EFFECTS OF LEAF AND BRACT TRICHOMES ON TRASH CONTENT AND QUALITY OF GINNED LINT

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Abstract

Spinning efficiency and yarn quality is improved for bales with reduced trash content. Some cotton varieties have been characterized as having smoother leaves (low trichome density) and fewer bract trichomes, and it has been shown that cotton harvested from these varieties are picked with lower trash content. Cotton picked with lower trash content is easier to clean at the gin and mill. In 2010, the first year of a two year study, ten varieties were grown in three locations, sampled for leaf and bract trichomes, machine harvested, and ginned in the microgin. Preliminary results for one year were reported. Leaf and bract trichomes were highly (positively) correlated with lint trash based on samples collected after lint cleaning and tested by HVI, AFIS, and Shirley Analyzer.

Introduction

Cotton mills pay a premium for bales of U.S. cotton with low trash content, currently based on HVI leaf measured at the USDA-AMS Cotton Classing offices. Various methods of reducing lint trash content are implemented in the field, during harvest, in the gin where cotton is cleaned before and after the lint is separated (ginned) from the seed, and in the mill where cotton is cleaned before spinning. Cotton in the U.S. is mechanically harvested, and other parts of the cotton plant tend to be extracted along with the cotton. Defoliants are typically applied prior to harvest to promote leaf drop and reduce the amount of leaf material in the harvested cotton, but some leaves remain attached to stems or cling to cotton bolls.

Lint trash is not the only property mills are interested in as many other properties of the fiber affect spinning and yarn quality. Fiber length distribution, for example, is important as cotton with longer fibers and higher fiber length uniformity can be spun into finer yarns. Neps (fiber entanglements) also reduce yarn quality. Cleaners in gins are very effective at removing trash from seed cotton and lint, but they also reduce fiber length, reduce length uniformity, and increase neps (Anthony, 1990). Therefore, reducing the trash content of cotton before it gets to the gin should reduce the need for cleaning and improve fiber quality.

Morey (1979) examined trash particles in ginned lint and found the origin of lint trash content was primarily other parts of the cotton plant such as leaf, bract, stem, and seed. Some cotton varieties are categorized as “hairy leaf” cottons due to high levels of leaf trichomes (leaf hairs) on the abaxial (bottom) sides of leaves which cause some leaves to cling to opened cotton bolls. This leaf material is harvested with the cotton, increasing trash content. Trichomes are also found attached to the margin (edge) of bracts causing the same problem. Trichomes of the leaf and bract cling to cotton fiber and potentially affect cleaning in the gin and trash content of ginned lint. Cotton varieties differ in leaf and bract trichome density (Bourland and Hornbeck, 2007). Though variety differences in leaf and bract trichome density are statistically correlated, bract trichomes may be more strongly related to lint trash content since most leaves are dropped to the ground after defoliation and prior to harvest. A two year study was initiated with two objectives: 1) to determine if lint trash content increased with leaf trichome density or bract trichome density and 2) to determine if these two relationships were independent.

Materials and Methods

Ten varieties were grown in 2010 as part of the Mississippi State Cotton Variety Trials. One Americot (Am), three Deltapine (DP), one Dyna-Gro (Dy), one FiberMax (FM), two Phytogen (PHY), and two Stoneville (ST) varieties were included in this study. Trials were conducted at several locations across the state with two replications per

variety at each location. Plots from four locations (Como, Dundee, Glendora, and Mattson) in Mississippi were sampled to determine leaf trichome density (no./cm^2) and bract trichome density (no./cm) determined by microscopic examination. Leaves and bracts were collected from mid-canopy and analyzed at the University of Arkansas Northeast Research and Extension Center, Keiser, AR, according to methods outlined by Bourland and Hornbeck (2007). Cotton plots from three locations (Como, Dundee, and Mattson) were machine harvested and ginned in the Stoneville, MS, USDA-ARS Microgin (Anthony and McCaskill, 1974) with typical gin machinery including dryers, seed cotton cleaners, and one lint cleaner. Lint samples were collected after lint cleaning for analysis by HVI, AFIS, and Shirley Analyzer.

Results and Discussion

These results include only one year of data and should be considered preliminary. Varieties varied statistically in both bract and leaf trichome density (table 1). For leaf trichomes, the difference among locations was not significant, nor was the interaction between location and variety. Location and the interaction between location and variety were statistically significant for bract trichomes, but the F-value for variety (106.60) was much larger than the F-value for the interaction (1.57) indicating overall differences in varieties was the dominant effect. These results show strong differences in varieties for both leaf and bract trichome, and leaf trichomes were more consistent between locations.

Table 1. Statistics (F-values) for treatment differences in leaf and bract trichome density.

Effect	DF	Leaf trichome density	Bract trichome density
Location	3	3.43	59.70 *
Variety	9	85.56 *	106.60 *
Location*Variety	27	1.43	1.57 *

* indicates F-values significant at $p<0.05$

Leaf trichome density for different varieties at different locations is shown in table 2 and figure 1. Overall, there were five distinct groupings which were consistent across locations. Bract trichome density for different varieties and locations is shown in table 3 and figure 2. There were four distinct groupings which were again mostly consistent across locations. The highest values for both leaf and bract trichomes were found for ST 5288 B2RF, while the lowest values for both leaf and bract trichomes were found for the same four varieties. Differences were observed in the middle groupings, such as ST 5458 B2RF with the second highest leaf trichome density and relatively low bract trichome density. Alternately, FM 1740 B2RF had a relatively low leaf trichome density and relatively high bract trichome density. Averaged over locations, leaf and bract trichome density for varieties are plotted in figure 3 to illustrate these inconsistencies.

Table 2. Leaf trichome density (no./cm^2) for varieties grown in different locations.

Variety	Como	Dundee	Glendora	Mattson	Mean
ST 5288 B2RF	228 A	327 A	200 A	209 A	241 A
ST 5458 B2RF	142 B	169 B	109 B	151 B	143 B
PHY 565 WRF	127 BC	123 BC	113 B	113 BC	119 B
PHY 375 WRF	84 DC	113 C	65 BC	78 DC	85 C
DP 0912 B2RF	66 D	105 C	66 BC	95 C	83 C
FM 1740 B2RF	44 DE	27 D	28 DC	38 DE	34 D
DP 1028 B2RF	13 E	8 D	7 D	9 E	9 E
DP 1034 B2RF	9 E	6 D	7 D	6 E	7 E
Dy 2570 B2RF	12 E	7 D	5 D	5 E	7 E
Am 1550 B2RF	6 E	4 D	5 D	3 E	5 E

* Numbers in same column followed by same letter not significantly different at $p<0.05$.

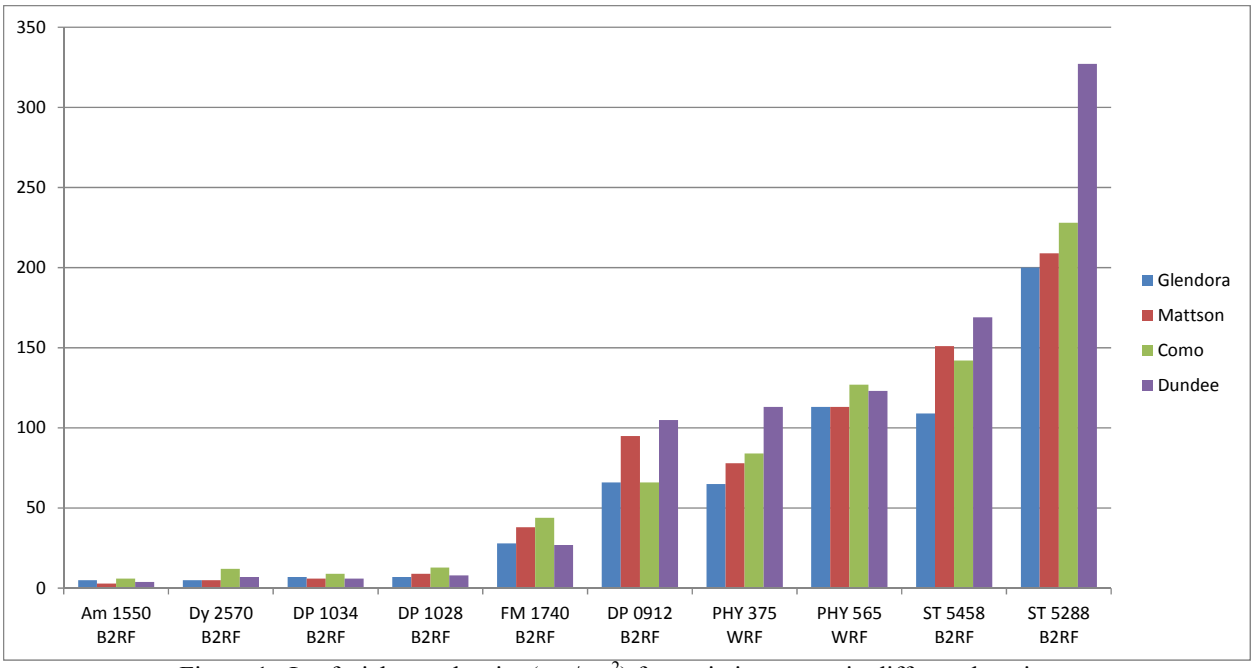

Figure 1. Leaf trichome density (no./cm^2) for varieties grown in different locations.

Table 3. Bract trichome density (no./cm) for varieties grown in different locations.

Variety	Como	Dundee	Glendora	Mattson	Mean
ST 5288 B2RF	37 A	33 A	38 A	33 A	35 A
PHY 565 WRF	38 A	27 B	30 B	26 B	30 B
DP 0912 B2RF	32 B	23 C	29 B	24 BC	27 C
FM 1740 B2RF	29 BC	23 C	28 BC	23 BC	26 CD
PHY 375 WRF	27 C	21 C	25 DC	21 C	24 E
ST 5458 B2RF	28 C	23 C	24 DE	22 C	24 ED
Dy 2570 B2RF	20 D	17 D	21 FE	15 D	18 F
Am 1550 B2RF	19 D	15 D	20 F	14 D	17 F
DP 1028 B2RF	20 D	17 D	18 F	14 D	17 F
DP 1034 B2RF	20 D	16 D	18 F	15 D	17 F

* Numbers in same column followed by same letter not significantly different at $p<0.05$.

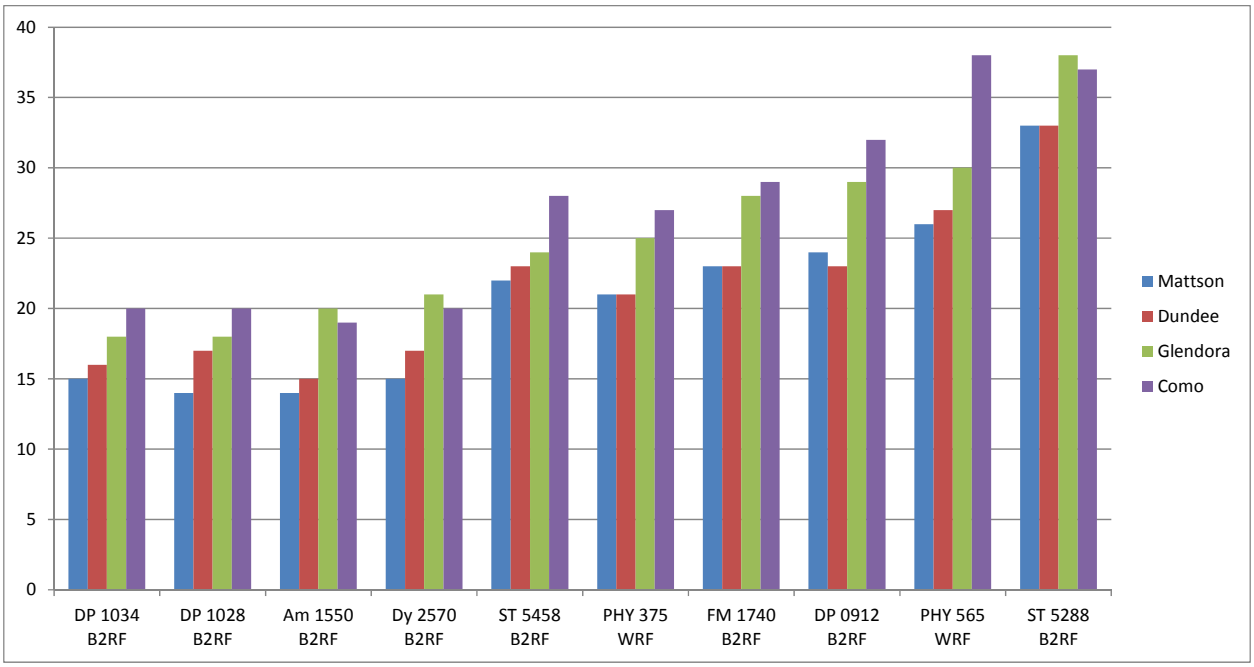

Figure 2. Bract trichome density (no./cm) for varieties grown in different locations.

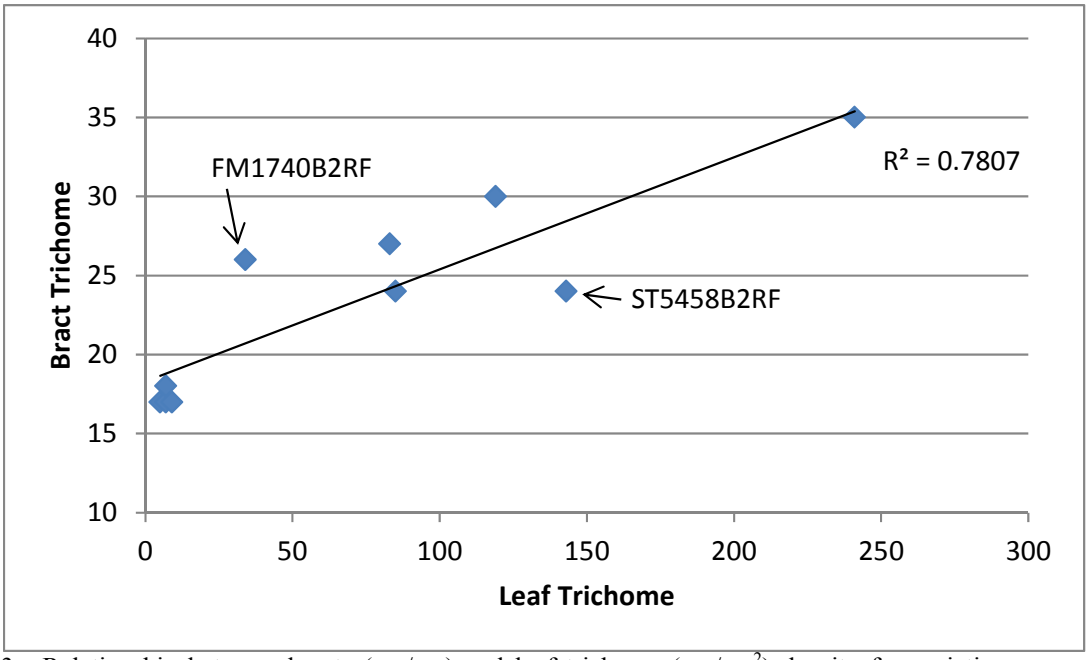

Figure 3. Relationship between bract (no./cm) and leaf trichome (no./cm^2) density for varieties averaged over locations.

For HVI leaf and AFIS visible foreign matter (figures 4 and 5, respectively), variety means over location were more strongly correlated with leaf trichomes than with bract trichomes. For Shirley Analyzer visible waste (figure 6), the opposite was true with bract trichomes more strongly correlated than leaf trichomes. In each of these cases, multiple regression models predicting lint trash with both bract and leaf trichomes did not reveal any significant additive effect or interaction between effects (results not shown). This was possibly related to the relatively strong relationship between leaf and bract trichomes for the varieties included in this study (figure 3).

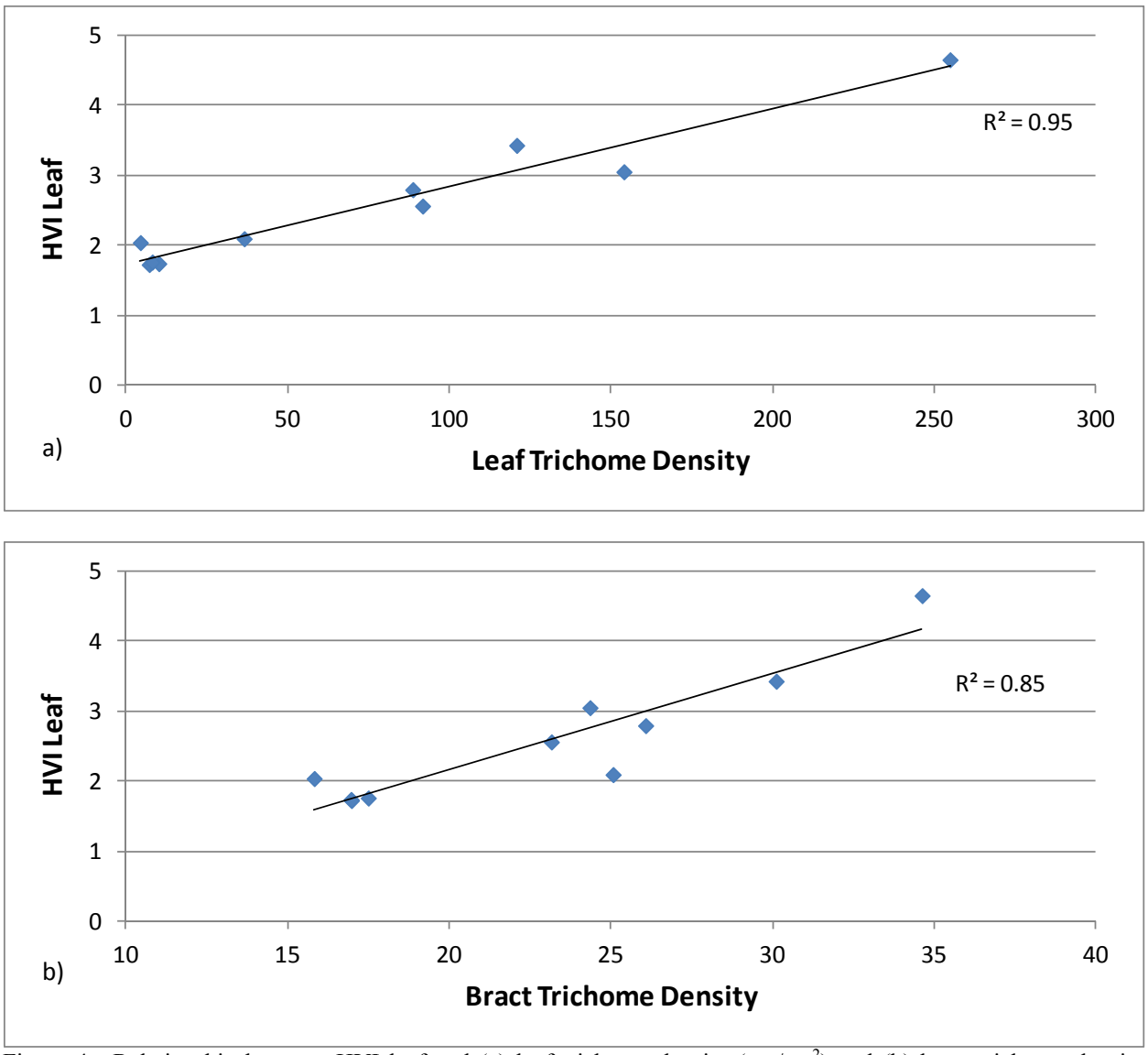

Figure 4. Relationship between HVI leaf and (a) leaf trichome density (no./cm^2) and (b) bract trichome density (no./cm) for varieties averaged over locations.

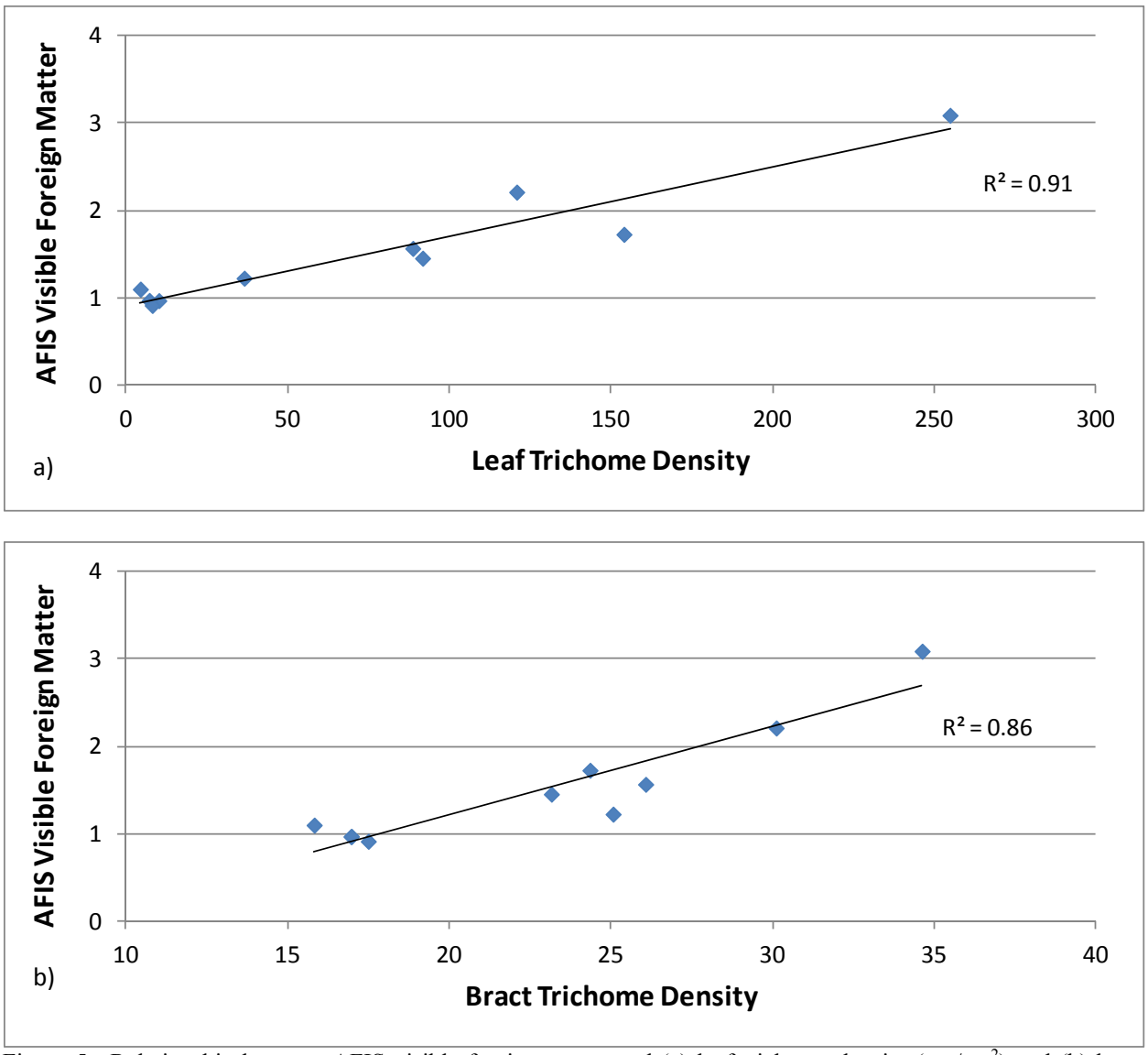

Figure 5. Relationship between AFIS visible foreign matter and (a) leaf trichome density (no./cm^2) and (b) bract trichome density (no./cm) for varieties averaged over locations.

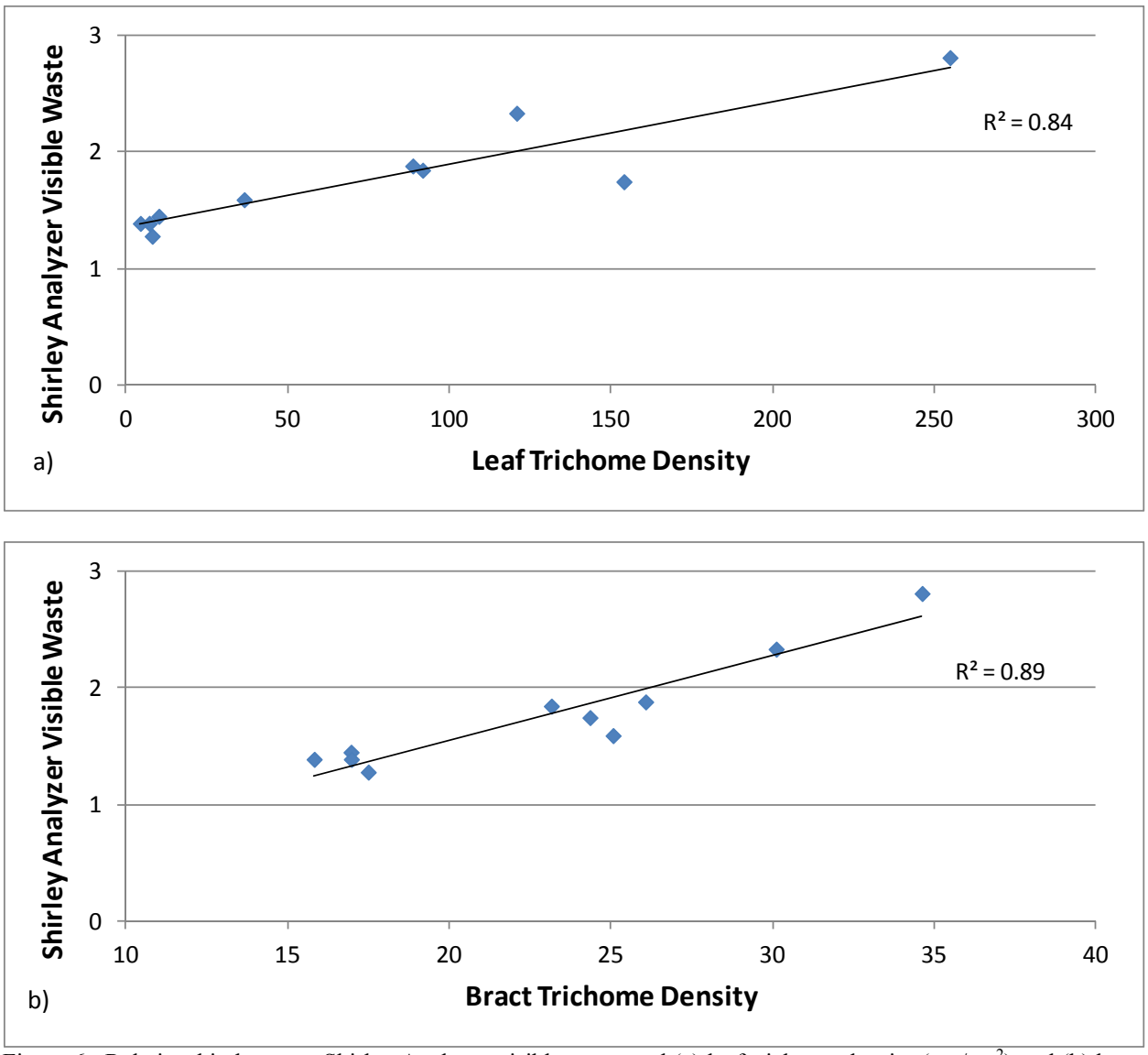

Figure 6. Relationship between Shirley Analyzer visible waste and (a) leaf trichome density (no./cm^2) and (b) bract trichome density (no./cm) for varieties averaged over locations.

Summary

Ten varieties were grown in three locations to relate leaf and bract trichome density to lint trash content. Results of this study were preliminary, including data from one year of a two year study. Large differences in leaf and bract trichome density were found among varieties. Lint trash content of commercially harvested cotton ginned in the microgin was determined by HVI, AFIS, and Shirley Analyzer. Overall, leaf trichome density was more correlated with lint trash measurements, but bract trichomes were also highly correlated. Preliminary results did not reveal any additive effect or additional value of predicting lint trash content with both leaf and bract trichome density. In other words, no evidence was found that leaf and bract trichome density were independently related to lint trash content, but this may have been due to the high correlation between bract and leaf trichome density for the varieties included in this study. Additional varieties tested in 2011 will be added to the analysis.

Disclaimer

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