Talking tomatoes: How their communication is influenced by enemies and friends

January 24 2024, by Ananya Sen

Credit: Pixabay/CC0 Public Domain

Plants produce a range of chemicals known as volatile organic compounds that influence their interactions with the world around them.

In a new study, researchers at the University of Illinois Urbana-Champaign have investigated how the type and amount of these VOCs change based on different features of tomato plants.

The research is published in the *Journal of Chemical Ecology*.

The smell of cut grass is one of the defining fragrances of summer. Smells like that are one of the ways plants signal their injury. Because they cannot run away from danger, plants have evolved to communicate with each other using chemical signals. They use VOCs for a variety of reasons: to help prepare their own defenses, to warn each other of threats, to recruit beneficial soil microbes that can help plants grow, and to alert insect predators that there is a pest chewing on that plant's leaves.

"When a caterpillar chews on a leaf, the plant sends out a signal that calls out to the caterpillar's predators. It's like a billboard that tells them where lunch is," said Erinn Dady, a graduate student in the Ngumbi lab.

Studying the factors that influence VOC emissions, therefore, is key to understanding plant health. In the past, other studies have looked at how soil microbes like arbuscular mycorrhizal fungi or caterpillars or the variety of tomato plant can influence VOCs. In the current study, the researchers studied the collective influence of all these factors on plant chemistry using four tomato varieties—two heirlooms and two hybrids.

"Previous studies looked at tomato varieties that are grown conventionally at a massive scale for processing, and are not usually grown by small farmers, so we decided to ask Illinois farmers what they grow. Based on their feedback, we chose tomato varieties that are commonly grown in central Illinois," Dady said. The hybrids used were Mountain Fresh and Valley Girl, and the organic heirlooms were Amish Paste and Cherokee Purple.

The researchers compared the responses of untreated plants to those that had been exposed to AMF, caterpillars, or both. They studied the VOCs by enclosing the eight-week-old tomato plants with an odor-blocking oven bag for an hour. They drew out the air around the plants and analyzed the different chemicals produced by each plant using gas chromatography-mass spectrophotometry.

The AMF and the caterpillars, separately, decreased the volatile emissions in all four varieties of tomato plants. Their effect when present together was minimal compared to the effects when either one was present.

Although it is unclear why the beneficial fungal associations decreased the VOCs, it is concerning that the plants were not as responsive to the caterpillars. Furthermore, the hybrid tomatoes emitted lower quantities of volatiles compared to the heirloom tomatoes.

Esther Ngumbi, left, and Erinn Dady studied the effect of arbuscular mycorrhizal fungi, caterpillars, and the variety of tomato plants on plant chemistry. Credit: Fred Zwicky

"Heirloom tomatoes—the big, juicy tomatoes we all love—are bred for flavor. Meanwhile, hybrids are grown for large scale conventional production, which comes at a cost to the plant," said Esther Ngumbi (CIS/MMG), an assistant professor of integrative biology. "Our work suggests that we are compromising plant defenses through our breeding processes."

The plants were also evaluated based on their growth both above the ground and in the soil. The researchers found that plants that had associations with the fungi had higher leaf biomass and more complex root structures.

"AMF form partnerships in over 80% of the land plants, setting up a trade where the fungi extract nutrients from the soil in exchange for carbon from plants," Dady said. "We found that especially in Cherokee Purple, AMF may confer additional benefits, including enhanced growth and greater emission of VOCs."

Surprisingly, the plants that were treated with caterpillars had greater plant growth.

"These plants had more biomass in both their roots and above the ground, which seems counterintuitive because they've actively been eaten. I would assume they would have less biomass," Dady said. "It is possible that the caterpillars triggered a growth response, similar to how you prune a tree to make it produce new growth."

The researchers are interested in further investigating the growth response to caterpillars.

"It's possible that the plants decided that the number of caterpillars we were using were not sufficient to be considered a threat and that's why they kept growing. It is also possible that the caterpillars weren't hungry enough to cause enough damage," Ngumbi said.

"There's a lot going on behind the scenes that we don't yet understand. For example, we are barely scratching the surface in understanding the role of different microbes," Dady said. "People tend to think that plants are not intelligent, but our studies have shown that they are actively responding to the environment around them using chemistry."

"We are trying to spread the gospel of plant chemistry, it's the language plants use to communicate and we are excited to learn more," Ngumbi said.

More information: Erinn R. Dady et al, Plant Variety, Mycorrhization, and Herbivory Influence Induced Volatile Emissions and Plant Growth Characteristics in Tomato, *Journal of Chemical Ecology* (2023). DOI: 10.1007/s10886-023-01455-w

Provided by University of Illinois at Urbana-Champaign

Citation: Talking tomatoes: How their communication is influenced by enemies and friends (2024, January 24) retrieved 28 April 2024 from https://phys.org/news/2024-01-tomatoes-communication-enemies-friends.html

This document is subject to copyright. Apart from any fair dealing for the purpose of private study or research, no part may be reproduced without the written permission. The content is provided for information purposes only.