How to Fight the Emerald Ash Borer

TREE CITY USA® BULLETIN

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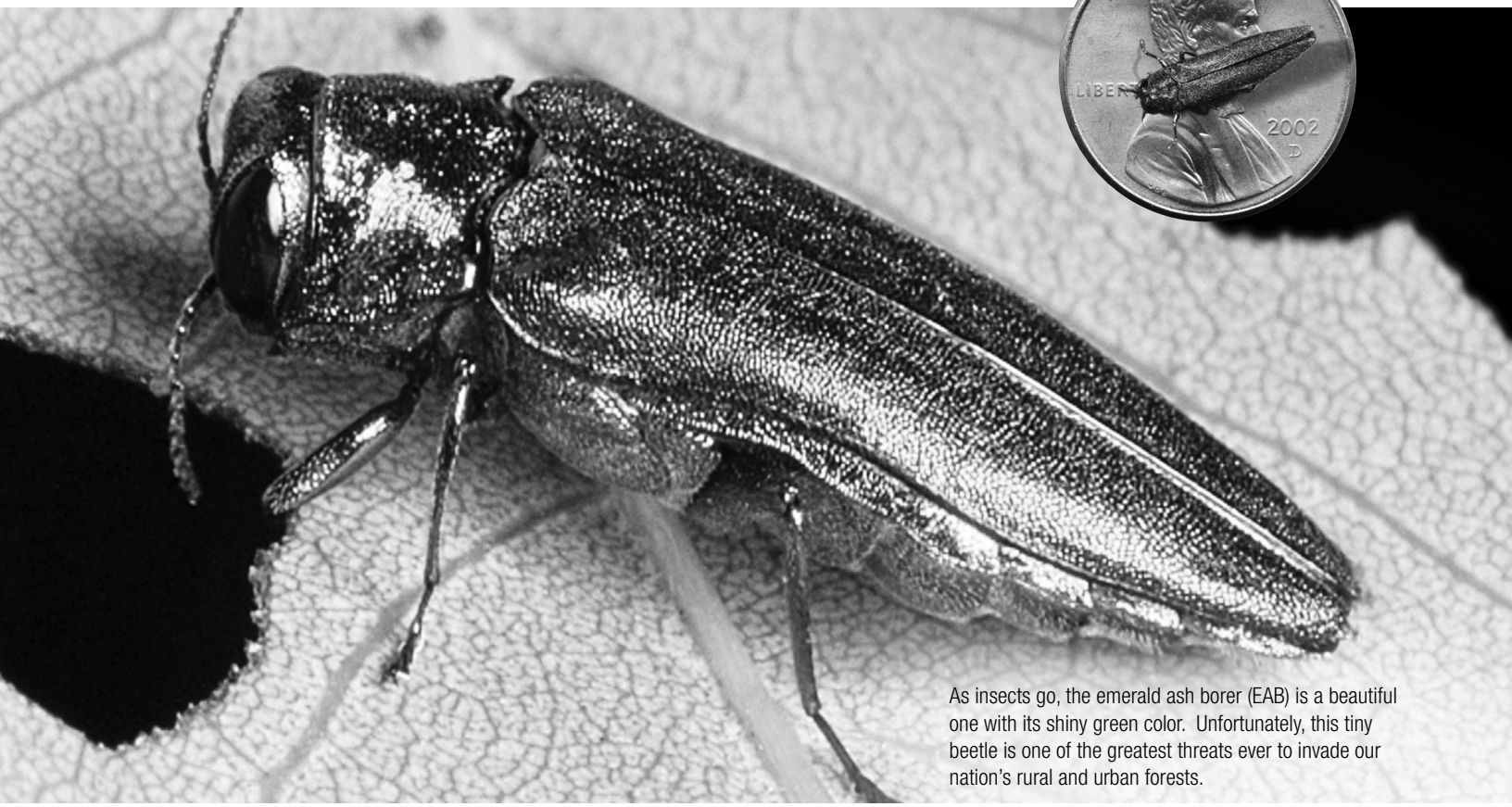

As insects go, the emerald ash borer (EAB) is a beautiful one with its shiny green color. Unfortunately, this tiny beetle is one of the greatest threats ever to invade our nation's rural and urban forests.

The emerald ash borer is one of the most notorious invasive insects in American history. From the discovery of this Asian species in the Detroit, Michigan, area in 2002, it has spread throughout most of the Midwest and Middle Atlantic states and is heading in all directions. If your community does not yet host this destructive beetle, it probably will in the future.

Ash is an incredibly important tree. There are 16 native species in the United States and dozens of commercially-available cultivars. Foresters estimate there are over 8 billion ash trees in rural forests worth well over $280 billion dollars. The wood of this forest tree is highly valued for its strength and elasticity, the very reasons it is the traditional wood used for baseball bats and often for bows, tool handles, guitars and many other products.

In urban areas, ash has been one of the nation's most popular trees for planting along streets, in parks and in shopping center parking lots. When Dutch elm disease decimated huge numbers of our nation's most graceful street trees, ash was often the tree of choice for its replacement. In some communities, up to 40 percent of the inventoried trees turn out to be ash species or cultivars. It has been a tree that has served extremely well providing relatively fast growth and the ability to withstand the harsh conditions of almost any urban environment. And it is estimated that a 12-inch diameter ash tree provides $131 every year in eco-services such as filtering air pollutants, reducing stormwater runoff and conserving energy.

When ash disappears, wildlife suffer along with the rest of us. The seeds of this tree are a boon to birdlife; many native butterflies and moths utilize its leaves; and some 44 species of arthropods are said to feed exclusively on ash trees. It is fair to say that without ash trees, ecological relationships will be affected in ways we may not yet understand.

In this bulletin, we summarize what is known about the emerald ash borer and present a case for fighting back against this epic threat.

Arbor Day Foundation®
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Know Your Enemy

Because of the serious nature of this invasive pest, scientists and field foresters – rural and urban – have spared no efforts in studying the biology and ecology of emerald ash borers (EAB). The understanding resulting from this impressive effort has been a first step toward fighting the invasion.

WHAT TO LOOK FOR

The most notorious sign that emerald ash borers are in the neighborhood is the unique, D-shaped holes in the bark of an ash tree. Unfortunately, these are exit holes, so by the time they are visible, the damage has been done. As can be seen in the drawing on Page 3, the deadly work of this insect is accomplished by the larvae that feed under the bark in the tissues a tree needs to transport nutrients and water. The tunneling of the larvae during autumn and winter destroys these life-sustaining tissues. The result is visible in the crown of the trees as leaves fail to appear or the upper third slowly dies back. Of course, there are other causes of ash dieback, but if it is in combination with the D-shaped holes (and sometimes vertical slits in the bark), you can be sure the tree was a victim of EAB.

The adult beetles are not easy to see, but can sometimes be spotted in late spring through mid-summer feeding on the leaves of an ash tree. Adults are slender and about 3/8 – 5/8 inch long. Their name comes from the metallic green color of their outer shell, or wing covers. The larvae, found under the bark, become creamy white as they grow.

HOW THEY SPREAD

The rate of spread of this invasive insect has been alarming. However, it is not due so much to the insect itself. The normal flight of an adult is only one-half to two miles in its lifetime. At this rate, elimination of vulnerable ash trees around an infected tree would have a good chance of being effective. Unfortunately, the bigger problem is transportation to new areas in firewood or other ash products.

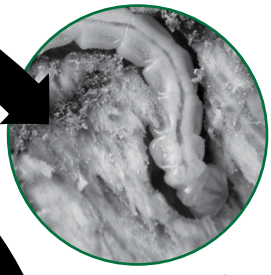
An infested ash can usually be spotted because of upper branches dying back in a once-healthy crown. Often a profusion of sprouts will also appear below dead portions of the tree and from its roots. The tree may take 2 – 5 years to die.

Various organizations and government agencies have teamed up to provide bumper stickers and other materials to enlist the public to help stop the unintentional spread of emerald ash borers and other invasive pests.

The Life Cycle of Emerald Ash Borers

The entire cycle of life may occur in 1 - 3 years depending on location. Adult males are believed to live only about two weeks but females survive for three. The female may mate several times in this short period, laying 65 – 90 eggs. The eggs, larvae or pupae are difficult to detect, making the transport of firewood or ash logs so conducive to spreading this invader.

Eggs about 1 mm. in size are deposited on ash bark or in the crevices on the trunk or branches. The eggs hatch in 7 – 10 days.



Lavae are cream colored and flattened. They tunnel under bark through barely visible holes and eventually grow to about 1.5 inches in length as shown here in their largest form. It is this 'boring' into the tree that gives them their common name.

Adults are especially active on warm, sunny days. At night, or on windy or rainy days, and in temperatures above 90° F., they seek shelter on leaves or in bark crevices.

Damage from EAB comes from the tunneling under the bark as the larvae feed. The larvae may remain here for 1 or 2 years, and then create a chamber where they overwinter, pupate in the spring, and emerge as adults through their signature D-shaped exit holes.

DON'T BE FOOLED BY LOOK-ALIKES

There are other insects that are sometimes mistaken for the EAB. These include the six-spotted tiger beetle, bronze birch borer, Japanese beetle, two-lined chestnut borer and caterpillar hunter. To compare with a suspected EAB, use your favorite search engine for illustrations of these insects.

Is There Any Hope?

When it comes to fighting the EAB, there is good news and bad news. The good news is that there are methods of treatment and control. The bad news is that to date these are effective mostly for individual trees or small acreages, not on the kind of scale needed to protect our vast rural forests. They also require tough decisions, no small expense, and great care in the use of chemicals.

SOME HELP FROM NATURE

Insects in their native habitat are normally kept in balance with plant life and fellow creatures thanks to predators that have co-evolved through the ages. In China, for example, three insect species provide biological control of the EAB.

When an insect is brought to a new land, there may not be natural predators to control their breeding and feeding. Such is the case with emerald ash borers — or almost the case. Scientists note that the EAB faces at least three potent enemies in America: red-bellied woodpeckers, white-breasted nuthatches and parasitic wasps. Some, like our native parasitic wasp, *Atanycolus cappaerti*, have even been observed increasing in number as a possible response to their now-abundant food supply. While these allies may not win the battle against the EAB, they can help slow the spread while scientists work on chemical controls and test the introduction of predator insects from Asia.

Another ray of hope is that scientists have noticed that blue ash, a Midwest species with peculiar twigs that approach being square, is apparently relatively resistant to the borers. If the reason for this resistance can be found, it may provide clues to new preventative treatments. This may also be a key to developing new cultivars of ash that can withstand the EAB epidemic.

WORKING TO MAKE FIREWOOD MOVEMENT SAFE

Researchers at Virginia Tech have developed a vacuum and steam method of treating infested firewood. It has proven effective for killing the insect in all of its life stages in the wood. Tests show that it is faster and cheaper than previous methods and requires no chemicals. Treatment chambers for large loads of wood as well as portable models like this one in the bed of a pickup are being developed.

TREATMENTS

Control methods are rapidly changing as more becomes known about the EAB and its potential vulnerabilities. To date, efforts have focused on:

- Removal of ash trees in areas adjoining infected trees.
- Quarantines that prohibit the movement of wood products out of affected areas.
- Education campaigns about the beetle and the movement of firewood or other ash products.
- Planting with other species to provide diversity.
- The rearing and release of parasitic wasps (parasitoids).
- Chemical treatments through direct application, soil drenches and trunk injections.

The latter seem to be the most effective, with trunk injections avoiding the potential side effects inherent to sprays and soil drenches. In most cases, the chemicals come with many restrictions, including use only by credentialed applicators. It is the policy of Arbor Day Foundation to not recommend specific chemicals or other treatments because so many local factors must be taken into consideration. This is the job of ISA-certified arborists, extension specialists and other local experts. However, for an excellent summary of available chemical treatments, see the supplemental resources library mentioned on page 8.

In all cases, the first steps are to identify the ash trees in the community, evaluate their condition and location to determine which are worth the expense of saving, and create a plan using the best method or combination of methods to fight off the EAB. Good examples of how this is being done are shown on pages 6 & 7.

Tree Injections and How They Work

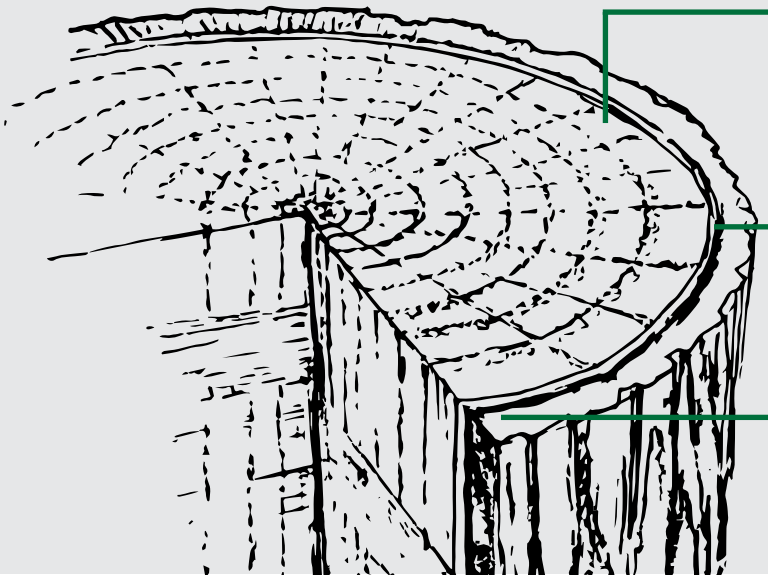
There are effective insecticides on the market that can fight the EAB. The chemicals are said to pose little danger to humans, but in most communities, delivery is by injection to make certain areas outside the tree are not contaminated. Another reason is that the chemical is quite expensive, so it is important to place it carefully and make every ounce count. Although some products are available to homeowners, the best approach is to hire an experienced arborist to do the work.

There are three basic methods of injecting a systemic insecticide (or fungicides, fertilizers and growth regulators) into a tree:

- One technique is to use a narrow needle that injects the chemical into the cambial zone under pressure.
- The second method, called micro-injections, uses small, pressurized capsules containing the chemical. This method requires a number of 3/8" holes, depending on tree diameter, with the stem of the capsules placed into the holes near ground level.
- Probably the most common method, and the one used by Milwaukee's Forestry Division as described on page 6, is a hydraulic system under pressure. With this equipment, the insecticide is mixed with water in containers that are then pressurized. As with micro-injections, a number of holes are drilled around the trunk, depending on the tree's diameter, and a small plug is inserted in each hole. The chemical compound is forced through tubes and through a hole in the plug that allows the liquid to go into the xylem, but not back out through the hole.

An insecticide is being injected under pressure into the outer tissues of an ash tree. The speed of uptake through the xylem depends on weather, but an experienced street tree crew can treat approximately 34 trees per day. Depending on the chemical used, the tree can be protected against EAB damage for up to two years before re-application is needed.

Once larvae bore through the bark and into the tree, it may take a vigorous but untreated tree 3 – 5 years to succumb, whereas one already weakened by drought or other stresses will be dead in 1 – 2 years.



XYLEM

The water conducting cells that bring life-sustaining moisture up from the roots to all parts of the tree. The best defense against the EAB is when an approved insecticide is injected into these cells. It can then be taken up with the water and spread throughout so the lethal compound comes in contact with the larval stage of the insects.

CAMBIUM

A microscopic zone of cells that specialize in cell division. Cells produced to the outside of this tissue layer become phloem; those to the inside become xylem. These are the cells that result in a tree's diameter growth and, unfortunately, they are also attractive to hungry larvae.

PHLOEM

The tissue that is often called 'inner bark.' Its role is to transport sugars from the leaves to the roots and other living cells throughout the tree. Feeding and tunneling here and in the xylem disrupts a tree's lifelines.

Communities are Fighting Back

Working in a team of two, Milwaukee forestry staff inject a healthy ash tree along a city street. Injections are proving effective for up to two years if the tree is treated before the EAB arrives or if less than 30 percent of the crown shows the effects of hosting the borer. To prevent wasting time and expensive materials, experts suggest that injections not be used unless a known population of EAB is within 10 – 15 miles.

In numerous Tree City USA communities throughout the country, tree boards and city foresters are not letting the EAB destroy their ash canopy — or at least not all of it, or all at once.

MILWAUKEE — A MODEL PROGRAM

Randy Krouse, urban forestry district manager for the City of Milwaukee, provided a detailed and encouraging description of Milwaukee's approach to fighting the EAB in *City Trees*, the journal of the Society of Municipal Arborists. Here is a brief outline of the process that Randy calls a win-win for the trees of Milwaukee and the residents that enjoy their benefits.

STEP 1: GATHERING INFORMATION

Like in unaffected cities everywhere, Milwaukee tree professionals knew it was just a matter of time until their city was hit by the EAB. For three years, staff gathered all the information they could about the borer. Contacts included researchers, industry professionals and colleagues in communities already under attack by the beetle. Let's call this stage self-education.

STEP 2: THE RESPONSE PLAN

A careful strategy was then developed and put on paper. It included what we will call the next steps.

STEP 3: RISK ASSESSMENT

An inventory was conducted to determine the extent of ash trees in the city, the ecological services/benefits they provide, and the potential impact of losing those trees. Using advanced remote sensing technology, locations were mapped and outreach was provided to more than 15,000 affected households.

STEP 4: ALERTING CITY OFFICIALS

With the above information in hand, the next step was to begin educating the public, starting with informing elected officials and the budget office about EAB. Importantly, this included describing the cost of doing nothing compared with the cost of being proactive.

STEP 5: SELECTION OF A TREATMENT METHOD

To minimize environmental risks, foresters decided on the trunk injection method of delivering a chemical labeled for use against EAB and approved in Wisconsin. In this case, a product named TREE-äge was selected because it was said to be effective for 2 – 3 years rather than needing to be applied annually.

STEP 6: DOING THE FIELD WORK

Milwaukee's tree inventory showed 33,000 ash trees and their locations along the city streets. Attempting to treat all of the trees at once would overwhelm city workers who still needed to attend to other more routine needs. Instead, the city was divided into segments and the area closest to known outbreaks of EAB was the starting point for treatment. Other parts of the plan included:

- Thirty Forestry Division workers were selected to work in teams of two and were carefully trained in the use and care of equipment, dosage and other protocols such as posting public notices.
- For public relations and education purposes, media representatives were invited to an event in which the mayor and an alterman injected the first tree.
- Injection would be done only on ash trees 8 inches in diameter or larger.
- Ash smaller than 8 inches or those in poor condition would be removed and replaced with a resistant species.
- One half the ash trees would be injected annually while eventually transitioning to alternative species and greater diversity within the tree population.
- Careful records were kept of the location and dates of application and entered into the city's tree inventory records.

A Citizen Takes Action

"The emerald ash borers crept up on me. It was not a 'King Kong' moment. Then all of a sudden the tree that gave shade in the front yard starts to fade. It was an exclamation point to what has been happening."

Jim Sack, a businessman in Fort Wayne, Indiana, says his street has gone through three periods of tree disasters. First, many of the trees in a monoculture of sycamores succumbed to weather and disease. These were replaced by a monoculture of elms. The Dutch elm took care of those! Next were ash trees.

As the first of approximately 100 ash trees began to fade on Jim's street, he heard a talk given by the city forester Chad Tinkel. "I heard him speak and was moved to action," says Jim. "Initially I just called to ask for information and he said we should work together." The city then planted about 50 trees along the boulevard, but as more ash trees fell victim to the borer, it was apparent that it was economically impossible to keep up with the city-wide demand for replacement trees. That is when Jim went into action. He became an advocate not only for replanting, but for making sure that a mix of species would be planted, not a monoculture. "I went around and identified individuals and organizations that might be sympathetic, inclined to listen, and had the wherewithal to help," says Jim. Through his efforts, $11,000 was raised and 90 additional shade trees were planted along the boulevard.

Keeping trees healthy and vigorous is one of the ways to help control the inroads of invasive insects. Careful selection and diversity of species and genera are others. Despite the onslaught of EAB, no community or property should let the borer diminish its green canopy.

MICHIGAN'S QUARANTINE LAW

Under the quarantine, it is illegal to move ash trees, branches, lumber with bark attached, wood chips larger than 1 inch, and any deciduous firewood from designated areas. Additionally, the movement of all ash nursery stock is prohibited within, into and from the entire Lower Peninsula.

EVERYONE HAS A STAKE

Even the smallest community and individual homeowners can and should fight back against the spread and impact of emerald ash borers. Here is some general guidance:

1. Know if you have ash trees and, if so, where they are located.
2. Monitor for the arrival of EAB and report it promptly to your county extension office or state forester. Ask for advice on how to handle it in your particular circumstance.
3. Make a plan suitable for your town or property. Consider removal of ash trees in poor condition or poor locations. In other words, trees that should probably be removed anyway. Replant with locally recommended species.
4. Conversely, note trees worth saving and contact an arborist about treatment when the EAB is within 10 – 15 miles, or your tree has recently become infected.
5. Cooperate with rules regarding not transporting firewood or other ash products. Put dead or removed ash wood to good use locally for such things as chips, firewood, lumber, and artistic products.

THE ECONOMICS OF TREATMENT

At the 2014 Partners in Community Forestry Conference, Ed Cunningham and Terry Wright of the Louisville Gas & Electric/ Kentucky Utilities, gave an eye-opening presentation titled, 'Understanding Risk from EAB: Pay Me Now or Pay Me Later.' Their point was that 'no action' is not a very wise option. Ignoring the spread of EAB or waiting until it devastates the ash trees in a community is more expensive than the kind of preemptive action taken by Milwaukee. For example, there is the high cost of removing mature ash as they succumb to the insect, or the costs of power outages from falling limbs or entire trees. There are the public safety issues of harboring dead or dying trees, and the significant loss of eco-services if all the ash trees in a community die over a short period of time.

In Milwaukee, the cost of injection per tree, including materials and labor, averages $70 for a 17-inch DBH tree. Randy Krouse reports that by comparison it would cost nearly $1000 to remove the same tree and replace it with a 3-inch caliper transplant. Milwaukee's approach to the EAB problem has been called highly cost-effective.

Other Bad Bugs

Okay, insects, not bugs. We know that, technically, true bugs are only those insects in the order *Hemiptera* and emerald ash borers are beetles, in the order *Coleoptera*. This scientific name comes from the Greek and refers to the hardened shell-like protection adult beetles have to protect the insect's second pair of wings and its abdomen. But to lay people, they are all bugs, especially when it comes to those that eat leaves or kill trees. Here are some others that have been declared by the U.S. Forest Service as pests that pose the greatest threat to our trees:

- Asian Longhorned Beetle
- Hemlock Woolly Adelgid
- Gypsy Moth
- Mountain Pine Beetle
- Southern Pine Beetle
- Sirex Woodwasp
- Spruce Beetle
- Spruce Budworm
- Polyphagous Shot Hole Borer

Some of these bad actors have been introduced from foreign lands and others are natives. In either case, it is believed that the effects of these insects will be more pronounced in the future if climate change continues. Under the worse case scenarios, warmer winters allow insect populations to increase, and prolonged drought stresses and weakens trees making them less able to naturally fend off invaders.

TREE CITY USA GROWTH AWARD

Taking action to fight the emerald ash borer will be rewarded with points toward your Tree City USA community receiving the Growth Award. For more information, visit **arborday.org** and type 'Growth Awards' in the search box.

Growth Award
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FOR MORE INFORMATION…

Considerable research information can be found on any of the above threats to trees and what can be done to fight back. Simply type the name of the insect into a search engine. For quick links to additional information about emerald ash borers, we invite you to visit the supplemental resources library at **arborday.org/bulletins** and navigate to Bulletin No. 76.

PHOTOS COURTESY OF: Howard Russell, Michigan State University, Bugwood.org (Cover, penny); David Cappaert, MSU Technician (cover, EAB; Page 2, ash tree; Page 3, larvae & adult); Art Wagner, USDA – APHIS, Bugwood.org (Page 3, Damage); Josh Sayers (Page 3, eggs); Kenneth R. Law, USDA APHIS PPQ, Bugwood.org (Page 3, Damage); Virginia Technical College of Natural Resources and Environment (Page 4); Randy Krouse (Page 5, tree injection); Randy Krouse (Page 6, injection team)

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