

Virus pulls bait and switch on insect vectors

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This is a wingless morph of *Myzus persicae* aphid on squash plant. Credit: Kerry Mauck

A common plant virus lures aphids to infected plants by making the plants more attractive, but when the insects taste the plant, they quickly leave for tastier, healthier ones. In the process, the insects rapidly transmit the disease, according to Penn State entomologists.

"The <u>virus</u> improves the cues that <u>insects</u> use to identify food by elevating some aspect of a trait that is already in the plant," said Mark C. Mescher, assistant professor of entomology. "In this case they appear to elevate the odor cue, without changing it."

This type of host alteration has implications beyond agriculture. If pathogens can alter hosts to make transmission more efficient, they may



be doing it in such insect-transmitted human diseases as malaria or dengue fever.

Some plant viruses entice insects to visit infected plants and stay awhile, incorporating the virus into the insect's system. Then, when they fly to another plant, they transfer the virus. This is a persistent mode of transmission because the plants will infect all the subsequent plants the insects dine on. However, the insects needed to spend a sizable amount of time on the original infected plant.

The researchers are looking at the cucumber mosaic virus because it is not a persistent virus. Insects pick up the virus when they take their first taste of leaf. The virus binds chemically to mouth parts and when the insect feeds on another leaf, the virus is transferred, but in most cases only to the first plant and not to subsequent ones, making this a nonpersistent virus. They reported their findings in this week's online <u>Proceedings of the National Academy of Sciences</u>.

"Viruses like these (non-persistent ones) use a different system to ensure transmission," said Kerry E. Mauck, graduate student in entomology. "They have not been examined as closely as persistent systems."

Aphids transmit cucumber mosaic virus, which will infect the entire squash family of plants. The researchers investigated two species of aphids that can transmit the virus, one that prefers squash but will eat other things, and one that prefers turnips but will also eat squash. They used a special insect arena developed for testing aphid responses to plant odors. The aphids could not see or alight on the plants so they did not have color or taste cues. The insects could only access the chemicals the plants released into the surrounding air.

"We wanted to see where they aggregated most often," said Mauck. "They tended toward the plants that were infected rather than the healthy



leaves."



This is a wingless morph of *Myzus persicae* aphid on squash plant. Credit: Kerry Mauck

Mauck, Mescher and Consuelo De Moraes, associate professor of entomology, next tested the aphids to see which plant allowed them to reproduce the best. They found that the aphids reproduced less well on the infected plants than they did on the healthy plants.

Next the researchers tested the aphids to see how long they stayed on infected or healthy plants. While the sick plants initially attracted the aphids, probably because of the increased odor cues, the insects remained on the healthy plants much longer.

"We demonstrated that there were attraction cues combined with a repellant response when the plant was eaten," said Mauck. "We used two species of aphid to ensure that it was not a fluke that one aphid behaved this way."

The researchers have not done a time study to see how many aphids



actually visit sick and healthy plants over time. All the studies so far have been only a snapshot in time. They have tested the sick plants and determined that these plants produce much more volatile chemicals than healthy plants, but that the chemicals are the same as those produced by healthy plants.

"If the viruses caused the sick plants to produce altered volatile cues, then the insects could learn how the sick plants smelled and avoid them," said Mescher. "Because the virus only increases the amount of chemicals, there may be no way for the insects to distinguish between sick and healthy <u>plants</u> until they feed on them."

Mescher notes that the team is working on similar questions in human disease systems.

"We know that malaria-infected people are more attractive to malariatransmitting mosquitoes," said Mescher. "We do not know if the same principles as in cucumber mosaic virus apply to malaria, but we are working on it."

Provided by Pennsylvania State University

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