



New Research to Help You Beat Ambrosia Beetles

By Steve Frank

Exotic ambrosia beetles attack hundreds of tree species and kill them quickly. For years ambrosia beetles have been one of the most costly and damaging pests of nursery trees. Fortunately, with the help of NCNLA research grants, we have learned a lot about the biology and management of these pests over the past several years. We have even zeroed in on why ambrosia beetles attack particular trees and how to make trees less attractive. I will review the identification and biology of these beetles and bring you up to date on our latest research and management suggestions.

There are several ambrosia beetle species that attack nursery stock. The most common and damaging species here is the granulate ambrosia beetle (*Xylosandrus crassisculus*). Granulate ambrosia beetles become active in early spring typically before bud burst of most tree species. Female beetles bore into trees, excavate a gallery, and lay eggs. They also inoculate trees with ambrosia fungus. The fungus grows within the gallery and is food for the larvae. Around 60 days later adult females emerge from the galleries to find new trees and start a new generation.

Granulate ambrosia beetles attack over 200 tree species including many ornamentals such as styrax, redbud, magnolia, red maple, dogwood, ornamental cherry and other fruit trees, Japanese maple, golden rain tree, and oak. Ambrosia beetles damage trees by boring into them and also by infesting them with the ambrosia fungus that clogs tree vascular systems. As beetles bore into trees they push out sawdust and frass in the shape of toothpicks that stick out of the trees. Infested trees die or become unmarketable due to holes or dead branches. Unfortunately, there is no way to kill the beetles or fungus once they enter the tree.

Since there is no way to 'cure' trees after attacks, growers need to prevent ambrosia beetle attacks. The primary preventive measure has been permethrin applications in early spring when beetles become active. But we wanted to know why ambrosia beetles attack nursery trees to begin with. In their Asian homelands they attack unhealthy, dying trees. So why do they attack our "apparently healthy" nursery trees here?

Our research shows that many nursery trees don't smell that healthy to beetles. Ambrosia beetles use olfactory cues to locate host trees. We know that ambrosia beetles are attracted to ethanol – that's what we use in ambrosia beetle traps. It turns out this is the same cue they use to find host trees. Trees produce ethanol when they are growing in soil that is too wet. Thus, our research hypothesis was that in early spring, when ambrosia beetles attack, trees are not transpiring and the weather is cool so potting media and field soil stay too wet. Water-logged trees emit ethanol as a by-product of anaerobic root respiration and thus attract ambrosia beetle attacks. This would also explain



Top: An overwatered dogwood with 'frass toothpick' structures created when ambrosia beetles bore into trees. Photo: S.D. Frank, North Carolina State University.

Left: Granulate ambrosia beetle. Spines on the front legs are out of view but notice the rough, hairy patch on the back. Photo: J.R. Baker & S.B. Bambara, North Carolina State University.

why ambrosia beetles primarily attack nursery trees in spring even though they are active throughout the spring and summer.

In the first experiment to test this hypothesis we grew dogwoods, magnolias, and redbuds in pots lined with trash bags to prevent drainage or in regular pots watered properly. We watered trees in lined pots until the pots were full and water was present on the soil surface; they were completely water-logged. After several weeks the water-logged plants each had up to 100 attacks. The properly water trees, which were just three feet away, were not attacked. Not a single one. We repeated this experiment three years always with the same result.

These experiments confirmed that water-logged trees get attacked more but most nursery trees are not quite this wet. So our next

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question was “How wet is too wet?” We wanted to know at what soil moisture level trees begin producing ethanol and become attractive to beetle attacks. To answer this we grew dogwoods in pots with 10, 30, 50, 70, or 90% soil moisture as measured by a tool called a Theta Probe. We tested the soil moisture every couple days to adjust our watering to maintain the correct level in every pot. After 8 weeks trees grown in 10, 30, or 50% soil moisture had no attacks. Trees grown in 70 or 90% all had dozens of attacks. Thus, we can recommend maintaining spring soil moisture below 50% as a first line of defense against ambrosia beetle attacks.

Now that we knew how wet was too wet, we wanted to know the soil moisture of actual nursery trees throughout the spring ambrosia beetle season. For two springs we visited 6-8 cooperating nurseries to measure soil moisture in containers of dogwood, redbud, and red maple. We also trapped ambrosia beetles at each nursery. It turns out that the average soil moisture at these nurseries at first and peak ambrosia beetle activity was near 80%. Almost every pot we measured at all the nurseries was above the 50% threshold we found in our experiment.

It is pretty clear based on our research and research of colleagues in Ohio, Virginia, and Tennessee that soil moisture is the primary factor influencing which trees get attacked and which don't. Remarkably, after several years of these experiments only two trees watered to 50% soil moisture or less were attacked. Only two out of more than one hundred. During experiments the trees are all mixed together just 3

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to 6 feet from each other. So, the beetles can really zero in on the most stressed, overwatered trees.

Our results suggest that if growers could maintain trees below the 50% soil moisture threshold they may not even need to spray them. Of course this is probably not that easy.

Some nurseries we visited had irrigation running in early spring when ambrosia beetles were attacking. I think we can confidently say this is unnecessary and a sure way to make trees too wet. Other nurseries were not irrigating but soil was wet from rain and just does not dry quickly in early spring. Thus, we may need a substrate for susceptible trees that would stay drier in spring. This should be the next step.

Exotic ambrosia beetles are not going away and we are likely to get more species over time. They are very good at being pests but we are getting better at stopping them. Think about what you could do to keep plants drier next spring so they do not smell sick to beetles. This will give you a baseline level of protection from ambrosia beetle attacks. 🌿

Steve Frank is Associate Professor and Extension Specialist in the Department of Entomology at North Carolina State University. His ambrosia beetle research is funded by the Horticultural Research Institute and North Carolina Nursery and Landscape Association. You can find more information about his research on ambrosia beetles and other nursery and landscape pests on his website, EcolPM.org. Follow @OrnaPests on Twitter to receive alerts about nursery and landscape pest activity.

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