DETERMINING THE DAY-DEGREE REQUIREMENTS FOR GLASSY-WINGED SHARPSHOOTER DEVELOPMENT AND QUANTIFICATION OF DEMOGRAPHIC STATISTICS AT FIVE TEMPERATURES

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ABSTRACT

Glassy-winged sharpshooter (GWSS) developmental and reproductive biology has received relatively little attention from researchers investigating management strategies for this pest. This is a major impediment to rearing this insect for experimental work, developing management plans, understanding interactions with natural enemies, predicting incursion risk into new areas, and spread in recently inoculated areas. Field-oriented management plans for GWSS, if they are to be effective, need solid data on day-degree accumulations to predict pest developmental times, number of expected generations per year, and estimates of expected longevity and fecundity. The purpose of this research is to generate these fundamental biological data for GWSS to assist pest management programs, biological control efforts, and incursion risk management. These laboratory-derived data, once collected and analyzed, can be compared to similar data for the major egg parasitoids attacking GWSS. When taken together, the influence of temperature on pest development and reproductive output, and its natural enemies will enable pest managers to determine incursion risks and the expected level of biological control that natural enemies could provide as GWSS continues to expand its range within California.

INTRODUCTION

Day-degree accumulation for development and estimates of adult longevity, fecundity, survival rates, and seasonal generational turn over are the fundamental factors driving population growth. Scientifically-based insect pest management programs rely heavily on day-degree models to help with predictions on pest population growth so adequate control measures can be initiated well in advance of the development of economically damaging populations. While the role of day-degree research in pest management is well recognized and employed widely across a diverse group of insect pests, these data can also be invaluable for assessing invasion risk to areas currently uninfested by the pest, and the rate of spread and population growth intensity in newly invaded areas. Despite the high economic and pest profile of GWSS, relatively little is known about the degree-day requirements for this pest or the effect of varying temperature regimens on the survivorship rates of nymphs in various instars, the longevity of adults, adult fecundity and sex ratio of offspring. The research currently being conducted and reported here will address these important informational shortcomings for GWSS.

OBJECTIVES

1. Develop day-degree models for GWSS by quantifying the developmental biology at five different temperatures (20, 25, 27, 30, &33°C).
2. Quantify reproductive biology and generate demographic statistics from $l_x m_x$ life tables at five experimental temperatures.
3. Use day-degree data (Obj. 1), and demographic estimates (Obj. 2) in GIS to predict the geographic range of GWSS within California, and intensity of population turnover in areas vulnerable to incursion. These predictions will be compared to those generated for two egg parasitoids of GWSS, *Gonatocerus ashmeadi* and *G. triguttatus*, thus enabling comparison to determine how well GWSS egg parasitoids will be able to track GWSS as this pest expands its range northwards in California.

RESULTS

Developmental times for GWSS nymphs, adult longevity, adult fecundity, and progeny sex ratio have been determined for eight-nine females at 25, 30 and 33°C. At the time of writing this report, the final 260 nymphs were being reared to adulthood and for reproductive demographic studies. An additional 20 nymphs are being reared at 20°C, 60 nymphs at 33°C and 180 nymphs are being reared at 25°C (90 nymphs) and 30°C (90 nymphs).
Work is ongoing for 20°C for all developmental and reproductive biology work. This low temperature is proving to be very slow and difficult to complete because nymphal development is extremely slow and adult sharpshooters are tardy when mating, maturing eggs, and ovipositing at 20°C. In addition to the four experimental temperatures we are currently running (20, 25, 30, and 33°C), we are planning to run a variable temperature experiment. For this variable temperature study, the mean daily maximum temperature will be set at 30°C and the mean nightly temperature will be set at 20°C. This variable temperature regimen will provide a mean temperature of 25°C. Data from this experiment can be compared to those obtained

for GWSS reared at a constant 25°C. This additional temperature regimen is considered necessary for GWSS as previous peer reviews of similar studies completed for the egg parasitoids *Gonatocerus ashmeadi* and *G. triguttatus* have correctly pointed out that in nature animals are not subjected to constant temperatures in the environment. Some studies suggest that exposure to fluctuating temperatures may actually be beneficial for developmental times, survival times, and estimates of fitness (e.g., longevity and fecundity).

Data analyses for fecundity and subsequent demographic statistics have not yet been completed as replicates at four temperatures are still being run (20, 25, 30 and 33°C). Partial data analyses on developmental times are provided in Table 1. These data estimates will change as additional replicates are added to respective temperatures once completed. Data on the reproductive biology of GWSS at the four experimental temperatures has not been provided as these data are still being collected from reproductively active females and fecundity estimates and progeny development is currently insufficient for sex ratio analyses that are needed for jackknifing demographic statistics. We anticipate having this project completely finished, and analyzed by the winter of 2007, and a manuscript submitted for publication in early 2008.

Table 1. Partial developmental and reproductive statistics for GWSS at four different temperatures. All developmental times are presented in days. These data are preliminary and estimates will change as additional replicates are currently being run to bolster the number of GWSS used for analyses.

Temperature	Egg Devpt Time (Days)	Nymph to Adult Devpt Time (Days)	Adult Longevity (Days)	Female Fecundity & Progeny Sex Ratio
20°C	16.4	82.3	70.2	Ongoing
25°C	8.3	65.8	56.2	Ongoing
30°C	6.1	54.9	46.8	Ongoing
33°C	7.6	41.9	32.5	Ongoing
Variable Temp (20°C at night 30°C during day)	Yet to be started	Yet to be started	Yet to be started	Yet to be started

CONCLUSIONS

Upon the anticipated completion of this ongoing project at the end of winter 2008, we expect to have collected sufficient data to determine the day-degree requirements for GWSS, to have quantified survival and longevity for nymphs and adults, and to have robust estimates of life time fecundity and sex ratio for populations reared at various experimental temperatures. These data are necessary for the development of day-degree models for pest management, to predict incursion risk and population growth in new areas, and to determine what the overlap in range will be between GWSS and its mymarid egg parasitoids, for which similar studies have already been completed.

REFERENCES

None.

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