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A physical barrier reduces capture of *Euschistus servus* (Hemiptera: Pentatomidae) in pheromone-baited traps near peach trees

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Numerous stink bug species (Hemiptera: Pentatomidae) cause economic injury to many agronomic crops (McPherson & McPherson 2000). The polyphagous habits of most of these pest species allows them to forage across farmscapes in response to changing food resources within local habitats (McPherson & McPherson 2000; Pilkay et al. 2015). Movement to new feeding sites is generally accomplished by adults although nymphs are also known to move (Cherry & Wilson 2011; Reisig et al. 2013; Lee et al. 2014; Acebes-Doria et al. 2017; Tillman & Cottrell 2017). Adult stink bugs can fly substantial distances, especially when moving to or from overwintering sites; however, most flight events tend to be short in distance and duration when moving between host plants or to new host plants (McPherson & McPherson 2000). The height above ground for these flights is not always known, but indirect evidence suggests that they occur within the host plant canopy and not too high above it (Tillman 2014). Stink bugs will sometimes invade the edges of a taller crop such as corn, but not penetrate into the interior (Cottrell & Tillman 2015). Schoeman (2014) documented that movement of the pentatomid *Bathyocheila natalicola* (Distant) (Hemiptera: Pentatomidae) into macadamia orchards was confined to edges during the early season, and suggested that tall, densely planted macadamia trees were an obstacle to penetration into the orchard, although the edge effect declined later in the season. Thus, it appears that stink bug flight can be affected by the physical attributes of plants serving as barriers. Tillman et al. (2015) showed that a 1.83-m-tall, black, polypropylene fence reduced damage to cotton compared with using pheromone-baited stink bug traps, a soybean trap crop, and a combination of the stink bug trap and trap crop. Physical barriers to stink bug dispersal, ultimately leading to lower stink bug injury, have potential use in numerous cropping scenarios, including row crops, orchard crops, and gardens. Our objective here was to determine if a physical barrier could be used to prevent *Euschistus servus* (Say) (Hemiptera: Pentatomidae) from reaching a pheromone-baited trap near a peach tree.

This study was conducted from 02 Jun to 14 Aug during 2014 and from 17 Jun to 12 Aug during 2015 at the USDA, ARS, Southeastern Fruit and Tree Nut Research Laboratory (SEFTNRL) in Byron, Georgia, USA. This interval covered when 'Contender' peach trees (generally with a mid-Jul harvest) have green fruit, ripening fruit, and post-harvest with no fruit (Okie 1998). Four replicates of 2 treatments, fence barrier and no fence barrier, were used. We constructed a 4-sided, 3.7-m-tall UV stabilized polypropylene barrier fence around a peach tree. Annual winter pruning maintains tree height at about 2 to 2.5 m

at the beginning of each season with regrowth generally exceeding 1 m by the end of the season. Each side of the fence was 3.7 m. Metal T-posts driven into the ground with attached wood 2 × 4 posts (taller than the fence) were used at each corner to support the fence (Fig. 1). A closeable, sealed entryway provided access into the enclosure. A yellow, pheromone-baited pyramidal stink bug trap with an insecticidal ear tag (Cottrell et al. 2000; Cottrell 2001) was placed within the enclosure beside the peach tree. A trap was similarly placed by a peach tree without an enclosure. Traps were monitored weekly for stink bug capture, and the lure replaced. Stink bug count data were modeled using a Poisson distribution. The analysis was done using PROC GLIMMIX (SAS Institute, Inc. 2010). The LINK=LOGIT function was used in the model statement. Model fit was evaluated by use of the chi-squared and df statistic provided by PROC GLIMMIX (Littell et al. 2006). For *E. servus* adults, cumulative data were analyzed with treatment as the fixed effect and weekly data were analyzed using fixed effects of treatment, week, and treatment by week. Random effects were replicate and residual error. Means were back transformed using the ILINK option in the LSMEANS statement, and compared using Tukey's honestly significant difference (HSD). Overall (and for unknown reasons), the density of *E. servus* was greater during 2014 than 2015.

Cumulative capture of adult *E. servus* was significantly higher in traps near trees without enclosures (107.75 ± 8.38) than with enclosures (11.0 ± 0.91) for 2014 ($F = 207.89$; $df = 1, 73$; $P \leq 0.05$) and for 2015 (57.5 ± 2.40 and 1.5 ± 0.29 , respectively) ($F = 63.10$; $df = 1, 52$; $P \leq 0.05$). However, the difference between traps with or without an enclosure was only significantly different on 7 dates during 2014 (09 Jun [$F = 21.95$; $df = 1, 3$; $P \leq 0.05$]; 19 Jun [$F = 59.29$; $df = 1, 3$; $P \leq 0.05$]; 26 Jun [$F = 16.79$; $df = 1, 3$; $P \leq 0.05$]; 03 Jul [$F = 16.63$; $df = 1, 3$; $P \leq 0.05$]; 17 Jul [$F = 10.54$; $df = 1, 3$; $P \leq 0.05$]; 07 Aug [$F = 22.74$; $df = 1, 3$; $P \leq 0.05$]; and 14 Aug [$F = 13.38$; $df = 1, 3$; $P \leq 0.05$]), and only for 3 dates during 2015 (24 Jun [$F = 11.81$; $df = 1, 3$; $P \leq 0.05$]; 29 Jul [$F = 11.87$; $df = 1, 3$; $P \leq 0.05$]; and 05 Aug [$F = 10.96$; $df = 1, 3$; $P \leq 0.05$]) (Fig. 2).

The tall barrier reduced cumulative capture of stink bugs in pheromone-baited traps near peach trees. Even though the difference in capture for traps with and without a barrier was not always significantly different for each date, 3 of 4 non-significant collection dates during 2015 approached statistical significance ($0.05 < P < 0.057$). We did not sample fruit for feeding injury because this was not the objective of the current study; however, comparison of trap capture between the 2 treatments suggests that stink bug fruit feeding would be lower when a barrier is used. It is not known how stink bugs entered the enclosure,

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Fig. 1. A $3.7 \times 3.7 \times 3.7$ m fence was erected around a peach tree to determine if this physical barrier would reduce adult *Euschistus servus* from reaching a pheromone-baited trap placed inside the enclosure near the tree.

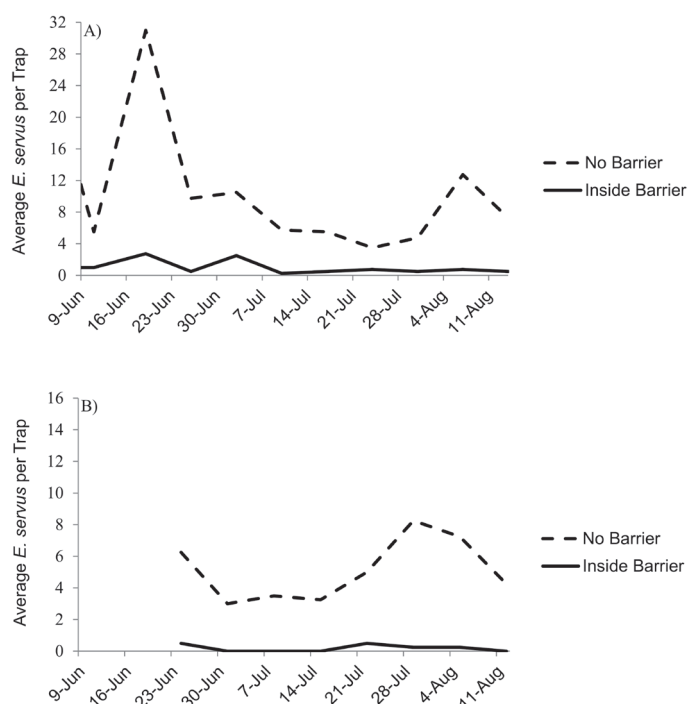


Fig. 2. Capture of adult *Euschistus servus* in pheromone-baited traps placed near peach trees when the trap occurred within the enclosure formed by a 3.7-m-tall physical barrier around the peach tree, or when there was no barrier around the tree: (A) 2014 and (B) 2015.

i.e., by crawling over or flying. An insecticide treatment to the barrier or constructing the barrier with an insecticide impregnated net (Arthurs et al. 2018) likely would reduce stink bug entry by those alighting on the exterior of the enclosure and crawling up. Our results add to the literature supporting that a physical barrier, whether it is plant based (e.g., a hedgerow or a tall, densely planted crop) or a wall, does inhibit stink bug movement. Future studies will assess the effect of physical barriers enclosing larger areas of an orchard on stink bug movement into peach, and if fruit injury is reduced.

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Summary

Many species of stink bugs (Hemiptera: Pentatomidae) are pests of many crop plants and the polyphagous nature of these pests facilitates their movement across farmscapes. However, when feeding, their movement generally entails short distance moves within the height of the host plant. During 2014 and 2015, we used a tall barrier fence around peach trees to determine if this structure would deter adult *Euschistus servus* (Say) (Hemiptera: Pentatomidae) from being attracted to a pheromone-baited trap near the tree. Each year, cumulative data

showed a significant decrease in capture of *E. servus* in traps enclosed with the barrier fence compared to traps near trees without the fence. Differences in treatments between sampling dates were not always significant. Overall, the barrier fence did reduce attraction of *E. servus* to pheromone-baited traps near peach trees. Future studies will assess the effect of physical barriers enclosing larger areas of an orchard on stink bug movement into peach, and if fruit injury is reduced.

Key Words: stink bug; attraction; dispersal; flight; *Prunus persica*

Sumario

Muchas especies de chinches (Hemiptera: Pentatomidae) son plagas de muchos cultivos y la naturaleza polífaga de estas plagas facilita su movimiento por los campos agrícolas. Sin embargo, cuando se alimentan, su movimiento generalmente implica movimientos de corta distancia dentro de la altura de la planta hospedera. Durante el 2014 y 2015, utilizamos una cerca alta alrededor de árboles de durazno (melocoton) para determinar si esta estructura disuadiría a los adultos de *Euschistus servus* (Say) (Hemiptera: Pentatomidae) de ser atraídos por una trampa con cebo de feromonas cerca del árbol. Cada año, los datos acumulativos mostraron una disminución significativa en la captura de *E. servus* en las trampas encerradas adentro del cerco en comparación con las trampas a la par de los árboles sin cerco. Las diferencias en los tratamientos entre las fechas de muestreo no siempre fueron significativas. En general, el cerco redujo la atracción de *E. servus* a las trampas con cebo de feromonas cerca de los árboles de durazno. Los estudios futuros evaluarán el efecto de las barreras físicas que encierran áreas más grandes de un huerto sobre el movimiento de las chinches hediondas en el melocotón, y si se reduce el daño a las frutas.

Palabras Clave: chinche hedionda; atracción; dispersión; vuelo; *Prunus persica*

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