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Improving Yellow Pan Trap Efficacy When Monitoring Emerald Ash Borer Parasitoids

The emerald ash borer [*Agrilus planipennis* Fairmaire (Coleoptera:Buprestidae)] was first discovered in the United States in 2002 near Detroit, Michigan, and has spread quickly throughout the eastern United States and Canada, with isolated populations as far west as Oregon and British Columbia. Because ash trees in North America lack natural resistance to the beetle, emerald ash borer populations grew very quickly and have killed more than 100 million native ash trees.

Since 2003, researchers with the U.S. Department of Agriculture, Forest Service, Northern Research Station have studied potential biological control agents, specifically parasitoid wasps from Asia, to control the spread of emerald ash borer. Several of these species, including *Tetrastichus planipennisi* Yang (Eulophidae) and *Spathius galinae* Belokobylskij & Strazanac (Braconidae), have been released in forests in Michigan.

Entomologists commonly use yellow pan traps to monitor released parasitoids in areas with emerald ash borer. Yellow pan traps are attractive to many insect species and provide a non-destructive way to sample parasitoids (as opposed to cutting down and dissecting infested ash trees). In a study conducted between 2016 and 2019 in Michigan, Northern Research Station research entomologist Toby Petrice and colleagues sought to evaluate and improve the efficacy of yellow pan traps as a monitoring tool for *T. planipennisi* and *S. galinae*. They published the results of their study in 2023.

Yellow pan trap attached to ash tree for recovering emerald ash borer parasitoids. USDA Forest Service photo by Toby Petrice.

KEY FINDINGS

- Scientists have released parasitoids, including *Tetrastichus planipennisi* and *Spathius galinae* to combat emerald ash borer, a threat to ash trees in the United States.
- Yellow pan traps are commonly used to monitor parasitoid populations.
- A study found that *T. planipennisi* prefer trees with suppressed or intermediate crown classes and trees with epicormic sprouts, which are a symptom of tree stress.
- The same study found a positive relationship between the number of *T. planipennisi* adults captured and parasitized emerald ash borer larval densities from the previous year.
- *Spathius galinae* was introduced more recently and had lower capture rates. The study did not find a significant relationship with characteristics of the host trees.

Finding Biological Controls for Emerald Ash Borer

Biological control for emerald ash borer emerged as a solution due to native ash trees' inability to defend themselves against the pest. "Because our ash trees did not evolve with emerald ash borer, they are very susceptible to this pest," says Petrice. "The emerald ash borer lays eggs on ash trees," he explains. "After hatching, their larvae tunnel into the trees, damage the trees' vascular tissues—the tissues that move water and nutrients throughout the trees—and essentially girdle the trees."

In 2003, Petrice and colleagues traveled to China, where emerald ash borer is native, to find natural enemies of the species—a challenge because Asian ash trees have evolved to resist the beetles. The scientists first found

T. planipennisi, and on subsequent trips to China and Russia, researchers found other species that could potentially serve as biological control agents. Four of these species, including *T. planipennisi* and *S. galinae*, are now approved and being released in the United States.

Evaluating the Effectiveness of Yellow Pan Traps to Monitor Parasitoids

For the recent study, Petrice and colleagues wanted to study the effectiveness of yellow pan traps for monitoring parasitoids and determine best practices. "We aimed to improve parasitoid recoveries by selecting the most attractive trees to put traps on and the best time to deploy them in the field," Petrice says. The researchers monitored the seasonal abundance of the parasitoids, and compared capture numbers and rates with host tree characteristics and parasitized emerald ash borer larval densities.

Although the researchers found low parasitoid capture numbers and rates, and no seasonal abundance trends for either of the two species studied, they identified tree characteristics that were preferred by *T. planipennisi*.

More *T. planipennisi* parasitoids were found in infested trees that had suppressed or intermediate crown classes compared to trees that had dominant or codominant crown classes. According to Petrice, the researchers were surprised to find more *T. planipennisi* in the traps in the suppressed or intermediate trees than in the open grown trees, which are more attractive to its host, emerald ash borer. "One of the common names used to refer to the group of beetles that emerald ash borer belongs to is 'sun loving beetles,'" he explains, "because they are often found on sunlit foliage."

Spathius galinae larvae consuming an emerald ash borer larva. USDA Forest Service photo by Toby Petrice.

Trees with evidence of emerald ash borer infestation, such as epicormic sprouts, woodpecker feeding holes, and thinning crowns from insect damage, were also more likely to have parasitoids present. "When we picked trees with some sign of emerald ash borer attack," Petrice says, "we had a better chance of recovering parasitoids."

Additionally, the researchers found a positive relationship between *T. planipennisi* and parasitized emerald ash borer larval densities from the previous year. They also found that in some years, higher numbers of *T. planipennisi* were found in trees that had smaller diameters; the parasitoid can more readily attack larvae in smaller trees.

The researchers did not find relationships between *S. galinae* captures and host tree characteristics, which may be due, in part, to low captures of *S. galinae* because it was introduced more recently into the United States and populations were still building.

Overall, more parasitoids were recovered in smaller, intermediate, and suppressed trees with evidence of emerald ash borer infestation. Placing traps preferentially on trees with these characteristics may increase the likelihood of catching parasitoids and improving monitoring efforts. These findings can help researchers improve the efficiency of using yellow pan traps to monitor the parasitoids introduced to fight the emerald ash borer.

FURTHER READING

Gould, Juli S.; Booth, Theresa; Sawallich, Nicole; Petrice, Toby. 2024. Emerald ash borer biological control release and recovery guidelines. Riverdale, Maryland: U.S. Department of Agriculture, Animal and Plant Health Inspection Service, Agricultural Research Service, Forest Service. 75 p.

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PROJECT LEADS

Toby Petrice is a research entomologist for the Northern Research Station in East Landing, MI. Toby's work focuses on the use of biological control for the management of invasive forest insect pests.

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