GIN EVALUATION OF ULTRA NARROW ROW COTTON IN 1999

W. Stanley Anthony
U.S. Cotton Ginning Laboratory
Stoneville, MS
William D. Mayfield (Retired)
USDA Cooperative State Research Education and Extension Service
Memphis, TN
Thomas D. Valco
Cotton Incorporated
Raleigh, NC

Abstract

This study investigated conventional (CONV) and ultra narrow row (UNR) cotton grown in 6 areas across the Midsouth and Southeast and ginned on a common gin for fiber quality after ginning and subsequent textile mill processing evaluation. The following gin machines were used for the UNR cotton: Separator-dropper, feed control, dryer, cylinder cleaner, stick machine, dryer, cylinder cleaner, combination bur and stick (CBS) machine, cylinder cleaner, extractor-feeder and saw-type gin stand followed by one air-type and one saw-type lint cleaner. For the conventional cotton, the CBS machine was not used. Initial foreign matter averaged 7.74% and 19.67% for the conventional and UNR cottons, respectively. The marketing classifications, including foreign matter, were not statistically different. Ultra narrow cotton received barky calls on 3 of the 6 locations as compared to none for the conventional. Lint turnout differed dramatically for conventional and UNR cottons, and averaged 34.77 and 30.71%, respectively. About 190 more pounds of material were removed from the UNR cottons in order to produce a 500-lb. bale.

Introduction

The current low profit margin is making it very difficult for even the most efficient U.S. cotton growers to remain solvent. With limited potential for increased prices, cotton growers are very interested in technologies and management systems that will reduce their production costs. Ultra narrow row cotton has the potential to reduce production costs and increase yields in some areas (Smith, 1998). Until recently, very little attention was given to the UNR crop after it was harvested. Producers assumed that the gins could handle the extra foreign material, merchants would pay the same price as for machine-picked cotton, and the textile industry could use it as they could machine-picked cotton. As long as the acreage was small, most of the UNR cotton was delivered through the marketing system as if it were machine picked.

Reprinted from the *Proceedings of the Beltwide Cotton Conference*
Volume 1:476-480 (2000)
National Cotton Council, Memphis TN

In 1997, when the production of UNR cotton exceeded experimental levels, some UNR cotton was segregated in marketing contracts, and price discounts were experienced even for identical grades.

The UNR cotton is produced in rows 7.5 to 10-inches apart. High plant populations (about 125,000 per acre) and uniform stands are necessary to reduce branching and help keep the plant short and slender. The UNR cotton must be harvested using a broadcast finger stripper header attached to a cotton stripper chassis because the row spacing is too narrow for a conventional spindle picker or brush stripper. An extractor-type field cleaner is used to remove some of the foreign matter.

Strippers remove the entire boll (including the burs or carpel walls) as well as some of the peduncles and short limbs from the cotton plant. If any leaves are on the plant, they may also be harvested and mixed with the cotton. As a result, stripped cotton may contain about 750 pounds of foreign material per 500-lb bale of lint as compared to machine-picked cotton, which contains only about 100 pounds. Seed cotton cleaners similar to stick machines are used in the stripper harvesting or on operation to remove some of the extra foreign matter and reduce it to about 300 pounds per bale. This can be accomplished if plant size and population are controlled properly, and defoliation, desiccation and harvesting are done well. Anthony et al. (1999) reported that about 245 pounds more material was required to produce a 500-pound bale of lint for stripper-harvested cotton as compared to spindle-harvested cotton. Greene (1998) ginned over 1,700 bales of UNR cotton in 1998 as compared to about 36,000 bales of CONV cotton. The UNR cotton was processed with more drying, seed cotton cleaning and lint cleaning than was the CONV cotton. The additional processing would normally produce slightly shorter staple and somewhat lower uniformity but higher color and leaf grades. Generally, however, better market grades were received from the CONV cotton. The UNR cotton had more light-spot bales (48%) than the CONV (23%) even though more lint cleaning and drying was used. The most important difference was that 75% of the UNR bales were reduced for bark as compared to 3% for the CONV bales. He found that 1,771 pounds of material was required to make a 500-pound bale of UNR cotton (based on 20 modules from 4 growers) as compared to 1,352 pounds of CONV cotton (based on 33 modules from 3 growers), i.e., 419 pounds more for the UNR cotton. Most picker gins are not equipped to remove or handle this extra foreign matter.

Some gins reduce their ginning rate about 20% to 40% and process the UNR cotton without additional seed cotton cleaning machinery, thereby dramatically increasing their ginning costs. This procedure cannot be sustained on substantial volumes of cotton because of the increased cost of ginning. In addition, it generally does not meet the needs of the UNR cotton adequately because it does not satisfactorily remove the bark.

In some cases, a bur-extractor section can be added to an existing machine to meet the requirement for the CBS machine; however, a second stage of stick extraction is still needed to remove the foreign material typically present in UNR cotton.

Current recommendations for the sequence and amount of gin machinery to dry and clean spindle-harvested cotton are as follows: dryer, cylinder cleaner, stick machine, dryer, cylinder cleaner, and extractor-feeder and saw-type gin stand followed by one or two stages of saw-type lint cleaning (Anthony, et al. 1994). These recommendations achieve satisfactory bale value and preserve the inherent quality of cotton. They have generally been followed and thus confirmed in the U.S. cotton industry for several decades. The recommendations consider marketing system premiums and discounts as well as the cleaning efficiency and fiber damage resulting from various gin machines.

Because stripped cotton contains more foreign matter than machine-picked cotton, ginning systems in stripper areas have to be more elaborate than those in spindle-harvester areas (Baker et al., 1994). Additional extraction and trash handling equipment is required to handle large amounts of burs and sticks. Burs and sticks will seriously lower gin stand performance and result in unacceptably high trash contents for cottonseed and ginned lint unless they are removed before they reach the gin stand. The following array of gin machinery is recommended for stripper-harvested cotton: green-boll separator, airline cleaner, dryer, cylinder cleaner, CBS machine, dryer, cylinder cleaner, stick machine, extractor-feeder and saw-type gin stand followed by two stages of saw-type lint cleaning. The machinery recommendations are general in that they are appropriate for most gins handling stripper-harvested cotton at typical conditions. Under such conditions, the recommended machinery arrangement will produce satisfactory lint grades and near-maximum bale values for most cottons. Thus, a CBS machine or equivalent must be added to a picker gin to allow processing of stripped cotton. Two stages of saw-type lint cleaning, which are normally available, may also be required. Similar grades can then be achieved from picked and stripped bales with the exception of increased occurrence of "barky bales" which usually cause a price discount.

Commercial stick machines have at least one primary sling-off saw and one reclaimer saw. Stick machines are classified as either two-saw or three-saw machines. In addition, a recently developed five-saw stick machine, called the multistage extractor, provides three stages of extraction in a single compact machine and likely can substitute well for a CBS machine and/or a stick machine (Baker, et al. 1989).

The CBS is used for stick extraction for stripper-harvested cotton. The CBS is a hybrid type of extractor that combines the best features of the bur machine and the stick machine. The upper section of a CBS machine resembles a bur machine in that it is equipped with an auger feed and trash extraction system and a large-diameter saw cylinder. The CBS machine, however, differs from a bur machine in several important respects. The CBS machine is not as wide, although its rated capacity per unit of width is much higher. Seed cotton is generally fed into a CBS machine across its entire width, as opposed to the end-feeding method used for bur machines. The lower section consists of a standard two- or three-saw stick machine. Thus, the upper section of the machine serves as a primary cleaner that feeds the lower stick-machine unit (Baker et al., 1994).

Purpose

Except for the first year of this study, the mill quality of UNR cotton has not been considered. Thus, the industry relies on the mill data from conventional stripped cotton produced primarily in Texas. Recent research studies of UNR cotton have not adequately documented fiber quality of specific interest to the textile industry. This study was undertaken for the second year to obtain sufficient quantities of UNR and conventional cottons produced in the Midsouth and Southeast and ginned under recommended procedures to evaluate mill processibility at the USDA, ARS Cotton Quality Research Station, Clemson, SC. This report primarily describes the ginning results and the mill results will be reported later. Future studies will also consider different machinery sequences at the gin.

Methodology

Cotton was grown in 6 areas in the Midsouth and Southeast in conventional 30" to 40" row spacings that were spindle-picked and UNR spacings of 7.5" to 10" that was harvested with a finger stripper. The cottons (1000 to 1500 pounds) were shipped to Stoneville, MS, for ginning. Information regarding production locations, varieties and cooperators is at Tables 1 and 2.

The cotton was stored at the Cotton Ginning Research Unit until all test cotton had arrived. It was then ginned in a commercial-size gin on November 16, 1999. The following machinery was used for the stripper-harvested cotton: separator-dropper, feed control, dryer, cylinder cleaner, stick machine (a CBS machine was not available at this position), dryer, cylinder cleaner, CBS machine, cylinder cleaner, extractor-feeder, air-type lint cleaner, saw-type gin stand, air-type lint cleaner, and one stage of saw-type lint cleaning. For the conventional cotton, all of these components except the CBS machine were used. Ten samples were taken from each treatment (location) for foreign matter analyses (wagon fractionation, feeder fractionation and Shirley Analyser); 10 samples were taken for moisture (wagon, feeder and lint at press); 10 samples were taken for classification (Classing Office); 10 samples were also taken for AFIS (fiber length and neps) analyses. The 12 bales were then shipped to the Cotton Quality Research Station, Clemson, SC, for mill processing.

Results and Discussion

Analyses of variance with locations as reps and harvest methods/production methods as the independent variable indicated that the initial total foreign matter (also the hulls, sticks and stems, and mote components), total foreign matter at the feeder apron (also the sticks/stems and mote components) and lint turnout were significant statistically (Tables 3-5). Initial moisture contents ranged from 6.6 to 10.5% for the cotton immediately before gin processing which is within the acceptable range for storage (Table 3). The lint moisture at the press area ranged from 4.0 to 4.9%, which was well within acceptable levels. Lint moisture differences within locations averaged 0.3% and ranged from 0 to 0.5% for CONV and UNR. Initial foreign matter averaged 7.74% and 19.67%, respectively, for the CONV and UNR cottons; differences were due to hulls, stick/stems and motes. Foreign matter after all the seed cotton cleaning averaged 3.3% and 5.1%, respectively, for the CONV and UNR cottons with differences caused by sticks/stems and motes. Thus the UNR cotton had nearly 3 times more foreign matter than the CONV cotton initially. The differences in laboratory-based final lint foreign matter (Shirley Analyser) detected between harvest methods were significant at the 0.06% level of probability (3.6% versus 4.3%). Visible waste was significant at the 0.08% probability level (1.9% versus 2.5%). Lint turnout (ratio of ginned lint weight to initial seed cotton weight) differed dramatically for CONV and UNR cottons, and averaged 34.8 and 30.7%, respectively. Thus, about 190 more pounds of material were removed from the UNR cottons per 500-lb. bale of lint.

The manual leaf and HVI trash grade were about the same for CONV and UNR cottons (Table 5). Thus, the additional CBS machine used to clean the UNR cotton satisfactorily removed foreign matter. Additional classification data indicates that the fiber quality characteristics as measured by the HVI and manual system were essentially the same for the CONV and UNR cottons. Ultra narrow row cotton received barky calls on 3 of the 6 locations as compared to none for the CONV locations. This indicates that the cleaning sequence adequately cleaned the stripper-harvested cotton but a problem exists with barkiness. In a similar study in 1998, only 1 of 10 locations had barky calls after two saw-type lint cleaners. Note that only one saw-type lint cleaner was used in 1999.

Analysis of the data from the Advanced Fiber Information System (AFIS) indicated a lack of significance for all variables although the means differed substantially for CONV and UNR for some variables such as short fiber content (9.4 versus 10.6%), neps (298 versus 356) and immature fiber content (5.7 versus 6.2%) (Table 3). Short fiber content averaged 14% higher for the UNR cottons across locations, and was higher in 5 of the 6 locations and the same in the other location (Table 6). Means for each location for the CONV and UNR production methods are in Table 6.

In summary, UNR-stripped cotton processed with properly equipped gins yielded HVI and manual grades equivalent to those obtained from CONV-picked cotton with the exception of barkiness. Higher levels of short fibers and neps were present in UNR-stripped cotton than in CONV-spindle-harvested cotton. About three times more foreign matter was removed from the UNR cotton.

Disclaimer

Trade names are used in this publication solely for the purpose of providing specific information. Mention of a trade name does not constitute a guarantee or warranty of the product by the U.S. Department of Agriculture or an endorsement by the Department over other products not mentioned.

Acknowledgments

The authors gratefully acknowledge the support of the following persons who produced the research cottons: Jess McCrory, Owen Gwathmey, Kenneth Hood, Herb Willcutt, Eugene Columbus, Sam Atwell, Mike Bader and Earl Vories.

References

Anthony, W.S., S.E. Hughs, and W.D. Mayfield. 1994. Ginning recommendations for processing machine-picked cotton. The Cotton Ginners Handbook, pp. 240-241. The U.S. Department of Agriculture, Agricultural Handbook 503.

Anthony, W.S., W.D. Mayfield, and T.D. Valco. 1999. Results of 1998 ginning studies of ultra narrow cotton. Proceedings of the Beltwide Cotton Conference, pp. 1484-1488. National Cotton Council, Memphis, TN.

Baker, R.V., W.S. Anthony, and R.M. Sutton. 1994. Seed cotton cleaning and extracting. The Cotton Ginners Handbook, pp. 69-89. The U.S. Department of Agriculture, Agricultural Handbook 503.

Greene, Robert W. 1998. Personal communication. December 1998.

Smith, Elizabeth. 1998. Cotton Farming Management, 42(14): 6-34. The Vance Publishing Corporation, Memphis, TN.

Table 1. Locations, cooperators and varieties for comparison of ultra narrow row (UNR) and conventional (CONV) cottons.

Location	Variety	Planting	Cooperator
Texas	BXN47	CONV	McCrory
Texas	BXN47	UNR	McCrory
Tennessee	PM1220BG/RR	CONV	Gwathmey
Tennessee	PM1220BG/BR	UNR	Gwathmey
Georgia	SG125B/RR	CONV	Bader
Georgia	SG125B/RR	UNR	Bader
Mississippi	PM1220BBRR	CONV	Atwell
Mississippi	PM1220BBRR	UNR	Atwell
Mississippi	DPL425RR	CONV	Hood
Mississippi	DPL425RR	UNR	Hood
Arkansas	BXN47	CONV	Vories
Arkansas	BXN47	UNR	Vories

Table 2. Information on production factors for comparison of ultra narrow row (UNR) and conventional (CONV) cottons.

Location	Yield, pounds/acre	Planting	Comments
Texas	976	CONV	-
Texas	947	UNR	-
Tennessee	552	CONV	-
Tennessee	528	UNR	-
Georgia	1042	CONV	-
Georgia	1031	UNR	-
Mississippi	750	CONV	54" tall
Mississippi	827	UNR	44" tall
Mississippi*	1272	CONV	-
Mississippi*	1300	UNR	150,000 plants
Arkansas	840	CONV	-
Arkansas	890	UNR	-
Average	905	CONV	-
Average	920	UNR	-

*Based on hand-picked plots.

Table 3. Comparison of measured factors for initial foreign matter, intermediate foreign matter, moisture, grade, turnout, neps and short fiber content for cotton grown at 6 growth locations and planted as ultra narrow row and conventional row widths.

Harvest Method	Conventional		Stripper	
Variable	Mean	Std Dev	Mean	Std Dev
Initial foreign matter %				
*Total	7.74	1.58	19.67	3.82
Bolls	0.02	0.03	0.05	0.08
*Hulls	0.97	0.65	8.62	3.10
*Sticks & stems	0.33	0.11	3.54	1.55
Grass	0.02	0.03	0.05	0.10
*Motes	3.53	0.70	4.50	0.64
Small leaf	1.30	0.40	1.35	0.27
Pin trash	0.18	0.07	0.12	0.04
Feeder foreign matter, %				
*Total	3.32	0.56	5.09	1.22
Hulls	0.09	0.09	0.43	0.46
*Sticks & stems	0.10	0.10	0.73	0.58
Grass	0.01	0.01	0.01	0.01
Miscellaneous	0.01	0.01	0.01	0.01
*Motes	2.04	0.39	2.84	0.56
Small leaf	0.16	0.07	0.17	0.04
Pin trash	0.02	0.01	0.03	0.01
Final foreign matter, %				
Total	3.57	0.38	4.26	0.71
Visible	1.87	0.31	2.47	0.68
Invisible	1.69	0.21	1.80	0.15
Marketing classification				
Staple length, in.	34.48	0.90	34.27	0.77
Leaf (manual)	3.1	0.64	3.37	0.81
Color grade index (manual)	97.4	5.4	98.1	3.8
Micronaire	4.43	0.43	4.02	0.32
Extraneous matter	0	0	3.3	4.2
Strength, g/tex	29.6	1.75	29.9	1.18
Reflectance	75.8	3.5	76.75	2.6
Yellowness	8.8	0.6	8.8	0.6
Trash, percent area	0.28	0.10	0.39	0.14
Length, in.	1.07	0.03	1.07	0.02
Uniformity	82.2	0.71	81.8	0.52
HVI color grade index	99.3	5.1	99.9	4.4
Moisture, %				
Initial	8.4	1.3	8.7	1.4
Final	4.5	0.3	4.5	0.2
Turnout, %				
*Lint turnout	34.77	2.50	30.70	2.23
Advanced Fiber Information System				
Short fiber content, %, by weight	9.4	1.2	10.6	1.2
Short fiber content, %, by number	26.7	2.5	29.4	2.4
Immature fiber content, %	5.7	0.9	6.2	0.5
Neps per gram	298	88	356	36

*Indicates significance at the 5% level

Table 4. Moisture and turnout for cotton produced at eight research locations and planted as ultra narrow row (UNR) and conventional (CONV) row widths.

		Moisture, %			Lint	Trash, %		
Cooperator	**Planting**	**Initial**	**Feeder**	**Lint**	**turnout, %**	**Initial**	**Feeder**	**Lint**
Gwathmey	CONV	7.2	7.0	4.4	37.8	6.8	2.8	3.1
Gwathmey	UNR	7.1	6.8	4.4	34.0	13.6	3.7	3.5
McCrory	CONV	7.2	6.6	4.5	31.0	10.4	3.4	3.8
McCrory	UNR	6.6	5.5	4.2	32.2	17.4	3.6	3.4
Hood	CONV	9.2	7.7	4.6	33.0	7.1	2.7	3.5
Hood	UNR	9.9	8.0	4.9	28.6	21.0	5.7	5.1
Vories	CONV	10.5	8.5	4.9	36.6	8.9	4.0	4.1
Vories	UNR	9.6	8.1	4.4	31.5	23.0	4.9	4.2
Bader	CONV	8.2	7.9	4.5	34.6	7.3	4.0	3.6
Bader	UNR	9.6	8.5	4.4	28.5	23.9	6.1	4.7
Atwell	CONV	8.2	7.0	4.0	35.6	6.0	3.0	3.2
Atwell	UNR	9.2	8.1	4.5	29.4	19.2	6.5	4.8
Average	CONV	8.4	7.5	4.5	34.8	7.7	3.3	4.1
Average	UNR	8.7	7.5	4.5	30.7	19.7	5.1	4.3

Table 5. High Volume Instrument (HVI) and manual classification for cotton produced at six growth locations and planted to ultra narrow and conventional row widths.

				HVI classification								Manual		
Cooperator	**Pltg.**	**Color grd index**	**Mode color**	**RD**	**Plusb**	**Mic**	**Bark***	**Strgth g/tex**	**Pctarea**	**Lgth, in.**	**Unif.**	**Leaf**	**Mode color**	**Color grade index**
Gwathmey	CONV	103.6	21	79.9	8.57	4.73	No	30.41	0.17	1.062	82.6	2.4	21	102.8
Gwathmey	UNR	104.0	21	80.0	8.71	4.48	No	29.79	0.21	1.052	82.3	2.3	21	102.0
McCrory	CONV	102.7	21	77.0	9.62	3.75	No	26.87	0.27	1.064	80.9	3.0	32	97.0
McCrory	UNR	102.0	21	77.6	9.10	3.74	No	27.69	0.21	1.057	81.2	2.4	31	100.5
Hood	CONV	94.0	41	73.1	8.14	4.98	No	30.73	0.26	1.123	82.6	3.0	41	94.0
Hood	UNR	94.0	41	72.7	8.39	4.30	Yes	30.58	0.53	1.109	81.8	3.8	41	93.0
Vories	CONV	99.1	31	75.3	9.21	4.29	No	30.75	0.46	1.080	82.6	4.3	31	98.8
Vories	UNR	102.5	21	77.3	9.74	3.67	No	29.81	0.43	1.061	81.2	3.6	32	98.0
Bader	CONV	92.2	41	70.7	8.43	4.58	No	27.80	0.24	1.041	81.7	2.8	42	88.8
Bader	UNR	94.6	41	74.8	8.20	3.87	Yes	30.54	0.51	1.067	82.2	4.2	41	94.0
Atwell	CONV	104.0	21	78.8	9.11	4.23	No	30.80	0.25	1.074	82.5	2.9	21	102.8
Atwell	UNR	102.4	21	78.1	8.69	4.06	Yes	31.01	0.42	1.069	82.3	3.9	31	100.8
Average	CONV	99.3	31	75.8	8.85	4.43	-	29.56	0.28	1.074	82.1	3.1	31	97.4
Average	UNR	99.9	31	76.8	8.81	4.02	-	29.90	0.39	1.069	81.8	3.4	31	98.0

*One or more sub samples were classified as bark.

Table 6. Advanced Fiber Information System analysis.

		Short fiber content, %		Neps	Immature fiber
Cooperator	**Planting**	**Weight**	**Number**	**per gram**	**content, %**
Gwathmey	CONV	9.4	26.4	234	5.2
Gwathmey	UNR	9.4	26.1	287	5.5
McCrory	CONV	11.3	30.8	465	7.1
McCrory	UNR	12.2	32.2	366	6.7
Hood	CONV	7.3	23.0	237	4.5
Hood	UNR	9.6	28.2	369	6.1
Vories	CONV	9.4	27.1	252	5.6
Vories	UNR	11.6	32.0	390	6.4
Bader	CONV	9.4	26.2	277	6.1
Bader	UNR	10.9	29.9	375	6.8
Atwell	CONV	9.5	26.6	321	5.8
Atwell	UNR	10.2	28.0	351	6.0
Average	CONV	9.4	26.7	298	5.7
Average	UNR	10.7	29.4	356	6.2