



Brown Marmorated Stink Bug

Halyomorpha halys Stål (Hemiptera: Pentatomidae)

INTRODUCTION:

The Brown Marmorated Stink Bug (BMSB) is an exotic invasive bug from Asia that probably entered the U.S. in packing crates originating in the Orient. First reported in the U.S. invading homes in Allentown, PA, in 2001, BMSB was likely present there since the mid-1990s. BMSB is an agricultural pest of soybeans and many fruit trees in Asia. In the U.S., it was first recognized as a nuisance pest when it entered homes in large numbers in the autumn. Initial fears that it might be a significant agricultural pest were recently confirmed when it appeared in field, vegetable, orchard, vineyard, and ornamental crops.

DISTRIBUTION/SPREAD:

BMSB is native to China, Japan, Korea and Taiwan. Although the first confirmed detection in the U.S. was in Pennsylvania in 2001, reports of a congregating stink bug had begun surfacing several years earlier. BMSB has since been reported in over 20 eastern and southern states ranging from Maine to Mississippi, as well as Ohio, California and Oregon. Most believe that the distribution of BMSB is much wider than currently documented and that detections will increase with greater public awareness of this pest. BMSB is a strong flyer and readily hitchhikes on vehicles, thereby contributing to the rapid spread of this pest.



BMSB adult. Chris Sargent, UMD

HOST PLANTS:

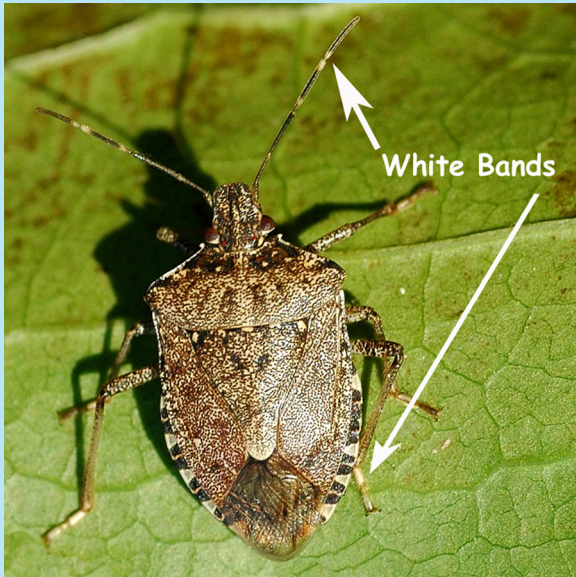
BMSB is polyphagous, feeding on many different species of fruit trees, ornamental plants, vegetables and legumes (Bernon et al., 2004, found BMSB on over 60 host plants). In Asia, BMSB is considered a major agricultural pest of a variety of fruit trees, particularly citrus, and of legumes, especially soybeans. It is also known to spread Paulownia witches' broom, a phytoplasma disease of Paulownia trees in China (Hoebeke, E. R. 2002). In the U.S., BMSB has been found feeding on a wide array of forest and ornamental trees and herbaceous plants, and vegetable, field, and fruit crops. The list of hosts that BMSB feeds on continues to grow.

Reported fruit hosts in Asia include: *Diospyros* spp. (persimmon), *Ficus* spp. (fig), *Malus* spp. (apple), *Morus* spp. (mulberry), *Prunus* spp. (cherry, peach, and apricot), and *Pyrus* spp. (pear). The expanding U.S. host list includes *Prunus persica* (peach), *Malus* spp. (apple), *Pyrus serotina* (Asian pear), *Rubus* spp. (raspberry), and *Vitis* spp. (grape).

Reported vegetable and field crop hosts in the U.S. include: flowers, stems and pods of various legumes (beans - *Phaseolus* spp.), particularly soybeans (*Glycine max*), corn, and many common garden vegetables such as tomatoes and peppers. BMSB has also been found on eggplant, but fruit injury due to their presence has not been detected thus far.

Reported ornamental hosts in the U.S. include: *Abelia* spp., *Acer* spp. (maple), *Buddleia* spp. (butterfly bush), *Catalpa* spp., *Celosia argentea* L. (celosia), *Cercis canadensis* (Eastern Redbud), *Cladrastis kentukea* (yellow wood), *Gleditsia triacanthos* (honey locust), *Hibiscus rosa-sinensis* L. (hibiscus), *Liriodendron tulipifera* (tulip tree), *Lonicera* spp. (honeysuckle), *Malus* spp. (crab apples), *Paulownia* spp. (princess tree), *Platanus* spp. (sycamore), *Prunus serotina* (black cherry), *Prunus x yedoensis* (Yoshino cherry), *Quercus* spp. (oak), *Rosa rugosa*, *Syringa* spp. (lilac), *Ulmus* spp. (elm), and *Zelkova serrata* (zelkova). Herbaceous plant hosts include: *Cleome* spp. (spider flower), *Dahlia* spp., *Helianthus annuus* (sunflower), *Zinnia* spp., and even some weeds such as burdock (*Articum* spp.).

The first BMSB found in Pennsylvania were feeding on ornamental plants, garden crops, fruit and shade trees in suburban areas and urban landscapes. Butterfly bush and princess tree was heavily fed on by both adults and nymphs of BMSB, causing significant leaf damage. Urban peach and pear trees have also been reported to suffer heavy damage. Homeowners with these favored host plants in their landscapes may be the first to notice BMSB as it spreads to new areas.



Adult BMSB showing white bands on antennae and legs (above); adult feeding on serviceberry (below). Michael Raupp, UMD



BMSB eggs and newly hatched 1st instar nymphs. Michael Raupp, UMD

BIOLOGY and DAMAGE:

BMSB belongs to the order Hemiptera in the suborder Heteroptera, a group known as true bugs. In the northern part of its native range, it has only one generation each year, but in southern China up to six generations a year have been reported. In the U.S., studies in New Jersey indicate only one generation per year is possible due to the number of degree days required for the bug to reach sexual maturity (Neilsen and Hamilton, 2009). However, research conducted in 2010 at the USDA ARS Appalachian Research Station, WV, found that two generations occurred. The number of generations BMSB can produce annually is likely temperature dependent, so as the pest moves south, more generations per year are expected to occur. BMSB overwinter as adults in protected locations such as natural rocky outcroppings and in structures such as houses and other buildings. Adults emerge in the spring over an extended period of time, usually from late March through June depending on location; however, BMSB sheltering in homes may become active on warm days in late winter. After emerging, adults begin to feed and are very active, dropping off plants or flying away if disturbed.

BMSB become sexually mature about two weeks after emergence, at which time mating occurs. Egg laying begins shortly after, and egg masses are laid at approximately one week intervals from June to September. Egg masses are deposited on the underside of host plant leaves in clusters containing 20-30 pale green or white spherical-shaped eggs, unlike the typical barrel-shaped eggs other stink bugs lay. Each female can lay about 250 eggs in her lifetime. First instar nymphs emerge four to five days after the eggs are laid and remain clustered around the egg mass for several days, or even until they molt to the 2nd instar. Nymphs complete five instars with each stage lasting about one week, depending upon temperature. Nymphs tend to be solitary feeders, but often congregate on leaves, bark, or fruit. Different nymphal instars are often observed on the same host plant throughout the season. New adults begin to appear in mid to late summer.

Adults and all stages of nymphs have been observed feeding on various plant parts, such as leaves, stems, and fruit. In many cases, direct damage to plant tissue has been observed, in others no obvious damage has been noted. BMSB adults and nymphs have piercing-sucking mouthparts called a proboscis, which they use to puncture fruit, bark, or leaf surfaces. They inject digestive enzymes which liquefy the plant tissues, and then suck out the liquefied nutrients. This feeding behavior is the primary cause of scarred fruit and damaged leaves, and the resulting injury could make plants more susceptible to secondary infections. BMSB are not known to harm humans or to reproduce inside of houses, but they are considered a nuisance in buildings and emit a pungent odor when crushed or disturbed. For several weeks starting in mid-September, hundreds of these pests may try to enter homes and may be found on the outsides of buildings or inside near doors and windowsills. Homeowner complaints about this pest invading homes actually led to the identification of BMSB in Allentown, PA, and are likely to help identify BMSB as they spread into new locations.

IDENTIFICATION:

- Adults are shield shaped, dark “mottled” brown in color with a darker spot at the posterior where the wings overlap.
- Adults range in size from $\frac{1}{2}$ – $\frac{3}{4}$ ” (13-19 mm) long and $\frac{1}{4}$ – $\frac{2}{5}$ ” (6-10 mm) in width.
- The outer edges of the abdomen have a pattern of alternating white and dark markings.
- The underside is pale, sometimes with grey or black markings, and the legs are brown and may have faint white bands.
- **The best field identifying characteristic is the pattern of alternating dark and light bands on the last two antennae segments.**
- Like all stink bugs, adult BMSB emit a pungent odor when disturbed. Some people find the odor similar to that of coriander.
- Eggs are spherical-shaped, about 0.06x0.05” (1.6x1.3 mm), white or pale green in color, found in clusters of 20-30 on the undersides of leaves from June to late summer.
- BMSB have 5 nymphal instars (immature developmental stages): all instars lack fully developed wings and range in size from 1st instar at ~ 0.09” (2.4 mm) to 5th instar at ~ 0.5” (12 mm).
- 1st instars are bright orange to red in color, and usually have a pattern of dark bars down the back and along the margins of the abdomen; head, thorax and legs are black; eyes are dark red; antennae are reddish-black.
- 2nd instars are egg-shaped, mostly black except for a pale abdomen with reddish spots, and have a tick-like appearance; eyes and antennae are reddish/black; the 3rd antennal segment has one whitish band.
- Later instars are pear-shaped; color ranges from brownish/black (3rd instar) to mottled brown with dark and pale markings on the back, and alternating black and white markings along the margins of the abdomen (5th instar); abdomen is whitish with reddish spots; eyes are reddish/black; antennae and legs have alternating black and white bands.

For excellent images of BMSB, see the UMD Home and Garden Information Center website at: <http://www.hgic.umd.edu/content/brownstinkbug.cfm>

WHAT TO LOOK FOR:

BMSB is usually identified either by the insect itself or by its feeding damage. Symptoms of damage include:

On fruit

- Small necrotic areas on leaves and fruits.
- Fruit damage may also include water-soaked lesions and/or distortion (puckering) referred to as “catfacing.” Interior of apples may become corky.
- Pitting, dimples, discoloration and/or depressed areas on mature fruit.



BMSB eggs, 1st and 2nd instars (dark, tick-like).
Gary Bernon, USDA APHIS, Bugwood.org



BMSB 4th instar nymph. Rutgers NJ Agricultural
Experiment Station BMSB website



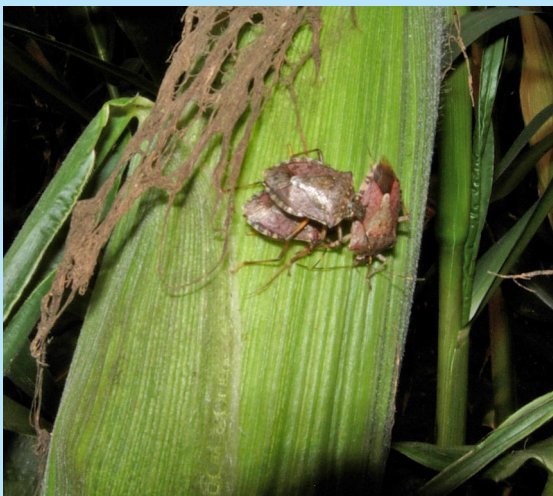
BMSB 5th instar nymph on pepper leaf. Galen Dively, UMD



BMSB nymphs on tomato. Michael Raupp, UMD



BMSB adults on pepper (above) and on sweet corn (below).
Galen Dively, UMD



On vegetables

- On tomatoes, damage to ripe fruit appears as whitish-yellow feeding sites referred to as “cloudy spots”, ranging up to ½ inch (13 mm) in diameter, with indistinct borders. Spots often join together into a larger area where there have been multiple feedings. Feeding results in whitish corky or spongy areas of tissue just below the skin. On green-pink tomatoes, damage appears as a pinprick surrounded by a light discolored area, which may turn yellow and decay as the tomato ripens.
- On peppers, damage appears as light-colored circular areas, which eventually form slight depressions due to the removal and digestion of tissues beneath the fruit surface. The skin over these feeding sites may rupture, resulting in eventual decay of the affected area.
- On okra and bean pods, damage appears as pimples or wart-like growths.
- On sweet corn, BMSB feed on the developing ears, driving their piercing-sucking mouthparts through the husk leaves and into the kernels. Removal of liquidized tissue causes the kernels to collapse and show brown discoloration, particularly when the harvested ear is cooked. BMSB feeding on ears right after pollination can cause incomplete kernel fill.

On soybeans

- BMSB feed on plant stems, foliage, and blooms, creating small brown or black puncture sites. However, they prefer to feed on developing seeds in pods. Injury to young seeds causes deformation and even abortion of the entire pod, whereas older seeds become discolored and shriveled. Germination of injured seeds may be reduced.
- Field infestations of BMSB exhibit strong edge effects, in which BMSB feed mainly along the field margins, delaying plant maturity.

On ornamentals

- On woody ornamentals in nurseries and landscapes, BMSB tend to feed on the main trunk and branches where they extract sap from the trees. On some trees “wet spots” on the trunks have been noted but no further injury has been observed. At this time we are unsure of the long term damage BMSB feeding will cause to woody plants. Researchers at UMD are studying the damage to ornamentals.
- Stippled areas, roughly circular and 1/8” wide (3.2 mm), have been observed on some plants such as Paulownia and butterfly bush (*Buddleia*) leaves.
- Wilting and death of some herbaceous plants have been reported.

In buildings

- In the fall and early winter, huge numbers of adult BMSB may congregate on the outsides of buildings and invade homes seeking winter shelter. This creates more of a nuisance than actual damage, but can be quite offensive to people.

MONITORING:

Rutgers University is monitoring the spread of BMSB by asking people to fill out a secure on-line form to report suspected sightings of the pest. The form can be found at: <https://njaes.rutgers.edu/stinkbug/report.asp>

MANAGEMENT:

Control inside structures is generally through mechanical exclusion and removal. In outdoor environments some insecticides offer a measure of control, but efforts lead to suppression rather than eradication of the pest. The BMSB Working Group, made up of university, USDA, and State Department of Agriculture professionals, and stakeholders, has identified research and extension priorities for this pest. For more details on the working group and the priorities go to: <http://www.northeastipm.org/priorities/Priorities-BMSBIPMWG-2010.pdf>. Research is currently being done in the area of Integrated Pest Management (IPM) and biological control.

Mechanical/Physical Control

BMSB do not harm people, pets, or building materials, but they are decidedly unwelcome house guests. The best method to prevent BMSB entering homes and buildings is simple exclusion: caulk or seal gaps around windows, doors, utility pipes and other openings; replace or repair damaged screens; screen openings to the outside such as attic and wall vents; and remove or seal window air conditioners in fall to prevent BMSB entering this way. If BMSB enter the home, they can be carefully removed by hand or with a vacuum. When disturbed, BMSB are likely to release an odor, but the odor dissipates. After vacuuming up the bugs, the pests can be eliminated by disposing of the bag or drowning the bugs in soapy water if bagless vacuums are used. Another option to eliminate BMSB from the home is to take advantage of their natural dropping behavior when disturbed. Cut the top off of a ½ to 1 gallon sized, straight-sided plastic container. Place your hand, a piece of cardboard or a whisk broom above the stink bugs, then sweep them down into the container. They'll cooperate by dropping down as you disturb them. You can also slide the container up a wall, window, or drapes to make the bugs drop into the container. Attach the container to a pole or broom handle to reach high locations.

Biological

BMSB poses a significant risk to agriculture. Consequently, the USDA Agricultural Research Service, UMD and other scientists began studying biological control as an option for IPM programs. Several native parasites and predators, including *Telenomus podisi* (Hymenoptera: Scelionidae), a generalist stink bug parasitoid, have been reported to attack this new host. Evaluation of natural enemies is underway.

Chemical

Indoors: There are no pesticides specifically labeled for use against BMSB for applications made indoors. Homeowners are

BMSB feeding damage on tomatoes, peppers, and sweet corn (below). Both adult and nymph BMSBs feed on the leaves, stems, and fruits of many vegetable, field, orchard, vineyard, and ornamental crops. Galen Dively, UMD



strongly encouraged to weigh the benefits of chemical use against a nuisance pest versus the risks to human health. Because BMSB enter homes over a long period of time and then move about a great deal within the house, chemical control would be difficult to achieve and is not recommended.

Outside buildings: There are some synthetic pyrethroid insecticides available to licensed commercial pesticide applicators (i.e. deltamethrin, cyfluthrin, lambda-cyhalothrin, cypermethrin, sumithrin or tralomethrin) that may be applied to building exteriors just as BMSB begin congregating in the fall. There are also several insecticide products available to homeowners that are labeled for application to the exterior of structures. Choose insecticides that are labeled for application around window sills and door thresholds, which are points of entry for this pest. **Note that stink bugs must be listed on the pesticide label for that material to be used against stink bugs, including BMSB.** Do not apply insecticides to the house foundation or mulch.

Pesticides are generally ineffective and are not recommended for controlling this pest inside or outside your home. See Mechanical/Physical section above for optimum control measures.

Home gardens: Residual-free pyrethrum sprays labeled for use in the home garden can be used to directly contact and kill BMSB *only* if stink bugs are listed on the label.

Nurseries and Landscapes: PyGanic (pyrethrin) is labeled for stink bug control on ornamentals but has not been evaluated specifically for BMSB, therefore the level of control for BMSB is not known. No other products are known to be labeled for stink bug or BMSB on ornamental plants at this time.

Fruits and Vegetables: Research is currently being done to evaluate the field efficacy of various insecticides for BMSB control, including new products and those already registered for other stink bug species. Pyrethroids such as lambda-cyhalothrin (Warrior, Lambda-Cy), cyfluthrin (Baythroid), zeta-cypermethrin (Mustang MAX) and acephate (Orthene) are effective and commonly used to control stink bugs. Several systemic neonicotinoids, dinotefuran (Venom 20), acetamiprid (Assail), and clothianadin (Clutch), show moderate levels of control but need further testing. With all insecticides, carefully read and follow label directions. If stink bug is not listed as a target pest, the product may not be effective.

Contact your local Cooperative Extension Service office for current pesticide recommendations.

LOOK-ALIKE INSECTS and DAMAGE:

There are a number of native insects that BMSB may be mistaken for, but in general BMSB can be distinguished from other stink bugs by its mottled brown coloration, white bands on the antennae, and the black and white markings along the margin of its abdomen.

- There are several native species of brownish stink bugs from the genera *Brochymena* and *Euschistus* that look very similar to BMSB. **The key feature that differentiates BMSB from other stink bugs is dark and light alternating antennal bands.**
- Stink bugs of the genus *Brochymena* have dark antennae but lack the alternating dark and light bands, and the margins of the pronotum (the structure behind the head) are strongly “toothed” as compared to the smooth margins of BMSB.
- *Euschistus servus* (Say), the common brown stink bug, has fourth and fifth antennal segments that are darker in color than the basal segments, and usually has a pinkish tinge to the ventral surface. The humeral angles of the pronotum are rounded.
- The spined soldier bug, *Podisus maculiventris*, is a beneficial predatory stink bug that could be mistaken for the BMSB. It is mottled brown in color and is associated with some of the same plants as the BMSB. The adult has a prominent spine on each “shoulder” which helps distinguish it from other stink bugs.
- Late instar nymphs of leaf-footed bugs (Hemiptera: Coreidae) are often mistaken for BMSB.
- For images of bugs that look similar to BMSB see the Rutgers website: <http://njaes.rutgers.edu/stinkbug/similar.asp>
- BMSB feeding results in similar surface damage to tree fruits such as apples and peaches as that of native stink bugs. However, internal damage from BMSB is much deeper than that of native stink bugs.
- BMSB nymphs have been found feeding on the fruits of apples and peaches, which is not common for native stink bug nymphs. The latter typically feed on the leaves.

- The aggregating behavior of BMSB and its tendency to invade buildings in the fall is similar to that of a number of other pests: Asian ladybird beetles, boxelder bugs, the western conifer seed bug, and cluster flies (which look like large house flies).
 - o Asian ladybird beetles are oval, convex, and, although the color can vary widely, typically tan to orange to red, often with several black spots on the wing covers.
 - o The boxelder bug is oval in shape (tapering at the head) and has a black body with red markings.
 - o The western conifer seed bug has an elongated body, no banding on its antennae, and a flattened leaf-like area on each hind leg.

How to Report a Possible Sighting/Infestation

In Maryland:

University of Maryland Cooperative Extension Exotic Pest Threats Website:
http://www.PestThreats.umd.edu/content/pestreport_form.cfm

Maryland Department of Agriculture: call 410-841-5920 to report suspect pests; visit http://www.mda.state.md.us/plants-pests/invasive_species.php for information.

Nationally: USDA-Animal and Plant Health Inspection Service (APHIS)
http://www.aphis.usda.gov/services/report_pest_disease/report_pest_disease.shtml

Adult BMSB Actual Size:



Where to Get More Information:

UMD Cooperative Extension Exotic Pest Threats Website: <http://www.PestThreats.umd.edu/index.cfm>

Mass. Introduced Pests Outreach Project: <http://massnrc.org/pests/pestFAQsheets/brownmarmoratedstinkbug.html>

Images:

Invasive.org: <http://www.invasive.org/species/subject.cfm?sub=9328>

Rutgers University and the N.J. Agricultural Experiment Station: <http://njaes.rutgers.edu/stinkbug/identify.asp>

Project Participants: Chris Sargent, Research Assistant; Galen Dively, Entomologist; Cerruti Hooks, Entomologist; Michael Raupp, Entomologist; Sandra Sardanelli, IPM Coordinator; Paula Shrewsbury, Entomologist; David Clement, Pathologist; Mary Kay Malinoski, Entomologist. Drawing of adult BMSB actual size: John Davidson, Entomology Professor Emeritus, UMD.

Selected References:

Anonymous. 2007. How to Control the Brown Marmorated Stink Bug. Rutgers New Jersey Agricultural Experiment Station: <http://njaes.rutgers.edu/stinkbug/control.asp>

Gyeltshen, J., G. Bernon, A. Hodges. 2005. Brown Marmorated Stink Bug, EENY-346. University of Florida: <http://edis.ifas.ufl.edu/in623>

Hoebeke, E. R. 2002. Brown Marmorated Stink Bug. Regulatory Horticulture Entomol. Cir. No. 204, Vol. 28:35-37. Pennsylvania Department of Agriculture Bureau of Plant Industry.

Hoebeke, E. R., M. E. Carter. 2003. *Halyomorpha halys* (Stål) (Heteroptera: Pentatomidae): A polyphagous plant pest from Asia newly detected in North America. Proc. Ent. Soc. Washington 105(1): 225-237.

Nielsen, A. L., G. Hamilton. 2009. Life History of the Invasive Species *Halyomorpha halys* (Hemiptera: Pentatomidae) in Northeastern United States. Annals of the Entomological Society of America 102(4):608-616.

Issued in furtherance of Cooperative Extension work, acts of May 8 and June 30, 1914, in cooperation with the U.S. Department of Agriculture, University of Maryland, College Park, and local governments. Cheng-i Wei, Director of Maryland Cooperative Extension, University of Maryland.

The University of Maryland is equal opportunity. University policies, programs, and activities are in conformance with pertinent Federal and State laws and regulations on nondiscrimination regarding race, color, religion, age, national origin, gender, sexual orientation, marital or parental status, or disability. Inquiries regarding compliance with Title VI of the Civil Rights Act of 1964, as amended; Title IX of the Educational Amendments; Section 504 of the Rehabilitation Act of 1973; and the Americans With Disabilities Act of 1990; or related legal requirements should be directed to the Director of Human Resources Management, Office of the Dean, College of Agriculture and Natural Resources, College Park, MD 20742.