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UPDATE ON REGIONAL TARNISHED PLANT BUG SAMPLING IN THE MID-SOUTH

Scott D. Stewart
The University of Tennessee
Jackson, TN
Glenn Studebaker
University of Arkansas
Keiser, AR
Gus M. Lorenz
Univ. of Arkansas CES
Little Rock, AR
Fred Musser and Angus Catchot
Mississippi State University
Mississippi State, MS
Jeremy Greene
University of Arkansas
Monticello, AR
Ralph D. Bagwell
LSU Agcenter
Winnsboro, LA

Abstract

Tarnished plant bug, *Lygus lineolaris*, has recently become the primary pest of mid-season cotton in the Mid-South. Sampling protocols during this period of development are poorly established, resulting in many insecticide applications being recommended based largely on a consultant's personal experience. An evaluation of 9 sampling methods was conducted on commercial fields throughout the Mid-South during 2005. Results show sweep nets and drop cloths to be much more efficient than other direct sampling methods. Sampling dirty blooms was the most efficient indirect sampling method. Correlations to other sampling methods show whole plant counts and sweep nets have the strongest correlations. Further research is needed to establish which methods are most strongly correlated to yield losses.

Introduction

The tarnished plant bug (TPB), *Lygus lineolaris*, is an important pest of cotton in the Mid-South (Layton 2000) that has frequently required insecticide applications prior to the blooming period of development in conventional cotton (Black 1973). Prior to 1995, later populations of TPB were controlled by insecticides directed at other pests so mid-season damage from TPB was rare. However, with >80% of Mid-South cotton now being planted to Bt-transgenic cotton and the eradication of the boll weevil, many of the foliar applications for mid-season pests have been eliminated. One consequence of this change is that hemipteran pests have become the dominant mid-season pest complex in Mississippi, Louisiana, Arkansas and Tennessee during the last five years. Control costs and crop losses associated with plant bugs have increased dramatically during the flowering period, with 4-8 insecticide applications for TPB in some years (Williams 2005).

Action thresholds have been developed so that insecticides are only applied when economically justified based on an estimate of the current insect population. These insect population estimates, obtained through sampling, need to have high accuracy while being collected in an efficient manner. Considerable work has been done to determine the most efficient and accurate methods for sampling TPB and their damage during the pre-bloom stages of cotton plant development (Fleischer et al. 1985, Snodgrass 1993). Consequently, agricultural pest managers have become comfortable with the sampling procedures and action thresholds recommended by state extension personnel for tarnished plant bugs in pre-bloom cotton where sweep net samples along with square retention counts are used to determine the appropriate timing of insecticide applications for TPB (e.g., Stewart and Lentz 2005). Unfortunately, there is no consensus on sampling methods for plant bugs during the flowering stages of cotton development. Drop cloth samples are generally perceived at the most accurate way to measure TPB infestations in flowering cotton (Young and Tugwell 1975, Snodgrass 1993) so mid-season treatment thresholds for TPB in cotton are typically based on drop cloth samples in the South (e.g., Greene 2004). However, consultants and pest managers are reluctant

to use drop cloths because of the perceived time and effort required for sampling. Many agricultural consultants are basing their control recommendations on visual observations, but methods of visual scouting are not standardized and vary considerably among individuals. Furthermore, accurate thresholds have not been established for visual samples, so many applications are based more on the experience of the consultant than on scientific research.

Several experiments have attempted to compare the accuracy and efficiency of drop cloths and sweep net samples for TPB in cotton. In flowering cotton, Gore (2005) found a relatively good correlation between these two sampling methods. Stewart et al. (2001) found that the relationship between these two methods varied, in part because drop cloths were better at sampling immature insects, and sweep nets tended to catch relatively more adults. Recent data suggest that plant-based monitoring procedures, such as numbers of damaged or frass-stained squares, may be more reliable than insect counts (Gore, 2005). Boll injury thresholds for stink bugs have been adopted in much of the Cotton Belt. These thresholds (e.g., Catchot 2005) call for treatment when 15-20% of thumb- or quarter-sized bolls show internal evidence of injury such as warts on the boll wall and lint staining. This approach was primarily validated in the Southeast (e.g., Greene et al. 2001), where stink bugs infestations in cotton are more common than tarnished plant bug infestations. To identify accurate and efficient sampling methods for TPB during mid-season in the Mid-South, numerous sampling methods were studied throughout the Mid-South during 2005.

Materials and Methods

An evaluation of nine sampling methods was conducted on 120 fields across a four-state region representing Mid-South cotton production environments. Within each field, each sampling method was used and timed in four sites. Five methods directly counted adult and immature TPB while four methods sampled damage done by these insects. The direct sampling methods and the sample unit evaluated were 15-inch diameter sweep net (25 sweeps), black drop cloth (5 row feet), whole plant count (25 plants searching the terminal, 2 squares, 1 bloom and 1 boll), squares (25 squares), and blooms (25 blooms). The plant-based indirect sampling methods and their sample unit were dirty squares (25 squares), dirty blooms (25 blooms), external boll damage (25 bolls) and internal boll damage (25 bolls). In addition to sample counts and times, date, time of day, average plant height, average number of plant nodes, average number of nodes above the first position white flower (NAWF), temperature, wind speed and the presence of dew or other moisture were recorded in each field to enable an evaluation of the impact of these factors on each sampling method.

An absolute reference for TPB density does not exist, so to estimate bias in each sampling method we created a reference from a composite of all 9 sampling methods. For each field (4 sample units), the count for each method was divided by the overall mean (120 fields) of that method. The composite count for each field is the mean of these 9 ratios. Correlations were then made between each sampling method and the composite count. Precision of sampling methods was evaluated by comparing the coefficients of variation after removing the field factor. Efficiency was estimated through the time required to collect a sample and the mean number of insects or damage found in a sample.

Results

Among the direct sampling methods, sweep nets caught the most adults and drop cloths caught the most nymphs (Figure 1). Sweep nets caught slightly more total TPB than drop cloths or whole plant methods per sample unit. When considering the time required for collecting a sample unit, sweep nets and drop cloths were able to collect many more insects per minute than all other sampling methods (Figure 2). Among indirect sampling methods, the highest damage per sample unit was found in dirty blooms, which was also the most rapid indirect sampling method (Figures 3, 4).

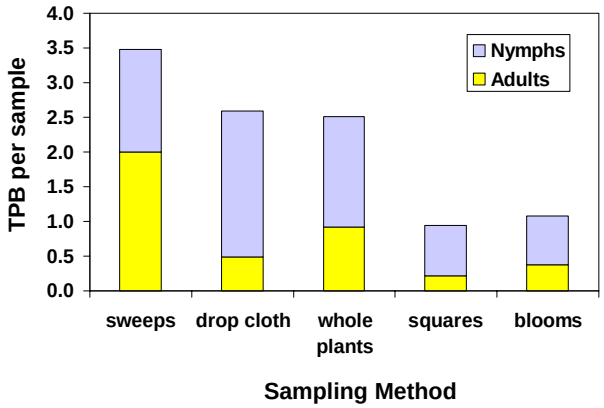

Figure 1. Mean adult and nymph TPB collected per sample unit.

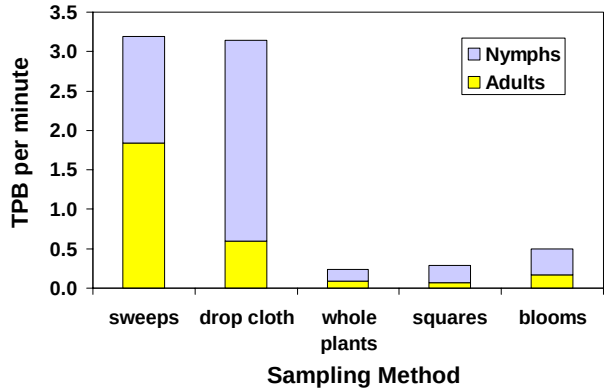

Figure 2. Mean adult and nymph TPB collected per minute of sampling.

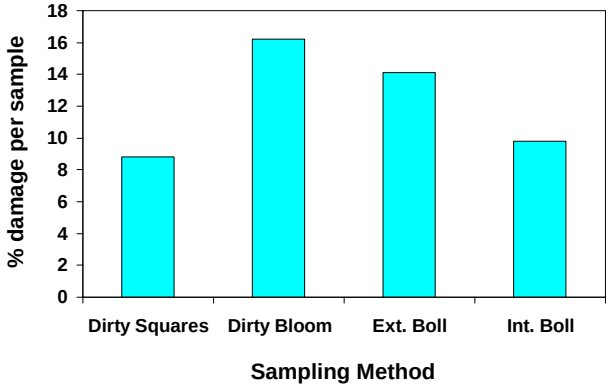

Figure 3. Mean TPB damage observed per sample unit

Figure 4. Mean TPB damage observed per minute of sampling

Correlations between individual sampling methods and the composite reference show that whole plant and sweep net sampling methods have the strongest correlations while counting TPB in blooms and dirty blooms have the weakest correlations (Table 1). However, when comparing the recommendations generated by each sampling method based on established or equivalent pest densities, sweep nets, whole plants and dirty blooms show the strongest level of agreement with the other sampling methods (Table 1). With the exception of square and bloom direct sampling methods which had small means, the differences in precision among the sampling methods tested were small (Table 1).

Table 1. Coefficients of variation and correlation coefficients between individual sampling methods and a composite of all sampling methods.

Sampling method	Correlation to composite (R)	Coefficient of variation (%)	% Recommendations different from majority[1]
Direct Sampling Methods			
Sweep net	0.900	73.2	10.5
Drop cloth	0.855	79.4	26.3
Whole plant	0.923	78.0	10.5
Squares	0.874	146.5	14.5
Blooms	0.671	109.1	31.6
Indirect Sampling Methods			
Dirty squares	0.869	74.2	21.1
Dirty blooms	0.764	49.2	11.8
Internal bolls	0.805	83.2	21.1
External bolls	0.776	65.5	26.3

[1]Recommendation to control TPB in comparison to the recommendation of the majority of the nine sampling methods. Thresholds (some of which were created from this data set in comparison to existing thresholds) used for this calculation were: sweep net- 20 TPB/ 100 sweeps, drop cloth- 1 TPB/ 2 row ft., whole plant- 15 TPB/ 100 plants, squares- 6 TPB/ 100 squares, blooms- 5 TPB/ 100 blooms, dirty squares- 10% damaged, dirty blooms- 20% damaged, internal bolls- 12% damaged bolls, external bolls- 16% damaged bolls.

Discussion

Sweep net and drop cloth sampling methods are equally efficient, but have different biases. While sweep nets catch many more adults, more nymphs are found on drop cloths. Sweep nets had a stronger correlation with other sampling methods than drop cloths. Visual counts are effective, but very inefficient. It is unlikely that consultants would count TPB on enough plants (4-6 sample units of 25 plants each) to make an accurate assessment, as this would take up to one hour per field compared with 5 minutes (plus walking time) with a sweep net or drop cloth. Dirty blooms were the most efficient indirect sampling method tested and generally generated a recommendation consistent with the other sampling methods.

Efficient sampling methods have been identified in this research and accuracy has been addressed as the correlation of one sampling method to other methods. However, accuracy is best defined as the correlation between TPB density or damage, and yield losses. This is an area of research that is being pursued with the goal of establishing a common recommended sampling protocol for tarnished plant bugs in mid-season cotton in the Mid-South.

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