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Emerald Ash Borer & **Your Community**

The Morton Arboretum
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HISTORY/DESCRIPTION

Adult EAB *(Fig.1)*

Emerald ash borer (***Agrilus planipennis***), or EAB, is a metallic green beetle native to Asia, about ½ inch long and 1/8 inch wide. In its larval stage, EAB feeds under the bark of an ash tree, creating channels known as galleries that restrict the tree's circulatory system, eventually girdling and killing it.

EAB was discovered in Illinois in 2006. The insects are naturally spreading on average 1 to 3 miles per year, but artificial spread, especially through movement of firewood or landscape materials, can be rapid (Poland & McCullough, 2006). It is imperative that firewood not be transported outside quarantine zones or across state lines. Purchased firewood should be certified by a state or federal agency and bought from the area in which the firewood will be burned.

HOST SPECIES

All native species of ash (*Fraxinus*) are susceptible to EAB. In Illinois, this includes four native ash species, green ash (*F. pennsylvanica*), white ash (*F. americana*), black ash (*F. nigra*), and blue ash (*F. quadrangulata*), along with several hybrids and cultivars. To date, no other tree has been identified that EAB can use to develop past its larval stage (Anulewicz, McCullough, Cappaert, & Poland, 2008).

After the devastation of Dutch elm disease, ash trees were a popular species for replanting because they grow quickly and are very tolerant of urban conditions. Ash trees are so common in public rights of way that they make up roughly 10 to 40 percent of the canopy cover in Midwest communities.[1] There may be twice as many ashes on private property as on public property.

ASH IDENTIFICATION

Identification of ash species is critical for EAB management. Here are the basic characteristics of the most common *Fraxinus* species.

Characteristics of Ash Trees

- **Opposite Bud/Branch Formation:** Each leaf or branch is paired with another directly across from it on the same limb.
- **Compound Leaves:** A leaf is made up of 5 to 11 small leaflets with a terminal leaflet pointing outward from the tip of a leaf.
- **Distinctive Bark Pattern:** Diamond-shaped furrows or "X" patterns are most visible on mature trees.
- **Ash Flower Gall:** Some ash develop black or brown clustered balls from mutated flowers in spring that last on the tree into winter.
- **Seeds:** Canoe paddle-shaped ash seeds are similar to a maple seed with a helicopter-like appearance, but are borne in clusters with each seed as a single wing.

Compound leaf *(Fig.2)*

Distinctive bark pattern *(Fig.3)*

Ash flower gall *(Fig.4)*

Ash seeds *(Fig.5)*

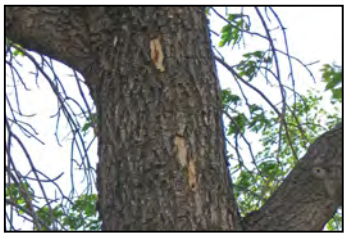
1 Coalition of Urban Ash Tree Conservation: Emerald Ash Borer Management Statement (www.emeraldashborer.info). Signed 1/6/2011

SIGNS AND SYMPTOMS

Although there are several symptoms of an EAB infestation, below are three of the most visible and distinct:

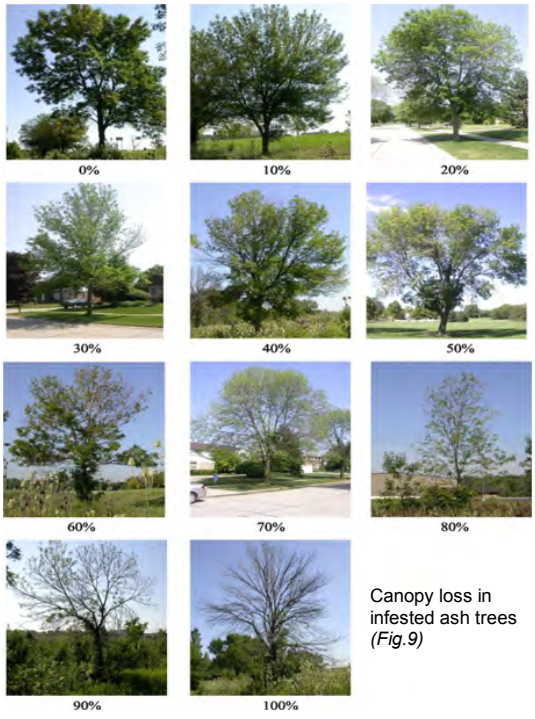
As galleries destroy the circulatory tissues, nutrients and water can no longer reach the top and thinning or dieback of the tree canopy occurs. *(Fig.6)*

As a tree begins to decline, suckers, or new growth, will sprout from the trunk, at branch unions, or around the base of the tree. *(Fig.7)*



Woodpeckers consume EAB larvae as a source of food. As a result, significant woodpecker damage may be seen on the bark of the trunk and branches of infested trees. *(Fig.8)*

Other symptoms of EAB include $^{1}/_{8}$-inch-wide D-shaped exit holes and bark splitting. These symptoms, although distinctive, can be difficult to notice with the naked eye (exit holes) or occur at such a point that the tree can no longer be left standing (bark splitting).



Canopy loss in infested ash trees *(Fig.9)*

Ash Canopy Decline

The earlier a tree stressed by EAB is identified, the more management options there are. Once a tree has lost 50 percent or more of its canopy, treatment options become limited (Herms, et al., 2009). The Morton Arboretum recommends that only trees with 30 percent or less canopy loss be considered for insecticidal treatment. This is due to the damage that occurs from the galleries bored by EAB larvae. With the water-conducting vessels cut off by galleries, the water-soluble insecticides available for EAB management cannot move through the whole tree.

Healthy ash trees near other ash trees displaying symptoms of infestation most likely will be infested as well.

Girdling is the final stage for EAB. As the population of borer larvae builds in a tree, the galleries multiply and begin to coalesce, cutting off all water and nutrient movement.

PREPARING FOR EMERALD ASH BORER

If you do not currently have emerald ash borer within your community, you still should take precautionary steps for the eventuality of an EAB infestation. Below are some steps to take in preparation for EAB.[2]

- Identify an EAB program coordinator who can be contacted for all things EAB related.
- Brief decision makers within your community.
- Conduct a tree inventory if you don't already have one, or update an existing inventory.
- Create a budget outline.
- Prepare an EAB management plan that includes removals, treatment, contractors, etc. based on the above information.
- Inform and educate the public.
- Monitor for signs and symptoms of EAB.
- Update tree-related ordinances/policies.
- Consider forming partnerships with surrounding communities.

MANAGEMENT OF INFESTED ASH TREES

The progression of EAB in a community depends on several variables:

- Is the discovery an isolated event?
- How long has the borer been in the area?
- Is this the progression of an infestation front?
- Do other communities in the area have a recorded infestation?
- What are the tree species diversity and ash density of the area?

The answers to these questions will indicate the damage and the types of options available to a community once EAB is found.

Isolation Event:
In an event where EAB is found and there is no indication of natural movement, the progression of damage is minimal at first. These isolated infestations take time to build the borer populations needed to cause rapid ash decline. In an isolation event, limiting the spread of ash materials such as firewood and landscape waste will have a significant effect on decreasing damage from EAB (BenDor, Metcalf, Fontenot, Sangunett, & Hannon, 2006).

Length of Infestation:
It has been suggested, due to the damage and known densities of borer populations in Michigan, that EAB may have been present there for seven to 10 years before it was confirmed in 2002. This implies that EAB had been in the area since the 1990s (Poland & McCullough, 2006). A similar situation was noted in Minnesota, due to the multitude of galleries found in dead ashes in the southeastern part of the state.

On the Front:
For a community that is on an encroaching EAB front, the effects and length of establishment are very different from than in isolated incidents. Behind the front, populations already will have reached levels sufficient to kill ash trees. If you are within 10 to 15 miles of a front, it is likely that EAB is already present, but at a low population level. You should consider beginning chemical treatment if you desire to preserve your ash trees. Communities near a front could easily see trees succumbing to EAB infestations within one to four years (Poland & McCullough, 2006).

2 Modified from the Minnesota Shade Tree Advisory Committee EAB Readiness Checklist.

CREATING A MANAGEMENT PLAN

Inventory

Gathering information on community tree populations is critical to an EAB management plan. The tree species diversity of an area will indicate the loss potential of tree canopy and help forecast the necessary budget for removal or chemical treatment of ash trees. Any inventory should include location, size, condition, and tree species. Based on this information, communities can create sound management strategies that are appropriate for their size, tree population, and budget.

It is important to note that most inventory methods do not account for privately owned trees. This section of a community should not be ignored in a management plan, as the hardship of coping with EAB will deeply impact residents and affect available monies. Ensuring that residents, as well as the public sector, are provided education and resources is a critical step in preparing for or managing EAB.

Choosing an Approach for a Community Tree Inventory or Assessment

Choosing the most useful inventory method for your community can be challenging. There are several options, but not every option is appropriate for every community. One common assessment method is an ash-only inventory, which can be completed quickly and provides basic information on how EAB is likely to affect a community. The ash-only inventory is not included in the list below because it does not provide necessary information on the overall composition of the tree population to guide replanting. The decision process should be supplemented with information from an experienced local nonprofit, city forester, state agency, or ISA certified arborist.

- **Windshield Survey:** A windshield survey may be just the first pass as a community prepares for a complete inventory, or it may provide enough anecdotal information for a small community to initiate minimal management.

- **Complete Tally:** This is an economical system that may be useful to small communities or in individual work units within larger cities. All public trees in the community are tallied, but the data are not linked to specific street locations. Minimal data collection makes this a very fast system to implement. The tally should be repeated every few years. Data can be used for strategic planning, but they are not particularly useful for daily management such as dispatching work crews. Creating sub-categories by species, size, and condition provides additional detail and allows some basic analysis. A tally is a good system for a first-time inventory. Many communities have used it effectively for years.

- **Representative or Randomized Sample Survey:** This is a sophisticated method used to create a baseline for strategic planning. However, data are not linked to street location to guide daily management decisions. Sample sites are structured to represent the overall composition of the tree population. This can include public trees only, or the survey can sample both public and private trees in an effort to gather total urban forest data. Representative or randomized sample surveys are most effective for medium to large communities, if a complete tree inventory is unnecessary or cost-prohibitive. Sample surveys can be even more effective in combination with a tally system and fewer sample points may be required.

- **Complete Inventory:** A complete inventory provides detailed information on all sectors of a community at the level of individual trees. This provides exact analysis of the tree population with the largest amount of structural data. Generally an extensive undertaking, complete inventories may be aided by contracting with a consultant. Consultant services vary widely.

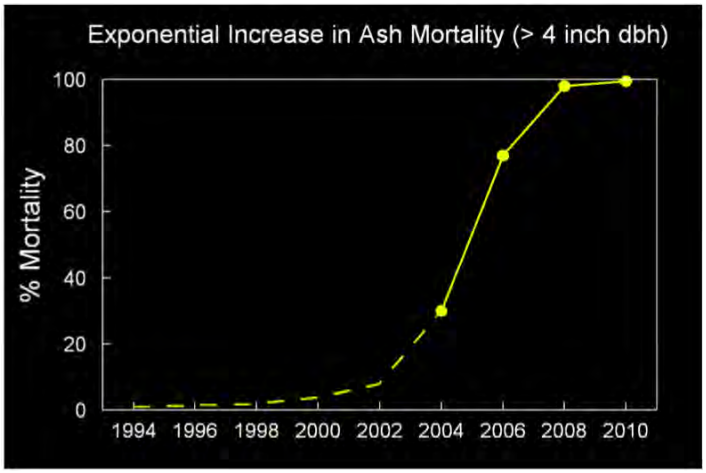
Cost Calculation and Analysis

Once an inventory is complete, serious consideration can be given to the best community approach for EAB management. Costs to consider include:

- Management and administration
- Tree removal and stump grinding
- Utilization and disposal
- Chemical treatment
- Replacement planting

These five categories encompass the main associated costs when managing EAB. The cost of each action is affected by amount of preparation, condition of trees prior to action, phasing of action, and resources available. If management can be spread over several years, the cost per year may be manageable for communities on a tight budget. However, the total cost for management may increase as continued expenses and work are required.

When a community is first infested with EAB, tree mortality is relatively low. As insect populations build there is an exponential jump in mortality. Unprepared communities may find this an overwhelming strain on their budgets.



D.A. Herms, The Ohio State University

Landowner Costs and benefits ($/tree)	Remove	Remove and replace	Treat	Annual benefit
Tree size = 1 to 12 inches in DBH				
Homeowner	200	600	54	289
Community	150	450	50	289
Tree size = 12 to 24 inches in DBH				
Homeowner	400	800	120	723
Community	300	600	100	723
Tree size = >24 inches in DBH				
Homeowner	1100	1500	200	1259
Community	900	1200	150	1259

Table 1: Cost estimates come from the EAB Cost Calculator (http://www.entm.purdue.edu/EAB). (Kovacs, et al., 2010)

TREATMENT OPTIONS

SLow Ash Mortality (SLAM)

The goal of the SLAM strategy is to "slow the onset and progression of ash mortality by slowing the growth of [emerald ash borer]."[3] This is a multi-tiered strategy for communities preparing for the arrival of EAB. There are several components, but ash phloem reduction (the reduction of ash trees within a community), educational awareness, and chemical treatment are the most prominent aspects. These components can be used independently or in combination.

Ash reduction is the systematic removal of ash trees. Ash reduction is best used in communities where EAB has not yet been detected. This option can be used along with chemical treatment to keep annual mortality rates at an acceptable level. By reducing the total amount of trees available for EAB larvae to consume, the population buildup is delayed and mortality is reduced.

The gradual removal of ash trees in a community prior to EAB infestation will accustom residents to tree removal in general and spread the cost of removal over time. When deciding which trees to remove, the rule should be "the worst first." Ash trees that already are declining for other reasons have a lowered value to the urban forest and should be the first to be removed.

SLow Ash Mortality (SLAM) is an overarching strategy in which reduction is one of several tactics. Another tactic is a campaign against moving firewood, which is critical to incorporate into any anti-EAB program.

Educational awareness is an ongoing task for communities. The critical pieces are workshops, meetings, videos, and outreach materials. Raising awareness can be difficult due to varying priorities, community involvement, and residential structure. Having an educated community causes fewer complications and builds support for future infestation management options.

Pesticide Options

Several pesticides can be used for EAB management. This section will not summarize all options, but instead will include some general discussion points and information. A chart has been provided with more specific information on three of the most popular and widely known types of pesticides. For more detailed information, a comprehensive document titled *Insecticide Options for Protecting Ash Trees from Emerald Ash Borer* can be found on The Morton Arboretum EAB Website.

3 McCullough, D.; Mercader, R. (2012) Evaluation of potential strategies to Slow Ash Mortality (SLAM) caused by emerald ash borer (*Agrilus planipennis*): SLAM in an urban forest. International Journal of Pest Management 58(1).

Though there has been skepticism about chemical treatment, it has been proven to be effective. Specific chemicals have been proven to prevent 99 percent of larval development in study trees (Smitley, Doccola, & Cox, 2010). Important factors that can affect the success of chemical treatment should be considered before making a long-term commitment.

Factors to Consider

- How close is a tree to an EAB infestation?
- What is the general health of the tree?
- How large is the tree?
- Does the tree provide any environmental benefits?
- Does the community wish to budget routinely for chemical treatments?

The three most common insecticides are:

- Imidacloprid
- Emamectin benzoate
- Dinotefuran

There are other chemicals that manage emerald ash borer, but these are the most common and well-researched chemicals and will be discussed at length here.

Imidacloprid is a systemic insecticide applied to the soil or introduced directly into the trunk of a tree. Formulations vary, but they generally are applied by mixing with water to aid in the distribution and uptake of the chemical through the conducting tissues of a tree. This chemical is a neonicotinoid, meaning it affects the central nervous system of specific insects, causing paralysis and death. Imidacloprid binds to organic matter, so applicators must remove any mulch or sod from the area before applying this chemical. Imidacloprid is easily accessible and greatly effective for small trees (under 15" diameter). Large trees (greater than 15" diameter) do not take up and disperse the chemical properly because of the large size of the molecule. However, in 2009 a 2x version of imidacloprid was rated for use in the US. This 2x concentration has shown marked success in protecting trees larger than 15" DBH. It is important to note that there is potential for chemical leaching in areas with shallow ground water and low organic matter if using a drench application (USEPA, 1994; Regimbal, Hines, Pigati, & Zachmann, 2011; Fossen, 2006). This likelihood is decreased significantly when the application is appropriately timed or when using the trunk-injection method. This chemical treatment must be applied annually. See manufacturer's directions for details.

Emamectin benzoate is trunk-injected chemical. It has been reviewed by several research studies and is still, to date, the only chemical treatment with an effective residual greater than one year. This is also the most common insecticide for large trees (greater than 15" DBH), as the chemical, a smaller molecule than imidacloprid, moves effectively and efficiently through their tissues. In East Lansing, Mich., one of the longest-running test sites, emamectin benzoate was shown to provide 100 percent control of emerald ash borer larvae for three years (Smitley, Doccola, & Cox, 2010). The label recommends reapplying this chemical, at a minimum, every two years. However, other studies have begun to look at rotating the treatment of ash trees to reduce the costs while still lowering the EAB population density in an area (McCullough & Mercader, 2012). Work will continue on these studies and new information may lead to a more cost-effective treatment strategy for communities. Until then, it is important to recognize that this insecticide can be more expensive due to its restrictive regulation. When emamectin benzoate is trunk-injected there are minimal concerns over environmental effects. But if it is spilled, it is highly toxic to mammals, fish and aquatic invertebrates (USEPA, 2009).

Dinotefuran is another neonicotinoid. This chemical is generally available as a bark spray or soil application. The dinotefuran molecule is much smaller than that of imidacloprid and therefore easily taken up through the tissues of a tree. This extremely water soluble chemical has been shown to be as effective as imidacloprid treatments, but more long-term research is needed to increase the consistency of these results. Control of EAB larvae is more consistent in small trees (under 15" DBH) and the insecticide must be reapplied annually. Due to the application methods of dinotefuran, care should be taken to prevent exposure to adjacent bodies of water, and areas of shallow ground water should be avoided (Durkin, 2009).

For further information on labeling and proper application, see the online document, *Emerald Ash Borer: Homeowner Guide to Insecticide Selection, Use, and Environmental Protection.*

Pesticide treatments are continuing treatments. Money must be put aside for treatment throughout the life of the tree to ensure continued protection or to space out removal costs, thereby mitigating hazards.

D-shaped exit hole in bark *(Fig.10)*

Timing recommendations may need to be adjusted for geographical location and seasonal variability.

APPLICATION METHOD	BRAND NAME	INSECTICIDE ACTIVE INGREDIENT	RECOMMENDED TIMING OF APPLICATION	SUGGESTED TREE SIZE (DBH*)	CHEMICAL LIFE (APPLICATION)
Soil injection or drench	Bayer Advanced/ Ferti-lome	Imidacloprid	April – June September – November	Up to 15" DBH	1 year
Granular soil drench	Green Light Product Line	Dinotefuran	April – June	Up to 12" DBH	1 year
Trunk injection	TREE-age	Emamectin benzoate	Leaf Out May – August	15"+ DBH	2 years
Soil injection or drench	Merit/Xytect	Imidacloprid	April – June September – November	Up to 20" DBH	1 year
Soil injection or basal trunk spray	Safari or Transtect	Dinotefuran	April – June	Up to 12" DBH	1 year

CHART KEY

☐ Find it at your local hardware store or garden center.

■ Call a professional, licensed or certified pesticide applicator. These treatments are restricted products and not available to homeowners.

Information based on the *Emerald Ash Borer: Homeowner Guide to Insecticide Selection, Use, and Environmental Protection* (Minnesota Department of Agriculture)

*DBH: Diameter at Breast Height is the diameter (circumference divided by 3.14) of tree taken at 4.5' off the ground.

Removals

The third management option is tree removal. Removal and proper disposal is the only 100 percent effective tool for preventing larval development in infested trees. The population of EAB in a community will tend to decrease as more ash trees, the food source for the larvae, are removed.

With ash reduction and insecticide treatment, mortality rates can be lessened and removals can be planned. But despite all the best efforts, ash removal will be an unavoidable reality of year-to-year urban forestry maintenance as EAB-infested trees decline or become unsafe. It is important to condemn and remove trees that are known to be infested and will not or cannot be treated. An infested ash tree that is allowed to linger can become a hazard by dropping limbs or falling over. A tree exhibiting more than 30 percent dieback of canopy should be considered for removal, as EAB has significantly damaged its ability to move water, nutrients, or insecticides.

This management tool can be costly. Completing removals in the fall and winter, generally the off-season for city crews and contractors, can help save money.

Stumps lining residential street *(Fig.11)*

Removals should be done between September 1 and April 30. This is outside the active season for emerald ash borer and prevents infestation of new trees during the insects' typical mating and feeding time (May through August).

Disposal

As part of the removal process, proper wood utilization and disposal are critical. Proper disposal by chipping or burning within quarantine zones ensures that larvae are destroyed and that the tree can no longer support larval development.

Below is a website with ideas and information on different ways of using ash wood (wood utilization) once cut:

illinoisurbanwood.org

CASE STUDIES[4]

Below are brief descriptions of various communities' approaches to managing EAB. These will be useful in identifying the approach your community may wish to take. These studies were compiled from across the Midwest and do not represent all situations.

No Action

City of Windsor, Ontario, CANADA (2002)
EAB was discovered in Windsor in July 2002. The city was unable to take any proactive action at the time, due to the lack of knowledge on EAB and its management strategies. Faced with a rapid spread of the infestation, the city chose a reactionary removal of dead and dying trees as its sole course of action. A total of 6,000 hazardous public ash trees, representing 9 percent of the city's urban tree canopy, were removed and replaced at the cost of $4 million. No attempt was made to remove thousands more dead ash trees in woodland areas. Trees on private property were left to the property owner's discretion. By 2010, only an estimated 5 percent of the former population of ash trees were still alive, with most infested with EAB. More than 1 million ash trees are estimated to have died in Windsor and surrounding Essex County, including most of the population of the endangered pumpkin ash (*Fraxinus profunda*).

City of Ann Arbor, Michigan, USA (2003)
EAB was discovered in Ann Arbor in 2003. At that time, ash trees comprised 17 percent of the city's tree population. Initially, no action was taken except for some concerted tree removals. By 2005, the city had about 10,000 dead or dying ash trees in its parks and rights-of-way. A 2005 proposal to spend $4.2 million to fund tree removal failed in a referendum. The management approach since then has been focused on tree removal and wood utilization. The city's new Traverwood Library was able to use some wood from EAB-impacted ash trees to create flooring and other wood features. The infestation has now spread through Ann Arbor, with few ash trees surviving within the city's boundary. Its six-member forestry crew has spent the last three years doing nothing but removing ash trees. An estimated 7,000 dead ash trees have been removed from streets so far, with 3,000 more in parks and natural areas waiting to be removed in the coming years. The cost is expected to exceed $2 million.

Pre-emptive Management

City of Toledo, Ohio, USA (2004)
A low-level EAB infestation was discovered in Toledo in 2004. The city had an estimated 9,100 ash trees, accounting for 9 percent of its urban canopy. Since eradication was the official management strategy for the state of Ohio at the time, the city removed 1,100 trees, using federal money, to create a buffer zone. By 2005, new infestations had been found outside the buffer zone and in other parts of the state. As a consequence, eradication was abandoned as a realistic goal. By 2009, an estimated 2,600 dead or dying ash trees were still standing. No chemical treatment was carried out due to fiscal constraints and high pest populations within the city. Costs for dead tree removal are expected to increase in the coming years.

4 Case studies were collected and written up by Houping Liu from the Pennsylvania Dept. of Conservation and Natural Resources. Emerald Ash Borer Management Plan for Pennsylvania Communities. 2012. They have been edited by The Morton Arboretum for use in this publication.

City of Grand Rapids, Michigan, USA (2007)
Ash trees accounted for 15 percent of the public tree population (approximately 10,000 trees) in Grand Rapids in 2007 when the city made "proactive tree removal on a rotating basis" the primary management action. The 10-year budget for removal and replacement was estimated at $7 to $127 million. However, the discovery of EAB in a high-profile area in 2009 caused the city to shift to a reactive model until the infestation could be slowed down. About $600,000 has been spent to date to remove and replace ash trees and to save some of the remaining 6,600 ash trees with several new treatments in city parks and rights-of-way.

Selective Management

City of Fort Wayne, Indiana, USA (2009)
EAB was discovered in Fort Wayne in 2006. The City of Fort Wayne had approximately 13,500 ash trees along its streets. Ash trees on both public and private properties provided 25 percent of the urban canopy. An EAB management plan was developed in 2009 to save about 1,000 trees with imidacloprid insecticidal treatment through soil drench (for trees with a diameter of more than 15" DBH) and trunk injection (for trees with a diameter of more than 15" DBH). The city anticipates treating ash trees for the next 15 years. The city budgets $900,000 annually for tree removal, chemical treatment, and replanting.

Village of Northbrook, Cook County, Illinois, USA (2010)
EAB was confirmed in Northbrook in May 2010. Ash trees represent about 20 percent of the village's 15,130 parkway trees. The village developed a proactive, multifaceted management plan in 2010 that included surveying village-owned ash trees, treating a portion with insecticides, and removing and replacing dead or dying trees. About 730 declining ash trees will be removed and replaced and 268 ash trees will be treated with the insecticide Tree-äge (emamectin benzoate) for the next four years (2011 through 2014), with a total projected cost of $426,500. See following link for details.
http://www.northbrook.il.us/Modules/ShowDocument.aspx?documentid=2351

Aggressive Management

City of Milwaukee, Wisconsin, USA (2009)
EAB was first detected in Wisconsin in the summer of 2008. New infestations found in other communities within the state in the following year prompted Milwaukee to adopt a pre-emptive insecticidal treatment approach for EAB management. All of the city's 33,000 public ash trees were to be treated with Tree-äge (emamectin benzoate) through trunk injection within two years, at the cost of $1.6 million. However, saving ash trees in the long term is considered unrealistic for the city due to the size of the ash population and the density of the EAB population. Therefore, all 33,000 ash trees will eventually be removed and replaced at an annual rate of 5 percent for the next 20 years. The goal is not to save the ash trees, but rather to maintain a proportion of ash trees in the urban canopy while they are replaced with other species. This method will allow for Milwaukee to effectively manage public safety and schedule removals so as not to significantly disrupt important forestry operations. It is considered as a cost-effective approach when compared to the estimated cost of $25 million to remove and replace all the ash trees at the same time.

City of London, Ontario, CANADA (2011)
EAB was discovered in London in 2006. The city's 9,938 ash trees accounted for 5.7 percent of the public trees along streets and in manicured areas of parks. A 15-year EAB management plan was developed in 2011 to treat and remove affected ash trees and then replant through active monitoring and coordination. A total of 384 ash trees were treated with the insecticide TreeAzin (azadirachtin, an annual-application, trunk-injection product) in 2011. The treated trees had been selected using a matrix developed to determine the best candidates. Those trees will be treated every two years for the next 15 years. The remaining 9,554 trees will be removed and replaced over the next 10 years. In addition, approximately 14,450 ash trees from wooded areas within public parks and greenways also will need to be removed to reduce hazards and liability. The total cost of this plan is estimated at $14.3 million over 15 years. See the following link for details.
http://www.london.ca/trees_lawns_and_gardens/pdfs/london_eab_final_090711.pdf)

REPLANTING/REFORESTATION

One of the most difficult tasks after a disaster is the rebuilding of a community. Ensuring that there is an adequate budget for replanting before, during, and after EAB is extremely important. Below are a few tips for a smooth and successful replanting effort:

- **Be sure to plant a diversity of trees!**
  The greater the diversity of tree species within a community, the less vulnerable it will be to the devastating effects of future pests or pathogens and natural disasters. Follow the 10/20/30[5] rule to ensure broad diversity:
  No more than 10 percent of the trees in the same species
  No more than 20 percent of the trees in the same genus
  No more than 30 percent of the trees in the same family

- **Find a local nursery for trees grown using native seed sources.**
  Buying native trees with native seed sources will ensure that the trees have the right characteristics and genetics to cope with local weather patterns.

- **Consider a cost share option** to help residents in your community replace ash trees.

- **Consider contract growing.**
  Contract growing will lock in prices, sizes, and species for replanting. By planning 5 or 10 years ahead, a nursery will be able to provide the exact trees a community desires and be able to predict its revenue.

Replanting *(Fig.12)*

5 Santamour, F.S. 1990. Trees for urban planting: Diversity, uniformity, and common sense. Proceedings of the 7th Conference of the Metropolitan Tree Improvement Alliance. 7:57–65.

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Visit The Morton Arboretum website for resource links and documents related to this guide and EAB.

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Photo Credits:
Cover photo, Minnesota Department of Agriculture; Fig.1, Adult EAB, Michigan Department of Agriculture; Fig.2, Compound leaf, The Morton Arboretum; Fig.3, Distinctive bark pattern, The Morton Arboretum; Fig.4, Ash flower gall, Dave Hanson, MN Department of Transportation; Fig.5, Ash seeds, USDA, Forest Service; Fig.6, Canopy dieback, Illinois Department of Agriculture; Fig.7, Sprouting, The Morton Arboretum; Fig.8, Woodpecker damage, Minnesota Department of Agriculture; Fig.9, Ash canopy decline, Smitley et al. 2008. J. Econ. Entomol. 101-1643-1650; Fig.10, Exit Hole, Jeff Hahn, UMN Extension; Fig.11, Tree stumps, Mike Perlman; Fig.12, Replanting, Andi Dierich, UMN, Forestry Dept.

Citations:

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