Study examines the effects of using insecticides for spotted lanternfly control

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Jon Elmquist, a former master's degree student in Penn State's College of Agricultural Sciences, led a study examining neonicotinoid residues in whole flowers of two spotted lanternfly host plant species—tree of heaven and red maple. Credit: Pennsylvania State University

Neonicotinoid insecticides used to control spotted lanternflies have the potential to harm pollinators, but the degree of risk depends on multiple factors, such as application timing, type of neonicotinoid, the species of tree being treated and pollinator species sensitivity.

That's the conclusion of entomologists in Penn State's College of Agricultural Sciences, who examined neonicotinoid residues in whole flowers of two spotted lanternfly host plant species—tree of heaven and red maple—in the season after application for three years beginning in 2018.

According to Jon Elmquist, a former master's degree student in entomology, the findings can guide homeowners and landscape professionals when deciding whether and when to use insecticides in managing spotted lanternflies. He led the research under the guidance of Kelli Hoover, professor of entomology, and David Biddinger, research professor and tree-fruit research entomologist.

"Insect pollinators are experiencing declines worldwide, and chemical pollution, particularly from agrochemicals such as neonicotinoid insecticides, is considered one of the primary drivers of these declines," Elmquist said.

He explained that neonicotinoids are the most widely used insecticide class to protect many crops and ornamentals. They currently are being used in control efforts against the spotted lanternfly, an invasive planthopper first detected in Pennsylvania in 2014. It since has spread to more than 14 states.

"The spotted lanternfly can damage host plants by feeding on sap and creating leaking wounds in the plant, and indirectly, by secreting honeydew that facilitates the growth of black sooty mold on leaves, which reduces photosynthesis," said Hoover.

This study, recently published in the *Journal of Economic Entomology*, focused on imidacloprid and dinotefuran, two neonicotinoid insecticides used to manage spotted lanternflies. Like the spotted lanternfly, tree of heaven is an unwanted, invasive species in the U.S., but red maple is a valued native ornamental and forest tree.

Experiments occurred at the Penn State Berks campus in Reading and other locations in Berks and Center counties. They started with surveys of the types of pollinators that visit the flowers of each tree species to forage, results which were published in *Great Lakes Entomologist*.

For tree of heaven, the dominant floral visitor by far was the margined leather-wing soldier beetle, considered beneficial as a natural predator and likely pollinator, followed mostly by bees and flies. Most floral visitors to red maple were bees, including honey bees, solitary bees and flies.

Certified pesticide applicators applied dinotefuran or imidacloprid insecticides to red maple at different times of the year, from May to October, over three years using different application methods. In contrast, they applied dinotefuran trunk sprays only to tree of heaven in the summer. These sprays were conducted at label rate as part of the U.S. Department of Agriculture's spotted lanternfly control program, and all were applied post-bloom. For this study, the researchers evaluated a year's worth of data.

The research team collected whole flowers and analyzed them for insecticide residues the season after application. The team detected dinotefuran residues in the flowers of only one tree of heaven sampled. These residues were at a very low concentration, suggesting that there may be minimal acute mortality risk to nontarget bee pollinators from tree of heaven trap trees using a post-bloom application of dinotefuran.

The researchers found that a diversity of early-spring-emerging bees and other pollinator groups may be impacted negatively by neonicotinoid residues carrying over into red maple flowers from post-bloom applications made the previous year. This is especially true if the red maples were treated with dinotefuran in the previous fall or with imidacloprid in the previous spring or summer.

"While we found that whole flower residue concentrations did not differ by application method, the season when neonicotinoids are applied can influence residue concentrations in red maple flowers the following spring," Biddinger said. "Dinotefuran application in the fall resulted in higher residue concentrations the following bloom periods."

One bee species, the western honey bee, seemed to be safe from residue concentrations found in flowers from red maple treated with imidacloprid or dinotefuran and from tree of heaven treated with dinotefuran. However, there is potential for acute risk to a more sensitive solitary bee species from some of the red maple treatment groups in the study, noted Hoover.

"Further research is needed to understand better the factors that influence the toxicity of neonicotinoids used for spotted lanternfly control and the risk to beneficial insects, especially treatments using dinotefuran on tree of heaven in the fall since we have no data on fall treatments," she said.

In the meantime, to decrease the chance of residues in flowers the following season, the scientists advise those considering using dinotefuran to time applications to mid-summer to achieve effectiveness on the spotted lanternfly nymphs rather than for the adults in the fall. For both tree species, applications of these insecticides should be made post-bloom. In Pennsylvania, bloom occurs around March–April for red maple and June for tree of heaven.

Additionally, other researchers have found that imidacloprid is less effective than dinotefuran against spotted lanternflies. Its residues are much more persistent, especially as soil drenches, thus presenting a greater risk to pollinators.

More information: Jonathan Elmquist et al, Potential risk to pollinators from neonicotinoid applications to host trees for management of spotted lanternfly, Lycorma delicatula (Hemiptera: Fulgoridae), *Journal of Economic Entomology* (2023). DOI: 10.1093/jee/toad032

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