Host Selection Behavior and Improved Detection For Glassy-winged Sharpshooter, *Homalodisca coagulata* (Say)

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Summary

The glassy-winged sharpshooter (GWSS), *Homalodisca coagulata*, a major leafhopper vector of Pierce's disease, *Xylella fastidiosa*, in the Southeast, has recently colonized many locations in CA with devastating results. Better and more effective monitoring tools are needed to detect GWSS presence at very low population levels for regulatory and quarantine purposes and to accurately estimate local GWSS population density. Other than direct observation or sweep net collection, the only available survey and detection tool is a yellow sticky trap. CDFA is presently using the Pherocon AM trap configured in two dimensions to capture GWSS adults. We investigated trap size, shape, and spectral reflectance pattern along with placement parameters (height, background, proximity to vegetation) to optimize a field detection method for GWSS. We are also investigating GWSS behavior during host plant searching and selection. Yellow traps capture significantly more GWSS than other colors. The results indicate that the response is specific for the yellow-green and longer wavelengths rather than the intensity of the spectral reflection. As little as 20% reflection at wavelengths below 500 nm decreased trap capture. Factors that elicited the highest trap capture rate were: three dimensional traps (cylinders) captured more GWSS than two dimensional traps, traps placed in the open were more effective than traps inside trees or directly against foliage, trap capture rate increased with trap surface area and more GWSS were captured when traps were placed at the height of surrounding plants. Caution is warranted in using traps to determine GWSS populations on host plants. GWSS may be captured on traps but not be feeding on local host plants. It was also determined that the stikem used on the Pherocon AM trap becomes fouled easily and does not last long before GWSS begin to escape capture. The results prompt the following recommendations to detect GWSS: a bright yellow cylinder-shaped trap of width 7.5 cm or larger and length of 30 cm or longer should be placed in the open even with or just above the foliage of surrounding host plants or on a stake in the ground ca. 1m above ground in the open. GWSS behavior is driven primarily by vision, and while GWSS apparently can visually discriminate between host plants and other objects, GWSS does not appear to use plant volatiles in host finding

OBJECTIVES

1. To improve and optimize a trapping method (size, configuration, spectral reflectance pattern, field placement, etc.) to detect and monitor GWSS.
2. To determine the mechanisms used by GWSS in host plant finding and selection.

Experiments:

Experiments to meet the objectives were conducted in the field by placing 5 or more replicated individual traps of each type covered with Tanglefoot (Forestry Suppliers, Jackson MS) stickem in a completely random design for 30-45 days. GWSS per trap were recorded and removed and the stickem was refreshed every 3-5 days. We have found little or no gender differences in GWSS trap response. Safety yellow refers to a bright yellow enamel paint produced by Glidden Paints used to color objects involved in safety warnings.

Current trap: CDFA is using the yellow Pherocon AM trap which provides a two dimensional surface that is 18 x 22 cm or 396 cm^2. These traps are inexpensive and easy to use because the stickem is already

applied to the trap. However, the stickem used in the traps becomes fouled with insect carcasses and the stickem loses its effectiveness after a short period of time. Trap size facilitates shipment, handing and storage. Any new trap configuration must balance the need for ease of use and cost versus improved detection and monitoring.

Trap Color: In previous and present research we have found that GWSS are only captured in significant numbers in traps yellow in color. Yellow traps actively attract GWSS and the trap catch does not rely on GWSS passively "bumping" into the trap (Table 1). We have found that bright yellows such a Glidden's safety yellow that have little or no reflectance below wavelengths of 500 nm (blue-violet-UV) are preferred by GWSS. As little as 20% reflectance in the wavelengths below 500 nm decrease yellow trap captures (Table 1, Fig. 1). Experiments using traps with a range of colors and intensities of gray (exhibited very low capture rates) strongly support these conclusions (Table 1, Fig. 2). Table 2 indicates that 8 x 30cm cylinder traps of bright yellow colors expressed by safety yellow, the Pherocon AM and "Marigold" yellow, a latex paint by Lucite were equally effective in attracting adult GWSS at very low population levels.

Trap Shape and Size: We have found that traps of 3-dimensional cylinders perform better then rectangles and other two dimensional configurations and provide a significant increase in trap captures over the regular Pherocon AM trap now being used by CDFA We have found that trap size affects trap capture. Trap capture increases with trap surface area without regard to shape (Table 3). By testing combinations of shape and size we have found that larger traps (plastic pots as large as 30 x 30 cm) perform better than smaller traps and that cylinders perform better than two dimensional traps (Table 3, Table 4. Trap capture increases proportionally as cylinder diameter increases from 5 - 7.6 -10.7 cm and cylinder length increases from 15.2 - 30.5 - 61 cm (Table 4).

Trap Placement (background and contrast): We have found that trap placement relative to host plants and other landscape structures is very important. Placement of two dimensional traps in the open increased trap capture rate by 2x over captures by traps placed against tree foliage or in the interior of host plants. Traps placed at heights near the top or just above the vegetation captured more GWSS than traps placed surrounded by vegetation or near the ground (Table 5, Table 6).

GWSS Host Finding:

Experiments were conducted in the field using a myriad of treatments in an attempt to determine the importance of odor and visual cues to GWSS host finding. We found no positive response by GWSS adults of either sex to conspecifics of any type or their by products (excreta) - virgin or mated males and females living or dead or nymphs. We tested GWSS visual and odor response to host plants of different quality in containers. The trees were ca 1.5 m in height in 10 gal pots under irrigation placed in the field ca. 5 m apart. Three brown unattractive sticky traps made of plastic and 10 x 50 cm were coated with Tanglefoot stickem and placed in the ground around each plant. Treatments consisted of 'FlordaKing' peach (poor) and 'Santa Rosa' plum (preferred) trees presented naturally or covered with a screen cloth cage and a blank - no plant - control space with traps only. Traps were monitored for response of GWSS 2-3 times per week. In this experiment GWSS adult capture was significantly higher on the traps around the plum trees than the peach trees and the open plum tree captured significantly more GWSS than the caged plum. These results indicate that GWSS likely use visual cues to determine host plant response prior to landing.

Recommendations: Table 7 indicates that an 8 x 30 cm cylinder trap painted safety yellow captures

significantly more GWSS adults than a Pherocon AM trap constructed into a cylinder of the same size using 2 Pherocon traps. However, we believe that part of this significance is the direct result of the stickem used by the Pherocon AM trap rather than a response by GWSS. Based on all experiments the most practical and effective trap appears to be an 8 x 30 cm (3" x 12") cylinder that is placed in the open away from the plant canopy or even with or slightly above the canopy.

Outside Presentations of Research:
Gave a presentation and provided a written summary for the proceedings of the CDFA workshop Dec. 2001 in San Diego, CA.

Research Success and Recommendations:
This research provides the industry and regulatory agencies with a better trap to detect and monitor for the presence of GWSS adults.

Funds Status: The majority of the funds have been expended for this project.

Table 1: The response of the glassy-winged sharpshooter (leafhopper), *Homalodisca coagulata* (Say), to different colored sticky traps in a field choice experiment during June and July, 1995. Traps (20 x 50 cm) of each color were mounted on a T-shaped post and board ca. 2m above ground. Traps of each color were displayed on the boards which were placed in five different locations (replicates). Leafhoppers were counted by sex , removed and the relative placement of each trap was re-randomized each time the traps were checked. Paints are all enamels and were covered with a thin layer of Tanglefoot.

	Mean ± SE Leafhoppers/Trap/Day	
Trap Color	***H. coagulata* Males**	***H. coagulata* Females**
Gliddon Safety Yellow[1]	0.41 ± 0.12A[2]	0.44 ± 0.10A
Kem Lustral Yellow[3]	0.39 ± 0.09A	0.35 ± 0.07A
Kem Lustral Yellow/White[4]	0.18 ± 0.05 B	0.32 ± 0.06A
Glidden Yellow	0.16 ± 0.04 B	0.13 ± 0.13 B
Kem Lustral Black	0.05 ± 0.02 B	0.06 ± 0.01 B
Kem Lustral Red	0.03 ± 0.01 B	0.05 ± 0.01 B
Kem Lustral White	0.03 ± 0.01 B	0.04 ± 0.01 B
Clear Plexiglas	0.01 ± 0.01 B	0.02 ± 0.01 B

[1]) Glidden Glid-guard alkyd industrial enamel, 4540 safety yellow.
[2]) Means not followed by the same letter are significantly different as determined by DNMRT, P=0.05.
[3]) Spectral reflectance patterns for these paints can be found in Owens and Prokopy (1978). J. Econ. Entomol. 71:576-578.

[4]) Mixture
provides higher
UV reflectance.