EVALUATION OF THE PROCESSING EFFICIENCY OF TWO ACALA COTTONS USING BALE LOTS

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Abstract

HVI fiber test data did not predict the spinning performance of these two cottons whereas individual instrument did. Yarn quality from bale lots is consistent irrespective of spinning system (ring or rotor) or preparation (carded or combed). The superiority of El Dorado is evident throughout. Yarn quality is consistent and shows the same level of difference for micro-rotor (75g fiber sample) and micro-ring (50g fiber sample) spun yarns. Micronaire values were 0.5 units higher for El Dorado Acala than for Acala Maxxa.

Introduction

The J. G. Boswell Cottonseed Breeding Team conducts applied acala and pima breeding programs for production of commercial cotton varieties for the San Joaquin Valley in California. Our major objective is yield associated with fiber quality traits required by the textile industry. The Cotton Processing Task Force Meeting was held on April 18-19, 1995 at Charlotte, North Carolina. The notes were summarized by Frank Werber NPS-USDA-ARS. The textile industries reported on some desired improvements such as better fiber length uniformity, reduced short fiber content (waste) and improved HVI strength measurement. We are reporting data on spinning tests which show some of the improvements requested and that this new cotton (El Dorado) will produce value added products to the textile mills and consumers. El Dorado Acala was released by the San Joaquin Valley Acala Cotton Board in 1995 for production in the San Joaquin Valley in California.

Materials and Methods

Fiber of Acala Maxxa, the standard cotton used by the San Joaquin Valley Cotton Board, and El Dorado Acala used in this study were produced on the J. G. Boswell Ranch at Corcoran, California. Five bales of each cotton were shipped to the USDA-ARS, Cotton Quality Research Station, Clemson, South Carolina. The bale lots were blended and subsampled for tests. Fiber samples were tested on individual instruments in the Boswell Cottonseed Breeding Laboratory, on the HVI at the AMS Laboratory, Memphis, Tennessee, and tested on the Mantis for single fiber properties at the Southern Regional Research Center at New Orleans, Louisiana.

Complete ring spinning tests were conducted at the USDA-ARS, Cotton Quality Research Station, Clemson, South Carolina. Rotor spinning tests were conducted by Schlafhorst, Inc. Charlotte, North Carolina. Fiber property HVI tests and micro-rotor spinning tests were conducted by Parkdale Mills, Inc. Fiber Research Center, Belmont, North Carolina.

Results and Discussion

The analysis of variance summary comparing fiber traits of Maxxa and El Dorado are shown in Table 1. Fiber property values obtained from individual instruments in the J. G. Boswell Cottonseed Breeding Laboratory show the fiber to be of equal length. The uniformity ratio, stelometer strength, elongation, and micronaire are significantly greater for El Dorado. Fiber properties obtained from the HVI were provided by the USDA-AMS Cotton Division Laboratory, Memphis, Tennessee. These data show that the length of the two cottons are near the same, El Dorado being slightly shorter (rounding made them equal in length). El Dorado has a significantly higher uniformity ratio and micronaire. It is significantly weaker than Maxxa by HVI and has slightly less trash.

The Mantis single fiber property values obtained from the Southern Regional Research Center shows that El Dorado is significantly stronger and has a higher fiber elongation than Maxxa.

The uniformity of fiber length is shown in Figure 1. Fiber arrays were prepared by Bragg and Simpson (2).

The HVI fiber data was used by Bragg and Simpson (2) and Duessen et. al. (1) to establish the parameters of the ring and rotor spinning tests. Both groups of researchers did not expect El Dorado to perform any better than Maxxa. The analysis of variance summary of ring spinning tests conducted by Bragg and Simpson comparing Maxxa and El Dorado are shown in the following Table 2. Waste is significantly lower for opening, under card, flat strips, and totals for El Dorado as compared to Maxxa in the carded 40's yarn test. The yarn strength (C-S Product) of carded 40's yarn is significantly greater for El Dorado as compared to Maxxa. The tenacity (g/tex), and elongation of the single yarn are significantly higher or better for El Dorado than Maxxa. The yarn strength (CV%) is higher for El Dorado which is not readily explained. The yarn evenness as measured by non-uniformity, thicks, thins, and neps was significantly better for El Dorado as compared to Maxxa. The traits contributed to a significantly improved appearance index. Reduced waste, reduced short fiber content, higher strength, and improved elongation contributed to the significant reduction in ends down per 1000 spindle hours. Spindle hours tested were 10584.

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Waste was significantly lower for opening, under card, flat strips, and total for El Dorado as compared to Maxxa in the combed 50's yarn tests. The yarn strength (C-S Product) tenacity (g/tex), CV%, and elongation of the combed 50's yarn are significantly better for El Dorado than Maxxa. The yarn evenness as measured by non-uniformity (CV%), thicks, thins, and neps is significantly better for El Dorado. These factors contributed to an approved appearance as shown by the appearance index. Reduced waste, reduced short fiber content, higher strength, and improved elongation contributed to the significant reduction in ends down per 1000 spindle hours. Spindle hours tested were 15120.

Bragg and Simpson (2) reported that the fiber property measurements of El Dorado indicated that it was not much different from Maxxa. The length was shorter, strength weaker, and it was a little coarser in micronaire. All of these factors indicated El Dorado would not process as well or make as good a yarn as Maxxa. Quite to the contrary, the processing and yarn tests indicated that it was a superior cotton. El Dorado excelled in reduced processing waste and ends down along with improved processing efficiency and yarn quality.

The results of a rotor-spinning test conducted by Schlafhorst, Inc. (1) researchers are summarized in Table 3. Based on the fiber properties available from individual instruments and HVI, it was experted that El Dorado and Maxxa should spin at the very top end of today's commercially practiced rotor speed range. The knitting yarn, count Ne 36, was spun at a rotor speed of 115,000 rpm. The weaving yarn, count Ne 35, was spun at a rotor speed of 130,000 rpm. The single end tenacity (cN/tex) is higher, approximately 10%, for El Dorado for both the knitting and weaving yarns, the single end strength (grams) is higher, approximately 10%, for El Dorado than Maxxa for both yarns. The CV% single end strength is higher for El Dorado than Maxxa for both yarns. Elongation (%) is higher and CV% of elongation is lower for El Dorado than Maxxa for both yarns. The total ends down per 1000 rotor hours is lower (3.78 times) and (2.08 times) for El Dorado than Maxxa for knitting and weaving yarns, respectively.

Duessen, et al. (1) pointed out that the fiber data from the HVI and individual instruments did not fully explain the good results that they obtained with El Dorado. High micronaire readings, high maturity, and fineness readings around a 150 mtex are an unusual combination. This suggests an unorthodox cell wall structure.

El Dorado and Maxxa were expected to perform well at top end of today's commercially practiced rotor speed range, which is 115,000 and 130,000 rpm for knitting and weaving yarns, respectively. This expectation was fully met by El Dorado but not quite by Maxxa. Maxxa produced unsatisfactory break levels, where as El Dorado is within the accepted total ends down range of 150 - 250 per 1000 rotor hours.

The yarn strength of El Dorado was 10% greater than Maxxa even though the HVI fiber strength was less than Maxxa and only slightly higher when measured by individual instruments. Duessen, et. al. (1) suggested that this could be the result of more fibers in the yarn cross section, if El Dorado had a smaller perimeter, thicker cell wall with a smaller lumen at high maturity. They stated that was the first time that higher yarn strength was obtained without a corresponding increase in fiber strength and with a significantly higher in micronaire 3.8 and 4.5 (Boswell Lab) and 4.1 and 4.6 (HVI AMS) for Maxxa and El Dorado, respectively.

The analysis of variance summary of fiber and micro-rotor spinning tests conducted by Parkdale Mills, comparing Maxxa to El Dorado are summarized in Table 4.

The HVI fiber length and strength data for the two cottons are the same. The uniformity, elongation, and micronaire are significantly higher for El Dorado (4.5) than Maxxa (3.9). The neps and short fiber content measured by AFIS are significantly lower. The trash as measured by the MDTA-3 is significantly less for El Dorado. B-Force as measured by the Tensojet is the same for each cotton; elongation (%) is greater for El Dorado. The fabric strength was 10% greater for El Dorado.

The fiber data from individual instruments and micro-spun 22's yarn strength data are summarized in Table 5. Length is shorter but uniformity, T1/g/tex, elongation, and micronaire are significantly greater for El Dorado. Yarn strength and yarn tenaacity are higher for El Dorado than Maxxa.

The yarn quality data is consistent irrespective of spinning system (ring or rotor) or preparation route (carded or combed). The superiority of El Dorado is evident throughout. The yarn strength is 10% (6% micro ring) or greater by all spinning tests and yarn elongation is significantly greater. Micronaire values were about 0.5 units higher for El Dorado which was of concern to researchers before they spun the cotton. Price (3) pointed out that length and fineness are major parameters influencing performance during spinning. He feels that these are supplemented by uniformity of length and fiber strength. The spinning results strongly suggest that fiber elongation (yarn elongation) reduced trash, short fiber content, seed coat fragments and fiber toughness (E1 x T1) are also major contributors to reduced ends down and yarn imperfections.

Summary

These fiber and spinning tests comparing Maxxa to El Dorado have revealed that HVI tests for fiber strength can

not separate the two cottons. The stelometer test for strength shows El Dorado to have significantly stronger fiber. El Dorado has cleaner fiber (lower trash and seed coat fragments) and lower short fiber content. El Dorado fiber has a 0.4 to 0.5 higher micronaire which suggests a more mature fiber. This does not suggest a coarser fiber because El Dorado produces a 10% (plus) stronger yarn and 10% stronger fabric. El Dorado fiber has a significantly higher elongation and uniformity for fiber length. The traits contributed to improved yarn. This fiber should perform well in wrinkle resistant fabrics.

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References

1. Duesssen, Helmut et. al. personal communication, Schlafhorst, Inc. Charlotte, NC.

2. Bragg, Charles K. And C. L. Simpson, personal communication, USDA-ARS, Cotton Quality Research Station, Clemson, SC.

3. Price, John personal communication, USDA-ARS Southern Regional Center, New Orleans, LA.

Table 1: Analysis of variance summary comparing fiber traits of Maxxa and El Dorado fiber used.

	Maxxa	El Dorado
J. G. Boswell (Individual Instruments)		
2.5% Span Length	1.16	1.16
Uniformity Ratio	50.3	54.7 *
Strength (T1, g/tex)	22.8	23.9 *
Elongation (E1, %)	6.3	7.0 *
Mic (Spinlab)	3.8	4.5 *
USDA - (HVI)		
2.5% Span Length	1.14	1.14
Uniformity Ratio	83	84 *
Strength	32.9	31.5 *
Micronaire	4.1	4.6 *
Trash	2.0	1.3
Mantis Single Fiber Data (SRRC)		
Strength (gm)	5.25	5.75 *
Elongation (%)	14.34	16.59 *

Table 2: Analysis of variance summary of ring spinning tests conducted at Clemson comparing Maxxa to El Dorado.

	Maxxa	El Dorado
CARDED 40's		
Waste		
Opening	1.62	0.80 *
Under Card	1.19	0.56 *
Flat Strips	3.50	2.35 *
Total	4.68	2.91 *
Yarn Strength		
C-S Product	2424	2718 *
Single Yarn Strength		
Tenacity (g/tex)	15.31	16.90 *
CV%	12.35	13.35 *
Elongation	5.40	5.95 *
Yarn Evenness		
Non-Unif (CV%)	23.6	19.9 *
Thicks	4154	2699 *
Thins	7029	4508 *
Neps	2273	1433 *
Appearance Index	60	87 *
Ends Down/1000 spindle Hours	34	3 *
Spindle Hours Tested	10584	10584
COMBED 50's		
Waste		
Opening	1.70	0.52 *
Card	1.29	0.54 *
Strips	3.40	2.44 *
Total	4.72	2.98 *
Yarn Strength		
C-S Product	2451	2797 *
Single Yarn Strength		
Tenacity (g/tex)	15.24	17.03 *
CV%	13.07	10.99 *
Elongation	5.04	5.72 *
Yarn Evenness		
Non-Unif (CV%)	19.5	16.1 *
Thicks	2572	1169 *
Thins	4830	2670 *
Neps	988	508 *
Appearance Index	78	104 *
Ends Down/1000 Spindle Hours	79	16 *
Spindle Hours Tested	15120	15120

Table 3: Summary of a rotor spinning test conducted by Schlafhorst, Inc., comparing Maxxa to El Dorado.

	Knitting Yarn		Weaving Yarn	
Yarn Count	Ne 36		Ne 35	
Rotor Speed (RPM)	115,000		130,000	
	Maxxa	El Dorado	Maxxa	El Dorado
Single End Tenacity (cN/tex)	12.1	13.3	13.5	14.8
Single End Strength (grams)	197.5	218.2	229.6	253.8
CV% Single End Strength	9.7	10.7	9.6	9.8
Elongation (%)	4.4	4.9	4.8	5.2
CV% of Elongation	8.0	7.9	8.3	7.7
Lint Content	99.75	99.7943	99.753	99.7943
Total Ends Down (Per 1000 Rotor Hours)	680	180	520	250

[1] One trash analysis was conducted.

Table 4: Analysis of variance summary of fiber and micro-rotor spinning tests conducted by Parkdale Mills, comparing Maxxa to El Dorado.

	Maxxa	El Dorado	
HVI			
Length	1.14	1.14	
Uniformity	83	85	*
Strength	31.6	31.7	
Elongation	11.2	13.2	*
Micronaire	3.9	4.5	*
AFIS - L+N			
Nep (CNT/g)	293	217	*
SFC(W) (%)	9.58	5.24	*
MDTA - 3			
% Lint	97.611	99.236	*
% Trash	2.389	0.764	*
TENSOJET			
B-Force (g)	492	493	
Elongation (%)	5.87	6.10	*
Fabric Strength (PSI)	114	126	*

Table 5: Analysis of variance summary of fiber and micro-spinning tests conducted at Starlab, Knoxville, Tennessee.

	Maxxa	El Dorado	LSD .05	CV%
2.5% Span Length	1.18	1.16	0.01	0.5
Uniformity	46.8	48.6	0.7	1.7
Stelometer T1 (g/tex)	22.9	23.5	1.6	3.6
Elongation	6.6	6.9	0.2	4.4
Micronaire	3.9	4.2	0.1	3.2
Yarn Strength	144	153	1.0	1.0
Yarn Tenacity	149	158	1.0	1.9

Figure 1. Fiber arrays prepared at Clemson.