QUICK GUIDE SERIES UCF 2016-1

Emerald Ash Borer

Much of the information for this brochure was provided by the USDA Animal and Plant Health Inspection Service, the Colorado Department of Agriculture and Colorado State University Extension.

What is the Emerald Ash Borer?

Figure 1. *Adult emerald ash borers are approximately 1/2-inch long. Photo: Dan West, CSFS*

The emerald ash borer (EAB), *Agrilus planipennis*, is an exotic insect responsible for the death or decline of tens of millions of ash trees throughout the eastern United States and Canada. Native to Asia, the first detection of the beetle in the U.S. occurred in southeastern Michigan in 2002, most likely arriving in the 1990s, hidden in wood-packing materials commonly used for shipping. EAB already has cost impacted communities billions of dollars to treat, remove and replace ash trees. Infestations are difficult to detect, as the larvae reside under the bark, the adults generally are only present from May through September, and ash trees may be infested for up to four years before there are visible signs of decline.

Potential Impacts in Colorado

In Colorado, EAB was detected for the first time in 2013 in the City of Boulder. As a non-native insect, EAB has no native predators to keep populations in check, and threatens all true ash species (*Fraxinus* spp.). As a result, the beetle poses a serious threat to Colorado's urban forests, where ash trees comprise an estimated 15 percent to 20 percent of all trees; the Metro Denver area alone has an estimated 1.45 million ash trees. Green and white ash, including 'Autumn Purple' ash and other varietals, have been widely planted in Colorado due to their fast growth, ability to tolerate urban growing conditions and high aesthetic value. Many of the state's ash trees are located on private property and in parks and other community areas. The future costs of EAB in Colorado, in terms of ash tree treatments, removals and replacements, could exceed 1 billion dollars.

Figure 2. *Ash trees comprise an estimated 15 percent to 20 percent of all trees in Colorado cities, neighborhoods, parks and backyards. Photo: Colorado State University Facilities*

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www.csfs.colostate.edu

Commonly mistaken for EAB:

Lilac/ash borer exit holes

Figure 3. *When lilac/ash borers exit an ash tree, they create irregular round holes. Photo: Whitney Cranshaw, Colorado State University*

Other metallic wood borers

Figure 4. *Several metallic green beetles are native to Colorado, including* Phaenops gentilis *(left) and* Buprestis langii *(right), both associated with declining or recently killed conifers. Photo: Whitney Cranshaw, Colorado State University*

Flatheaded appletree borer

Figure 5. *Dead and dying branches on ash trees may be infested with the flatheaded appletree borer. Photo: James Solomon, USDA Forest Service*

Life History

EAB adults are approximately 1/2-inch long, with a metallic, emerald-green head/back and a coppery reddish-purple abdomen. The adult beetles consume ash foliage, but cause little damage to affected trees, which allows them to remain unnoticed by homeowners.

Females lay eggs in bark crevices, where they develop into worm-like larvae in the fall. The larvae are cream colored and consist of bell-shaped segments. The EAB larvae feed on the inner bark of ash trees, girdling the tree and disrupting the transportation of water and nutrients, much like mountain pine beetle larvae affect pines.

The tunneling and feeding under the bark is what eventually kills impacted trees. Once the larvae mature into adults in the spring, they emerge from under the bark, leaving D-shaped exit holes. The adult beetles may fly up to a half-mile to infest new trees; however, under certain conditions, they are capable of flying up to several miles. Adults also may re-infest the same tree from which they emerged.

Insects commonly mistaken for EAB include other metallic wood borers and the flatheaded appletree borer. Also, lilac/ash borer exit holes can be mistaken for those left by EAB.

Figure 6. *S-shaped emerald ash borer galleries under the bark. Photo: David Cappaert, Michigan State University**

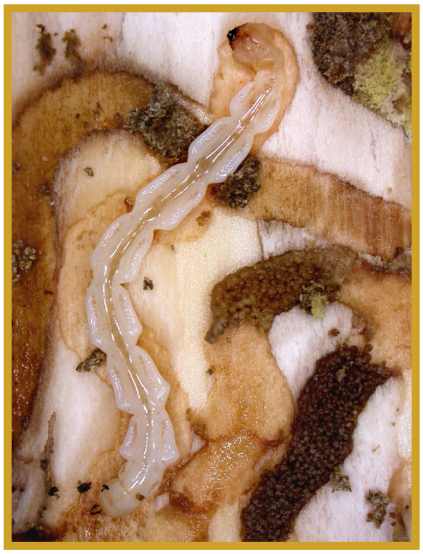

Figure 7. *Emerald ash borer larva. Photo: David Cappaert, Michigan State University**

Figure 8. *Adult beetles can fly approximately a half-mile to infest a new tree. Photo: Howard Russell, Michigan State University**

Figure 9. *EAB adults have an emerald-green head/back and a coppery reddish-purple abdomen. Photo: David Cappaert, Michigan State University**

Ash Tree Identification

Only ash trees are at risk from EAB* – but all species of true ash (*Fraxinus* spp.) are at risk. To detect an EAB infestation, it is important to first identify the tree species to ensure that it is an ash tree. In Colorado, ash trees can be found in most communities. Ash trees have the following characteristics:

- Branches and buds grow in pairs, directly opposite from each other, rather than alternating on a stem.
- Leaves are compound, which means multiple leaflets occur on a common stalk, and typically have five to nine leaflets. The exception is single-leaf ash (*Fraxinus anomala*), which may have simple or compound leaves, with up to five leaflets.
- Leaflets are smooth or finely toothed along the edges.
- Seeds on female trees are paddle-shaped.
- Mature bark displays diamond-shaped ridges.

A video on ash tree identification is available at www.csfs.colostate.edu/emerald-ash-borer.

Figure 10. *Ash trees have been planted extensively in Colorado over the last 50 years because they grow quickly and can tolerate the growing conditions in urban areas. Photo: William M. Ciesla*

Figure 11. *Ash trees have five to nine leaflets on each stalk. Photo: Julie Stiewig, CSFS*

Figure 12. *The bark on mature ash trees has diamond-shaped ridges. Photo: Ryan Lockwood, CSFS*

Figure 13. *Seeds on ash trees are paddle-shaped. Photo: Franklin Bonner, USDA Forest Service**

Figure 14. *Ash leaves can either have smooth or finely toothed edges. Photo: Ryan Lockwood, CSFS*

Figure 15. *Branches and buds on ash trees grow in pairs, directly opposite from each other. Photo: Ryan Lockwood, CSFS*

*Although rare in Colorado, white fringetree (*Chionanthus virginicus*) also has been documented as susceptible to EAB.

Figure 16. *EAB is responsible for the death or decline of tens of millions of ash trees in at least 25 states. Photo: Dan West, CSFS*

Figure 17. *New sprouts grow on the lower trunk of an ash tree infested with EAB. Photo: James W. Smith, USDA APHIS PPQ**

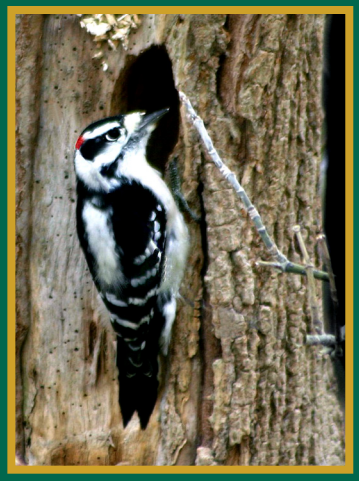

Figure 18. *Woodpeckers are an important predator of EAB. Photo: David Cappaert, Michigan State University**

Signs and Symptoms of EAB Infestation

Signs of EAB infestation include:

- Sparse leaves or branches in the upper part of the tree
- D-shaped exit holes approximately 1/8-inch wide
- New sprouts on the lower trunk or lower branches
- Vertical splits in the bark
- Winding, S-shaped tunnels under the bark
- Increased woodpecker activity

Many ash trees in Colorado are in poor health, which can make it even more difficult to determine if they are impacted by EAB. If you're not sure if a tree has EAB or not, the CSFS offers a diagnostics video at www.csfs.colostate.edu/emerald-ash-borer.

If an ash tree is experiencing dieback or appears unhealthy, have it examined by a professional. Landowners that suspect the presence of EAB in their ash trees should contact the Colorado Department of Agriculture (CDA) at (888) 248-5535 or send an email to CAPS.program@state.co.us.

Figure 19. *D-shaped exit holes can indiciate the presence of EAB. Photo: Pennsylvania Department of Conservation and Natural Resources**

Figure 20. *Ash trees may be infested with EAB for up to four years before signs of decline are visible. Photo: David Cappaert, Michigan State University**

Figure 21. *Vertical splits in the bark are another sign that EAB has infested the tree. Photo: Joseph O'Brien, International Society of Arboriculture**

Figure 22. *S-shaped tunnels or galleries can be found under the bark of an infested ash tree. Photo: Ryan Lockwood, CSFS*

Responding to EAB

Quarantines

Like many other states, Colorado has established a quarantine and detection process to prevent the spread of EAB into new areas, and to reduce the impacts of EAB on ash trees in already impacted areas. The EAB quarantine prohibits the movement of all regulated material that has not met treatment requirements – which includes ash nursery stock, green lumber, ash wood products, all hardwood firewood and related products – out of EAB-regulated areas. To legally move regulated material out of a quarantined area, it must meet the treatment options defined by the federal quarantine options. For updated information on the Colorado EAB quarantine and treatment requirements, visit www.eabcolorado.com.

Figure 23. *A CSFS forester and CSU Extension specialist assess the branch of an ash tree to determine the presence of EAB. Photo: Ryan Lockwood, CSFS*

Management & Prevention

The best EAB management option depends on the value of each ash tree to a landowner, and the costs associated with each option. Options for treating at-risk or infested trees include removal, replacement and chemical treatments. For more information about treatment options, visit www.csfs.colostate.edu/emerald-ash-borer.

Tree Removal

Trees killed by EAB will need to be removed at some point, but homeowners who are concerned about future infestation also may elect to remove dying or even healthy trees prior to infestation. Trees may become more expensive to remove as they decline and after they have died. Dead and dying trees also may represent a hazard to surrounding property and infrastructure. When choosing to remove an ash tree, it is best to hire a licensed and insured arborist or tree service company. A list is available at www.isa-arbor.com.

Figure 24. *Planning for tree replacement is an effective management strategy for EAB. Photo: Vince Urbina, CSFS*

Tree Replacement

Planning for tree replacement can begin prior to the removal of an ash tree, as can planting small trees under existing ash to give them a head start. To reduce the impacts of EAB and other insect and disease threats in Colorado's urban and community forests, the Colorado State Forest Service encourages diversity when planting new trees. A single type of tree should comprise no more than 10 percent of all trees in a planted landscape. Ash trees (*Fraxinus* spp.) have been widely planted in Colorado, but due to the risk of EAB, future plantings are not recommended. The Colorado Tree Coalition offers a list of the best replacement trees for ash at www.coloradotrees.org.

Chemical Treatments

The decision to chemically treat individual ash trees is a personal preference, and consumers should educate themselves and use caution when purchasing products that claim to protect trees against the pest. Homeowners may opt to periodically apply insecticide treatments to help protect high-value trees; however, the early presence of EAB in Colorado may not warrant immediate preventive treatments in communities where EAB has not been detected. The closer ash trees are to an area of known infestation, the higher the risk that they will become infested by EAB through natural spread. Also, trees within or near the EAB Quarantine area are at a higher risk of infestation through human-assisted spread of the pest, because infested

Figure 25. *A syringe-like applicator is used to inject imidacloprid to control EAB. Photo: David Cappaert, Michigan State University**

wood can legally be moved throughout the area. Current information on the extent of the EAB infestation within the state is available at www.eabcolorado.com.

Trees not regularly treated with an insecticide will die once infested with EAB. Ash trees can be chemically treated if they are healthy or are showing only early signs of EAB. If a tree appears unhealthy, or is showing many outward signs of EAB, it most likely is too late to save the tree. Talk to a forestry professional first when considering the use of chemical treatments to protect high-value trees, and only hire licensed professionals certified by the Colorado Department of Agriculture to administer treatments.

Don't Move Firewood!

Removed ash trees can be used for firewood or mulch at the removal site. However, this wood should not be transported to other locations due to the high risk of spreading EAB to healthy trees. Remember, moving regulated wood materials outside of a quarantine area is illegal and punishable by significant fines.

Never transport firewood or other untreated products from ash trees, including logs or nursery stock, as this is the most likely method of accidental spread. Transporting firewood is a primary cause of many costly insect introductions, often due to the larvae's ability to survive under the bark. When wood is moved from one place to another, pests can hitchhike to new locations and spread further. More information is available at www.dontmovefirewood.org.

For More Information

- EAB in Colorado (including management, identification, reporting, quarantine boundaries and treatment options): www.csfs.colostate.edu/emerald-ash-borer or www.eabcolorado.com
- General EAB information: www.EmeraldAshBorer.info or http://stopthebeetle.info
- Facts about insects and diseases that threaten Colorado's trees (Colorado State Forest Service): www.csfs.colostate.edu
- Information about the dangers of moving firewood: www.dontmovefirewood.org
- Common problems of ash trees (Iowa State University): www.extension.iastate.edu/Publications/SUL21.pdf
- Treatment options: www.csfs.colostate.edu/emerald-ash-borer
- General tree facts (Colorado Tree Coalition): www.coloradotrees.org/find.php

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COLORADO DEPARTMENT OF AGRICULTURE

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DONTMOVEFIREWOOD.org

COLORADO TREE COALITION

Emerald Ash Borer: What is it?

Originally from Asia, the emerald ash borer (EAB) was first discovered in the Detroit area in 2002. It is believed to have entered the country on wooden packing materials from China. The bright metallic-green beetle may be smaller than a dime, but it is capable of taking down ash trees thousands of times its size. Adults are typically ½ inch long and ⅛ inch wide. Eggs are extremely small—approximately 1/25 inch—and are reddish-brown in color. Larvae are white, flat-headed borers with distinct segmentation.

Adults usually emerge in mid- to late-May from infestations to the trees during the previous year (earlier if the weather is warm), with females laying their eggs shortly after. The larvae bore into the ash tree and feed under the bark, leaving tracks visible underneath. The feeding disrupts the tree's ability to transport water and nutrients, resulting in dieback and bark splitting.

What is the threat?

Ash trees are one of the most valuable and abundant North American woodland trees: estimates of total number of ash trees in the United States alone range between seven and nine billion. The emerald ash borer has destroyed 40 million ash trees in Michigan alone and tens of millions throughout other states and Canada. Small trees can die as soon as one to two years after infestation, while larger infested trees can survive for three to four years. Heavy infestations of larval borers speed up the devastation of formerly healthy trees. For more information on Emerald Ash Borer, visit emeraldashborer.info.

What can you do?

Know the symptoms of EAB: thinning or dying of ash tree crowns, suckers at the base of the tree, splitting bark, tunneling under the bark, D-shaped exit holes and woodpecker activity. The United States Department of Agriculture (USDA) recommends the following to help manage this pest:

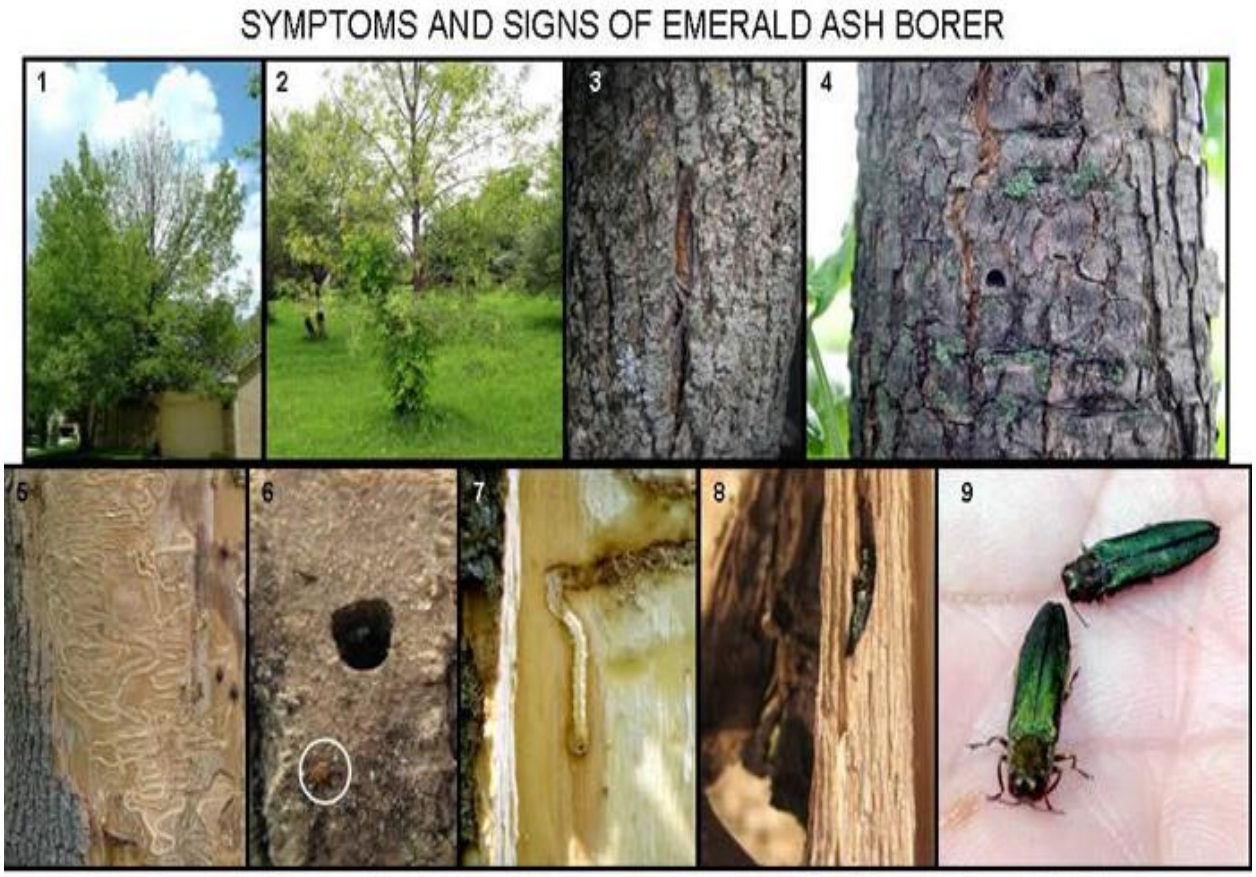
- Call the USDA Emerald Ash Borer Hotline at 1-866-322-4512 or your local USDA Animal and Plant Health Inspection Service (APHIS) office if you think you've found an EAB infestation. Find contact information for your local APHIS office at the USDA website.

EAB beetles can have a one or two year life cycle. Adults begin emerging from trees in mid to late May with peak emergence in late June. Adult beetles leave D-shaped exit holes in the outer bark of the tree trunks and branches. Females usually begin laying eggs on the surface of or just under the bark or in cracks and crevices about 2 weeks after emergence. Eggs hatch in 1-2 weeks, and the tiny larvae bore through the bark and into the cambium of the tree (the area between the bark and wood where high amounts of water and nutrients are transported). The larvae feed under the bark for several weeks, usually from late July or early August through October. The larvae pass through four stages and eventually reach a size of roughly 1 to 1.25 inches long. Most EAB larvae overwinter in a small chamber in the outer bark or in the outer

inch of wood. Pupation occurs in spring and the new generation of adults will emerge in May or early June, to begin the cycle again.

Signs of infection included tree canopy dieback, yellowing, and browning leaves. “The biggest concern about EAB is that you will more than likely notice your ash tree dying before you ever see the insect responsible for its decline (Wedge Community Coop Newsletter, Aug-Sept, 2009).” Heavily infested trees exhibit canopy die-back usually starting at the top of the tree. One-third to one-half of the branches may die in the first year. Most of the canopy will be dead within two years of when symptoms are first observed. Some ash trees will also push out sprouts from the trunk after the upper portions of the tree dies. Most trees will be completely killed in 3 to 4 years. In the Detroit, MI area alone, the infestation was so significant that over 70,000 city ash trees were lost!

Research has shown that EAB adults can fly only ½ mile from the tree where they emerge. It appears that many infestations were started when people moved ash nursery stock, logs, or firewood. The movement of firewood it is believed to be the most common form of transportation for these insects. It is likely that people may move firewood that originated from trees infected or killed by EAB. The people moving firewood are not likely aware that they are moving eggs or larvae of these pests, which may be hidden on or under the bark or buried deep within the logs.



Emerald ash borer insecticide treatment considerations

Several insecticide products are available to homeowners for control of emerald ash borer (EAB). Since the presence and infestation level of EAB is quite difficult to determine at early stages of an infestation, insecticide treatments may be merited to mitigate damage by EAB. However, not all ash trees should be treated as some may be too extensively compromised or in poor condition to receive treatment. Independent studies strongly recommend that treatments be applied early, before extensive disruption to the vascular tissues occurs. Dieback symptoms should be <40%. Tree location, value, and health, as well as

the cost of treatment are all factors to consider. Due to the expense of yearly insecticide treatments, one should consider the value of a particular ash tree in relation to insecticide treatment costs before making any treatments. In addition, consider the health of each tree before treating. Research suggests that insecticide treatments are significantly more effective on EAB-infested ash trees with less than 50% canopy thinning. Insecticide treatments are **not** suggested for trees with greater than 50% canopy thinning. If treatment is a financial option, it is recommended when EAB is detected in your area, but for best outcomes trees should still appear healthy. Trees with greater than 50% canopy thinning should be removed and handled in accordance with local guidelines – typically this means chipping ALL debris or disposing of any infested material at a sanctioned biohazard green waste facility.

Emerald ash borer insecticide treatment options

Insecticide products available for use by homeowners are summarized below. They include:

- Arborjet to treat with either TREE-äge® Insecticide (emamectin benzoate) or IMAjet (imidacloprid) using the TREE I.V. system for high volume dosages
- QUIK-jet® or QUIK-jet Air® micro-injector for lower volume applications (also with TREE-äge and IMA-jet which will kill the EAB larvae inside the tree).
- ACECAP Systemic Insecticide Tree Implants (acephate)
- BioAdvanced 12 Month Tree & Shrub Insect Control (imidacloprid)
- BioAdvanced 12 Month Tree & Shrub Protect & Feed (imidacloprid)
- BioAdvanced 12 Month Tree & Shrub Protect & Feed II (imidacloprid + clothianidin)
- Bonide Annual Tree & Shrub Insect Control with SYSTEMAXX (imidacloprid)
- Compare N Save Systemic Tree & Shrub Insect Drench (imidacloprid)
- Ferti-lome Tree and Shrub Drench (imidacloprid)
- Monterey Once a Year Insect Control II (imidacloprid)
- *Several other products containing imidacloprid are also currently available*

Most of the products available to homeowners are systemic insecticides containing imidacloprid and are applied as soil drenches around the base of ash trees. A few granular products are also available. Recent university research suggests that applications of imidacloprid should be made in spring to be most effective. Research also has demonstrated that soil applications of imidacloprid-containing homeowner products provide excellent EAB protection for ash trees that are less than about 47 inches in circumference [i.e., 15 inches in diameter at breast height (DBH)]. Due to differences in application rates and label restrictions, treatment by a tree care professional (e.g., arborist) may be the best option for larger trees. For best results, treatment of trees should begin before trees become infested and insecticide treatments must be repeated each year to maintain the health of ash trees. Lastly, the products containing imidacloprid have strict limits for the amount that can legally be applied per acre each year. Thus, homeowners can treat and protect several smaller-diameter trees in their yard, but such products are not appropriate for treating many large yard trees or for woodlots or forested areas. Homeowners using imidacloprid-based products will need to

carefully check the label each year and measure the size of trees to determine the total amount required. Some of these products are restricted use and treatments should be done by certified applicators/contractors.

Be aware that many insecticide products available at hardware stores and garden centers look alike. Carefully check all product labels before purchase to make sure that you have selected the correct product/active ingredient. ALWAYS read and follow the pesticide label directions on the product that you select!

Finally, note that although ACECAP Systemic Insecticide Tree Implants are available to homeowners, we do NOT recommend that homeowners use these because they require physically drilling into a tree during their application each year.

Other emerald ash borer treatment options

Homeowners may also contact a certified arborist or certified pesticide applicator to treat their trees. See www.isa-arbor.org for a list of certified arborists in your area. Professionals have access to some products that are not available to homeowners, including products that can protect trees for multiple years. Products discussed in this fact sheet have been evaluated in university research tests on EAB.