



Brown Marmorated Stink Bug

Halyomorpha halys Stål (Hemiptera: Pentatomidae)

Introduction:

The Brown Marmorated Stink Bug (BMSB) is an exotic invasive bug that probably entered the U.S. in packing crates originating in Asia, where it is a serious pest of soybeans and many fruit trees. It was first reported as a nuisance pest invading homes in Allentown, PA, in 2001, but was likely present there since the mid-1990s. BMSB, unlike other stink bug species, invades warm buildings in the fall to seek overwintering sites. BMSB was recently confirmed as a significant agricultural pest in the U.S. as well, when it appeared in many commercial crops in 2010.

U.S. Distribution/Spread:

BMSB has been detected in over 20 eastern and southern states ranging from Maine to Mississippi, as well as Ohio, California and Oregon. Most believe the distribution 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, contributing to the rapid spread of this pest over great distances.

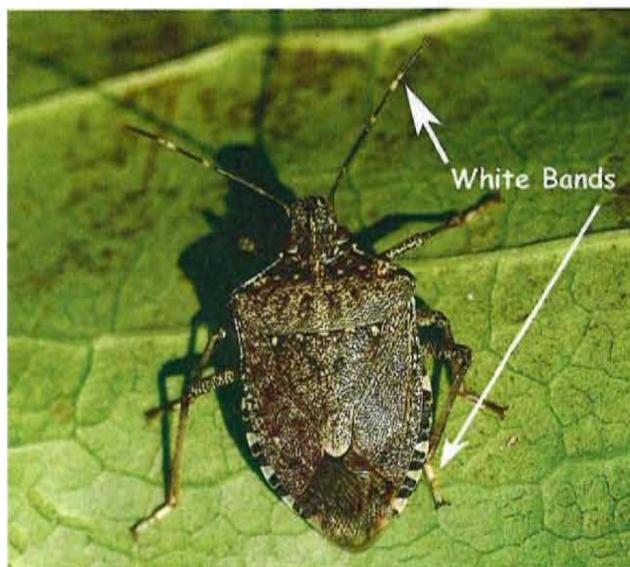
Host Plants:

BMSB is polyphagous, and feeds on many different species of fruit trees, ornamental plants, vegetables and legumes. In Asia, it is considered a major agricultural pest of fruit trees, particularly citrus, and of legumes, especially soybeans. In the U.S., BMSB has been found feeding on a wide array of fruit and ornamental trees, herbaceous plants, vegetable, field, and other fruit crops. Unlike native stink bug nymphs, BMSB nymphs as well as adults have been observed feeding on plant leaves, stems, and fruit. The list of hosts that BMSB feeds on continues to grow.

Biology and Damage:

In China, BMSB have only one generation per year in cool northern regions, but up to six per year in southern areas. A similar pattern is expected in the U.S. as BMSB spread north and south. BMSB overwinter as adults, primarily inside houses and other sheltered locations. Adults emerge throughout spring, and may appear during warm sunny periods during the winter. Adults begin feeding upon emergence, and are very active, dropping off plants or flying away if disturbed.

After mating, each female may lay up to 250 pale green or white, spherical-shaped eggs, deposited in clusters of 20-30 on the underside of host plant leaves at about one week intervals from June to September. Eggs hatch in 4 to 5 days into nymphs that will complete five instars (developmental stages), each lasting about one week. Different nymphal instars are often seen on the same host plant throughout the season. Nymphs tend to be solitary feeders, but may congregate on leaves, bark or fruit. New adults begin to appear in mid to late summer.



Adult BMSB. Note white bands on antennae and legs, and alternating white and dark markings along the outer edge of the abdomen. Michael Raupp, UMD

BMSB adults and all nymphal stages damage plants by puncturing fruit or leaf surfaces with their piercing-sucking mouthparts and sucking out liquid nutrients in a straw-like fashion. This leads to scarred fruit and damaged leaves, and may make plants more susceptible to secondary infections. Although not known to harm humans, BMSB are considered a nuisance inside homes and emit a distinctive odor when crushed or disturbed. From mid-September until first frost, hundreds of BMSB may try to enter homes, clustering on outer walls or inside near windowsills and doors. Homeowner complaints about BMSB invading homes will likely help in detecting this pest as it spreads to new locations.

Identification:

- Adults are shield shaped, dark "mottled" brown colored with a darker spot at the tail where the wings overlap.
- Adults range from ½-¾" (13-19 mm) long and ¼-2/5" (6-10 mm) wide.
- **The best field identifying characteristic is the pattern of alternating dark and light bands on the last two antennae segments.**
- 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; the legs are brown and may have faint white bands.
- Like all stink bugs, adult BMSB emit a pungent odor when disturbed.

- Eggs are tiny, spherical-shaped, white or pale green, found in clusters of 20-30 on the undersides of leaves from June to late summer.
- There are 5 nymphal instars: all 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 instar nymphs: orange/red bodies with black markings; black head, thorax, legs; dark red eyes; dark antennae.
- 2nd instar: black, tick-like appearance; reddish/black eyes.
- Later instar nymphs: marbled brownish/black with dark and pale markings on the back; alternating dark/pale markings along margins of abdomen; abdomen pale; dark eyes; alternating black/white bands on antennae and at times on the legs.



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

What to Look For:

BMSB are usually identified by the bug itself, by its feeding damage, or by entering buildings in the fall. BMSB can generally be distinguished from other stink bugs by the alternating dark/white markings on the antennae and outer edge of the abdomen.



BMSB 2nd instar nymph (lower left) and later instar nymphs feeding on ripening tomato. Michael Raupp, UMD

Symptoms of BMSB infestation include:

- Feeding damage appearing as small, roughly circular stippled areas, and/or necrotic areas on leaves of some plants.
- Fruit damage may include water-soaked lesions, discoloration, pitting, dimples, puckering ("catfacing"), and/or depressed areas on mature fruit. Injury extends deeper into fruit than does that of native stink bugs.
- Whitish-yellow "cloudy spots" on some vegetables such as tomatoes and peppers.
- Pimples or wart-like growths on okra and bean pods; deformation or shriveling of pods.
- Early feeding may cause incomplete kernel fill of sweet corn; later feeding may cause kernel collapse and brown discoloration.
- In fall, huge numbers of adult BMSB may congregate on building walls and invade homes.

How to Report a Possible Sighting/Infestation

In Maryland:

University of Maryland Cooperative Extension Exotic Pest Threats Website:
<http://hgic.umd.edu/faq/sendAQuestion.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) at
http://www.aphis.usda.gov/services/report_pest_disease/report_pest_disease.shtml



Where to Get More Information:

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

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

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.

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Asian Longhorned Beetle

Anoplophora glabripennis Motschulsky (Coleoptera: Cerambycidae)

Introduction:

The Asian Longhorned Beetle (ALB) is an exotic wood boring beetle that entered the U.S. via solid wood packing materials originating in East Asia. First detected in Brooklyn, NY, in 1996, then in Chicago, IL, in 1998, ALB attacks both healthy and stressed specimens of many species of hardwood trees found in North America. In 1997 the USDA enacted federal regulatory and control actions to eradicate the beetle. To date, over 66,000 infested trees have been destroyed at a cost of more than \$269 million.

U.S. Distribution/Spread:

There have been multiple interceptions of ALB at shipping ports throughout the U.S., and ALB infested cargo has been found and destroyed in warehouses in at least 17 states nationwide. ALB infestations have become established in New York City and Long Island (NY), Chicago (IL), New Jersey, Worcester and Boston (MA), and Ontario, Canada. Quarantines and control efforts aimed at eradication have been initiated in all locations; however, the established ALB infestations detected in Worcester and Boston in 2008 and 2010 raise concerns that new, stricter international import regulations enacted in 2001 may not be adequate to prevent new introductions.

ALB adults are very strong flyers, easily covering distances greater than 400 yards. ALB larvae live deep inside trees, undetectable for up to one year, and are spread by people moving infested materials such as firewood, timber or nursery stock. North America has an abundance of host trees and ALB are tolerant of very cold temperatures, so it is thought that ALB will be able to spread through both landscapes and forests, and further north than they are currently found.

Host Plants:

In the U.S., ALB is known to attack and reproduce in 23 species of deciduous hardwood trees, preferring many maple species, as well as boxelder, elm, willow, birch, London Plane-tree, Mountain ash, horsechestnut and buckeye. ALB has also been reported to attack a number of other tree species, such as oaks, Russian olive and Linden, but it has not been documented that it successfully reproduces in these trees.

Biology and Damage:

ALB complete one generation every one or two years and usually overwinter as larvae in the cambium and xylem, although they may also overwinter as eggs or pupae. Mature larvae pupate just beneath the bark in spring. Emergence of adult beetles begins in late May to early June, peaks from early to late July and quickly declines in August. Emerging adult beetles create dime-sized, round exit holes in the bark. Newly emerged adults begin feeding



UGA 1265006

ALB adult (top); larva (below). K. R. Law, USDA APHIS PPQ, Bugwood.org



UGA 0949054

on leaves and twigs of the current host trees, or may fly to new hosts to feed. Adults continue feeding and laying eggs throughout the summer into late fall, but perish before winter.

After mating, female ALB chew individual, oval/round shaped shallow notches into the bark of trees and lay one egg in each notch. The hole is then plugged with digested wood to protect the egg and young larva. Females repeat this procedure until they lay 25-90 (ave. 35) eggs. Eggs hatch in about 11 days and the small, white, legless larvae tunnel into and begin feeding in the tree. Larvae are the most destructive stage, feeding on and damaging cambial tissues, disrupting nutrient transport vessels, and damaging water transport vessels deep in the tree. In the fall, the large, mature larvae tunnel deep into the heartwood and feed on living tree tissue over the winter.

Identification:

- Adult beetles are large, ¾-1½" long (20-40 mm), shiny black, with irregular white spots.
- Antennae are very long (1½-2½ times the body length) with black and white alternating bands.
- Eggs are the size/shape of a grain of rice: 1/5-1/3" long (5-7 mm).
- Larvae are cylindrical, segmented, roundheaded, and legless, with a white body and brown head, and breathing pores (spiracles) along the sides.
- Mature larvae are robust and reach 2" long (5 cm).
- Pupae are 1¼" long (~ 32 mm). See an image at: <http://tncweeds.ucdavis.edu/photos/anogl03.jpg>

What to Look For:

ALB attack trees that are healthy or stressed, young or old, living or felled, and from nursery stock size to trees large in diameter.

Symptoms of ALB infestation include:

- Adult feeding damage on leaves (holes, often clustered along a vein), leaf stems, and small twigs (stripped bark).
- Shallow oval/round depressions (oviposition notches) up to ½” diameter (13 mm), in the bark of infested trees.
- Round, nearly dime-sized (¾-½” diameter, or 9.5-13 mm) adult exit holes in bark.
- Bark staining and oozing sap from oviposition notches or exit holes may be present on tree trunk.
- Frass may be brown to cream-colored; stringy and wet or coarse and dry; extruding from vent or oviposition holes, clinging to the bark, lodged within the crotches of branches, or piled at the base of the tree.
- Galleries are individual, 4-12” long (10-30 cm), initially horizontal deep into the sapwood, then turn upwards.
- Broken branches/stems in heavily mined trees, especially after strong winds.
- Adult beetles may be found anywhere, not just on trees.



ALB oviposition notch (upper left) and exit hole (lower right).
Dennis Haugen, USDA Forest Service, Bugwood.org



Adult feeding damage on twig (stripped bark). Dean Morewood, Health Canada, Bugwood.org



Adult feeding damage on leaf (holes clustered along a vein). Michael T. Smith, USDA-ARS, BIIRU, Newark, DE

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http://www.aphis.usda.gov/services/report_pest_disease/report_pest_disease.shtml

Adult ALB Actual Size:



Where to Get More Information:

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Project Participants: Chris Sargent, Research Assistant; Michael Raupp, Entomologist; Sandra Sardanelli, IPM Coordinator; Paula Shrewsbury, Entomologist; David Clement, Pathologist; Mary Kay Malinoski, Entomologist; Michael T. Smith, USDA ARS Research Entomologist.

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Emerald Ash Borer

Agrilus planipennis Fairmaire (Coleoptera: Buprestidae)

Introduction:

The Emerald Ash Borer (EAB) is an aggressive exotic wood boring beetle native to East Asia that attacks stressed and healthy ash trees, frequently causing death within three years of infestation. First detected in the U.S. in Michigan in 2002, EAB has spread rapidly, destroying over 25 million ash trees and threatening this important resource of timber, wildlife habitat, and urban landscape trees. The USDA estimates losses could reach billions of dollars if EAB is not controlled.

U.S. Distribution/Spread:

EAB is thought to have entered North America in infested wood shipping materials. EAB has been confirmed in Michigan, Ohio, Maryland, Indiana, Virginia, Illinois, Pennsylvania, West Virginia, Missouri, Wisconsin, Kentucky, Minnesota, New York, Iowa, Tennessee, and Canada (Ontario, Quebec). EAB is a competent flier, readily traveling ½ to about 1 mile (0.8-1.6 km). In the U.S., EAB is spread long distances primarily by people moving infested ash wood products (e.g., firewood, branches, nursery stock) into uninfested areas, leading to quarantines and fines to control human activities that spread EAB.

Host Plants:

In North America, only ash trees have been attacked. EAB has killed both stressed and apparently vigorous ash trees in woodlots and urban settings.

Biology and Damage:

EAB typically completes one generation per year, although when healthy trees are attacked it may take up to 2 years. Mature larvae overwinter in shallow pupal chambers constructed into the outer sapwood or thick bark, and pupate in spring. New adults begin emerging in early to mid-May, peak in June, and may continue into August. Adults mate and lay eggs late-May through mid-August and are most active on sunny, calm days.

Females each lay an average of 77 eggs, laid individually in cracks in the bark. Eggs hatch in about a week and the young larvae bore beneath the bark and feed until fall. As larvae feed they tunnel throughout the sapwood, creating meandering S-shaped galleries that widen as the larvae grow. Larvae are the destructive stage, tunneling in and feeding on tissues beneath the bark, eventually girdling the tree, leading to its decline and death.

Identification:

- Adults are slender, elongate beetles, ~ ½" long (13 mm), 1/16" wide (1.6 mm), lacking a defined waist, flattened laterally.
- Adults are dark metallic green in color with a coppery green head; the top of the abdomen under the wings is purplish red.
- Adults may be found late spring through summer.



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EAB adult. Howard Russell, Michigan State Univ., Bugwood.org

- Larvae are creamy white flat-headed borers with a small brown head retracted inside an enlarged, distinct, flattened prothorax.
- Larvae have bell-shaped abdominal segments without legs, flattened laterally (top to bottom), with a pair of brown pincers (urogomphi) on the last segment.
- Mature larvae can reach 1-1¼" in length (25-32 mm).
- Larvae are under the bark in shallow S-shaped galleries.



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EAB larva. David Cappaert, Michigan State University, Bugwood.org

What to Look For:

EAB has infested and killed ash trees in urban and forest settings, and has been found in trees and branches ranging from 1 to 55" (2.5-140 cm) in diameter. EAB are difficult to detect in newly infested trees because eggs are usually laid in bark cracks high on the upper trunk, and larvae are hidden under the bark. Most symptoms do not show up until a year after the initial attack.

Symptoms of EAB infestation include:

- Woodpecker feeding injury (small bark patches stripped away, jagged holes).
- Foliage wilts and yellows; tree canopy thins; crown die-back occurs (30-50% after 2 years of infestation).
- D-shaped exit holes about 1/8" wide (3-4 mm) left by emerging adults.
- Vertical splits in the bark 2-4" long (5-10 cm) above larval galleries.



EAB D-shaped exit hole (left) and woodpecker damage (right).
David Cappaert, Michigan State University, Bugwood.org

- Epicormic branches ("sprouts") along the lower trunk and on some major branches.
- Larval galleries beneath the bark: typically S-shaped (serpentine), meandering, frass-packed, increasing in width as larvae grow, 4-20" long (10-50 cm).



EAB galleries. Art Wagner, USDA APHIS PPQ, Bugwood.org

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Nationally: USDA-Animal and Plant Health Inspection Service (APHIS)

http://www.aphis.usda.gov/services/report_pest_disease/report_pest_disease.shtml

Adult EAB
Actual Size:



Where to Get More Information:

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

Look-alikes: MSU Ext. pub. #2939: <http://www.emeraldashborer.info/files/e-2939.pdf>

Project Participants: Chris Sargent, Research Assistant; Michael Raupp, Entomologist; Sandra Sardanelli, IPM Coordinator; Paula Shrewsbury, Entomologist; David Clement, Pathologist; Mary Kay Malinoski, Entomologist.

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