed weight. Seed cotton cleaning and ginning rates were calculated based on recorded times for each test.

Ginning performance and fiber quality data were analyzed using the general linear model in SAS (SAS v. 9.1, SAS Institute, Cary, NC) using a 0.05 level of significance. Testing for separation of means was conducted in SAS using Tukey's HSD test.

Results and Discussion

Fractionation results from the analysis on seed cotton samples collected from the trailer are shown in Table 1. Differences were observed in the trash and seed cotton fractions by variety and harvest method and variety by harvest method interactions were significant for each component. Fractionation results for the trailer seed cotton samples are not presented by number of extractors since the samples were collected prior to subjecting the samples to the ginning treatments. Differences in the amount of trash by variety reflect the variation in the amount of vegetative growth between cultivars. DP 143 B2F plants were physically larger in height and width than the FM 9180 B2F plants.

Table 1. Fractionation analysis results for seed cotton samples collected from the trailer.

Variety	Harvest Method	Seed Cotton (%)	Burrs (%)	Sticks & Stems (%)	Fine Trash (%)
DP 143 B2F	Picked	93.8	2.0	0.8	3.5
	Stripped w/FC	80.3	8.5	5.4	6.0
	Stripped NFC	64.9	20.2	7.9	7.0
FM 9180 B2F	Picked	94.0	1.8	0.5	3.3
	Stripped w/FC	89.8	4.1	1.5	4.2
	Stripped NFC	72.1	19.3	3.5	5.0
Means*					
Variety (V)	**DP 143 B2F**	79.7^{A}	10.2^{A}	4.7^{A}	5.5^{A}
	FM 9180 B2F	85.3^{B}	8.4^{B}	1.8^{B}	4.2^{B}
	F	*47.86*	*14.02*	*58.6*	*28.81*
	p > F	*<0.0001*	*0.0009*	*<0.0001*	*<0.0001*
Harvest					
Method (HM)	**Picked**	93.9^{A}	1.9^{A}	0.6^{A}	3.4^{A}
	Stripped w/FC	85.1^{B}	6.3^{B}	3.4^{B}	5.1^{B}
	Stripped NFC	68.5^{C}	19.8^{C}	5.7^{C}	6.0^{C}
	F	*335.64*	*517.89*	*61.7*	*38.67*
	p > F	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*
Interaction					
V x HM	*p > F*	*0.0002*	*0.0031*	*0.0002*	*0.0080*

*Means by variety or harvest method in the same column with the same letter are not significantly different according to Tukey's HSD test ($\alpha = 0.05$).

Similar to the trailer seed cotton fractionation results, the extractor-feeder apron seed cotton sample fractionation results shown in Table 2 indicate differences in percent seed cotton and trash fractions by variety and harvest method. Differences by number of stick machines were observed for the percent seed cotton, burrs, and sticks and stems fractions, but not for percent fine trash. The seed cotton lots were exposed to the same number of cleaning cylinders in the inclined cleaners, regardless of the number of stick machines used. Extractor type cleaners (e.g. stick machines) do not remove fine trash as efficiently as cylinder cleaners and thus it is logical not to see a

difference in the percent fine trash by number of stick machines. Variety by harvest method interactions were significant for all fractions while no variety by number of stick machine interactions were significant. Harvest method by number of stick machine interactions were significant for all fractions except fine trash.

Table 2. Fractionation analysis results for seed cotton samples collected at the extractor-feeder apron.

Means*	Seed Cotton (%)	Burrs (%)	Sticks & Stems (%)	Fine Trash (%)
Variety (V)				
DP 143 B2F	95.57^{A}	0.82^{A}	1.27^{A}	2.27^{A}
FM 9180 B2F	97.78^{B}	0.38^{B}	0.39^{B}	1.25^{B}
F	204.64	43.69	109.34	181.78
p > *F*	<0.0001	<0.0001	<0.0001	<0.0001
Harvest Method (HM)				
Picked	98.39^{A}	0.1^{A}	0.23^{A}	1.16^{A}
Stripped w/FC	97.01^{B}	0.43^{B}	0.68^{B}	1.72^{B}
Stripped NFC	94.63^{C}	1.26^{C}	1.57^{C}	2.4^{C}
F	201.65	107.54	87.06	90.69
p > *F*	<0.0001	<0.0001	<0.0001	<0.0001
No. of Stick Machines (SM)				
One	96.26^{A}	0.77^{A}	0.99^{A}	1.81
Two	97.1^{B}	0.42^{B}	0.66^{B}	1.71
F	29.85	27.79	15.77	1.96
p > *F*	<0.0001	<0.0001	0.0005	0.1734
Interactions (p > F)				
V x HM	<0.0001	<0.0001	<0.0001	<0.0001
V x SM	ns	ns	ns	ns
HM x SM	0.0019	0.0006	0.0081	ns

*Means in the same column with the same letter are not significantly different according to Tukey's HSD test ($\alpha = 0.05$).

Moisture content analyses on seed cotton samples (see Table 3) collected at the extractor feeder apron indicated differences by variety and harvest method. Seed cotton moisture content was 6.06 and 6.71% for FM 9180 B2F and DP 143 B2F, respectively and was 5.71, 6.2, and 7.25% for picked, stripped w/FC, and stripped NFC samples, respectively. Lint moisture content at the lint slide averaged 4.76% over all factors and no differences were observed by variety, harvest method, or number of stick machines.

Lint turnout values (Table 3) were different by variety and harvest method, but not by the number of stick machines used. Turnout for DP 143 B2F averaged 29.54% and was lower than FM 9180 B2F (average turnout of 33.32%) due to increased seed weight and foreign matter content. Mean turnout values for picked, stripped w/FC, and stripped NFC cotton were 36.77, 32.45, and 25.07%, respectively. A significant variety by harvest method interaction was observed for the turnout data.

Seed cotton cleaning rates (Table 3) were statistically different by variety and harvest method, but not by the number of stick machines used. The range of seed cotton cleaning rates were within the recommended capacity for the equipment used (2 bales/hr-ft). Differences in seed cotton cleaning rate by variety are likely a consequence of not adjusting the steady-flow feed control based on turnout. The trend in seed cotton cleaning rates, by harvest method, does not follow the same trend observed by variety (i.e. seed cotton cleaning rate decreases with decreasing turnout) due to a significant variety by harvest method interaction. Ginning rate was not significantly different by variety, harvest method, or number of stick machines and averaged 6.27 bales/hr over all factors.

Table 3. Moisture content, seed weight, and gin performance data.

Means*	Seed Cotton Moisture Content (Ext/Fdr. Apron) (%)	Lint Moisture Content (Lint Slide) (%)	Lint Turnout (%)	Seed Weight (lb/bale)	Seed Cotton Cleaning Rate (bales/hr-ft)	Ginning Rate (bales/hr)
Variety (V)						
DP 143 B2F	6.71^{A}	4.87	29.54^{A}	769.13^{A}	1.50^{A}	6.19
FM 9180 B2F	6.06^{B}	4.66	33.32^{B}	721.26^{B}	1.88^{B}	6.35
F	*14.16*	*1.29*	*190.44*	*128.91*	*61.03*	*0.54*
p > F	*0.0009*	*0.2671*	*<.0001*	*<0.0001*	*<.0001*	*0.4687*
Harvest Method (HM)						
Picked	5.71^{A}	4.68	36.77^{A}	728.14^{A}	1.67^{AB}	6.60
Stripped w/FC	6.20^{A}	4.73	32.45^{B}	749.99^{B}	1.61^{A}	6.17
Stripped NFC	7.25^{B}	4.88	25.07^{C}	757.47^{B}	1.80^{B}	6.03
F	*27.21*	*0.41*	*621.81*	*17.41*	*5.36*	*2.24*
p > F	*<.0001*	*0.6681*	*<.0001*	*<0.0001*	*0.0113*	*0.1271*
No. of Stick Machines (SM)						
One	6.24	4.67	31.31	750.77^{A}	1.66	6.41
Two	6.53	4.85	31.56	739.63^{B}	1.73	6.13
F	*2.68*	*0.94*	*0.91*	*6.99*	*1.78*	*1.49*
p > F	*0.1139*	*0.3408*	*0.3496*	*0.0137*	*0.1937*	*0.2331*
Interactions (p > F)						
V x HM	NS	NS	<.0001	NS	0.0008	NS
V x SM	NS	NS	NS	NS	NS	NS
HM x SM	NS	NS	NS	NS	NS	NS

*Means in the same column with the same letter are not significantly different according to Tukey's HSD test ($\alpha = 0.05$).

The total trash removed during ginning, trash removed by each extractor, extractor feeder, and each lint cleaner is shown in Table 4. Total trash was different by variety and harvest method, but not by number of stick machines. DP 143 B2F averaged 457 lb/bale total trash, whereas FM 9180 B2F averaged 287 lb/bale. Total trash by harvest method trended as seen in previous research (Baker et al., 1994) with picked, stripped w/FC, and stripped NFC cottons having 116, 282, and 718 lb/bale, respectively. For both the first and second stage extractors, the trash removed per bale was different by variety and harvest method, but not by number of stick machines used. The first stage extractor removed an average of 218 and 123 lb/bale from the DP 143 B2F and FM 9180 B2F cottons, respectively, while the second stage removed 40.8 and 16.7 lb/bale from the same lots, respectively. The first sage extractor removed 28.2, 94.8, and 388 lb/bale from the picked, stripped w/FC, and stripped NFC harvested cotton lots, respectively, while the second stage removed 7.9, 19.7, and 58.7 lb/bale from the same lots, respectively. Variety by harvest method interactions were significant for total trash removed, extractor 1 trash, and extractor 2 trash. Since cleaning efficiency increases for extractor type cleaners with increasing initial foreign matter content, the observed interaction can be explained by the difference in initial foreign matter content by variety. The response in trash removed by the extractor feeder was different by variety, harvest method, and number of stick machines. Although interactions were significant for variety by harvest method, variety by number of stick machines, and harvest method by number of stick machines, the general trend of increasing trash removal with higher initial trash content was observed.

The trash removed by the first stage lint cleaner was different by variety and harvest method, but not by number of stick machines. The first stage lint cleaner removed 31.6 and 13.1 lb/bale from DP 143 B2F and FM 9180 B2F, respectively. Trash removed by the first stage lint cleaner was different between the picked cotton (16.7 lb/bale) and stripped cottons (stripped w/FC = 21.3 lb/bale and stripped NFC = 29 lb/bale), but no difference was observed between the stripped cottons. The second stage lint cleaner removed significantly more trash from DP 143 B2F (7.7 lb/bale) than the FM 9180 B2F (4.0 lb/bale). Differences were observed in the amount of second stage lint cleaner trash by harvest method, but only the stripped NFC (7.2 lb/bale) cotton was different from the picked (5.4 lb/bale) and stripped w/FC (4.9 lb/bale) cottons. Significant variety by harvest method interactions were observed for the trash removed by both stages of lint cleaning and can be explained by differences in incoming trash content by variety.

Table 4. Trash removed during the ginning process.

Means*	Total Trash (lb/bale)	Extractor #1 Trash (lb/bale)	Extractor #2 Trash (lb/bale)	Extractor Feeder Trash (lb/bale)	Lint Cleaner #1 Trash (lb/bale)	Lint Cleaner #2 Trash (lb/bale)
Variety (V)						
DP 143 B2F	456.62^{A}	217.55^{A}	40.83^{A}	26.31^{A}	31.61^{A}	7.65^{A}
FM 9180 B2F	287.34^{B}	123.41^{B}	16.70^{B}	9.80^{B}	13.09^{B}	4.01^{B}
F	*101.12*	*44.77*	*29.39*	*69.69*	*37.26*	*77.27*
p > F	*<.0001*	*<.0001*	*0.0002*	*<.0001*	*<.0001*	*<.0001*
Harvest Method (HM)						
Picked	115.79^{A}	28.20^{A}	7.93^{A}	4.94^{A}	16.74^{A}	5.44^{A}
Stripped w/FC	281.96^{B}	94.76^{B}	19.68^{A}	11.34^{B}	21.32^{AB}	4.85^{A}
Stripped NFC	718.18^{C}	388.47^{C}	58.68^{B}	37.88^{C}	28.98^{B}	7.20^{B}
F	*455.41*	*247.62*	*47.47*	*104.07*	*5.51*	*11.5*
p > F	*<.0001*	*<.0001*	*<.0001*	*<.0001*	*0.0101*	*0.0003*
No. of Stick Machines (SM)						
One	373.15	168.05	na	25.08^{A}	21.53	5.73
Two	370.81	172.91	28.76	11.02^{B}	23.16	5.93
F	*0.02*	*0.12*	*na*	*50.5*	*0.28*	*0.21*
p > F	*0.8895*	*0.7319*	*na*	*<.0001*	*0.5991*	*0.6525*
Interactions (p > F)						
V x HM	<.0001	<.0001	0.0027	<.0001	0.0479	0.004
V x SM	NS	NS	na	0.0219	NS	NS
HM x SM	NS	NS	na	<.0001	NS	NS

*Means in the same column with the same letter are not significantly different according to Tukey's HSD test ($\alpha = 0.05$).

Lint loss values for the first and second stage extractors and the extractor feeder are shown in Table 5. Lint loss values for all three sampling locations were different by variety with more lint loss observed for DP 143 B2F than for FM 9180 B2F. Differences by harvest method were observed for the lint loss for the first stage extractor and extractor feeder. For both the first stage extractor and the extractor feeder, lint loss for the stripped NFC cotton was higher than that for picked and stripped w/FC cottons which were not different. The trend in lint loss followed the same trend as trash removal in that more lint was lost for cotton with higher initial trash content. However, the amount of lint lost by the extractor machines was not enough to result in a decrease in turnout by number of stick machines. The machinery used in this experiment was all adjusted according to manufacturer specifications and operated at feed rates below the rated capacities. Different results showing higher lint loss and poorer cleaning efficiencies would likely be observed for tests run at feed rates above rated capacities. Significant variety by harvest method interactions were observed for the extractor #1 and extractor feeder lint loss.

Table 5. Lint loss for extractor 1, extractor 2, and the extractor feeder.

Means*	Extractor #1 Lint Loss (lb/bale)	Extractor #2 Lint Loss (lb/bale)	Extractor Feeder Lint Loss (lb/bale)
Variety (V)			
DP 143 B2F	1.54^{A}	0.26^{A}	0.16^{A}
FM 9180 B2F	0.51^{B}	0.08^{B}	0.06^{B}
F	*23.75*	*5.8*	*22.08*
p > F	*<.0001*	*0.0331*	*<.0001*
Harvest Method (HM)			
Picked	0.26^{A}	0.07	0.06^{A}
Stripped w/FC	0.74^{A}	0.17	0.05^{A}
Stripped NFC	2.08^{B}	0.26	0.22^{B}
F	*26.13*	*2.27*	*30.27*
p > F	*<.0001*	*0.1455*	*<.0001*
No. of Stick Machines (SM)			
One	1.18	na	0.13
Two	0.87	0.17	0.09
F	*2.12*	*na*	*4.15*
p > F	*0.1574*	*na*	*0.0519*
Interactions (p > F)			
V x HM	0.0084	NS	0.0001
V x SM	NS	na	NS
HM x SM	NS	na	NS

*Means in the same column with the same letter are not significantly different according to Tukey's HSD test ($\alpha = 0.05$).

The results of MTM analysis on samples of the trash removed by the first and second stage lint cleaners are shown in Table 6. Differences in percent lint were observed by variety, harvest method, number of stick machines, and number lint cleaners. Similarly, differences in percent trash were observed for variety, harvest method, number of stick machines, and number of lint cleaners. A consistent indirect relationship was observed in the percent lint and percent trash data for each of the main factors indicating that lint content increased with decreasing trash content. Differences in percent fiber fragments were observed by harvest method and by the number of lint cleaners used. Percent fiber fragments for lint cleaner waste samples from picker harvested cotton (1.31%) was different from stripped NFC (1.52%) samples, but neither were different than stripped w/FC samples (1.38%). Fiber fragment content of samples from the first stage lint cleaner waste (1.53%) was larger than from the samples collected from the second stage lint cleaner (1.28%). Micro-dust content was different only by the number of lint cleaners used and was lower for the first stage lint cleaner (0.19%) than the second stage (0.24%). Invisible foreign matter (IFM) content was different by harvest method and the number of stick machines used and tended to increase with increasing initial foreign matter content. IFM content is the balance of the initial sample weight not accounted for in the lint, trash, fiber fragments, and micro-dust fractions. The IFM content was different for picker, stripped w/FC, and stripped NFC samples and was 4.63%, 5.24%, and 6.04%, respectively. IFM content of lint cleaner waste samples collected from tests using only one stick machine were higher than those from tests using two stick machines and were 5.61% and 5.0%, respectively. Variety by harvest method interactions were only significant for lint percent and trash percent, while the only significant variety by number of lint cleaners interaction was for IFM. Harvest method by number of lint cleaners interaction was significant for lint, trash, fiber fragments, and IFM but not for micro-dust.

Table 6. MTM analysis results from lint cleaner trash samples.

Means*	Lint (%)	Trash (%)	Fiber Fragments (%)	Micro-Dust (%)	IFM** (%)
Variety (V)					
DP 143 B2F	47.03^{A}	46.11^{A}	1.40	0.21	5.24
FM 9180 B2F	54.83^{B}	38.19^{B}	1.40	0.21	5.37
F	124.64	139.04	0.00	0.02	0.63
p > *F*	<0.0001	<0.0001	0.9807	0.891	0.4301
Harvest Method (HM)					
Picker	60.25^{A}	33.61^{A}	1.31^{A}	0.20	4.63^{A}
Stripped w/ FC	51.96^{B}	41.21^{B}	1.38^{AB}	0.22	5.24^{B}
Stripped NFC	40.59^{C}	51.63^{C}	1.52^{B}	0.23	6.04^{C}
F	266.36	241.49	4.89	1.99	26.71
p > *F*	<0.0001	<0.0001	0.0109	0.1458	<0.0001
No. of Stick Machines (SM)					
One	49.60^{A}	43.19^{A}	1.38	0.21	5.61^{A}
Two	52.26^{B}	41.10^{B}	1.42	0.21	5.00^{B}
F	14.54	9.67	0.41	0.03	15.26
p > *F*	0.0003	0.0029	0.5266	0.855	0.0003
No. of Lint Cleaners (LC)					
One	41.33^{A}	51.72^{A}	1.53^{A}	0.19^{A}	5.24
Two	60.54^{B}	32.58^{B}	1.28^{B}	0.24^{B}	5.37
F	756.97	811.13	18.86	14.87	0.68
p > *F*	<0.0001	<0.0001	<0.0001	0.0003	0.4139
Interactions (p > F)					
V x HM	0.0001	<0.0001	NS	NS	NS
V x SM	NS	NS	NS	NS	NS
V x LC	NS	NS	NS	NS	<0.0001
HM x SM	NS	NS	NS	NS	NS
HM x LC	0.0017	0.0008	0.0292	NS	0.0002
SM x LC	NS	NS	NS	NS	NS

*Means in the same column with the same letter are not significantly different according to Tukey's HSD test ($\alpha = 0.05$).
**IFM = invisible foreign material

HVI fiber analysis results for the lint samples collected after both stages of lint cleaning are shown in Table 7. Significant differences by variety were observed for all fiber quality parameters and loan rate and favored FM 9180 B2F, which was the faster-maturing variety. Differences by harvest method were observed for micronaire (MIC), upper half mean length (UHM), strength (STR), elongation (ELO), reflectance (Rd), short fiber content (SFC), and loan rate (Loan). Picker harvested cotton had higher MIC (3.8) than either stripped w/FC (3.6) or stripped NFC (3.52) samples, which were also different. UHM was longest for stripped NFC samples (1.16 in), which was different than stripped w/FC samples (1.151 in), but the UHM of fiber samples from picked cotton was 1.155 in and was not different than measurements from either stripper method. STR was different between all harvest methods with picked samples being weakest (29.25 g/tex) and stripped NFC samples the strongest (30.34 g/tex). The trend in strength is counter intuitive as one would expect the picked cotton to be the strongest, but the range on strength values is likely not large enough to have practical significance. Elongation for stripped NFC samples (5.98 %) was lower than both picked (6.15 %) and stripped w/FC (6.21 %) samples, which were not different. Again, the range on elongation values is likely not large enough to have practical significance. Rd values for picked and stripped w/FC samples were not different (81.3 and 81.42%, respectively), but were different than the stripped NFC samples (80.17%). SFC was different for picker (9.95 %) and stripped w/FC (10.23 %) samples, but SFC for stripped NFC samples (10.0 %) was not different than the other two harvest methods. Loan value for picked lint samples ($0.5611

/lb) was different than both stripper methods (stripped w/FC = $0.5508 /lb and stripped NFC = $0.5423 /lb). No differences were observed in the HVI data by number of stick machines used. One stage of lint cleaning produced significantly favorable fiber quality with regard to UHM, UI, STR, yellowness (+B), and SFC, while two stages of lint cleaning produced favorable fiber quality for ELO and Rd. Differences in HVI fiber quality by number of lint cleaners were minimal and may not be practically significant. Significant variety by harvest method interactions were observed for MIC, +B, and Loan. Variety by number of lint cleaners interactions were significant for UHM and SFC while the variety by number of stick machines interaction was only significant for UHM. Harvest method by number of lint cleaners interaction was significant for Rd only.

Table 7. HVI fiber analysis results for lint samples collected after one and two stages of lint cleaning.

Means*	MIC	UHM (in)	UI (%)	STR (g/tex)	ELO (%)	Rd (%)	+B (%)	Area (%)	SFC (%)	Loan ($/lb)
Variety (V)										
DP 143 B2F	3.22^{A}	1.143^{A}	78.61^{A}	28.35^{A}	6.03^{A}	79.71^{A}	8.03^{A}	0.45^{A}	11.43^{A}	0.5277^{A}
FM 9180 B2F	4.06^{B}	1.168^{B}	82.04^{B}	31.20^{B}	6.20^{B}	82.22^{B}	6.93^{B}	0.24^{B}	8.70^{B}	0.5751^{B}
F	*1103.76*	*107.72*	*740.97*	*459.42*	*13.32*	*118.03*	*187.2*	*5.78*	*1053.16*	*186.54*
p > F	*<.0001*	*<.0001*	*<.0001*	*<.0001*	*0.0006*	*<.0001*	*<.0001*	*0.0194*	*<.0001*	*<.0001*
Harvest Method (HM)										
Picker	3.80^{A}	1.155^{AB}	80.36	29.25^{A}	6.15^{A}	81.30^{A}	7.51	0.35	9.95^{A}	0.5611^{A}
Stripped w/FC	3.60^{B}	1.151^{B}	80.17	29.73^{B}	6.21^{A}	81.42^{A}	7.49	0.26	10.23^{B}	0.5508^{B}
Stripped NFC	3.52^{C}	1.160^{A}	80.46	30.34^{C}	5.98^{B}	80.17^{B}	7.44	0.43	10.00^{AB}	0.5423^{B}
F	*43.04*	*5.17*	*1.89*	*22.31*	*9.33*	*11.9*	*0.24*	*1.21*	*4.1*	*9.84*
p > F	*<.0001*	*0.0087*	*0.1604*	*<.0001*	*0.0003*	*<.0001*	*0.7884*	*0.3055*	*0.0218*	*0.0002*
No. of Stick Machines (SM)										
One	3.65	1.154	80.27	29.73	6.15	80.89	7.50	0.40	10.08	0.5517
Two	3.63	1.156	80.39	29.82	6.08	81.04	7.46	0.29	10.04	0.5511
F	*0.28*	*0.7*	*0.9*	*0.39*	*2.13*	*0.42*	*0.2*	*1.61*	*0.21*	*0.03*
p > F	*0.6019*	*0.4072*	*0.3472*	*0.5325*	*0.1497*	*0.519*	*0.6558*	*0.2102*	*0.6454*	*0.8576*
No. Lint Cleaners (LC)										
One	3.64	1.164^{A}	80.64^{A}	29.93^{A}	6.06^{A}	80.52^{A}	7.39^{A}	0.35	9.83^{A}	0.5506
Two	3.64	1.147^{B}	80.01^{B}	29.63^{B}	6.16^{B}	81.41^{B}	7.57^{B}	0.34	10.29^{B}	0.5523
F	*0.06*	*49.54*	*25.03*	*5.11*	*4.8*	*14.79*	*4.71*	*0.03*	*30.82*	*0.23*
p > F	*0.8109*	*<.0001*	*<.0001*	*0.0276*	*0.0326*	*0.0003*	*0.0341*	*0.8626*	*<.0001*	*0.6299*
Interactions (p > F)										
V x HM	0.0400	NS	NS	NS	NS	NS	0.0033	NS	NS	0.0071
V x LC	NS	0.0042	NS	NS	NS	NS	NS	NS	0.0243	NS
V x SM	NS	0.0472	NS	NS	NS	NS	NS	NS	NS	NS
HM x SM	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
HM x LC	NS	NS	NS	NS	NS	0.0049	NS	NS	NS	NS
SM x LC	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

*Means in the same column with the same letter are not significantly different according to Tukey's HSD test ($\alpha = 0.05$).
MIC = micronaire, UHM = upper half mean length, UI = uniformity index, STR = strength, ELO = elongation, Rd = reflectance, +B = yellowness, AREA = trash area, SFC = short fiber content, LOAN = CCC loan rate

Selected AFIS analysis results on fiber samples collected after one and two stages of lint cleaning are presented in Table 8. Similar to the HVI data, differences by variety were observed for all AFIS parameters and favored FM 9180 B2F. Differences by harvest method were observed and favored picker harvested cotton for nep count, mean length by weight, short fiber content by weight, total foreign material, seed coat neps, fineness, immature fiber content, and maturity ratio. Differences in mean length by weight, upper quartile length by weight, and seed coat neps were observed by number of stick machines. However, for both the length and seed coat nep parameters, the difference in values between one and two stick machines was minimal and likely has no practical significance. Differences were observed by the number of lint cleaners used for nep count, mean length (w), upper quartile length (w), short fiber content (w), total foreign material, immature fiber content, and maturity ratio and favored one stage with the exception of total foreign material. Significant variety by harvest method interactions were observed for all of the AFIS parameters reported in table 8 except seed coat neps. Variety by number of lint cleaners interaction was

significant for nep count and total foreign material. The variety by number of stick machine interaction was significant for mean length by weight and upper quartile length by weight. Harvest method by number of lint cleaners interaction was significant only for total foreign material, while the number of lint cleaners by number of stick machines interaction was significant for upper quartile length by weight only.

Table 8. Selected AFIS fiber analysis results on lint samples collected after lint cleaning.

Means *	Nep Count (cnt/g)	Length (w)** (in)	Upper Quartile Length (w) (in)	Short Fiber Content (w) (%)	Total (cnt/g)	Seed Coat Neps (cnt/g)	Fineness (mTex)	Immature Fiber Content (%)	Maturity Ratio
Variety									
DPL 143	689.31 A	0.91 A	1.18 A	15.38 A	646.22 A	26.72 A	155.67 A	7.41 A	0.860 A
FM 9180	344.89 B	0.99 B	1.23 B	10.08 B	294.03 B	16.97 B	169.94 B	5.67 B	0.913 B
F	*568.51*	*484.78*	*246.07*	*494.87*	*165.05*	*63.68*	*456.17*	*299.61*	*543.07*
P > F	*<.0001*	*<.0001*	*<.0001*	*<.0001*	*<.0001*	*<.0001*	*<.0001*	*<.0001*	*<.0001*
Harvest Method									
Picker	439.58 A	0.96 A	1.20	11.65 A	313.50 A	19.21 A	164.67 A	6.28 A	0.893 A
Stripped with FC	535.67 B	0.95 B	1.20	12.98 B	403.63 B	21.92 AB	162.67 B	6.56 AB	0.885 B
Stripped NFC	576.04 B	0.94 B	1.20	13.56 B	693.25 C	24.42 B	161.08 B	6.78 B	0.883 B
F	*31.4*	*6.43*	*0.76*	*22.7*	*69.85*	*6.06*	*9.62*	*7.96*	*6.54*
P > F	*<.0001*	*0.003*	*0.4715*	*<.0001*	*<.0001*	*0.0041*	*0.0003*	*0.0009*	*0.0028*
No. of Stick Machines									
One	511.33	0.947 A	1.20 A	12.83	486.25	20.61 A	162.75	6.55	0.886
Two	522.86	0.954 B	1.21 B	12.63	454.00	23.08 B	162.86	6.53	0.888
F	*0.64*	*4.31*	*5.73*	*0.77*	*1.38*	*4.09*	*0.03*	*0.06*	*0.37*
P > F	*0.4282*	*0.0423*	*0.02*	*0.3853*	*0.2443*	*0.0477*	*0.8686*	*0.8053*	*0.5443*
No. Lint Cleaners									
One	457.72 A	0.96 A	1.21 A	12.40 A	580.94 A	22.00	162.69	6.42 A	0.889 A
Two	576.47 B	0.94 B	1.19 B	13.06 B	359.31 B	21.69	162.92	6.66 B	0.884 B
F	*67.58*	*19.39*	*27.34*	*7.64*	*65.37*	*0.06*	*0.11*	*6.00*	*5.37*
P > F	*<.0001*	*<.0001*	*<.0001*	*0.0077*	*<.0001*	*0.8034*	*0.7408*	*0.0174*	*0.0241*
Interactions (P > F)									
V x HM	0.0005	0.0004	0.0004	0.0009	<.0001	NS	0.0432	0.0421	0.0008
V x LC	0.0028	NS	NS	NS	0.0054	NS	NS	NS	NS
V x SM	NS	0.0126	0.003	NS	NS	NS	NS	NS	NS
HM x LC	NS	NS	NS	NS	0.0005	NS	NS	NS	NS
HM x SM	NS	NS	NS	NS	NS	NS	NS	NS	NS
LC x SM	NS	NS	0.0462	NS	NS	NS	NS	NS	NS

*Means in the same column with the same letter are not significantly different according to Tukey's HSD test ($\alpha = 0.05$).
**(w) = Parameter calculated on weight basis.

Conclusions

Seed cotton from two varieties (DP 143 B2F and FM 9180 B2F) was harvested from an irrigated field near Lubbock, TX, using three harvest methods: picker, stripper w/FC, and stripper NFC. Ginning tests were conducted on 1/3 bale portions of the seed cotton, on full scale ginning equipment at the USDA – ARS Cotton Production and Processing Research Unit in Lubbock, TX, to investigate the influence of variety, harvest method, and ginning treatment on lint turnout and fiber quality. The results of these tests indicate that the number of seed cotton extractor type cleaners used in the ginning process have very little effect on turnout, fiber quality, or lint value. Processing rates used in the study were approximately 1.5 – 1.8 bales/hr-ft and were within manufacturer stated capacities. It is expected that increasing the processing rate through the seed cotton cleaning equipment to levels seen in commercial ginning plants near 3 bales/hr-ft will result in reduced cleaning efficiency and fiber quality. Differences in fiber quality and lint value were most pronounced between varieties due to differences in foreign matter content and fiber maturity. Differences in fiber quality, turnout, and lint value were observed by harvesting method and tended to favor picker harvested cotton. Differences in fiber quality by the number of lint cleaners used were observed, but were not large enough to significantly influence lint loan value. Additional work on ginning picker and stripper harvested cotton produced in the High Plains is planned for 2010. The study conducted in 2010, will focus on two harvest methods: picked and stripped with field cleaner, and the same gin treatments applied at increased processing rates approaching 3 bales/hr-ft in the seed cotton cleaning equipment.

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