

# Emerald Ash Borer: Biology and Control Options

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**R**oughly six to ten years ago, an exotic wood-boring beetle arrived in southeastern Michigan, probably as a stowaway in wooden crates shipped from Asia. At some point, the shiny green beetles left the wooden crating and flew off to their favorite food, ash trees. Before the beetle was discovered in the summer of 2002, it had spread to at least six Michigan counties, one county in Ohio, and across the Detroit River to Windsor, Ontario. In its wake are up to five million dead or dying ash trees. The Emerald Ash Borer (EAB) is now firmly established in North America. Make no doubt about it, this is a very aggressive beetle. Virtually all ash trees growing in the area where the beetle is known to occur are at risk.

## Identification

The Emerald Ash Borer, known in scientific circles as *Agrilus planipennis*, is a member of the beetle family Buprestidae, or Metallic Wood-Boring Beetles. Like EAB, many species in this group are bright and shiny. The larval stages are commonly known as flat-headed borers. There are approximately 675 species of buprestids in the US and Canada. The genus *Agrilus* is one of the largest in the family with approximately 161 species in the US and Canada. However, unlike our native *Agrilus* beetles that normally only attack stressed or declining trees, EAB will attack healthy trees and kill them in one to four years. EAB is native to northeastern China, Korea, Mongolia, Japan, Taiwan, and eastern Russia.



EAB Adult Howard Russell,  
Michigan State University

Like other buprestid larvae, EAB larvae are called flat-headed borers because of the enlarged, disk-like first thoracic segment located directly behind the head. Flat-headed borers in the genus *Agrilus* possess two dark brown pointed structures on the tail end, called urogomphi. A characteristic that appears to distinguish EAB larvae from other *Agrilus* species is the three bell-shaped abdominal segments toward the tail end of the larvae. Full-grown EAB larvae may approach 1.5 inches in length.



Approximate native range of EAB.

## Biology

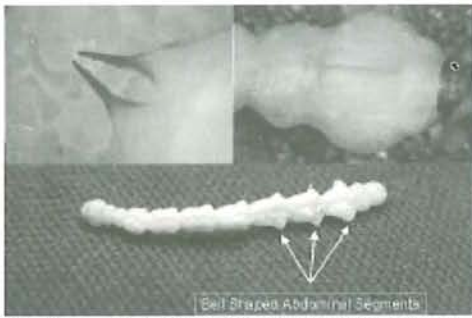
Adult beetles begin to emerge from infested trees around mid-May. Adult emergence holes are D-shaped because the beetle is D-shaped in cross-section, i.e., they have flat backs and rounded bellies. Most adult beetles live for 2 to 4 weeks. They are active fliers and occasionally



Adult emergence holes are D-shaped. Dr.  
Deborah McCullough, Michigan State  
University

eat small amounts of foliage. Eggs are laid individually on the bark of branches and the trunks of ash trees. On average, each female beetle lays roughly 75 eggs.





Top left: two dark brown pointed structures on the tail end, called urogomphi; Top right:enlarged, disk-like first thoracic segment; Bottom: three bell-shaped abdominal segments. Photographs by Howard Russell

The eggs hatch in about a week. Larvae tunnel under the bark and feed in the cambium area, between the inner bark and outer ring of wood. The larval feeding galleries are distinctively S-shaped and packed with

powdery frass. The galleries excavated by EAB larvae disrupt the transport of water and nutrients within the tree. Deprived of these life sustaining essentials, the branches begin to die as the feeding progresses. Decline of the canopy continues until the tree is dead. Some

dying trees produce new shoots (suckers) from the base of the tree. The time required for EAB to kill a tree is determined, in part, by the size of the tree. Saplings and small trees may be killed in one year,



Larval feeding galleries. Photograph by Dr. Deborah McCullough, Michigan State University

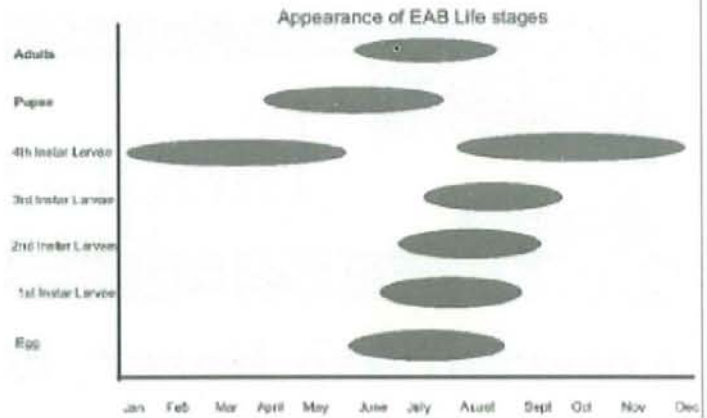
while it may be two to four years before large trees die. Scientists believe that EAB has four larval stages (called instars). Most EAB pass the winter as prepupal larvae in chambers constructed in the sapwood or thick outer bark. As the weather warms in the spring, larvae pupate and the new adults emerge and begin the cycle again.

### Hosts

All North American species of ash (*Fraxinus sp.*) are likely to be suitable hosts for EAB. A Chinese report suggested



Green ash leaves:photograph by Paul Wray, Iowa State University Image 00088289, Green ash flowers photograph by Paul Wray, Iowa State University Image 0008056



that Asian species of walnut (*Juglans*) and elm (*Ulmus sp.*) could be hosts as well. To-date, however, only ash trees have been attacked in North America. Please note that Mountain ash (*Sorbus sp.*) is not a host for EAB. Go to <http://forestry.msu.edu/uptreeid/Species/ashes.htm>, a site that will help you to identify ash trees.

### General Considerations for Controlling EAB

**Help Stop the Spread Of EAB.** Because of the potential impact of EAB on all North American ash trees, one might argue that drastic measures are necessary to keep EAB from spreading to other areas of the continent. One such measure would be to cut down and destroy every ash tree in the area known to be infested by the beetle plus a buffer zone surrounding this area. This course of action is not likely to be employed because of the costs involved. But removing and chipping infested ash trees can be an important step in reducing the spread of the EAB by reducing the population of beetles. Another step is to kill the stump of infested trees. EAB kills the above ground portion



Ash root sprouts. Photograph by James W. Smith

of the tree but sometimes the roots respond by producing sprouts or suckers. These will grow until they reach 2-3 inches in diameter and are again attacked by EAB. Steve Gower, MSU Diagnostic Services, recommends products containing triclopyr (Garlon, Pathfinder), picloram (Tordon, Pathway), and 2,4-D (many brush killers). Glyphosate (Roundup, Rodeo) can also be effective on cut stumps. For best results, herbicides should be applied immediately after the trees are felled using a handheld sprayer or sponge-type applicator.

**A large-scale program to eradicate EAB from North America will begin in 2003.**



**It is extremely important not to transport ash logs, ash firewood and live ash trees out of the area known to be infested.** There have already been confirmed cases where logs with live EAB larvae inside were moved outside of the infested area.

**When to give up on an infested tree.** A tree that has been heavily attacked by EAB probably will not survive despite your best efforts to save it. If an untreated tree shows 20% to 30% dieback in the spring, then expect to see 50% to 60% dieback by fall. Larval feeding galleries not only prevent the transport of water and nutrients, but they also prevent transport of insecticides that may have been injected into the soil or tree. If 50% or more of the canopy is dead the tree is probably too far gone to save.



*Canopy decline*  
Photograph by James W. Smith

**What to do with an infested tree.** Trees with more than 50% canopy dieback should be felled and chipped if at all possible. Dead trees that remain standing pose a serious risk. Falling branches or even worse, falling trees can cause serious injury to people and property. The Michigan Department of Agriculture and cooperating municipalities have identified four marshalling yards that will accept and chip ash trees free of charge. Stumps can be ground or treated with an herbicide to prevent root sprouts.

**Marshalling Yards for Disposing Dead Ash Trees**

**Mid Michigan Recycling**  
24935 21 Mile Road  
Macomb, MI 48042  
HOURS: Mon - Fri 8 to 5

**Asplundh Tree Expert Co,  
Plymouth Industries Yard**  
13101 Eckles Road  
Plymouth, MI 48170  
HOURS: Mon - Fri 8 to 5

**City of Pontiac Sanitation Division**  
575 Collier Road  
Pontiac, MI 48326  
HOURS: Mon - Fri 9 to 4

**City of Westland**  
Department of Public Service  
37137 Marquette  
Westland MI 48185  
HOURS: Mon - Fri 7 to 5, Sat 9 to 5

**Diversify your plantings!** For obvious reasons, ash trees should be avoided in landscape plantings in southeastern Michigan. Dead ash trees should be replaced with an array of different tree species.

**This pest is brand new.** The following control options may help to protect your ash trees. Remember, however, that EAB had never been found outside of Asia until it was discovered in Michigan in June, 2002. Possible options for protecting healthy ash trees or saving infested ash trees have not yet been tested. Scientists plan to evaluate insecticide products and application methods in 2003.

**Options for Controlling EAB**

The following options will be tested in 2003 to evaluate their effectiveness.

1. Hire a professional tree care service to inject ash trees or the soil around ash trees with Merit (imidacloprid).
2. Do-It-Yourselfers can apply imidacloprid (sold as Bayer Tree and Shrub Insect Control) to the soil over the roots of ash trees.
3. Hire a professional tree care service to inject ash trees with Bidrin.
4. Hire a professional tree care service to spray ash trees at least twice with a persistent insecticide from late May to mid-July when the beetles are laying eggs on the trees. The goal of this strategy is to kill the female beetles before they lay eggs on the trunk of the tree, and to kill any newly hatched larvae as they chew their way through the bark.

Adult EAB beetles could be laying eggs from mid-May through mid-August.

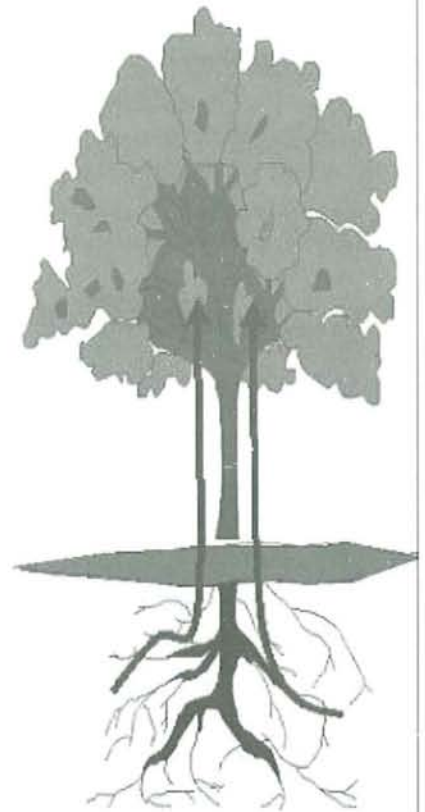
A single application is not likely to remain effective for this 10 to 12 week period. At least 2 sprays and maybe more could be needed to protect ash trees throughout the summer. If only a single spray is to be applied, then the best timing will be early June.





## General considerations for applying imidacloprid

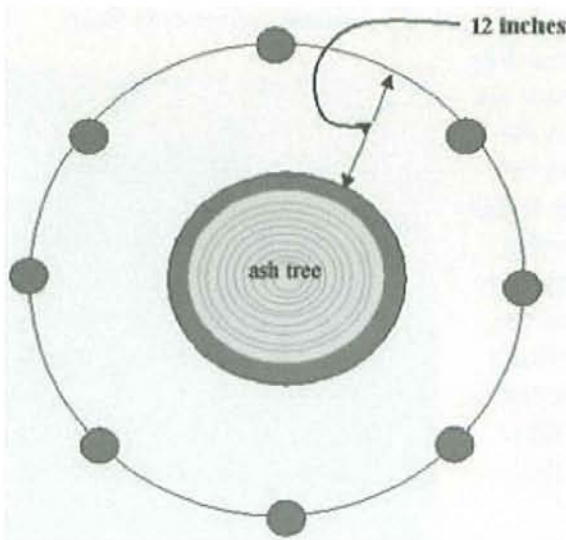
Imidacloprid is a 'systemic' insecticide, meaning that it is taken up and translocated throughout the tree. Larvae of EAB encounter the insecticide as they feed under the bark. Imidacloprid can be injected in the soil or the tree trunk by a professional tree service. Homeowners can apply it over the roots of the tree. It will likely take at least 4 weeks for the imidacloprid to move through a large tree. It should be applied to the soil in mid April or as a trunk injection in early to mid May. Imidacloprid is widely available and sold under the brand names Merit™ for professional applicators, or as Bayer Tree and Shrub Insect Control™ for homeowners.



*Imidacloprid can be absorbed through the roots and translocated in the tree*

Products that will be tested for control Emerald Ash Borer Provided by Dr. Dave Smitley, MSU Department of Entomology		
Chemical name	Product name(s)	Applications
Imidacloprid	Imicide	Mauget tree injection
	Pointer	Wedgel tree injection
	Merit	Soil injection
Bidrin	Inject - a - cide "B"	Mauget tree injection
Cyfluthrin	Tempo2	Trunk and foliage spray
	Tempo 20 WP	Trunk and foliage spray
Carbaryl	Sevin SL	Trunk and foliage spray
	Sevin 80 WSP	Trunk and foliage spray
Acephate	Orthene Turf, Tree and Ornamental Spray 97%	Trunk and foliage spray
	Orthene Turf, Tree and Ornamental Spray 75%	Trunk and foliage spray
Bifenthrin	Talstar F	Trunk and foliage spray
	Talstar Lawn and Tree	Trunk and foliage spray

## EAB Control for Do-it-yourselfers



**Consider** applying Bayer Tree and Shrub Insect Control in mid-April. It likely takes at least four weeks for the insecticide to move through the tree.

**Remove** any mulch from base of the tree.

**Dig** 8 small holes approximately 8" across and 6" deep equally spaced around trunk, and about 12" away from trunk. Try not to injure tree roots.

**Mix** the imidacloprid with water following the instructions on the label.

**Pour** equal amounts of mixture into each hole.

**Water** in with garden hose.

**Fill** the holes in with soil and replace mulch.

**Repeat** treatment every April.

Acknowledgement: The authors thank Dr. Dan Herms, The Ohio State University, for his assistance in developing the Do-It-Yourselfer Recommendation. Thanks, also, to Maxine Schafer for her assistance in proof-reading.

NOTICE: The user of this information assumes all risks for personal injury or property damage. Always read the label before making pesticide applications. The pesticide label is the legal document that regulates the use of a pesticide. Pesticide labels can change suddenly. These recommendations are not intended to replace the specific product labels.

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