REARING THE BROWN MARMORATED STINK BUG *HALYOMORPHA HALYS* (HETEROPTERA: PENTATOMIDAE)

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The brown marmorated stink bug (BMSB), *Halyomorpha halys* (Stål) (Heteroptera: Pentatomidae) is a potential threat to Florida agriculture (Halbert & Hodges 2011; Zhu et al. 2012). It is native to China, Japan, Korea and Taiwan (Hsiao 1977; Zhang 1985) and was recently introduced into the United States. It was originally detected in Allentown, Pennsylvania in 1998, and since then has been reported in approximately 37 states (NAPIS 2009; Jacobs 2012). Several interceptions of the BMSB have been reported from Florida in the last several years, however it is apparently not yet established there (Leroy Whilby, Personal Communication). BMSB is a polyphagous sucking insect that feeds on a variety of fruit trees including citrus as well as vegetables, ornamental and weedy plants The BMSB has become a serious pest of fruits and vegetable crops in the mid-Atlantic region. The estimated apple losses reached $37 million in 2010 from BMSB for mid-Atlantic apple growers (Hamilton & Shearer 2003; Nielsen & Hamilton 2009; Gill et al. 2010). Feeding damage is caused by both nymphs and adults on the leaves, fruits and stems of plants. In addition to direct feeding damage, BMSB is also known as a vector of witch's broom phytoplasma in *Paulownia tomentosa* (Thunb.) (Lamiales: Paulowniaceae) in Asia (Gao et al. 2008; Jones & Lambdin 2009). However, in the USA it has not been reported as a vector of any pathogen (Gyeltshen et al. 2011). BMSB is able to overwinter inside houses and other enclosed structures becoming a nuisance pest for homeowners before migrating in the spring into crops and weedy areas where it develops large numbers during summer and fall (Gill et al. 2010, Maryland Department of Agriculture 2010).

BMSB has 3 developmental stages (egg, nymph, adult). The 5 nymphal instars from eclosion to adult take from 33 to 55 d. The life cycle was studied by Funayama 2002; Niva & Takeda 2003; Nielsen et al. 2008; and Medal et al. (2012).

It is important to rear an insect pest such as the BMSB in order to study its life cycle, host range and management tactics including susceptibility to potential biological control agents, such as the egg parasitoid *Trissolcus halyomorphae* Yang (Hymenoptera: Scelionidae) (Yang et al. 2009), and to other management tactics. On 6 Oct 2011, 63 adult females and 60 adult males BMSB were shipped to the Florida Biological Control Laboratory quarantine facility in Gainesville from the USDA-ARS Beneficial Insect Introduction Research Unit in Newark, Delaware. All insects arrived alive and in good condition; however they were already in a reproductive diapause, which was reversed by exposing the adults to a bright intense light (T5 HO [High Output] bulbs; 6,400K) on a 16-hour photoperiod (16:8 h L:D) at 26 °C ± 2, and 50-55% RH.

Several different rearing methods were attempted with the BMSB to provide the number of egg masses required to conduct host-specificity tests with an egg-parasitoid. These procedures described herein are those that gave satisfactory results. These techniques are not meant for mass rearing, but will provide a limited number of insects required for biological studies and management technique testing.

The most effective rearing method for daily collection of egg masses included placement of approximately 10-15 pairs of BMSB adults in clear plastic round containers (25 cm diam × 9 cm high), with four 5 cm diam vents drilled along the sides of the container to allow for air circulation; and clear plastic rectangle containers (30 cm long × 23 cm wide × 10 cm high) having 4 meshed openings (5 cm diam) to allow for air circulation (Fig. 1e). A 50 mL glass container filled with water and covered with cotton was placed at the center of the plastic container to provide moisture. Containers placed on shelves with reproductive adults were exposed to 16-h photoperiod (16:8 h L:D) at 26 °C ± 2, and 50-55% RH.

Insects were fed green bean pods, lima bean (*Phaesolus lunatus* L.) pods, carrots *Daucus carota* L. (Apiaceae), and raw peanuts *Arachis hypogaea* L. (Fabaceae) every other d. Funayama (2006) reported that adding carrot to a peanut-soybean [*Glycine max* (L.) Merr (Fabaceae)] diet

Fig. 1. Clear plastic rectangular and circular containers for rearing *Halyomorpha halys*.

significantly improved the BMSB rearing success. Other foods occasionally added to the diet included raisins [*Vitis vinifera* L. (Vitaceae)], apple [*Malus pumilla* Mill. (Rosaceae)], papaya [*Carica papaya* L. (Caricaceae)], mango [*Mangifera indica* L. (Anacardiaceae)], okra, orange [*Citrus sinensis* (L.) Osbeck (Rutaceae)], tangerine [*Citrus tangerine* (Tanaka) Tseng (Rutaceae)], cucumber [*Cucurbita sativus* L. (Cucurbitaceae)], jalapeño [*Capsicum frutescens* L (Solanaceae)], tomato [*Lycopersicon esculentum* Mill. (Solanaceae)], strawberry [*Fragaria* × *ananassa* (Rosaceae)], common ragweed [*Ambrosia artemisiifolia* L. (Asteraceae)] bouquets and other seasonal produce. Layers of Kimwipes® Kimberly-Clark and paper towels were placed inside the containers to provide an oviposition substrate, hiding places, and additional surface area. Egg masses were hand collected every other d. This method proved to be very effective for obtaining fresh high quality eggs (Fig. 2). To avoid egg predation by adults and to avoid overcrowding, egg masses were collected regularly and placed in a separate labeled container. Nymphs tended to feed on the eggs, and adults were observed feeding on recently molted adults when placed in larger cages. Consequently, eggs, nymphs and adults were segregated to avoid cannibalism and improve rearing success. The number of cages (clear plastic containers) with 10-15 pairs per container varied depending on the number of egg-masses required each wk. Adult female started laying eggs approximately two weeks after the last molt, and laid approximately one egg mass (mode: 28 eggs in each mass) every wk (Medal et al. 2012). Therefore, 100 reproducing females were necessary to obtain 100 egg masses a wk.

Summary

The brown marmorated stink bug, *Halyomorpha halys*, is a potential threat to Florida agriculture. Several interceptions have occurred in the last several yr, but BMSB is apparently not yet established in Florida. At the FDACS-DPI quarantine facility different rearing methods were evaluated with *H. halys* to provide the number of egg masses required to

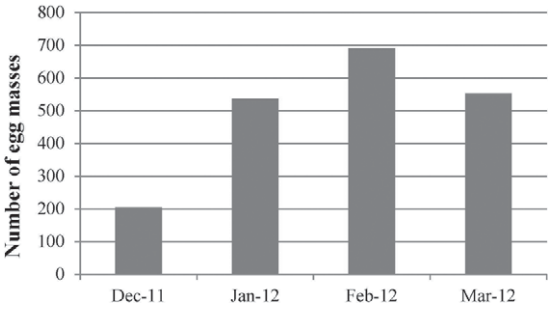

Fig. 2. Laboratory production of *Halyomorpha halys* egg masses using clear plastic rectangular and circular containers during Dec 2011-Mar 2012.

conduct the needed host-specificity tests with an egg-parasitoid. Here we described a very effective rearing method for the daily collection of egg masses so that 100 egg masses per wk could be reliably provided for use in experiments.

Acknowledgments

The authors are grateful to Dr. Walker Jones (USDA-ARS), Dr. Amanda Hodges, Ashley Poplin (University of Florida). and Ms. Julieta Brambila (USDA-APHIS-PPQ) for their suggestions and contributions to improve this manuscript. we also thank Dr. Kim Hoelmer, Dr. Christine Dieckoff and Katty Tatman (USDA-ARS) for reviewing the manuscript, providing the initial BMSB colonly and offering training for the laboratory rearing of BMSB. This research was approved by the Florida Department of Agriculture and Consumer Services, Division of Plant Industry for publication as contribution #1215.

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