Research identifies mechanism that helps plants fight bacterial infection

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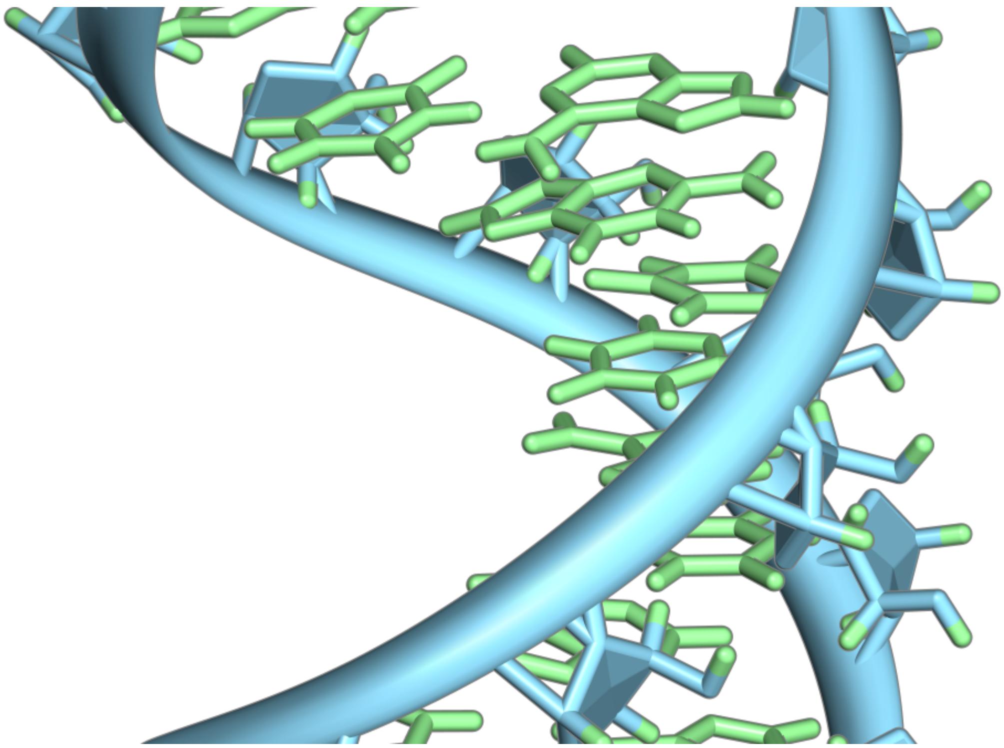

A hairpin loop from a pre-mRNA. Highlighted are the nucleobases (green) and the ribose-phosphate backbone (blue). Note that this is a single strand of RNA that folds back upon itself. Credit: Vossman/ Wikipedia

A team led by a plant pathologist at the University of California, Riverside, has identified a regulatory, genetic mechanism in plants that could help fight bacterial infection.

"By better understanding this molecular mechanism of regulation, we can modify or treat crops to induce their immune response against bacterial pathogens," said Hailing Jin, a professor of microbiology and plant pathology, who led the research.

Working on Arabidopsis thaliana, a small flowering plant widely used by biologists as a model species, Jin's research team found that Argonaute protein, a major core protein in the RNA interference machinery, is controlled by a process called "post-translational modification" during bacterial infection.

This process controls the level of the Argonaute protein and its associated small RNAs—molecules that regulate biological processes by interfering with gene expression. This provides double security in regulating the RNA interference machinery. RNA interference, or RNAi, is an important cellular mechanism that many organisms use to regulate gene expression. It involves turning off genes, also known as "gene silencing."

A previous study in Jin's lab identified that one of 10 Argonaute proteins in Arabidopsis is induced by bacterial infection and contributes to plant immunity—the higher the level of the protein, the higher the plant immunity. A high level of the protein, however, can limit the plant's growth.

Under normal plant growth conditions, the Argonaute protein and its associated small RNAs are well controlled by arginine methylation—a type of post-translational modification of the Argonaute protein. This regulates the Argonaute protein and prevents it from accumulating to high levels. The small RNAs associated with the Argonaute protein are also prevented from accumulating to higher levels, allowing the plant to save energy for growth.

During bacterial infection, however, arginine methylation of the Argonaute protein is suppressed, which leads to the accumulation of the Argonaute protein and its associated small RNAs that contribute to plant immunity. Together, these two changes allow the plant to both survive and defend itself.

"If the Argonaute protein and the associated small RNAs were to remain at such high levels after normal conditions returned, it would be detrimental to plant growth," Jin said. "But post-translational modification of the Argonaute protein, restored under normal conditions, decreases these levels to promote plant growth."

Study results appear in *Nature Communications*.

Jin explained that all plants possess the RNAi machinery, as well as the equivalent plant-immunity-related Argonaute protein. RNA silencing is seen in all mammals, plants, and most eukaryotes.

"Until our study, how the Argonaute protein got controlled during a pathogen attack was unclear, and just how plants' immune responses got regulated by the RNAi machinery was largely a mystery," said Jin, who holds the Cy Mouradick Endowed Chair at UCR and is a member of UCR's Institute for Integrative Genome Biology. "Ours is the first study to show that post-translational modification regulates the RNAi machinery in plant immune responses."

More information: Po Hu et al, Dual regulation of Arabidopsis AGO2 by arginine methylation, *Nature Communications* (2019). DOI: 10.1038/s41467-019-08787-w

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