

Emerald Ash Borer: An Invasive Pest of Ash Trees in Arkansas

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In August 2014, the **emerald ash borer** (Figure 1), an invasive pest that kills ash species, was confirmed from infested ash trees in Arkansas. All ash trees in Arkansas are now at risk through natural spread from infested trees, the movement of infested firewood, infested nursery stock and infested ash timber.



Figure 1. Adult emerald ash borer on penny

This invasive beetle from Asia was first discovered in the U.S. in July 2002 feeding on ash trees (*Fraxinus* L. spp.) in southeastern Michigan. The beetle was identified as *Agrilus planipennis* Fairmaire (Coleoptera: Buprestidae). Larvae feed in the cambium between the bark and wood, producing galleries that eventually girdle and kill branches and entire trees. In Michigan alone, tens of millions of ash trees are dead or dying from this pest. Newly established populations were detected in 2003 in other areas of southern Michigan and several locations in Ohio. Infested ash nursery trees were also found in Maryland and Virginia. This devastating pest continues to spread in Canada and the U.S. (For more information on this pest,

check out the following web site:
<http://www.emeraldashborer.info/#sthash.5Qe2Pwpv.XunWwKMj.dpbs.>)

Identification

Adult beetles (Figure 2) are generally larger and a brighter green than the native North American species of *Agrilus*. Adults are slender, elongated and 7.5 to 13.5 mm long. Males are smaller than females and have fine hairs on the ventral side of the thorax, which the females lack. Color varies, but adults are usually bronze or golden green overall with darker, metallic emerald green wing covers. The top of the abdomen under the wings is metallic purplish-red and can be seen when the wings are spread. The prothorax, the segment behind the head to which the first pair of legs is attached, is slightly wider than the head but the same width as the base of the wing covers. Larvae reach a length of 26 to 32 mm, are white to cream-colored and are dorso-ventrally flattened (Figure 3). The brown head is mostly retracted into the prothorax, and only the mouthparts are visible externally.



Figure 2. Adult emerald ash borer

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The 10-segmented abdomen has a pair of brown, pincer-like appendages on the last segment.



Figure 3. Second-, third- and fourth-stage larvae

Biology

The emerald ash borer is expected to have a one-year life cycle in Arkansas, as it does in southern Michigan. In colder regions, the emerald ash borer can require two years to complete a generation. In Michigan in 2003, adult emergence began in early June, peaked in late June and early July and continued into late July. These activities would occur slightly earlier in Arkansas due to the difference in climate between Arkansas and Michigan. Adults usually live for about three weeks and are present into mid-August. Adult beetles are active during the day, particularly when conditions are warm and sunny. Most adults remain in protected locations in bark crevices or on foliage during rain, heavy cloud cover, high winds or temperatures above 32°C (90°F). Adults feed on ash foliage, usually in small, irregularly shaped patches along the margins of leaves.

Females can mate multiple times, and egg laying begins a few days after the initial mating. Females can lay at least 60 to 90 eggs during their lifetime. Eggs are deposited individually in bark crevices on the trunk or branches. Eggs hatch in 7 to 10 days.

Newly hatched larvae chew through the bark and into the cambial region. Larvae feed on phloem and the outer sapwood for several weeks. The S-shaped feeding gallery winds back and forth, becoming progressively wider as the larva grows (Figure 4). Galleries are packed with fine, sawdust-like frass. Individual galleries often extend over an area that is 20 to 30 cm in length, though the length of the affected area can range from 10 to 50 cm or longer.

Feeding is completed in autumn, and pre-pupal larvae overwinter in shallow chambers excavated in the outer sapwood or in the bark on thick-barked

trees. Pupation begins in late April or May in Michigan but could be as early as March in Arkansas. Newly enclosed adults often remain in the pupal chamber for one to two weeks before emerging head-first through a D-shaped exit hole that is 3 to 4 mm in diameter (Figure 5).



Figure 4. Galleries excavated by larvae



Figure 5. D-shaped exit holes where adult beetles emerged

Distribution and Hosts

The emerald ash borer is native to Asia and is known to occur in China, Korea, Japan, Mongolia, the Russian Far East and Taiwan. A Chinese report

indicates high populations of the borer occur primarily in forests of *Fraxinus chinensis* Roxb. Other reported hosts in Asia include *F. mandshurica* Rupr. *Ulmus davidiana* Planch., *Juglans mandshurica* var. *sieboldiana* (Maxim.) Makino and *Pterocarya rhoifolia* Seibold & Zucc. In North America, this borer has only attacked ash trees. Green ash (*F. pennsylvanica* Marshall), white ash (*F. Americana* L.) and black ash (*F. nigra* Marshall) as well as several horticultural varieties of ash have been killed. Arkansas is home to five native ash species. Two of those, white ash and green ash, are common trees in our forests. The other three – Carolina ash (*F. caroliniana* Mill.), pumpkin ash (*F. profunda* (Bush) Bush) and blue ash (*F. quadrangulata* Michx.) – are much less common. All species of North American ash appear to be susceptible to attack by the emerald ash borer.

A related species is also at risk. Information from Wright State University in Ohio indicates that white fringetree (*Chionanthus virginicus* L.), a relative of ash, can also serve as a host for the emerald ash borer. (See *Entomology Today* at <http://entomology-today.org/2014/10/10/emerald-ash-borer-may-have-spread-to-different-tree/>).

Samples submitted for identification from an infested white fringetree were confirmed as emerald ash borer by the APHIS Systematic Entomology Laboratory as reported by Joseph S. Beckwith, national operations manager, USDA, APHIS, PPQ, Pest Management Programs on October 15, 2014 (personal communication).

Symptoms

It is difficult to detect emerald ash borer in newly infested trees. Jagged holes excavated by woodpeckers feeding on pre-pupal larvae may be the first sign that a tree has become infested (Figure 6).



Figure 6. Jagged holes left by woodpeckers.

When a tree has been infested for at least one year, the D-shaped exit holes left by emerging adults will be present on the branches and the trunk

(Figure 5). Bark may split vertically above larval feeding galleries. When the bark is removed from infested trees, the distinct, frass-filled larval tunnels that etch the outer sapwood and phloem are readily visible on the trunk and branches (Figure 4). An elliptical area of discolored sapwood, usually a result of secondary infection by fungal pathogens, sometimes surrounds larval feeding galleries.

Serpentine tunnels excavated by feeding larvae interrupt the transport of nutrients and water within the tree during the summer. Foliage wilts and the tree canopy becomes increasingly thin and sparse as branches die. Many trees appear to lose about 30 to 50 percent of the canopy after two years of infestation, and trees often die after three to four years of infestation (Figure 7).



Figure 7. Much of the canopy is dead on a heavily infested ash tree.

Epicormic sprouts may arise on the trunk of the tree, often at the margin of live and dead tissue. Dense root sprouting sometimes occurs after trees die.

Emerald ash borer has killed trees of various sizes and conditions in Michigan. Larvae have developed in trees and branches ranging from 2.5 cm (1 inch) to 140 cm (55 inches) in diameter. Stress likely contributes to the vulnerability and rapid decline of infested ash trees. However, emerald ash borer has killed apparently vigorous trees in woodlots and urban trees under regular irrigation and fertilization regimens.

Quarantines

As of September 2014, twenty-five (25) Arkansas counties have been included in the emerald ash quarantine established by the Arkansas State Plant Board to slow the spread. Quarantined items include firewood of all hardwood species, and the following ash items: nursery stock; green lumber with bark

attached; other material living, dead, cut or fallen including logs, pulpwood, stumps, roots, branches, mulch and composted/un-composted chips (1 inch or greater). Firewood is the only quarantined item that relates to all hardwood; all other quarantined items are relative to ash only. Counties affected include Ashley, Bradley, Calhoun, Clark, Cleveland, Columbia, Dallas, Drew, Garland, Grant, Hempstead, Hot Spring, Howard, Jefferson, Lafayette, Lincoln, Little River, Miller, Montgomery, Nevada, Ouachita, Pike, Saline, Sevier and Union.

As more is learned about the emerald ash borer's current range and life history in Arkansas, this quarantine will evolve. Please check the Arkansas State Plant Board web site for the latest quarantine information (<http://plantboard.arkansas.gov/Pages/default.aspx>).

Treatments

Limited treatment options to protect ornamental ash trees from emerald ash borer are available. However, treatment is not warranted unless the emerald ash borer has been confirmed within 15 miles of your location. Please contact your county extension agent for current recommended treatment options.

References

Yu, Chengming. 1992. *Agrilus marcopoli* Obenberger. In Xiao, G., ed. *Forest Insects of China*, 2d ed. Beijing, China: China Forestry Publishing House, 400-401. Translation by Houping Liu, USDA Forest Service.

Jendek, E. 2002. *Agrilus planipennis* fact sheet. PDF file provided by Eduardo Jendek, Institute of Zoology, Slovak Academy of Sciences, Bratislava, Slovak Republic.

Resources

Visit the following web sites for information on emerald ash borer biology, identification, management, quarantines and related topics.

1. Michigan Multi-Agency Emerald Ash Borer Web Site: <http://www.emeraldashborer.info>
2. USDA Forest Service: <http://na.fs.fed.us/fhp/eab/>
3. Arkansas State Plant Board: <http://plantboard.arkansas.gov/Pages/default.aspx>
4. <http://www.arinvasives.org/potential-invaders-of-arkansas/emerald-ash-borer/>
5. <https://www.uaex.uada.edu/environment-nature/default.aspx>
6. <http://entomologytoday.org/2014/10/10/emerald-ash-borer-may-have-spread-to-different-tree>

Contact your local county Extension office for more information.

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