Pest Alert

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Forest Service
State and Private Forestry
Northeastern Area

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Emerald Ash Borer

An exotic beetle from Asia was discovered in July 2002 feeding on ash (*Fraxinus* spp.) trees in southeastern Michigan. It 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. Evidence suggests that *A. planipennis* has been established in Michigan for at least six to ten years. More than 3000 square miles in southeast Michigan are infested and more than 5 million ash trees are dead or dying from this pest. This exotic pest is also established in Windsor, Ontario, Canada. In 2003, newly established populations were detected in other areas of southern Michigan and several locations in Ohio. Infested ash nursery trees were also found in Maryland and Virginia.

Identification

Adult beetles are generally larger and a brighter green than the native North American species of *Agrilus* (Fig. 1). Adults are slender, elongate 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.

Figure 1. Adult emerald ash borer.

Larvae reach a length of 26 to 32 mm, are white to cream-colored and dorso-ventrally flattened (Fig. 2). The brown head is mostly retracted into the prothorax and only the mouth-parts are visible externally. The 10-segmented abdomen has a pair of brown, pincer-like appendages on the last segment.

Figure 2. Second, third, and fourth stage larvae.

Biology

The emerald ash borer generally has a one-year life cycle in southern Michigan but could require two years to complete a generation in colder regions. In 2003, adult emergence began in early June, peaked in late June and early July, and continued into late July. Beetles usually live for about 3 weeks and are present into mid-August. Adult beetles are active during the day, particularly when conditions are warm and sunny. Most beetles remain in protected locations in bark crevices or on foliage during rain, heavy cloud cover, high winds, or temperatures above 32°C (90°F). Beetles 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.

After hatching, first instar 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 (Fig. 3). 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.

Figure 3. Galleries excavated by larvae.

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. Newly eclosed adults often remain in the pupal chamber for 1 to 2 weeks before emerging head-first through a D-shaped exit hole that is 3–4 mm in diameter (Fig. 4).

Figure 4. D-shaped exit holes where adult beetles emerged.

Figure 5. Jagged holes left by woodpeckers

Figure 6. Much of the canopy is dead on a heavily infested ash tree.

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 *Fraxinus chinensis* and *F. rhynchophylla* forests. Other reported hosts in Asia include *F. mandshurica* var. *japonica*, *Ulmus davidiana* var. *japonica, Juglans mandshurica* var. *sieboldiana* and *Pterocarya rhoifolia*. In North America, this borer has only attacked ash trees. Green ash (*F. pennsylvanica*), white ash (*F. americana*) and black ash (*F. nigra*), as well as several horticultural varieties of ash have been killed.

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 (Fig. 5). 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 (Fig 4). 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 (Fig. 3). 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% of the canopy after 2 years of infestation and trees often die after 3-4 years of infestation (Fig. 6). Epicormic shoots 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 size and condition 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 regimes.

Bibliography

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 websites 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://www.na.fs.fed.us/spfo/eab/
3. Michigan Department of Agriculture: http://www.michigan.gov (keyword emerald ash borer)

Contact your State Department of Agriculture, State Forester, or County Extension Office for more information.

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