Pest Alert

United States
Department of Agriculture
Forest Service
State and Private Forestry
Northeastern Area

NA-PR-07-02
August 2002

Emerald Ash Borer

A new exotic beetle from Asia was discovered feeding on ash (*Fraxinus* sp.) trees in southeastern Michigan. It was identified in July 2002 as *Agrilus planipennis* Fairmaire (Coleoptera: Buprestidae). Larvae feed in the phloem and outer sapwood, producing galleries that eventually girdle and kill branches and entire trees. Evidence suggests that *A. planipennis* has been established in Michigan for at least five years. Surveys to determine the extent of the infested area are underway.

Identification

Adults are larger and a brighter green than any of the native North American species of *Agrilus* (Figure 1). The slender, elongate adults are 7.5 to 13.5 mm long, and females are larger than males. The adult body is brassy or golden green overall, with darker, metallic, emerald green wing covers, or elytra. The top of the abdomen under the elytra is metallic coppery red (seen only when the wings are spread). The prothorax, to which the first pair of legs is attached, is slightly wider than the head but the same width as the base of the elytra. The back edges of the covering on the prothorax are sinuate or wavy, and the top is sculptured with tiny, transverse wavy ridges. The surfaces of the elytra are granularly roughened. Tips of the elytra are rounded with small teeth along the edge.

Larvae reach a length of 10 to 14 mm, are cream-colored and dorso-ventrally flattened (Figure 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.

Biology

The Emerald Ash Borer appears to have a one year life cycle in southern Michigan but could require two years to complete a generation in colder regions. Adult emergence begins in mid to late May, peaks in early to mid June, and continues into late June (Figure 3). The adults 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). Chinese literature indicates that beetles usually fly within 2 meters of the ground. The likelihood of long distance flights is not known. Adults, which may be present into July, feed on up to 0.45 cm^2 of foliage per day, leaving irregularly-shaped patches of leaf tissue with jagged edges.

Information from China indicates that male adults live an average of 13 days and females live about 21 to 22 days. Females can mate multiple times and oviposition begins 7 to 9 days after the initial mating. Females lay 65 to 90 eggs during their lifetime. Eggs are deposited individually on the bark surface or in bark crevices on the trunk or branches. In southeastern Michigan, the oviposition period likely extends into mid to late July.

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 (Figure 4). Galleries are packed with fine frass. Individual galleries usually 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. In some areas, woodpeckers feed heavily on larvae.

The insect overwinters as a full-grown larva in a shallow chamber excavated in the sapwood. Pupation begins in late April or early May. Newly eclosed adults may 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 (Figure 5).

Figure 1. Adult beetle

Figure 2. Late stage larva

Figure 3. Newly merged emerald ash borer

Figure 4. Larval gallery

Figure 5. D-shaped exit hole

Figure 6. Vertical split in the bark above larval gallery

Figure 7. Green ash killed by emerald ash borer showing D-shaped exit holes

Figure 8. Heavily infested ash trees

Distribution and Hosts

The emerald ash borer is indigenous 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 Michigan, this borer has been observed only on ash trees. It has killed green ash (*F. pennsylvanica*), white ash (*F. americana*) and black ash (*F. nigra*), as well as several horticultural varieties of ash.

Symptoms

Infestations of emerald ash borer can be difficult to detect until canopy dieback begins. Evidence of infestation includes D-shaped exit holes on branches and the trunk. Callus tissue produced by the tree in response to larval feeding may cause vertical splits 5–10 cm in length to occur in the bark above the gallery (Figure 6). Distinct, frass-filled larval tunnels etch the outer sapwood and phloem of the trunk and branches (Figure 7). An elliptical area of discolored sapwood, likely a result of secondary infection by fungal pathogens, sometimes surrounds larval feeding galleries in live trees.

Infested branches in the canopy die when they are girdled by the serpentine tunnels excavated by feeding larvae. Many trees appear to lose about 30 to 50 percent of the canopy in one year and the tree is often killed after 2–3 years of infestation (Figure 8). Frequently a profusion of epicormic shoots arises at the margin of live and dead tissue on the trunk. When trees die, dense root sprouting occurs.

Emerald ash borer killed trees of various size and condition in Michigan. Larvae successfully developed on trees as small as 5 cm in diameter, but pole-sized and sawtimber-sized trees were also killed. Stress likely contributes to vulnerability of ash trees and recent summer droughts may have contributed to high emerald ash borer populations in southeastern Michigan. However, emerald ash borer attacked and killed apparently vigorous trees in woodlots and urban trees under regular irrigation and fertilization regimes.

Sources

Xiao, G. (Ed.) 1992. Forest insects of China. 2d ed. Beijing: China Forestry Publishing House; 1362 p.

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

Authors:

Deborah G. McCullough, Assistant Professor, Department of Entomology and Department of Forestry, Michigan State University

David L. Roberts, Extension specialist and District horticulture agent, Michigan State University

Photo credits:

Howard Russell, Andrew Storer, Deborah G. McCullough, and David L. Roberts

Prepared by:

USDA Forest Service
Northeastern Area, State and Private Forestry
Newtown Square, Pennsylvania