

Tiny protein helps bacteria 'talk' and triggers defensive response in plants

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Scientists have discovered a new signal that helps invading bacteria communicate but also helps targeted rice plants coordinate defensive attacks on the disease-causing invaders, a finding that could lead to new methods of combatting infection not just in plants, but in humans.

Findings from the study, conducted by a team of researchers led by a University of California, Davis, scientist, will be reported in the Dec. 12 issue of the journal [PLoS ONE](#) and in the journal *Discovery Medicine*.

"Just as invading armies often use coded messages to coordinate attacks on their targets, so single-celled bacteria use biological signals to communicate when they attack [plants and animals](#)," said Pamela Ronald, a UC Davis professor of [plant pathology](#) and the lead researcher on the study. "Scientists have known this for 20 years, however results from our study reveal a type of bacterial signal that has never been described before."

UC Davis has a long history of tackling agricultural and [environmental challenges](#) related to [rice production](#) in the United States and around the world. Today, campus researchers are using [molecular biology](#) to better understand how to improve the hardiness and yield of this grain, which is a staple food for more than half of the world's population and an important model for plant research.

Up until now, scientists thought that two major groups of bacteria used two distinctly different types of communication codes, Ronald said.

However Ax21, the small protein examined in this study, doesn't fit into either of those previously identified communication codes.

Ax21 is made inside the bacterial cell and processed to generate a shorter signal that is secreted outside the bacterium. This signal tips off other bacteria to assemble themselves into elaborate protective bunkers, called [biofilms](#), which make the bacteria resistant to drying out and antibiotic treatment.

"Additionally, Ax21 triggers a change in the expression of nearly 500 [bacterial genes](#), transforming the bacteria from fairly benign organisms into fierce invaders," Ronald said.

"In essence, through communication and communal living, the bacteria increase their chances of survival and proliferation," she said, noting that in rice, the bacteria multiply rapidly in the arteries that transport water, causing the plant to wither and die.

While most rice plants have little defense against the Ax21-mediated bacterial attack, some [rice plants](#) carry an immune receptor called XA21 that detects the Ax21 protein produced by the invading bacteria. XA21 belongs to a large class of immune receptors in plants and animals.

The importance of these receptors in immunity is reflected in the awarding of the 2011 Nobel Prize in physiology and medicine to researchers Bruce Beutler of The Scripps Research Institute in La Jolla and Jules Hoffman of the National Center of Scientific Research in Strasbourg, France, for their discoveries of similar receptors in animals.

The new study points out that the Ax21 signaling protein triggers the XA21 immune receptor to biologically alert the plant to launch a powerful defense response against the invading bacteria. The researchers also demonstrated that Ax21 is present in a human disease-causing

bacterium that is known to infect hospital patients.

"This study demonstrates that bacteria communicate using private messages. However, plants can intercept these messages and gain a tactical advantage in the evolutionary battle," Ronald said. " It's a fascinating story."

More information: Han S-W, Sriariyanun M, Lee S-W, Sharma M, Bahar O, et al. (2011) Small Protein-Mediated Quorum Sensing in a Gram-Negative Bacterium. *PLoS ONE* 6(12): e29192.
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