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## University of South Carolina

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## Study Could Lead to Tomato Plants with Stronger Defenses

Few things say summer like a home-grown tomato.

But getting that red, juicy tomato challenges home gardeners and farmers alike, all of whom battle insects and diseases from the moment that young plants spring from the ground until the last tomato on the vine is picked.

Researchers in the plant-biology laboratory of Dr. Johannes Stratmann at the University of South Carolina are seeking to discover how tomato plants defend themselves against plant-eating insects, such as caterpillars, and microorganisms. Their discovery could help scientists develop new tomato varieties with stronger defense systems to battle the insects, bacteria, fungi and viruses that threaten and destroy crops.

"Tomatoes are frequently attacked by a number of enemies – insects and microbial pathogens alike. But they have a very effective and sophisticated defense system that has evolved over millions of years," said Stratmann, whose research team includes USC undergraduate biology students Wayne Miller of Greenville and Suchita Pancholi of Columbia.

"We are trying to understand these defense mechanisms at the molecular level," said Stratmann, whose studies are funded by the National Science Foundation.

"Our research could help other scientists develop new crop plants that are effective in battling insects and other stressors. But before we can develop better plants, we have to know how the plant works."

Stratmann likens the workings of the tomato plant's cellular defense system to a radio, where waves are perceived by the antenna and relayed to a transistor that amplifies the signal, producing sound.

"We see a similar situation in a cell," said Stratmann. "When tomato plants are attacked and wounded by plant-eating insects, a small peptide (protein) called systemin is released at the wound site."

At a target cell, the systemin interacts with a receptor, the equivalent of the radio antenna. The systemin signal is then amplified along a so-called "signal transduction pathway." Ultimately, defense genes are activated. These genes encode proteins that block digestive enzymes in the insects' guts. This reduces the growth of the attacking insects, which begin to starve or move on to other plants.

Miller is looking at a protein that functions in the signal transduction pathway of systemin. To characterize the function of this protein, he engineered a harmless plant virus that turns off the gene that encodes the signaling protein. The assumption is that when the gene is turned off, the signal transduction should be interrupted and the defense response halted. This would prove that the protein is essential for the defense response.

"This technique is giving us an understanding of the signal pathways involved in the plant's defense system," said Miller, a senior who wants to continue graduate studies in plant biology. "Our work on signaling genes is proving to be successful."

Pancholi, a South Carolina Honors College senior who hopes for a career in research or medicine, is working on another signaling protein, which is part of the systemin signaling pathway. She is studying how this protein

responds to wound signals that are generated by insects at the wound site and travel to distant parts of the plant.

These signals are very fast, with a speed of up to one inch per second. It is thought that the signals prepare the entire plant for an attack by an insect.

Pancholi's work with Stratmann will help provide clues for biotechnology on how to alter the signaling pathways in crop plants to make them more resistant to the stresses they encounter.

"This experience is a very important component of my education," she said. "You can't conduct research without knowing the basic concepts of biology."

Pancholi and Miller, recipients of USC's Belser Award that recognizes outstanding students in plant biology, are working with Stratmann as part of USC's Magellan Scholars Program, which enables undergraduate students to conduct research in the labs of the university's top scientists.

Stratmann said it's important for the university to provide research experiences for undergraduates.

"These students are producing valuable results," he said. "They bring a fresh perspective to our research."

Miller, whose work will be part of a paper being submitted for publication in a scientific journal, said, "I've been able to apply what I've learned in the classroom to my research. It has helped me to see the practical applications of what I'm learning."

So, whether you grow your tomatoes or depend on local farmers to produce them for you, USC researchers are finding ways to make this red joy of summer even better.

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