

BIOLOGY AND ECOLOGY OF GLASSY-WINGED SHARPSHOOTER IN THE SAN JOAQUIN VALLEY

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INTRODUCTION

Table, raisin, and wine grapes grown in the San Joaquin Valley (SJV) comprise some of California's largest and economically productive agricultural commodities. Their commercial existence is now threatened by presence of both the glassy-winged sharpshooters (GWSS), *Homalodisca coagulata*, in the SJV (Phillips 1998, Blua et al. 1999) and the bacterial pathogen, *Xylella fastidiosa*, which is the causal agent of Pierce's disease (PD) (Purcell and Sanders 1999a). GWSS may not be a more "efficient" vector than the native California sharpshooters (Purcell and Saunders 1999a), but it is certainly more important. While initial control efforts will most certainly be directed at chemical suppression or spot eradication, there are a number of questions on GWSS biology and ecology in the SJV that should be addressed in order to improve control programs and/or increase control options. The primary focus of this research is the description of GWSS preference, egg deposition, age structure, population dynamics and levels of natural regulation on different host plants in urban / agricultural interface in the SJV where untreated populations serve as an inoculum source for nearby vineyards and citrus. We will also test sampled GWSS, from selected host plants and ecosystems, for the presence of *X. fastidiosa*.

OBJECTIVES

1. Determine glassy-winged sharpshooter (GWSS) biology and ecology throughout the season, particularly its age structure on and utilization of the different host plants that represent common breeding or dispersion refuges for GWSS in the San Joaquin Valley.
2. Determine the presence of *Xylella fastidiosa* in GWSS collected from different host plant species and in selected ecosystems in the San Joaquin Valley.
3. Begin to evaluate predator release as an additional suppression tactic.

RESULTS AND CONCLUSIONS

We began to categorize GWSS age structure, ecology, and resident natural enemies (particularly predators) on different host plants common in the SJV in spring 2002. Our initial methodology relied on field samples taken over a series of dates and on different host plant in untreated urban and agricultural regions in Fresno County. The search and spray program in that region was so effective that new GWSS sightings were treated within days or, if left untreated, the GWSS population density was too low to sample for our purposes. For these reasons, we adjusted our methodology and region sampled. Studies were moved to Bakersfield and host plant preference studies using potted host plant were included to manipulate the availability of same-aged and same-condition (e.g., irrigation and fertilization amounts) host plants to natural GWSS and natural enemy populations.

Host preference studies were conducted in unsprayed, GWSS infested areas (a citrus orchard and a residential area) in Bakersfield, California. Potted (6.6 liter) ivy, photinia, citrus, gardenia, privet, euonymus, hibiscus, agapanthus (lily of the Nile), grapevine, crape myrtle, eucalyptus, and oleander were set in a randomized block design (3 blocks in the citrus orchard and 4 in residential areas). GWSS eggs, nymphs and adults and GWSS predators and parasitoids were counted weekly from July through October. Initial results confirm field surveys from the Temecula and Riverside infestations that GWSS populations dynamics are influenced by host plants. There was a significant ($P < 0.1$) oviposition preference for some host plants, with more GWSS egg masses on crape myrtle, privet, grape, gardenia, and citrus than other plants (Figure 1). No or few egg masses were found on oleander and ivy. Interestingly, GWSS egg mass density was not related to adults or nymphs density ($F=0.16$, $df=1,82$, $P=0.68$, $r^2=0.002$; $F=0.03$, $df=1,82$, $P=0.86$, $r^2=0.001$, respectively). For example, GWSS nymphs

were significantly more common on oleander, which had no GWSS egg masses, than citrus, which had the most egg masses (Figure 2). There was no treatment difference in the number of adults observed (Figure 3); still, it is difficult to accurately measure adult densities through visual counts. The potted plants were in contact with each other and, therefore nymphs could move between plants, suggesting that oviposition preference may be different from nymph feeding preference.

Another possibility is disparate egg and nymph mortality among treatments, which may be suggested by both a significant treatment difference in the number of predators observed on the potted plants (Figure 4) and significant relationship between predators and GWSS egg masses ($F=8.52$, $df=1,82$, $P=0.005$, $r^2=0.09$). There was no relationship between predator and GWSS nymph densities, although GWSS population dynamics showed a clear reduction in nymph density after oviposition (Figure 5), which may have reduced predators during the very small sampling window. Furthermore, a significant relationship between observed parasitoids foraging on plants and GWSS egg masses ($F=16.2$, $df=1,82$, $P<0.001$, $r^2=0.16$) suggest many nymphs did not emerge (these data are not yet analyzed). In the unsprayed citrus block, we found a season-long “egg mass” parasitism rate of $68.2 \pm 0.02\%$; when an egg mass was attacked most of the eggs were parasitized, resulting in a season-long “egg” parasitism rate of $51.8 \pm 1.8\%$ (there were 11.6 ± 0.2 eggs per egg mass). Late-season parasitism was $>90\%$, as has been reported in previous studies. A subsample of emerged parasitoids has found only *Gonatocerus ashmeadi* present (Triapitsyn et al. 1998). The results from the potted plant experiment suggest GWSS adults have host oviposition preferences that may be different from the nymph feeding preference (see Brodbeck et al. 1995, 1996). Results also suggest that parasitoid and predator densities tract GWSS density. Abiotic and biotic mortality factors accounts for a reduction of ca. 35 eggs per plant to ca. 0.15 large GWSS nymphs per plant.

The experimental use of potted plants presents potential bias. For example, in the citrus block the resident GWSS and parasitoids may have been preconditions to citrus, resulting in both greater GWSS and parasitoid densities on that treatment. Surveys of urban areas were made to determine GWSS and natural enemy host plant relationships. Results are still being processed. Figure 6 provides an example from one survey. The information shows GWSS host plant preference in urban settings. Observations indicate that host plant condition between surveyed regions may be as important as host plant species, with plant vigor (typically fertilization, age or irrigation amounts) being the primary factor. During the GWSS surveys, egg masses are collected to determine parasitoid species composition and activity. Similarly, predator species and density are recorded. Predators are collected and stored at -80°C for later processing by Dr. James Hagler with immunologically-based assays that employ pest-specific monoclonal antibodies (MAbs) that can be used in an ELISA to identify the key predators of GWSS (Hagler et al. 2001). To date, samples have been taken (Bakersfield, Porterville Fresno and Ventura, CA) and will soon be processed.

A description of GWSS biology and ecology on host plants in urban areas of the SJV will help understand GWSS seasonal movement and infestation foci. For example, information on the abundance, host plant use, and seasonal dispersal patterns of resident sharpshooters (e.g., blue-green sharpshooter) (Goodwin and Purcell 1992, Perring et al. 2001). The same critical information for GWSS is lacking for the SJV. This work will provide a needed baseline on resident natural enemies of GWSS in the SJV and their contribution to GWSS mortality. Information on GWSS movement and host plant succession in the SJV may be useful for modification of surrounding vegetation or traps crops can potentially suppress GWSS movement into a vineyard.

Research has not yet begun on identifying the incidence of *X. fastidiosa* in GWSS adults collected from different habitats in different geographic regions, which will aid researchers currently mapping out PD and *X. fastidiosa* sources in the SJV, and on the augmentation of selected natural enemy species.

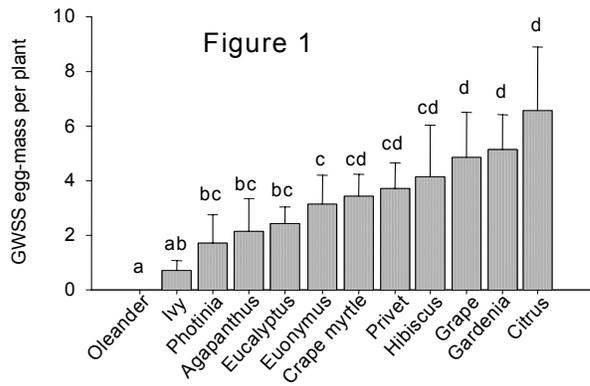


Figure 1. Average densities (sum ± SEM) of GWSS egg masses on potted plants shows a significant oviposition preference for some host plants or avoidance of other plants. Letters above each mean are significantly different, Fisher's LSD at $P < 0.1$.

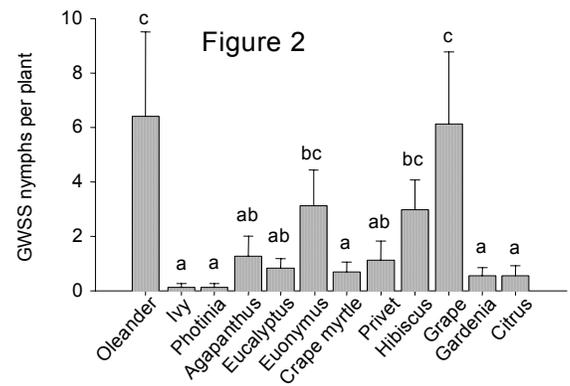


Figure 2. Average densities (sum ± SEM) of GWSS nymphs on potted plants shows wide discrepancy between egg mass density (Figure 1) and GWSS nymph density. Letters above each mean are significantly different, Fisher's LSD at $P < 0.1$.

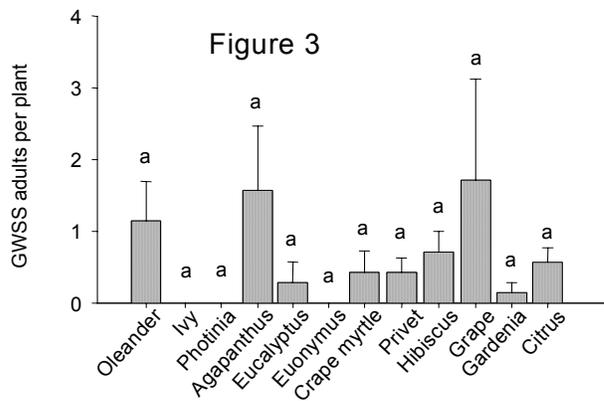


Figure 3. Average densities (sum ± SEM) of adults observed resting or feeding on potted plants shows no significant different among treatments. These data were collected during last adult flight (July to October 2002). Letters above each mean are significantly different, Fisher's LSD at $P < 0.1$.

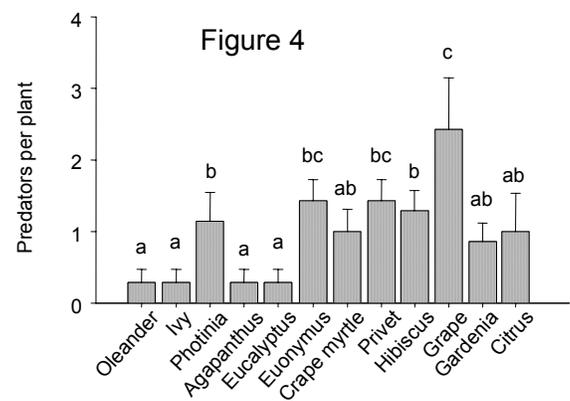


Figure 4. Average densities (sum ± SEM) of predators observed on potted plants shows a significant different among treatments. Predators were spiders (82.9%), lacewings (11%), preying mantids (3.6%) and assassin bugs (2.4%). Letters above each mean are significantly different, Fisher's LSD at $P < 0.1$.

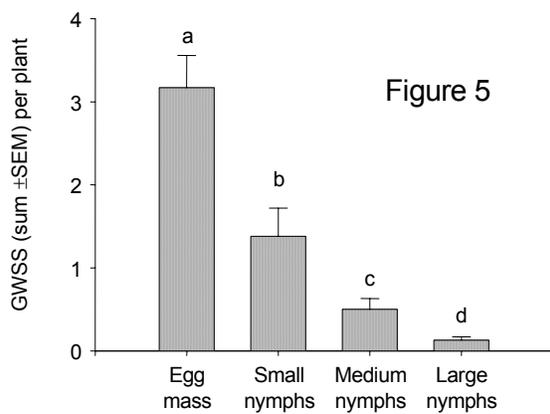


Figure 5. Average densities (sum ± SEM) of GWSS life stages found on potted plants shows a significant density reduction for each grouping of life stages. These data were collected during last adult flight (July to October 2002). Letters above each mean are significantly different, Tukeys' LSD test at $P < 0.05$.

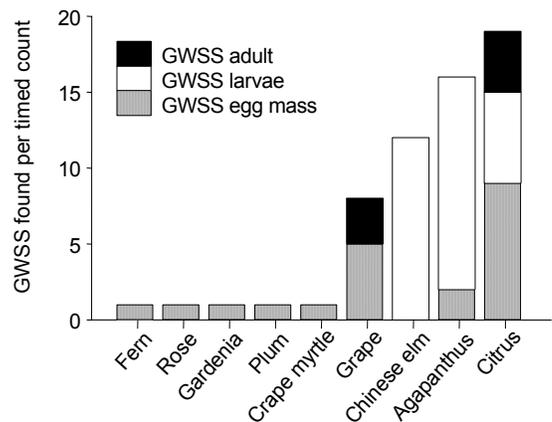


Figure 6. Example of survey information on GWSS life stages found in one sample of host plants on a residential street in Bakersfield, CA (July 10, 2002). During this survey, GWSS were not found on eucalyptus, pecan, pine, ornamental plum, persimmon, oleander, fig, *Opuntia* spp. or acacia.

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