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The Effect of Harvesting Procedures on Fiber and Yarn Quality of Ultra-Narrow-Row Cotton

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ABSTRACT

The ultra-narrow-row (UNR) cotton system is defined as planting a cotton field with closely spaced rows (typically less than 38.1 centimeters). Because this narrow-row spacing provides the potential for increased yield, it has caught the attention of U.S. cotton producers, ginners, and textile mills. While these three groups share an interest in UNR cotton, they do not share the same opinion on its merits. Producers favor UNR because of the potential for increased yield, a shorter growing season, and lower equipment costs. Conversely, cotton ginners, buyers, and spinners are wary of UNR cotton because of perceived increased levels of non-lint material. For gins not prepared to handle UNR stripper-harvested cotton, increased non-lint content can reduce the cleaning efficiency of the gin and increase wear on ginning equipment. Spinners are wary of UNR cotton because studies have shown that increased non-lint content in cotton fiber can cause an increased number of ends-down in spinning, increased waste in the card room, and reduced yarn and fabric quality. Little research has been conducted on the impact of UNR cotton in the textile plant. This study focuses on the impact of harvesting methods on waste, percentage efficiency, and processing and yarn quality, which are important factors to the yarn spinner. The results indicate that an alternative harvesting method could make UNR an attractive planting choice, particularly in marginal fields.

Traditionally, cotton has been grown with a row spacing of 76.2 to 101.6 cm, which was based on width of the mule plowing the field. The desire and need to increase yield have led to new and different farming practices and chemicals. One practice used to increase yield has been to adjust the spacing between cotton rows, which led to the development of ultra-narrow row (UNR) spacing.

Until recently, the history of UNR cotton has been one of repeated failure. Narrow-row cotton was evaluated in Australia in the late 1960s and throughout the 1970s and was considered impractical with the production practices at the time, but new technology has made the application of UNR cotton production possible today (Larson and English, 1997). This new technology includes plant growth regulators, broad spectrum over-the-top weed control formulas, herbicide-tolerant plant cultivars, and the availability of precision seed planting drills, and close-row planters (Bader et al., 1999).

A producer's goal for using the UNR cotton system is to grow high quality, high yielding, short-season cotton (Trehune, 1998). A major advantage of the UNR cotton system to a grower is increased yield, because of higher plant density and more uniform distribution of plants within a field. In a conventional field, a plant population of 100,000 plants per hectare is planted with101.6 cm between rows and 7.62 to 10.16 cm between plants within the row. In contrast, a typical UNR field has a plant population of 300,000 plants per hectare with a configuration of about 25.4 cm by 12.7 cm (Dowling, 1996).

Over the past few years, BASF Corp. (Research Triangle Park, NC) has conducted trials on UNR yield in five Cotton Belt states. UNR cotton averaged 15% higher yield than cotton grown on the traditional 101.6-cm rows. Mississippi and Texas recorded the highest increases, 32 and 37%, respectively. The largest yield gains have been in areas and fields which would be classified as poor or marginal (Dowling, 1996).

Harvesting and ginning methods are the areas of greatest concern with UNR cotton. Because of the close spacing of rows, UNR cotton is harvested with a stripper harvester, instead of the more commonly used spindle harvester. One result of using the stripper harvester is increased non-lint content, and plant densities can compound the effect of the

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stripper on the non-lint content of cotton (Mayfield, 1999). Lower plant densities can cause an undesirable branching that results in excessive removal of bark by mechanical strippers and serious operating problems in the field (Harris et al., 1999). One solution for reducing the higher levels of non-lint content is the addition of field cleaners to the stripper harvester, which allows the removal of some of the sticks, burrs, and other trash (Mayfield, 1999). This additional cleaning equipment provides cotton to Southeast gins that more closely resembles spindle-picked cotton (Perkins and Atwell, 1996).

Attempting to gin UNR cotton in a spindle-picker gin can cause many problems. Unsatisfactory levels of trash and reduction in lint quality are likely to occur, unless additional seed cotton cleaning equipment is added to the gin. Increased trash places a greater load on the trash handling and drying system in the gin, which results in a reduced processing rate. Additional trash, primarily sticks, can accumulate in the seed roll of the gin stand. If this happens, fibrous material on the sticks is removed during ginning, resulting in bark contamination of the lint. Higher trash content can increase repair and maintenance costs that will inevitably contribute to higher ginning costs.

To overcome some of the problems created by ginning UNR cotton on a gin set-up for spindle-picked cotton, Mayfield (1999) suggested that the gin include additional equipment to handle the extra foreign matter. A gin in the Southeast would require an additional stick machine or an additional combination burr and stick machine as the first cleaner. Also, a second stage of lint cleaning is recommended for UNR cotton. The trash handling system would have to be improved to handle the greater volume of trash from the individual cleaners on the way to the trash pile (Mayfield, 1999).

The presence of increased visible foreign matter (VFM) is expected in UNR cotton. VFM is defined as "the sum of all the non-fibrous material that can be separated from the fibers on a test instrument similar to the Dust and Trash Tester developed at the Denkendorf Institute for Textile Research and Technology" (McCreight et al., 1997). With an extra lint cleaner and an extra combination burr and stick machine on the gin, significant amounts of foreign matter can be removed from UNR cotton, which makes it comparable to conventional cotton (Anthony et al., 1999). In their study, initial foreign matter content of stripper-harvested UNR cotton and spindle-harvested conventional cotton was 20.9 and 7.8 %, respectively. After ginning, the foreign matter contents in the UNR and conventional cotton were 4.8 % and 3.9 %, respectively.

Studies on the impact of VFM on fiber quality have provided variable results. High volume instrument (HVI) test results from a study by Larson and English (1997) indicated that stripper-harvested UNR cotton had a higher trash content and lower micronaire than spindle-harvested conventional cotton. In another study with stripper-harvested UNR cotton and spindle-harvested conventional cotton, none of the HVI properties were affected except for micronaire (Vories et al., 1999). The UNR cotton had a lower micronaire than the conventional cotton. Advanced fiber information system (AFIS; Uster Technologies; Knoxville, TN) tests indicated that UNR cotton had significantly more neps, higher short fiber content, and more visible foreign matter that the conventional cotton (Vories et al., 1999).

Little research has been conducted on the spinning efficiency of UNR cotton. In a study comparing UNR and conventionally grown cottons on a ring-spinning system, there were no significant differences in processing efficiency between UNR and conventionally grown cottons (McAlister, 1999). While there was no significant difference in spinning efficiency, yarn single-end strength variability, yarn neps, yarn thick and thin places, and Classimat minor defects were significantly worse for the UNR cottons. These results indicate that the differences are attributable to the production methods or the additional ginning required for UNR cotton.

The stripper-harvesting method used for UNR cotton collects more trash with the cotton than the spindle-harvesting method, and increased trash in cotton corresponds with increased ends-down in spinning (McCreight et al., 1997). For this reason, stripper-harvested UNR cottons have not been well received by textile mills. Currently, no practical method of spindle harvesting UNR cottons exists. Therefore, past research has not studied the effect of spindle harvesting on the fiber properties of cotton grown in ultra-narrow rows. It would be beneficial for producers, ginners, and spinners of cotton to know the effects of harvesting method on fiber properties and on spinning performance of UNR cottons when they are ginned with two lint cleaners, which is recommended for stripper-harvested, ultra-narrow row, upland cottons. The objective of this study was to evaluate the effect of harvesting method of cottons grown in ultra-narrow rows on the productivity of a spinning mill, as well as on the resultant quality of open-end spun yarns.

MATERIALS AND METHODS

In 1999, the equivalent of six bales of cotton (Paymaster 1220 BG/RR; Delta Pine and Land Co.; Scott, MS) were grown in ultra-narrow rows (19.05 cm apart) on a commercial farm in Kingstree, SC. During the growing season, the crop was managed using typical UNR cotton production practices. At harvest, half the cotton was spindle-picked with a conventional, six-row spindle-picker and the remaining half was stripper-harvested with a conventional finger-stripper with a field cleaner. The field cleaner was used to overcome the lack of an additional stick machine and incline cleaner at the gin. The spindle harvester was set for 76.2 cm (30 in) rows, which only allowed for one of every four rows to be picked. The remaining rows were driven over by the picker as it picked each fourth row. These cottons were harvested after Christmas due to unusually wet weather during the harvest period.

The cotton was ginned at a commercial gin near the field. The gin, which included a combo separator, fountain dryer, split to two incline cleaners and back to a stick machine (three saw), incline cleaner, gravity cleaner, feed control, gin stand, and two lint cleaners, was setup for handling spindle-harvested cottons. Cotton fiber from each of these treatments was then tested to determine the influence of harvest method on fiber properties.

Once the bales of cotton had been conditioned, they were tested for micronaire, upper-half mean length, uniformity index, strength, elongation, length distribution, maturity, and non-lint content. These tests were conducted with the following instruments: HVI & AFIS (Uster Technologies; Knoxville, TN), Peyer AL-101 (Siegfried Peyer Ltd; Wollerau, Switzerland), and Shirley Analyzer (Shirley Development Labs; Stockport, England). Details of the tests with these instruments are provided in Table 1.

After the cottons from the two treatments were ginned, there were three bales of cotton for each treatment (a total of six bales). For processing purposes, three lots were used for each of the two treatments to give a total of six spinning lots. In other words, each treatment had three replications in textile processing. Each lot consisted of 68.04 kg of cotton. To emulate a mill environment where several bales of cotton are blended together, each lot was composed of a mixture of the three bales from each harvesting condition.

The cotton for each lot was processed through the opening and cleaning line at the Cotton Quality Research Station (CQRS), USDA, at a throughput rate of 45.36 kg h^{-1}. The processing equipment used in the card room consisted of three tandem opening hoppers, an Axi-Flo opener/cleaner, a GBRA big bin hopper, a RN coarse cleaner, a RST multi-roll cleaner, a DX de-duster, and a DK-740 card (all Truetzschler; Monchengladbach, Germany). A 227-g sample of the card mat was taken from each lot and tested on AFIS for length distribution and non-lint content. The waste suction for the opening line was turned-off in order to collect waste from the Axi-Flo, the RN, the RST, and the DK-740 card. Waste removed from the cotton for each lot at each location was placed into separate bags, individually weighed, and the waste percentage calculated by dividing the weight of the waste collected at each point by the total amount of ginned cotton fed to the opening line. After conditioning, waste was tested for non-lint content on the Shirley Analyzer. The remaining waste lint was tested for length distribution and non-lint content on the AFIS.

After carding, six cans of 4,252-tex grain sliver were processed through a Rieter RSB (Rieter; Winterthur, Switzerland) (one pass) leveled finisher draw frame, resulting in 24 cans of 3,898-tex sliver for rotor spinning. Samples of card sliver and finisher drawing sliver were collected from each lot processed. These samples were conditioned and tested for mass evenness on the Uster Tester 3 (Uster Tech-

Table 1. Specifications of samples used for fiber testing

Instrument	Sample location	Sample size (g)	Samples/trmt.	Reps./sample
HVI	Bale	50.0	3	4
AFIS	Bale	0.5	3	4
Peyer AL-101	Bale	0.9	3	2
Shirley Analyzer	Bale	100.0	3	2

nologies; Knoxville, TN). The AFIS was used to test for length distribution and non-lint content.

For rotor spinning, 24 cans per lot of 3,898-tex sliver were fed into a Schlafhorst SE-11 (Schlafhorst; Monchengladbach, Germany) rotor spinning frame to spin a 29.53 tex yarn. The process parameters used were a follows: a twist multiple of 3.85, a rotor speed of 90,000 revolutions per minute, and a combing roll speed of 8,000 revolutions per minute. Stops for each lot were visually monitored and recorded. Each lot ran approximately 9-10 hr on a 24-position rotor spinning frame. Upon completion of each lot, the frame was thoroughly cleaned and prepared for the next lot.

The resulting yarn was conditioned in a controlled environment and tested for the following properties: hairiness, mass evenness defects, tensile properties, infrequent defects, and yarn count. The instruments used to test for these properties, as well as the details of tests with these instruments, are listed in Table 2. Yarn from each of the six lots (three lots per treatment) was knitted into body-width fabric. This fabric was then dyed and inspected for white specks. Four samples per lot of 2.58 x 10^4 sq mm fabric were each inspected for the presence of white specks.

All results were subjected to analysis of variance to determine the effect of the treatments on the fiber and yarn properties. A minimum significant difference (MSD) between treatments for the affected dependent variables was determined by calculating the 95% confidence interval. This confidence interval was calculated using a q-test, where q is determined by $\alpha = 0.05$, k = the number of means, and degrees of freedom = degrees of freedom of the mean-square error divided by the square root of the sample size. If the two treatments have a difference greater than the number from the q-test, these two treatments are considered statistically different for the dependent variable analyzed. All statistical analyses were conducted on SYSTAT (SYSTAT; Richmond, CA).

RESULTS AND DISCUSSION

Micronaire, maturity, and fineness. Much can be determined about a cotton fiber by analyzing its micronaire, maturity, and fineness values. Textile manufacturers use micronaire for determining if the cotton is worth purchasing for the processing of yarns and fabrics for specific end-uses. Interesting results were obtained when investigating the relationship between maturity and fineness in determining micronaire values.

Micronaire is an indirect measure of cotton fiber gravimetric fineness (mass per unit length), and is influenced by both biological fineness and maturity. Micronaire is commonly used as an indicator of cotton fiber maturity, although care must be applied when doing this. For marketing purposes, a micronaire value of 3.7 to 4.2 is considered premium with regard to price. Values of 3.5, 3.6, and 4.3 through 4.9 are considered normal. Values of 3.4 and below and 5.0 and above are considered to have lesser value and are in the price discount range. Micronaire values for the cottons in this study were in the discount range (Table 3). Adverse weather and row spacing more than likely contributed to these low micronaire values.

Because micronaire is an indicator of gravimetric fineness, and gravimetric fineness is influenced by both biological fineness and maturity, it is important to discuss these parameters. To determine the maturity of the cottons, AFIS test results were analyzed (Table 4). Maturity refers to the degree of secondary wall thickening in a cotton fiber. In cottons with normal maturity, the secondary wall constitutes about 90% of the fiber's total weight. Inclement weather can adversely influence the maturity of a cotton fiber, and immature cotton contributes to lower yarn strength, and nep formation, and poor dye uptake (Bradow and Bauer, 1997). Maturity results are typically reported in terms of maturity ratio. Based on the low micronaire of these cottons,

Table 2. Specifications of samples used for yarn testing

Instrument	Sample location	Sample size	Samples/trmt.	Packages/sample
Uster Tester 3	Yarn	914 m	3	20
Zweigle Hairiness	Yarn	100 m	3	4
Classimat	Yarn	100,000 m	3	6
Statimat	Yarn	20 breaks/pkg	3	10
Tensojet	Yarn	1000 breaks/pkg	3	10

it appears likely that AFIS tests would show low or extremely low maturity values. The maturity ratio for both treatments tested ranged from 0.85 to 0.89 (Table 4). These values are within the range of what is considered a mature fiber, since any value less than 0.80 indicates an immature fiber (Williams and Yankey, 1996).

Color. Cotton color can be described by degree of reflectance (Rd) and degree of yellowness (+b). The range of values for reflectance is 40 to 85%, with 85% representing high reflectance. The range of values for yellowness is 4 to 18 units, with 18 representing very yellow. U.S. upland cotton is typically creamy white. Exposure to various environmental conditions can cause the cotton to become more yellow and gray with late harvesting (Duckett et al., 1999). Harvesting and ginning also influence cotton color. The spindle-harvested treatment exhibited a lower +b value than its stripper-harvested counterpart (Table 3). Although not statistically significant, the spindle-harvested treatment exhibited a numerically lower Rd value than the stripper-harvested treatment. This is more than likely a reflection of the field cleaning by the stripper harvester that the picker did not have.

Tensile strength. In HVI testing, a strength measurement was made on the same beard of cotton that is used for measuring fiber length. As might be expected from the lower micronaire and gravimetric fineness value of the fiber, strength of cotton from the stripper-harvested treatment was significantly weaker than the spindle-picked treatment (Table 3).

Length. Previous studies comparing cotton grown in UNR cottons with those grown with conventional spacing indicate that UNR cottons have lower uniformity indices (McAlister, 1999). In this study, the

Table 3. High volume instrumentation (HVI) and classer fiber properties for spindle-harvested and stripper-harvested ultra-narrow row (UNR) cotton

Property	Spindle-harvested	Stripper-harvested	MSD [y]
Micronaire	3.47	2.26	0.22*
Strength (g/tex)	27.04	23.24	1.56*
Reflectance (Rd)	65.90	68.10	3.15
Yellowness (+b)	9.04	10.60	0.46*
Trash (%)	4.00	5.00	2.21
Upper half mean length (mm)	28.19	25.91	0.02*
Uniformity index (%)	80.75	78.33	0.96*
Color grade	52	44	--
Extraneous matter [z]	0	11	--
Leaf grade	3	4	--

[y] Treatments marked with an asterisk are significantly difference according to minimum significant difference (MSD) at *P* = 0.05.

[z] The extraneous matter code for Bark Level 1 is 11, as determined by the classer.

Table 4. AFIS fiber properties for spindle-harvested and stripper-harvested ultra-narrow row (UNR) cotton

Property	Spindle-harvested	Stripper-harvested	MSD [z]
Short fiber content (w) (%)	9.50	16.70	2.39*
Fineness (mTex)	162.00	152.00	5.98*
Maturity Ratio	0.89	0.85	0.02*
Dust (cnt/g)	734.00	1952.00	232.07*
Trash (cnt/g)	84.00	263.00	25.29*
Visible foreign matter (%)	2.12	5.70	0.63*
Neps (cnt/g)	385.00	1069.00	78.19*

[z] Treatments marked with an asterisk are significantly difference according to minimum significant difference (MSD) at *P* = 0.05.

spindle-harvested treatment had a higher upper half mean length (UHML) than the stripper-harvested treatment tested (Table 3). These results can be explained by the fact that plants grown in ultra-narrow rows support fewer bolls, so they are able to provide 1st and 2nd position bolls with more growth-related nutrients. The fibers in these bolls would have a chance to more fully develop. When spindle harvesting UNR cotton, only the locks from the open bolls are harvested, making it more selective in retrieving fiber from the plant than the stripper harvester.

Length uniformity index (UI) is a measure of the fiber length distribution in a sample. A low uniformity index value would indicate that there are more short fibers (fibers <12.7 mm in length) in a sample than in one with a high uniformity index value for cottons of the same upper half mean length. The stripper-harvested treatment exhibited a significantly lower uniformity index than the spindle-picked treatment (Table 3). The stripper-harvested cotton also exhibited a significantly higher amount of short fiber content (SFC) by weight as measured by the AFIS than the spindle-picked treatment.

Neps. Neps are a collection of one or more fibers occurring in a tangled and unorganized mass and are mainly composed of immature fibers. While the maturity tests indicated that both cottons had average maturity, AFIS results indicated that the stripper-harvested cotton had a higher nep counts than its spindle-harvested counterpart (Table 4). This trend is consistent with the fineness measurement for both treatments (the UNR cotton was finer) and is important because a fine fiber tends to be less rigid and easily tangled into a nep.

Non-lint content. The non-lint content of cotton includes stalk, leaf particles, dirt, dust, micro-dust, and respirable dust. There is concern over the non-lint content of UNR cottons compared with cottons grown with conventional spacing and spindle harvesting. The stripper-harvested cottons received extraneous matter classifications for bark level 1 (Table 3). AFIS dust levels were higher for the stripper-harvested treatment (Table 4). In addition, the stripper-harvested treatment had a higher trash count level than the spindle-harvested treatment. Although a field cleaner and two lint cleaners were employed as recommended, the weathering of the cotton could have had an adverse effect on the stripper treatment. Moisture content of the plant at harvest has been cited as a cause of increased bark in stripper-picked cottons (Brashears, 1984).

Waste. The stripper-harvested treatment contained 18.52% waste, which was greater (least significant difference = 2.15; $\alpha = 0.05$) than the 12.23% waste generated by the spindle-harvested treatment. This is not surprising since cotton with a higher trash level is expected to process with a higher level of waste in a spinning mill.

Spinning. Ends-down are a measure of spinning efficiency with lower numbers indicating a higher efficiency. The ends-down per 1000 rotor hours (108.56 for the stripper-harvested cotton and 63.22 for the spindle-harvested cotton) was not statistically different between treatments (minimum significant difference = 60.0; α =0.05). This is surprising since higher short fiber and higher trash levels were determined in the stripper-harvested treatment. High levels of short fiber and trash are known to negatively influence spinning efficiency. Since the stripper-harvested treatment resulted in a significantly lower micronaire, the higher number of fibers per cross-section in the stripper harvested treatment (332) compared with spindle harvested cotton (216) could have overcome the effects of the high short fiber content and trash.

Yarn quality. Regardless of how well the sliver was spun into yarn, the two treatments influenced the quality of the yarn produced. A comprehensive measure of yarn quality was provided in the Monthly Yarn Quality Control and Calibration (MQC) Program of the Institute of Textile Technology. The MQC Program gives a ranking of the quality of a yarn on several properties, including yarn count, tensile properties, appearance, mass evenness, and frequent and infrequent defects. The values of these tested properties were loaded into a database that ranked the quality of the yarn against industry standards. An index value of 100 indicates that the yarn is comparable to the industry average and any value greater than 100 indicates an above average yarn quality and any value below 100 indicates a below average yarn. A discussion of quality results follows.

Both harvesting procedures exhibited a low short term evenness (CVm) and low defect level (thick, thin and neps) (Table 5). The Classimat tests for defects are categorized as minor, major, long thick, and long thin. Previous research indicates that the occurrence of long thin places in yarn directly impacts the appearance of fabric made from that yarn. The Classimat results exhibited a low level of long thin defects in the yarn for both treatments (Table 5).

Generally, for a yarn to be considered useful for textile applications it must have good tensile properties. Tensile properties are measurements of the ability of the yarn to be stretched or drawn before it breaks. Common measurements for tensile properties include strength, elongation, and tenacity. There were no differences in tensile properties between the two treatments, based on the Uster Tensojet (Uster Technologies; Knoxville, TN) tensile test (Table 5).

Yarn hairiness can be both desirable and undesirable, depending on the application for which the yarn is being used. Hairy yarns provide good heat retention and a softer hand (feel) for finished fabrics. The presence of shorter hairs on yarn can also be beneficial in air-jet weaving. The downside to yarn hairiness is that hairs tend to increase the amount of lint generated in processing and can affect processing at warping, slashing, weaving, and knitting by contaminating the process with loose lint. Yarns from the two treatments were tested with a Zweigle Hairiness tester (Reutlingen, Germany), and the results are expressed as number of hairs per 100 meters for each hair length. The stripper-harvested treatment exhibited more hairs in the 1, 2, and 3 millimeter length groups than the spindle-harvested treatment (Table 6). It is possible that the higher amount of short fiber in this treatment, as discussed earlier, could be a cause of the higher amount of shorter hair lengths in the yarn. In fact, there is a strong correlation ($R^2 = 0.977$; $\alpha \leq 0.01$) between short fiber and total hairs at the 1, 2, and 3 mm lengths.

Yarns from the two harvesting treatments were graded based on ASTM method D-1776 (ASTM, 2001), and each treatment was given a numerical and letter grade for its respective yarn appearance. For statistical purposes, only the numerical grade

Table 5. Yarn properties for spindle-harvested and stripper-harvested ultra-narrow row (UNR) cotton

Property	Spindle-harvested	Stripper-harvested	MSD [z]
Short term evenness	13.41	13.73	0.33
Thin	7.50	7.83	6.02
Thick	52.67	70.67	16.45*
Neps	4.33	6.63	3.35
Majors	1.00	0.33	--
Minors	23.22	19.00	11.80
Long Thick	11.50	2.22	--
Long Thin	1.78	1.00	15.12
Tenacity (cN/tex)	12.14	12.02	1.77
Elongation (%)	6.39	6.36	0.98

[z] Treatments marked with an asterisk are significantly difference according to minimum significant difference (MSD) at $P = 0.05$.

Table 6. Zwiegle yarn hairiness results spindle-harvested and stripper-harvested ultra-narrow row (UNR) cotton

Property	Spindle-harvested	Stripper-harvested	MSD [z]
1 mm	10739	14761	3156*
2 mm	1962	2739	697*
3 mm	769	982	172*
4 mm	529	528	242
6 mm	186	139	43*
8 mm	49	27	21*
10 mm	8	3	9.1
Index	722	734	89
S3	1541	1679	231

[z] Treatments marked with an asterisk are significantly difference according to minimum significant difference (MSD) at $P = 0.05$.

was used, and there was no difference in yarn appearance grade between treatments (100 for spindle-harvested and 93 for stripper-harvested cottons). It is important to remember that the yarn appearance grade is subjective.

White specks are likely to occur in fabric if immature fibers are present. A high white speck count would indicate that immature fibers were present in the fabric, therefore making it undesirable for dyed goods. Based on micronaire values alone, a high white speck count should have been expected for these cottons, especially the stripper-harvested treatment. The number of white specks in 2.58 x 10^4 sq mm of fabric was determined from each of the six lots. Neither of the treatments had a high white speck count (0.42 for spindle-harvested and 0.75 for stripper-harvested).

The values for yarn quality ranking by MQC were developed through the use of multiple regression analysis. An index of 125 represents a property or variability better than 84% of all the measured yarns in that particular database. An index of 150 represents values that are better than 98% of a particular database. The MQC rankings for the spindle-harvested and stripper-harvested treatments were 114 and 115, respectively.

CONCLUSIONS

The purpose of this study was to evaluate the impact of harvesting method on the spinning mill performance and quality of rotor-spun yarns made from cotton grown in ultra-narrow rows. Although it is not practical to use a spindle harvester designed to pick cotton from wider row spacings to harvest cottons planted in 19.05 cm rows, if it were possible to design the spindle harvester to pick narrow row cotton it would provide an advantage to the producer in improved quality. It is useful to investigate the need for a better harvesting technology for UNR cotton or a modified planting arrangement for UNR based on the resultant fiber properties and textile performance and quality. Therefore, this study was an attempt to investigate one of those needs to make UNR cotton more attractive to the textile mill consumer.

In comparing the fiber quality, the spindle-picked cotton had better color +b, fiber strength, fiber length, uniformity index, neps, and non-lint content than stripper-harvested cotton. In textile processing, the spindle-harvested cotton resulted in lower processing waste, which benefits yield at the textile mill, and lower yarn hairiness, which reduces lint shedding at the loom and knitting frame. Although the yarn appearance, yarn quality ranking, and fabric white speck counts were not significantly different between the two treatments, there is some benefit from harvesting UNR cotton with some form of spindle-picker. This work provides a foundation for more in-depth research on the possibility of spindle harvesting UNR cotton.

DISCLAIMER

Mention of a trademark, warranty, proprietary product or vendor does not constitute a guarantee by the U. S. Department of Agriculture and does not imply approval or recommendation of the product to the exclusion of others that may be suitable.

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