TARNISHED PLANT BUG MOVEMENT IN A COTTON / CORN ECOSYSTEM

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Abstract

A key economic pest of cotton in the mid-south is the tarnished plant bug (TPB), *Lygus lineolaris* (Hemiptera: Miridae). It is believed that early season crops like corn play a major role in building up TPB populations which then move to nearby cotton fields. TPB densities within cotton fields are often much higher near corn fields, but the degree of movement between corn and cotton, or the range at which corn influences movement is not known. A better understanding of this movement could play a key role in managing TPB. The objective of this research was to determine the movement dynamics of TPB at the interface of these crops using the mark- release- recapture technique to record movement of TPB over time at the interface of corn and cotton fields. Our 2009 data indicate TPB movement into cotton from corn occurred when corn was maturing from green to brown silk. However, corn at tassel stage and cotton at pre-squaring stage were equally attractive to TPB. Growers need to scout frequently at the interface from tassel to brown silk stage corn to minimize TPB damage to cotton.

Introduction

Tarnished plant bug (TPB), *Lygus lineolaris* (Palisot de Beauvois) is a serious pest of cotton, *Gossypium hirsutum* L., in the mid south (Scott et al. 1985). Tarnished plant bugs can be collected from as many as 169 host plant species representing 36 plant families, in the Mississippi River Delta of Arkansas, Louisiana, and Mississippi (Snodgrass et al. 1984). TPB adults overwinter in weeds, leaf litter or plant debris. They become active in early spring and start reproducing on a variety of spring weeds. Wild hosts play an important role in TPB population increases in the fall and in early spring when cultivated crops are not flowering. Corn, being an early season crop, provides a habitat for TPB when spring weed hosts start drying out. Tarnished plant bugs find corn attractive for oviposition during VT (tasseling) and R1 (silking) stages (Abel and Snodgrass 2003). Cotton generally reaches the squaring stage, when it is attractive to TPB, as the corn is advancing to the later reproductive stages. Because higher TPB damage is observed in cotton near corn, it is believed that TPB are migrating from corn to cotton, but this movement has not been documented. The current experiment was conducted to understand the movement of tarnished plant bugs at the interface of corn and cotton and within cotton fields. We used diffusion models to quantify the rate of movement of tarnished plant bugs in these habitats.

Materials and Methods

We used the mark- release- recapture (MRR) technique. We chose one location in a commercial field for this experiment where natural TPB densities were low. We selected the field where corn was at tasseling stage and cotton was pre-squaring at the same time. Corn and cotton were planted side by side with their rows running parallel to each other in this field. TPB maintained on an oligidic diet (Cohen 2000) were marked a day before releasing them with a 10% egg white solution using a fine sprayer. Extreme care was taken to avoid spraying too much which could hinder their ability to fly normally. Thirty marked TPBs were kept in a 250 ml plastic cup with green bean pieces. We released 3300 TPB along a 225m interface (300 TPB/25m line), giving us nine 25m release lines flanked on each end by 25m where TPB were also released. Insects were released between 9 am and 11 am. In each 25m, 10 cups were placed gently and evenly spaced on the ground in between two rows of the corn-cotton interface. We returned 1, 3 and 6 days after the release and collected TPB 2.5, 5.5, 10 and 16 m away from the line of release in both habitats. We used a different 25 m for each collection day in each habitat. We had 3 replicates of this experiment within the field. In cotton, TPBs were collected using a sweep net as it is the most efficient method to collect adult TPB in cotton (Musser et al. 2007). We thoroughly swept each distance away from the release line, dumping the contents into kill jars to minimize the risk of unmarked insects becoming marked during collection. For tasseling corn, TPB are mostly found on tassels, we used a modified sweepnet with an extended net of size 21" diameter, 49" long (7221NA, BioQuip). The plant was sampled, from tassel to the ear zone by covering the plant with the sweepnet from top to bottom and shaking thoroughly. TPBs were recovered from the net using an aspirator. Since in the process we were disturbing adjacent plants, we sampled 2 plants together and then skipped 2 plants in the row. For corn at green silk and brown silk stage, since TPBs were mostly found in corn silks, so an aspirator was used to collect TPB at this stage. For green silk and brown silk stage, we sampled all the plants in the 25m line row. Collection of TPB began at the furthest distance from the release line and moved toward the TPB release line. Captured TPB were brought to the lab and individually transferred to microcentrifuge tubes. They were washed in a buffer solution and then removed from the buffer. The buffer was then stored at -70°C in microcentrifuge tubes labeled with the day, habitat and distance. Later they were analyzed for the egg white mark using indirect ELISA (Jones et al. 2006). Tasseling stage corn numbers were corrected for difference in sampling. We also fit a diffusion model for line release to the data using the NLIN in SAS. Here we estimated D (diffusion coefficient) to estimate the rate of dispersal (Crank 1989). These mathematical models can be used considering the random movement of insects over a population (Rudd and Gandour 1985). A higher D value indicates higher dispersal rate.

Results and Discussions

Results from the mark-release-recapture experiment showed that when corn was at tasseling stage and cotton at pre-squaring, 60% of the marked insects were found in corn and 40% in cotton (Fig. 1). The diffusion model estimated a D (±SE) value of 10.0 ± 2.6 in corn and 14.6 ± 2.8 in cotton. When corn was at green silk stage and cotton at squaring approximately 65% of the marked insects were found in cotton and 35% in corn (Fig. 2). The diffusion model estimated a D value of 9.7 ± 2.0 in corn and 2.4 ± 0.3 in cotton. There was no movement of tarnished plant bugs into corn during brown silk stage (Fig. 3). The diffusion model estimated a D value of 4.5 ± 0.6 in blooming cotton. These outcomes indicate that movement rates in corn at tassel stage and cotton at pre-squaring stage are equal. There is a shift in attractiveness and movement rate during green silk corn and squaring cotton. Corn was becoming less attractive relative to cotton. The increased suitability of cotton was reflected in the reduced dispersal rate in squaring and blooming cotton. The dispersal rate of tarnished plant bug was higher in corn than in reproductive cotton, which corresponded to a higher percentage of tarnished plant bugs moving into corn than cotton. Therefore it appears that squaring cotton is more attractive to TPB than corn at its green silk stage, even though corn is a suitable host for tarnished plant bug development at this time (Abel and Snodgrass 2003). Corn was not attractive to tarnished plant bugs after the green silk stage, so in the landscape with these two crops, all TPB will be found in cotton after green silk stage.

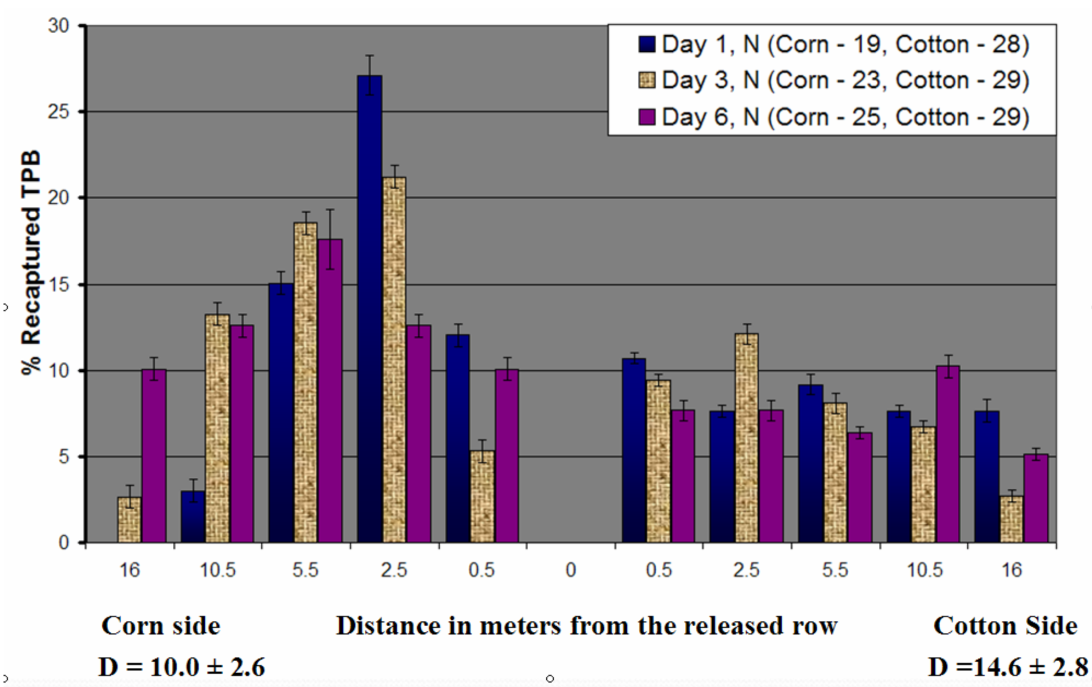

Figure 1. Movement pattern of TPB at the corn-cotton interface. Corn was at tasseling stage and cotton was pre-squaring, 2009.

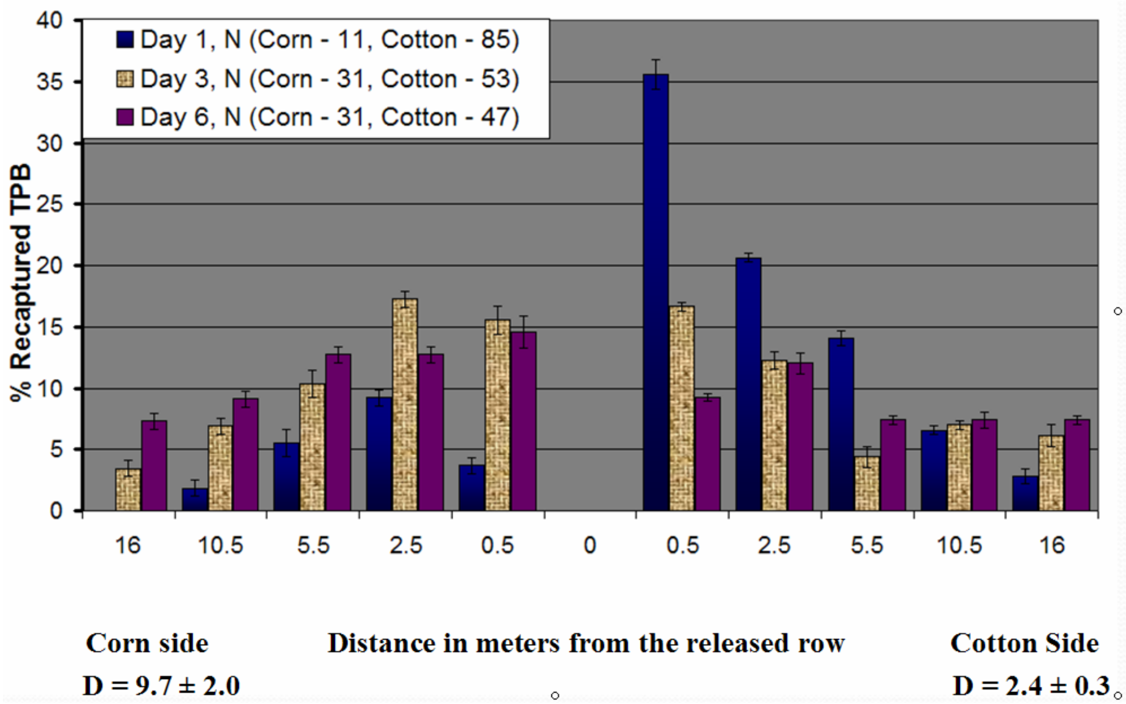

Figure 2. Movement pattern of TPB at the corn-cotton interface. Corn was at green silk stage and cotton was squaring, 2009.

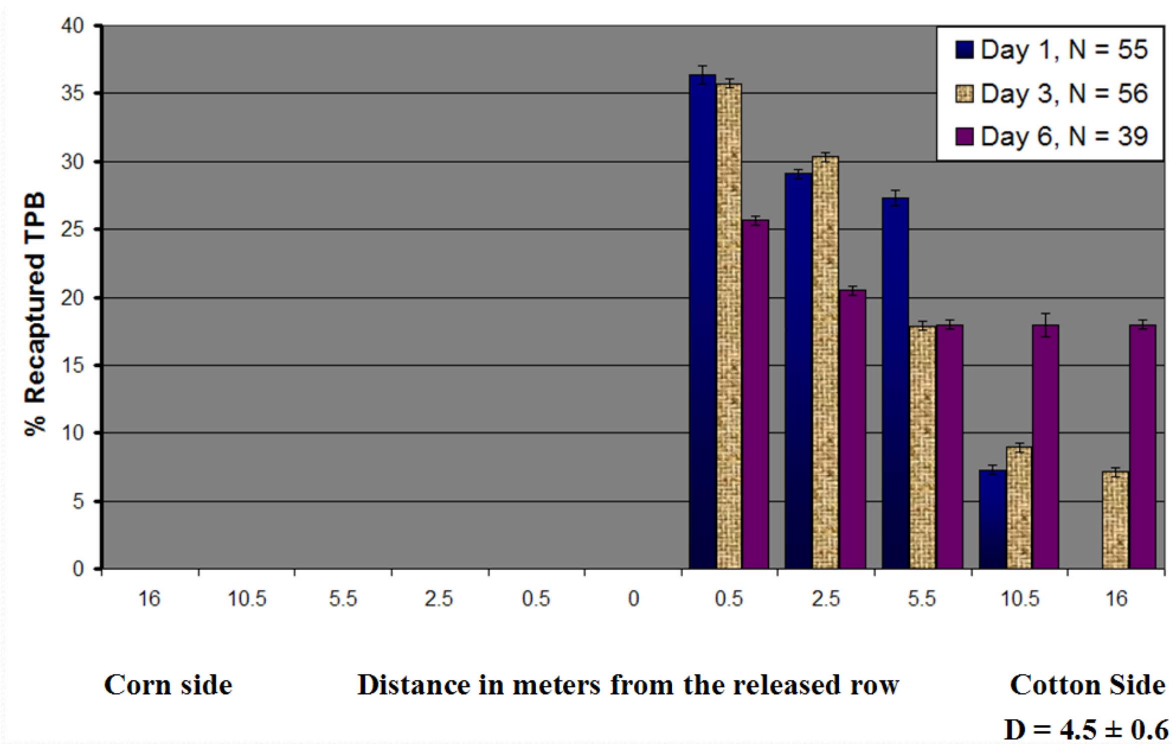

Figure 3. Movement pattern of TPB at the corn-cotton interface. Corn was at brown silk stage and cotton was at blooming, 2009.

In addition to sampling at the interface, we also sampled the interior of the cotton field, so we compared the natural population of tarnished plant bugs from interior cotton to the edge of the same field. We always found higher tarnished plant bug densities at the cotton edge to the cotton interior (Fig. 4) ($F = 31.33$, $df = 1, 50$ $P < 0.001$). However, the differences were least during pre-square stage, suggesting that movement from corn is one factor, but not the only factor causing the frequently observed edge effect at corn & cotton interfaces.

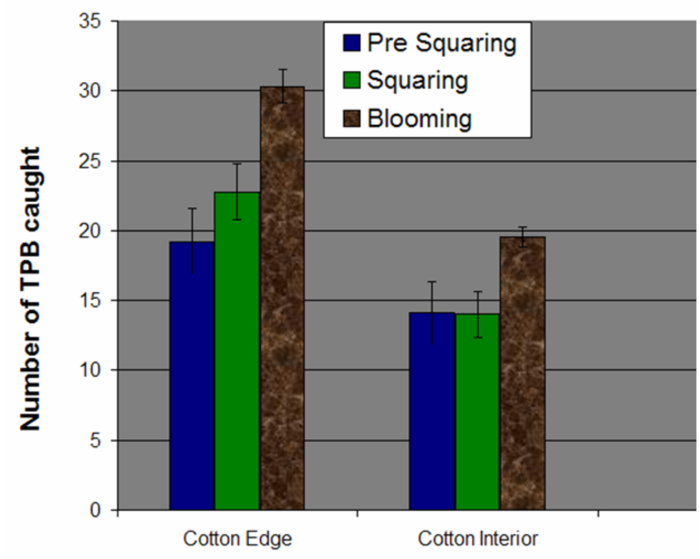

Figure. 4: Natural tarnished plant bug population density, 2009.

Tarnished plant bugs are capable of moving at least 16 m in a day. However, dispersal is low when the crop is highly attractive, so cotton edges tend to accumulate higher densities. Furthermore, a high number of nymphs were observed near the edges during sampling later in the season, so TPB oviposition, upon finding a suitable host, may cause cotton edges near corn to move elevated densities beyond the period when TPB are actively migrating from corn.

Summary

Corn at tasseling stage is somewhat more attractive to TPB than pre-squaring cotton, but cotton becomes more attractive than corn once it reaches squaring. By brown silk corn stage, no adult TPB are found in corn, indicating significant movement from corn to cotton. Dispersal rates in corn and pre-squaring cotton were similar, but dispersal rates in squaring or flowering cotton were lower, indicating that TPB move less when they are in a suitable host. Relative attractiveness and dispersal rates help explain the observed high TPB damage in cotton near corn fields.

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