

LANDSCAPE MOVEMENT OF TARNISHED PLANT BUG

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Abstract

The impact of field corn on tarnished plant bug, *Lygus lineolaris* (Palisot de Beauvois), populations infesting cotton fields in the Mississippi delta was investigated from June through August in 2008 and 2009. Adult tarnished plant bugs were collected weekly from four to five cotton fields adjacent to field corn and from four to five cotton fields distant (greater than 1 mile) from field corn. Wings from these adults were analyzed to determine whether individual tarnished plant bugs had developed as nymphs on a C₃ or C₄ host. Because the primary hosts (based on acreage) of tarnished plant bugs during the growing season are cultivated hosts (cotton, soybean, field corn), a C₄ host signature was assumed to be indicative of nymphal development on field corn. During both years of the study, tarnished plant bug populations infesting cotton fields during late June through early July most likely originated from field corn. Generally 70-90% of the tarnished plant bugs infesting cotton during this period possessed a C₄ host signature. In 2008, a higher proportion of tarnished plant bug adults infesting cotton fields adjacent to field corn during mid-July had a C₄ host signature compared to those collected from cotton distant from field corn; however, this was not as evident in 2009. From mid-July through mid-August, the proportion of tarnished plant bugs in cotton with a C₄ host signature declined rapidly. During both years of the study, August populations of tarnished plant bugs in cotton primarily developed as nymphs on C₃ hosts, which would indicate reproduction in cotton. These results suggest that a significant portion of the tarnished plant bug population develops on field corn during June and July, and these populations eventually infest cotton. This information could lead to alternative control measures for tarnished plant bug populations in the future.

Introduction

Tarnished plant bug, *Lygus lineolaris* (Palisot de Beauvois), has been the most significant insect pest in cotton for the last few years (Williams 2008, 2009). Infestation of cotton by tarnished plant bug populations is related to its phenology, as well as the phenology of non-cotton crop hosts and wild hosts (Snodgrass et al. 1984). The suitability of field corn as a host for tarnished plant bug reproduction and development was recently documented. Tarnished plant bugs move into field corn during the tassel stage where they readily feed and reproduce. During the tassel stage, a single field corn plant can produce as many as 50 million pollen grains (Paton 1921). These pollen grains have a high level of protein (Goss 1968), making it a very suitable food source for developing tarnished plant bug nymphs. However, once the pollination period ends, field corn becomes a much less suitable host for tarnished plant bug. At this time, usually around the R2-R3 growth stage, tarnished plant bug adults move from field corn to other hosts. This movement typically occurs when cotton is producing flowers that are very attractive to tarnished plant bugs. Thus, many of these tarnished plant bugs that develop in field corn likely move to cotton.

Extreme damage to cotton fruiting structures can take place at the interface of cotton and field corn. These edge effects are typically blamed on tarnished plant bug populations moving from field corn into cotton. Kumar and Musser (2009) described tarnished plant bug adult movement from maize into cotton as a “high influx”, which occurred during the R2-R3 growth stage of field corn. Although the influence of field corn on populations of tarnished plant bugs infesting adjacent cotton fields has been studied, little effort has gone into investigating the impact of field corn on tarnished plant bug populations on a landscape level. This study was designed to measure the contributions of field corn to tarnished plant bug populations infesting cotton fields across the landscape.

Materials and Methods

Four to five cotton fields adjacent to field corn were identified for tarnished plant bug collections in early June during 2008 and 2009. In addition, another 4-5 cotton fields were identified for sampling that were greater than 1 mile from any field corn. Tarnished plant bug adults were collected from these cotton fields on a weekly basis. Adults were transported to the laboratory and frozen.

Stable carbon isotope analysis has been previously used to determine whether an adult insect developed as an immature on either a C_3 or C_4 host plant (Gould et al. 2002). Tarnished plant bug adults that were collected from cotton fields were subjected to this analysis. Moths with $\delta^{13}C$ values between -14 and -7 units per mil (‰) were considered to have a C_4 host signature (primarily grass hosts), whereas moths with $\delta^{13}C$ values between -28 and -20‰ developed on C_3 hosts (primarily broadleaf hosts). To process tarnished plant bug adults for analysis, both forewings from each adult were cut into small pieces. These wing pieces were placed into a 5x9mm tin capsule that was tightly folded into a cube. Wing tissue within each tin capsule was converted to CO_2 by micro-Dumas combustion using a Costech ECS4010 Elemental Analyzer coupled to a Thermo Finnigan Delta plus Advantage Mass Spectrometer using a ConFlo II Interface at USDA-ARS in Stoneville, MS. Various isotope standard reference materials were used including acetanilide, urea, caffeine, and lyophilized corn tissue powder.

Results from the analysis were used to distinguish between insects that developed on a C_4 host from those that developed on a C_3 host. A C_4 host signature was assumed to be indicative of nymphal development on field corn.

Results and Discussion

The majority of tarnished plant bug adults infesting cotton fields adjacent to field corn and distant from field corn during mid- to late June possessed a C_4 host signature (Figs. 1 and 2).

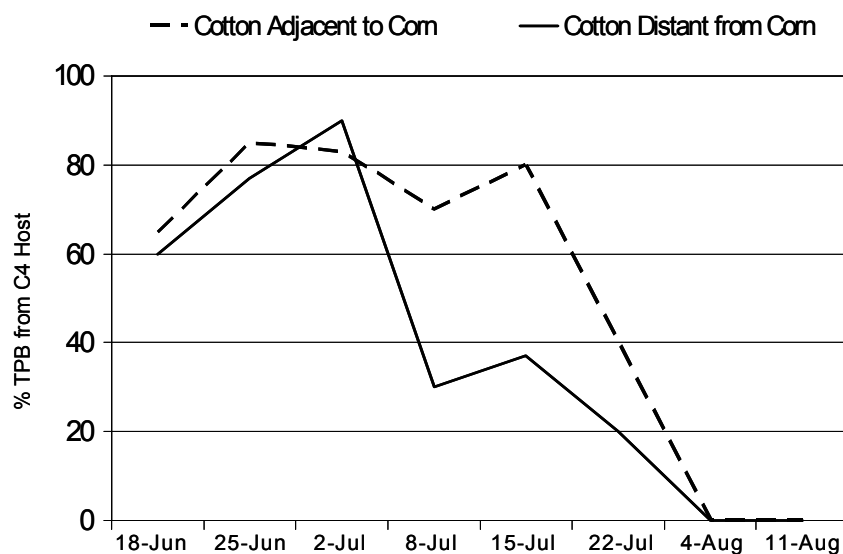


Figure 1. The proportion of tarnished plant bug adults infesting cotton fields that developed as nymphs on a C_4 plant host, most likely field corn, in 2008.

In 2008, a higher proportion of tarnished plant bug adults infesting cotton fields adjacent to field corn during mid-July had a C_4 host signature compared to those collected from cotton distant from field corn (Fig. 1). At this time, greater than 50% of the field corn acreage in Mississippi was in the R4 growth stage. This phenological stage is a little later than the “high influx” observed by Kumar and Musser (2009). However, this “high influx” may explain why a higher proportion of tarnished plant bug adults infesting cotton adjacent to corn originated from corn. Adults leaving field corn likely moved to the nearest suitable host for a period of time before dispersing further. This phenomenon was not evident in 2009 as shown in Fig. 2. From mid-July through mid-August, the proportion of tarnished plant bugs in cotton with a C_4 host signature declined rapidly, followed by little to no contributions of C_4 hosts in August. During both years of the study, August populations of tarnished plant bugs in cotton primarily developed as nymphs on C_3 hosts, which would likely indicate reproduction in cotton. These results suggest that a significant portion of the tarnished plant bug population develops on field corn during June and July, and these populations eventually infest cotton. This information could lead to alternative control measures for tarnished plant bug populations in the future.

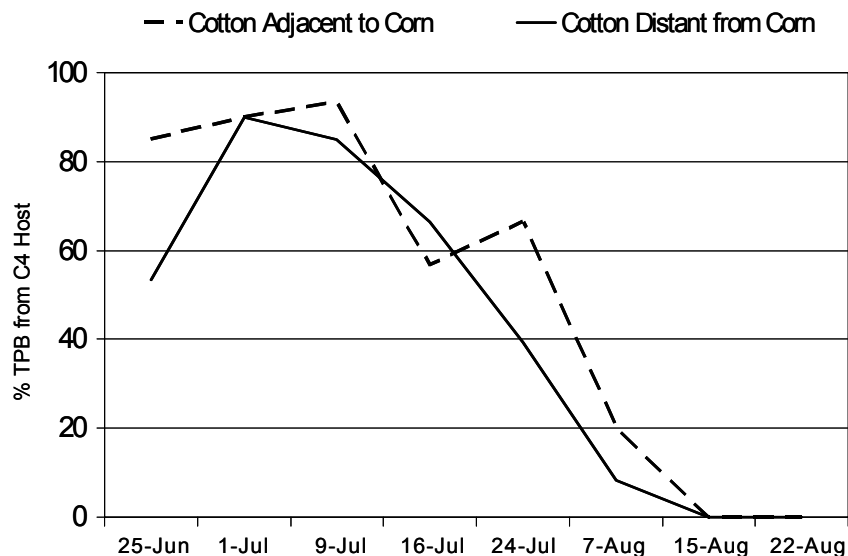


Figure 2. The proportion of tarnished plant bug adults infesting cotton fields that developed as nymphs on a C₄ plant host, most likely field corn, in 2009.

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Literature Cited

- Goss, J. A. 1968. Development, physiology, and biochemistry of corn and wheat pollen. *Bot. Rev.* 34: 333-358.
- Kumar, A., and F. R. Musser. 2009. Intra and inter-crop movement of tarnished plant bugs. *In Proceedings Beltwide Cotton Conferences, 5-8 Jan., San Antonio, TX. National Cotton Council of America, Memphis, TN.* <http://www.cotton.org/beltwide/proceedings>.
- Paton, J. B. 1921. Pollen and pollen enzymes. *Amer. Jour. Bot.* 8: 471-501.
- Snodgrass, G. L., W. P. Scott, and J. W. Smith. 1984. Host plants and seasonal distribution of the tarnished plant bug (Hemiptera: Miridae) in the Delta of Arkansas, Louisiana, and Mississippi. *Environ. Entomol.* 13:110 - 116.
- Williams, M. R. 2009. Cotton insect losses-2008. *In Proceedings Beltwide Cotton Conferences. National Cotton Council of America, Memphis, TN.* <http://www.cotton.org/belwide/proceedings>.
- Williams, M. R. 2008. Cotton insect losses-2007. *In Proceedings Beltwide Cotton Conferences. National Cotton Council of America, Memphis, TN.* <http://www.cotton.org/belwide/proceedings>.