Emerald Ash Borer / EAB (*Agrilus planipennis*)

EAB is an exotic beetle that was first discovered in the US in 2002 near SE Michigan. Native to Asia, EAB probably arrived in the US in solid wood packing material carried in cargo ships and/or airplanes. Since its arrival in the Midwest, **millions of trees** have been killed.

Studies have shown that once EAB arrives in a healthy Ash stand, nearly **100% mortality** occurs within just **3-6 years**. Accordingly, the best time to treat for EAB is **before** it arrives, and the latest peer-reviewed research recommends that preventative treatment commence once EAB is **within 30 miles** of the tree(s) needing protection. As per the North Carolina Forest Service, EAB arrived in Asheville in **May 2017**.

While the adult beetles feed on foliage, it's the larvae (the immature stage) that do most of the damage. They feed on the inner bark of the tree and disrupt its ability to transport vital water and nutrients between the canopy and roots.

Initially, the tree is without symptoms, but over time as larval loads increase, the damage to the tree's vascular system becomes significant enough that the crown starts to decline. Similarly, D-shaped exit holes, increased woodpecker activity/damage (trying to find larvae), and splitting bark often accompany the canopy decline, and are additional signs of EAB infestation.

Multiple treatment options are available, and depending upon the treatment approach used, 70% to nearly 100% control is achievable. Most treatment options are closer to the lower end of that spectrum and have to be applied annually, but RTS can use an **advanced trunk-injection protocol** applied April-June that offers **nearly 100% control for a 3-year period.**

Watch RTS' Plant Health Care Director talk more about EAB on WLOS here.

Royce's Tree Service / 828-768-2747 / estimate@roycestreeservice.com

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Signs and Symptoms of the Emerald Ash Borer

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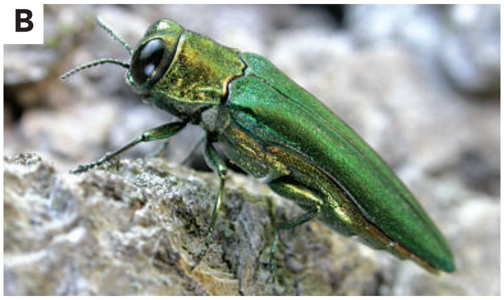
Adult

A

Michigan State University

B



Michigan State University

- Bright, metallic green (Figs. A, B).
- 1/2 inch long, flattened back (Figs. A, B).
- Purple abdominal segments beneath wing covers.

Larva

C

D. Cappaert, MSU

- Creamy white, legless (Fig. C).
- Flattened, bell-shaped body segments (Fig. C).
- Terminal segment bears a pair of small appendages.

Canopy Dieback

D

E. Rebek, MSU

E

E. Rebek, MSU

- Begins in top one-third of canopy (Fig. D).
- Progresses until tree is bare (Fig. E).

Epicormic Shoots

F

J. Smith, USDA APHIS PPQ

G

J. Smith, USDA APHIS PPQ

- Sprouts grow from roots and trunk (Figs. F, G).
- Leaves often larger than normal.

Emerald Ash Borer

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Bark Splitting

H

J. Smith, USDA APHIS PPQ

I

A. Storer, Mich. Tech. Univ.

- Vertical fissures on bark (Fig. H) due to callous tissue formation (Fig. I).
- Galleries exposed under bark split.

Serpentine Galleries and D-shaped Exit Holes

J

D. Cappaert, MSU

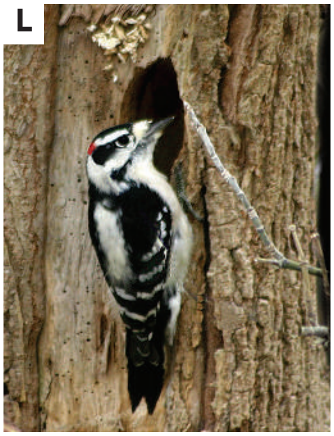
K

D. Cappaert, MSU

- Larval feeding galleries typically serpentine (Fig. J).
- Galleries weave back and forth across the woodgrain.
- Packed with frass (mix of sawdust and excrement).
- Adults form D-shaped holes upon emergence (Fig. K).

Increased Woodpecker Activity/Damage

L



D. Cappaert, MSU

M

Karen D'Angelo, MSUE

- Several woodpecker species (Fig. L) feed on EAB larvae/pupae.
- Peck outer bark while foraging (Fig. M).
- Create large holes when extracting insects (Fig. M).

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Revised - 12:05 - 5M - KMF/LB

www.emeraldashborer.info

University of Minnesota Extension | Michigan State University | The Ohio State University OARDC Extension

Frequently Asked Questions Regarding Potential Side Effects of Systemic Insecticides Used To Control Emerald Ash Borer

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What systemic insecticides are commonly used to protect ash trees from emerald ash borer (EAB)?

Systemic insecticides containing the active ingredients imidacloprid, dinotefuran or emamectin benzoate are commonly used to protect ash trees from EAB. All three are registered for agricultural use and have been designated by the Environmental Protection Agency as Reduced-Risk insecticides for certain uses on food crops. The most widely used insecticide in the world, imidacloprid has been utilized for many years to control pests of agricultural crops, turfgrass, and landscape plants. Because of its low toxicity to mammals, it is also used to control fleas and ticks on pets. Dinotefuran is a relatively new product that has properties similar to those of imidacloprid, but it has not been researched as thoroughly. Emamectin benzoate, derived from a naturally occurring soil bacterium, has been registered for more than 10 years as a foliar spray to control pests in vegetable and cotton fields and parasitic sea lice in salmon aquaculture. Similar products are used in veterinary medicine as wormers for dogs, horses, and other animals.

The invasive emerald ash borer has killed millions of ash trees in North America.

To control EAB, some products containing imidacloprid or dinotefuran are applied as a drench directly to the surface of the soil or injected a few inches under the soil surface. Dinotefuran can also be applied by spraying the bark on the lower five feet of the trunk. Emamectin benzoate and specific formulations of imidacloprid are injected directly into the base of the tree trunk. Systemic insecticides are transported within the vascular system of the tree from the roots and trunk to the branches and leaves. This reduces hazards such as drift of pesticide to non-target sites and applicator exposure that can be associated with spraying trees with broad-spectrum insecticides, and has less impact on beneficial insects and other non-target organisms. Many products registered for control of EAB can be applied only by licensed applicators. In all cases, the law requires that anybody applying pesticides comply with instructions and restrictions on the label.

Ash trees lining a street before (left) and after (right) they were decimated by EAB.

Precautions should be taken to prevent pesticides from reaching surface or groundwater.

Will systemic insecticides applied to the soil impact ground or surface water quality?

Several surveys have been conducted in the United States and Canada to monitor imidacloprid in surface and groundwater. Results indicate that imidacloprid is rarely detected in surface water in agricultural or urban areas. Similar monitoring studies have not been conducted with dinotefuran, which is more soluble in water. In the presence of sunlight, imidacloprid and dinotefuran are very unstable in water and degrade rapidly, which reduces their environmental risk to surface water.

When not exposed to light, imidacloprid and dinotefuran break down slowly in water, and thus have the potential to persist in groundwater for extended periods. In surveys of groundwater, imidacloprid was usually not detected. When detected, it was present at very low levels, mostly at concentrations less than 1 part per billion (ppb) with a maximum of 7 ppb, which are below levels of concern for human health. The detections have generally occurred in areas with porous rocky or sandy soils with little organic matter, where the risk of leaching is high — and/or where the water table was close to the surface.

Every precaution should be taken to protect surface and groundwater from pesticide contamination. Trunk-injected insecticides pose little risk to ground and surface water when used as directed because the material is placed inside the tree.

To protect groundwater, soil applications of systemic insecticides should be made immediately adjacent to the trunk of the tree, which increases uptake (and efficacy) because the high density of absorptive roots in this area filters the chemical from the soil. Systemic insecticides bind to varying degrees to organic matter, silt, and clay, which restricts their movement in soil. They should not be applied to porous sandy soils lacking organic matter, especially where the water table is shallow, or when heavy rain is predicted within the next 24 hours.

To protect surface water, systemic insecticides should not be applied to soil near ponds, lakes, or streams. Soil drenches should not be applied to sloped surfaces from which runoff can occur, nor should pesticides be misapplied carelessly to impervious surfaces such as sidewalks or streets, or otherwise allowed to reach conduits to surface water such as drains, ditches, or gutters.

The imidacloprid profile presented in the Extension Toxicology Network Pesticide Information concluded there is generally not a high risk of groundwater contamination when products are used as directed and appropriate precautions are taken. Similarly, the Canadian Water Quality Guidelines for the Protection of Aquatic Life noted that when imidacloprid is used correctly, it does not characteristically leach into deeper soil layers.

Will these insecticides impact aquatic organisms?

The toxicity of imidacloprid to aquatic life varies. Studies indicate it has low toxicity to fish, amphibians, and some aquatic invertebrates such as Daphnia (small aquatic crustaceans), but high toxicity to other invertebrates such as mysid shrimp (a salt water species) and larvae of some aquatic insects such as midges, black flies, and mosquitoes. Dinotefuran is not as thoroughly researched, but existing data reflect a pattern of toxicity similar to that of imidacloprid. Toxicity to fish and Daphnia is low, while mysid shrimp are sensitive. As previously noted, imidacloprid and dinotefuran are broken down rapidly in water when exposed to light. In the rare occasions when imidacloprid has been detected in surface water, the levels were too low (less than 1 ppb) to impact even sensitive aquatic organisms.

Imidacloprid soil injections have been widely used in ravines of Smoky Mountain National Park and other forested areas to control hemlock woolly adelgid, an invasive insect that is devastating hemlock trees in the Appalachian Mountains. A risk assessment prepared for the USDA Forest Service ("Imidacloprid — Human Health and Ecological Risk Assessment") concluded that these treatments pose negligible risk to aquatic organisms when applied as directed to clay or loam soils, and that even a worst-case scenario of a major spill of imidacloprid into a small pond would have negligible effects on fish, amphibians, or tolerant aquatic invertebrates. When used as directed, imidacloprid soil treatments for EAB control are unlikely to impact aquatic organisms.

What about insecticide residues in senesced leaves that fall from trees in autumn?

This question has not been thoroughly researched. One study conducted in experimental microcosms found that imidacloprid residues in senesced (dead) leaves from treated trees had no effect on microbial respiration or decomposition, or survival of leaf-shredding insects that decompose dead vegetation. Insect feeding rates were decreased by imidacloprid concentrations of 1.3 parts per million (ppm), while lower concentrations (0.8 ppm) had no effect. When leaf-shredding insects or earthworms were given senesced maple leaves with higher concentrations of imidacloprid (3-11 ppm), their feeding rates were reduced but their survival was not affected. In another microcosm study, imidacloprid inhibited breakdown of leaf litter, but foliar concentrations in this study (18-30 ppm fresh weight) were more than an order of magnitude higher than those reported in leaves from trees treated for EAB control. In all of these experiments, organisms were exposed only to leaves from treated trees. In many situations, leaves from treated ash trees would be mixed with senesced leaves of other species growing nearby.

Similar studies have not been conducted with emamectin benzoate, which is broken down rapidly by microbial activity and sunlight. Because of its short residual activity on the surface of leaves, it is considered a biorational insecticide compatible with integrated pest management programs, including biological control. These characteristics suggest that environmental impacts will be negligible as emamectin benzoate is released from decomposing leaves. Regulatory agencies concluded that foliar applications of emamectin benzoate to vegetable crops will have no adverse effects on ground or surface water, birds, mammals, fish, or aquatic invertebrates when used as directed.

Will these insecticides harm honey bees?

Ash trees are wind-pollinated and are not a nectar source for bees. Furthermore, ash flowers are produced early in the growing season and are present for only a limited number of days. It is highly unlikely that bees would be exposed to systemic insecticides applied to ash.

Flowering plants that are pollinated by bees or other insects should not be planted immediately adjacent to ash or other trees that will be treated with systemic insecticides applied to the soil, as they may also absorb insecticide. Honey bees and other insects can be affected when systemic insecticides are translocated to nectar and pollen. Imidacloprid is fatal to honey bees when it reaches high enough concentrations, and can have harmful sublethal effects at lower concentrations.

Honey bees and other pollinators can be harmed by insecticides applied to flowering plants.

There has been much concern recently about the potential role of imidacloprid and related neonicotinoid insecticides in colony collapse disorder (CCD). Research is ongoing to investigate the relative effects of pesticides, bee pathogens and parasites, and nutrition on honey bee health. To date there are no conclusive answers, but researchers have not been able to establish a link between imidacloprid and CCD. Stronger evidence implicates a combination of pathogens as well as other pesticides used in hives to control pests that afflict bees.

Will these insecticides harm other insects?

All of the systemic insecticides used to control EAB will impact other species of insects that feed on treated ash trees. However, ash trees that are not treated will be killed by EAB, which will also impact these insects. Some products can affect many kinds of insects, while others affect only certain groups of insects. For example, emamectin benzoate has been shown to affect a broad range of plant-feeding insects. Products with imidacloprid generally have little effect on caterpillars, mites, and armored scales, but will impact most sawflies, leaf-feeding beetles, and sap-feeding insects such as aphids and soft scales. Studies have shown that beneficial insect predators and parasitoids — such as lady beetles, lacewings, and parasitic wasps — can be killed by indirect exposure to imidacloprid through their prey, or directly by feeding on nectar from treated plants. However, systemic insecticides are generally considered to have less impact on natural enemies than broad-spectrum insecticides applied as foliar or cover sprays.

Woodpeckers are important predators of overwintering EAB larvae.

Will these insecticides harm woodpeckers?

This is unlikely. Woodpeckers feed on live, mature EAB larvae, mostly in late fall, winter and early spring. Many of these mature larvae overwinter in the nonliving, outer bark where they will not be exposed to systemic insecticides. Imidacloprid, dinotefuran, and emamectin benzoate are much more toxic to insects than to birds that have been tested, and insecticide concentrations that have been measured in treated trees are far below the levels known to be toxic to birds. An EAB larva that has been killed by insecticide will desiccate quickly and decompose. There is little evidence that woodpeckers will feed on larval cadavers. Furthermore, living larvae that are suitable prey for woodpeckers will not have been exposed to a lethal dose of insecticide, and these products do not bio-accumulate in animals in the way that fat-soluble insecticides such as DDT do. In Michigan and Ohio, where EAB has been established for several years, many ash trees have been treated with systemic insecticides. There have been no reported cases of woodpecker poisoning caused by insecticides applied for control of EAB.

Does injecting insecticides into trunks injure the trees?

Drilling through the outer bark creates a wound in the tree. The response of the tree to these wounds is affected by factors such as the size and depth of the hole and the vigor of the tree. In recent studies, the injury associated with drilling holes and injecting two insecticide products (Imicide® applied with Mauget® capsules and TREE-äge™ applied with the Arborjet Tree IV™ and Quickjet™) into trunks of ash trees was examined. In nearly all cases, ash trees that were relatively healthy and properly injected showed little evidence of damage. New, healthy wood was produced over the injection sites and there was no evidence of pathogen infection, decay, or other signs of serious injury. Other devices used to inject ash trees generate wounds that differ from those caused by drilling discrete holes in the tree. However, their impact has not been thoroughly evaluated in research projects. We do know that untreated ash trees in areas with EAB infestations will eventually be killed.

Will treating ash trees result in development of resistance of EAB to insecticides?

This is highly unlikely. Pests typically evolve resistance to pesticides only in situations where a high proportion of the insect population was subjected to strong selection pressure. For example, pesticide resistance has evolved in insect and weed populations in agricultural fields, greenhouses, and grain storage bins where nearly all of the pest population was exposed to the pesticide. Ash trees are very common in many natural environments. Landscape trees represent a small fraction of all the ash that will be colonized by EAB in a given area, and only a small proportion of high-value trees will ever be treated to control EAB. Thus, most of the EAB population will never be exposed to insecticides. Because the selection pressure is so low, and there will be plenty of cross breeding with individuals that have never been exposed to insecticides, the risk of a resistant EAB population evolving is minimal.

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