Protecting plants from stealthy diseases

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A team of international scientists led by Michigan State University's Sheng Yang He is helping plants counter attacks by boosting plants' alert system. Credit: Gary Malerba AP and HHMI

Stealthy diseases sometimes trick plants by hijacking their defense signaling system, which issues an alarm that diverts plant resources for the wrong attack and allows the enemy pathogens to easily overrun

plants.

A team of international scientists led by Michigan State University, however, is helping plants counter these attacks by boosting plants' alert system. New research in the current issue of *Proceedings of the National Academy of Sciences* shows that the team has engineered the receptor for jasmonate, a plant hormone that plays a central role in plant defense, to fend off such stealthy attacks from highly evolved pathogens.

"This is the first example of using receptor engineering to fix a disease-vulnerable component of the plant immune system that is frequently hijacked by highly evolved pathogens to cause disease," said Sheng Yang He, an MSU Distinguished Professor in the MSU-Department of Energy Plant Research Laboratory. "This new strategy is different from conventional resistance gene-based crop breeding and is based on a deep understanding of a key component, the jasmonate receptor, of the plant immune system."

This study may have significant practical implications and may serve as an example of finding and fixing disease-vulnerable components of the plant immune system. It also may provide a general strategy of producing a new generation of disease-resistant crop plants against many plant diseases, which collectively cause crop losses of more than $200 billion annually worldwide, added He, a Howard Hughes Medical Institute-Gordon and Betty Moore Foundation Plant Biology Investigator.

Jasmonate regulates plant defenses against a wide variety of pathogens and insects. In an evolutionary arms race between plants and pathogens, however, a group of highly evolved pathogens produce a jasmonate-mimicking toxin, coronatine. The wily bacteria use this toxin to override the jasmonate receptor, which divert plant resources to allow these pathogens to waltz through the security door without tripping any alarms.

To stem this hijacking, He and his team created an enhanced receptor, one that can still signal for insect defense but also has a greatly reduced sensitivity to coronatine toxin. The team's proof-of-concept demonstration shows that the coronatine-based takeover of the jasmonate receptor by bacterial pathogens can be stopped and that plants can be engineered to be resistant to both insects and pathogens, which has been one of the elusive goals of plant pathology/entomology research.

"It took many years of fundamental research by a number of laboratories, but we made a precise repair of the jasmonate decoding system so that it can now distinguish between endogenous jasmonate in plants and bacterial toxin coronatine," He said. "We show that modified Arabidopsis plants equipped with the repaired jasmonate decoding system not only protects against insects, but it also does not allow bacteria to cause disease."

The concept of repairing plant defense system components is appealing and could become a new trend in future efforts to protect plants from numerous plant diseases.

More information: Host target modification as a strategy to counter pathogen hijacking of the jasmonate hormone receptor, *Proceedings of the National Academy of Sciences*, www.pnas.org/cgi/doi/10.1073/pnas.1510745112

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