

Asian longhorned beetle larvae eat plant tissues that their parents cannot

Finding explains how recently overshadowed invasive pest expands its territory



Penn State researchers continue to focus on Asian longhorned beetles because the U.S. Department of Agriculture's Animal and Plant Health Inspection Service has spent approximately \$640 million to eradicate outbreaks of the wood-boring insect in four states, and eradication efforts continue in three states.

IMAGE: CHARLIE MASON/PENN STATE

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UNIVERSITY PARK, Pa. — Despite the buzz in recent years about other invasive insects that pose an even larger threat to agriculture and trees — such as the spotted lanternfly, the stink bug and the emerald ash borer — Penn State researchers have continued to study another damaging pest, the Asian longhorned beetle.

Their most recent research revealed that the larval offspring of the wood-borer native to China can feed and thrive on tree species whose tissues would sicken their parents, perhaps explaining how the beetle expands its range, even when its preferred host trees — maples, elms and willows — are not nearby.



This photo shows tunneling by Asian longhorned beetles. By feeding on the wood and burrowing through tree limbs, making them weak, unstable and liable at any time to collapse on people below, the invasive insects have wreaked havoc on trees in urban areas.

IMAGE: U.S. DEPARTMENT OF AGRICULTURE

The researchers' attention on Asian longhorned beetles remains well-placed because the U.S. Department of Agriculture's Animal and Plant Health Inspection Service has spent approximately \$640 million to eradicate outbreaks of the wood-boring beetle in Illinois, New Jersey, New York and Massachusetts. And eradication efforts continue in New York, Massachusetts and Ohio.

The Asian longhorned beetle most likely came to the United States inside wood packaging material from Asia in the early 1990s, according to Kelli Hoover, professor of entomology. Her research group in the College of Agricultural Sciences has been studying the pest for 19 years.

"In North America, the beetle attacks and can kill dozens of species from 15 plant families," she said. "Northern hardwood forests reaching from the Atlantic Ocean to the Great Lakes and beyond are made up of vulnerable species — approximately 48 million acres in the United States, plus the majority of Canada's hardwood forests."

This is not a new pest, but it still threatens billions of dollars in economic damage, Hoover pointed out, adding that if USDA had not undertaken its eradication efforts, Asian longhorned beetles would be causing a tremendous amount of damage over a much larger area.

"Those eradication efforts will have to continue," she said.



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Some trees, such as poplar, have limited resistance to attacks by Asian longhorned beetles, noted lead researcher Charlie Mason, postdoctoral scholar in entomology. In trying to assess the difference in resistance between Chinese poplar and native poplar — which consists of trees secreting compounds into their bark and wood tissues making them unpalatable to the wood-boring beetles — the researchers made a startling discovery: Larval Asian longhorned beetles can consume tree tissues that the adults cannot.

In their study, researchers realized that different plant species had strong effects on adult performance, but these patterns did not extend to effects on juveniles consuming the same hosts. They saw that female adult beetles were capable of producing eggs when feeding on red maple, but not when provided eastern cottonwood, also called necklace poplar, or Chinese white poplar.

Yet females that produced eggs by feeding on red maple deposited eggs into all three plant species and the larvae that hatched from these eggs performed equally on the three hosts. The differences between adult and juvenile utilization of poplar was very different.

"That is because poplar has markedly higher salicinoid phenolic concentrations in bark, which discourage adult Asian longhorned beetles from feeding, while poplar wood had only trace amounts," said Mason. "The tree's resistance is due to compounds present in the bark that make it unpalatable for adults."



Adult Asian longhorned beetles are able to feed on many fewer tree species than their offspring larvae, Penn State researchers discovered.

IMAGE: U.S. DEPARTMENT OF AGRICULTURE

But the adult female cuts a small notch in the bark and deposits her eggs, and the hatched larvae from there are able to tunnel into the wood tissues and be nourished by eating them, avoiding having to feed on bark.

By feeding on the wood and burrowing through tree limbs, making them weak, unstable and liable at any time to collapse on people below, Asian longhorned beetle have wreaked havoc on trees in urban areas such as New York City, Worcester, Massachusetts, and Chicago. The damage they caused has resulted in the removal of thousands of infested trees.

This research, recently published in the Journal of Animal Ecology, offers insight into how the pest has survived sustained efforts to eradicate it, Hoover believes.

"Now we know that the host range is not equal between adults and larvae," she said. "The young ones appear to have a broader range of trees they can feed on because they can avoid the toxic chemicals in the bark."

Also involved in the research were David Long, Penn State research technologist in entomology, and Richard Lindroth, professor of ecology in the Department of Entomology, University of Wisconsin-Madison.

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