Researcher looks for answers about unique disease-resistant gene

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Virginia Tech faculty member Bingyu Zhao is investigating a disease-resistant gene in corn that prevents bacteria from invading distantly related plant species.

Zhao, assistant professor of horticulture in the College of Agriculture and Life Sciences, hopes to discover why Rxo1 violates a rule in modern plant pathology and show plant breeders how to transfer disease-resistant genes from model plant species into economically important crops. He has received a $1 million, five-year Faculty Early Career Development (CAREER) Award, which is the National Science Foundation's most prestigious award for creative junior faculty considered to be future leaders in their academic fields.

"All plants have disease problems. Each year, we lose more than 20 percent of all crops to plant diseases worldwide," Zhao said. "To save the food supply, we must either increase yields or improve plant disease resistance."

Traditional plant breeding involves identifying members of a species with desirable traits - such as a natural resistance to a disease - and propagating those traits in successive generations. Plant molecular biologists can also use genetic engineering to transfer a disease-resistant gene found in one species, such as corn, into a closely related species, such as rice. Because corn and rice belong to the same taxonomic family, their genes function in similar ways.

"However, it is known in the field of molecular plant pathology that a disease-resistant gene would not be functional when it was transferred into a plant species that belongs to a different plant taxonomic family," explained Zhao, who calls this principle "restricted taxonomic functionality." "For example, a gene in pepper would not be functional in rice because they belong to the Solanaceae and Poaceae families, respectively."

Surprisingly, Rxo1, a disease-resistant gene originally cloned from corn, does not follow this rule. When Zhao cloned the Rxo1 gene and transferred it into tobacco, it showed resistance to the pathogen that expressed a bacterial effector called AvrRxo1. Because corn and tobacco are members of two evolutionarily distant groups of flowering plants, many of their genes have different functions.

Zhao hopes to figure out what allows Rxo1 to recognize AvrRxo1 and trigger disease resistance in both corn and tobacco, a phenomenon he calls "broad taxonomic functionality." Zhao and his group are employing plant molecular biology, cell biology, and biochemistry tools to characterize the molecular interaction between Rxo1 and AvrRxo1 proteins.

"I also want to know why certain disease-resistant genes, like Rxo1, can be transferred between different plant taxonomic families while others cannot," said Zhao, who speculates that other disease-resistant genes with similar properties exist in nature but have not yet been found. "If you can understand how to break the rule, you can transfer a disease gene from one plant species to any other plant species. This will offer plant breeders with almost unlimited resources for breeding disease-free cultivars."

If successful, Zhao would revolutionize attempts to control plant disease for economically important crops, including biofuel feedstocks like

switchgrass. Rxo1 prevents bacterial pathogens from invading plant cells, providing resistance to various crop diseases such as rice bacterial leaf streak, sorghum leaf streak, tomato bacterial leaf spot, and watermelon fruit blotch.

The grant also provides training for undergraduate and graduate students and supports workshops at the Institute for Advanced Learning and Research in Danville, Va., to attract minority high school students to a career in modern plant biology.

Source: Virginia Tech (news : web)