

Signs and Symptoms of Emerald Ash Borer

Background

Mississippi landowners and communities may soon be threatened by a tree pest that is one of the most devastating invasive insects ever introduced to North America (Herms and McCullough 2014). The emerald ash borer (*Agrilus planipennis*) (EAB) has killed hundreds of millions of ash (*Fraxinus* spp.) trees since its introduction to southeast Michigan in the mid-1990s (Siegert et al. 2007). Efforts to contain the spread of EAB largely have been unsuccessful, as 25 states currently have confirmed infestations, including Louisiana, Arkansas, and Tennessee.

Although ash represents only a small fraction of all forest trees in Mississippi, the recent advance of EAB into the South is troubling. This is because ash lumber has a high economic value and has recently (in the past 20 years) been widely planted on alluvial soils throughout the state through federally funded conservation programs. In the Delta region of Mississippi, ash makes up about 20 percent of the marketable timber species. In addition to its value as a commercial forest species, countless ash trees are planted in city and residential landscapes.

While we cannot predict if or when EAB will reach Mississippi, it is widely accepted that early detection will be an important factor in reducing its potential financial impact. Consequently, learning to recognize the signs and symptoms of EAB is important for anyone with a vested interest in ash. This publication gives information that will help you identify EAB in the adult and larval stages, recognize signs and symptoms of an EAB-infested tree, and understand the life cycle of the EAB. Collectively, this information will help you identify EAB if it appears in ash trees in your forest or municipality.



EAB adult. Photo by Debbie Miller, U.S. Forest Service

EAB Identification

Adults

EAB adults are peg-shaped beetles (blunt at the head end and tapering to a dull point at the rear) that are about three-eighths to one-half inch long and a little less than one-eighth inch wide. The most distinctive characteristic of EAB is its metallic green color. It should be noted, however, that many insects have a similar metallic green appearance, and some EAB are colored in shades of red or blue. One distinguishing characteristic of EAB is its bright purple abdomen (beneath the wings), which is visible when the beetle is in flight. In the northern half of the state, adult EAB emerge in March and are active through November. In the southern half of the state, adult EAB can be active throughout the year.



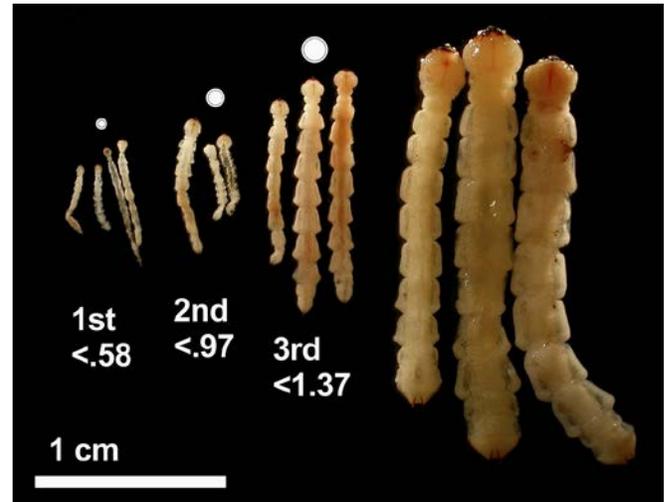
EAB adult. Photo by David Cappaert, Michigan State University



EAB adult. Photo by Debbie Miller, U.S. Forest Service

Larvae

EAB larvae are cream-colored and about 1½ inch long when fully grown. The key identifiable feature is their flattened, elongate bodies, which are composed of a series of segments shaped like stacked bells or cones. The larvae can be found beneath the bark where they feed on the cambium.



EAB larval classes. Photo by David Cappaert, Michigan State University

Signs and Symptoms

Woodpecker Damage

EAB larvae provide an excellent food source for woodpeckers. As a result, infested trees typically receive a high degree of damage to their outer bark from woodpeckers attempting to extract EAB larvae. Woodpecker damage is an important early detection sign, as it may precede any other visible sign or symptom. However, the presence of woodpecker damage does not necessarily indicate the presence of EAB larvae, as woodpeckers also feed on other wood-boring insects. If you see extensive woodpecker damage on your ash trees, you should look for galleries beneath the bark to confirm EAB's presence.



Woodpecker damage. Photo by David Cappaert, Michigan State University

Exit Holes

Exit holes are a reliable sign of EAB infestation, but EAB exit holes are small and can be difficult to detect. While most boring insects leave exit holes, EAB's are quite distinctive in that they are D-shaped and very small (one-eighth inch). Two drawbacks to relying on exit holes are (1) the beetles have already inflicted damage to the tree and moved on, and (2) the earliest exit holes are formed high in the canopy where EAB attacks typically initiate. Nevertheless, periodic examination of ash trees for small, D-shaped exit holes is a useful practice for early EAB detection.



Exit holes. Photo by David Cappaert, Michigan State University

Galleries

Finding larval galleries in the cambium is another reliable sign of EAB attack. These winding, S-shaped galleries exist just beneath the bark and are created by the feeding larvae. It is the girdling effect of these galleries that damages the tree and eventually causes tree death. Of course, you will need to use a hand tool to remove the outer bark in order to see feeding galleries. We strongly encourage you to consult with a professional forester before removing any segment of the bark.



Galleries. Photo by Tina Ciaramitaro, U.S. Forest Service

Crown Dieback

Crown dieback is the most visible symptom of EAB infestation. Unfortunately, dieback typically does not occur until 2–5 years after the tree was initially attacked. Dieback results from the tree's diminishing ability to transport water and nutrients throughout its vascular system as a result of extensive larval feeding. Because there are many other types of injury or stress that can cause ash trees to experience crown dieback, you should also check for the presence of exit holes and galleries to confirm whether EAB is responsible.



Crown dieback. Photo by Therese Poland, U.S. Forest Service

Basal Sprouting

Another highly visible symptom of EAB infestation is basal sprouting. In response to stress, trees sometimes grow new branches from the trunk of the tree. With EAB, this generally happens near the area where the tree was attacked. Much like crown dieback, basal sprouting takes time to develop as the tree becomes stressed. As a result, the tree has already suffered serious damage by the time sprouts appear. It should be noted, however, that basal sprouting does not confirm EAB presence, as many factors can facilitate basal sprouting.

Life Cycle

Because EAB is relatively new to the South and because climate/ecosystem differences may result in changes in the life cycle of the species, there is limited documentation of EAB behavior in the region. Consequently, the life cycle of EAB as it occurs in northern states is given for reference here. In northern climates, EAB completes one generation every 1–2 years. Eggs are laid between layers of outer bark and in crevices of the trunk/branches from mid-June into August. Depending on temperature, egg hatch occurs after about 2 weeks. Newly hatched larvae then tunnel through bark

into the tree's cambium (the living part of the tree) to feed. Galleries are created in the outer sapwood during this feeding. These galleries are S-shaped and are packed with frass (waste).

The majority of larvae mature during September and then pupate inside a cell formed within the feeding gallery. Younger larvae may overwinter in feeding galleries and continue to feed through the next summer before maturation. During April and May, overwintering pupae metamorphose into adult EAB. Upon maturing, new adults chew D-shaped exit holes through the bark and emerge. Emergence begins in late May and peaks in June, with some continued emergence throughout the summer. Mating occurs approximately 1 week post-emergence, with egg-laying occurring 2 weeks later. Females live about 2 months, and males live about 1 month.

Conclusions

Surrounded by three states with confirmed EAB populations, Mississippi appears likely to be one of the next states invaded by EAB. While this is an unenviable position, many lessons have been learned in other states. If applied correctly, such lessons can help reduce the potential impact of EAB. One lesson from other locations is the importance of early detection. This may be especially true for municipalities and residential areas where insecticide options are only effective at saving uninfected or lightly infected trees. As such, we encourage all citizens to become familiar with biological information presented in this publication, as it can guide you in your EAB detection efforts. If you believe you have detected an EAB-infected ash tree, please call your local Mississippi Forestry Commission office or the Mississippi State University Extension Service.

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