2006 Beltwide Cotton Conferences, San Antonio, Texas - January 3 - 6, 2006

TENNESSEE UPDATE - AREAWIDE TARNISHED PLANT BUG MANAGEMENT

Scott D. Stewart, Kevin Willis and Sandy Steckel
The University of Tennessee
Jackson, TN

Abstract

Studies were done to evaluate the feasibility of areawide management of tarnished plant bug (*Lygus lineolaris*) populations in cotton via the springtime removal of alternate, broadleaf weed hosts using herbicide. This areawide management program was implemented in a total of three areas of West Tennessee during 2004-2005. Data indicated that a single herbicide application reduced populations of early-spring, broadleaf hosts of tarnished plant bug from non-cropping areas surrounding production fields. A corresponding reduction in plant bug populations was found on weed hosts in herbicide-treated areas. When areas receiving herbicide treatment were compared with adjacent untreated areas, no predictable reduction of plant bug populations were detected in cotton fields.

Introduction

Tarnished plant bugs (TPB) have many alternate, weedy hosts that occur commonly in non-tillable areas adjacent to row-crop fields. These hosts include henbit, clovers, vetch, fleabane, geranium, Shepard's purse, purple deadnettle, curly dock, mustard and other common in-field and roadside broadleaf plants. Overall, grasses are less suitable hosts for the TPB. During early spring, TPB populations begin to build on these weedy hosts and eventually may infest cotton fields. Because many growers manage in-field weed populations during the spring with tillage and/or herbicide, TPB populations are often concentrated into relatively finite, non-cropping areas. There is an opportunity to reduce populations of TPB by eliminating their weedy hosts in the spring while TPB are still concentrated in these non-cropping areas. This may potentially reduce TPB populations that subsequently occur in cotton. The intent of this study was to determine if the elimination of key weed hosts from areas adjacent to fields during early spring would retard the growth of TPB populations, resulting in reduced populations in cotton. The experimental design was based on pilot research conducted by the USDA ARS in Mississippi, which also provided funding for this program.

Materials and Methods

Site Description

At each location, the treated area consisted of a contiguous land area surrounded by an untreated (check) area. In 2004, tests were established in Lauderdale and Hardeman Co., Tennessee. The Lauderdale location is located in the Mississippi River Delta in close proximity to the river, and most of the cotton acreage was conventionally tilled. The Hardeman location is more characteristic of reduced-tillage, "hill-type" cotton production common in Tennessee. Both areas have a history of relatively intensive cotton production. However, more soybeans were planted in 2004 than anticipated because of high soybean market prices. In 2005, a different test site was selected in Dyer Co., Tennessee. Like the Lauderdale location, this was a delta environment, and many fields were conventionally tilled. However, there was a much higher percentage of cotton planted at the Dyer site compared with the Lauderdale or Hardeman locations.

Lauderdale County (2004). This area was largely bordered by the Mississippi River (Fig. 1) and was chosen because it had a history of problematic TPB populations. A secondary reason for choosing this area was that the county highway department was applying herbicide during a similar time frame along parts of the roadway surrounding the test area, thus eliminating the need to treatment. Their goal, using glyphosate and sulfometuron methyl (Oust®), was to convert right-of-ways to bermudagrass. The treated area comprised about 4,900 acres and was roughly square in shape (2.9 x 2.7 miles). About 2,340 of these acres were cotton, and the remainder of the farmable acreage was primarily soybean (1,225) or corn (980). Roughly 8% of the treated area was non-tillable land (roadways, drainage ditches, etc.). The check area consisted of the surrounding cotton acreage up to a maximum distance of one mile from the nearest border of the treated area.

Hardeman County (2004). This location was primarily selected to evaluate the relative ease and expense of implementing an areawide TPB management program for a hill-type environment that is more typical of Tennessee cotton production. The treated area was relatively small, comprising 1,500 acres. About 600 acres were cotton, and

the remainder of the farmable acreage was corn (375), soybean (150) or pasture (150). Approximately 15% of the area was wooded or otherwise non-farmable. The check area was the surrounding acreage within about 1.5 miles of the treated area (Fig. 1). Because we used tree lines to define some borders of the treated area, a much higher percentage of the check area was wooded. Bordering the southern edge of the treated area were two fields, one of clover and one fallow, about 8 and 15 acres in size respectively. The fallow field had large populations of fleabane and horseweed, and both fields supported large populations of tarnished plant bugs.

Dyer County (2005). The treated area was bordered on the west by a small levee, and the Mississippi River, and on the east by a large levee (i.e., Big River Road, Fig. 1). The area was 4.5 - 5 miles long by 1 - 1.5 miles wide. There were approximately 4000 acres within this area, and a high percentage of this acreage was cotton (82%). The remaining acreage was soybean (3%) or non-farmable ground (15%) consisting primarily of levees, ditches and field margins. Because the farm land to the east of the treated area was exclusively soybean fields or wetland areas, the check area consisted of cotton fields to the south and north of the treated area. These fields were within 2.0 miles of the nearest border of the treated area.

Herbicide Application

During March of 2004 and March and early April of 2005, herbicide was applied to ditch banks, levees, field borders and other non-crop sites within the treated area. The vast majority of the herbicide (Strike 3® at 1.5 qts/acre) was applied with a Kawasaki Mule equipped with a 12-foot boom calibrated to deliver 7 gallons per acre using low-drift flat fan nozzles. A spray wand was sometimes used where driving access was limited. Production fields were not treated with herbicide by the scientists, but rather, we relied on producers to cultivate or apply "burndown" herbicides during a similar time frame. Indeed, margins immediately adjacent to fields often did not require treatment because of grower applications of herbicide.

Lauderdale County (2004). A total of 50 gallons of Strike 3 herbicide, representing approximately 133 treated acres, were applied from March 15-19. A follow-up visit was made on March 31 to make spot treatments as needed. About 15-20 additional roadside acres were treated by the highway department in early April. A small amount of non-cropland, particularly on slopes around drainage ditches and other wetlands, could not be effectively treated.

Hardeman County (2004). Although this treatment area was much smaller, nearly as much herbicide (i.e., 45 gallons) was used in Hardeman Co. as in Lauderdale Co. Applications were made on five dates from March 23-29. Wooded areas and pastures were not treated with herbicide.

Dyer County (2005). Much more herbicide was used at the Dyer location primarily due to the presence of large river levees which required treatment. A total of 178 gallons of Strike 3 herbicide was applied, indicating a total treated land area of about 475 acres. About 90% of the herbicide was applied from March 8 - April 5, but some follow-up applications were made after this time to cover misses from previous applications.

Data Collection and Analyses.

Several kinds of data were collected to determine 1) the efficacy of herbicide applications in controlling broadleaf weeds that are potential TPB hosts, 2) if TPB populations were reduced in non-cropping areas due to herbicide application, and 3) whether populations of TPB were subsequently reduced on cotton within the treated area. Insecticide treatment histories were also collected for fields within and outside the treated areas. We also recorded information to help evaluate the cost of making herbicide applications, including the amount of time and herbicide needed for the applications.

Herbicide efficacy was evaluated by taking pre- and post-application counts of weed density within herbicide treated and untreated areas. Pre- and post-treatment counts of weeds and TPB were made from March - May. Our sample unit was a 15-inch diameter ring placed on the ground, and we counted the number of plants within the ring and many locations. Counts of grass plants were grouped across species. Counts for many common broadleaf weed species were made, but we only report total numbers of broadleaf plants in this paper. For each sample, we also estimated the percent of the vegetation that was grass (2005) or the percent ground cover provided by grass species (2004). TPB populations on weed hosts were recorded at the same time by taking 25 sweeps with a standard, 15-inch sweep net at each of the above locations.

TPB populations in cotton were sampled for a 5-6 week period beginning in early June and ending in mid July. Each week, selected cotton fields within and external to our treatment area were sampled. A sample consisted of 10 sweeps taken at six locations per field. Depending upon the location, 12-16 cotton fields were sampled weekly for both the herbicide treated and untreated (check) areas.

Although this experiment is not replicated in design, we did perform analysis of variance (AOV) for selected variables to help identify the probable impacts of our herbicide treatment on weed populations and TPB numbers. These procedures were used to detect changes in weed composition that occurred, pre- vs. post-treatment, following our herbicide applications (data shown for treated area only). We also used AOV to detect treatment effects in TPB populations on weeds, comparing pre- and post treatment counts in the treated and check areas. For these analyses, weed or insects counts for all samples, regardless of sample date, were lumped as either pre-treatment or post-treatment. In Dyer County, the data for TPB populations in weeds were log transformed because of heterogeneous variances. TPB populations in cotton were analyzed using sample date and treatment (fields from treated vs. check areas) as main effects.

Results

Impact of Herbicide Application on Weed and Tarnished Plant Bug Populations in Non-cropping Areas

In all areas treated with herbicide, there were herbicide effects on the incidence of broadleaf and grass species (Fig. 2). At all locations, there was a significant reduction in the number of broadleaf plants following our herbicide application ($P < 0.05$). The number of grass plants, which was difficult to estimate, was not affected by the treatment. However, the size and percent ground cover of grasses increased dramatically after the herbicide was applied ($P < 0.05$).

There were significant impacts of herbicide application on numbers of TPB caught in sweep-net samples of non-cropping areas. Generally, TPB populations increased in areas that were not treated with herbicide, whereas, populations remained relatively static in treated areas (Fig. 3). Compared with 2004, average TPB populations on weeds from the untreated area were considerably higher at the Dyer location in 2005. Post-treatment counts within the check area averaged over 36 TPB per 25 sweeps at the Dyer location; whereas on average, we caught less than 1 TPB per 25 sweeps in areas treated with herbicide (Fig. 3). Thus, there was a significant interaction of TPB populations for pre- and post-treatment counts from the treated and check area ($F = 33.9$; $df = 1, 138$; $P < 0.01$). We only caught an average of about 2 TPB per 25 sweeps in post-treatment counts from the check areas at both the Lauderdale and Hardeman locations. Nevertheless, at both locations, there was a trend of catching more TPB in post-treatment counts in the check area verses the treated area (Fig. 3). In Lauderdale County, this resulted in a significant interaction between pre- and post-treatment counts of TPB in the treated and check area ($F = 4.39$; $df = 1, 74$, $P < 0.04$).

Impact of Herbicide Application on Tarnished Plant Bug Populations in Cotton

At both the Hardeman (2004) and Dyer (2005) locations, early season TPB populations in cotton could be characterized as low. In Dyer county, there were significant effects of sample date ($F = 8.41$; $df = 4, 1136$; $P < 0.01$) and treatment ($F = 4.59$; $df = 1, 1136$; $P = 0.03$) on tarnished plant bug numbers, but there was an interaction between these two factors ($F = 4.90$; $df = 4, 1136$; $P < 0.01$). More TPB were caught in the check area during early June, but fewer insects were caught in these same fields later in the month (Fig. 4). Other than a significant effect of sample date ($P < 0.01$), there was no effect of herbicide treatment ($F = 0.05$; $df = 1, 640$; $P = 0.82$), nor was there an interaction of treatment and sample date ($F= 0.95$; $df = 3, 640$, $P = 0.42$), at the Hardeman location (Fig. 4).

In contrast, there were many plant bugs found in cotton at the Lauderdale site in 2004, and numbers often exceeded Tennessee's treatment threshold of 8 TPB per 100 sweeps. Overall, there was no significant effect of our herbicide treatment on number of TPB caught in cotton ($F = 2.23$; $df = 1, 561$; $P = 0.14$). However, there was a weak but significant interaction of sample date with TPB numbers in treated and untreated areas ($F = 2.71$; $df = 3, 561$; $P = 0.04$). Early in June, relatively more insects were caught in the treated area than in the untreated area. At the end of June, this pattern was reversed (Fig. 4).

In 2004, the number of grower applied insecticide treatments were not reduced by our herbicide treatment when compared to those made in the check areas (data not shown). In fact, slightly more applications were made for TPB infestations in the treated area at the Lauderdale location. We have not completely collected insecticide treatment

histories for 2005, but again, there is little preliminary indication that growers applied less insecticide in treated areas.

Discussion

Although our data showed that herbicide applications effectively reduced weedy hosts and TPB populations on these hosts, we did not observe an obvious, predictable impact on TPB populations that subsequently occurred in cotton. Early-season populations of TPB were very low at the Hardeman and Dyer locations. We did observe a trend for lower TPB populations in cotton within the treated area of Dyer County during the first one-half of June, but populations after this time were higher than in the check area. At the Lauderdale location, regardless of herbicide treatment, growers were plagued by significant early-season infestations of TPB in cotton.

In 2004, there were several problems that influenced the potential effectiveness of our program. There were several large, late-planted soybean fields within our treated area at the Lauderdale location. Growers in this region typically delay burndown applications and planting of soybeans because of the possibility of flooding. Consequently, broadleaf weeds (particularly henbit) and TPB populations persisted in these fields throughout much of April and May. This undermined the effectiveness of our herbicide application. It was even suggested by some cooperators that our treatments may have funneled TPB into cotton fields once the weeds in these soybean fields were eventually eliminated. Given the likelihood of flooding in this area, it may be unrealistic for growers to change their production practices to complement this areawide management program.

The Hardeman County location had such low early-season populations of TPB that treatment effects, in any, may not have been detectable. One consultant suggested he “saw” a potential benefit of the program for fields in the southern part of the treated area. Our data did not support this. Even if this observation was correct, there was a nearby, fallow field (with high populations of fleabane, horseweed and TPB) that may have acted as a trap crop, luring TPB away from adjacent cotton fields. The fallowed field was an unforeseen complication resulting from death of the land owner.

Our applications of herbicide were completed in reasonable time and with good effectiveness. We observed that herbicide application was difficult, requiring relatively more time and chemical at the Hardeman location compared with the Lauderdale site. The Hardeman site was characterized by smaller field sizes, and access to some field edges was limited. Herbicide application, particularly at the Dyer location, could have been done more efficiently if a larger sprayer was used to treat the large levee. At all locations, there were some wetland areas and other potentially sensitive areas that could not be treated. An additional problem we encountered was the unwillingness of consultants and producers to change production practices including the unnecessary, sometimes scheduled applications of insecticides for TPB.

Tarnished plant bugs tend to be the dominant hemipteran pest in the delta environments of the Mississippi River, but this composes only about 10-15% of the total cotton acreage in Tennessee. In other parts of the state, the clouded plant bug and stink bugs are common mid-season pests. The necessity to treat for these pests may reduce the potential benefits of an areawide tarnished plant bug program. An additional limitation of this areawide management approach is that the application of herbicide is more efficient and potentially more beneficial when the treated area contains a high percentage of crop land, and more specifically cotton. Unfortunately, much of West Tennessee is characterized by having relatively small fields that are inter-dispersed with fields of soybean, corn, pasture and woodlands. (e.g., the Hardeman County location).

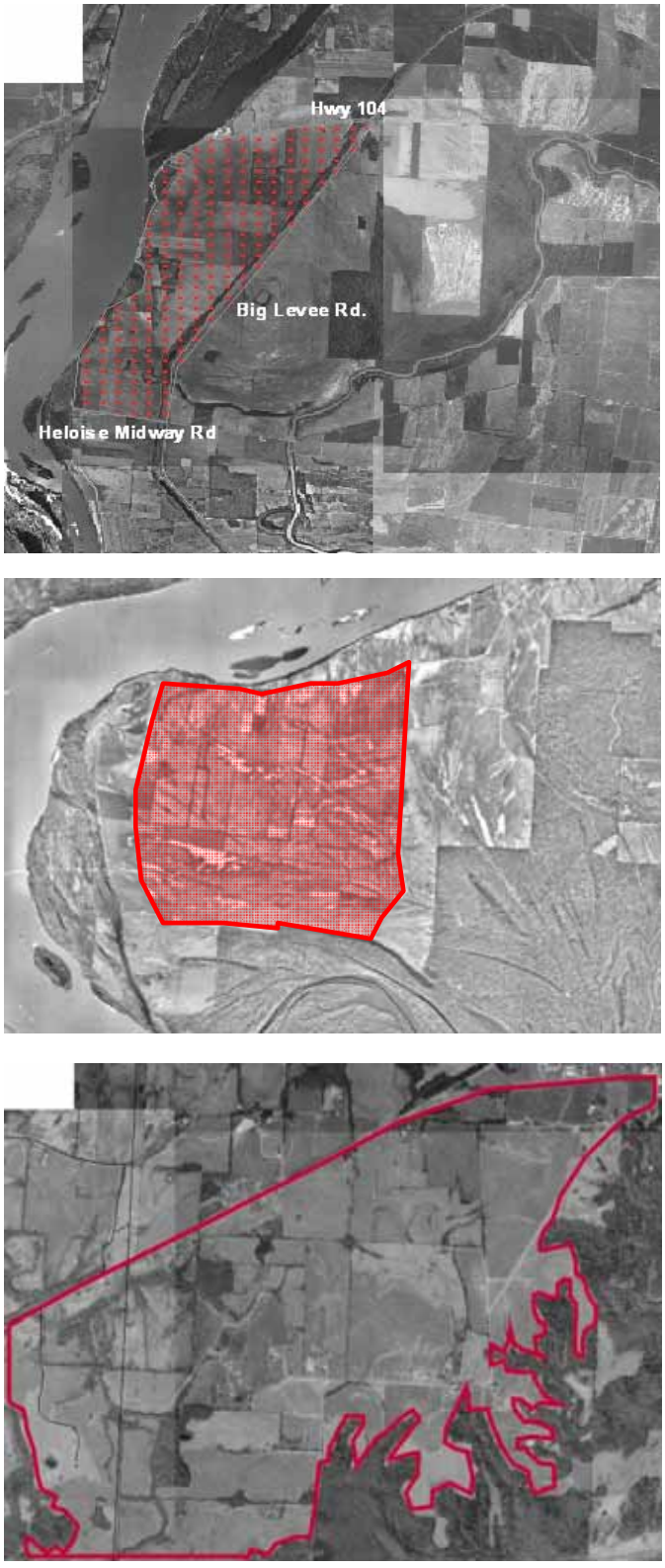

Figure 1. Study areas in areawide project in Tennessee (top = Dyer Co., 2005; middle = Lauderdale Co., 2004; bottom = Hardeman Co., 2004). Treated areas are highlighted or outlined with red.

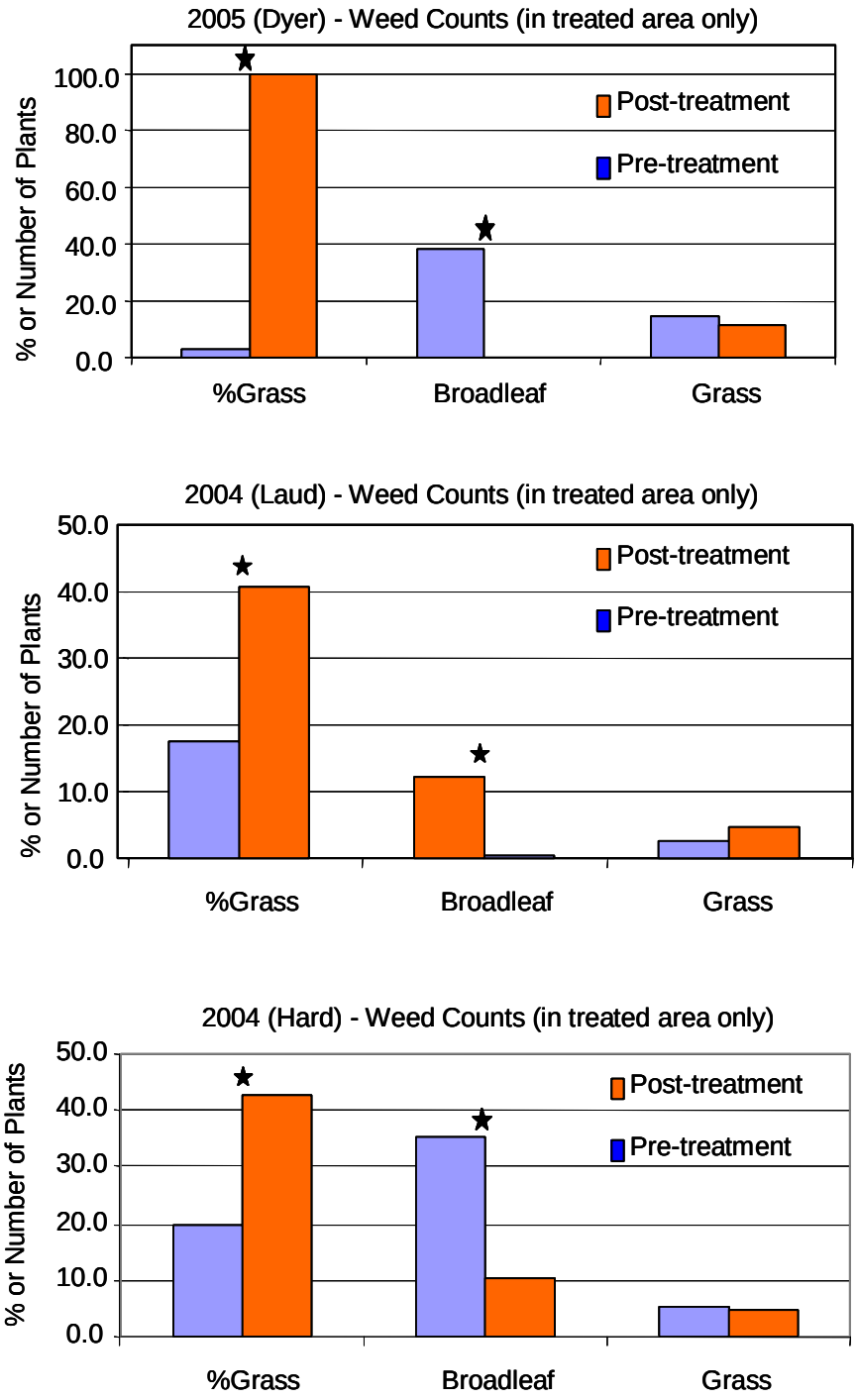

Figure 2. Average pre- and post-treatment weed counts in Dyer (top), Lauderdale (middle) and Hardeman counties (bottom). Broadleaf and grass species are lumped as groups, and only counts from herbicide treated areas are shown. Counts are numbers of plants per 15-inch diameter circle. %Grass in 2005 is the estimated percent of vegetation that was grass. In 2004, %Grass was the estimated ground cover provided by grass species. Stars indicate differences between pre- and post-treatment counts ($P < 0.05$).

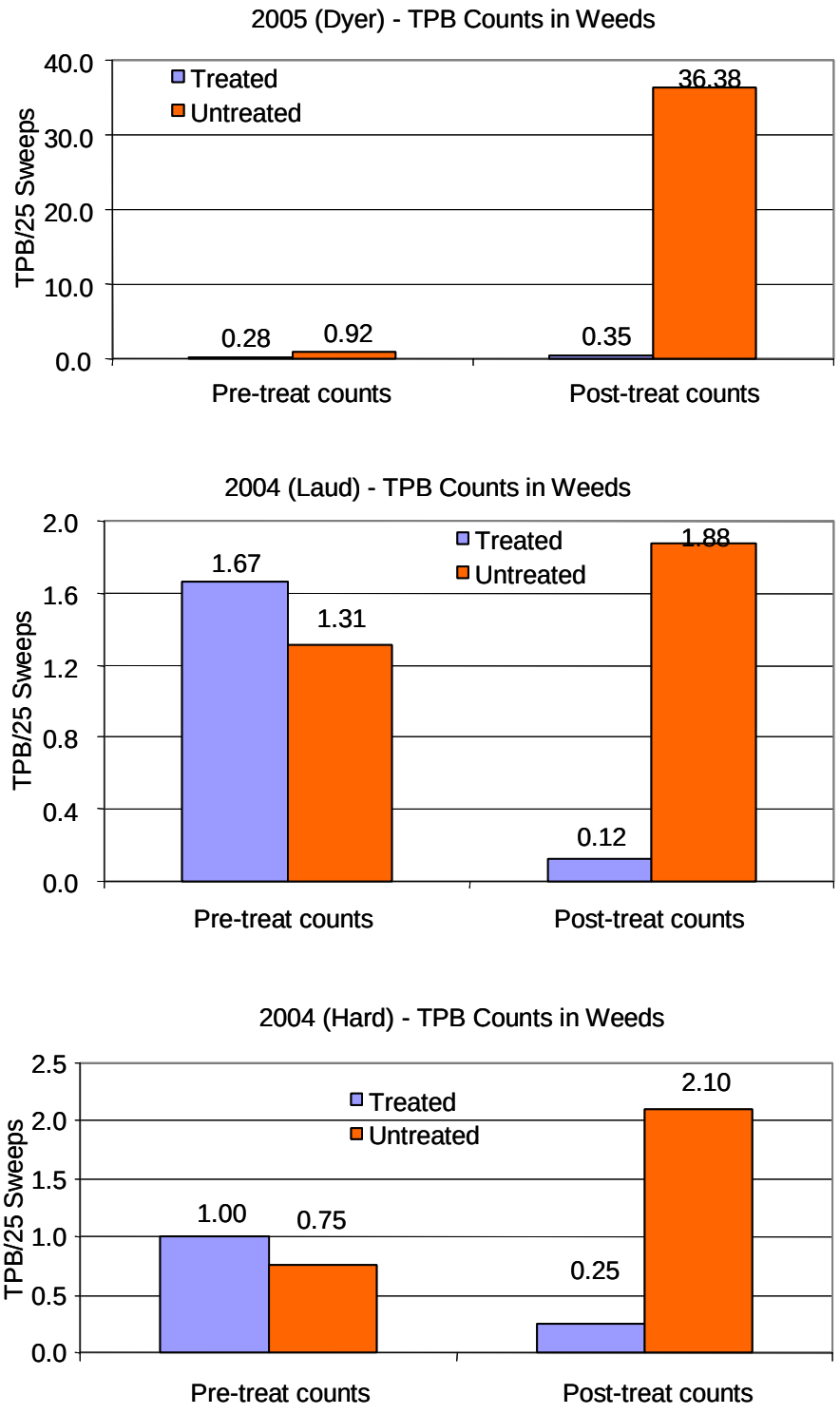

Figure 3. Average pre- and post-treatment counts of tarnished plant bugs in samples from weedy, non-crop areas in Dyer (top), Lauderdale (middle) and Hardeman counties (bottom). Counts are numbers of insects per 25 sweeps.

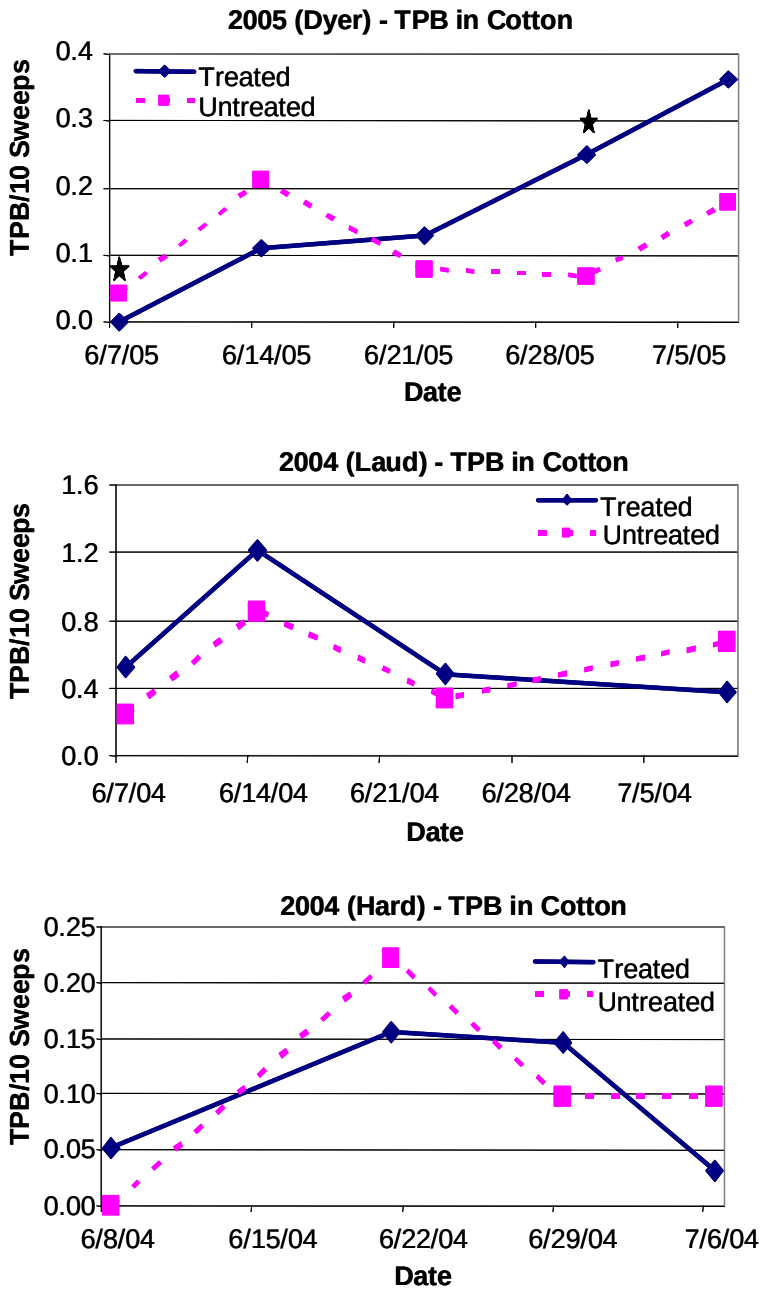

Figure 4. Average number of tarnished plant bugs in cotton within treated and untreated areas of Dyer (top), Lauderdale (middle) and Hardeman counties (bottom). Counts are numbers of insects per 10 sweeps. Stars indicate dates when there were significant differences between TPB numbers in treated and untreated areas ($P < 0.05$).