HOST SELECTION AND LOW TEMPERATURE STORAGE OF THE GLASSY-WINGED SHARPSHOOTER, *HOMALODISCA COAGULATA*

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INTRODUCTION

The egg parasitoid, *Gonatocerus ashmeadi*, is a mymarid wasp that accounts for most of the observed parasitism in California on the glassy-winged sharpshooter (GWSS), *Homalodisca coagulata* (Say), a vector for Pierce's disease. In the absence of techniques for propagating the wasp via artificial methods, it is very important to mass-rear the GWSS to provide host eggs for this parasite to be used in bio-control programs. Low temperature storage is an integral part of the process of mass-rearing insects for use in agricultural pest control programs (Leopold 1998). Through cold storage, parasitized and unparasitized GWSS eggs may be accumulated and held for later use in rearing and releasing parasitoids. Although Al-Wahaibi and Morse (2002, submitted) reported that the development of GWSS eggs held at 11.5 °C was retarded and aborted during early stages of eye spot formation, data regarding the effect of low temperature throughout the development of the GWSS and that of the egg parasitoid are lacking.

Further, choosing suitable host plants, which are amenable to cold storage, will be very critical for establishing and maintaining the leafhopper colony and for obtaining large numbers of leafhopper eggs. The sharpshooter is a highly polyphagous leafhopper having over 100 known host plants in Florida (Adlerz 1979). Recent observation shows that the leafhopper can feed on at least 72 plant species in 37 families (Hoddle at al. 2002, submitted), and 73 plant species in 35 families (Blua et al. 1999). Although feeding is apparently limited to xylem vessels on all host plants (Anderson et al. 1989), some studies have shown that the leafhopper exhibits host-plant preference (Adlerz 1979; Mizell and French 1987), and that the amide concentrations in host plants may potentially cause an oviposition preference by the leafhopper (Andersen et al. 1992). Some field observations have indicated the preference for different plant species varied with different times of the year (Adlerz 1979; Mizell and French 1987; Brodbeck et al. 1990). However, little quantitative data are available so far on host plant preference of feeding adult males and females under laboratory or mass-rearing conditions.

OBJECTIVES

1. Examine feeding behavior of GWSS adults on various host plants and determine the effects of cold storage tolerant host plants on size of the egg masses, egg hatch, nymphal development.
2. Determine the cold tolerance of GWSS eggs and parasitized eggs during development.
3. Determine the most effective method for cold storage of GWSS eggs and parasitoids.

RESULTS AND CONCLUSIONS

Host Selection:

The experiments were conducted in USDA-ARS, Biosciences Research Laboratory, Fargo, from July through October 2002. These studies showed that adult female sharpshooters (fourth generation from parents collected in Riverside, California) had a significant host preference when given a choice of 12 plant species at 25˚C, RH 65% and L 14: D 10 photoperiod. The test plants included corn (*Zea mays*), sorghum (*Sorghum aethiopicum*), millet (*Milium effusum*), euonymus (*Euonymus spp.),* mums (*Chrysanthemum spp.),* hibiscus (*Hibiscus spp*.), sunflower (*Helianthus annuus*), eggplant (*Solanum spp.*), cantaloupe (*Cucumis melo*), cotton (*Gossypium hirsutum*), wild grape (*Parthenocissus quinquefolia*) and a plant of Lamiaceae family. The percentages of feeding females varied significantly among different plant species at time intervals examined between 6 to 48 hours (Table 1). A majority of the female adults preferred feeding on sunflower while less than 6% females were observed feeding on millet, corn, sorghum, cantaloupe, wild grape and the Lamiacae plant. For males, no significantly different feeding preferences were observed, although at the end of the test almost 40% of the insects were found on just 3 plants: egg plant, hibiscus and sunflower (Table 1). The sharpshooter deposited eggs on leaves of 7 of the 12 plant species, which were corn, sorghum, millet, euonymus, chrysanthemum, hibiscus and sunflower. Our data indicate that plant species had no significant influence on the size of egg mass (the average number of eggs per mass) but egg hatch was affected (Table 2). Although sunflower was one of preferred host plants, egg hatch was significantly lower on it than the other plants.

Approximately 68% of the sunflower leaves bearing eggs died or wilted from desiccation while still attached to the plant and this consequently caused many of the eggs to die. In addition, our observations indicate that the sharpshooters from the colony shipped to us from the APHIS facility in Texas readily oviposit on eggplant while it is not preferred by our colony females.

Low Temperature Storage:
In a comparison with hibiscus, chrysanthemum and sunflower plants, euonymus cuttings and leaves remain viable the longest in incubators set at either 2, 5, 7, 10, or 12°C. The leaves of hibiscus cuttings or whole plants begin to wilt when stored at 2°C for 24 hr while chrysanthemum remains fresh for 3-4 weeks. Euonymus cuttings placed in nutrient solution remain fresh and viable for rooting after nearly 60 days at 10°C. We collected sharpshooter eggs by using euonymus plants and placed the 0-1 day-old embryos into incubators. After storage at 10°C for 1-6 days, the eggs could hatch in part or all (Figure 1). Furthermore, these embryos had a similar developmental time to hatching as the controls after they were taken out of cold storage (Figure 2). However, no eggs hatched after cold storage for 8 or 10 days at 10°C. The embryos placed at 2°C for 2 or 4 h could hatch within 8-9 days and hatching was 67% and 62%, respectively. After storing 0-1 day-old eggs at 5°C for 6 days, up to 63 % of the embryos emerged as nymphs. No eggs stored at 5EC for more than 8 days would hatch. At 12°C, embryonic development proceeded very slowly and we found that 24% of the eggs could hatch after storage for 20 days. However, because of the low number of egg masses obtained (some of the points on Figures. 1 and 2 had < 10 egg masses), these experiments will be repeated again. Finally, *Gonatocerus ashmeadi* parasitoids within 1-2 day-old sharpshooter eggs on euonymus leaves could completely emerge in the 5°C incubator within 20 days. Furthermore, we found that on the chrysanthemum leaves the parasitoids within 1-2 day-old sharpshooter eggs could emerge after storage at 2°C for 6 days. Further studies are planned to identify the threshold for development for the parasitoid and which developmental stage is the most tolerant to cold storage.

Table 1. Mean (± SE)% of total number of H. coagulata adults on different host plants at different time intervals

Plants	**Sex**	**Per cent adults on plants at time interval**[a]				
		6h	12h	24h	36h	48h
Purple millet	male	4.6 ± 2.9 b	5.9 ± 3.2 b	5.0 ± 0.9 b	6.0 ± 3.9 b	4.9 ± 2.9 b
Euonymus		6.4 ± 3.2 b	9.4 ± 5.3 b	6.4 ± 3.2 b	9.4 ± 5.3 b	9.4 ± 5.3 b
Egg plant		10.8 ± 3.5 b	13.8 ± 1.6 b	12.3 ± 2.6 b	12.2 ± 3.4 b	12.2 ± 4.0 b
Hibiscus		10.3 ± 4.4 b	9.5 ± 5.4 b	7.2 ± 4.3 b	8.4 ± 5.4 b	10.9 ± 7.8 b
Cotton		9.1 ± 2.9 b	9.1 ± 2.9 b	7.6 ± 2.0 b	7.5 ± 3.9 b	9.0 ± 4.5 b
Corn		4.1 ± 2.7 b	2.6 ± 1.4 b	2.6 ± 1.4 b	2.6 ± 1.4 b	2.6 ± 1.4 b
Sunflower		10.7 ± 6.4 b	12.3 ± 5.2 b	12.3 ± 5.2 b	16.1 ± 5.1 b	16.1 ± 5.1 b
Sorghum		1.5 ± 1.5 b	1.5 ± 1.5 b	1.5 ± 1.5 b	2.7 ± 1.4 b	2.8 ± 1.4 b
Cantaloupe		10.7 ± 5.5 b	9.2 ± 5.3 b	10.7 ± 5.5 b	11.0 ± 5.6 b	9.5 ± 4.8 b
Chrysanthemum		5.0 ± 0.9 b	7.4 ± 1.9 b	9.0 ± 1.3 b	9.4 ± 3.1 b	9.4 ± 3.1 b
Lamiacea		0 b	2.2 ± 2.2 b	2.2 ± 2.2 b	3.5 ± 1.9 b	3.5 ± 1.9 b
Wild grape		2.6 ± 1.4 b	7.6 ± 2.0 b	7.7 ± 0.7 b	7.4 ± 1.9 b	6.2 ± 0.9 b
Purple millet *	female	1.2 ± 1.2 c	4.9 ± 1.3 bc	3.6 ± 0.1 bcd	2.5 ± 1.2 b	2.4 ± 1.1 b
Euonymus*		5.8 ± 4.1 bc	10.7 ± 3.9 bc	10.7± 5.4 bcd	11.8 ± 6.2 b	11.8 ± 6.2 b
Egg plant		11.0 ± 4.4 ab	8.6 ± 3.3 bc	11.0 ± 4.4 bc	11.0 ± 4.4 b	11.0 ± 4.4 b
Hibiscus*		4.9 ± 3.3 bc	7.2 ± 2.1 bc	7.2 ± 2.1 bcd	9.6 ± 3.2 b	13.0 ± 5.1 b
Cotton		8.3 ± 2.9 abc	13.3 ± 2.6 b	13.3 ± 2.6 ab	9.8 ± 3.4 b	8.6 ± 5.4 b
Corn*		4.8 ± 2.4 bc	3.6 ± 2.1 bc	3.5 ± 2.0 cd	2.5 ± 2.5 b	2.5 ± 2.5 b
Sunflower*		15.6 ± 2.3 a	25.2 ± 7.1 a	21.5 ± 4.7 a	22.7 ± 5.2 a	26.3 ± 4.6 a
Sorghum*		1.2 ± 1.2 c	3.7 ± 2.1 bc	3.7 ± 2.1 bcd	3.7 ± 2.1 b	3.7 ± 3.7 b
Cantaloupe		2.4 ± 1.2 c	3.6 ± 1.1 bc	4.9 ± 1.3 bcd	5.9 ± 2.2 b	5.9 ± 2.2 b
Chrysanthemum*		2.4 ± 1.2 c	4.8 ± 1.1 bc	6.0 ± 1.2 bcd	2.5 ± 1.2 b	2.5 ± 1.2 b
Lamiacea		0 c	1.1 ± 1.1 c	1.1 ± 1.1 d	1.1 ± 1.1 b	2.3 ± 1.2 b
Wild grape		2.4 ± 1.2 c	2.4 ± 1.2 c	2.4 ± 1.2 cd	3.5 ± 2.0 b	2.4 ± 1.2 b

[a] One-way ANOVA – means were separated by Duncan's Multiple Range Test
* Denotes plants on which oviposition occurred.

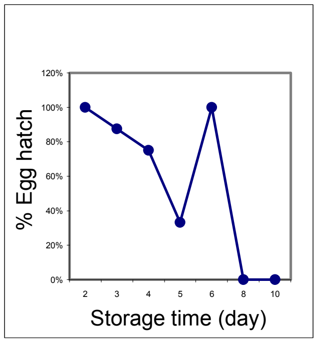

Figure1. Percentage egg hatch at different cold storage times at 10EC

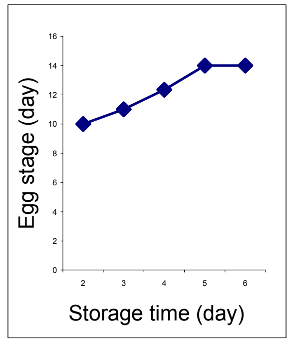

Figure 2. Egg stage of *H. coagulata* eggs stored at 10EC

Table 2. Egg mass size and hatching related to host plants

Plants	No. of eggs/mass (range) [a]	Per cent egg hatch[a]
Euonymus	16.8 ± 1.6 (10~37) b	81.8 ± 9.1 ab
Chrysanthemum	15.0 ± 3.1 (9~23) b	72.8 ± 16.1 ab
Hibiscus	12.0 ± 2.7 (6~19) b	81.3 ± 12.0 ab
Sunflower	11.1 ± 1.9 (2~31) b	24.7 ± 9.9 c
Sorghum	11.5 ± 1.5 (10~13) b	100.0 ± 0.0 a
Corn	15.0 ± 2.0 (13~17) b	94.1 ± 5.9 a
Purple millet	14.0 ± 3.0 (11~17) b	95.5 ± 4.5 a

[a]Values followed by different letters in each column were significantly different (P<0.05)

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