RESULTS OF 1998 GINNING STUDIES OF ULTRA NARROW COTTON

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

Abstract

Ultra narrow row (UNR) cotton has decreased production costs and increased yields in some areas. The UNR cotton is planted in 7.5- to 10-inch rows and is harvested with a finger-stripper because the row spacing is too narrow for a conventional spindle picker. This study investigated conventional and UNR cotton grown in 10 areas across the Midsouth and Southeast and ginned on a common gin for subsequent textile mill processing evaluation. The following gin machines were used for the UNR cotton: Separator-dropper, 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 two stages of saw-type lint cleaning. For the conventional cotton, the CBS machine and one of the stages of lint cleaning were not used. Initial foreign matter averaged 7.8 and 20.9%, for the conventional and UNR cottons; the UNR cotton had over 3 times more foreign matter than the conventional cotton initially. The marketing classifications, including foreign matter, were not statistically different. Ultra narrow cotton received barky calls on 1 of the 10 locations as compared to none for the conventional. Lint turnout differed dramatically for conventional and UNR cottons, and averaged 34.9 and 29.8%, respectively. About 245 more pounds of material were removed from the UNR cottons.

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 which will reduce their production costs. Ultra narrow row (UNR) cotton has shown the potential to reduce production costs and increase yields in some areas. 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. 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 attached to a conventional cotton stripper 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. Short and slender cotton plants are required for the finger-type stripper to work satisfactorily.

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 on the stripper harvester or on the boll buggy 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. 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 should generally produce slightly shorter staple and somewhat lower uniformity but higher color and leaf grades. Generally 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. In addition, it generally does not meet the needs of the UNR cotton adequately.

Reprinted from the *Proceedings of the Beltwide Cotton Conference*
Volume 2:1484-1485 (1999)
National Cotton Council, Memphis TN

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

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 (Cotton Ginners Handbook, 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. Generally, 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.

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 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

The mill quality of UNR cotton is not known. Thus, the industry relies on the mill data from conventional stripped cotton. Recent research studies of UNR cotton have not adequately documented fiber quality of specific interest to the textile industry. This study was undertaken to produce 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 10 areas in the Midsouth and Southeast in conventional 36" to 40" row spacings which was spindle-picked and UNR spacings of 7.5" to 10" which was stripper harvested. The cottons 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 December 2-3, 1998. 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, saw-type gin stand, and two stages of saw-type lint cleaning. For the conventional cotton, the CBS machine and one of the stages of lint cleaning were not used. Ten samples were taken from each treatment for foreign matter analyses (wagon fractionation, feeder fractionation and Shirley Trash Separator (to be reported later)); 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 and will be reported later. The 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 only the initial total foreign matter (also the hulls, sticks and stems, and mote components), hulls, sticks/stems, grass and mote components of feeder foreign matter, and lint turnout were significant statistically (Tables 3-5). Initial moisture contents, with one exception, ranged from 8.6 to 11.8% for the cotton immediately before gin processing which is within the acceptable range for storage (Table 3). The Arkansas CONV cotton at 13.8% exceeded the 12% maximum normally suggested for storage. Care must be exercised in using classing and mill data from this cotton because fiber degradation can occur at high storage moisture. The lint moisture at the press area ranged from 4.7 to 5.4% which was well within acceptable levels. Initial foreign matter averaged 7.8 and 20.9%, respectively, for the CONV and UNR cottons. Foreign matter after all the seed cotton cleaning averaged 3.9 and 4.8%, respectively, for the CONV and UNR cottons. Thus the UNR cotton had about 3 times more foreign matter than the CONV cotton initially. The laboratory-based final lint foreign matter (Shirley Trash Separator) did not detect significant differences between harvest methods (2.1% versus 1.8%); note that an additional stage of saw-type lint cleaning was used to clean the UNR cotton. Lint turnout (ratio of ginned lint weight to initial seed cotton weight) differed dramatically for CONV and UNR cottons, and averaged 34.9 and 29.8%, respectively. Thus, about 245 more pounds of material were removed from the UNR cottons.

The manual leaf and HVI trash grade were about the same for CONV and UNR cottons (Table 4). Thus, the additional CBS machine and the second stage of lint cleaning 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 1 of the 10 locations as compared to none for the CONV locations. This indicates that recommended cleaning practices for stripper harvested cotton adequately clean the cotton but a problem may exist with barkiness.

Samples were also collected after one stage of lint cleaning to compare market classification factors at the Classing Office. None of the factors were significant.

In summary, UNR-stripped cotton processed with properly equipped gins can yield HVI and manual grades equivalent to those obtained from CONV-picked cotton with the exception of barkiness. About three times as much as foreign matter will be 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: Charles Burmester, Jess McCrory, Owen Gwathmey, Craig Bednarz, Jay Hardwick, Bill Molin, Wade Stewart, Brad Guice , Allen Baucom, and Greg Ferguson.

References

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
Alabama-TVA	PM1220Bt/RR	CONV	Burmester
Alabama-TVA	PM1220Bt/RR	UNR	Burmester
Texas	BXN4740	CONV	McCrory
Texas	BXN4740	UNR	McCrory
Tennessee	BXN47	CONV	Gwathmey
Tennessee	BXN47	UNR	Gwathmey
Georgia-Plains	SG 125	CONV	Bednarz
Georgia-Plains	SG 125	UNR	Bednarz
Georgia-Midville	BXN4740	CONV	Bednarz
Georgia-Midville	BXN4740	UNR	Bednarz
Louisiana	PM1220	CONV	Guice
Louisiana	PM1220	UNR	Guice
Stoneville	SG501	CONV	Molin
Stoneville	SG501	UNR	Molin
Mississippi	BXN47	CONV	Stewart
Mississippi	BXN47	UNR	Stewart
North Carolina	PM1220	CONV	Baucom
North Carolina	PM1220	UNR	Baucom
Arkansas	BXN47	CONV	Ferguson
Arkansas	BXN47	UNR	Ferguson

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

Location	Yield, b/ac	Planting	Comments
Alabama	764	40" planter	Ideal harvest
Alabama	832	7.5" grain	Ideal harvest
Texas	625	40" planter	Late pick, rain
Texas	800	7.5 " planter	Early harvest
Tennessee	.	30" planter	Regrowth
Tennessee	.	7.5" drill	Regrowth
Georgia-Plains	1102	36" planter	High moisture
Georgia-Plains	1102	10" planter	Regrowth
Georgia-Midville	1145	38" planter	.
Georgia-Midville	892	10" planter	.
Louisiana	.	.	.
Louisiana	.	.	.
Stoneville	500	40" planter	Late plant
Stoneville	500	7.5" drill	.
Mississippi	.	38" planter	.
Mississippi	.	7.5" drill	.
North Carolina	668	38" planter	.
North Carolina	881	7.5" drill	.
Arkansas	500	38" planter	Early harvest
Arkansas	950	10" drill	.

Table 3. Comparison of measured factors for initial foreign matter, intermediate foreign matter, moisture, grade and turnout for cotton grown at 10 research locations and planted as ultra narrow row and conventional row widths.

Variable	Mean	Std Dev	Mean	Std Dev
Harvest method	Conventional		Stripper	
Initial foreign matter %				
*Total	7.81	2.3	20.9	4.0
Bolls	0.25	0.2	0.1	<.1
*Hulls	1.51	0.9	9.71	3
*Sticks & stems	0.62	0.3	3.45	0.9
Grass	0.04	<.1	0.06	0.1
Miscellaneous	0.46	0.6	0.14	0.2
*Motes	2.98	0.8	4.7	0.9
Small leaf	1.22	0.3	1.5	0.5
Pin trash	0.17	<.1	0.16	<.1
Feeder foreign matter, %				
Total	3.37	0.7	4.8	0.9
*Hulls	0.2	0.1	0.4	0.2
*Sticks & stems	0.21	0.1	0.58	0.4
*Grass	0.01	<.1	0.02	<.1
Miscellaneous	0.15	0.2	0.05	<.1
*Motes	1.79	0.4	2.62	0.4
Small leaf	0.2	0.1	0.2	0.1
Pin trash	0.02	0.1	0.02	<.1
Final foreign matter, %				
Total	2.08	0.40	1.80	0.27
Visible	1.41	0.35	1.18	0.13
Invisible	0.67	0.14	0.63	0.22
Marketing classification				
Staple length, in.	34.67	1	34.3	1.01
Leaf (manual)	2.87	0.5	2.78	0.4
Color grade index (manual)	93.91	6.8	95.83	5.8
Micronaire	4.5	0.3	4.34	0.4
Extraneous matter	.	.	11	0.0
Strength, G.tex	28.89	1.4	28.98	1.3
Reflectance	73.43	4.3	74.84	3.0
Yellowness	8.71	0.5	8.76	0.5
Trash, percent area	0.02	0.1	0.02	<.1
Length, in.	1.08	0.1	1.07	<.1
Uniformity	81.6	0.8	81	0.8
HVI color grade index	93.49	7.3	95.89	5.8
Moisture, %				
Initial	9.66	1.8	9.94	1.1
Final	5.06	0.3	5.01	0.2
Turnout, %				
*Lint turnout	34.86	1.9	29.83	2.3

* Indicates significance at the 5% level

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

			Foreign matter, %			Moisture, %		Lint
Location	Variety	Planting	Initial	Feeder[1]	Final[2]	Wagon	Lint	turnout, %
Alabama-TVA	PM1220B/RR	CONV	4.8	2.2	1.5	8.9	5.0	37.3
Alabama-TVA	PM1220B/RR	UNR	14.0	3.2	1.5	8.9	5.0	33.8
Texas	BXN4740	CONV	7.6	3.7	2.7	10.8	5.4	35.2
Texas	BXN4740	UNR	18.7	4.1	1.8	8.08	4.7	29.8
Tennessee	BXN47	CONV	7.3	3.1	2.2	9.5	4.8	35.5
Tennessee	BXN47	UNR	22.7	4.6	2.3	10.6	4.7	30.3
Georgia-Plains	SG 125	CONV	8.1	3.3	2.3	10.5	5.3	34.6
Georgia-Plains	SG 125	UNR	26.0	6.6	2.0	10.6	5.0	28.5
Georgia-Midville	BXN47	CONV	10.8	4.6	2.4	8.6	4.7	36.3
Georgia-Midville	BXN47	UNR	23.0	5.1	1.9	8.8	4.7	31.2
Louisiana	PM1220	CONV	6.9	3.6	2.1	9.4	5.2	34.2
Louisiana	PM1220	UNR	16.1	5.0	1.7	10.2	5.4	30.7
Stoneville	SG501	CONV	6.7	2.8	1.5	9.6	5.1	33.3
Stoneville	SG501	UNR	24.7	5.0	1.3	10.3	5.3	25.2
Mississippi	BXN47	CONV	9.4	3.7	2.3	7.8	5.0	33.4
Mississippi	BXN47	UNR	24.7	5.1	1.9	11.8	5.1	28.2
North Carolina	.PM1220.....	CONV	4.7	2.6	1.5	7.7	4.7	37.3
North Carolina	PM1220	UNR	19.0	4.1	1.8	10.4	5.1	31.1
Arkansas	BXN 47	CONV	11.8	4.1	2.1	13.8	5.4	31.3
Arkansas	BXN 47	UNR	20.2	4.6	1.9	9.8	5.1	29.5
Mean	.....	CONV	7.8	3.4	2.1	9.7	5.1	34.9
Mean	.....	UNR	20.9	4.8	1.8	9.9	5.0	29.8

[1]CONV processed through normal seed cotton cleaning system for machine picked cotton; UNR processed through normal system plus a CBS machine.
[2]CONV received one lint cleaning; UNR received two lint cleanings.

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

					HVI classification								Manual		
Location	Variety	Pltg.	Color grd index	Mode color	RD	Plusb	Mic	Bark	Strgth g/tex	Pctarea	Lgth, in.	Unif.	Leaf	Mode color	Color grade index
Alabama-TVA	PM1220B/RR	CONV	104.4	21	80.0	9.25	4.39	No	28.92	0.019	1.073	81.8	2.0	21	104.4
Alabama-TVA	PM1220B/RR	UNR	104.9	11	80.9	9.29	4.27	No	29.24	0.015	1.057	81.6	2.0	11	104.8
Texas	BXN4740	CONV	89.0	42	70.7	9.17	4.87	No	29.76	0.038	1.104	82.8	3.9	42	90.0
Texas	BXN4740	UNR	97.0	32	74.1	9.38	4.74	No	28.49	0.023	1.057	81.3	2.6	31	98.5
Tennessee	BXN47	CONV	85.4	51	68.4	7.82	4.67	No	28.49	0.026	1.077	81.5	2.7	51	85.9
Tennessee	BXN47	UNR	85.9	51	71.1	7.63	4.53	No	28.66	0.027	1.060	80.8	3.0	51	85.9
Georgia-Plains	SG 125	CONV	86.3	42	68.5	9.43	3.94	No	28.05	0.033	1.120	81.1	3.0	42	87.2
Georgia-Plains	SG 125	UNR	90.0	42	72.0	9.01	3.89	Yes	27.95	0.035	1.110	80.9	3.0	42	90.0
Georgia-Midville	BXN47	CONV	97.6	31	74.9	8.64	4.18	No	26.95	0.026	1.026	80.2	3.2	41	96.4
Georgia-Midville	BXN47	UNR	97.6	31	75.5	8.44	4.14	No	27.13	0.020	1.024	79.6	3.0	41	95.8
Louisiana	PM1220	CONV	98.1	31	75.1	8.85	4.88	No	29.57	0.017	1.054	81.0	2.4	31	97.7
Louisiana	PM1220	UNR	98.3	31	74.6	8.99	4.91	No	29.70	0.018	1.041	80.1	2.3	31	97.0
Stoneville	SG501	CONV	98.2	31	76.2	8.30	4.88	No	31.98	0.022	1.115	82.8	2.8	31	99.4
Stoneville	SG501	UNR	100.4	31	77.4	8.69	4.61	No	31.72	0.028	1.118	82.4	2.9	31	100.4
Mississippi	BXN47	CONV	93.6	41	73.0	8.93	4.36	No	29.36	0.024	1.098	81.8	3.2	41	93.6
Mississippi	BXN47	UNR	95.3	41	74.0	8.69	4.49	No	28.74	0.023	1.078	80.9	3.1	41	96.4
North Carolina	PM1220	CONV	100.0	31	78.8	7.99	4.35	No	28.55	0.023	1.073	81.3	2.4	31	100.0
North Carolina	PM1220	UNR	100.0	31	77.1	8.51	3.94	No	29.91	0.028	1.078	81.6	3.1	31	100.0
Arkansas	BXN47	CONV	82.3	52	68.7	8.71	4.49	No	27.25	0.038	1.070	81.6	3.1	42	84.5
Arkansas	BXN47	UNR	89.5	42	71.7	9.00	3.85	No	28.24	0.028	1.066	80.8	2.8	42	89.5
Mean	....	CONV	93.5	.	73.4	8.70	4.5	No	28.89	0.027	1.081	81.6	2.9	.	93.9
Mean	....	UNR	95.9	.	74.8	8.76	4.38	No	28.98	0.025	1.069	81.0	2.8	.	95.8