

Cultivars and IPM Systems for Organic Cotton Production: Distribution of Thrips Resistance in Multiple Generations of Cotton

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Introduction

- Over 90% of commercial cotton (*Gossypium hirsutum* L.) acreage in U.S. is planted with genetically-modified (GM) seed.
- Use of GM varieties is forbidden by organic certification guidelines.
- Nearly all cotton produced on the Texas High Plains (THP) is grown with one or two non-GM cultivars and seed-saving is ubiquitous—commercial non-GM seed sources are almost non-existent.
- Thrips (Thysanoptera: Thripidae) have been identified as a major arthropod pest by organic cotton producers on the THP.
- Thrips management in organic systems can be problematic—synthetic insecticide use is prohibited by organic certification guidelines.
- Use of host-plant thrips-resistant cultivars could improve organic cotton production.
- Conventional method of developing new cultivars requires > 10 years.
- Use of molecular markers for thrips resistance has the potential to significantly accelerate resistant cultivar development.
- Objective 1: Evaluate phenotypic distribution of an F₂ mapping population for potential molecular marker development for the thrips resistance trait.**
- Objective 2: Evaluate parent, F₁, and susceptible phenotypes.**

Results

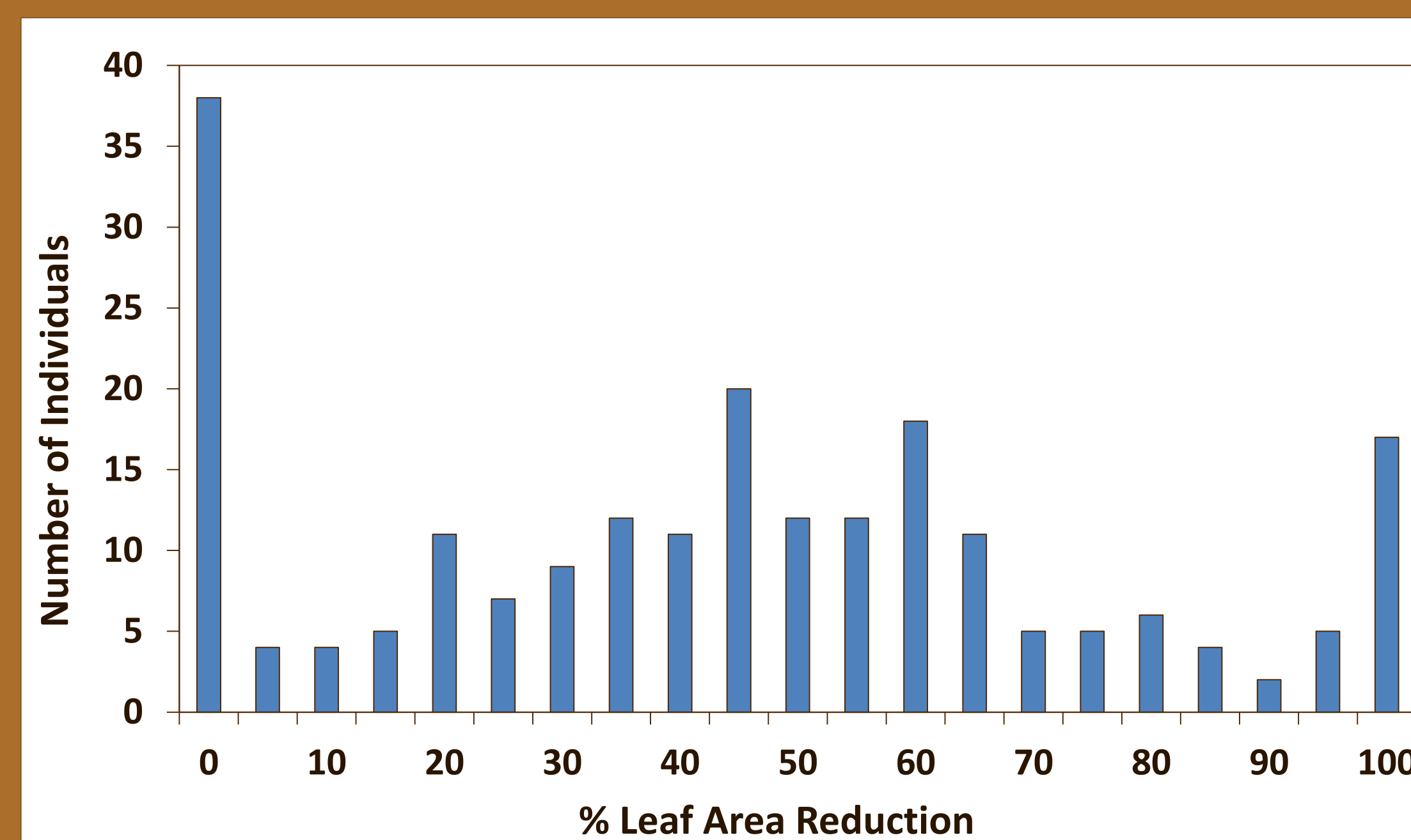


Fig. 1. Frequency density histogram of percent leaf area reduction values for an F₂ population derived from a CA 2266 x TX 110 cross in Lubbock, TX, 2011.

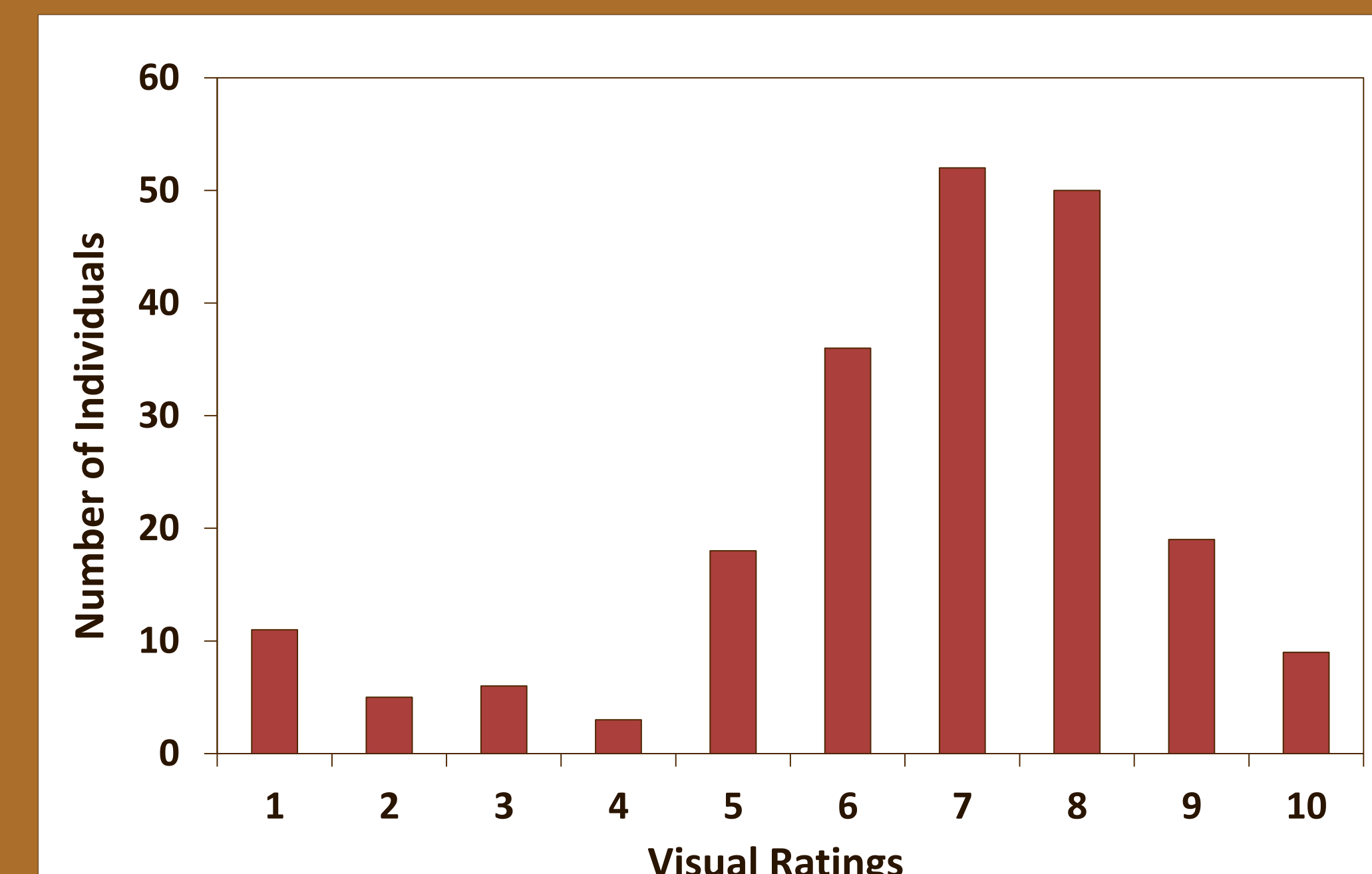


Fig. 2. Frequency density histogram of visual thrips injury rating values (1 = “plant death; 10 = “no damage”) for an F₂ population derived from a CA 2266 x TX 110 cross in Lubbock, TX, 2011.

Table 1. Leaf area reduction, visual injury rating, and thrips number results of parent, F₁, and susceptible genotypes in Lubbock, TX, 2011.

Entry	Leaf Area Reduction	Visual Injury Rating ^a	Number of Thrips ^b
All-Tex [®] Atlas	44 a	4.2 b	2.6 b ^c
CA 2266	38 a	6.0 a	9.8 a
F ₁ CA 2266 x TX 110	20 b	6.4 a	4.8 ab
TX 110	38 a	6.4 a	2.0 b

Means within a column followed by the same letter are not different based on multiple pairwise t-tests at P = 0.05. ^a Ratings conducted on 1-10 rating scale (1 = “plant death”; 10 = “no damage”); ^b Nymphs only—numbers of adults were too low to report; ^c Significant at P = 0.10.



Source: R.B. Shrestha, Texas A&M AgriLife Research



Materials and Methods

- Location:** Greenhouse facility at Texas A&M AgriLife Research and Extension Center, Lubbock, TX.
- Wheat Establishment:** Wheat (*Triticum aestivum* L.) was hand-planted 6 Oct. 2011 in small containers to provide host for thrips pests.
- Cotton Genotypes Planted:** Two parent lines (‘CA 2266’ and ‘TX 110’), the F₁ CA 2266 x TX 110 generation, the F₂ CA 2266 x TX 110 generation, and a susceptible control (All-Tex[®] ‘Atlas’) were planted 8 Nov. 2011. Wheat was terminated with herbicide on 17 Nov. 2011, forcing thrips onto the cotton.
- Experimental Design:** An F₂ population of 240 individuals was planted in a completely randomized design (CRD). Parent and F₁ lines were planted as 6-plant experimental units (EUs) in a randomized complete block design (RCBD) with 5 blocks, interspersed throughout the F₂ population. Three “clean” control blocks (containing each genotype in 6-plant EUs) were also planted and maintained thrips-free with insecticide, for determination of leaf area reduction from thrips injury.
- Data Collected:**
 - Visual damage ratings
 - Thrips numbers
 - Percent leaf area reduction
- Data Collection Methods:** Visual ratings of thrips injury were conducted on 19 Dec. 2011. Cotton seedlings were subsequently removed above node 0 and washed using the Burris method to remove and collect thrips individuals (Burris et al., 1990). Leaf area was measured with a LI-COR LI-3100C Leaf Area Meter (LI-COR, Lincoln, NE). Percent leaf area reduction was then determined from the difference in leaf area between each experimental line and its corresponding clean control.



Discussion and Conclusions

- Significant level of segregation for thrips resistance among F₂ individuals.
- Percent leaf area reduction was an insufficient phenotyping method because of significant segregation for leaf area in sprayed F₂ control groups.
- Visual damage ratings provided a more reasonable estimate of thrips injury—less leaf area bias. Phenotypic data also suggest the resistance trait is multigenic.**
- Thrips counts were not feasible on an individual plant basis (data not shown), but appeared to provide an accurate estimate of thrips numbers on a 6-plant EU basis.
- Thrips pressure in the greenhouse during experiment was low, likely due to an insufficient period of growing wheat prior to cotton planting—evidenced by atypical distribution of resistance among parent and control genotypes.
- Segregation for photoperiodicity and seed production among F₂ individuals—seed was not available from all individuals for a subsequent F₃ progeny test.
- Repeating experiment on field scale with a non-photoperiodic F₂ population could ensure more reliable results and seed availability for F₃ progeny testing.**
- Greater reliance on visual injury ratings necessary for future F₂ phenotyping.**

References and Acknowledgements

- Burris, E., A.M. Pavloff, B.R. Leonard, J.B. Graves, and G. Church. 1990. Evaluation of two procedures for monitoring populations of early season insect pests (*Thysanoptera: Thripidae* and *Homoptera: Aphididae*) in cotton under selected management strategies. *J. Econ. Entomol.* 83:1064-1068.
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