

Northern Research Station

Rooted in Research

ISSUE 13 | JANUARY 2023

Controlling an Introduced Invasive: On the Search for *Ailanthus*' Achilles Heel

Over 200 years ago, *Ailanthus altissima* (tree-of-heaven) was introduced to the United States for use as an ornamental. The tree was recognized for its ability to tolerate various soil types and climates, rapid growth, high reproductive capacity, and lack of apparent insect pests or diseases. Initially, *Ailanthus* represented a reliable tree to plant in cities and revegetate disturbed areas. Today, however, the species is a common invader in many forests across the nation.

A team of scientists, including USDA Forest Service researchers, identified a unique biocontrol measure for managing *Ailanthus altissima*—*Verticillium nonalfalfae*, a native soil-borne fungus. Joanne Rebbeck, a former research plant physiologist with the Northern Research Station (NRS), started this research in the 2000s after colleagues began to notice large patches of wilting *Ailanthus* in Pennsylvania.

Penn State University researchers identified and isolated the fungus responsible for the dying trees in Pennsylvania. Rebbeck wanted to use it to manage an infestation of *Ailanthus* in southern Ohio but introducing a biological control can pose risk. When regulations made bringing *Verticillium* across state lines arduous, she began her search for an isolate of the fungus endemic to Ohio. That was 2009.

Three years, several false alarms, and countless communications with foresters later, Rebbeck had identified an isolate in Ohio. “I wasn’t going to release an organism that could escape, do harm, or have off-target effects, so I got the permissions to use it for research. We performed some greenhouse experiments and then took it to the field,” said Rebbeck. That field research was recently published in *The Journal of Forestry* in April 2022, thanks to Lauren Pile Knapp, a research ecologist with NRS. Pile Knapp took over the project when Rebbeck retired in 2019.

KEY MANAGEMENT CONSIDERATIONS

- *Verticillium* targets *Ailanthus* exclusively, minimizing harm to nontarget organisms while controlling the invasive tree.
- *Verticillium* inoculation requires less work than chemical herbicide application since the fungus spreads to at least half of nearby non-inoculated trees.
- Managers can use *Verticillium* in tough-to-treat areas because, while it spreads slowly, it has a lasting effect.



Forest Service researcher Joanne Rebbeck inoculates an *Ailanthus* tree with *Verticillium nonalfalfae*, a native soil-borne fungus. USDA Forest Service photo.

A Novel, Native Biocontrol

Ailanthus is commonly affiliated with disturbed areas along roadsides and more recently, with disturbance on forest land. In their recent paper, the team assessed the efficacy of *Verticillium* on *Ailanthus* trees in highly disturbed, *Ailanthus*-invaded forests. They found that *Verticillium* reduces mature *Ailanthus* without increasing sapling abundance or reproduction. After inoculating a few trees, *Verticillium* can also spread to kill more than 50 percent of non-inoculated trees within 4 years. In patches with high populations of *Ailanthus*, that percentage can climb even higher. Also, *Verticillium* doesn’t appear to affect any tree or plant species other than *Ailanthus*.

“One of the really cool pieces of this research is that *Verticillium* is a native fungus,” Rebbeck said. “It’s different from classical biocontrol where you go back to the place of origin of the pest and look for its natural predators or pathogens to attack it—we are using a native control agent.”

Slow and Steady

Verticillium's movement through a forest is by no means speedy. According to Pile Knapp, the fungus' slower pace is both a pro and a con. "It allows shade or mid-tolerant native species to grow without a release from competitive nonnative species. Because this fungus is slower, it moves into the vascular system of the tree and can reduce the tree's ability to produce root suckers in the long term, as well." Plus, *Verticillium* requires much less effort to apply than chemical herbicides.

If a faster response is needed, however, a chemical herbicide might be the way to go. "*Verticillium* does have a lasting effect in forest communities. So, the best thing would be to prioritize where to use the fungus in remote pockets, versus areas where you need an immediate effect and you know you can go back and treat year after year," Pile Knapp said.

Future Directions

Currently, Pile Knapp and collaborators are working to publish research findings and also to conduct new research. "We are doing this research so [the fungus] can become available for live use," she said. "It has not been found in all states, so you can't just replicate the fungus from any dead *Ailanthus*."

Collaborators on the project are meeting with the Environmental Protection Agency (EPA) in early 2023 to review the data on *Verticillium*'s behavior in the field. The researchers hope to acquire the registration needed to use the fungus more broadly shortly thereafter.



A mature *Ailanthus*. USDA Forest Service photo by Joanne Rebbeck.

In the meantime, Pile Knapp is grateful to Rebbeck not only for initiating this important work, but also for transitioning the project so effectively before retiring. "Allowing researchers from different generations to overlap is really important in terms of not letting research lapse with the retirement of a scientist."

Project Lead

Lauren Pile Knapp is a research ecologist with the Sustainable Management of Central Hardwood Ecosystems and Landscapes unit. Learn more about her work at <https://www.fs.usda.gov/research/about/people/lpile>.

FURTHER READING

Iverson, L.R.; Rebbeck, J.; Peters, M.P.; Hutchinson, T.; Fox, T. 2019. [Predicting *Ailanthus altissima* presence across a managed forest landscape in southeast Ohio](https://doi.org/10.1186/s40663-019-0198-7). *Forest Ecosystems*. 6(1): 41. <https://doi.org/10.1186/s40663-019-0198-7>.

Pile Knapp, L.S.; Rebbeck, J.; Hutchinson, T.; Fraser, J.; Pinchot, C.C. 2022. [Controlling an invasive tree with a native fungus: inoculating *Ailanthus altissima* \(tree-of-heaven\) with *Verticillium nonalfalfae* in highly disturbed Appalachian forests of Ohio](https://doi.org/10.1093/jofore/fvac013). *Journal of Forestry*. 120(5): 558–574. <https://doi.org/10.1093/jofore/fvac013>.

Rebbeck, J.; Hutchinson, T.F.; Iverson, L.R. 2019. [Effects of prescribed fire and stem-injection herbicide on *Ailanthus altissima* demographics and survival](https://doi.org/10.1016/j.foreco.2019.02.044). *Forest Ecology and Management*. 439: 122–131. <https://doi.org/10.1016/j.foreco.2019.02.044>.



Ailanthus mortality following treatment with *Verticillium nonalfalfae*, a native soil-borne fungus. USDA Forest Service photo by Joanne Rebbeck.

Forest Service Research and Development (FS R&D) works with partners to deliver the knowledge and tools that land managers need to sustain the health, diversity, and productivity of our Nation's forests and grasslands for present and future generations. The Northern Research Station (NRS), one of seven FS R&D units, is rooted in the geography of the Northeast and Midwest. NRS Science supports a sustainable future. For more information visit <https://www.nrs.fs.usda.gov>.

Subscribe online to the Northern Research Station's Rooted in Research at: <https://www.nrs.fs.usda.gov/rooted/>.

