# SHOULD NEOCLASSICAL BIOLOGICAL CONTROL AGENTS FROM ARGENTINA BE RELEASED IN CALIFORNIA FOR CONTROL OF THE GLASSY-WINGED SHARPSHOOTER?

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## ABSTRACT
*Gonatocerus tuberculifemur* and *G*. sp. 6. *morrilli* complex are two sharpshooter parasitoids from Argentina that have been held at the UC Riverside I & Q facility since September 2002 and reared on glassy-winged sharpshooter (GWSS; *Homalodisca vitripennis*; formerly *H. coagulata*) egg masses. There is substantial uncertainty about the safety of releasing these agents and whether they would provide additional control of GWSS in California or disrupt the efficacy of the existing parasitoid complex which has been constructed with natural enemies that have evolved to exploit GWSS. The purpose of this grant is to ascertain in Quarantine whether these two neoclassical biological control agents from Argentina can outperform the dominant GWSS parasitoid in California, *G. ashmeadi*. These data will help guide the decision to release the Argentinean parasitoids from quarantine for liberation and establishment in California. Work has not commenced on this project as the quarantine colony was recently infused with "new blood" from specimens collected in Argentina in August 2006.

## INTRODUCTION
Neoclassical or new association biological control is the deliberate establishment of natural enemies against a target pest with which these natural enemies have no evolutionary history. The intent of this form of inoculative biological control is to suppress target pest populations by creating novel pest-natural enemy associations. The rationale for this strategy is the development of new exploiter-victim relationships which are hypothesized to be more effective at controlling pests. Greater impact can occur because new association avoids using old association co-evolved natural enemies that have developed population stabilizing mechanisms with the pest. It is proposed that old associations potentially result in higher population equilibrium densities compared to what would be observed if a novel efficacious natural enemy was attacking the pest with which there is no evolutionary history (Hokkanen and Pimental, 1984; 1989). Neoclassical biological control is considered to be the least ethically defensible course of action when considering use of natural enemies for pest control because of: (i) uncertainty over adverse effects of novel associations on pest population dynamics, and (ii) potential loss of ecological functions of native species because of non-target attacks (Ehler, 2000). However, these potential concerns should be addressed on a case by case basis, rather than relying on broad generalizations that ranks the ethical desirability of employing new associations lower than old associations, and the environmental risk factor substantially higher. Survey work by the USDA in Argentina has revealed a complex of parasitoid species attacking Proconiini [this is the same tribe that the glassy-winged sharpshooter (GWSS; *Homalodisca vitripennis*; formerly *H. coagulata*) belongs to] sharpshooters in South America. Some of these discovered species are new to science, and two species, *Gonatocerus tuberculifemur* and *G*. sp. 6, from Argentina have been in quarantine at UC Riverside since September 2002. These two parasitoids dominated the natural enemy fauna attacking Proconiini cicadellids in arid areas of Argentina (i.e., provinces of Mendoza and Rio Colorado) and it is thought that they may be well suited to California's climate and could provide substantial control of GWSS. Limited work on host specificity testing conducted by the CDFA suggests that native California non-Proconiini sharpshooters are not at substantial risk from non-target attacks by *G. tuberculifemur* (Pickett pers. comm. 2005). However, all native U.S. Proconiini sharpshooters are considered to be at high risk of attack by these Argentinean parasitoids (Goolsby pers. comm. 2005). Consequently, concerns have been raised about non-target impacts on native USA Proconiini sharpshooters that could result from establishing these Argentinean parasitoids in California. The most salient risk scenario is the successful incursion of native GWSS habitat in the southeast USA and northeast Mexico by these neoclassical biological control agents from Argentina. This could readily occur via the transportation of plant material from California to Florida that carries GWSS egg masses parasitized by *G. tuberculifemur* or *G*. sp. 6. Should this occur, potential impact on native southeastern USA Proconiini sharpshooters is almost certain to occur, but the magnitude of the severity of successful infiltration is impossible to predict *a priori*. Consequently, the purpose of this research project is to determine if the neoclassical biological control agent, *G. tuberculifemur*, is competitively superior to the omnipresent *G. ashmeadi*, and exhibits the potential to be an extremely aggressive and efficacious natural enemy that can dominate the system to the almost total exclusion of all current parasitoids thus providing higher levels of biological control of GWSS than is currently observed.

**OBJECTIVES**

1. Ascertain oviposition preferences of *G. ashmeadi*, *G. tuberculifemur*, & *G*. sp. 6 for GWSS egg masses of different ages.
2. Determine the competitiveness of these parasitoids simultaneously foraging for GWSS egg masses in simple and complex environments.
3. Statistically compare the functional response of each species attacking GWSS egg masses of different sizes.
4. Compare the mean daily and lifetime reproductive output for each species at 20, 25, and 30$^{o}$C.
5. Determine mean developmental times for each species at 20, 25, and 30$^{o}$C.

**RESULTS**

No results have been achieved on this project so far. Fast progress is expected next season when GWSS colonies begin to produce abundant egg masses for experimentation.

**CONCLUSIONS**

Work is yet to commence on this project. Rapid progress is expected once the project starts in spring 2007.

**REFERENCES**

Ehler, L.E. 2000. Critical issues related to nontarget effects in classical biological control of insects. In: Nontarget Effects of Biological Control. Eds: Follet, P.A. and Duan J.J. pp3-13. Kluwer Academic Press.

Hokkanen, H. and D. Pimentel. 1984. New approach for selecting biological control agents. Canadian Entomologist 116: 1109-1121.

Hokkanen, H. and D. Pimentel. 1989. New association biological control: theory and practice. Canadian Entomologist 121: 829-839.

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# REALIZED LIFETIME PARASITISM OF GLASSY-WINGED SHARPSHOOTER EGG MASSES BY *GONATOCERUS ASHMEADI*

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## ABSTRACT
Oosorption and egg maturation results suggested that *Gonatocerus ashmeadi* is a pro-synovigenic species and females mature more eggs during their lifetime. In the absence of hosts, oosorption was initiated on day 7, where the number of reabsorbed eggs increased at a rate of 1-4 eggs per day. In the presence of hosts female *G. ashmeadi* matured 3-27 eggs per day.

## INRODUCTION
The self-introduced *Gonatocerus ashmeadi* (Vickerman et al. 2004) is the key natural enemy of glassy-winged sharpshooter (GWSS; *Homalodisca vitripennis*; formerly *H. coagulata*) egg masses in CA at present (Pilkington et al. 2005). Over summer, parasitism levels of GWSS egg masses and individual eggs in masses by *G. ashmeadi* can approach 100% but parasitism levels of the spring generation of GWSS are substantially lower, and parasitism generally averages ~19-20% (Pilkington et al., 2005; Triapitsyn and Phillips 2000). Naturally occurring populations of *G. ashmeadi* in CA have been augmented with mass reared individuals from populations found in the southeastern U.S.A. and northeastern Mexico which encompasses the home range of GWSS (CDFA 2003).

Substantial laboratory work with *G. ashmeadi* has been conducted in an attempt to understand and parameterize basic aspects of this parasitoid's reproductive biology, and host selection behaviors. Irvin and Hoddle (2005a) have evaluated oviposition preferences of *G. ashmeadi* when presented GWSS eggs of various ages. Interspecific competition between *G. ashmeadi* with *G. triguttatus* and *G. fasciatus* for GWSS egg masses of different ages has been assessed (Irvin and Hoddle 2005b; Irvin et al. 2005) along with factors influencing the sex ratio of offspring (Irvin and Hoddle 2006a). The effect of resource provisioning and nutrient procurement on the longevity of *G. ashmeadi* has also been determined (Irvin and Hoddle 2006b). Furthermore, Pilkington and Hoddle (2006) have assessed laboratory-level fecundity rates of *G. ashmeadi* under different constant temperature regimens.

The GWSS-*Gonatocerus* system has benefited from this intensive laboratory study to generate a basic understanding of factors influencing host selection and parasitism success. The next step that is now required is to test hypotheses generated from lab studies in the field. Field level assessments will help determine the most important aspect of the GWSS biological control program: "How big an impact do individual female *G. ashmeadi* parasitoids have on GWSS population growth via parasitization of eggs?" Addressing this question will allow us to form a much better understanding of the levels of control we can expect from *G. ashmeadi* individually and collectively on GWSS population growth in the field during the spring and summer generations.

## OBJECTIVES
To measure real lifetime contributions of individual female *G. ashmeadi* to the parasitism of GWSS egg masses in citrus orchards. Before field assessments can be conducted, laboratory studies will be run to ascertain and verify four critical factors outlined below. Answers to these four critical factors will allow us to develop a composite index that describes the correlative relationship of these four factors that will predict parasitoid age and egg load in the field and to assess the contribution of individual female parasitoids to GWSS suppression under field conditions. The four critical factors are:

1. Determine the relationship between adult female *G. ashmeadi* size as measured by right hind tibia length (HTL) and 24-hr egg load for spring and summer generations (this work was completed and reported in Hoddle et al. 2005).
2. Ascertain the extent to which oosorption occurs, and the length of time without ovipositing that is required to initiate this physiological response if it does occur.
3. Determine whether female parasitoids can mature eggs in excess of those they are born with.
4. Estimate parasitoid age using near infrared spectroscopy (NIRS) (Perez-Mendoza et al. 2002) and develop an alternative measure for comparison by developing a wing deterioration index that estimates parasitoid "age" through visually grading the severity of 'wear and tear' (i.e., numbers of broken setae) of setae on wings (this work was completed and reported in Hoddle et al. 2005).