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CURRENT RESEARCH ACTIVITIES AT THE INTERNATIONAL TEXTILE CENTER

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Abstract

An overview is given of the program of work at the International Textile Center. The presentation is organized around four major categories: collaborative research with breeders and agronomists; measurement research; spinning research; and chemical research.

Introduction

I have been charged with the task of providing an overview of activities at the International Textile Center (ITC). The ITC is a unit within the College of Agricultural Sciences and Natural Resources of Texas Tech University. It is devoted to research, education and technology transfer related to fiber properties and textile manufacturing, in order to increase the market value and use of natural fibers. In fulfilling this mission, the ITC does research on fibers, yarns, fabrics, textile processing systems, dyeing and finishing, special treatments to fibers and textiles, and fabric care (both wetcleaning and drycleaning).

I would strongly emphasize that the ITC is multidisciplinary and collaborative. Our activities involve collaboration with multiple departments within our college, with multiple colleges and other units at Texas Tech University, with other U.S. universities, with state and national organizations and companies, and with international companies, institutes, and universities. Our collaboration with multiple units of Texas A&M University deserves particular emphasis, with one of our staff (Eric Hequet) holding a joint appointment between Texas Tech and Texas A&M.

We have a strong collaboration with the Lubbock Cotton Exchange and the Texas Cotton Association, whose merchant members market cotton in the U.S. and around the world. With these merchants, we offer twice a year the Texas International Cotton School. Since its beginning, the school has been attended by 365 students from 51 countries around the world.

Overview of Activities

The work of ITC is organized around four major categories:

1) collaborative research with breeders and agronomists;
2) measurement research;
3) spinning research; and
4) chemical research.

Collaborative Research with Breeders and Agronomists

This dimension of our work has only recently begun to realize its potential, with primary leadership from Eric Hequet. Under this category, we are deeply involved in cotton fiber quality evaluation for breeders and biotechnologists. While this work has been going on for a number of years, it has been integrated over the past three years with Cotton Incorporated's "genetics initiative". The ITC leads in the development of procedures for sampling and testing cotton fibers, using best available measurement technology. We are focused on working with the appropriate U.S. plant scientists involved to develop distinct testing and evaluation protocols for each phase of genetic alteration and breeding. A fundamental need is for more reliable differentiation between genetic and environmental causes of fiber quality variations, in order to provide better guidance to our cotton breeders in deciding which cottons to select for advancement in their breeding programs.

A component of this work is delivery of a graduate course titled "Advanced Studies in Cotton Fibers", which is taught every other year by Eric Hequet as a distance education course. It serves primarily M.S. and Ph.D. agronomy students. To date, the numbers of students have been about evenly divided between Texas Tech University and Texas A&M University. Perhaps the reach of this course may eventually be extended beyond Texas and ultimately to the entire Cotton Belt.

Another dimension of the work we do with our agronomists is the study of effects of production, harvest and ginning practices on cotton fiber properties. These studies involve both small- and large-scale experimental designs that cannot be executed without the field work provided by our agronomic partners. Some of it uses satellite image analysis, in order to document differences in cotton fiber properties at different parts of the fields. A very interesting aspect of this work is the evaluation of different procedures used to terminate the cotton crops.

Somewhat related to this is our work on determining the sources of stickiness in cotton fibers. This issue has been advanced both by formal research projects and a combination of dialogue and detective work; again, a close working relationship with the agronomists is the key to progress.

Measurement Research

Measurement research constitutes the largest single component of our program of work at the ITC. Among the issues that currently preoccupy us are useful measures of the length distribution of cotton fibers. Another is the maturity distribution of the fibers. We are convinced that a reliable quantification of the distributional behavior of these fiber properties will provide the foundation for greatly needed advances in diverse aspects of cotton science, ranging from cotton breeding to textile manufacturing.

Included in this work is a project to develop a reference method for measurements of fineness and maturity. This long term project has been funded by Cotton Incorporated and has been done in collaboration with the Southern Regional Research Center. It will be formally completed within the next few months.

Another long-term project involves the measurement of stickiness of cotton fibers. As our capabilities in measurement have advanced, we have learned that much of what we thought we knew about stickiness several years ago is not true. In 2003 a patent was granted to Texas Tech University on a method we developed to measure stickiness on cotton fibers.

We also have focused on measurement of seedcoat fragments. The tendency toward seedcoat fragments is definitely heritable; therefore, with reliable measurement the characteristic can be selected in cotton breeding programs. The primary process that generates either more or less seedcoat fragments is the cotton gin; therefore, reliable measurement will facilitate gin process control and guide gin machinery development.

I would also highlight our work on applications of the Fourier Transform Infrared Instrument to both identify and measure contents, contaminants and finishes on fibers, yarns and fabrics. Successful uses span from stickiness on fibers to resins on fabrics.

We are also developing the use of x-ray microtomography, with the current focus being on identification of contaminants throughout a 3-dimensional sample of cotton. Simple, radiographic images throughout the sample may be generated within seconds, while high-resolution, tomographic images may be obtained within minutes. The technology requires minimal sample handling, allows rich interpretations based on shape and size factors, and allows interpretation of density factors. Utility of the instrument is limited primarily by accompanying image analysis algorithms, which must be created through software programming.

We have shown that this x-ray technology can identify and measure diverse contaminants in raw cotton. It can even detect cotton neps. And it may provide a reference method for evaluating and calibrating high-speed instruments that measure contaminants. A patent application by Texas Tech University has resulted from this research.

The last area of measurement research I will highlight involves the dimensional stability of fabrics. We have produced a proven fabric shrinkage measurement using scanner technology, and a proven wrinkling measurement using laser technology. Cotton Incorporated funded the efforts on both of these. The shrinkage instrument is being used regularly now in the labs at Cotton Incorporated and the ITC. The wrinkle measurement system, which was developed to adhere to a dominant AATCC Test Method, resulted in a joint patent application by Cotton Incorporated and Texas Tech. Cotton Incorporated will be the sole licensing agent for this technology.

Spinning Research

One focus of our spinning research is on short-staple applications of compact ring spinning. The “compact” technology allows precise control of the shorter fibers. We are generating comparative results between the compact ring spinning and conventional ring spinning. What we seek is improved yarn quality with given fiber lengths or the same quality with shorter lengths.

Another spinning initiative involves what is called high-performance rotor spinning. In this we are collaborating with the ITV in Denkendorf, Germany. The technology is based on a completely redesigned spin box with smaller rotors than have ever been used before. An interesting aspect of this technology is that it actually requires short-staple cottons for efficient operation.

Inherent in the foregoing initiatives, but worthy of its own mention, is our research on impacts of fiber length distribution on spinning performance. This, in turn, is involved in research on fiber blending applications that benefit cotton performance. The blending is generally targeted at improving either the length or strength distributions of fibers incorporated into the yarns.

We are also developing a micro-spinning system as a tool for ranking the spinning performance of fibers that are available in very small quantities; say, 50 to 100 grams. Use is made of an SKF Lab Spinner machine that has been modified to ring-spin the cotton directly from a sliver.

Chemical Research

In the area of chemical research, my first emphasis is on work toward the development of plasma technology to impart multi-functional properties to cotton fabrics. This is not traditional "wet chemistry"; it is a dry process. Treatment alters only the fabric surface, leaving desirable cotton properties largely unchanged. It even enables different finishes on each side of the fabrics. The expectation is that plasma technology will be useful to impart to cotton fabrics the characteristics of crease resistance, antistatic behavior, hydrophobic or hydrophilic behavior, flame resistance, UV protection, and other performance aspects.

Our focus on UV protection deserves a separate mention. A primary objective is to obtain very good sun protection ratings with thin and light-colored cotton fabrics, thereby optimizing both the comfort and the protection to the wearer of clothes made from these fabrics.

Finally, an integral part of our chemistry-related work includes our fabric care laboratory. It is fully equipped with both wet-cleaning and drycleaning machinery, made possible by collaboration with the Southwest Drycleaners Association, which encompasses eight states and has it home offices in San Antonio, Texas. We are doing research, for example, to evaluate the effectiveness of alternative drycleaning solvents and detergents. We are increasingly providing sophisticated tests for specialized clientele throughout the U.S. We expect to increasingly utilize these cleaning machines to evaluate the durability of specialty finishes, whether applied with plasma technology or by other means.

Acknowledgements

The indispensable collaboration of numerous people in other entities has been made clear; nevertheless, I would close with a re-emphasis on this point. I will refrain from naming names, because there are many and the risk of leaving someone out is daunting.

I trust it is also clear that both the funding and the collaboration of the staff of Cotton Incorporated is indispensable to the ITC's program of work. I would name two people with Cotton Incorporated who we greatly rely on: Michael D. Watson, Vice President of Fiber Quality Research, and Roy G. Cantrell, Vice President of Agricultural Research.

Finally, the funding and the guidance of the Texas Food and Fibers Commission (TFFC) affect almost everything we do. Robert V. Avant, Executive Director of the TFFC, is an integral part of the ITC team. The Industry Advisory Committee that steers the course of the TFFC also determines the strategic directions taken by the ITC.