AgInfomatics

The Value of Neonicotinoids in Turf and Ornamentals:

A Case Study of Neonicotinoid Use for Controlling Emerald Ash Borer—The Naperville, Illinois Experience

2014

This report series, researched and produced by AgInfomatics, LLC, is a comprehensive analysis of the economic and societal benefits of nitroguanidine neonicotinoid insecticides in North America. The research was sponsored by Bayer CropScience, Syngenta and Valent in support of regulatory review processes in the United States and Canada, with Mitsui providing additional support for the turf and ornamental studies.

AgInfomatics, an agricultural consulting firm established in 1995 by professors from the University of Wisconsin-Madison and Washington State University, conducted independent analyses exploring the answer to the question: *What would happen if neonicotinoids were no longer available?* Comparing that answer to current product use revealed the value of neonicotinoids.

Robust quantitative and qualitative study methods included econometrics modeling of insecticide use, crop yield data and market impacts; surveys of growers, professional applicators and consumers; regional listening panel sessions; and in-depth case studies.

Active ingredients in the study included clothianidin, dinotefuran, imidacloprid and thiamethoxam.

The Value of Neonicotinoids in North American Agriculture

Reports include:

Estimated Impact of Neonicotinoid Insecticides on Pest Management Practices and Costs for U.S. Corn, Soybean, Wheat, Cotton and Sorghum Farmers

Methods and Assumptions for Estimating the Impact of Neonicotinoid Insecticides on Pest Management Practices and Costs for U.S. Corn, Soybean, Wheat, Cotton and Sorghum Farmers

Value of Insect Pest Management to U.S. and Canadian Corn, Soybean and Canola Farmers

A Meta-Analysis Approach to Estimating the Yield Effects of Neonicotinoids

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Executive Summary

The Value of Neonicotinoids in Turf and Ornamentals

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The Value of Neonicotinoids to Turf and Ornamental Professionals

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A Case Study of Neonicotinoid Use for Controlling Emerald Ash Borer—The Naperville, Illinois, Experience

A Case Study of Neonicotinoid Use for Controlling Silverleaf Whitefly in Ornamentals

Executive Summary

For more information, please contact
AgInfomatics@gmail.com

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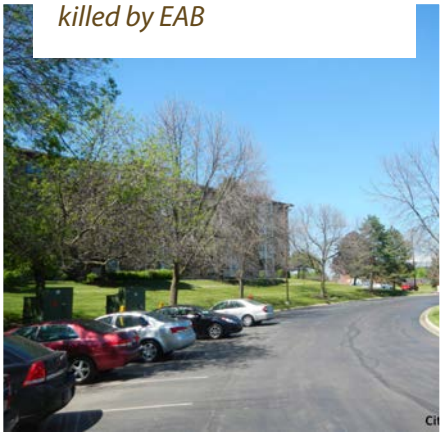
Above: Neonicotinoid treated ash trees

Below: Untreated ash trees killed by EAB



Emerald ash borer, *Agrilus planipennis* Fairmaire, is a small beetle that is destroying ash trees across the eastern and midwestern United States on a scale reminiscent of Dutch elm disease several decades ago. Neonicotinoids, which are primarily applied as a systemic treatment, protect ash trees from the emerald ash borer (EAB) and thereby protect a large part of the existing urban tree canopy in areas where EAB is present. This case study focuses on Naperville, Illinois, and the use of neonicotinoid products to save public trees. Protecting their trees saved the city from expensive removal and replanting costs, while keeping in place the many community benefits provided by a mature urban street canopy. This case describes the context for EAB, the problems created by the beetle, the use of neonicotinoids for control and Naperville's experience protecting their ash trees.

1.0 Context and Background

Urban trees are essential components of many community landscapes. In addition to increasing property value and decreasing home cooling costs, urban trees also provide comfort and aesthetic benefits for individual properties and neighborhoods, as well as numerous environmental (ecosystem) benefits, including stormwater retention, carbon sequestration, filtration of air from pollutants and decreased energy use.[1] Trees planted on municipal properties and along roadsides are owned and managed by local governments and combine with the privately owned trees throughout a community to comprise the urban forest. As with private lands, municipal foresters seek to plant a diversity of species across urban parkways; however ash trees, primarily green and white ash, are prevalent (and in some cases the primary species) in communities throughout the eastern and midwestern United States and Canada.

Ash trees have been a popular choice among urban foresters and private homeowners because of their overall aesthetic appeal, low maintenance needs, wide canopy and longevity. Many communities expanded their ash populations in the wake of devastating Dutch elm disease impacts in the 1950s-70s, and mature ash comprise a substantial percentage of their urban canopies. For individual homeowners, a mature ash adds to a home's visual appeal, provides shade (for cooling and reducing exterior home maintenance) and has a positive impact on home value. Online tools such as the "Tree Benefit Calculator"[2] suggest a single ash tree provides an individual homeowner with upwards of $200 in annual benefits.

EAB infestations are threatening ash trees across the U.S. and Canada, causing communities and individual homeowners to either treat or remove infested ash trees.[3] If not treated, ash trees infested with EAB will die within three to six years of detection. The damage caused by EAB makes the tree very brittle and dangerous to both people and property due to falling limbs, falling sheets of bark and potential full-tree toppling from strong winds. Local governments and individual homeowners may be liable for resulting damage to property and personal injury, thus EAB protection is a serious public safety issue that communities must address. Ash trees are expensive to remove and replace, with larger trees costing $1,500 or more.[4] Due to the brittleness caused by EAB, removing larger diameter dead ash trees requires the use of additional safety measures involving cranes and other large equipment. As EAB spreads across the country, more commu-

nities are struggling with decisions about saving or replacing their trees. The loss of ash trees killed by EAB has also been correlated with an increase in human mortality due to cardiovascular and lower respiratory disease.[5] These decisions will have significant environmental, economic, public safety and public health impacts.

2.0 The Problem—Emerald Ash Borer

The emerald ash borer, *Agrilus planipennis* Fairmaire, is a small beetle that feeds exclusively on ash trees.[3] Adults are slightly less than one-half inch long and have an emerald green color. Adults feed on foliage, and females lay their eggs on ash tree bark. The EAB larvae tunnel into a host tree's vascular system and feed, causing damage to the phloem and disrupting (and ultimately destroying) the tree's ability to circulate nutrients and water. Adults leave a distinctive D-shaped exit hole in the bark when they emerge. Infestations begin in the upper canopy, and trees with low beetle populations may not show signs of damage for two years or more, by which time infestations are significant.[6] As noted above, if untreated, infested trees die within three to six years, creating a substantial hazard and eliminating the environmental and economic benefits provided by healthy ash trees.

EAB is thought to have arrived in the Detroit, Michigan, area from Asia sometime in the mid 1990s, most likely as larvae in packing and shipping material.[3] It was first detected in the U.S. and Canada in 2002 and by July 2014 had spread to more than 20 states and two provinces.[7] EAB is an exotic invasive species, and ash trees in North America have no native immunity or natural protection, such as predators or parasites that feed on the beetle. EAB is spread primarily by people inadvertently moving ash wood or adult beetles. Because of the hazard created by dead trees, communities in Michigan, Indiana and Ohio dealt with early infestations by removing all ash trees. Tree removal prior to death prevents trees from becoming a hazard, but removal has not stopped the spread of EAB and has been expensive and painful for affected communities.

In an effort to slow the spread of EAB, state, federal and provincial governments cooperate on imposing quarantines for the transport of wood, as well as collaborate on public awareness activities about EAB and how it spreads.[8] Government agencies, universities and communities also work together to track the spread of EAB, share information about methods for treatment and control, and help local governments prepare for and respond to infestations. Potential economic impacts to communities and homeowners could be very high. One study estimated a total $10.7 billion cost to communities through 2019 for treating, removing and replacing ash trees due to EAB infestation.[4]

Communities facing EAB have three management options: proactive removal of ash trees before infestation, reactive removal of trees after they are infected by EAB or targeted treatment of ash trees with insecticides. Research has identified some predators that have been introduced in attempts to control the beetle, but in general, biological controls have not been able to keep pace with the EAB population's growth and movement.[3] Because most of the damage is caused by larvae inside the tree, the most effective treatments are systemic insecticides that spread through the tree's vascular system and into the leaves.[9] Systemic pesticides are applied either as a soil treatment (surface

Ash tree in Naperville, IL, being treated with neonicotinoid product using root zone injection. The process takes 1-2 minutes per tree.

drench or root zone injection at base of the tree), direct tree injections (solution injected into the trunk near the base) or basal spray (applied to the lower part of the trunk with a low-pressure spray). Most insecticide treatments require professional applications, but some smaller trees can be treated by individual homeowners with retail products.

3.0 Use of Neonicotinoids to Control the Problem

Neonicotinoids have been very effective at protecting trees from EAB and restoring trees with less than 50 percent canopy damage.[9] Imidacloprid is registered for EAB control when applied as a soil injection or drench and as a trunk injection. Dinotefuran is registered as a soil injection or drench and as a basal trunk spray. The neonicotinoid products are pulled into the tree through its vascular system, which distributes the chemical to branches and leaves throughout the canopy. EAB adults and larvae die after ingesting the neonicotinoid. Ash trees are wind pollinated, have a brief and early flowering period and are not attractive to pollinators.[10]

Tree size dictates the amount of product to use in treatment. For example, with an imidacloprid soil injection, the tree diameter at chest height would determine the amount of mixed solution and the number of injections around the base of the tree to use. However, even large trees can be rapidly treated with neonicotinoid soil or trunk spray applications. It takes a professional applicator only 1-2 minutes to treat a single tree with a 2-foot trunk diameter. Neonicotinoid treatments are repeated annually.

Non-neonicotinoid chemistries are also used for systemic treatment of EAB. Emamectin benzoate and acephate are both used as a trunk injection and are applied only by a licensed applicator. The injection occurs by drilling into the tree at two-inch spaces around the trunk of the tree and injecting the solution into the tree's vascular system. Application time depends on the tree size but can take up to 30-45 minutes for larger trees. This longer time period is based on the actual uptake of the product into the vascular system. Trunk injection treatments are applied every 1-3 years, depending on the active ingredients. Some products are also registered for foliar application. Many communities are using an integrated management approach that combines selective removal of unhealthy trees and tree conservation with different EAB control products.

Focus Example: Naperville, Illinois

Naperville is located within the Chicago metropolitan area about 30 miles west of downtown Chicago. With over 140,000 residents, it is among the largest cities in Illinois. The local discovery of EAB in 2008 sparked the City of Naperville into an initial containment and inventory approach characterized by the removal of infested trees.[11] Naperville has more than 15,000 publicly owned parkway ash trees and many more on private lands. Initially, damage and extent of infestation in Naperville was relatively minor, but in 2010, warning signs of an impending EAB population explosion began to appear.

Two key activities took place in the spring of 2010 that eventually led to a decision by the City of Naperville to save its trees rather than remove them. The first was the inclusion of Naperville in the Legacy Tree Project – organized by Valent Professional Products to raise awareness of the EAB threat and

Since learning of the threat, Naperville residents have been very concerned about the potential for EAB to wipe out ash trees throughout the city and dramatically change the feeling and quality of our neighborhoods and community. Neonics, with their quick and lower cost-treatment method, have allowed us to do the right thing for our residents and protect parkway ash trees across the entire city.

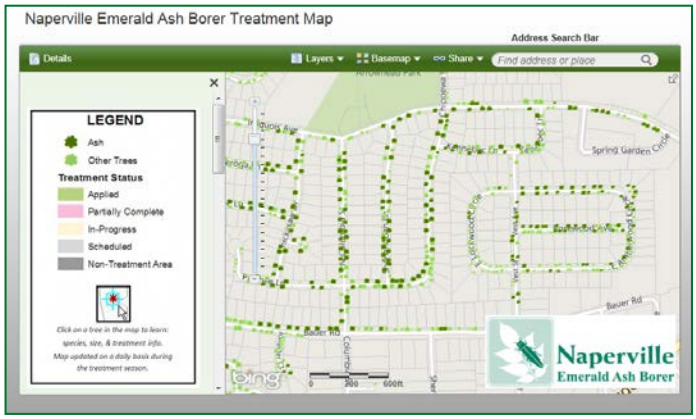
Doug Krieger
City Manager, Naperville, IL

treatment options for communities facing EAB.[12] As part of the Legacy Tree Project, Valent worked with the City of Naperville to identify 200 ash trees in city parkways and paid the full cost of treating those trees with their neonicotinoid product, Safari® (dinotefuran), applied under a contract with Davey Tree Company. The second activity was a presentation from the local Davey Tree Company representative to the Naperville Area Homeowners Confederation (NAHC) about EAB and its impact on the urban forest. NAHC is comprised of representatives from Naperville's 140-plus homeowner associations.[13]

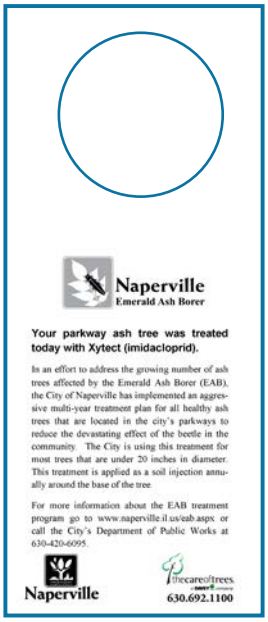
Nearly two years later in early 2012, the president of the NAHC, who had attended the 2010 presentation from Davey Tree Company, read an article comparing EAB to an epidemic and recalling the earlier presentation, organized a large public community meeting to raise awareness of the issue and to discuss options. By this point, the number of EAB infestations within Naperville had increased, and the city was removing more trees and issuing notices to homeowners to remove their infested trees as well. Neighboring communities facing similar challenges were moving ahead with preemptive removal of healthy trees, and some neighborhoods were losing all of their parkway trees along with many of those on private land. In those areas, the loss of nearly all tree canopy created a dramatic and sudden change. The initial community meeting in April 2012 was well attended and demonstrated an intense community concern about the potential loss of over 15,000 trees and interest in taking action to save their trees where possible.

At the time, Valent's Legacy Tree Project was entering its third year of treatments, and Naperville's 200 legacy trees were providing a vivid demonstration of healthy treated trees contrasted with nearby infested and untreated trees. The project demonstrated the success of treatment and also the relatively low cost of treatment (approximately $100 per tree per year) compared to removal and replanting (from $1,200 - $1,700 per tree). The city was also considering several other factors: a high percentage of Naperville's urban canopy was comprised of ash trees; the city owned (and was liable for) 15,000 parkway ash trees; removing them all within two-to-three years would put extreme pressure on an already tight municipal budget. Shortly after the community meeting, the city decided to pursue an aggressive treatment program for healthy parkway trees. Some time later, city leaders commented that the proven success of the treatment option established by the Legacy Tree Project was persuasive in their decision. Another very important factor was the ability to stage or pace the timing of tree removal and replacement.

Naperville's program is based on an inventory and assessment of all parkway trees, which the City of Naperville makes public through an interactive website that includes detailed information about each tree and its treatment status.[14] Naperville uses a combination of selective tree removal and treatment with imidacloprid (soil injection), dinotefuran/Safari® (soil injection) and emamectin benzoate (a non-neonicotinoid trunk injection). All treatment work is provided through a certified arborist contractor, who as private landowners become aware of the issue, has also experienced a substantial increase in business for treating private residential customers. Two years into the program, more than 90 percent of the parkway ash trees showed only minor or no EAB damage.[14] Neighboring communities, who have not treated their trees, have lost substantial ash tree canopy that will take many years to replace.



Naperville's online inventory and tracking system allows residents to see the status of parkway trees across the city, in neighborhoods and along individual streets.[14]


Naperville
Emerald Ash Borer

Your parkway ash tree was treated today with Xytect (imidacloprid).

In an effort to address the growing number of ash trees affected by the Emerald Ash Borer (EAB), the City of Naperville has implemented an aggressive multi-year treatment plan for all healthy ash trees that are located in the city's parkways to reduce the devastating effect of the beetle in the community. The City is using this treatment for most trees that are under 20 inches in diameter. This treatment is applied as a soil injection annually around the base of the tree.

For more information about the EAB treatment program go to www.naperville.il.us/eab.aspx or call the City's Department of Public Works at 630-420-6095.

Naperville

thecareoftrees

630.692.1100

Door hanger were used to notify residents of treatments on their street.

The City of Naperville has a proud heritage of being a city that has been designated as a "Tree City" for about 20 years with many residents being transplants from areas of the country that had few trees as compared to Naperville. Our citizens truly appreciate the fact that it takes a lifetime to replace an ash tree. Any discussion about tree removal is considered to be serious and is not entered into lightly.

The emerald ash borer (EAB) educational forum conducted by the Naperville Area Homeowners Confederation for city residents and our neighbors was driven by local press releases describing the "epidemic" spread of the EAB infestation. The forum was publicized for about two weeks, and attendees filled the entire City Council Chambers for a two hour interchange between EAB researchers, professional arborists and city public works' staff.

*As a city, the residents were extremely lucky to have the Legacy Tree Project to experience the full meaning of the saving of **all size** ash trees. It was a night and day difference between untreated, dead trees on one side of a street and treated, lush, living ash trees on the other side.*

In a few Naperville neighborhoods that were infested before the treatment program began, ash trees had to be removed. The effect of cutting down these trees resulted in a "moon scape" topography and revealed homes requiring exterior repair, painting and serious landscape restoration. Property values dropped significantly on these "exposed" homes.

We certainly affirmed the value of our urban forest, the value of treating EAB infestation and have witnessed the complete devastation of areas that were forced to have the trees removed.

*In looking back, we really did the "right thing" by having the foresight to treat our ash trees even when the popular concept was using chain saws and chippers to control EAB. We correctly interpreted the scientific data and were willing to step out of the comfort zone to save our urban ash forest of **some 15,000 ash trees**. I am so very proud of our City of Naperville.*

Dr. Robert Buckman
Immediate Past President, Naperville Area Homeowners Confederation

In 2012, the City of Naperville staff and community stakeholders recommended to the City Council that an aggressive strategy be adopted to fight the Emerald Ash Borer. The City Council was presented with costs associated with treating our ash trees and the costs associated with the removal and replacement of the dead trees. Since we did not have any historical data to support the assumptions for treating the trees, I was reluctant to support this option. I did agree to invest in treating the trees, but I made it clear that my decision to support the project is pivotal and based on seeing results.

In 2013, I toured several subdivisions in Naperville that had experienced both sides of the possible EAB outcomes. The first subdivision had been treated and had streets lined with a full canopy of healthy trees. The second subdivision was not treated and as a result, all of the trees had died and been removed. What became clear to me is that the costs associated with losing so many ash trees was far greater than the hard cost of removal and replacement. The property value of these homes will undoubtedly sink, the cost for air conditioning will rise, but most importantly, the feeling of the neighborhood has changed.

Now that we have data to support the EAB program, I can comfortably support investing in a treatment solution. All of the treated and healthy trees will eventually die, as all trees do, but the EAB program has allowed our city to manage this problem in such a way that it makes sense from return on investment, and it has improved the quality of life in our neighborhoods.

Steve Chirico
Councilman, Naperville, IL

4.0 Implications of Neonicotinoid Loss

For Naperville, neonicotinoids provided the most economic option for managing EAB infestation and protecting their urban environment through tree conservation. City leaders have reflected that if the only option available in 2012 had been the higher priced, non-neonicotinoid trunk injection method, then they may have decided to remove ash trees rather than treat them. Because the neonicotinoid products can be soil-injected quickly and efficiently (1-2 minutes per tree), the treatment process is faster and less expensive for the city. It also allows for the protection of more trees, and it creates a more affordable option for homeowners wanting to save their private trees from EAB. Neonicotinoid products for protecting ash trees from EAB can be purchased at local home improvement or garden stores and do not require a license for homeowners to apply.

As noted previously, trees have many benefits for public spaces and private homes. If higher-priced options prevent homeowners from treating their trees, EAB infestation and tree deaths could negatively impact public health, property values, home cooling and maintenance costs, overall aesthetic appeal, and if dead trees are not removed – safety. At the local government level, without neonicotinoids, municipalities would have fewer options and mode of action choices for protecting their trees from the invasive and devastating EAB pest.

5.0 Main Insights From This Case Study

- EAB is a devastating invasive pest that destroys ash trees, turning them into brittle, dangerous hazards. The destruction of such a significant component of many urban forests also poses large economic and environmental costs. EAB is spreading rapidly across the eastern and midwestern U.S. and Canada, reaching more than 20 states and two provinces since first detected in 2002.
- Local governments responsible for managing streets and public parkways face substantial public work costs for removing and replacing ash trees both in advance and in the wake of EAB.
- Neonicotinoids are effective at protecting ash trees from EAB at relatively low cost compared to removal and other treatment options.
- Cities like Naperville, Illinois, are winning their fight against EAB with the help of neonicotinoids. Conservation of ash trees with neonicotinoids has saved Naperville taxpayers money, conserved the environmental benefits provided by the urban forest and potentially, influenced public health.
- Without this class of pesticides, Naperville very likely would not have acted to save their trees. Many other communities will be facing those same decisions in the near future.
- Ash trees self-pollinate (which happens very early in the spring), making pollinator exposure to systemic chemicals used in treating ash trees for EAB highly unlikely.

6.0 Footnotes

1. For information about benefits of urban trees, see for example, http://www.fs.fed.us/ucf/treesforpeople.shtml, or http://www.americanforests.org/conservation-programs/urban-forests/.

2. The Tree Benefits Calculator at http://www.treebenefits.com/calculator/.

3. Herms, D.A., D.G. McCullough. 2014. *Emerald Ash Borer Invasion of North America: History, Biology, Ecology, Impacts and Management.* Annual Review of Entomology. 59:13–30.

4. Kovacs K.F., R.D. Haight, D.G. McCullough, R.J. Mercader, N.A. Seigert, A.M. Liebhold. 2010. *Cost of Potential Emerald Ash Borer Damage in U.S. Communities, 2009–2019.* Ecological Economics. 69:569–78.

5. Donovan G.H., D.T. Butry, Y.L. Michael, J.P. Prestemon, A.M. Liebhold, D. Gatziolis, M.Y. Mao. 2013. *The Relationship Between Trees and Human Health: Evidence From the Spread of the Emerald Ash Borer.* Am J Prev Med. 44(2): 139-45.

6. Knight, K.S., J.P. Brown, R.P. Long. 2013. *Factors Affecting the Survival of Ash (Fraxinus spp.) Trees Infested by Emerald Ash Borer (Agrilus planipennis).* Biological Invasions. 15(2):371-383.

7. USDA/APHIS map of county EAB detections available at: http://www.emeraldashborer.info/files/MultiState_EABpos.pdf

8. For a multi-state, multi-organizational, online information clearing house, see http://www.emeraldashborer.info/.

9. Herms D.A., D.G. McCullough, D.R. Smitley, C. Sadof, R.C. Williamson, P.L. Nixon. 2014. *Insecticide Options for Protecting Ash Trees From Emerald Ash Borer.* North Central IMP Center Bulletin. 12 pp, available at: http://www.emeraldashborer.info/files/multistate_EAB_Insecticide_Fact_Sheet.pdf.

10. Hahn, J., D.A. Herms, D.G. McCullough. 2011. *Frequently Asked Questions Regarding Potential Side Effects of Systemic Insecticides Used to Control Emerald Ash Borer.* Joint publication of the Cooperative Extension Services of The Ohio State University, University of Minnesota, and Michigan State University, available at: http://www.emeraldashborer.info/.

11. City of Naperville, Illinois, EAB webpage: http://www.naperville.il.us/eab.aspx/.

12. Legacy Tree Project: http://legacytreedev.valent.com/about-legacy-tree/.

13. Naperville Area Homeowners Confederation: http://www.naperville-homeowners.com/.

14. City of Naperville, Illinois, EAB treatment map: http://gis.naperville.il.us/mashups/eab/.