DEVELOPMENT OF A BINOMIAL SAMPLING PLAN TO ESTIMATE THRIPS POPULATIONS IN COTTON TO AID IN IPM DECISION MAKING

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Abstract

Thrips are problematic throughout much of the U.S. cotton belt and can negatively impact early-season cotton if curative action is not taken. In this study we compare two different methods (visual and cup) for sampling thrips on seedling cotton, and using these sampling methods we began the process of developing a binomial sampling plan. This study was conducted in a variety of locations across the Texas High Plains and far west Texas in commercial cotton fields. The sample data collected from both methods of sampling were used to determine how many cotton leaves were infested to mean thrips density relationship needed to develop the binomial sample plan using the following formula ($P(I)=1-e^{-m[LN(amb-1)/(amb-1-1)]}$). Taylor's power law effectively modeled the thrips sample data from both sample methods. Taylor's coefficients suggest that thrips nymphs tend to be more clumped than adult thrips, but neither appear to be highly clumped. This may be an artifact of small sample unit size. The relationship between the P(I) cotton leaves and thrips mean density was also modeled well by using the method of Wilson and Room (1983). The relationship was similar for both sample methods and thrips age classes, thus both sample methods should perform equally well. However, additional data is needed to determine the relative cost reliability of each sample method and develop sample plans. This will be completed in 2010.

Introduction

Thrips are a serious early-season pest of cotton throughout much of the U.S. cotton belt, and have been demonstrated to cause a 21% average yield loss to irrigated cotton on the Texas High Plains. Currently, much of the cotton on the Texas High Plains is protected from thrips damage preventively by the use of in-furrow and seed-applied insecticides. However, where thrips are not perennial pests, preventive insecticide use may not be necessary and foliar curative actions may be more economical. Additionally, many growers are interested in eliminating at planting preventive pesticide applications for thrips management as a means of reducing early season production costs. Currently, thrips in Texas are sampled using a whole plant inspection method where all the thrips are counted. This technique is extremely time consuming, tedious, difficult, and may lead to inaccurate results depending on the scout's experience. A binomial, presence or absence, sampling protocol may reduce sampling time as much as 85% and may make insecticide application decision making more accurate.

Materials and Methods

This study took place in a number of commercial cotton fields located across far west Texas and the Texas High Plains. Western flower thrips were sampled in each cotton field in an area at least 60 rows x 200 ft that was left untreated by foliar and/or preventative treatments for thrips.

Thrips at each location were counted from individual plants on a weekly basis from crop emergence to the 5 true leaf stage. Fifty sampling bouts per field were conducted for each sampling method. Each sampling bout consisted of three plants from the same location within the field.

The two sampling methods evaluated were conducted using two destructive sample methods (Figure 1); a visual and a 16oz plastic cup sampling method. Individual plants were removed from the soil by gently grasping the cotton stem at the soil line and pulling straight up. Then the cotton plant was either subjected to visual or the cup sample method. Visual inspection was accomplished using a sharpened pencil to pry apart folded or creased leaf tissue to expose hidden thrips then adults and nymphs were counted and recorded. The cup method was employed by inserting the cotton plant into the cup and shaken vigorously for several seconds to dislodge any thrips on the plant into the cup. Adult and nymph thrips dislodged into the cup were counted and recorded, then discarded.

Sample data from both methods was used to determine the proportion cotton leaves infested to mean thrips density relationship (Wilson and Room 1983) needed for development of the binomial sampling plan. With enough data, a binomial sequential sampling plan will be developed following procedures developed by Wilson and Room (1983a,b). The relationship of the mean and proportion of thrips infested cotton leaves will be determined by:

$$P(I)=1-e^{-m[LN(amb-1)/(amb-1-1)]}$$

where P(I)=the proportion of thrips infested leaves, a and b are parameters from Taylor's power law (1961), and m=the mean density at which a management decision is needed.

The variance component k of the negative binomial distribution will be determined:

$$k = m/(am^{(b-1)}-1)$$

where a and b are parameters from Taylor's power law (1961) and m is the threshold.

The threshold used in this study is 1 thrips per true leaf and is a nominal threshold as an economic threshold has yet to be established for western flower thrips in cotton.

Results and Discussion

Taylor's power law effectively modeled the mean/variance relationship for total thrips for both sample methods, thrips age classes and pooled across age classes (Table 1). Interestingly, Taylor's a-coefficient was less than 1 regardless of age class or sample method. Wilson (1994) regards Taylor's values that are less than 1, as artifacts of curve fitting or random sample variability, which is likely the reason here. Regressing the observed P(I) cotton leaves on the estimated P(I) cotton leaves illustrate how well the method of Wilson and Room (1983a,b) modeled the relationship between mean adult and nymph thrips density and proportion thrips infested cotton leaves (Figure 1 A & B). This was true for both sampling methods, although the cup sample method appeared to provide a better fit than the visual sample method as evidenced by the greater variability explained by the model for the cup sample method relative to the visual sample method. This may have occurred because of the potential for greater sampler error associated with the visual method.

The effect of age class on thrips aggregation was evident for both sample methods. Immature thrips tend to hide in the terminals of the cotton plant and are less mobile than winged adults, thus it was not unexpected to find that nymphs, regardless of sample method, exhibited a more aggregated distribution than adults (Figure 2 A & B). Wilson and Room (1983a) reported similar findings for *Heliothis* spp. age classes. The estimated P(I) for the nominal ET of 1 thrips per leaf derived using the binomial model of Wilson and Room (1983a, b) for the cup and visual sample methods was 0.77 and 0.74 respectively. These values were determined from the pooled thrips data, although using adult thrips would provide similar results.

These preliminary results indicated that further analysis is needed to determine if pooling across thrips age classes should be used to determine the upper decision line for the SPRTs developed.

Table 1. a and b of Taylor's power law and coefficient of determination.

Thrips age classes and Pooled age classes	a	b	R^2
Cup Sample Method			
Adult	0.6035	1.366	0.958
Nymph	0.7349	1.290	0.928
Pooled	0.6231	1.379	0.937
Visual Sample Method			
Adult	0.6873	1.397	0.963
Nymph	0.9436	1.3840	0.912
Pooled	0.7711	1.490	0.950

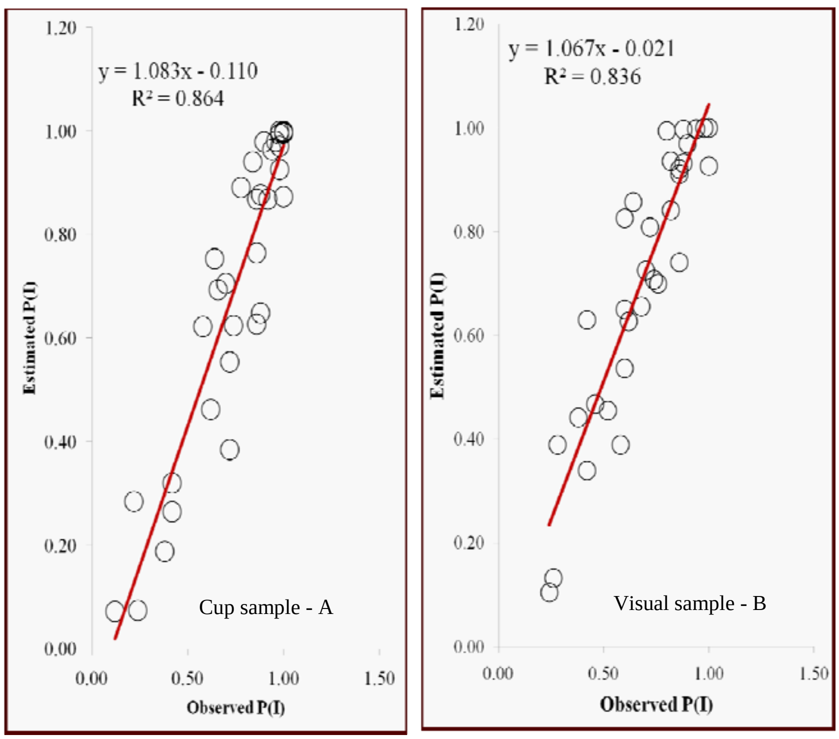

Figure 1. A) Cup sample method total thrips: relationship between observed and estimated P(I) cotton leaves; B) Visual sample method total thrips: relationship between observed and estimated P(I) cotton leaves.

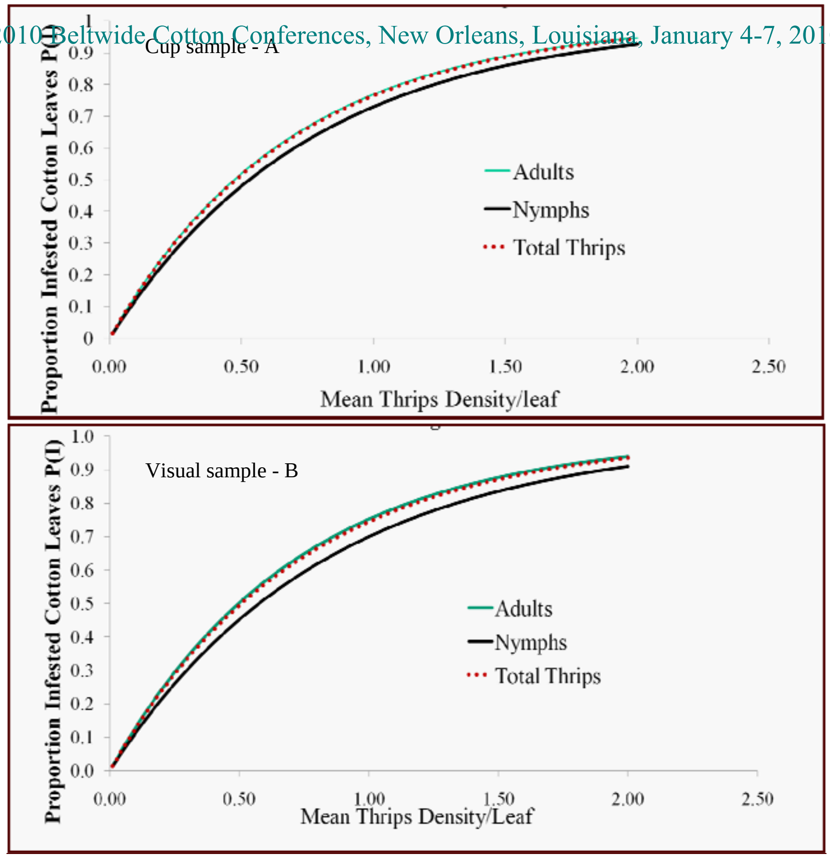

Figure 2. A) Cup sample and B) Visual sample methods: proportion of infested cotton leaves as a function of density for different thrips age classes and pooled across age classes.

Summary

Taylor's power law effectively modeled the thrips sample data from both sample methods. Taylor's coefficients suggest that thrips nymphs tend to be more clumped than adult thrips, but neither appear to be highly clumped. This may be an artifact of small sample unit size. The relationship between the P(I) cotton leaves and thrips mean density was also modeled well by using the method of Wilson and Room (1983). The relationship was similar for both sample methods and thrips age classes, thus both sample methods should perform equally well. However, additional data is needed to determine the relative cost reliability of each sample method and develop sample plans. This will be completed in 2010.

Acknowledgements

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