TESTING FOR NON-TARGET IMPACTS BY *GONATOCERUS ASHMEADI* AND *GONATOCERUS FASCIATUS* ON INDIGENOUS SHARPSHOOTERS IN SOUTHERN CALIFORNIA

Elizabeth A. Boyd and Mark S. Hoddle
Department of Entomology, University of California, Riverside

ABSTRACT

A rigorous testing strategy involving choice and no-choice test arenas was used to explore the potential impacts of biological control organisms. The glassy-winged sharpshooter (GWSS), *Homalodisca coagulata* Say (Hemiptera: Cicadellidae), biological control program was examined as a model system for analyzing this technique and also for performing a retrospective non-target impact assessment. *Gonatocerus ashmeadi* Girault and *G. fasciatus* Girault, (both Hymenoptera: Mymaridae), egg parasitoids of the exotic GWSS, were tested against three possible non-target sharpshooters indigenous to southern California. *G. ashmeadi* and *G. fasciatus* parasitized eggs of smoke-tree sharpshooter (STSS), *Homalodisca liturata* Ball, but not eggs of blue-green sharpshooter (BGSS), *Graphocephala atropunctata* (Signoret), or green sharpshooter (GSS), *Draeculacephala minerva* Ball (all Hemiptera: Cicadellidae). Parasitism of STSS eggs by *G. ashmeadi* and *G. fasciatus* does not appear to be significantly different when compared to the GWSS control in no-choice experiments. Additionally, it appears *G. ashmeadi* exercises no preference of host eggs for parasitization when presented with a choice of STSS and GWSS simultaneously.

INTRODUCTION

Examining possible non-target effects of biological control agents is becoming a more common requirement for many biological control programs targeting arthropod pests. Currently, for classical biological control of weeds, the centrifugal method provides an excellent means for eliminating possible natural enemies that could cause harm to non-target plants. However a rigorous, reliable, and broadly applicable testing standard for arthropod biological control is currently lacking. No-choice and choice testing strategies are a common way to test for possible non-target effects of new biological control organisms. However, these lab studies are often carried out in small testing arenas where the study organism is forced onto the host which may be adequate for determining physiological host range but may seriously overestimate its ecological host range in nature. Our research involves the use of rigorous testing strategies utilizing standard Petri dish test arenas, coupled with larger-scale entire plant test arenas in no-choice and choice comparisons. As retrospective studies in ongoing biological control programs can yield valuable information on non-target impacts, we chose the GWSS classical biological control program in California as a model for our non-target studies. We are examining the possible non-target impacts of the self-introduced *Gonatocerus ashmeadi* and the recently introduced *G. fasciatus*, egg-parasitoids of the GWSS, and three sharpshooters native to California, U.S.A.: the STSS, BGSS, and GSS. Our study, along with the use of small-scale Petri dish studies and larger-scale full plant studies are supplemented with sentinel plants and habitat surveys to determine the invasiveness of GWSS parasitoids.

MATERIALS AND METHODS

Choice and no-choice tests were conducted with *G. ashmeadi* and *G. fasciatus* on BGSS, GSS, and STSS eggs using GWSS eggs as a control. Tests were conducted on two scales, micro (= Petri dish, 100 x 15 mm) and macro (= full plant, approximately 30cm height), using single, one day old, mated, honey water-fed *G. ashmeadi* or *G. fasciatus*. BGSS eggs have not been tested at the micro scale. Each test was conducted utilizing two different host plants for each of the sharpshooters examined. An effort was made to include at least one native host plant. Eureka lemon (*Citrus limon* (L.) Burm.f. cv. 'Eureka'; Sapindales: Rutaceae) and jojoba (*Simmondsia chinensis* (Link) Schneid.; Euphorbiales: Simmondsiaceae) were used for STSS, sweet basil (*Ocimum basilicum* L.; Lamiaceae: Lamiales) and wild grape (*Vitis girdiana* Munson; Rhamnales: Vitaceae) for BGSS, and milo (*Sorghum bicolor* L. Moench; Cyperales: Poaceae) and rescuegrass (*Bromus catharticus* Vahl.; Cyperales: Poaceae) for GSS. In choice tests, the parasitoid was exposed to approximately 20 eggs each of the test species and control on the same host plant simultaneously. For no-choice testing each parasitoid was supplied approximately 40 target eggs. All target eggs were less than 48 hours of age. In all tests the parasitoid was provided honey water as a food source and allowed 24 hr to parasitize the eggs before removal from the testing arena.

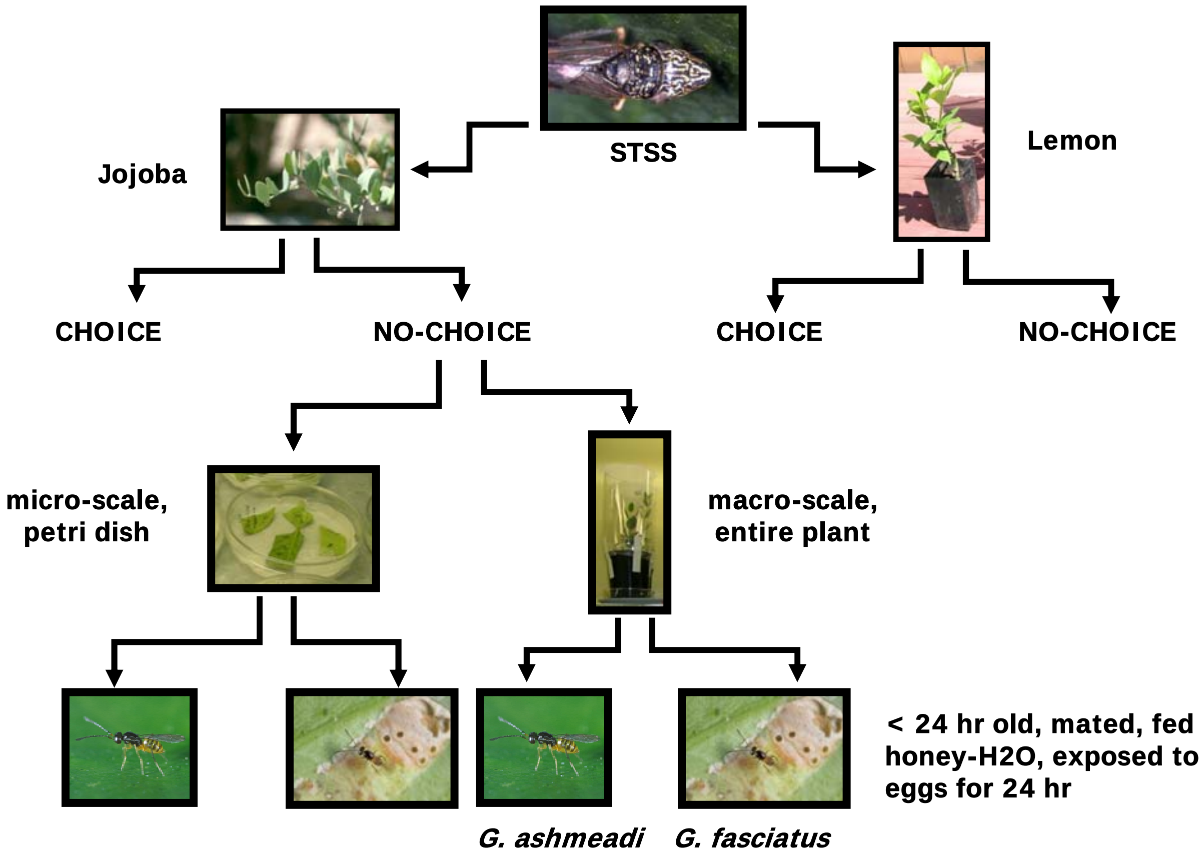

Figure 1. Pictorial schematic of non-target testing strategy using STSS as an example with elaboration of no-choice trial. Parasitoid photos by Jack Kelly Clark.

RESULTS

Percent parasitism of STSS egg masses by *G. ashmeadi* averaged ca. 70% for both micro and macro scale no-choice tests on each host plant, while parasitism of GWSS controls ranged from 50-80%. Preliminary tests of *G. fasciatus* show similar results, however many replicates are still in progress and results are not shown. Parasitism of STSS eggs by *G. ashmeadi* and *G. fasciatus* does not appear to be statistically different from the GWSS control in no-choice experiments. Additionally, it appears *G. ashmeadi* exercises no preference of host eggs for parasitization when presented with a choice of STSS and GWSS simultaneously. No parasitism of BGSS or GSS eggs by *G. ashmeadi* or *G. fasciatus* was observed for either host plants.

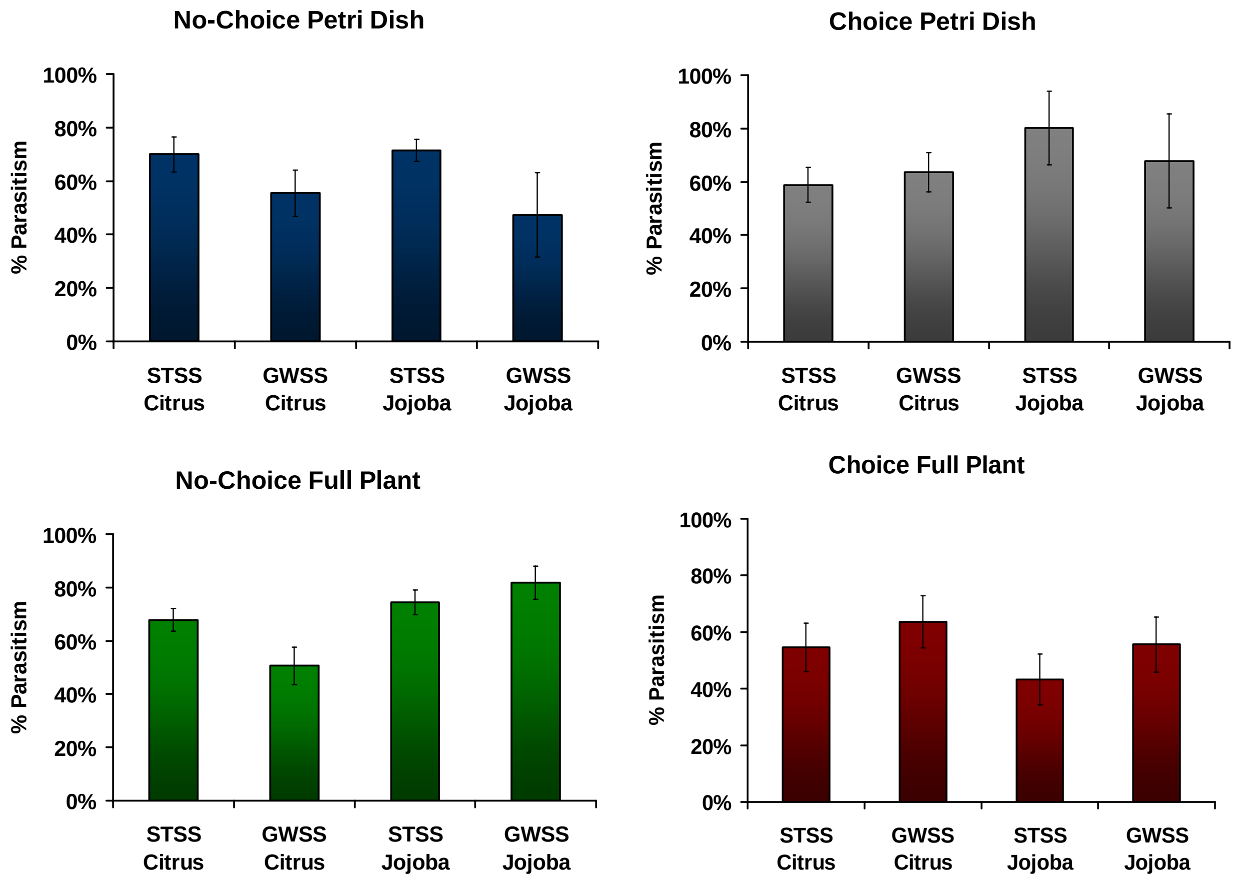

Figure 2. No-choice and choice test results of STSS eggs parasitized by *G. ashmeadi*.

DISCUSSION

While results for laboratory choice and no-choice tests with *G. fasciatus* are still being tabulated for STSS, preliminary data shows neither *G. ashmeadi* or *G. fasciatus* egg parasitoids will parasitize BGSS or GSS eggs, but will parasitize STSS eggs. In fact, STSS egg masses appear to be attacked as readily as the GWSS control in no-choice tests at both Petri and whole plant scales and with no preference for either host eggs in choice tests at both scales. Given the substantial availability of GWSS eggs, these parasitoids may impact the native *Ufens* spp. (Hymenoptera: Trichogrammatidae) parasitoid complex if large numbers of *G. ashmeadi* spill out of GWSS infested areas and attack STSS eggs, the preferred host for *Ufens* spp.. Furthermore, *G. ashmeadi* emerging from STSS eggs are smaller and less fecund than those developing from GWSS eggs (N. Irvin unpublished data). We would speculate these 'runts' may have an overall reduced fitness, and that STSS eggs may ultimately be a dead-end host for *G. ashmeadi*, especially if no selection of evolutionary significance occurs for use of STSS eggs. However, if these parasitoids were to establish in large numbers in the xeric habitats where STSS is most abundant, and if these larval parasitoids are able to out-compete larval *Ufens* spp., then we might expect a drastic impact on the natural enemy fauna of STSS in desert regions. For example, the establishment of these exotic parasitoids in the fragile ecosystems of the desert oases at Joshua Tree National Park, where the STSS and *Ufens* spp. coexist in a delicate balance, could have significant impacts. Presently, we suspect that *G. ashmeadi* and most likely *G. fasciatus* are unlikely to physiologically withstand the harsh environments of desert areas of eastern California, but the possibility and the consequences of such an incursion, should it occur, are worth consideration.

Our research approach with GWSS parasitoids attempts to include not only the physiological, ecological, but also the temporal and spatial elements in determining possible native sharpshooter (and associated native parasitoids) non-target effects. Via choice & no-choice testing at two scales, parasitoid behavioral studies in the field, non-target habitat monitoring and natural enemy classification, and by determining oviposition, egg, and habitat characteristics of the possible non-target species, we are obtaining important information for retroactively assessing the possible risk posed by these exotic natural enemies of GWSS to native members of the receiving ecosystem.

ACKNOWLEDGEMENTS

I would especially like to thank Abigail P. Moss and Justin E. Nay for their immeasurable assistance and support. Many thanks to the UCR Herbarium for identification of native plants used in the experiments. This project was funded in-part by UC Exotic Pests.