IMPACTS OF LEAF AND BRACT PUBESCENCE ON FIBER QUALITY OF NORMAL AND OKRA LEAF COTTON

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Abstract

Lint contamination has become a critical issue in cotton production throughout the United States. Increases in cotton leaf grade values can have a detrimental impact on economic returns. Characteristics of cotton cultivars, specifically differences in trichome density and leaf shape may have a key role in reducing leaf grades. The objectives of this research was to determine the actual range of trichome density within leaf type as well as across leaf type of various leaf hairiness categories. Compare the relationship between trichome density counts across leaf type with leaf pubescence rating. In this study normal leaf cultivars had the greatest leaf trichome density compared to okra leaf cultivars. Trichome density of bracts were similar across leaf type in regardless of leaf hairiness category.

Introduction

Cotton (*Gossypium hirsutum* L.) fiber quality is an extremely important factor in cotton production. Lint contamination due to leaf and bract material can reduce fiber quality leading to discounted prices and impacting economic returns. Cotton leaf grades are defined as the amount of leaf and bract material in a ginned lint sample (Eder et al., 2017). Leaf grade values are reported (1-7), as plant material increases, leaf grade value increases (Anonymous, 2018).Sporadic increases in cotton leaf grades have been observed in recent years throughout the Cotton Belt (USDA-AMS, 2019). The risk for price reductions due to leaf grade alone is increased when leaf grades reach four and above (Larson and English, 2001).

Multiples agronomic factors play a role in increasing leaf grade values including: environmental conditions, cotton defoliation, and leaf pubescence or hairiness (Anthony and Rayburn, 1989). Okra leaf type cotton is being evaluated as a visual purity marker in organic productions systems. In organic systems, producers rely on a killing frost to condition the crop for harvest. Therefore, cotton cultivar selection may play a major role in reducing leaf grade values. Leaf hairiness, determined by trichome density may be an extremely important factor to reducing cotton leaf grades.

Methods

Studies were conducted at Texas A&M AgriLife Research and Extension Centers in Lubbock, TX and Halfway, TX in 2019. Treatments were arranged in a randomized complete block design with four replications. Eight cultivars, four okra-leaf shape and four normal-leaf shape entries were included that also consisted of a range of leaf pubescence categories from smooth to hairy. The four okra-leaf cultivars included: All-Tex 220 OL (hairy), TAM WK 11 OL (moderately hairy), FiberMax 832 (semi-smooth), and OL selection FiberMax 958 (smooth). The four normal-leaf cultivars included: CA 4006 (hairy), Stoneville 474 (moderately hairy), All-Tex Atlas (semi-smooth), and FiberMax 958 (smooth). Cultivar entries were arranged in 2 - 1.02 m rows x 8m in plot length. Plots were harvested with a two-row mechanical stripper. Data collection throughout the growing season included: leaf trichome density, bract trichome density, and leaf hairiness ratings. As cotton reached physiological cutout, leaf and bract samples were collected from each location. Leaf hairiness ratings was also conducted at this time following bourland et al., (2003) rating methods. Following Bourland et al., (2003) methods, ten leaf samples were collected from the 4th node down from the terminal (uppermost fully expanded leaf). Five bract samples were collected from a first position boll on the lower half of the cotton canopy (Bourland and Hornbeck, 2007). Leaf trichome density was determined by utilizing an index card with a 0.65 cm diameter hole (0.33 cm^2) that was placed over the interveinal area near the base on abaxial side of the leaf, and leaf trichome densities we counted. On both sides of the bract center tooth, two margins were counted and the mean value was reported for 0.65 cm length. Trichomes were counted using a dissecting microscope with a separate light source. In this study data was analyzed with Statistical Analysis System (SAS),

Version 9.4 (SAS Institute, 2007). Proc Mixed was utilized for the analysis of variance test ($P \leq 0.05$). A Protected Fishers Least Significant difference test at $P = 0.05$ was used to separate means.

Results

When cotton trichome density was compared against cotton leaf type across both locations, the trichome density of normal leaf cultivars was higher compared to okra leaf cultivars across all cultivars (Table 1).

Table 1. Leaf trichome density (cm^2) by cotton leaf type (pooled over cultivar) in 2019.

Leaf Type	Trichome Density (cm^2)
Normal	204 a
Okra	91 b
p-value	.0001

Leaf trichome density counts in 2019 were significantly different between cotton cultivars (Table 2). Trichomes were the densest on normal leaf cultivars CA 4006 (296) and ST 474 (337) with pubescence categories of hairy and moderately hairy (Table 2). Okra leaf cultivars AT 220 (171) and TAM WK 11 (103) which are categorized as hairy and moderately hairy, respectively, had less trichome density values compared to their normal leaf counterparts in the same category (Table 2). All normal leaf cultivars reported had higher trichome densities compared to the okra leaf cultivars regardless of how they were categorized (Table 2).

Bract trichome density counts had greater similarity between leaf types compared to leaf trichome density (Table 2). No differences were observed in bract trichome density counts between normal leaf and okra leaf cultivars with hairy and mod. hairy pubescence ratings (Table 2). Although, bract trichome density was significantly lower on okra leaf type OL Sel. FM 958 (36) compared to normal leaf type FM 958 (63) (Table 2).

Table 2. Leaf and bract trichome density (cm^2) of normal (N) and okra leaf (OL) cotton cultivars (pooled over location) in 2019.

Cultivar	Pubescence Rating	Leaf Trichome Density (cm^2)	Bract Trichome Density (cm^2)
CA 4006 (N)	Hairy	296 a	74 a
ST 474 (N)	Mod. Hairy	337 a	72 a
AT Atlas (N)	Semi-Smooth	103 c	53 bc
FM 958 (N)	Smooth	77 cd	63 ab
AT 220 (OL)	Hairy	171 b	75 a
TAM WK 11 (OL)	Mod. Hairy	103 c	68 ab
FM 832 (OL)	Semi-Smooth	37 d	45 cd
OL Sel. FM 958 (OL)	Smooth	51 cd	36 d
p-value		.0001	.0001

Means followed by the same letter do not differ significantly at the 0.05 level

Summary

In conclusion, data observed from this study shows normal leaf cultivars had greater leaf trichome density in 2019. Furthermore, trichome density of okra leaf cultivars was considerably less within similar pubescence categories compared to normal leaf cultivars. Although, bract trichome density was fairly similar across leaf type in 2019. To evaluate effects from trichome density differences, a fiber quality analysis is needed to determine differences among cotton leaf grades.

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