

# The way to (kill) a bug's heart is through its stomach

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A study at Michigan State University has revealed a potential new way for plants to fend off pests – starvation.

Gregg Howe, biochemistry and molecular biology professor, cites that this defense mechanism is just one example of a veritable evolutionary arms race between [plants](#) and herbivores.

Howe, in the current issue of the *Proceedings of the National Academy of Sciences*, offers insights to understanding the chemical weaponry of this war, which could lead to new approaches to protect crops.

All plants produce the enzyme threonine deaminase, or TD1. Howe's research focused on potato and tomato plants, which also have the ability to produce a closely related enzyme TD2 when attacked by caterpillars. Rather than repel caterpillars, however, TD2's devastating effects come later – in the pests' stomachs. TD2 goes to work in the gut of caterpillars to degrade threonine, a key nutrient they need to grow. In essence, the plant actively starves the caterpillar.

The battle sees plants continually developing chemical defenses to fend off their herbivore adversaries' ever-adapting arsenal, said Howe, who co-authored the paper with Eliana Gonzales-Vigil, visiting research associate in MSU's horticulture department.

"The arms-race paradigm is quite important for explaining plant chemical diversity and interactions between plants and herbivores in

general," he said. "Unfortunately, our understanding of the molecular evolution of chemical defensive traits is still in its infancy."

What the young research has revealed already, however, is that the ability of TD2 to break down threonine is activated only after it enters the insect's gut in the form of a chewed up leaf. The capacity of TD2 as a defense against pests was bolstered when the research team identified the enzyme's x-ray crystal structure. Seeing that it had a more stable structure and is more resilient than TD1 or other TDs, suggests that the enzyme is a key that could lead to new forms of pesticides, Howe said.

"This confirms a role for gene duplication in the evolution of plant defenses that target the digestive process of insects," he said. "It represents a novel approach to protecting plants against [pests](#)."

Provided by Michigan State University

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