SEED-COAT FRAGMENT FIBER AND FABRIC QUALITY IN WORLD COTTONS
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Abstract
Seed coat fragments (SCF) can be neps that can cause spinning problems and fabric defects, which ultimately cause losses to the cotton industry. 12 US and 10 International cottons were processed with AFIS and compared to the fabric samples. Fabrics were tested on the new Autorate (for dark specks) system and then compared to the hand-counted fabric data. The AFIS data showed promising relationships to the fabric data.

Introduction
There are classically two different types of neps: mechanical neps and biological neps. Mechanical neps are neps that contain only fibers and have their origin in the manipulation of the fibers during processing (van der Sluijs, 1999). Biological neps are those that contain foreign material, whether the material is seed coat fragments, leaf, or stem material (Hebert et. al., 1988). One particularly troublesome form of biological nep is the seed coat fragment with attached fiber (Figure 1). Those neps are not easily removed in processing and can contaminate yarn and fabric (Verschraege, 1989; Krifa et al., 2001). In this study we are concerned with seed coat fragment neps.

Figure 1. Typical seed coat fragment with fiber

Seed-coat fragments are part of a seed coat that has been broken from the surface of either mature or immature seeds during mechanical processing. They are usually black or dark brown [Hebert and Thibodeaux, 1993]. Seed-coat fragments in cotton fabric spoil its aesthetic effect, because they differ in color and morphology from the fibers themselves.

According to Hebert and Thibodeaux (1993) and Anthony et al. (1988), 13 to 27 % of all neps contain seed coat fragments. White speck neps can be composed of fibers attached to the seed coat fragments of mature seeds or to mote fragments (Watson et. al., 1991), sometimes resulting in both white and dark specks. SCF is measured in fiber and fabric and reported in this paper.
Materials and Methods

The Advanced Fiber Information System (AFIS)
AFIS tests individual fibers and when non single fiber elements pass the sensors they can be identified as Neps, SCN (Seed coat fragment neps), or trash depending on the signals. There are two modules, one for testing the number of neps and the size of neps AFIS-N (ASTM, 2004) module, while the other one is used for testing the length and the diameter, AFIS-L&D module which measures things such as Fineness and Length by weight (L(w)) and number L(n)) and their CV%. Both modules can be applied separately or together. Five reps of 500 mg fiber samples can be tested in 3 minutes by the AFIS-N module. Ten international bale cottons and 12 US bale cottons were tested on AFIS.

Autorate (Fabrate, LLC)
Autorate (Fabrate, LLC) can quickly and automatically detect, count and measure white speck neps on dyed cotton fabrics. The system is expected to replace human evaluation and to provide reliable and repeatable measurements. Initially, this system used 6 spot lights and a live video camera with frame grabber. “Hot spots” were found on the fabric from the lighting and had some effect on the data (Figure 2). Therefore, when the Autorate system was modified to measure dark specks/seed coat fragments, a digital camera was installed with a flash (Figure 3) that uniformly lights the sample and eliminates “hot spots” seen in the old system.

Figure 2. Autorate for white specks used a live video camera and 6 spot lights which caused minor “hot spots” on the image of the fabric.

Figure 3. New Autorate incorporates a camera with a flash eliminating “hot spots”
The computer grabs an image when the camera flashes and then analyses it for dark specks (number of specks, % area of specks and mean size of specks). The ROI (region of interest) is 24,111 sq mm. The analyzed fabric shows the dark specks highlighted in light aqua on the computer monitor (Figure 4).

Figure 4. Program shows original fabric and fabric analyzed for dark specks

Fabrics were also hand counted for dark specks.

Statistical analysis of the collected data was performed using the general linear model procedure, and mean property values were generated. Regression analysis was done using these mean values to measure trends between fiber and fabric. Multiple regression analysis procedure was used for simple linear regression analysis between AFIS fiber properties and the three Autorate dark speck measurements.

Results

Figure 5 compares fabrics hand-counted for dark specks and then measured by Autorate. The fabrics hand-counted with bark have a higher R-square of 0.9395 as compared to without bark (R-square = 0.8949). From this one can surmise that Autorate is counting all dark specks (with and without bark).
Figure 5. Autorate vs. Hand Counted - Number of dark specks on Fabric

Figure 6 shows the Autorate dark speck data for US and international cottons. The first year of ATMI cottons were processed in 100 lb. lots and the card had not yet been rewired. When the second year of ATMI cottons came in the card had been rewired and 30 lb lots were spun for comparison to the international cottons. The international cottons had much smaller lots and only 15 lbs were run on the rewired card.

The white speck levels in Figure 7 are visibly different. The differences in processing were processing weights and the card wire was new for the 30 lb lots. Due to these differences in processing the cotton white speck and dark speck levels can not be compared from study to study. There is very little of the international cottons left, so in the near future, we would like to run small (≤1 lb.) lots at SRRC (mini-spinning) for the 1st and 2nd years of the ATMI studies and the International Cottons for dark specks.
Figure 7. White speck levels for the same cotton processed at 100 and 30 lbs.

Figure 8. Autorate vs AFISPro SCN
Figure 8 compares fabrics measured by Autorate to AFISPro SCN (Seed coat fragments), resulting in an R-square of 0.6994. Figure 9 shows an improved R-square of 0.7548 using AFISPro SCN, Fineness & L(w) CV% when compared to Autorate. Many SCFs have immature fine fiber attached, which would account for the fineness. As processing increases, SCF increases along with short fiber, creating higher %CV for length and this relationship also improves the correlation.

Conclusions

Image analysis of the fabrics using Autorate had high correlations to the dark specks in the fabric based on hand counting. AFIS Pro SCN had reasonable correlations to the SCF in the fabric, and the regressions were strengthened by the addition of AFIS Pro Fineness & L(w) CV%. The US and international cottons will have to be processed under the same conditions so that the white speck and dark speck nep levels can be compared.

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References


