Nailing down a crucial plant signaling system

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Plant biologists have discovered the last major element of the series of chemical signals that one class of plant hormones, called brassinosteroids, send from a protein on the surface of a plant cell to the cell's nucleus. Although many steps of the pathway were already known, new research from a team including Carnegie's Ying Sun and Zhiyong Wang fills in a missing gap about the mechanism through which brassinosteroids cause plant genes to be expressed. Their research, which will be published online by *Nature Cell Biology* on January 23, has implications for agricultural science and, potentially, evolutionary research.

"Brassinosteroids are found throughout the plant kingdom and regulate many aspects of growth and development, as well as resistance from external stresses," said Wang. "Mutant plants that are deficient in brassinosteroids show defects at many phases of the plant life cycle, including reduced seed germination, irregular growth in the absence of light, dwarfism, and sterility."

Previous research had identified a pathway of chemical signals that starts when a brassinosteroid binds to a receptor on the surface of a plant cell and activates a cascade of activity that consists of adding and removing phosphates from a series of proteins.

When brassinosteroids are not present, a protein in this pathway called BIN2 acts to add phosphates to two other proteins called BZR1 and BZR2, which are part of a special class of proteins called transcription factors. The phosphates inhibit the transcription factors. But when a brassinosteroid binds to the cell-surface receptor, BIN2 is deactivated, and as a result phosphates are removed from the two transcription factors. As a result, BZR1 and BZR2 can enter the cell's nucleus, where they bind directly to DNA molecules and promote a wide variety of gene activity.

Before this new research, the protein that detaches the phosphates and allows BZR1 and BZR2 to work was unknown. Using an extensive array of research techniques, the team was able to prove that a protein called protein phosphatase 2A (PP2A) is responsible.

"We discovered that PP2A is a key component of the brassinosteroid signaling pathway," Wang said. "This discovery completes the core signaling module that relays extracellular brassinosteroids to cue activity in the nucleus."

Further research is needed to determine whether brassinosteroid binding activates PP2A, or just deactivates BIN2, thus allowing PP2A to do this job. Additionally, PP2A is involved in a plant's response to gravity and light, among other things.

This aspect of the brassinosteroid signaling pathway bears some surprising resemblances to signaling pathways found in many members of the animal kingdom. More research could demonstrate details of the evolutionary split between non-protozoan animals and plants.

Provided by Carnegie Institution

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