Avocado farmers face unique foe in fungal-farming beetle

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This is the female *Euwallacea validus* that infests tree of heaven. A related beetle is killing avocado trees in the US and Israel. Credit: Mathew Kasson, Penn State

(Phys.org) —Beetles with unusual "green thumbs" for growing fungi are threatening avocado crops and could transform into a more destructive pest, according to an international team of researchers.

Ambrosia beetles are insects that bore into trees and cultivate fungi to use as a food source for their young. The fungi—species of *Fusarium*—carried by types of the Ambrosia beetle can damage or even kill trees, making the beetle and its fungi a threat to avocado production

in the U.S. and Israel, according to Matthew Kasson, who recently received his doctorate in forest pathology from Penn State.

Kasson, currently a post-doctoral researcher in plant pathology, physiology and weed science at Virginia Tech, said the ambrosia beetle that is threatening avocado crops is similar to many other ambrosia beetles, including one he discovered attacking the invasive *Ailanthus altissima* trees—Tree of Heaven—in the Northeast.

While the type of beetle threatening avocado crops attacks living trees, the ambrosia beetle associated with the *Ailanthus* is less of a problem because it is only known to attack trees that are dying or already dead, Kasson said.

However, researchers are worried that hybrid versions of either the beetle or fungus could pose a larger threat to farms and forests.

This is *Ailanthus* bolt with the bark removed showing the *Fusarium* fungus farmed by the abrosia beetle growing out from the galleries. Credit: Matthew Kasson, Penn State

"This really wasn't on the radar screen of too many researchers," said David Geiser, professor of plant pathology, Penn State, who worked with Kasson on the study. "But, over the past four or five years, ambrosia beetles seem to be really out of control."

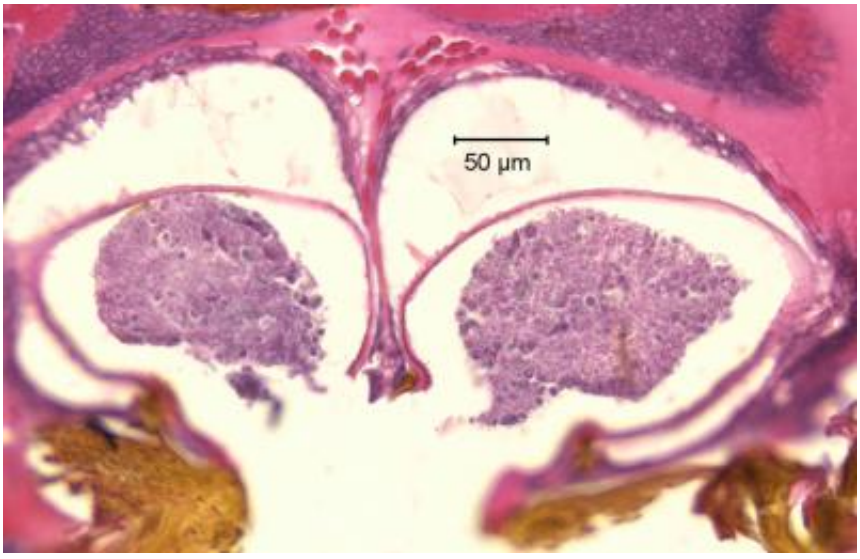
Evidence that the fungi associated with the beetles easily form hybrids is one reason for the alarm, according to Geiser.

"There is already strong evidence for genetic exchange between fungi from different beetles," said Geiser. "We want to know if a beetle of one

species bored into the same tree as another beetle species, can the fungi they maintain mate and produce new genotypes that are even more problematic?"

The partnership between the fungi and ambrosia beetles may be an example of co-evolution, in which beetles essentially domesticated the fungi, analogous to how people domesticated crop plants. The beetles carry the *Fusarium* and other fungi in specialized pockets in their heads, and the beetle-associated fungi have evolved a unique spore shape. Both of these adaptations are indications that the beetles and fungi co-evolved, according to Geiser. A total of seven evolutionary lines—lineages—of the *Fusarium* have an unusual club shape that is distinct from the canoe-shaped spores typical of other *Fusarium*. The club shape may be an adaptation for serving as a food source, he said.

"We think this fungus actually co-evolved with the beetle," said Geiser. "There are no other examples of this in *Fusarium*, which is mostly known as an associate of plants and soil."



This is a cross-section of the paired mandibular mycangia in the head of the ambrosia beetle, *Euwallacea validus*, which house the symbiotic fungus the

beetle farms. Credit: Matthew Kasson, Penn State

The researchers, who published their findings in a recent issue of *Fungal Genetics and Biology*, identified nine lineages of *Fusarium* associated with ambrosia beetles. The fungi, which look similar, but are genetically distinct from each other, include four lineages of *Fusarium* that are currently threatening avocado crops in Israel, Australia and in the U.S., specifically in California and Florida.

Because the *Ailanthus* is an undesirable, noxious tree and the beetles are already present in Pennsylvania, Kasson said researchers could use this system as a good research model for studying how the beetles and fungi interact.

Kasson said that the ambrosia beetle infestation is a global concern because the beetles can be introduced into wood pallets that are transported around the world by cargo ships.

Provided by Pennsylvania State University