ULTRA NARROW ROW COTTON GINNING AND TEXTILE PERFORMANCE RESULTS

Thomas D. Valco
Cotton Incorporated
Cary, NC
W. Stanley Anthony
USDA Cotton Ginning Lab
Stoneville, MS
David D. McAlister III*
USDA Cotton Quality Research Station
Clemson, SC

Abstract

This study evaluated the fiber quality and textile performance of ultra narrow row cotton (UNR) and conventionally (CONV) grown cottons in several regions of the Cotton Belt, during two different production seasons. Due to harvest method, UNR cotton had over three times the foreign matter of the CONV cotton entering the gin, significantly reducing lint turnout from 35 to 30 percent. However, with proper ginning, the marketing classifications, including foreign matter, were not statistically different. UNR cotton did receive barky calls at 4 of the 15 locations, compared to none for the CONV cotton. The largest majority of barky calls occurred when only one saw-type cleaner was used in 1999. Because the UNR cotton contained more fine trash, yarn-manufacturing wastes were higher. Lint cleaning and carding wastes increased about one percent in the UNR cotton. However, the effect on spinning performance, ends down, was not statistically different between production methods and varied between years. The data revealed no differences between yarn strength or evenness between CONV and UNR cotton. Although there was similar yarn quality, it came at the expense of higher wastes for UNR cotton.

Introduction

For the past several years, farmers and researchers have been growing and studying ultra narrow row (UNR) cotton throughout the Cotton Belt. With limited potential for increased prices, cotton growers are very interested in technologies and management systems that will reduce their production costs or increase yields. . The potential for increased yield by using UNR planting methods has caught the attention of cotton growers and thus the attention of ginners and textile mills.

In general, UNR cotton is planted in rows spaced 7.5- to 10 -inches apart using a grain drill. High plant populations (greater than 100,000 plants per acre) and uniform stands are necessary to reduce branching and help keep the plant short and slender. 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. A field cleaner is used to remove some of the foreign matter from the harvested crop.

Some growers favor UNR cotton because of the potential for increased yield, a shorter growing season, and lower equipment costs (Cawley, et.al.,1999;Bednarz, et.al., 1999; Delaney, et.al., 2000; Bader, et.al.,2000; Molin, 2000; Witten and Cothern, 2000). Conversely, cotton ginners, buyers, and spinners are wary of UNR cotton because of the current perception of increased foreign matter, neps and short fiber content. For gins not prepared to handle UNR cotton, increased foreign matter can reduce the efficiency of the gin and/or reduced color and trash grades. 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 content unless they are removed before they reach the gin stand (Baker, et.al.,1994). The additional foreign matter will also increase wear on ginning equipment.

Spinners are wary of UNR cotton because increased foreign matter content can cause an increased number of ends down in spinning, increased waste in the card room, and poor yarn and fabric quality. The mill quality of UNR cotton has not been adequately documented to the textile industry. This study was undertaken to produce sufficient quantities of UNR and spindle-picked cottons and ginned under recommended procedures to evaluate fiber quality and textile performance.

Background of Ginning and Textile Performance Studies

A cooperative study between USDA and Cotton Incorporated (Anthony, et.al.,1999; Anthony, et.al., 2000; McAlister, 1999) was conducted to evaluate the fiber quality and textile performance of UNR and conventionally (CONV) grown cotton under similar environments and ginned using a common ginning sequence. The study included cotton grown in producers' fields at several different locations across the Cotton Belt, including nine locations in 1998 and six in 1999 (Table 1).

At each location, wide-row cotton was grown in 30- to 40-inch row spacing and was spindle picked. The same variety of cotton was grown in 7.5- to 10-inch rows and was harvested using finger strippers equipped with a field cleaner. About 1000 pounds of seed cotton from each row width at each location was shipped to the U.S. Cotton Ginning Laboratory in Stoneville, Mississippi, for ginning. The bales were then shipped to the Cotton Quality Research Station in Clemson, South Carolina, for analysis of textile performance.

Ginning Procedures and Results

The seed cotton was stored at the Cotton Ginning Research Unit until all test cottons had arrived. Sub-samples from each location were analyzed for foreign matter. The UNR and CONV cotton were then ginned in a commercial size gin. Table 2 lists the equipment used during ginning. For the CONV cotton, the CBS machine and one of the stages of lint cleaning were not used. In 1999, all cotton received only one stage of lint cleaning.

Table 3 presents 1998, 1999 and averaged data for foreign matter and lint turnout. Initial foreign matter analysis of the seed cotton included bolls, hulls, sticks, stems, grass, motes, small leaves, pin trash and miscellaneous material. The feeder foreign matter included hulls, sticks, stems, grass, motes, small leaf, and pin trash. The final lint foreign matter measured by the Shirley Trash Separator includes both invisible and visible foreign matter.

The initial foreign matter of seed cotton was significantly higher for UNR cotton, averaging 8 and 20 percent respectively for spindle- and stripper-harvested cottons. Additional extraction and trash handling equipment is required to remove this foreign material before the UNR cotton reaches the gin stand. Additional lint cleaning is generally needed to remove foreign matter and to reduce bark discounts of UNR cottons. With the elimination of the 2nd stage lint cleaning in 1999, final foreign matter % was numerically higher, although not significant at the 5% level. Lint turnout (ratio of ginned lint weight to initial seed cotton weight) differed greatly between CONV and UNR cotton.

Fiber Quality Measurements

Fiber and yarn properties and processing performance were studied to determine if UNR cotton and CONV cotton differ significantly with respect to properties important in textile utilization. Analysis of the yearly data (Table 4) revealed no significant differences in HVI analysis. The

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numerical difference in micronaire reading can be explained by the harvesting method for the UNR cotton, because the finger-stripper usually removes more immature bolls from the cotton plant. The differences in length and length uniformity are likely caused by harvest method and the extra cleaning required for the UNR cotton. UNR cotton had more barky classifications than did the CONV cotton. Barky bales cause a price discount of about $20 per bale.

AFIS (Advanced Fiber Information System) measurements of neps per gram were significantly higher for UNR cottons in both the 1998 and 1999 studies, regardless of the omission of the second stage of lint cleaning in 1999. Although not statistically different in either year, short fiber percentage was numerically higher for UNR cottons each year.

Textile Performance Results

All cottons in this study were processed at the USDA Cotton Quality Research Station Pilot Spinning Laboratory using the same equipment as shown in Table 5. All waste was collected for each condition at the cleaning line and at the card. The results in Table 6 show the raw stock data and the amounts of waste removed as a percentage of the fiber processed. Year-to-year differences between raw fiber provide some degree of inconsistency in the data. Some inconsistency is attributed to the different stages of lint cleaning used for UNR cotton. Total cleaning and carding wastes were numerically higher in 1998 and statistically higher in 1999.

Yarn was spun on ring spinning frames producing 27/1 Ne yarn at a spindle speed of 14,500 rpm and a twist multiple of 3.75. There was no significant difference in spinning ends-down between CONV and UNR cottons (Table 7). Spinning performance for both CONV and UNR cottons improved in 1999. The data reveals no statistical differences in yarn strength or evenness between CONV and UNR cotton. Differences did occur between IPI Neps and IPI Thick and Thin places but were variable between years. These differences may not necessarily exist as a result of row spacing but from the additional cleaning of the UNR cottons received in 1998. Yarn from this study was knitted into a single jersey knit fabric, dyed with C.I. Direct Blue 80 and visually inspected for white specks. The number of white specks was higher in the UNR cotton in 1998 but was the same in 1999 in both CONV and UNR cotton.

Summary of Results

This study evaluated the fiber quality and textile performance of ultra narrow row cotton (UNR) and conventionally (CONV) grown cottons in several regions of the cotton belt, during two different production seasons. The analysis was based on yearly averages and not on specific regions.. This study did not attempt to evaluate differences in production practices or yield of UNR or CONV cotton. Due to harvest method, UNR cotton had over three times the foreign matter of the CONV cotton entering the gin, significantly reducing lint turnout from 35 to 30 percent. However, with proper ginning, the marketing classifications, including foreign matter, were not statistically different. UNR cotton did receive barky calls at 4 of the 15 locations, compared to none for the CONV cotton. The largest majority of barky calls occurred when only one saw-type cleaner was used in 1999.

Because the UNR cotton contained more fine trash, yarn-manufacturing wastes were higher. Lint cleaning and carding wastes increased about one percent in the UNR cotton. However, the effect on spinning performance, ends down, was not statistically different between production methods and varied between years. The data revealed no differences between yarn strength or evenness between CONV and UNR cotton. Although there was similar yarn quality, it came at the expense of higher wastes for UNR cotton.

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Disclaimer

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Table 1. Field Locations of UNR and CONV Performance Study.

Location	Year	Variety
Alabama – TVA	1998	PM1220B/R
Arkansas – Kaiser	1998	BXN47
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Georgia - Plains	1998	SG125
Georgia – Midville	1998	BXN4740
Georgia – Tifton	1999	SG125B/R
Louisiana – Winsboro	1998	PM1220R
Mississippi –Stoneville	1998	SG501
Mississippi - Greenville	1998	BXN47
Mississippi – Gunison	1999	DPL425R
Mississippi -	1999	PM1220B/R
North Carolina – Monroe	1998	PM1220R
Tennessee – Jackson	1998	BXN47
Tennessee – Jackson	1999	PM1220B/R
Texas – Bryan	1998	BXN47
Texas - Bryan	1999	BXN47

Table 2. Order of Machinery for UNR Cotton Ginning.

	1998		1999	
Gin Machinery	**CONV**	**UNR**	**CONV**	**UNR**
Cleaning and Drying	X	X	X	X
Combination Bur and Stick Machine		X		X
Saw-Type Gin Stand	X	X	X	X
Air Lint Cleaner			X	X
Saw lint cleaner	X	X	X	X
2nd Stage Saw Lint Cleaner		X		

Table 3. UNR and CONV Foreign Matter and Lint Percentages.

Collection	1998		1999		Average	
Location	**UNR**	**CONV**	**UNR**	**CONV**	**UNR**	**CONV**
Initial Foreign Matter %	20.9*	7.8	19.7**	7.7	20.3	7.8
Feeder Foreign Matter %	4.8	3.9	5.1**	3.3	5.0	3.6
Final Foreign Matter %	1.8	2.1	4.3	3.6	3.1	2.9
Lint Turnout %	29.8*	34.9	30.3**	34.8	30.3	34.9

* Significant difference at 95 percent confidence level for 1998 data.
** Significant difference at 95 percent confidence level for 1999 data.

Table 4. HVI and AFIS Classifications of 1998 and 1999 Cotton.

	1998		1999		Average	
Property	**CONV**	**UNR**	**CONV**	**UNR**	**CONV**	**UNR**
Micronaire	4.5	4.34	4.43	4.02	4.5	4.2
Strength (g/tex)	28.89	28.98	29.6	29.9	29.2	29.4
UHML (inches)	1.08	1.07	1.07	1.07	1.08	1.07
LUI	81.6	81	82.2	81.8	81.9	81.4
Color: Rd	73.43	74.84	75.8	76.75	74.6	75.8
Color: +b	8.71	8.76	8.8	8.8	8.8	8.8
Trash (% area)	0.27	0.25	0.28	0.39	0.28	0.32
Leaf Grade	2.87	2.78	3.1	3.1	2.99	2.94
Bark (bales)	0	1	0	3	0	2
AFIS Short Fiber %	8.6	9.4	6.4	7.9	7.5	8.65
AFIS Neps/Gram	268	373*	275	338**	272	356

* Significant difference at 95 percent confidence level for 1998 data.
** Significant difference at 95 percent confidence level for 1999 data.

Table 5. Order of Machinery for UNR Cotton Milling.

Operation	***Equipment Process***
1. Opening and cleaning	Axi-Flow>GBRA>RN>RST>DX)
2. Carding	DK740 Card
3. Breaker drawing	RSB Drawing (2 stages)
4. Roving	Zinser660 Roving
5. Ring spinning	Zinser321 Ring Spinning

Table 6. 1998 and 1999 Cleaning and Card Waste Percentages.

Waste Removal	1998		1999		Average	
Percentage	**UNR**	**CONV**	**UNR**	**CONV**	**UNR**	**CONV**
Cleaning Wastes %	1.45*	1.88	2.16**	1.71	1.81	1.80
Under Card Wastes %	1.58	1.54	6.32	6.20	3.95	3.87
Card Flats Wastes %	5.73*	5.08	1.94**	1.71	3.84	3.40
Total	8.76	8.50	10.4**	9.62	9.59	9.06

* Significant difference at 95 percent confidence level for 1998 data.
** Significant difference at 95 percent confidence level for 1999 data.

Table 7. Spinning Performance and Yarn Property Data.

	1998		1999		Average	
Property	**CONV**	**UNR**	**CONV**	**UNR**	**CONV**	**UNR**
Ends Down/ 1000 Spindle Hour	15.0	17.5	7.6	6.8	11.3	12.2
Yarn Size (Ne)	27.38	27.36	27.3	27.3	27.34	27.33
Single End Strength (g/tex)	14.27	14.35	14.51	14.86	14.39	14.61
Yarn Evenness (C.V.)	18.17	18.70	18.73	18.38	18.45	18.54
IPI Neps (200%)	78	95*	178	142**	128	119
IPI Thick Places (+50%)	567	699*	1017	924	792	812
IPI Thin Places (-50%)	119	186*	198	161	159	174
White Specks (Fabric)	6	8.5	1	1	3.5	4.8

* Significant difference at 95 percent confidence level for 1998 data.
** Significant difference at 95 percent confidence level for 1999 data.