

## Insecticides Used to Control Emerald Ash Borer on Residential Shade Trees

Fact Sheet 5.626

Insect Series | Trees & Shrubs

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Emerald ash borer (EAB) is a beetle that attacks, and can ultimately kill, ash trees (*Fraxinus species*). This includes species of trees that are very commonly planted in Colorado, particularly green ash and white ash, including the popular cultivar 'Autumn Purple'.

Trees are damaged when the immature stage of the insect, known as a flatheaded borer, develops in the living tissues (cambium) present just under the bark.



Figure 1. a) Emerald ash borer damages ash trees when the developing flatheaded borer stage tunnels through the area just under the bark. b) Emerald ash borer injuries prevent the plant from moving nutrients, causing progressive decline. Trees ultimately die from the cumulative effects of these injuries. Photograph of the larva courtesy of David Shetlar, The Ohio State University. Photograph of the ash trunk with EAB tunneling courtesy of Eric Day, Virginia Polytechnic and State University.

The tunneling by the insect reduces the ability of the tree to move water and nutrients, producing a progressive weakening of the plant. As the number of these wounds increase over time effects on tree growth become more apparent. Damage usually begins at the top of the tree, and this may result in a thinning of the leaf canopy, as smaller leaves are produced. Twigs and branches may die and in later stages of an infestation the insect may be found in high numbers in the main trunk.



Figure 2. An ash tree showing advanced thinning of the canopy related to injuries produced by the tunneling of the flatheaded borer stage. This tree shows about a 60-70% reduction in crown canopy due to EAB injury. Trees showing this much injury are beyond recovery with insecticides.



### Quick Facts

- Emerald ash borer wounds ash trees by tunneling areas under the bark. When wounds become extensive, trees show symptoms of decline and, ultimately, are usually killed.
- Several types of insecticide applications can control emerald ash borer.
- Emerald ash borer insecticides move systemically in plants and are typically applied as either soil drenches, trunk sprays or direct injections into the trunk, depending on product.
- Insecticides can prevent new injuries by emerald ash borer and if damage to the tree caused by the insect is not too advanced, trees can recover when insecticides are used.

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*Figure 3. An ash tree showing a slight thinning of the top of the tree related to emerald ash borer injury. In this tree the canopy has thinned 10% or less from emerald ash borer damage. Trees that have thinned up to 30% can usually recover with a program that uses trunk injections of emamectin benzoate.*

Once emerald ash borer has begun to infest a tree the injury it causes will increase over time so that the tree will ultimately be killed, unless treated with insecticides. The length of time it will take from the day a tree is first colonized by emerald ash borer until it will die will normally take several years, but the speed of tree decline will depend on many factors. These include the original health of the tree, weather, and the number of emerald ash borers developing in nearby trees.

Individual trees can be protected from emerald ash borer using certain insecticides. These insecticides can be used preventively, applied when the insect is first detected near the neighborhood. Most of the emerald ash borer insecticides can also be used effectively a couple of years after emerald ash borer has first colonized a tree, when populations of the insect are still low and tree damage is minimal. One of

the insecticides, emamectin benzoate, has been demonstrated to often allow tree recovery as a “rescue treatment” even when emerald ash borer injuries have begun to produce as much as a 30 percent reduction visible thinning of the leaf canopy of the ash tree.

## **Insecticides Used to Control Emerald Ash Borer**

Emerald ash borer is controlled by the use of certain systemic-types of insecticides that can be taken into the tree in some manner and will then move to areas where it can kill adults (leaves) or the flatheaded borer larvae (cambium). This is a different approach than is used for many other wood boring insects. Most wood borers, and bark beetles, are controlled using preventive insecticide sprays applied to the bark that kill the insects after egg hatch before they enter the tree ([Fact Sheet 5.530, Shade Tree Borers](#)). Emerald ash borer is not effectively controlled in this manner, but certain systemic insecticide can be very effective that kill either the adults as they feed on leaves and/or the developing larvae underneath the bark.



*Figure 4. Adult emerald ash borers emerge beginning in late May and feed on leaves for several weeks before the female begins to lay eggs on the bark. Most insecticides used for EAB control can kill adults if applied in time for the insecticide to move into the leaves when adults feed. Photograph courtesy of Debbie Miller, USDA-FS.*

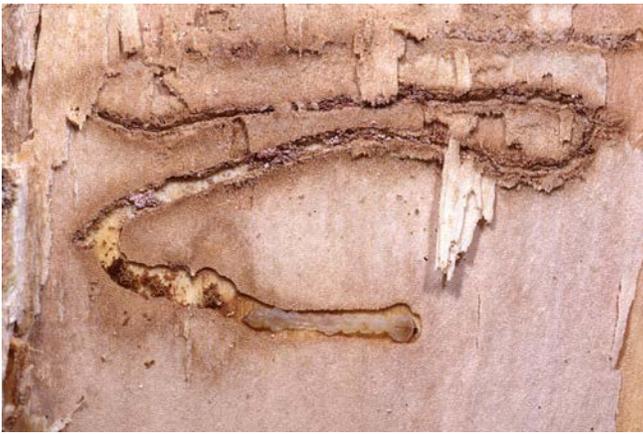


Figure 5. The systemic insecticides used to control emerald ash borer can kill the flatheaded borer stage under the bark. This is an older borer larva, some of the EAB insecticides can only kill young stages. Photograph courtesy of David Shetlar, The Ohio State University.

There are four active ingredients used to control emerald ash borer: imidacloprid, dinotefuran, emamectin benzoate, and azadirachtin.

### **Imidacloprid.**

Imidacloprid is the most easily applied and usually least expensive of the insecticides used to control emerald ash borer. It is the only EAB insecticide that can be found for sale at retail outlets (nurseries, hardware stores, box stores).

Imidacloprid is normally applied as a treatment to the soil that is then picked up by the roots of the tree. This can be done as a drench, mixed with several gallons of water, poured onto the surface around the base of the trunk of the tree.



Figure 6. Imidacloprid can be easily applied as a drench around the base of the tree. If mulch is present it should be removed from the area treated then put back in place. The area must remain moist for at least a couple of weeks after an application to allow the insecticide to move to and be picked up by the tree roots. Photograph courtesy of Joe Findlay, Iowa State University.

If mulch is present around the tree this must be removed prior to application. *This treatment cannot be made if flowering plants are present around the base of the tree*, as the insecticide may move into the nectar of plants exposing it to pollinating insects.



Figure 7. If there are flowering plants around the base of the tree, soil treatments of systemic insecticides cannot be used, as this would cause risk to pollinators visiting the flowers, which may contain insecticide residues in the nectar or pollen following applications.

Alternatively, imidacloprid can be injected into the soil by a professional, using special equipment, with injections made at multiple points under the canopy of the tree.

Whether applied as a soil drench or injected, *the soil must remain moist* to allow the roots of the tree to pick up and to then transport the insecticide through the tree. Immediately after application the treated area should be watered and continued watering may be necessary to keep the soil moist for two to three weeks after application. Compared to other EAB insecticides, imidacloprid moves slowly into the tree and can be expected to take two or three weeks to be present in high enough levels to kill emerald ash borer. If soil remains dry after application, this method of treatment will be ineffective.

The amount of imidacloprid to apply for EAB control is related to the size of the tree, as it is for all of the EAB insecticides. However, in large diameter trees that support a very large canopy, rates need to be further increased. The rate of imidacloprid must be

doubled in trees with a diameter of over 15 inches to provide control. This higher rate of use is not allowed on retail formulations of imidacloprid.

Imidacloprid will provide control for a single season. Treatments are best applied in spring shortly after bud break so that it will be present in leaves when newly emerged adults first begin to feed on leaves, before they begin laying eggs. Adults can normally be expected to begin to emerge from trees in mid-late May and adults will continue to emerge from trees into early summer.



*Figure 8. An optimum time for applying most emerald ash borer insecticides is shortly after leaves have emerged in spring. Systemic insecticides will not move in plants when leaves are not present. Also, ash flowers, shown in this picture, are dead at this time and no longer produce pollen that may attract some insects.*

### **Dinotefuran.**

Dinotefuran is most often used as a spray on the trunk. This insecticide is more mobile in plants than are the other EAB insecticides and is able to move through the bark and then move rapidly through the tree. Dinotefuran can also be applied to the soil in the same manner as imidacloprid, but is considerably more expensive and control is similar by this method.



*Figure 9. Dinotefuran is highly water soluble and moves rapidly in plants. It is the only emerald ash borer insecticide that can be applied as a spray on the bark, which can then move into the plant and move systemically. Photograph courtesy of Daniel Herms, The Davey Tree Company.*

Dinotefuran is not available through retail outlets and it is complicated to apply it correctly at the proper rate as a trunk spray. The insecticide is mixed with water and the amount of the spray mixture needed will vary by the size of the tree. Professional application is highly recommended.

Dinotefuran will provide control for a single season. Treatments are best applied in spring when trees are mostly leafed out about a month following bud break. Since it is more mobile in the plant, dinotefuran can effectively move into leaves more rapidly than imidacloprid, usually within a week, where it will be able to kill adult beetles. However, if applied too early it may not remain in sufficient concentration when it is needed to kill developing larvae under the bark. As for all of the insecticides used for EAB control, following application the soil must be moist enough for the plant to be actively moving water. Supplemental irrigation is needed if the site where the tree roots are growing is droughty.

### **Emamectin Benzoate.**

Emamectin benzoate can only be applied through injection of the trunk using specialized equipment. Professional application is required both to apply it effectively and to avoid plant injury.



*Figures 10a, b. The emerald ash borer insecticides emamectin benzoate and azadirachtin must be injected into the tree. This requires specialized application equipment, such as illustrated, and must be done professionally. These trunk-injected insecticides can provide control for at least two years.*

Emamectin benzoate is extremely effective for emerald ash borer control. It can very reliably control emerald ash borer for two years following application and increasing evidence indicates that it may usually be effective when used at 3 year intervals.

Emamectin benzoate has been demonstrated to provide effective “rescue treatment” of ash trees that have sustained enough injury over the years that there is a reduction in the thickness of the leaf canopy due to accumulated EAB injuries. This insecticide has been shown able to allow tree recovery when trees have sustained some EAB injury but it is not extensive enough to have produced more than a 30% thinning of the canopy of the tree.

Because of its persistence in the tree and ability to kill late stage larvae, there is more latitude in when the insecticide can be applied. Treatments are probably best applied in the period from spring bud break through late June or early July.

### **Azadirachtin.**

Azadirachtin is a natural-sourced insecticide, extracted from the seeds of the neem tree. For emerald ash borer control it can only be applied through injection of the trunk using specialized equipment. Professional application is required both to apply it effectively and to avoid plant injury.

Trunk injections of azadirachtin can be expected to provide two years of control in the early stages of an EAB invasion and one year of control when EAB populations reach the peak of their abundance. Because of its persistence in the tree and ability to kill late stage larvae, there is more latitude in when the insecticide can be applied. Treatments are probably best applied in the period from spring bud break through late June or early July.

### **When to Start Treatments for Emerald Ash Borer**

There are no guidelines for when it is best to start insecticide treatments for emerald ash borer. All ash are not necessarily candidates for treatment and trees should be carefully and

subjectively assessed for overall size, health, and environmental and aesthetic function. The ultimate decision on whether treatment is appropriate must be made by the tree owner based on their own priorities and judgement as what is the situation with the ash tree on their property and the current situation with emerald ash borer at the site.

### **Present Situation (May 2020) with Emerald Ash Borer in Colorado**

Emerald ash borer was first found in Colorado in 2013, in Boulder, and Colorado is presently the only state west of the High Plains where this insect is currently known to be present. Over five years following its Colorado discovery, new emerald ash borer detections occurred in several other Boulder County communities (Longmont, Superior, Lafayette, Lyons). In 2019, it was detected in a few sites immediately adjacent to Boulder County, including Broomfield, Westminster, and a rural area of Larimer County southwest of Berthoud. Most recently (May 2020) emerald ash borer was found in northern Fort Collins, presumably by movement of infested wood into the area a few years earlier. Over time, this insect can be expected to expand its range and increase in number throughout the Northern Front Range, moving naturally or by human assistance.

Updates on the known locations of emerald ash borer within Colorado are tracked by the Colorado Department of Agriculture and can be found at the [CDA Emerald Ash Borer home page](#).

### **Other Sources of Information on Use of EAB Insecticides**

- [Insecticide Options for Protecting Ash Trees from Emerald Ash Borer, 3rd Edition](#)
- [Frequently Asked Questions about Potential Side Effects of Systemic Insecticides Used to Control Emerald Ash Borer](#)

**Table 1.** Characteristics of insecticides used to manage emerald ash borer.

Insecticide	Trade Names (Retail)	Trade Names (Commercial)	Susceptible EAB Life Stages	Method of Application	Optimum Time of Application	Required Treatment Frequency
imidacloprid	Bayer Advanced Tree & Shrub Protect & Feed Concentrate, <u>Bonide</u> Annual Tree & Shrub Control, <u>ferti-lome</u> Tree & Shrub Systemic Insect Drench	Merit, Mallet, Zenith, <u>Xytect</u> , Imidacloprid, Criterion, others	Adults, young larvae	Soil drench or soil injection	Shortly after bud break	Annual
dinotefuran	None. Professional application highly recommended	Safari, <u>Transtect</u> , <u>Zylam</u>	Adults, young larvae	Trunk spray. Soil drench/injection can be made.	Within month following bud break	Annual
<u>emamectin benzoate</u>	None. Professional application required	TREE-age, <u>Mectinite</u> , Brandt <u>enTREE EB</u> , <u>TreeMec Inject</u> , <u>Boxer</u>	Adults, young larvae, older larvae	Trunk injection	Mid-late spring, after leaves produced	At least two years.
<u>azadirachtin</u>	None. Professional application required	<u>Treeazin</u> , <u>AzaSol</u> , <u>AzaGuard</u>	Young larvae, older larvae; may suppress egg laying by adults	Trunk injection	Mid-late spring, after leaves produced into early summer	Normally two years. Annual applications recommended during outbreak peak.

*Colorado State University, U.S. Department of Agriculture and Colorado counties cooperating. CSU Extension programs are available to all without discrimination. No endorsement of products mentioned is intended nor is criticism implied of products not mentioned.*