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Sharing current research information and trends in the fiber and textile industries.

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Preparations Being Completed as Date of World Cotton Research Conference-4 Nears

WCRC-4
Cotton: Nature's High-Tech Fiber
10-14 September, 2007
www.wcrc4.org

Final preparations are being made to gather cotton researchers for the Fourth World Cotton Research Conference, scheduled 10-14 September, 2007 at the Lubbock Memorial Civic Center in Lubbock, Texas, U.S.A. Hundreds of scientists, students and industry experts have already registered to attend and exchange groundbreaking research in 13 disciplines across the global fiber/textile matrix.

Recently, WCRC-4 organizers announced new plenary sessions Cotton Genomics and Biotechnology, featuring international experts investigating this technological explosion. Will you be there? Learn more and register at http://www.wcrc4.org

New Texas Tech Graduate Class taught by ITC Researcher.

Textile Manufacturing Systems (PSS 5372), a new graduate course offered in the Plant and Soil Science Department of Texas Tech University's College of Agricultural Sciences and Natural Resources will be taught the fall semester by Dr. Mourad Krifa, ITC's Head of Textile Research. Classes will take place on the Texas Tech campus but will also be available to distance education students throughout Texas. The class will focus on fundamental principles and processes for converting fibers into textile structures, with emphasis on cotton systems and on evaluating and optimizing performance criteria in cotton processing.

For more information, consult www.ttu.edu, see the TTU Catalog.

Textile Topics Subscribers Encounter Online "Spoofing."

In January of 2007, internet criminals sent emails to *Textile Topics* subscribers. They did not access the subscriber database, but instead sent the items *as if* from ITC servers.

To date, no word of any virus in the guise of a *Textile Topics* email has been received. Nevertheless, Texas Tech's Office of the Chief Information Officer, IT Division was forced to delete the *Textile Topics* mailbox. As a result, you have received notice of the new, delayed issue of *Textile Topics* via the general ITC mailbox. We regret any inconvenience caused our subscribers. Changes to *Textile Topics* will continue to ensure online safety and ease for subscribers. Contact Mike Stephens at michael.l.stephens@ttu.edu with questions and comments.

Next Session of Texas International Cotton School Looms

The Lubbock Cotton Exchange has annoucned the next session of the Texas International Cotton School will occur August 13-24. More than 400 students, managers and textile professionals from 54 counties have joined top cotton, commodities and textile experts for an intensive two-week session of the Cotton School.

The program comprises hands-on instruction of all phases of cotton production, harvesting, ginning, classing, testing, preparation, processing, marketing and trading--providing their students with an integrated understanding of the U.S. Cotton Industry and how it interacts with the global cotton/textile complex. Visit http://www.texasintlcottonschool.com for full details on the school and the next session.

TEXAS PLAINS COTTON PERFORMANCE IN HIGH VALUE-ADDED RING SPINNING APPLICATIONS: A PROGRESS REPORT

Mourad Krifa and Dean Ethridge

Support for this research is provided by the Texas State Support Committee of Cotton Incorporated, and by the Food and Fibers Research Program of the Texas Department of Agriculture

INTRODUCTION

There is a "revolution" taking place in the cotton varieties grown on the Texas Plains, which is transforming the fiber properties. This is clearly revealed in Figure 1, showing the average values of staple length, strength, and micronaire for cotton classed on the Texas Plains for the 2000 crop versus the 2006 crop. The most remarkable change is in the HVI fiber length, which went from an average of just over 1 inch (32 32nds) to just over 1⅛ inch (36 32nds). The HVI strength increased from an average 27 grams/tex to over 29 grams/tex, while the HVI micronaire went from an average of 3.9 to an average of 3.8. In 2006 Upland cottons grown in the Texas Plains had the longest average HVI fiber length of any U.S. production region except the Acala Upland cottons grown in California.

It would appear that cottons in the Texas Plains have the potential to serve high-value yarn markets that it historically has not been able to do. In order to clarify the issue, this paper presents results from ongoing research supported by the Texas Department of Agriculture, Food and Fibers Research Program, and by the Texas State Support Committee of Cotton Incorporated. The objective is to evaluate processing performance and yarn quality using the better fibers now produced on the Texas Plains to make fine-count, ring-spun yarns.

While it is true that key fiber parameters for cottons on the Texas Plains have improved markedly during the past several years, a more accurate and useful statement of reality is that there is an ongoing process of improvement in fiber quality. The foundation of the improvement may be genetics and biotechnology, but the total process involves changes in seed selection, agronomic management practices, crop termination, harvest and ginning practices, etc. It is important that this transition to higher quality be successfully pursued and that the benefits accrue to both cotton producers and textile manufacturers.

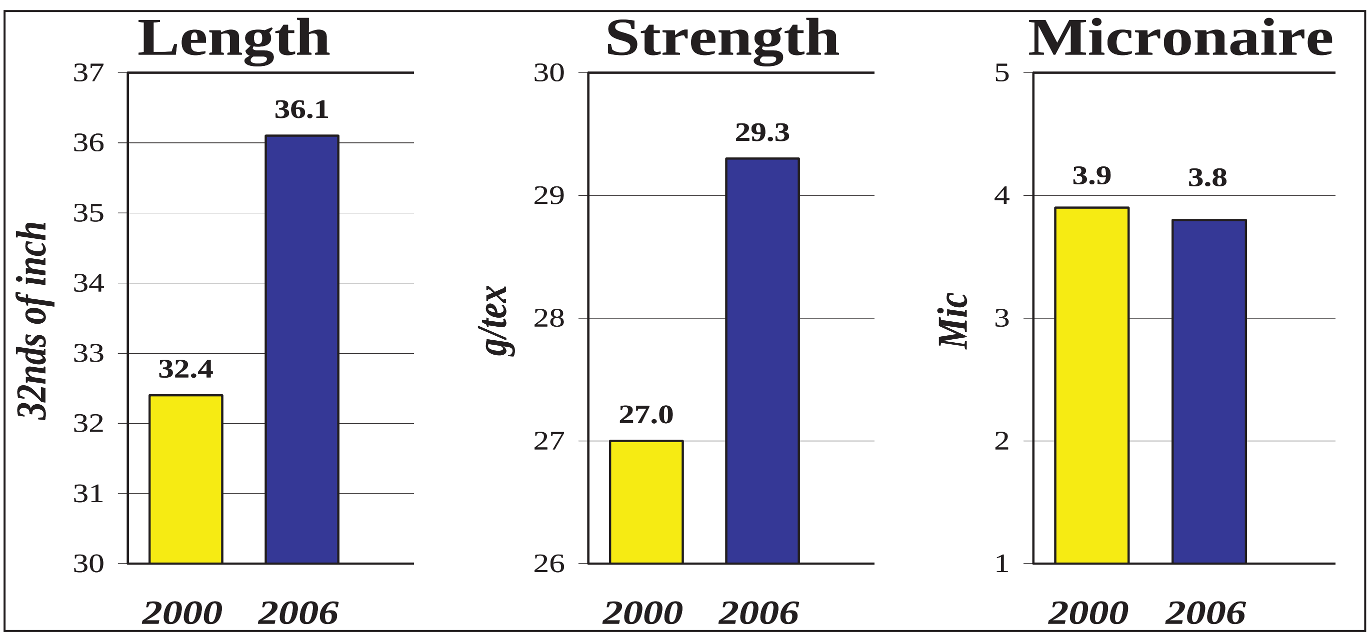

Figure 1 - Average Values of Fiber Properties on the Texas plains, 2000 versus 2006

THE 'PACKAGE' CONCEPT OF FIBER QUALITY

A useful guide for identifying a 'high quality' cotton fiber is the fact that a 'package' of fiber properties is required; i.e., a single fiber property cannot be interpreted without reference to other necessary properties. Of course this has always been the case; the traditional description of a high quality fiber 'package' is "long, strong, and fine," at least when the use is to spin high quality yarns that result in high-value textile products. Thus the Extra Long Staple (ELS) cotton fibers – such as the American Pima and the Egyptian Giza – are the longest, strongest, and finest cottons produced in the world. To this explanation it must be added that a tacit assumption is made that the cotton fibers are mature; i.e., the cellulose deposition within the fibers has reached an advanced state of completeness.

Unfortunately, the words "fine" and "fineness" often cause confusion. Fineness has traditionally been defined in terms of the weight per unit length of a fiber and generally expressed in millitex (the weight in milligrams of one kilometer of such fiber). Such a definition is adequate only when a constant state of fiber maturity is assumed. This is because cotton fibers exhibit a genetically determined circumference (length of the fiber perimeter), which is quite variable across the cotton varieties in commercial use and in nature. Thus, a cotton fiber that has a very small circumference (e.g., Pima) will not hold as much cellulose per unit length as a fiber with a large circumference (as do some of the Upland cotton varieties). Therefore, if both fibers are mature, the weight per unit length will be much greater for the large-circumference fiber than it is for the small-circumference fiber.

The only way for the weight per unit length to be similar between a Pima cotton variety and an Upland cotton variety is for the Pima fibers to be mature and the Upland fibers to be immature. Given that the density of the cellulose in cotton fibers varies much less than does the circumference, it is much more useful to evaluate the "fineness" of cotton fibers in terms of circumference, rather than weight per unit length.

The confusion caused by the fineness-maturity complex is clearly illustrated by the use of micronaire values for cotton fibers. The micronaire is a rough indicator of the average weight per unit length of the fibers being tested; it describes both the maturity and the fineness of the cotton. Therefore, unless the genetic circumference of different fibers being tested is known, confusion about fineness versus maturity of the fibers is unavoidable. A cotton sample that is "fine" and mature can have a micronaire value equal to one that is "coarse" but immature – yet, the implications for use-value in textile applications are very different.

Thus, micronaire is a critical fiber property that must be included in this 'package' concept of fiber quality, with the precautions warranted by the complexity of the fineness-maturity interactions. Despite the apparent stability of the Texas Plains crop micronaire between 2000 and 2006 (averaging 3.9 and 3.8, respectively); important changes have occurred over the last seven seasons. As the average staple length and strength increased, so did the ranges and dispersions of other fiber properties, both within and between growing seasons. In particular, the range of micronaire values produced in 2006 on the Texas Plains goes from 2 to 6, with about 32% of the bales having a 3.5 micronaire or lower. The rest of the U.S. crop had only about 1.3% of the total bales in this "low micronaire" range. The danger is that such large variations in fiber properties could hinder the high-quality potential which Texas producers now aspire to achieve. For instance, observation of staple length distribution in conjunction with that of micronaire shows that only 20% of the bales classed as staples 34 and shorter had micronaire lower than 3.5, while 41% of the bales classed 37 and longer had such micronaire. Such lower micronaire values may offset the quality gains warranted by the improved staple. Thus, for the quality improvement potential to be fully realized, the improving crop has to offer optimum interactions among fiber traits, i.e., a balanced "package" of all fiber properties.

IDENTIFYING THE "BETTER" UPLAND COTTONS FROM THE TEXAS PLAINS

The standard for quality Upland cotton fibers in the United States is the Acala varieties grown in the San Joaquin Valley (SJV) of California. Not only are these the longest, strongest, and finest Upland cotton fibers; they are also the most homogeneous in terms of these properties. The desert growing conditions allow more accurate water management and ensure more reliable heat-unit accumulations. The relatively homogeneous climate allows relatively homogeneous varieties, to which has been added a quasi-regulatory program to suppress planting of diverse varieties that lower fiber quality. The result has been very tight distributions in the important fiber properties around the optimum values.

Unlike the SJV, the cotton growing region of the Texas Plains is very large, with significant geographic and climate variations. Inevitably, the distributions of cotton fiber properties are much greater than in the SJV, both within and between growing seasons. In any given year, a much smaller percentage of the Texas Plains cotton crop will be of "high quality" than it will be in the SJV. But the production of Upland cotton on the Texas Plains is on the order of 7 times larger than it is in the SJV. Therefore, the absolute quantity of 'high quality' cotton in the Texas Plains may be much larger than it is in the SJV. The challenge, of course, is to identify and assemble this cotton for marketing.

Meeting this challenge is made much more feasible by the availability of 100% HVI classification by the U.S. Department of Agriculture, as well as by the fact that all of this cotton is classed in two USDA classing offices: Lubbock and Lamesa, Texas.

Using the EFS© USCROP database of cotton classification results (Cotton Incorporated, Version 3.8.0), we may sort the crop by any fiber property included in the HVI results. Since the interest is in the "package" of fiber properties that identifies the "better" cottons, we will use an illustrative package based on four quality parameters:

1. Fiber length (L) of 36 and longer,
2. Fiber length uniformity index (LUI) of 81% and higher,
3. Fiber bundle strength (S) of 29 g/tex and greater, and
4. Fiber micronaire (M) of 3.7 to 42.

The length uniformity index is included to eliminate many of the cottons with a degraded length distribution (i.e., elevated short fiber content), due to fiber breakage at any point prior to bale packaging. The micronaire range chosen corresponds to the 'premium' micronaire range as specified in the USDA's loan premium and discount schedule.

When we sort the USDA classing data for the 2006 crop of Upland cotton, we get the following results:

Fiber Property	Texas Plains	SJV
$L \geq 36$	*3,125,954 bales*	*646,663 bales*
$LUI \geq 81\%$	*2,383,080 bales*	*635,681 bales*
$S \geq 29$ g/tex	*2,798,465 bales*	*659,125 bales*
$3.7 \leq M \leq 4.2$	*1,428,375 bales*	*286,811 bales*
ALL OF THE ABOVE	*486,006 bales*	*257,508 bales*

Therefore, the 2006 crop in the Texas Plains contained 486,006 bales that satisfied the combination of length, length uniformity, strength, and micronaire stipulated for "high quality" fibers. While this volume represents only about 10% of the total crop in the Texas Plains, it is still about 2 times larger than the Acala volume from the SJV. This represents a potential opportunity to the cotton production sector in the Texas Plains and a significant benefit to the global textile manufacturing sector. The challenge is twofold:

1. Continue increasing the better quality of fibers available from the Texas Plains through the progressive adoption of appropriate cotton varieties,improved production management practices, and implementation of termination, harvest and ginning practices that preserve the superior fiber properties.
2. Develop marketing structures and techniques that enable selling of the high quality fibers to the textile manufacturing customers that value these fibers.

EXPERIMENTAL ASSESSMENT OF TEXAS PLAINS COTTON PERFORMANCE IN RING SPINNING

The major objective of this research is to evaluate the competitive value of new cotton varieties grown in the Texas Plains (with comparison to high-quality market benchmarks) and to determine the factors limiting the access of this fiber to high-value-added applications.

Thus, the focus of our research is on cottons with a potential to claim a share in the high-value-added market (the upper quality percentiles of Texas crop). Accordingly, the comparisons we conduct between cottons from different growth areas cannot be generalized to all the regional production, but are representative only of the cottons we select for the trials. The question this research attempts to answer is whether cottons having similar HVI properties but grown in different regions would offer the spinner similar performance levels. In other words, if a spinner purchases cotton bales from Texas based on HVI properties typically suitable for his high-value added operation, how likely is he to get the performance levels offered by established market benchmarks? Furthermore, in instances where the performance levels are different in spite of the similarities in HVI fiber properties, what indicators could be used to ensure the spinner is not negatively surprised by cottons from Texas? What criteria could we use to confidently identify a pool of Texas cottons that will satisfy the high-value-added application requirements?

Obviously, addressing these questions represents a long-term endeavor that requires analysis over multiple crop seasons; it may even necessitate perennial efforts in order to respond to changes in both the crop and the international market requirements. Results presented here are for the first two years of the research (2005 and 2006).

Material and Methods

Twenty commercial cotton bales were selected from the 2004-05 and 2005-06 crops (10 bales each season) of the Texas Plains, and the San Joaquin Valley. Staple length constituted the main selection criterion with five medium to medium-long staples, i.e., 35, 36, 37, 38, and longer than 38 (all in 1/32"). Other fiber properties were held in a range as narrow as possible to avoid interactions among multiple fiber attributes. Specifications concerning these fiber property ranges included: Micronaire: 4.1 – 4.3; Strength: 29 – 31 g/tex; Uniformity: 82-83 %; Color grade: 42 or better; Leaf grade: 4 or better.

Upon receiving all the cottons, the bales were opened on 10 layers and fiber samples were collected from each layer and tested on HVI with 4 replications for micronaire, 4 for color and 10 for length and strength. All cottons were then spun simultaneously on a 240-spindle Suessen Fiomax 1000 ring spinning frame into 40 Ne, 3.8 TM yarn. The spinning process (see outline in Figure 2) was monitored for ends-down.

Given the low frequency of the occurrence of yarn ends-down when spinning under normal conditions, it is necessary to run long tests in order to obtain an accurate assessment of the cotton spinning performance. The ASTM standard method D2811-77 (ASTM, 1991) describes four different options for running the test, with the number of spindle*hours ranging from 84 (small laboratory scale) to 25,000 (mill scale). The laboratory scale procedure (84 spindle*hours) is presented as a rough screening method. Early efforts to investigate the accuracy of spinning performance assessment were reported in the literature by Ruby and Parsons (Ruby and Parsons, 1949) who suggested a minimum number of 5,000 spindle*hours to achieve acceptable accuracy under controlled testing conditions.

For the purpose of our study, we selected the test procedure recommending 5,000 spindle*hours (pilot mill scale). In order to allow simultaneous spinning of all the bales, 10 lots of 15 roving bobbins were constituted from each bale (one lot per layer) and each lot was used to complete

35 spinning hours. Spinning positions were assigned randomly to each lot in order to eliminate possible errors due to variations among spindles. In total, each bale was spun on 15 spindles for 350 hours to complete 5,250 spindle*hours. After completion of all spinning trials, yarn end-breakage data was compiled for all the tests. Yarn samples were tested for evenness, hairiness and tensile properties.

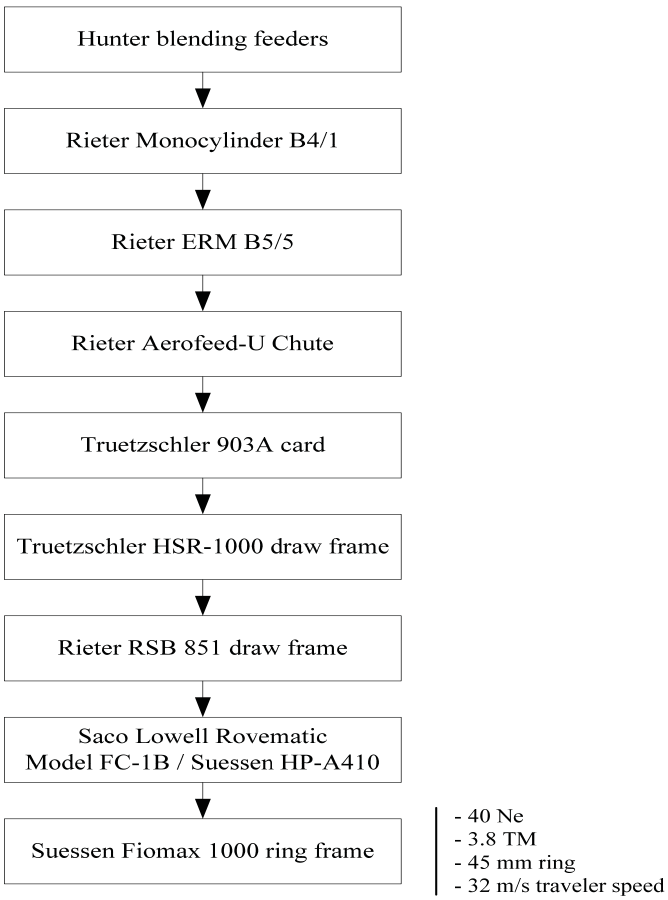

Fig. 2 - Spinning Procedure

Results and Discussion

Although all the bales were selected based on the same specifications (in order to constitute similar quality ranges from the two growth areas), differences in HVI properties were observed on the results obtained using the high-accuracy testing procedure at the ITC (10-layer samples with 4 replications for micronaire, 4 for color, and 10 for length and strength). This deviation from the bale specifications is expected and due to sampling errors and testing condition variability. However, the differences observed were within acceptable ranges. Furthermore, this deviation was taken into account in the analyses conducted in this study and in the conclusions drawn based on the results. Thus, spinning performance criteria and yarn quality variables were examined through analysis of covariance, with HVI fiber properties as continuous predictors and the growth region as categorical predictor.

Results shown here are for the first two years of the research and are thus presented as a progress report rather than final conclusions. We examine the performance of the tested cottons considering measures that encompass two fundamental aspects:

(1) processing performance as characterized by the number of yarn end-breakages observed during spinning; and,
(2) quality of the yarn produced as characterized by evenness, hairiness and mechanical strength parameters.

As indicated earlier, all results were scrutinized using analysis of covariance (ANCOVA), in order to include both categorical factors (growth region: TX Plains VS. SJV) and continuous predictors or covariates (fiber properties) that affect yarn ends-down and quality parameters.

Spinning performance: Yarn ends-down

A summary of the ANCOVA results for yarn ends-down can be seen on Figure 3, which shows average numbers of ends-down per growth region with the confidence intervals corresponding to the region effect. The results in Figure 3 show that in average, the cottons selected from SJV tend to have lower frequencies of ends-down occurrence.

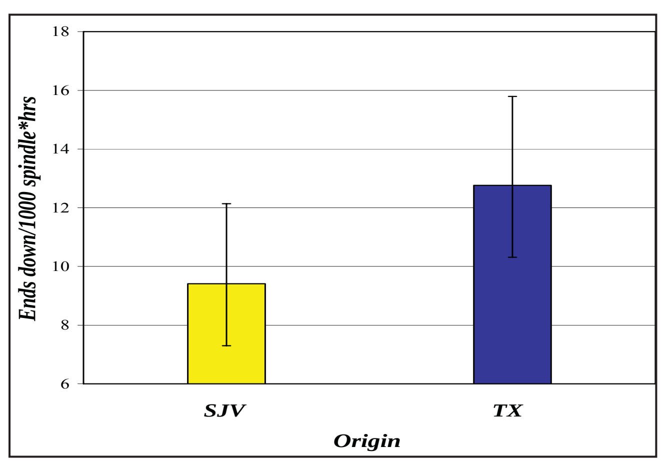

Fig. 3 - Ends-down occurrence, analysis of covariance results (vertical bars denote 0.95 confidence intervals).

However, despite this apparent trend, average ends-down levels differ very little from a growth origin to another and show overlapping confidence intervals. The overall origin effect was found non-significant based on the ANCOVA analysis of the current data (the bale origin effect was associated with $p > .05$).

Among the fiber properties introduced in the analysis as continuous predictors (covariates), staple length was the only one significantly affecting yarn ends-down during spinning. We further examine this effect in the following discussion. Figure 4 depicts the relationship between ends-down levels and staple length for both Texas Plains (TX) and SJV bales.

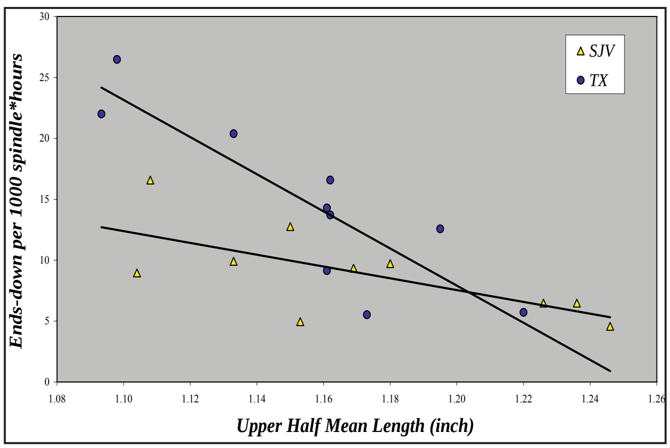

Fig. 4 - Relationship between ends-down occurence and fiber length for Texas Plains and SJV bales

Although the data points show a substantial degree of dispersion, there is a clear negative trend relating ends-down to staple length (lower ends-down for longer cottons, as expected). Moreover, the pattern of the scatter plots of Figure 4 suggests that when considering the shorter staples, cottons from Texas Plains tended to yield slightly higher numbers of ends-down than their SJV counterparts (for the same staple length). However, for the longer staple levels, the two scatter plots appear to converge and the number of ends-down appears similar for both regions.

Yarn quality

In addition to the spinning performance aspects discussed above, we have collected yarn quality data (evenness, hairiness, and tensile properties). Yarn results were analyzed using ANCOVA as previously mentioned. Continuous predictors were selected based on the relevant fiber properties that are significantly related to the yarn property being examined. In what follows, results are presented and discussed in an analogous way as for ends-down data. Figure 5 depicts results obtained for yarn strength, elongation, unevenness (mass CV%), thin places, neps and hairiness. Differences in mean values of each of these yarn parameters are apparent on the figure. However, the confidence intervals appear to overlap and based on the ANCOVA analysis of the 2-years data, the bale origin was not found to significantly affect any of the yarn properties considered ($p > 0.05$ for all properties).

Based on the data collected thus far (and with the limitations relative to the number of bales tested), both ends-down counts and yarn quality measures show similar results for cottons from Texas Plains and SJV having similar HVI properties. Overall, none of the spinning performance or yarn quality parameters we tested revealed any statistically significant differences that could be attributed to the growth region (TX versus SJV).

SUMMARY - CONCLUSIONS

Analysis of the Texas Plains commercial cotton quality trends, based on classing office data, shows significant improvements over the past 7 years. Spinning tests conducted in 2005 and 2006 on commercial bales from the emerging Texas Plains "high-quality" fiber indicate that cottons from the Texas Plains compare favorably to SJV cottons of similar HVI properties. Plains cottons showed slightly higher numbers of ends-down than SJV cottons, but the difference was not statistically significant. Furthermore, patterns obtained in both 2006 and 2005 trials suggest that the higher numbers of ends-down are observed primarily for the shortest staples among the tested bales. Bales with staples 37 and longer did not appear to show differences in the number of ends-down between the Texas Plains and SJV. Finally, yarns spun from the selected Plains bales had quality levels (evenness, imperfections, hairiness, strength) that were generally similar to those of SJV bales.

In summary, it appears that quality ring-spun yarn can be spun from selected Texas Plains

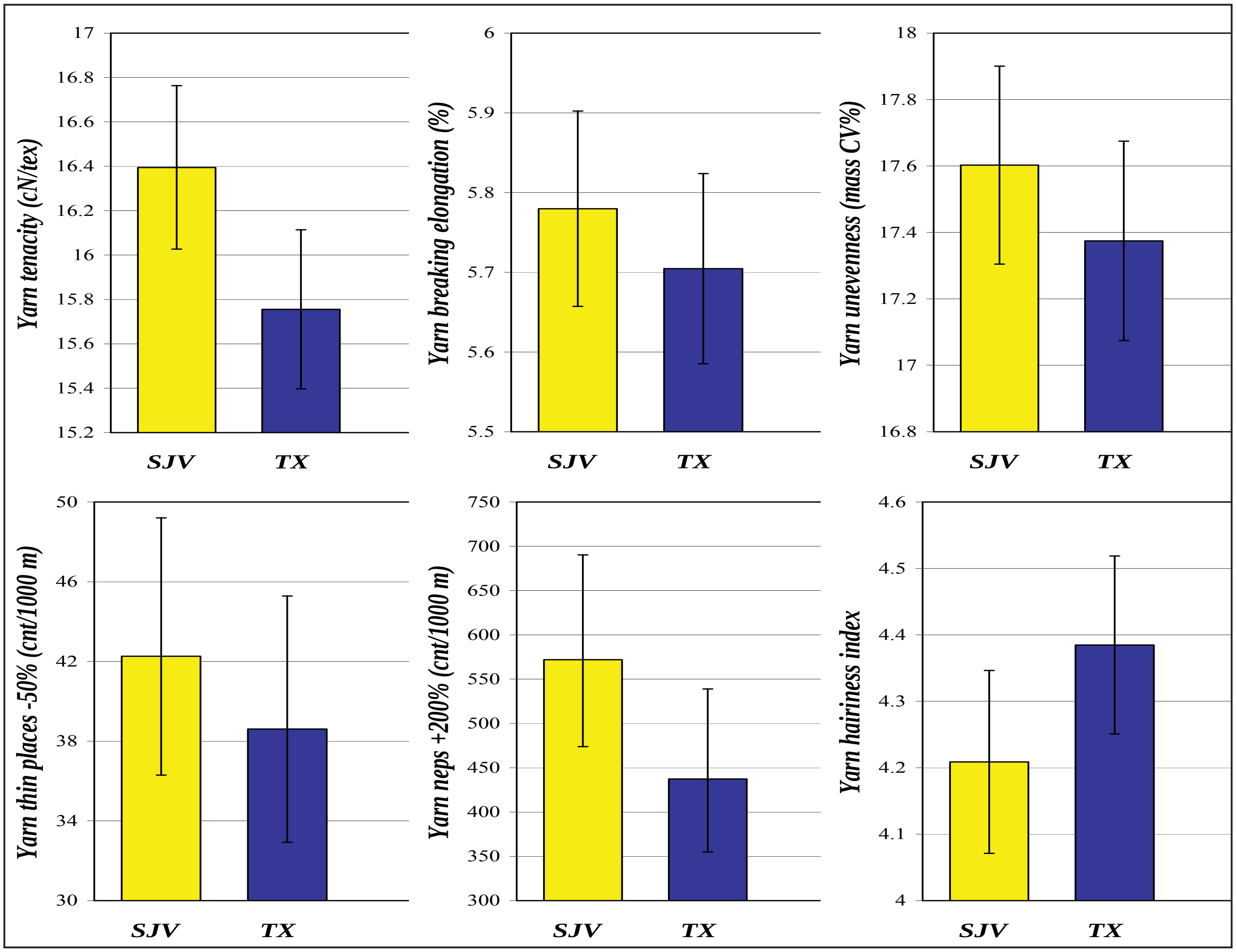

Fig. 5 - Yarn quality of the bales selected from the three growth ares (tenacity, evenness, neps and hairiness).

cottons with processing performance levels that are comparable to some high-value market benchmarks, such as SJV cottons. Results obtained so far are encouraging but further confirmation is needed. The process of genetic improvement and adoption of the improved varieties is ongoing and will affect the portion of the crop meeting the high-value added requirements. It is important that the world market be made aware of the real industrial potential of this developing portion of the Texas cotton crop.

Fiber quality issues not captured by HVI measurements should get increased focus in future research. Examples include issues related to distributions of individual fiber properties (length in particular), neps, and cleanability of such particles as bark, seed coat fragments and abrasive dust. All these issues are part of the comprehensive research program being conducted at the International Textile Center in order to adequately assess and demonstrate the competitive value of Texas cotton.

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