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RESEARCH NEWS

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Stitching Together a Receptor Reveals Plant Hormone Action

Researchers have created a chimeric receptor in rice cells that allows an *Arabidopsis* hormone to switch on disease-resistance machinery.

The researchers created the chimeric receptor by joining one segment of a steroid hormone receptor from the plant *Arabidopsis* with another receptor segment from rice. The experiments, which are reported in the June 30, 2000, issue of *Science,* show that the plant steroid hormone, brassinolide, is perceived by the extracellular portion of the receptor. More broadly, the scientists' technique for stitching together receptor parts offers a highly promising approach to determining the function of a large array of plant signaling hormones and receptors.

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— Joanne Chory

The technique might also offer a way to manipulate the signaling machinery of plant cells to improve plant development and boost disease resistance, said research leader Howard Hughes Medical Institute investigator Joanne Chory. Chory and colleagues at The Salk Institute and the University of California, Davis performed the experiments described in the *Science* article.

Arabidopsis, a small flowering plant that is a member of the mustard family that also includes cabbage and radish, is a reference organism widely used by plant scientists. Although both the *Arabidopsis* and rice genomes have been fully sequenced, Chory says that very little is known about many critical plant proteins, such as the receptor-like kinases and other signaling enzymes studied in her laboratory.

"There are probably upwards of 300 receptor kinases in the plant genome, and in general we're clueless about their function," said Chory. Also missing is fundamental information about the hormones that trigger these receptor kinases. Plant biologists have been hampered in their efforts to learn about plant signaling because they have had difficulty in developing techniques to obtain measurable biological responses when experimentally manipulating plant-signaling molecules.

Chory and her colleagues chose the rice disease-resistance receptor-like kinase, XA21, because it normally triggers a dramatic reaction in the rice plant when the plant is infected by a pathogenic bacterium called *Xoo* (*Xanthomonas oryzae* pv. *oryzae*). When infected by *Xoo,* the rice plant activates defense genes, kills off infected cells and produces a burst of bacteria-killing hydrogen peroxide.

In their work, Chory and her colleagues were particularly interested in finding out whether the steroid plant hormone brassinolide was the trigger — or ligand — for the *Arabidopsis* receptor kinase, called BRI1. BRI1 is a member of the largest group of receptor kinases, called leucine-rich repeat receptor kinases.

Brassinolide is a potent growth-promoting hormone that is believed to be a key element in the plant's response to light. Such responses, which include adjusting plant growth to reach light or strengthening stems to support leaves, are central to plant survival.

To investigate brassinolide's role in BRI1 triggering, the researchers stitched the segment of the BRI1 receptor that normally sticks outside the plant cell, to the internal segment of the XA21 receptor that signals the rice cell to mount a response to infection. When they inserted the chimeric receptor into rice cells and then treated the rice cells with brassinolide, the cells reacted as if they were being infected by *Xoo.*

"While achieving such a measurable signaling response in cell culture is quite standard for our colleagues who work with animal cells, it is big news in the plant research community," said Chory.

According to Chory, the achievement also offers lessons for understanding the basic nature of the leucine-rich repeat receptor kinases.

"It's quite interesting to see that these receptor kinases are probably modular like the animal receptor kinases," she said. "No one even knew that you could take an extracellular domain of one and stick it onto another kinase and see a response. We're hoping that this finding will stimulate a whole cottage industry in which researchers begin to look for the ligands for other such kinases."

Chory's colleagues at UC, Davis, are now studying whether rice plants genetically altered to have such a hormone-sensitive receptor could be made more resistant to diseases. In the event of an attack by a pathogen, for example, researchers could induce the disease-fighting machinery by spraying the plant with a steroid.

Chory's group is also working to explore further the binding of brassinolide to BRI1, as well as the still-unknown signal transduction pathways within the plant cell that are activated by the receptor kinase.