DEVELOPING AN ACTION THRESHOLD FOR THRIPS IN THE TEXAS HIGH PLAINS

David Kerns
Megha Parajulee
Texas AgriLife Research and Extension Center, Texas A&M System
Lubbock, TX
Ed Bynum
Texas AgriLife Research and Extension Center, Texas A&M System
Amarillo, TX
Monti Vandiver
Texas AgriLife Extension Service, Texas A&M System
Muleshoe, TX
Manda Cattaneo
Texas AgriLife Extension Service, Texas A&M System
Seminole, TX
Kerry Siders
Texas AgriLife Extension Service, Texas A&M System
Levelland, TX
Dustin Patman
Texas AgriLife Extension Service, Texas A&M System
Crosbyton, TX

Abstract

In the Texas High Plains and most of the cotton growing areas of the United States thrips are a dominating pest during the pre-squaring stage of cotton. The most dominate thrips species affecting irrigated cotton fields on the Texas High Plains is the western flower thrips, *Frankliniella occidentalis* (Pergande). This was the third year conducting this study. The purpose of this study was to determine at what population density western flower thrips should be subjected to control tactics to prevent yield reduction and significant delayed maturity, to compare two action thresholds for thrips, and to determine whether there is a relationship thrips induced yield reduction and temperature. This study was conducted in irrigated cotton across the Texas High Plains. Based on limited data; it appears that when the daily maximum temperature is at or below 83° F for a 4-5 day period, the current action threshold of 1 thrips/true leaf appears to be too high and that a better threshold should probably be about 0.5 thrips/true leaf. When the daily maximum temperature is > 83° F, the current action threshold of 1 thrips/leaf appears to be acceptable or possibly too high when temperatures exceed 90° F.

Introduction

Thrips are a significant economic pest of cotton during the pre-squaring stage of growth and development in most of the cotton growing areas of the United States. On the Texas High Plains, the western flower thrips, *Frankliniella occidentalis* (Pergande), is the primary thrips species comprising 75-95% of the population infesting cotton (Figure 1). In irrigated cotton where thrips populations are historically high (usually areas where there is significant acreage of wheat) many growers opt to utilize preventative insecticide treatments such as in-furrow applications or seed treatments to control thrips. However, where thrips populations are not "guaranteed" to be especially troublesome, preventive treatments may not be necessary and represent an unnecessary expense. In these situations, well timed banded foliar insecticide applications for thrips control may be more profitable. Currently the treatment threshold for thrips on irrigated cotton on the Texas High Plains is when the average total thrips per plant equals or exceeds the number of true leaves.

Additionally, thrips damage to cotton appears to be most severe in years when cool early-season temperatures persist. However, at what temperatures damage is most severe is not known.

Materials and Methods

This study was conducted in irrigated cotton in Bailey County in 2007, in Bailey, Crosby, Gaines, Hale, Hockley and Lubbock counties in 2008, and in Gaines, Lubbock and Hale counties in 2009. In 2007-08, plots at all locations were 2-rows wide × 100-ft long, while in 2009 all plots were 4-rows wide × 100-ft. Plots were arranged in a RCB design with 4 replicates. The foliar treatment regimes are outlined in (Table 1). These treatments were simply a means of manipulating the thrips populations at different times in an attempt to focus on when thrips feeding is most damaging.

All foliar sprays consisted of Orthene 97 (acephate) applied at 3 oz-product/acre with a CO_2 pressurized hand boom calibrated to deliver 10 gallons/acre. Thrips were counted weekly by counting the number of larvae and adult thrips from 10 plants per plot. Whole plants were removed and inspected in the field. Each plot was harvested in entirety in 2007, using a stripper with a burr extractor, and a 1/1000th acre portion was harvested from each plot using an HB hand stripper from tests in 2008-09. Data were analyzed using linear regression models and PROC MIXED with means separated using an F protected LSD ($P \leq 0.05$) (SAS Institute 2003).

Table 1. Foliar treatment regime timings.

	2007	2008	2009
1) Untreated check	X	X	X
2) Automatic treatment on week 1	X	X	X
3) Automatic treatment on weeks 1 and 2 (only week 2 in 2008)	X		X
4) Automatic treatment on weeks 1, 2 and 3	X	X	X
5) Automatic treatment on week 2		X	X
5) Automatic treatment on weeks 2 and 3	X	X	X
6) Treatment based on the Texas AgriLife Extension Threshold[a]	X	X	X
7) Treatment based on the above threshold with 30% larvae	X	X	
[a]One thrips per plant from plant emergence through the first true leaf stage, and one thrips per true leaf thereafter until the cotton has 4 to 5 true leaves			

Results and Discussion

In 2007, we only had one test site. At this location the thrips numbers were relatively low throughout the test period (Figure 1A). The thrips did not exceed the action threshold in the untreated plots until week 3. All of the treatment regimes that were sprayed during week 1 yielded significantly more lint than the untreated (Figure 1B), although the thrips populations were below 0.5 thrips/plant during this period (Figure 1A). Although both of the threshold treatment regimes were sprayed at the same time, and did not differ from each other, the threshold regime that did not depend on the occurrence of thrips larvae yielded significantly more than the untreated. The treatment regime sprayed on weeks 2 and 3 failed to produce significantly more lint than the untreated.

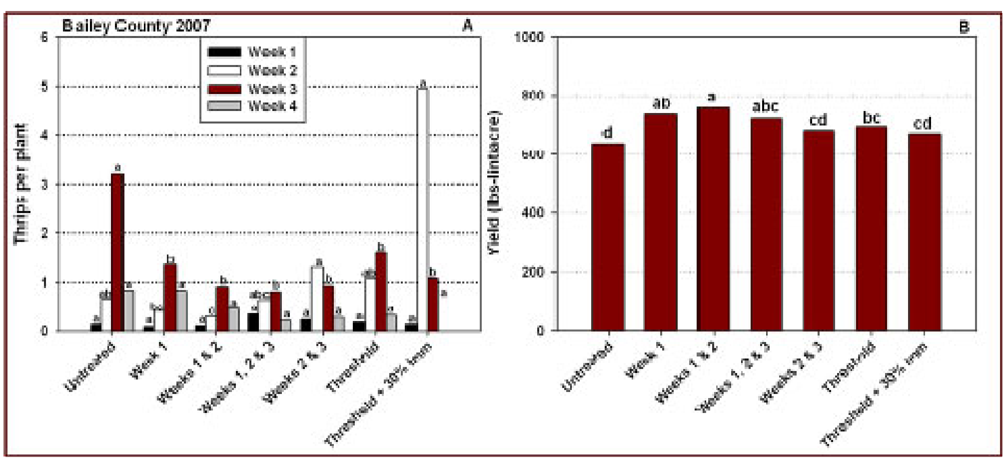

Figure 1. (A) Number of thrips per plant at various treatment regimes. (B) Yield of cotton exposed to various treatment regimes for thrips. Same colored bars capped with the same letter are not significantly different based on LSMEANS and a *F* protected (LSD, $P <$ 0.05).

There was a significant correlation between yield and thrips density at week 2 or 1 true leaf stage (Figure 2A) and week 3 or 2 true leaf stage (Figure 2B). Week 3 exhibited the closest correlation with an R^2=0.97 probably because it represents cumulative damage over the entire time period. On both graphs yield reduction appeared to level off at approximately 1 thrips per plant. At the 1 true leaf stage, the decline in yield appeared to lessen at approximately 0.5 thrips/plant (Figure 2A) while at the 2 true leaf stage yield reduction appeared to lessen at about 1 thrips per plant (Figure 2B). Regardless of growth stage, 0.5 thrips/true leaf appears to be the most suitable threshold in this test, which is 50% of the current recommended threshold.

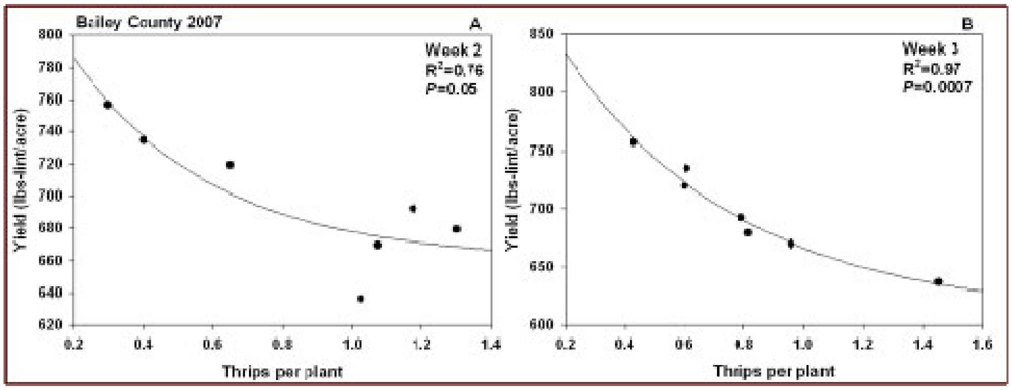

Figure 2. Linear relationship between thrips per plant and yield

For the 2008 tests, the data for thrips densities and yields were pooled across locations for presentation. Additionally, yields were normalized across locations to account for variation due to other factors. Overall thrips densities were higher in 2008 than in 2007, particularly during the first 2 weeks of development (Figure 3A). There were significant differences in the thrips populations among treatments during weeks 2 and 3. Invariably, plots receiving an insecticide application the previous week tended to have lower thrips numbers than those that were not treated. Despite higher thrips numbers, unlike 2007 there were no significant differences in yield across tests when pooled, or by test that could be attributed to thrips damage despite obvious injury due to thrips at several locations (Figure 3B). Similarly, regression analyses of the 2008 data could not detect any significant relationships between thrips density and yield.

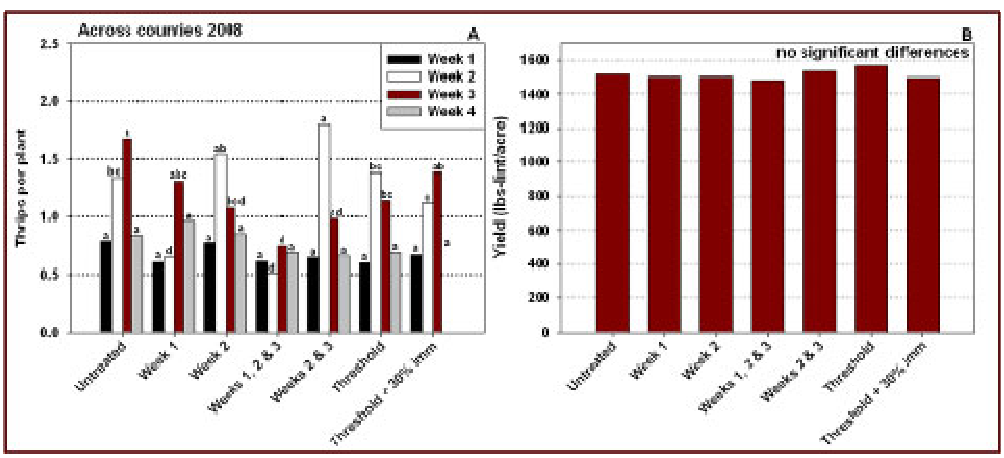

Figure 3. (A) Number of thrips per plant at various treatment regimes. (B) Yield of cotton exposed to various treatment regimes for thrips. Same colored bars capped with the same letter are not significantly different based on LSMEANS and a *F* protected (LSD, P < 0.05).

The lack of impact of thrips on yield in 2008, despite higher thrips densities during the first few weeks of plant development (critical time period based on 2007), appears to be related to temperature and subsequent rapidity of plant growth (Table 2). Although sites such as Hale County in 2008 had temperatures similar to those experienced at week 1 in Bailey County in 2007, cool temperatures were short lived and subsequent temperatures were much warmer.

Table 2. Test sites plant growth and climatic conditions.

County	Week 1 Growth stage Avg Temp °F (min-max)	Week 2 Growth stage Avg Temp °F (min-max)	Week 3 Growth stage Avg Temp °F (min-max)	Week 4 Growth stage Avg Temp °F (min-max)
2007				
Bailey	Cotyledon	1 true leaf	2 true leaves	4 true leaves
	52-79	54-82	57-82	56-86
2008				
Bailey	Cotyledon	2 true leaves	4 true leaves	6 true leaves
	68-100	61-93	62-97	62-90
Crosby	Cotyledon	2 true leaves	5 true leaves	--
	68-102	66-95	67-98	--
Gaines	Cotyledon	1 true leaf	2 true leaves	5 true leaves
	59-95	63-91	68-102	65-95
Hale	Cotyledon	1 true leaf	3 true leaves	5 true leaves
	56-74	58-93	57-93	60-94
Hockley	Cotyledon	2 true leaves	4 true leaves	6 true leaves
	67-103	64-95	67-100	63-90
Lubbock	Cotyledon	2 true leaves	4 true leaves	5 true leaves
	61-91	68-96	65-95	70-99
2009				
Gaines	Cotyledon	2 true leaves	4 true leaves	6 true leaves
	56-81	59-87	65-93	--
Hale	Cotyledon	2 true leaves	4 true leaves	5 true leaves
	56-74	58-88	61-93	--
Lubbock	Cotyledon	2 true leaves	4 true leaves	5 true leaves
	58-82	58-82	58-88	64-92

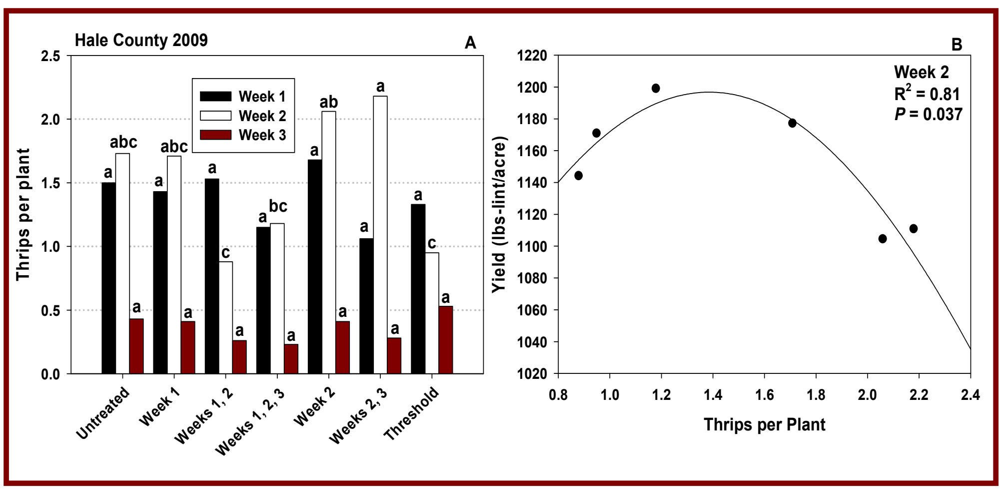

Figure 4. (A) Number of thrips per plant at various treatment regimes; same colored bars capped with the same letter are not significantly different based on LSMEANS and a *F* protected (LSD, $P < 0.05$). (B) Linear relationship between thrips per plant and yield.

In 2009, thrips density at our test sites were lower than desired with the highest numbers being encountered at the Hale County site where thrips density approached 1.5, 1.75 and 0.4 thrips/plant during weeks 1, 2, and 3 respectively (Figure 4A). Additionally temperatures at Hale County were initially cool with lows and highs of 56 and 74 °F, but warmed considerably within a few days (Table 2). Although yield differences could not be detected among the various treatments, significant correlations for thrips density and yield were observed. The best correlation occurred at week 2 (Figure 4B). Based on this correlation, the highest yields were observed when thrips averaged approximately 1.5/plant. At week 2 the cotton was at the 2 true leaf stage and the recommended threshold at this time is 2 thrips/plant. Thus it appears that the recommended thrips threshold may be slightly too high under these circumstances.

When looking at thrips densities pooled across locations in 2009, the overall thrips density was lower than in 2008 (Figure 5A). These values were especially suppressed by data from the Gaines County site which had very low thrips numbers. Similar to 2008, we could not detect any differences in yield within sites or across sites, however, unlike 2008 significant correlations between pooled thrips density and pooled normalized yields were observed. When thrips density for week 3 and yield for 2009 are regressed, a highly significant correlation is observed (Figure 5B). This suggests that thrips populations at any one period in time during 2009 were too low to impact yield, but since week 3 represents an accumulation of damage over a 3 week period, a trend towards yield loss did occur. In this model, yield declines until thrips reach 0.5 to 1.0 thrips/plant. Due to the cumulative damage effect, it is difficult to identify a specific action threshold based on this data, but it appears that thrips populations should be maintained at least below 1 thrips/plant.

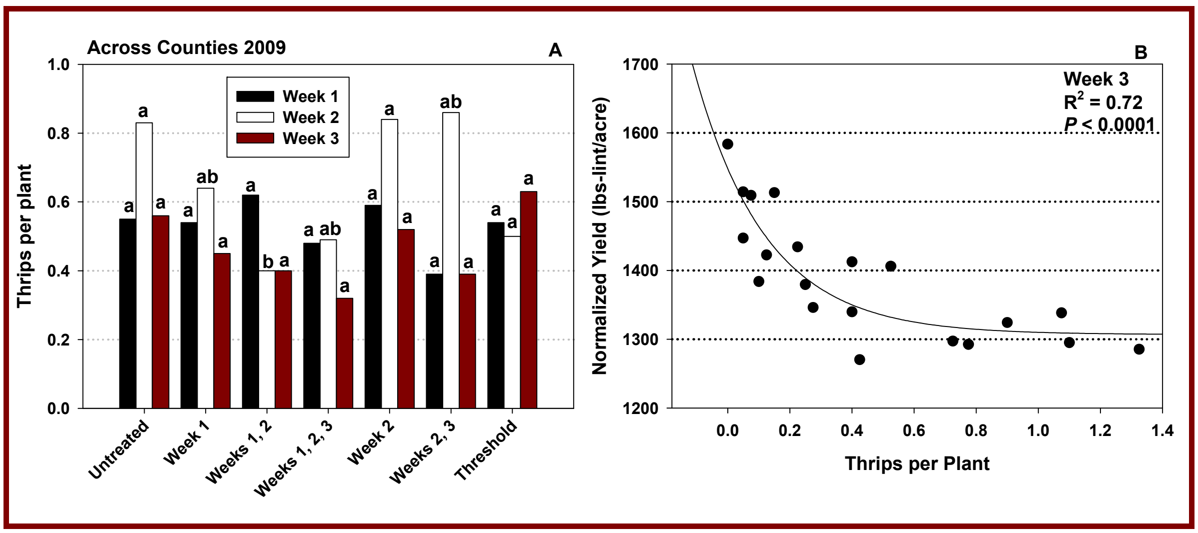

Figure 5. (A) Number of thrips per plant at various treatment regimes; same colored bars capped with the same letter are not significantly different based on LSMEANS and a *F* protected (LSD, $P < 0.05$). (B) Linear relationship between thrips per plant and yield.

Conclusion

Based on limited data, it appears that when the daily maximum temperature is at or below 83° F for a 4-5 day period, the current action threshold of 1 thrips/true leaf appears to be too high and that a better threshold should probably be about 0.5 thrips/true leaf. When the daily maximum temperature is > 83° F, the current action threshold of 1 thrips/leaf appears to be okay or possibly too high when temperatures exceed 90° F.

Acknowledgements

This project was funded by Cotton Incorporated, Texas State Support, and in part by Plains Cotton Growers, Inc.

References

Harp, S.J., and V.V. Turner. 1976. Effects of thrips on cotton development in the Texas Blacklands. Southwest. Entomol. 1:40-45.

Hawkins, B.S., H.A. Peacock, and T.E. Steele. 1966. Thrips injury to upland cotton (*Gossypium hirsutum* L.) varieties. Crop Sci. 6:256-258.

Kerns, D.L., C.G. Sansone, K.T. Siders and B.A. Baugh. 2009. Managing cotton insects in the High Plains, Rolling Plains, and Trans Pecos areas of Texas. Texas AgriLife Extension Bull. E-6.

SAS Institute. 2003. PROC User's Manual, Version 9.1. SAS Institute, Cary, NC.

Williams, M.R. 2008. Cotton insect losses-2007. pp. 927-979. *In* Proceedings, Beltwide Cotton Conf., National Cotton Council, Memphis, TN.