DEVELOPING AN INDUSTRY-WIDE STANDARD FOR LEAF HAIRINESS

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Abstract

Several factors were previously believed to negatively influence the leaf grade values in cotton, including defoliation and desiccation levels. However, recent research in 2013 identified leaf hairiness as being a primary culprit in higher leaf grade values in Texas. Additionally, during these trials, discrepancies in seed company ratings for leaf hairiness and quantified trichome densities were observed. Due to these findings, widespread support exist to obtain an objective and robust method for quantifying an industry-wide standard for leaf hairiness. Leaf hairiness data were collected from existing variety trials and is being used in developing an industry-wide leaf hairiness standard.

Introduction

Cotton leaf hairiness, also known as trichome density, is highly variable between cotton varieties and can range from 0 to over 550 hairs/cm^{-2} (Bourland, et al. 2003). Previous research by Norman et al. (1994) with whiteflies and Mekala (2004) with fleahoppers has shown important impact of leaf hairiness on insect management and thus variety selection. For example, cotton varieties with a high density of leaf hairs have resulted in increased insecticide applications for white flies in the Rio Grande Valley and leaf hairiness should be a major variety selection criteria for these producers (Norman, 1994). Eder et al. (2013) and Boykin et al. (2012) demonstrated the detrimental impact of leaf hairiness on cotton leaf grade both in small plot research and commercially grown and ginned cotton.

Research at multiple locations in Arkansas and Texas identified the environmental conditions impact the leaf hair density, but has a minimal impact on the leaf hairiness ranking among varieties (Bourland et al., 2003, Norman and Sparks, 1997, Boykin, et al., 2013, and Eder, et al., 2013). Consistency of variety ranking across locations and years for leaf hairiness provides an excellent opportunity to develop an industry-wide leaf hairiness rating system that is much more objective and descriptive than the current leaf rating system.

Objectives

1. To document leaf trichome densities for many varieties at numerous growing regions across the Cotton Belt.
2. To determine if the trichome densities are consistent enough to develop an objective industry-wide leaf hairiness rating system.

Methods

In 2013, the concept of developing an industry-wide leaf hairiness rating system was proposed and discussed with the agronomists, entomologists, breeders, and ginners from universities, Cotton Incorporated, and Cotton Foundation. All provided very positive support of the industry-wide rating system, with the assumption that a robust and objective methodology can be developed. Additionally, we met with Bayer, Monsanto, and Phytogen to seek

their input on the concept of developing an industry-wide standard for leaf hairiness and obtain their input on the most appropriate procedures to obtain a robust and objective rating system. We have received favorable feedback from each of these companies, assuming the industry-wide standard will be uniformly adopted.

From existing small plot variety trials in 2013 in Palacios, TX, Lubbock, TX, Keiser, AR, and Tifton, GA, leaf trichome densities were quantified across major cotton production regions using Bourland's published methodology. See examples of low and high trichome densities in Figure 2. In 2014, a Louisiana site was added and identical methodology was used. ST 5288B2RF, a pilose genotype, and TX-06-WE were planted at all locations to serve as hairy checks in 2014. Seven varieties were in-common across all locations in 2013, and nine were in-common across four locations in 2014.

Results

For each of the four locations included in the 2013 trial, seven varieties were included at each location; however, trichome densities were quantified for each of the entries at each of the locations accounting for over 75 commercial varieties and experimental cotton lines. The trichome densities for each of the seven varieties and locations are included in Figure 3. Varietal differences were observed for each location and relative hairiness was similar across locations. However, the trichome densities of some varieties were more consistent across locations (e.g. PHY 339WRF) than other varieties (e.g. PHY 499WRF).

In 2014, four varieties were included at all locations, including ST 5288B2RF and TX06-WE as standard high trichome density checks. The Lubbock location had the fewest common varieties and is excluded to increase the number of varieties presented in this poster. Figure 4 includes the list of the nine varieties and their respective trichome densities for each location.

Similar to 2013, varietal differences were observed at each location with low trichome density varieties remaining low at all locations. The varieties with higher trichome densities had higher variability across locations. Georgia had the lowest average trichome density while Louisiana had the highest mean trichome density. The ST 5288B2RF was had the highest trichome density of all the commercial varieties at each of the locations. So, the ST5288B2RF should serve as a good variety to normalize the trichome density and allow for compiling data across locations.
Four varieties were included in the 2013 and 2014 trials, and the trichome densities are included in Figure 5. Overall, the trichome densities were higher in 2014 versus 2013. When comparing the varieties, the relative trichome density remained similar across both years.

Summary

Leaf trichome densities do differ by environment, including by location and year, which concurs with previous findings by Bourland et al. and Norman et al. However, the relative hairiness of a variety to other varies within a trial locations appears to be fairly consistent and agrees with Bourland et al., (2003) reports of a site by variety interaction not existing. If this lack of site by variety interaction across the diverse locations of this research trial, then the premise for developing an industry-wide standard for leaf hairiness is highly possible.
Some varieties have exhibited a higher level of variability in trichome densities across locations than other varieties. To develop and industry-wide rating system, a fair classification of these varieties will need to be considered.

Acknowledgements

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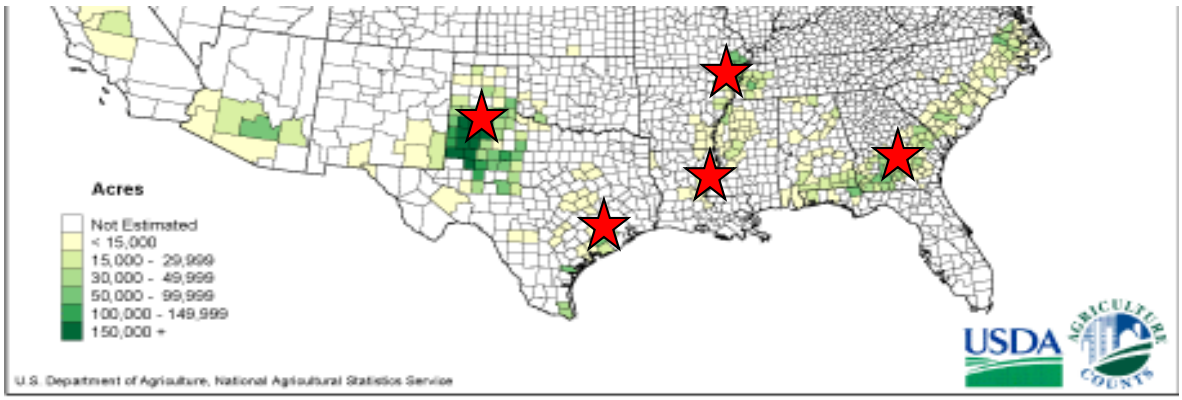

Figure 1. Map of geographic regions and testing sites in 2014.

Figure 2. Cotton leaf with low (left) and high (right) leaf trichome density.

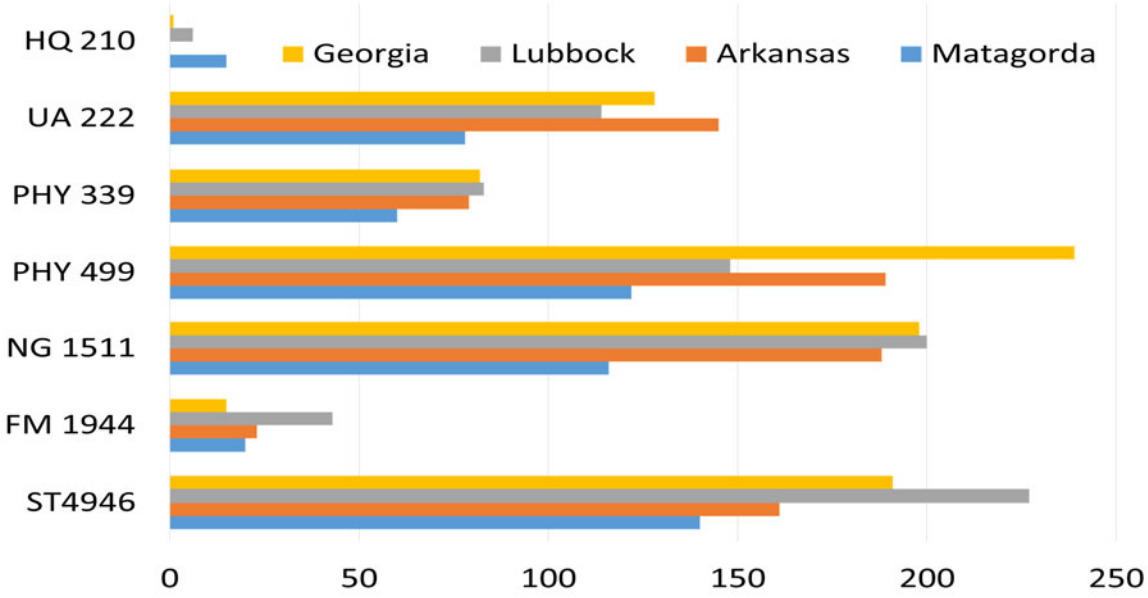

Figure 3. Trichome density for seven varieties at four locations across the Cotton Belt in 2013.

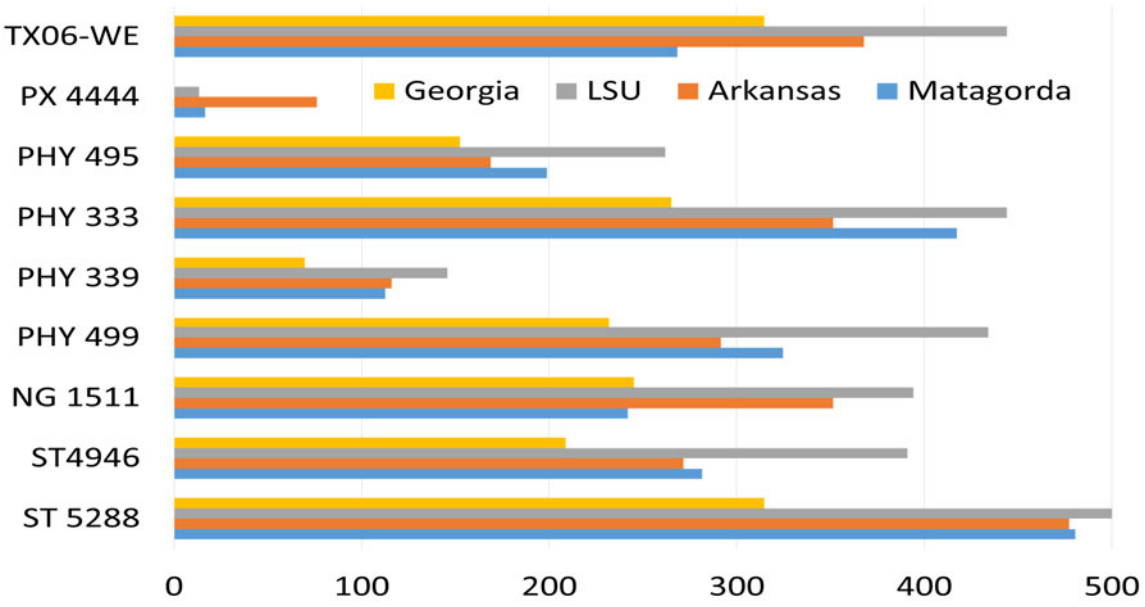

Figure 4. Trihome density for nine varieties at four locations across the Cotton Belt in 2014.

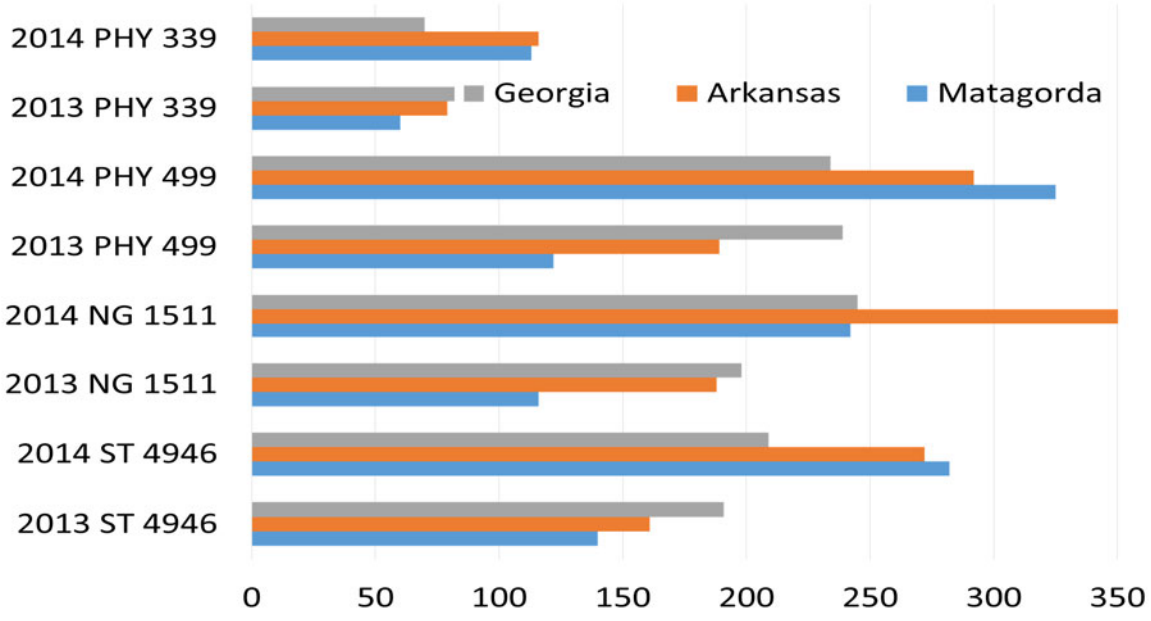

Figure 5. Trichome density or four varieties in common at three locations across the Cotton Belt.