Phytoplasma effector proteins devastate host plants through molecular mimicry

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Phytoplasma are a type of bacteria that live within the cells and cause devastating diseases with damaging effects. For example, in many cases plants infected with phytoplasma are no longer able to develop flowers. These plants have actually been described as "zombies," since they allow the reproduction of phytoplasma but are unable to reproduce themselves anymore. A group of biologists based at Friedrich Schiller University and the Fritz Lipmann Institute in Germany are working to help better understand exactly how phytoplasma cells bring about the so-called zombification of plants.

"Our group has been studying the proteins that are targeted by the phytoplasma effector proteins for almost 30 years," said Günter Theißen, one of the scientists involved in the study. "In our latest research, based on just few data and some simple assumptions, we predicted the structure of the respective effector protein (termed SAP54) about 5 years ago. With the new work, we tested our hypothesis experimentally, and found that our prediction was quite accurate."

Phytoplasma cells bring about devastating changes in plants by secreting effector proteins that interact with some molecules of the plant host, which leads to developmental abnormalities. This interaction is very specific as only very special host molecules are recognized by the phytoplasma effector molecules.

"This specificity is achieved by the effector proteins adopting a special structure that somewhat mimics part of the structure of the host

molecules bound," explained Theißen. "This way, structural analyses at the molecular level help explain an important group of plant diseases."

Almost simultaneously, two other groups of scientists determined the crystal structure of very similar and highly related proteins, providing strong confirmation of the findings of Theißen and his colleagues. The team at Friedrich Schiller University also found that the effector protein SAP54 binds better to multimeric complexes of the target proteins than to protein dimers (pairs of proteins), suggesting an exciting avenue for future research.

"We are doing basic research," said Theißen. "However, there is no effective cure for phytoplasma infections that can be used in agronomy yet so, for example, when an orchard is affected, the only solution is to cut down all the infected trees, with dramatic economic ramifications. We hope that the more we know about how phytoplasma cells affect their hosts, the more we can help avoid the damage."

More information: Marc-Benjamin Aurin et al, Structural Requirements of the Phytoplasma Effector Protein SAP54 for Causing Homeotic Transformation of Floral Organs, *Molecular Plant-Microbe Interactions®* (2020). DOI: 10.1094/MPMI-02-20-0028-R

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