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Predicting Yarn Quality: An Indispensable Tool for Cotton Breeders

ICCTM, Bremen. March 18th, 2014

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Introduction

- **Cotton breeders face the task of developing cultivars that will perform well in the field, at the gin, and in textile processing but spinning trials are time consuming and expensive.**
- **Therefore, they must select lines with improved spinning performance indirectly, based on fiber quality attributes.**
- **How can we do that?**
- **The logical answer to this question would be: by carefully evaluating fiber quality.**

Introduction

- **Unfortunately most of the breeding programs use HVI (High Volume Instrument) only to assess fiber properties. Is it sufficient?**

Introduction

- **HVI is the primary source for cotton fiber quality, worldwide.**
- **HVI fiber quality parameters are ubiquitous and are likely to be a part of breeding the cotton of the future.**
- **Is it possible to supplement HVI fiber quality parameters in order to properly identify elite lines for spinning?**

Bale Selection

- 110 cotton bales were selected to represent a wide range in variability of fiber quality within and between bales.
- The commercial bales represent several years and locations from across the United States Cotton Belt.
- Fiber quality was evaluated on:
  - HVI – Bundle Testing
  - AFIS – Individual Fiber Testing

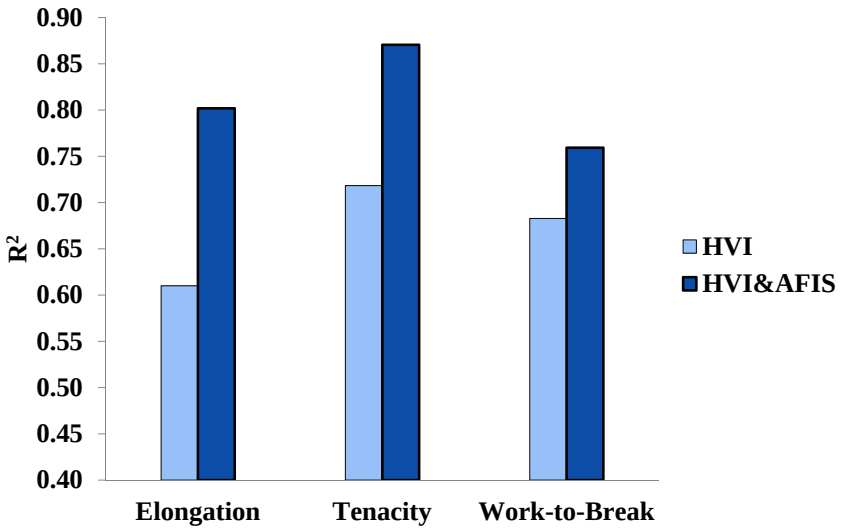
Yarn Quality

- Samples from each bale were spun into 30Ne ring spun yarn.
- Yarn quality was evaluated for:
  - Tensile properties – Uster Tensorapid
  - Imperfections – Uster Tester 3

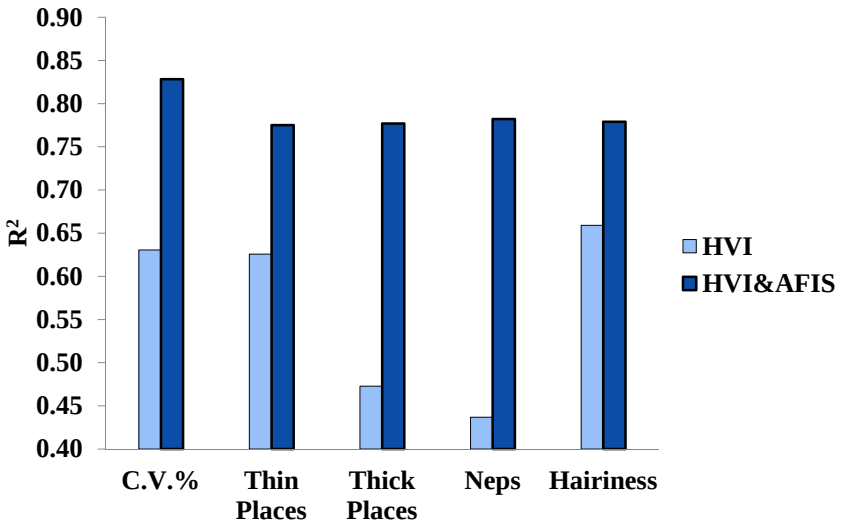
Regression

- Fiber quality parameters were setup into two sets of predictor variables for regression.
  - The first group contains only the most common HVI fiber qualities.
  - The second group is composed of HVI fiber quality attributes along with AFIS fiber qualities.
- Yarn quality attributes were kept as a single set of dependent regression variables.
- A partial least square regression was used to predict yarn quality with each fiber quality set.

Yarn Tensile Properties Explained Variance



Yarn Imperfections Explained Variance



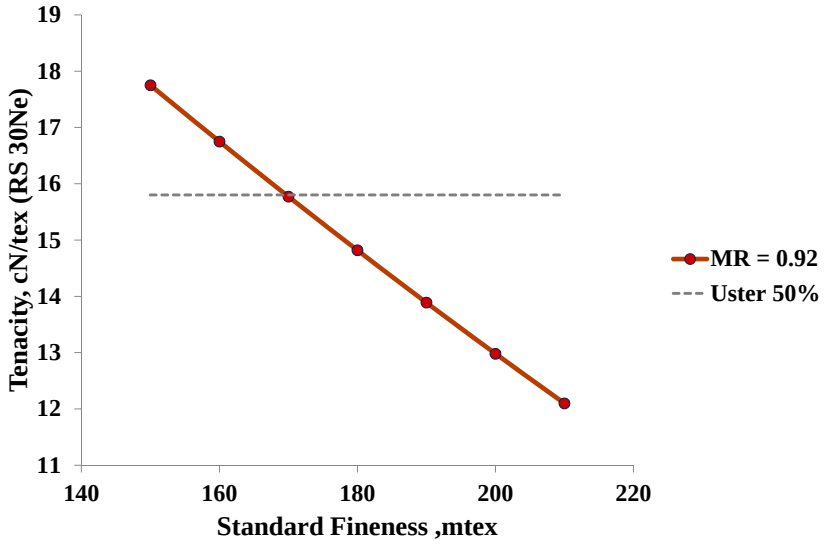
Discussion

- **HVI parameters perform best at predicting yarn tensile properties.**
- **HVI parameters do not perform as well when predicting yarn imperfections.**
- **AFIS fiber quality parameters provide a substantial improvement in explained yarn quality variability.**
- **Knowledge of fiber quality variability within a bale or a sample is needed to develop the superior germplasm.**

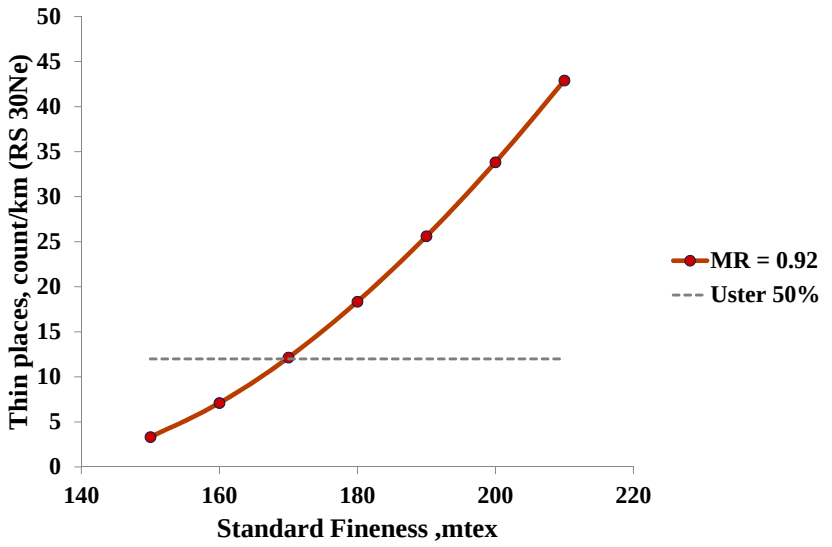
Discussion

- The model presented today could be a very valuable tool for developing the cotton of the future.
- Breeders and biotechnologists could use it to investigate the potential impact of modifying a single fiber quality attribute on ring spinning performance (RS 30Ne with a knitting twist in this case).
- In this example, a known cotton with relatively poor fiber length distribution (HVI UHML = 1.09, Uniformity Index = 78.3) is used.

Impact of Std. Fineness on Yarn Tenacity (ring spun yarn 30Ne)



Impact of Std. Fineness on Yarn Thin places (ring spun yarn 30Ne)



Discussion

- The model reveals that standard fineness (fiber diameter) has a very large impact on yarn tenacity, i.e., smaller fiber diameter leads to stronger yarns while reducing the number of thin places in the yarn.
- Also, this could also be used to establish a selection index for breeders. Instead of trying to improve HVI length and strength for example, they would try to improve the predicted yarn quality (different models would apply for different targeted markets).

Acknowledgments

- Cotton Incorporated
- Texas Department of Agriculture
- U.S. Department of Agriculture

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