Photo 1: Large trees stimulate some of the most intriguing interest in Nature by the general public. Hence, the preservation of large champion trees is first and foremost in many people's endeavors. The author poses beside what may the largest ash tree in North America, located near Elk Rapids, Michigan.

Photo 2: The large ash in Photo 1 is being saved from EAB destruction by a collaborative effort involving Arborjet Inc., Gary Kuhlman (The Northern Tree Doctor) and the author. Here, Joe Aiken, a representative from Arborjet, Inc., injects the tree with a relatively new injection system and the newly labeled product, Treeage. The tree is being treated preventatively and to the author's knowledge has not yet been challenged by the EAB.

Photo 3: This EAB adult clung to the author's vehicle after driving for several miles, possibly representing another mode of long distance spread.

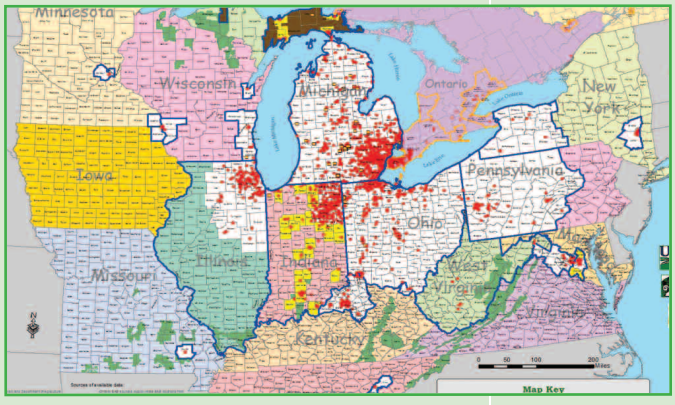

Figure 1: At the time of discovery, the EAB's known distribution was limited to six counties in southeast Michigan. As of December 2010, the Emerald Ash Borer is known to have spread to 14 states and Canada. This alarmingly rapid spread of the insect surprised many scientists and government officials.

The Plant Doctor's LANDSCAPE TIPS

By David L. Roberts, Ph.D, *Michigan State University*

THE EMERALD ASH BORER: 8½ YEARS LATER

INTRODUCTION:

While the title of this article might be reminiscent of the somewhat erotic movie, 9½ Weeks, starring Kim Basinger and Mickey Rourke, this article is really an update of an exotic, not erotic, bug. It has been about 8½ years since the author's research on ash decline led to the discovery of the Emerald Ash Borer (EAB), Agrilus planipennis. From the author's perspective, the EAB issue was one of the most controversial and political horticultural events in recent Michigan history. We have learned much about this invasive insect from Asia in the past 8½ years. For example, we learned that there are management techniques that can save ash trees from EAB destruction, contrary to some earlier beliefs that there were no control procedures that could save ash trees. Many of these control techniques and products were already being utilized by the tree care industry and simply had to be adapted to control the EAB. Examples include imidacloprid applied as Merit soil treatments and ArborSystems' Wedgle/Pointer combination. Other products and techniques were developed in response to the EAB threat (Photos 1 & 2). We've also learned more about the insect's life cycle. We've learned that the practice of chipping ash trees is largely ineffective at exterminating the EAB or at slowing the spread of the EAB. Even so, other states were slow to discontinue the chipping program as a method to contain and eradicate the EAB once the insect was discovered in their states. Based on some less than stellar science, it was originally believed that the EAB could only move about ½ mile per year; we now know that the EAB can travel much farther. So, what have we learned and where did we go wrong in addressing the Emerald Ash Borer issue in North America, given that we in Michigan were on the front line of this continental battle? Following is a discussion of some of the major issues encompassing the EAB in North America 8½ years after its initial finding.

EAB SPREAD AND DISTRIBUTION:

In 2002, immediately after the discovery of the EAB, six counties in southeast Michigan (Oakland, Livingston, Washtenaw, Macomb, Monroe and Wayne) were quarantined to prevent further spread of the EAB. As of December 2010, the EAB has subsequently spread to or has been found in 14 other states and Canada (Figure 1). These other states include Illinois, Indiana, Iowa, Kentucky, Maryland, Minnesota, Missouri, New York, Ohio, Pennsylvania, Tennessee, Virginia, Wisconsin and West Virginia. Based on some research performed by scientists, the insect was initially thought to move only about ½ mile per year, on its own flight efforts. If the insect would move only by flight, it would probably take more than 300 years to spread across Michigan. Obviously, the insect is capable of flying much farther than ½ mile per year. In addition, other modes of transportation that dwarf its spread by flight are transportation in nursery trees, firewood, and logs for lumber. It was also demonstrated by the author that the EAB can be spread in wood chips, which were considered non-regulated items under the Michigan and federal quarantine for many years. In addition, the author and others have personally witnessed the spread of the insect on automobiles and trucks for many miles at a time (Photo 3). When conditions are "windy," such as during windy periods or during vehicle movement, these insects seem to hunker down and hang on rather than fly away.

RESISTANT ASH TREES:

Every so often, I encounter individuals who claim they've seen resistant ash trees

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Photo 4: Some trees (left) initially appear to be resistant to the EAB while all nearby trees succumb to the EAB attacks. Invariably, these "resistant" trees die within 2-3 years after the others.

Photo 5: This site near Plymouth, Michigan, represents the longest running and most successful EAB management experiment, managed by the author. This photo of dormant trees, taken in 2002, discloses trees near death due to severe cankering by the EAB.

Photo 6: With treatment by ArborSystems Wedgle/Pointer combination, all 30 trees at this Plymouth site had fully recovered by 2006. No further attacks were noted until treatments were discontinued for 2-3 years on some test trees to determine how long we might space treatments in a presumably EAB "burned-out" area.

THE EMERALD ASH BORER: 8½ YEARS LATER

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(Photo 4). I have examined such trees and could find little evidence of EAB activity on many of them at the time I examined them. In most cases, these "resistant" trees tend to represent the white ash species rather than the green ash or other highly susceptible species. For some reason, certain ash trees are not attacked as readily as other trees. Perhaps some trees are not as attractive to or as palatable to the insect. We know that healthy, vigorously growing trees are not as susceptible and are not as prone to revealing EAB activity and decline symptoms as readily as stressed trees. However, if we follow those so-called "resistant" trees for another year or two, they invariably succumb to the EAB. We know from observations that all North American Fraxinus species are susceptible; some species or individual trees within a population of species are more tolerant of the EAB or less attractive to the EAB. By comparison, we know that in China, Fraxinus species are generally not susceptible to EAB activity unless they are under severe drought or other stress factors.

EAB MANAGEMENT:

Back in 2002, the initial "official word" from some government and university sources was that the EAB was 100% fatal and that there was no known control other than cutting down trees and chipping the wood. This official word was advanced by "cooperative" government and scientific sources to promote the national containment and eradication program, practically speaking, the cut and chip program. Apparently, Michigan and other states could not receive federal containment and eradication funding if they promoted treatment of ash trees. Over the years, we have subsequently found that the EAB is readily manageable on ash trees even if some people were slow to relinquish the cut and chip program as the only "proven" successful program to destroy the EAB. The author is managing what many would consider to be the world's oldest and most successful EAB management site near Plymouth Michigan. The trees at this site began receiving ArborSystems' Wedgle/Pointer treatments in 2001, over a year before the discovery of the EAB. The original caretakers of these trees (Mark Baldwin & Associates) had witnessed severe insect borer activity on these trees and began treatments before the problem was identified. These trees, despite being 90% girdled in most cases, fully recovered and resumed aggressive, abundant growth (Photos 5 & 6). Other professional arborists have used similar procedures with similar success. At another site, upon my advice, a friend began treating her ash tree preventatively with imidacloprid soil drenches in 2004, before arrival of the EAB into the area; as of 2010, all non-treated ash trees in the area have subsequently died from the EAB while her tree shows no sign of any EAB attack or decline (Photo 7). While this example may be dismissed as anecdotal by some scientists, it can nevertheless serve as important observational evidence that this application technique might have some validity. Even if anecdotal, it may be important to study this tree and try to explain this tree's survival from a scientific basis. In my observations and research, most if not all of the various treatments have proven to be effective provided they were applied correctly and provided they were applied before specific ash trees were severely infested by the EAB. As I have lectured repeatedly and summarized in articles, the success of various treatments may be more related to proactive treatments rather than treatments after infestations have occurred. Regrettably, some scientists dismiss these successful treatments as "anecdotal."
I recently heard statements through several second-hand rumor mills that the surviving ash trees at the above discussed Plymouth site is not a legitimate study because it has no control trees. In many experiments or field applications, untreated "control" trees are quickly killed by the EAB; the destruction of the control trees years ago should not negate the validity of this long-term experiment or of arborists attaining success using various treatments in their business. Unfortunately, some scientists are still not receptive of others' views or results.

EAB PERSISTENCE OR "BURN OUT"?:

One of the original theories for containing and eradicating the EAB from Michigan, and hence North America, particularly after the implementation of the above discussed quarantine, was to cut a mile-wide swath of ash-devoid land around southeast Michigan. Presumably, the insect would

not spread across this ash-free gap, the Great Lakes or wide bodies of water. The mile-wide swath was proposed because it was believed that the EAB could only travel about ½ mile per year on its own flight, a false assumption based on faulty science. The notion was that the EAB would kill all ash trees in this large containment area and simply "burn out." By "burn-out," it is meant that the insect would exhaust its food source and exterminate itself from North America. Of a practical nature and in regards to the possible "burn-out" theory, I am often asked if treatment of ash trees can be discontinued after the EAB is "gone." At my EAB treatment site near Plymouth, Michigan, all nearby non-treated ash landscape and street trees died and were removed by 2004 and 2005. And because this treatment site is probably within a few miles of the original EAB epicenter, does that suggest that the EAB is no longer in the area? Does that also imply that ash trees surviving in this area and those at my research site would no longer need treatment in the future? Observations over the past several years reveal that the EAB is not only here to stay, but that it is still alive and doing quite well near areas such as the epicenter near Canton, Michigan, where the EAB was probably originally released into North America. We addressed this issue with some research at this Plymouth site experimentally. We ceased treatment for some of the ash trees for 2-3 years. While following an experimental design in which some of the ash trees at this site would only be treated every two or three years, it was discovered that some of these trees were attacked if left untreated for too long. A survey of the area revealed that many ash trees in nearby woodlots maintained high populations of and damage by the EAB (Photo 8). Apparently, huge seed reserves and sprouts from roots of "dead" trees have kept colonies of the insects viable in areas many believed would be "burned out" by now. Hence, it would seem that ash trees will have to be treated into the foreseeable future, even in those areas where there appear to be few ash trees left.

ENVIRONMENT AND THE EAB:

One of the rumors I've heard about the EAB from time to time is that the reason the EAB is so serious here in the Midwest of North America is that we have a warmer climate than Asia, particularly China, where the EAB is native. This follows earlier contrasting rumors around the 2002-2003 time period that the EAB is not likely to survive the harsh Michigan winters. In my understanding, neither of these rumors have much validity. The EAB is reported to exist in the cold regions of Siberia and in much warmer regions of China. Certainly, as is the case with most insects, variable environmental conditions can cause a reduction or increase in insect population survival. However, the dramatic population increase of the EAB on so many susceptible ash trees in North America is not likely to be measurably affected by environmental conditions, with respect to how many ash trees will decline and die.

BIOLOGICAL CONTROL OF EAB:

There has been a concerted effort by some scientists at universities and Government agencies in recent years to find natural enemies of the EAB in Asia. Some are promoting the idea that the reason the EAB is so devastating here in North America is that there are no natural enemies or that the potential enemies that exist here are not efficient at keeping the EAB in check. This notion became very evident when I visited the Morton Arboretum near Chicago to give a lecture. An educational poster display at the entrance to the conference center conveyed the message that the reason the EAB is so serious in the U.S. is due to no natural enemies. In fact, natural enemies such as parasites and predators of the EAB are known in the U.S. Perhaps one of the most important biological controls in this country is woodpeckers, which can extract 50% or more of the larval population from specific trees. In reality, the real reason or at least a major contributing factor to the differences of EAB devastation in the U.S. and China is purely genetic. The EAB and Fraxinus species in China have evolved together for many thousands of years. During these many thousands of years of coexistence, it would not have been in the best interest of the insect to eliminate its host plant. Likewise, it will take many thousands of years of evolution in North America before the EAB and North American species of Fraxinus can coexist. While there may be some potential for biological control of the EAB by foreign predators, parasites and pathogens, there may also be the potential for serious unintended consequences with these introductions.

For more information, please feel free to email me at robertsd@msu.edu or contact a professional plant health-care provider. The author, MSU and MGIA do not endorse any particular products. If using pesticides, be sure to read and follow label directions.

Photo 7: This rather large ash tree was planted many years ago for shade near this resident's home. In 2004, preventative treatments of imidacloprid soil treatments (Bayer) were initiated even though the EAB was not believed to be in the area. By 2010, all ash trees in the area have been killed by the EAB. This one treated tree remains unaffected.
(Photo by Pamela Timmons)

Photo 8: This Plymouth site photo shows an experimental tree taken through a trunk crotch of a "Typhoid Mary" tree. This Typhoid Mary tree, like many ash trees developing from sprouts of killed trees or from germinating seed, harbors fairly high populations of the EAB in nearby woodlots. Hence, the insect did not "burn out" as some might have expected.

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