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DEVELOPMENT OF A RELIABLE AND EFFICIENT SAMPLING PLAN FOR COTTON FLEAHOPPER AND WESTERN TARNISHED PLANT BUG USING THE BEAT BUCKET SAMPLING METHOD

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Abstract

Several commercial cotton fields from several locations in Texas were sampled from 2000 through 2002 in order to develop an efficient and reliable sampling plan. Results indicate that the beat bucket sampling plan was less efficient, but required fewer samples and less sampling time than the visual sample method when estimating CFH population densities. The beat bucket in this study was more efficient and cost reliable relative to the visual and drop cloth sample methods when estimating WTPB population densities. Regardless of pest species and density the beat bucket required fewer samples and less sampling time to make an estimate or management decision relative to the visual and drop cloth sample methods.

Introduction

Several species of insects occur across the cotton producing states that cause significant cotton lint quality and lint yield reduction. Cotton fleahopper and Lygus plant bug (WTPB) have consistently been some of the most destructive insect pests of cotton. Estimated cotton yield loss attributable to CFH and WTPB feeding activity across the cotton-growing belt was in excess of 108, 86, and 249 million dollars in 1997, 98, and 99 respectively (Williams 1998, 1999, 2000). Imperative to the reduction of cotton yield loss attributable to these insect pests is the development and implementation of an efficient and reliable monitoring method to make cost effective, intelligent pest management decisions.

Sampling CFH and WTPB using different sampling methods intuitively increases sampling effort. In addition, visual sampling has shown to be more time consuming in time required per sample and number of samples required to estimate various beneficial arthropod population densities relative to the sweepnet and beat bucket methods (Knutson and Wilson 1999). Thus, the primary object of this proposed study is to develop an efficient and reliable sampling plan for both CFH and WTPB by developing a beat bucket sample plan and comparing the results to the commonly used visual and drop cloth sample methods. Presented herein are preliminary results from data collected during the three year period.

Materials and Methods

A total of 29 commercial cotton fields and 1 research cotton field were sampled for cotton fleahopper (CFH) and (WTPB) from 2000 through 2002. Each cotton field was divided into 4 approximately equal quadrates to ensure more uniform sampling from the entire field. From each quadrate 5 beat bucket, 6 drop cloth, and 3 visual sample bouts were taken. A single beat bucket, drop cloth, and visual sample bout consisted of 5 randomly selected two plant samples within a row, 5 randomly selected 3ft of row samples within a row, and 10 randomly selected plants within a row respectively, so that a total of 100 beat bucket, 120 drop cloth, and 120 visual samples were taken per field. Each sample bout x sample method was timed using a stopwatch. Sampling began the first week of squaring and ended at first flower for CFH, and continued throughout the growing season for WTPB. Western tarnished plant bugs were only found in sufficient population densities for sample plan development in El Paso and Hudspeth counties. The drop cloth sampling method data was collected only for Western tarnished plant bug and sampling for this method was not initiated until the 2002 growing season. Data recorded included the number of CFH and WTPB per sample, time required per sample bout, approximate field size, location of field sampled, sample date, and cooperator.

Aggregation characteristics for each insect species by sample method were determined by modeling the sample data using Taylor's Power Law (Taylor 1961). Aggregation statistics derived for each species by sample method were used to develop Green's fixed precision sequential sampling plans. Sample methods for each species were then evaluated by the sequential sample plans, relative cost reliability (CR) (Wilson 1994), and relative efficiency (RE). Relative cost reliability is a ratio of "costs" (required number of samples X sample time) of two sampling methods (Wilson 1994) and relative efficiency is a measure of arthropod recovery of one sample method relative to one or more other sample methods.

Results and Discussion

In this study, the Beat Bucket was less efficient in recovering CFH relative to the visual sample method, but more efficient than both visual and drop cloth sample methods for recovery of WTPB (Table 1). These results appear to be attributable, at least in part, to plant size and sampler bias. It seems reasonable that as plant size increases the relative efficiency of visual sampling decreases because of increased plant surface area to be visually inspected. Thus, as plant surface area increases sampler efficiency decreases with visual sampling. The beat bucket method reduces sampler error because the sampler is no longer visually inspecting the plant. Analysis is still needed to support this hypothesis.

Regardless of pest species, density, or relative efficiency the beat bucket sample method required fewer samples to estimate pest population densities, less time to collect these samples and therefore possessed better cost reliability values relative to the visual and drop cloth sample methods (Figs 1-2, Table 1). For example to estimate a population density of 0.3 WTPB per plant would require 26 beat bucket samples for a total of 17minutes, 89 visual samples for a total of 102 minutes, and 44 drop cloth samples for a total of 31minutes. To estimate the same population density for CFH, 47 beat bucket samples at 31 minutes and 87 visual samples at 100 minutes would be required. Thus, using the beat bucket to sample CFH would reduce sampling effort by 69% and for WTPB would reduce sampling effort by 83% relative to visual sampling and by 45% relative to drop cloth sampling.

References

Green, R. H. 1970. On fixed precision level sequential sampling. Res. Popul. Ecol. 12: 249-251.

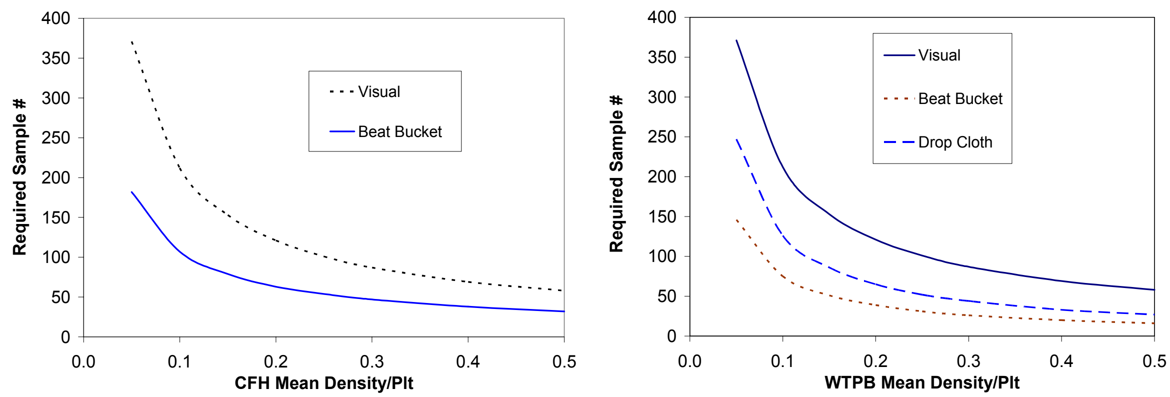
Knutson, A. & T. Wilson 1999. The Beat Bucket: a rapid, reliable method for sampling predatory insects and spiders in cotton. Proc. Beltwide Cotton Conf. : 1120-1125

Taylor, L.R. 1961. Aggregation, variance, and the mean. Nat. 189: 732-735.

Williams, M.R. 1998-2000. Cotton Insect Losses. Proc. Beltwide Cotton Conf.

Table 1. Relative efficiency and cost reliability of each sample method for cotton fleahopper and Western tarnished plant bug. Values for visual set at 1.0 as a standard reference.

Species	Sample Method	Relative Efficiency	Cost Reliability
CFH	Visual	1.00	1.00
	Beat Bucket	0.765	0.354
WTPB	Visual	1.00	1.00
	Beat Bucket	1.90	0.353
	Drop Cloth	1.57	0.525



Figures 1-2. Stop lines for Green's fixed precision sequential sampling plans based on beat bucket, visual and drop cloth sample methods and for cotton fleahopper and Western tarnished plant bug: Precision: 0.35.