IMPROVED DETECTION, MONITORING AND MANAGEMENT OF THE GLASSY-WINGED SHARPSHOOTER

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ABSTRACT
The glassy-winged sharpshooter, (GWSS), *Homalodisca vitripennis* (Germar), as a vector of *Xylella fastidiosa,* is a threat to grapes, almonds, stone fruit and oleander and impacts citrus and nursery crops throughout much of California. It remains an important high-risk quarantine pest for the Napa and Sonoma Valleys and other uninfested areas. Accurate and precise methods for detection of new colony infestations and for monitoring GWSS population dynamics on a temporal and spatial basis are lacking. Due to the unique behavior, biology and ecology of the xylophagous GWSS which is driven by plant xylem chemistry and nutrition, conventional detection and monitoring approaches do not provide the necessary statistical precision needed by the regulatory and producer communities for management decisions. This proposal will address the detection and monitoring needs as well as develop a more strategic approach to management of GWSS.

INTRODUCTION
In previous research we evaluated trap color, size, configuration and height. We compared a large number of commercially available as well as home-made sticky traps in attempts to find a practical and reliable trap to detect and monitor GWSS population dynamics. The conventional two-sided Pherocon AM trap used in CA was tested as the standard for comparisons to other trap types in FL. Traps colored “Safety yellow” placed at 2 m or less from the ground captured the highest numbers of GWSS in these tests. Of all traps tested, we found that a 32.5 cm height x 7.6 cm dia. yellow cylinder (painted mailing tube, referred to as “tube” trap) captured the highest number of GWSS. However, when GWSS trap capture numbers were related to visual counts on host plants, host plant species and nutritional condition were important variables affecting GWSS capture rate. In patches of non-preferred hosts such as peach, there was no significant relationship between trap capture rate and GWSS numbers on trees. GWSS passed through the patches but spent very little time on the trees. In monoculture patches of a preferred host crape myrtle, higher numbers of GWSS were captured with better correlation to GWSS numbers present on trees, but the results were inconclusive due to variation by date and patch type. Moreover, on some sample dates there was an inverse correlation between GWSS plant numbers and trap captures, suggesting that nearby high quality host plants actually reduce trap capture rates.

We have compared the standard Pherocon AM trap configured with two flat surfaces to the same trap configured in the form of a cylinder (somewhat smaller than the tube trap) and to the tube trap. In all tests the mailing tube trap captured significantly more GWSS adults of both sexes with tube capture rates of ca. 5-15 x higher than the other traps. We have tried other embellishments of the tube trap with limited success. We have also attempted to ascertain the “active distance” of operation of the trap with respect to how far away GWSS will respond to the tube trap. These experiments enabled an estimation of the active distance of the tube trap to be at least 8-12m, but these results were inconclusive statistically. In other work we have combined single plants of various species with traps to determine whether combinations of traps with plants will improve trap capture. Again, plant species affected the outcomes. We have also tested larger numbers of traps alone and in combination with preferred crape myrtle and non-preferred peach plants to increase the visual presentation offered to GWSS. Also, we have done mark-recapture studies in large peach and crape myrtle plantings (Northfield et al. 2008b). In these studies, more GWSS were captured by traps in crape myrtle for a longer period of time than on traps in peach or on traps alone. Emigration from the plots was much higher and more rapid in peach than crape myrtle. Finally, the landscape context of the study plots, i.e., whether the plots were isolated by at least 100 m of grassy area or had vegetation within 100 m of the plot, affected GWSS emigration and immigration, as well as within plot trap capture rates. We have concluded that the searching flight, trap and host response behavior of GWSS, while highly visually oriented, is complex and affected by host plants, and driven by a number of habitat variables, landscape structure and unknown innate GWSS behaviors. It appears that single traps will not provide the necessary accuracy in predicting the population dynamics of GWSS for management decision making nor the reliability required for regulatory objectives. However, the tube trap is superior to the standard Pherocon AM trap in detection of GWSS and could easily be implemented for GWSS monitoring in CA. Our objectives are to develop and implement a practical detection and monitoring system for GWSS with requisite statistical precision. At the time of submission of this report we have not received the funds to initiate this project.

OBJECTIVES

General Objective: To determine the most efficient and cost effective trapping system to detect and monitor GWSS population dynamics and the potential to manage GWSS populations.

1a. Evaluate and summarize previous sampling and trapping efforts for GWSS.

1b. Trap configuration and number: Determine potential and optimize the number of traps that are most efficient and cost effective in detecting and estimating GWSS populations.

1c. Effect of host plants in combination with traps: Determine the potential and optimize a combination of GWSS host plants in sentinel plots to detect, estimate and manage GWSS population dynamics.

RESULTS

Objective 1a

Other investigators have addressed various aspects of our objectives in a number of crops with similar mixed results. As part of this project we will review and synthesize previous research into a summary document.

Objective 1b

We have initiated new experiments with only preliminary results at this time.

Objective 1c

While current trap methodology does not enable statistical quantification of GWSS population dynamics at the level needed within crops, traps can be used for investigations that will contribute other important knowledge relevant to improving detection and monitoring for GWSS. Toward that end we have conducted several experiments investigating the landscape level distribution and abundance of GWSS using tube traps. We sampled a 52 trap grid covering 2.59 km^2 of terrain at the North Florida Research and Education Center in Quincy, FL throughout the year for a 3 year period (Northfield et al. 2008a). Traps were placed 229 m apart to detect movement in the landscape, and to correlate GWSS trap catch with different types of vegetation. Tube traps were placed on steel rods in open areas approximately 1 m above ground. Trap catch was recorded and traps were cleaned weekly from 25 January to 6 September in 2001, from 28 February to 10 October in 2002 and from 13 March to 7 August 2003. Years 2001 and 2003 differed from 2002 in rainfall with 2002 receiving much less rain. The location is divided in the middle by a 4 lane highway resulting in east and west sections with 25 and 27 traps, respectively. The east section is characterized by greater irrigated acreage and more diverse vegetation including several plots of crape myrtle, *Lagerstroemia indica*. Weekly trap count distributions were analyzed (kriging) using spherical models in ESRI ArcMap Version 9.2 to view spatial and temporal dynamics. Trap counts indicated differences in abundance and distribution of GWSS across years and between the east and west locations (Figure. 1). To evaluate the response to habitat type over time, traps were categorized into traps along forest edges, and traps away from the forest edges. On the east side of the road there were 13 traps along the forest edge and 12 traps away from the edge. On the west side, there were 14 traps along the forest edge and 13 away from the edge. The proportion of the *H. vitripennis* trap catch that occurred near the forest edge was plotted over time separately for each side of the road to evaluate the seasonal movement from the forest edge to summer hosts. A quadratic equation was fit to the data (Figure 2). We quantified the movement of GWSS populations moving from overwintering in the forest-forest edges out into managed areas during the growing season and back to the forest in the fall (Figure 1) as suggested by Pollard and Kaloostian (1961). Cluster indices, *v* were calculated using SADIE (Spatial Analysis of Distance Indices, version 1.2, Harpenden, UK) red-blue methodologies (Perry et al., 1999). Random permutations in SADIE were then conducted to test for the probability that a randomly distributed population would be more clustered than the data for each date and plot (Perry et al., 1999). GWSS adults were rarely aggregated at the scale tested; indicating that any population clusters had a radius smaller than 229 m (trap grid size). The spatial association tests demonstrated a difference in spatiotemporal stability in the east during the drought in 2002, in comparison to 2001 and 2003. Further details of this study will be published by Northfield et al. (2008a) as will the results from another study using mark-recapture techniques to compare the behavior of GWSS in a preferred and non-preferred host block (Northfield et al. 2008b). This and other research has been synthesized into a model of GWSS biology and behavior that is also submitted for publication (Mizell et al. 2008).

CONCLUSIONS

We are only beginning to understand what will be necessary to develop effective management schemes for GWSS. Clearly, understanding, quantifying and predicting GWSS population dynamics to meet strict regulatory and management objectives will be neither easy nor simple for this unusual insect vector. However, approaching the problem on several levels of resolution will facilitate progress toward implementing useful tactics and strategies to detect and monitor GWSS successfully. We have established that quantitative trapping results will vary greatly depending on patch type (adjacent host plant species, landscape structure, season, climate) and we are now working toward integrating these effects with trap type and spatial distribution to develop functional and useful trapping protocols. This should lead to better methods of disease management.

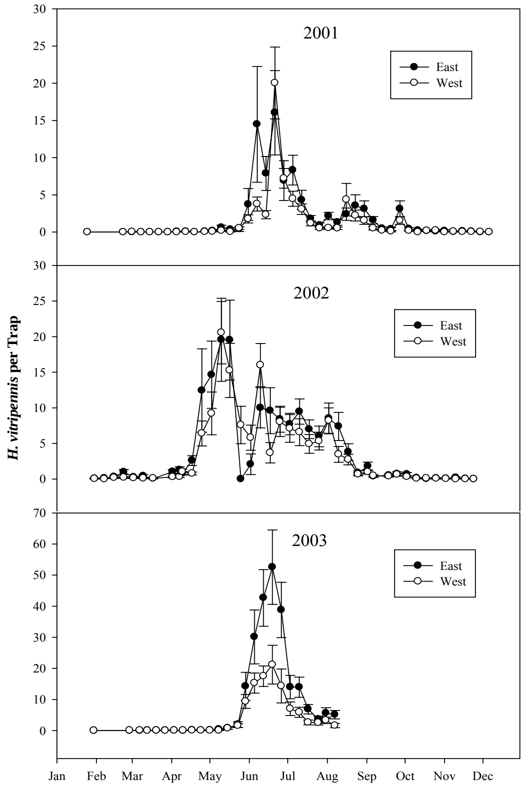

Figure 1. Mean trap catch of GWSS in East and West plots in 2001, 2002 and 2003 on the North Florida Research and Education Center in Quincy, FL.

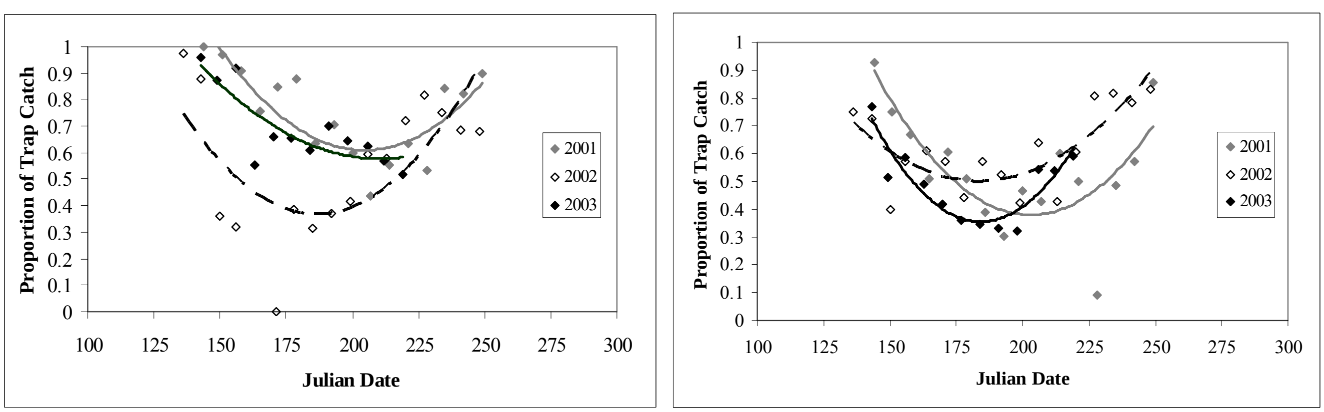

Figure 2. Proportion of total GWSS collected that were found on traps along the forest edge (as opposed to away from the forest edge) on each sample date, in the east (A-left) and west (B-right) plots in 2001, 2002, and 2003. R^2 values for quadratic trendlines in the east are 0.692, 0.451 and 0.686 for 2001, 2002 and 2003, respectively. R^2 values for quadratic trendlines in the west are 0.586, 0.608 and 0.826 for 2001, 2002 and 2003, respectively.

REFERENCES

Mizell, R. F., C. Tipping, P. C. Andersen, B. V. Brodbeck, T. Northfield and W. Hunter. 2007. Behavioral model for the glassy-winged sharpshooter, *Homalodisca vitripennis*: optimization of host plant utilization in a risky environment and the management implications. Environ. Entomol. (Submitted).

Northfield, T. R. F. Mizell, T. C. Riddle and P. C. Andersen. 2008a. Landscape level geospatial distribution of glassy-winged sharpshooter *Homalodisca vitripennis* (Hemiptera: Cicadellidae) in north Florida. (In manuscript).

Northfield, T., R. Mizell, T. Riddle, P. Andersen and B. Brodbeck. 2008b. Dispersal, patch leaving and aggregation of the glassy-winged sharpshooter, *Homalodisca vitripennis* (Hemiptera: Cicadellidae). Environ. Entomol. (Submitted).

Perry, J.N., L.Winder, J. M., Holland and R. D. Alston. 1999. Red-blue plots for detecting clusters in count data. Ecology Letters, 2, 106-113.
Pollard, H.N. and G. H. Kaloostian. 1961. Overwintering Habits of *Homalodisca coagulata*, Principal Natural Vector of Phony Peach Disease Virus. Journal of Economic Entomology, 54, 810

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