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# BIOLOGY OF THE BROWN MARMORATED STINK BUG *HALYOMORPHA HALYS* (HETEROPTERA: PENTATOMIDAE) IN THE LABORATORY

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The brown marmorated stink bug (BMSB), *Halyomorpha halys* (Heteroptera: Pentatomidae) probably arrived accidentally in the United States from Asia most likely in packing material. Native to Asia (Hsiao 1977; Zhang 1985) it was first found in Allentown, Pennsylvania in 1998. As of Dec 2012 it has spread or was sighted in approximately 40 states (NAPIS 2009; The Northeastern IPM Center 2012). Several interceptions of the BMSB have been reported through Florida in recent years, but it is not apparently established (Julieta Brambila, Personal Communication). In its native range, it feeds on a wide variety of plants including fruits, ornamental, legumes, vegetables, and weedy plants (Hamilton & Shearer 2003; Nielsen & Hamilton 2009a; Gill et al. 2010). BMSB survives the winter by invading houses and other enclosed structures, and then in the spring it migrates back into crop fields in search of potential host plants. Large populations typically appear in the summer and fall (Gill et al. 2010; Maryland Dept. Agric. - Office of the Secretary 2010).

The biology of BMSB under quarantine-laboratory conditions in Gainesville, Florida is reported herein. The BMSB has 3 developmental stages (egg, nymph, adult). The barrel-shaped eggs are light yellow to light blue, laid in clusters of 20 to 32 eggs (mean = 28.7; mode and median = 28 eggs; $n$ = 32), and glued to the host surface (leaf, stem, fruit). Egg clusters of the BMSB were obtained from a quarantine colony kept under an intense bright light (HOT 5 bulbs; 6,400K) at 16:8 h L:D, 25 °C, and 50-55% RH. Thirty-two egg masses were individually placed in a clear plastic Petri dish (14.5 cm diam × 2.5 cm height) with moistened tissue paper, and checked daily for emergence. Nymphs are oval in shape and have a tick-like appearance. They are yellowish brown, and mottled with red and black. The last instars are darker with white bands on the antennae and legs, similar to the adults. Nymphs were reared on common bean pods (*Phaseolus vulgaris* L.; Fabales: Fabaceae) and carrot (*Daucus carota* L.; Apiales: Apiaceae) purchased from local markets. Food was replaced every other day, and moistened tissue paper was provided daily. The nymphs were checked daily to determine survival, and number and duration of the individual instars. Development or molting time was determined by the presence of exuvia or molted skin. After the final molt to adult, all individuals were sexed. Males (1.20 cm length; n = 30) are smaller than females (1.44 cm length; n = 30), and can be distinguished by a rear ventral scoop (Fig. 1). Nymphs emerged in approximately 4 to 7 days (mean = 6 days) after the eggs were laid. The 5 nymphal stages (Fig. 2) from hatching to adult took from 33 to 55 days (mean = 43 days). The mean lengths in cm of the stages based n = 30 per stage were as follows: 1.43 (1st instar), 2.75

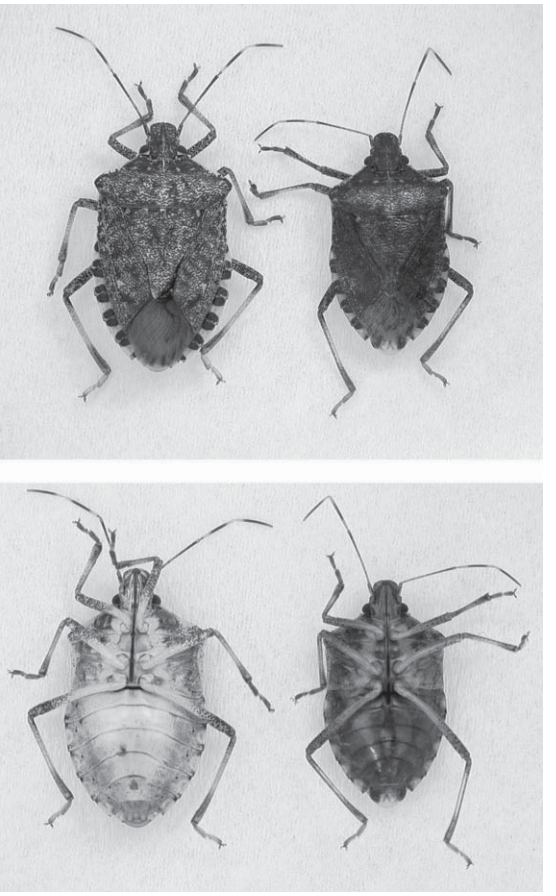

Fig. 1. Brown marmorated stink-bug, *Halyomorpha halys*, adults (female left; male right); upper panel: dorsal view, lower panel: ventral view.

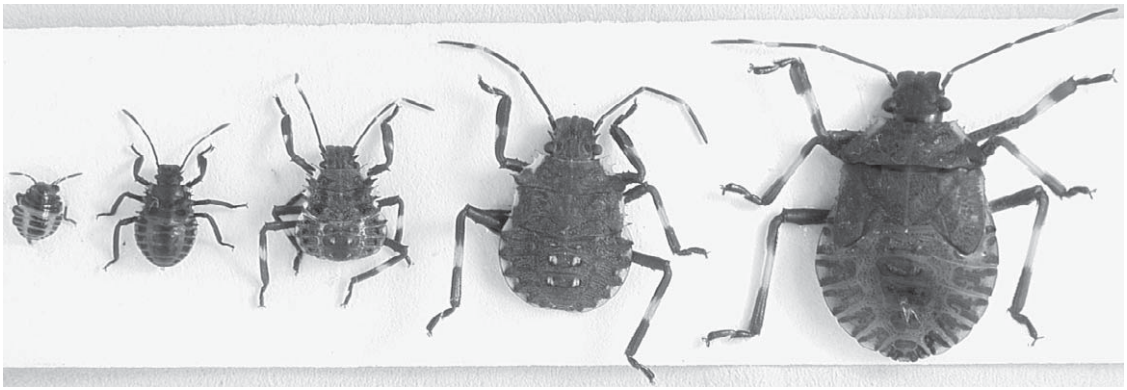

Fig. 2. The 5 nymphal stages of the brown marmorated stink bug, *Halyomorpha halys*.

(2nd instar), 4.29 (3rd instar), 9.44 (4th instar), and 11.39 mm (5th instar) (Table 1). The length of the 1st instar recorded in this study is shorter than the length (2.4 mm) reported in other studies, but we found no differences in our measurement of the lengths of the subsequent instars and those of Jacobs (2011). The developmental time of each of the first to 4 instars was approximately 1 wk, which was shorter than that of the fifth instar that lasted approximately 2 wk at 25 °C and 55% RH. The developmental times of the first to fourth instars assessed at 25 °C were similar to those obtained at 30 °C by other researchers, but shorter than those reported at 20 °C (www.geochembio.com/biology/organisms/stinkbug).

Nymphal mortality from egg hatch to adult emergence ranged from 23% to 50% (mean = 36%). The adult is grayish brown with a typical stink bug shield shape, but it can be easily recognized by having alternating dark and white bands on the legs and on the last 2 segments of the antennae. The edge of the abdomen also has alternating white and dark bands (Fig. 1). Twenty-five recently emerged pairs of male and female bugs were placed in pairs in 1L transparent plastic containers with an 8 cm mesh screen in the lid. Mating time ranged from 8.43 to 11.00 min (mean = 10.15 min, n = 20). Females started laying eggs from 14 to 25 days (mean =18 days) after their final molt. The number of egg masses per female ranged from 5 to 9 (mean =6), and the total number of eggs per female ranged from 124 to 253 (mean = 168), and these parameters differ greatly from those reported by Nielsen et al. (2008) (average of 212 eggs and 8 egg masses in BMSB reared in a growth chamber, and by Kawada & Kitamura (1983) (487 eggs per female in a Japanese *H. halys* culture). These significant differences in the number of eggs laid per female could be partially attributed to different rearing conditions and genetic variability among populations of different geographical locations. We observed that 1 mass of eggs was laid every 5 to 12 days. The shortest interval between successive ovipo-

TABLE 1. DIMENSIONS AND DEVELOPMENTAL TIME OF ALL LIFE STAGES OF THE BROWN MARMORATED STINK BUG, *HALYOMORPHA HALYS* REARED AT (25 °C, 50-55% RH AND 16:8 H L:D.

| Stage | Body length (mm) Mean (range) | Development time of immatures stages & adult longevity (days) Mean (range) |
|---|---|---|
| Egg | 1.2 (1.2-1.3) diameter<br>1.7 (1.6-1.8) height | 6 (4-7) |
| 1st Instar | 1.43 (1.2-1.5) | 6 (5-7) |
| 2nd Instar | 2.75 (2.6-3.0) | 9 (7-10) |
| 3rd Instar | 4.29 (4.2-4.4) | 7 (6-10) |
| 4th Instar | 9.44 (8.8-10.2) | 7 (5-10) |
| 5th Instar | 11.39 (11.0-11.6) | 14 (10-18) |
| Adult Female | 14.36 (12.8-15.5) | 84 (63-112) |
| Adult Male | 11.97 (11.1-13.5) | 119 (56-224) |

sition events was similar to the interval (4.32 ± 0.41 days) reported by Nielsen et al. (2008). At a constant temperature of 25 °C, the longevity of the females ranged from 9 to 16 wk, and that of males ranged from 8 to 18 wk, although 2 males survived 32 wk ($n$ = 23). The male/female ratio of emerged BMSB was 0.9:1 (n = 2,685). Based on the duration of the BMSB life cycle obtained under laboratory conditions and the occurrence of overlapping generations, we anticipate this species can produce multiple generations per yr once it becomes established in Florida, which would differ from only 1 generation per yr reported in Pennsylvania and New Jersey and 2 generations per yr observed in West Virginia (Nielsen & Hamilton 2009b; Holtz & Kamminga 2010). Information about the life cycle of this potential Florida crop invader is important for the development and implementation of IPM programs.

## Summary

The life cycle of the brown marmorated stink bug, *H. halys*, was studied at the Gainesville, Florida quarantine facility at 25° C constant temperature, 16:8 h L:D and 50-55% RH. Nymphs, which emerged from 32 egg masses, were reared on bean pods and carrots in Petri dishes and checked daily to determine the number and duration of each nymphal stadium and percent survival. Twenty-five recently emerged couples were set-up in clear plastic containers, fed daily with bean pods and carrots, and provided with moisture. The pre-oviposition period, number of egg masses, and longevities of males and females were determined. The general life cycle of this potential crop pest of Florida is discussed.

Key Words: stink bug, pest, Pentatomidae, Florida

## Resumen

El ciclo de vida del chinche hediondo conocido en ingles como 'brown marmorated stink bug', *H. halys* fue estudiado en la cuarentena de Gainesville a una temperatura constante de 25° C, 16 horas de fotoperíodo (16:8 Luz/Oscuridad) y una humedad relativa de 50-55%. Ninfas emergidas de 32 masas de huevos fueron criadas con vainas de frijol común y zanahorias en platos Petri y revisadas diariamente para determinar el número y la duración de cada estadío ninfal y porcentaje de sobrevivencia. Veinte y cinco parejas de adultos recién emergidos fueron colocadas en recipientes de plástico trasparente, alimentados con vainas de frijol común, zanahorias y humedad fue suministrada diariamente. Se determinó el período de pre-oviposición, el número de masas de huevos, y duración del ciclo de vida de los machos y hembras. El ciclo de vida en general de esta plaga potencial de cultivos en la Florida es presentado.

Palabras Clave: Chinche hediondo, plaga, Pentatomidae, Florida

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