

Plants respond to leaf vibrations caused by insects' chewing

July 1 2014



A cabbage butterfly caterpillar feeding on an *Arabidopsis* plant where, on an adjacent leaf, a piece of reflective tape helps record vibrations. Credit: Roger Meissen

Previous studies have suggested that plant growth can be influenced by sound and that plants respond to wind and touch. Now, researchers at the University of Missouri, in a collaboration that brings together audio and chemical analysis, have determined that plants respond to the sounds that caterpillars make when eating plants and that the plants respond with more defenses.

"Previous research has investigated how [plants](#) respond to acoustic energy, including music," said Heidi Appel, senior research scientist in the Division of Plant Sciences in the College of Agriculture, Food and Natural Resources and the Bond Life Sciences Center at MU. "However, our work is the first example of how plants respond to an ecologically relevant vibration. We found that feeding vibrations signal changes in the plant cells' metabolism, creating more defensive chemicals that can repel attacks from [caterpillars](#)."

Appel collaborated with Rex Cocroft, professor in the Division of Biological Sciences at MU. In the study, caterpillars were placed on *Arabidopsis*, a small flowering plant related to cabbage and mustard. Using a laser and a tiny piece of reflective material on the leaf of the plant, Cocroft was able to measure the movement of the leaf in response to the chewing caterpillar.

Cocroft and Appel then played back recordings of caterpillar feeding vibrations to one set of plants, but played back only silence to the other set of plants. When caterpillars later fed on both sets of plants, the researchers found that the plants previously exposed to feeding vibrations produced more mustard oils, a chemical that is unappealing to many caterpillars.

"What is remarkable is that the plants exposed to different vibrations, including those made by a gentle wind or different insect sounds that share some acoustic features with caterpillar feeding vibrations did not

increase their [chemical defenses](#)," Cocroft said. "This indicates that the plants are able to distinguish feeding vibrations from other common sources of environmental vibration."

Appel and Cocroft say future research will focus on how vibrations are sensed by the plants, what features of the complex vibrational signal are important, and how the [mechanical vibrations](#) interact with other forms of plant information to generate protective responses to pests.

"Plants have many ways to detect insect attack, but feeding vibrations are likely the fastest way for distant parts of the plant to perceive the attack and begin to increase their defenses," Cocroft said.



Appel and Cocroft determined that plants respond to the sounds that caterpillars make when eating plants and that the plants respond with more defenses. Credit: Roger Meissen

"Caterpillars react to this chemical defense by crawling away, so using vibrations to enhance [plant defenses](#) could be useful to agriculture," Appel said. "This research also opens the window of plant behavior a little wider, showing that plants have many of the same responses to outside influences that animals do, even though the responses look different."

The study, "Plants respond to leaf vibrations caused by insect herbivore chewing," was funded in part by the National Science Foundation and was published in *Oecologia*.

Provided by University of Missouri-Columbia

Citation: Plants respond to leaf vibrations caused by insects' chewing (2014, July 1) retrieved 21 September 2024 from <https://phys.org/news/2014-07-leaf-vibrations-insects.html>

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