Cultivars and IPM Systems for Organic Cotton Production: Field Mapping Populations for Thrips Resistance

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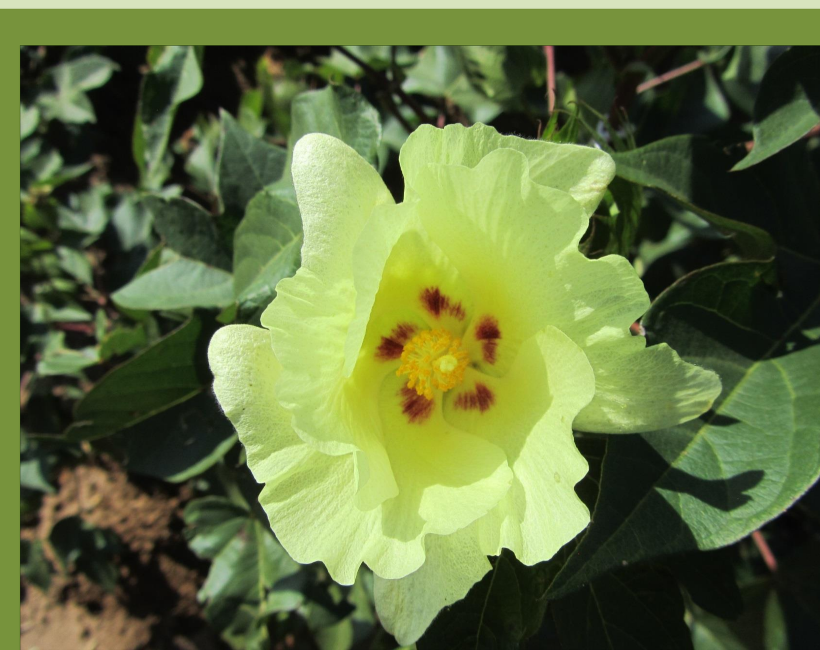
Introduction

- 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 organic 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 thrips-resistant cultivars could have greatest economic impact on 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: Evaluate phenotypic distribution of F_2 and F_3 mapping populations at the field level for potential molecular marker development for the thrips resistance trait.**



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

Materials and Methods

- **Location:** Texas A&M AgriLife Research and Extension farms at Halfway, TX and Lubbock, TX.
- **Cotton Genotypes Planted:** Two parent lines ('07-7-1407CT' and 'Cobalt'), F_2 07-7-1407CT x Cobalt (2012 only), F_3 07-7-1407CT x Cobalt (2013 only), and resistant and susceptible controls ('TX 110' and All-Tex® 'Atlas', respectively) were planted on 23 May 2012 and 16 May 2013.
- **Experimental Design:** 247 F_2 individuals and 204 F_3 families were planted in a completely randomized design (CRD) in 2012 and 2013, respectively. Parent lines and controls were planted as single rows in a randomized complete block design (RCBD) with > 5 blocks, interspersed throughout the F_2 and F_3 populations.
- **Data Collected:** Visual damage ratings, utilizing a 1-9 scale (1 = plant necrosis; 9 = no damage). Ratings were conducted on individuals in both F_2 and F_3 populations, but the distribution of F_3 family means were evaluated.

Results

Table 1. Visual thrips injury ratings of parents and resistant and susceptible controls in Lubbock and Halfway, TX, 2012-2013.

Genotype	2012[a]	2013
07-7-1407CT	6.1 ab	4.0 a
All-Tex® Atlas	5.9 b	3.5 a
Cobalt	6.7 a	4.0 a
TX 110	6.6 a	2.7 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 using 1-9 rating scale (1 = "plant death"; 9 = "no damage").

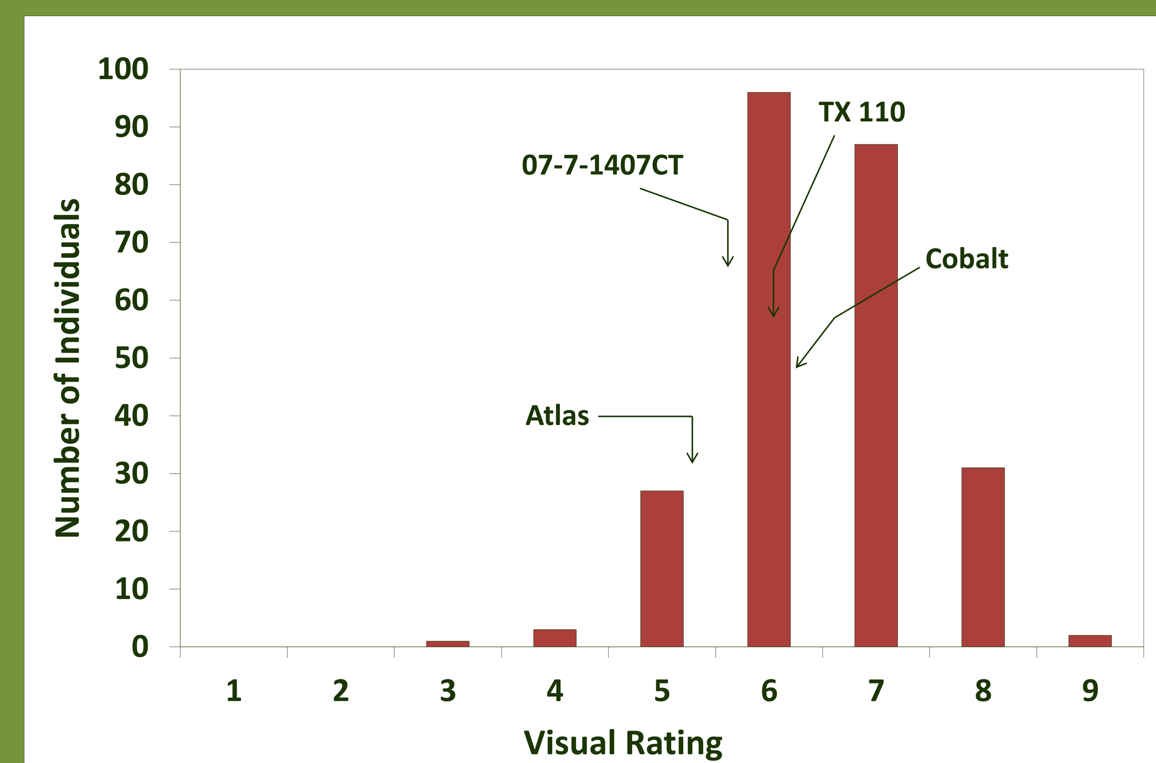


Fig. 1. Frequency density histogram of visual thrips injury rating values (1 = "plant death; 9 = "no damage") for a field F_2 population derived from a 07-7-1407CT x Cobalt cross in Lubbock, TX, 2012.

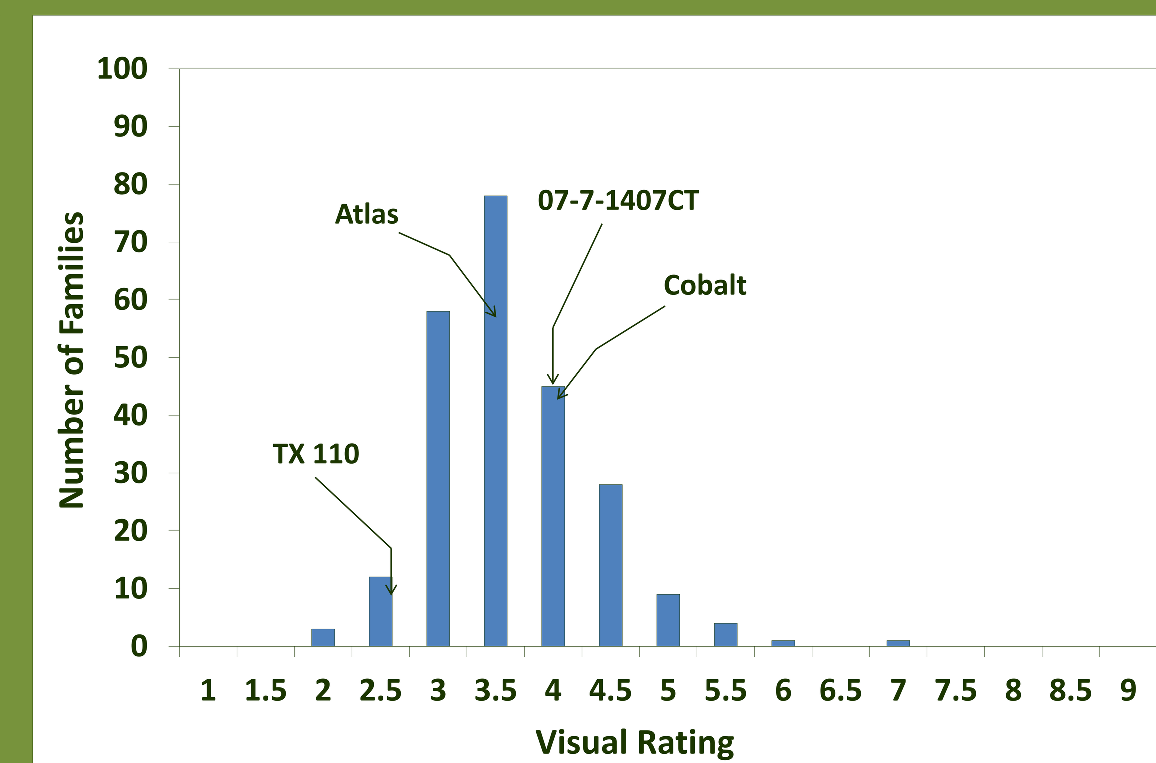


Fig. 2. Frequency density histogram of visual thrips injury rating values (1 = "plant death; 9 = "no damage") for a field F_3 population derived from a 07-7-1407CT x Cobalt cross in Halfway, TX, 2013.

Discussion and Conclusions

- Significant differences in thrips tolerance among parents and resistant and susceptible controls occurred both years (Table 1). Ambient thrips pressure varied dramatically between the two site-year-locations. The 2012 location (Lubbock) had relatively low ambient pressure, while the 2013 location (Halfway) exhibited heavy pressure.
- In 2012, Cobalt and TX 110 sustained less injury than susceptible Atlas ($P \leq 0.05$). In 2013, TX 110 appeared severely damaged by thrips, likely due to inadequate stand establishment and subsequent leaf development resulting from poor seed quality. Damage ratings were not different among the other parents and susceptible control ($P > 0.05$), likely as a result of the greater ambient thrips pressure at that location.
- **These results indicate that true resistance to thrips injury likely does not exist—only a high level of tolerance.**
- Significant level of segregation for thrips resistance among F_2 individuals and F_3 families (Figs. 1 & 2).
- Narrow distribution for F_2 population due to low ambient thrips pressure in 2012—necessary to also evaluate selfed F_3 progenies under elevated thrips pressure.
- **Molecular analysis will be conducted on both populations.** Fresh leaf tissue was collected from each F_2 individual and composite samples were collected from each F_3 family.
- More continuous distribution for F_3 family means than for F_3 individuals (F_3 individual data not shown). **Continuous distribution of phenotypes alludes to resistance mechanism that is multigenic and thereby a possible candidate for QTL analysis.**

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