TEXTILE TOPICS

INTERNATIONAL TEXTILE CENTER • TEXAS TECH UNIVERSITY
LUBBOCK, TEXAS USA

SPRING 1999

FIBER AND TEXTILE DEGREE PROGRAM OFFERS FIRST CLASSES

The fall 1999 semester will mark the official beginning of a new masters degree program in fibers and textiles at Texas Tech University. Core courses being prepared for the first year include Properties and Applications of Textile Fibers, Textile Manufacturing and Management, and Advanced Studies in Cotton Fibers. Also, for the first time Texas International Cotton School may be offered for graduate credit to participants in the degree program (see below). For more information about the program, contact Dr. Dean Ethridge, ITC Director at d.ethridge@ttu.edu or phone 806-747-3790.

TEXAS INTERNATIONAL COTTON SCHOOL SCHEDULED

During May 17-28, the 18th session of the Texas International Cotton School will be conducted. This two-week period of intensive instruction and interaction provides a thorough overview of the cotton industry from field to fabric. Done in conjunction with the Lubbock Cotton Exchange and utilizing expertise from all over the U.S., the School carefully exploits the complete infrastructure of the cotton industry that is located in and around Lubbock, Texas. For information, contact Ms. Mandy Howell at the Lubbock Cotton Exchange (tel: 806-763-4646—fax: 806-763-8647—e-mail: lcecotton@aol.com)

FIBER PROPERTIES SEMINAR SCHEDULED

A two-day Cotton Fiber Properties Seminar will be offered in the fall for cotton breeders, textile mill cotton buyers, merchants, researchers, and anyone who deals with cotton fiber properties. The two-day event covers basic instruction on the fiber properties, the measurement instruments used, evaluation of data, and the impact of fiber properties on textile processing. The cost is $250, which includes a large reference manual and lunches.

GRADUATE STUDENT ARRIVES FROM FRANCE

Graduate student Antoine Vuillemard, from ENSITM-Haute Alsace University in Mulhouse, France, arrived in May. He will be at the ITC for four months working under the direction of Eric Hequet, Assistant Director at the ITC. His research will focus on issues related to spinning sticky cotton and will help fulfill requirements for the Engineering Degree from ENSITM.

AN EVALUATION OF THE AFIS® SHORT FIBER CONTENT MEASUREMENT

M. Dean Ethridge, Ph.D., Director
Eric Hequet, Assistant Director

The authors thank Dr. Dick Bassett, University of California Agricultural Research and Extension Center at Shafter, who managed the field trials of cotton provided in this study.

Introduction

The International Textile Center has increasingly exploited the Uster AFIS® (Advanced Fiber Information System) to increase the range and precision of fiber property measurements. The applications are useful not only in the context of commercial textile manufacturing operations; they are proving to be quite valuable to the process of selecting superior cotton varieties. The ability of the AFIS® to operate on very small samples (2.5 g for 5 replications) is especially advantageous for testing cotton breeders' fiber samples.

Of great current interest is the short fiber content (SFC) of cotton and its impact on spinning performance and on yarn and fabric quality. The only instrument technology that currently offers an adequate combination of measurement speed and accuracy is the electro-optical technology embodied in the Uster AFIS®. The purpose of this article is to report the measurements of SFC (by weight) obtained with the AFIS® and to evaluate the usefulness of these measurements.

Results are taken from a fiber analysis of Upland cotton variety trials in California. These trials have been done for many years with regulatory oversight by the San Joaquin Valley Cotton Board and the California Department of Food and Agriculture. The base of operations is at the University of California Agricultural Research and Extension Center at Shafter.

The 1998-99 crop year provided a good opportunity to examine the AFIS® measurement of SFC, because for the first time an expanded group of Upland cotton varieties was included in the variety trials. In prior years only the Acala-type varieties were grown; therefore, a very limited range of fiber property values was exhibited. The inclusion of several non-Acala Upland cotton varieties offered enough genetic variability to get substantial differences in SFC measurements.

Procedures

A total of 27 cotton varieties were included, with the Maxxa variety being represented twice because it was used as a control. Six of the varieties were non-Acala Upland cottons. Each variety was grown at 3 different locations with samples taken from 2 replications at each location. Therefore, a total of 162 observations (27x3x2) were provided by the experimental design.

A summary of the 27 cotton varieties tested is given in Exhibit 1, with the last six entries being non-Acala varieties. The identification numbers 1 through 27 will be used throughout the remainder of this paper.

A brief statistical summary of fiber properties is given in Exhibit 2, showing the mean, minimum and maximum values for each characteristic. An examination of this data reveals that all of the cottons exhibit relatively good fiber properties, as they must if they are to compete for land in the San Joaquin Valley growing region. The range of SFC shown is on the lower end of the range for a large representative group of Upland cottons; the average SFC (5.1%) is quite good. Measurements on the SFC, as well as other measurements given by the AFIS® multidata, were replicated five times and the average of these is used for analysis. In each replication, 3,000 fibers were measured; therefore, a total of 15,000 fibers were measured for each sample. This is the preferred procedure at the International Textile Center whenever precision in the AFIS® estimates is important.

Exhibit 1. Cotton Varieties Included in Study

ID No.	Variety	Company
1	Maxxa	California Planting Cotton Seed Distributors
2	Br 9707	Buttonwillow Research
3	C-175	California Planting Cotton Seed Distributors
4	C-176	California Planting Cotton Seed Distributors
5	C-181	California Planting Cotton Seed Distributors
6	DP 6100R	Deltapine
7	GC-9642	Germains Cottonseed
8	GC-9643	Germains Cottonseed
9	GC-9645	Germains Cottonseed
10	GC-9646	Germains Cottonseed
11	Fibermax 989	AgrEvo
12	OA-247	Olvey & Associates
13	OA-250	Olvey & Associates
14	PHY 60	Phytogen
15	PHY 61	Phytogen
16	PHY 64	Phytogen
17	PHY 65	Phytogen
18	PHY 72	Phytogen
19	Maxxa	California Planting Cotton Seed Distributors
20	GTO Maxxa	California Planting Cotton Seed Distributors
21	PHY 33	Phytogen
22	BR 9801	Buttonwillow Research
23	BXN 47	Stoneville Cottonseed
24	GC120	Germains Cottonseed
25	IF 1000	AgrEvo
26	NuCotn 33B	Deltapine
27	PSC-569	Phytogen

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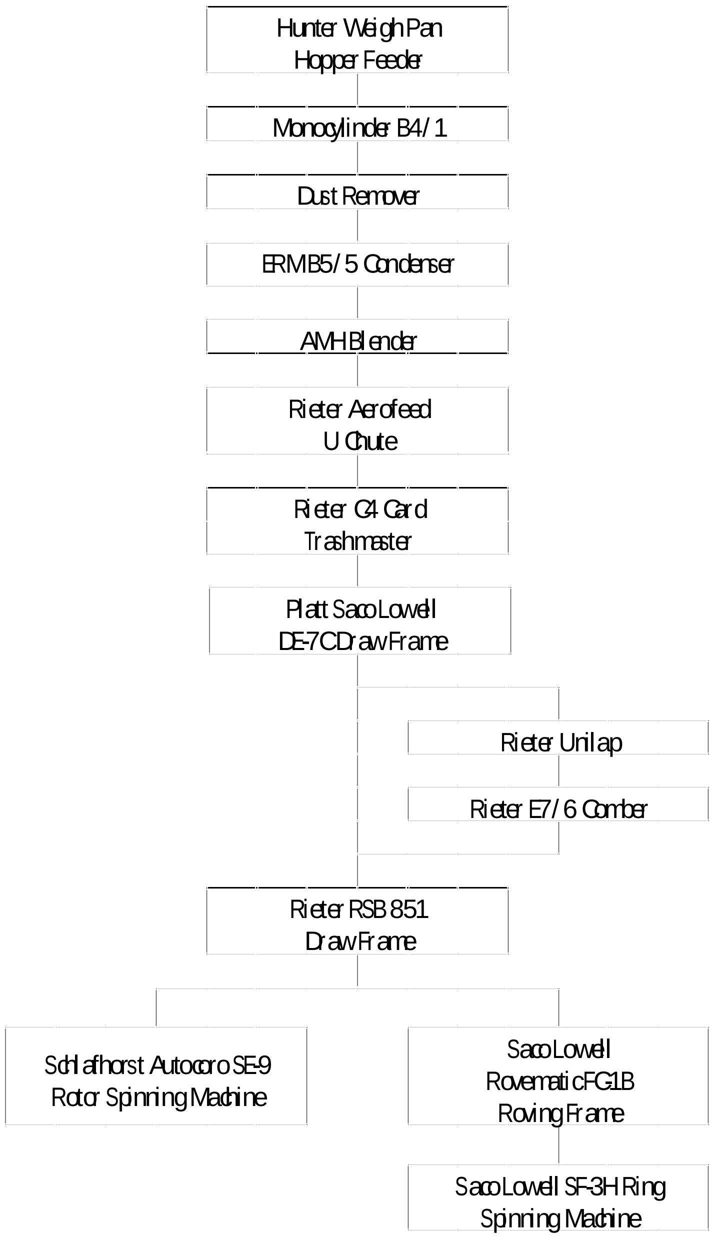
Exhibit 2. Raw Fiber Data for 162 Cotton Samples*

Instrument & Measurement	Units	Mean	Minimum	Maximum
Zellweger Uster HVI 900A				
Micronaire		4.3	3.3	5.1
Leaf Grade		3.3	1.0	5.0
Reflectance	%	75.0	69.0	77.7
Yellowness		7.8	6.8	8.9
Upper Half Mean Length	in	1.18	1.09	1.29
Uniformity	%	83.5	80.8	85.2
Strength	g/tex	34.2	28.7	37.5
Elongation	%	5.9	5.3	6.9
AFIS Multidata				
Mean length (w)	in	1.07	.97	1.16
Short Fiber Content (w)	%	5.1	3.2	8.7
Upper Quartile Length (w)	in	1.27	1.17	1.38
Maturity Ratio		0.95	0.85	1.01
Immature Fiber Content	%	5.8	3.9	9.1
Fineness	mtex	172	157	194
Nep	cnt/g	219	98	436
Seed Coat Nep	cnt/g	32	13	58
Dust	cnt/g	641	286	1218
Trash	cnt/g	144	53	268
Shirley Analyzer				
Trash Content	%	3.20	1.50	5.01

*(27 Varieties) x (3 Locations) x (2 Replications)

The cotton fibers from each variety were processed through the Short Staple Spinning Laboratory at the Inaternational Textile Center and were made into both ring-spun and rotor-spun yarns of different sizes. Exhibit 3 provides an outline of the mechanical process for all the cottons.

Exhibit 3: Outline of Mechanical Process



Roll Speed = 750 rpm

R20/10 Beater Speed = 850 rpm

Production Rate = 75 lb/hr
Sliver Weight = 60 gr/yd

Delivery Speed = 570 ft/min
Sliver Weight = 55 gr/yd

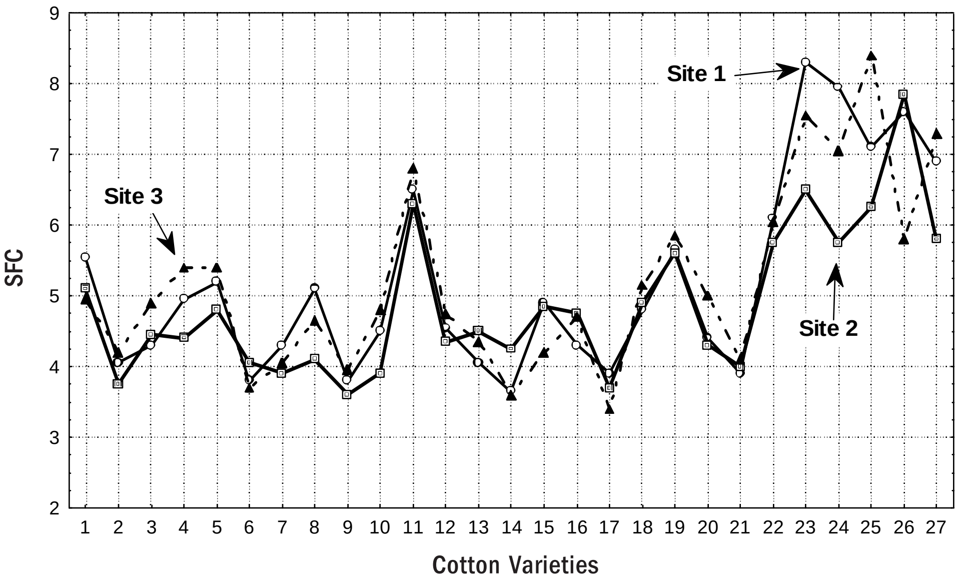
Delivery Speed
Combed = 990 ft/min
Carded = 1320 ft/min
Sliver Weight = 55 gr/yd

Spindle Speed = 1425 rpm
Roving = 1.8 hank

Results

It is noteworthy that the SFC values for each cotton variety were repetitive across the three test sites used for them (Exhibit 4). The Acala-type

Exhibit 4. SFC Values at Three Test Sites

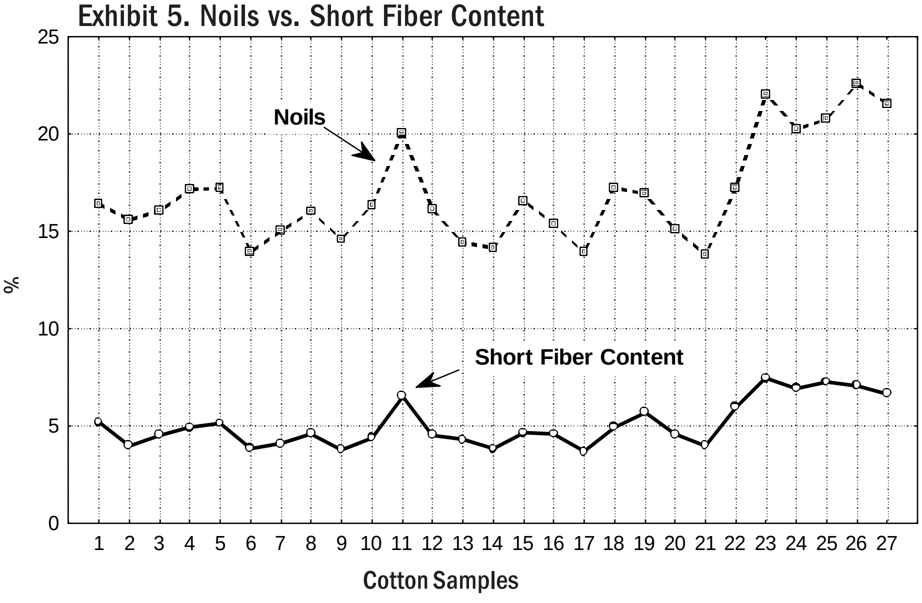


varieties were remarkably stable across test sites (see cotton varieties 1 through 21 in Exhibit 4). Given that all the cottons were harvested in the same manner and all were ginned on the same system at the Shafter Research Center, the conclusion is that the differences in SFC for the varieties are genuine and that the differences are primarily genetic in nature. While the other Upland varieties (varieties 22 through 27) were not as consistent across test sites, they generally moved in the same direction across test sites. Therefore, the correlation between SFC and variety is still quite good for the other Upland varieties, which again reveals a strong genetic component to SFC.

The genetic component of SFC needs to be emphasized because of a widespread assumption that the SFC can be controlled by appropriately managing the ginning process. In this study, all ginning was done with careful monitoring at the Shafter Research Center. It is likely that some "noise" was introduced in the data for the other Upland varieties, both because of the "plasticity" characteristics exhibited by cotton varieties that have not adapted to a growing area and the fact that agronomic management practices most appropriate for the Acala varieties may cause location-related variations in the non-Acala varieties. This is why the SFC data on the other Uplands is still quite convincing about genetic causes for SFC. Furthermore, the repeatability of measurements across test sites encourages confidence in the AFIS® measurements.

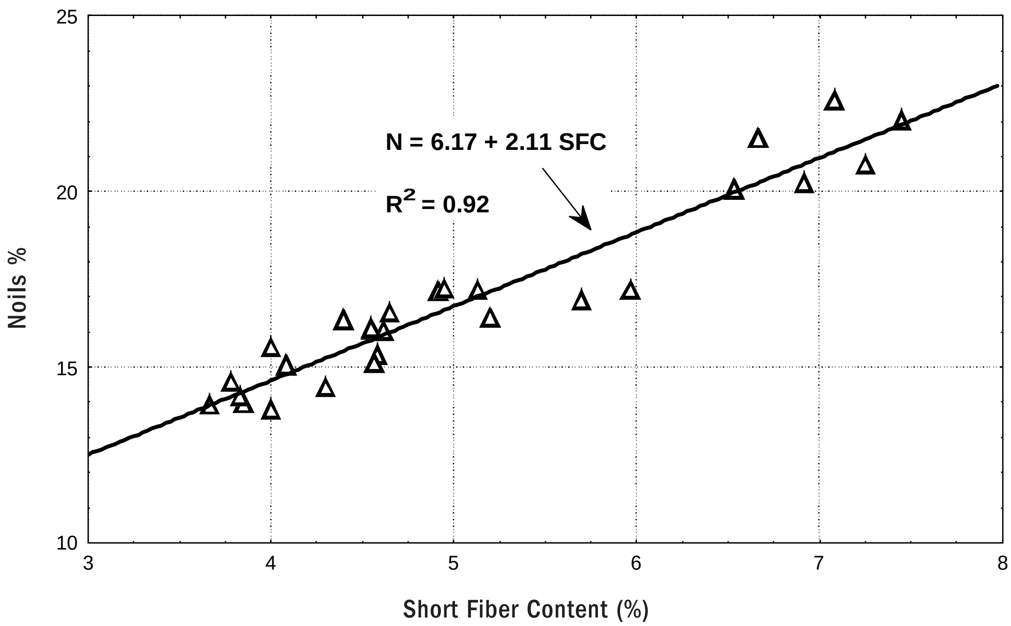
Perhaps the best indicator of the usefulness of any SFC measurement is a comparison of the measurement with the amount of noils (waste) generated at a combing machine which is carefully monitored to keep machine settings and other conditions constant. Under carefully controlled combing treatments, the higher the SFC, the larger the amount of fiber removed by combing. Exhibit 5 charts the movements of

Exhibit 5. Noils vs. Short Fiber Content



both SFC and noils for each of the varieties. It is easy for the eye to see that the movements between the two curves track together very well. Clearly the noils line is several percentage points above the SFC line. Also, the movements in the noils line appears to be magnified relative to the movements in the SFC line. But the correspondence between the two lines certainly appears to be strong.

Exhibit 6. Regression of Noils (N) on Short FIber Content (SFC)



By definition, the level of noils must be above the level of SFC, because the criterion for determining "short fibers" is that they be ½ inch or less in length. While the combing machine will remove a high percentage of these "short fibers," it will inevitably remove many fibers that are longer than ½ inch. Just how many more fibers are removed will depend on the settings and operation of the combing machine. It is only the careful control of the combing machine within the International Textile Center laboratory that enables confidence about the consistency of noil removal by this machine.

The foregoing observations are corroborated by executing a statistical regression of noils on SFC (Exhibit 6). The fit of the regression equation is quite good, with $R^2 = 0.92$. The constant term is 6.17, meaning that, on average, the noils level would be at just over 6 percentage points even if the SFC level were near zero. (Of course the SFC is never near zero; even for these relatively long staple cotton samples, it never falls below 3.2%.) The slope coefficient is 2.11, meaning that, on average, a 1-percentage-point increase in SFC results in just over a 2-percentage-point increase in noils. To illustrate the implications of this regression equation, a SFC value of 4% predicts a noils level of 14.6%, while a SFC value of 7% predicts a noils level of 21.0%. Given the good statistical fit of the equation, one can have confidence in these predictions whenever cotton is processed on the same equipment and in the same manner.

Another reliable indicator of the usefulness of a SFC measurement is how well it correlates with critical yarn properties; e.g., non-uniformity, thin and thick places, and hairiness. This is especially so for ring-spun yarns, because the yarn structure readily reveals these impacts from short fibers. Rotor-spun yarns are not as sensitive because the yarn structure conceals many of these problems. Exhibit 7 summarizes the correlation coefficients between these defects for carded, 36 Ne yarns and the AFIS® SFC measurements. For comparison, it also provides the correlation coefficients between these yarn defects and the noils obtained from combing. (As implied above, the noils level provides a kind of "reference test," but it is infeasible to use it as a practical test.) The yarn measurements were made on a Uster UT3®, using 10 bobbins with each containing 400 yards of yarn.

Exhibit 7. Correlation Coefficients: Yarn Properties vs. SFC and Noils

Yarn Property	Units	SFC	Noils
Ring Spun, 36 Ne			
Nonuniformity	CV%	0.93*	0.97*
Thin Places	cnt/1000yd	0.90*	0.94*
Thick Places	cnt/1000yd	0.94*	0.98*
Hairiness		0.90*	0.95*
Rotor Spun, 36 Ne			
Nonuniformity	CV%	0.54*	0.50*
Thin Places	cnt/1000yd	0.46	0.44
Thick Places	cnt/1000yd	0.36	0.28
Hairiness		0.79*	0.83*

* Significant at 99% confidence level.

Take note that the yarns reported in Exhibit 7 were not combed, in order to avoid disguising the impacts of the SFC on fiber properties. Thus, the noils measured from combing were not part of the spinning process, but only an "instrument" to track the SFC. Also take note that when the combing was done for this purpose, the same processing procedure was used between opening and combing as is illustrated in Exhibit 3. Finally, take note that other yarn counts were spun and some of these were combed as an integral part of the spinning process; but only the 36 Ne carded yarn is shown in Exhibit 7 because it was the only count that was common to both the ring and rotor spinning systems.

It is clear from Exhibit 7 that, for the ring-spun yarns, the SFC is highly correlated with non-uniformity, thin and thick places, and hairiness. All of the correlation coefficients are at 0.90 or higher. These results are as expected, assuming that the SFC measurements are valid. It is also seen that the correlation coefficients for noils are higher than they are for SFC; therefore, the conclusion is that measuring noil levels is a superior—but infeasible—method of tracking short fiber content. The more important conclusion is that the AFIS® SFC measurements can provide a fairly rapid and useful indicator of the impact of short fibers on yarn quality.

Neither the AFIS® SFC measurements nor the noil measurements are highly correlated with the yarn properties of the rotor-spun yarns (Exhibit 7). Only two of the yarn properties—non-uniformity and hairiness—exhibit correlation coefficients that are statistically significant at the 99% confidence level. The other two are not significant. Furthermore, results for the noils are not better than results with the AFIS® SFC measurements. These results testify to the ability of the rotor spinning system to compensate for short fiber content.

Conclusion

These results reveal why the International Textile Center increasingly utilizes the AFIS® instrument to track and evaluate the short fiber content of cotton. Besides being useful in predicting fiber processing waste and yarn quality, the measurement is a practical tool for providing guidance to those working to develop new varieties of cotton.

TRAVEL BY ITC PERSONNEL

Recent travels for ITC Director Dean Ethridge included: (1) January 28-30, attending the annual meeting of the National Textile Center, at Myrtle Beach, South Carolina; (2) February 1, speaking before the annual meeting of the Texas Seed Trade Association in Dallas, Texas; and (3) March 18-19, participating in a meeting of the Committee on Cotton Quality Measurement in Memphis, Tennessee.

Pam Alspaugh, Communications Coordinator, took time from a vacation to give a presentation on U.S. cotton production at a pre-ITMA textile industry seminar in Como, Italy. The Swiss Institute of Textile Machinery of ETH presented the seminar on March 25-26.