Researchers explain mystery of cereal grain defense

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Crop scientists at Washington State University have explained how genes in the barley plant turn on defenses against aging and stressors like drought, heat and disease.

Professor Diter von Wettstein and assistant research professor Sachin Rustgi showed that specific genes act as a switch that enables barley to live longer and become more tolerant of stress, including attack by common diseases like mildew and spot blotch.

The finding, reported in the *Proceedings of the National Academy of Science*, solves a long-standing mystery and offers hope for the production of grain crops able to thrive during unpredictable weather and climate change.

Cereal grains such as wheat, barley, corn and rice need an essential amount of growing time to produce abundant yields. Environmental stressors such as heat and drought can trigger early aging of plants, which slows growth and decreases yield and grain quality.

Von Wettstein and Rustgi discovered that two barley genes, called JIP60 and JIP60-like, play a major role in the protective actions triggered by a key plant defense hormone called jasmonate or JA.

Like a watchful sentry, JA takes action at the first sign of plant distress, producing proteins that prepare the plant to combat excess heat, lack of water, or attack by disease organisms. They also slow aging.

It had been known since the 1990s that JA played a role in plant resistance but von Wettstein and Rustgi are the first to document how it actually takes place.

Rustgi said it was a surprise to discover that the JIP60 genes are also connected to boron sensitivity and disease resistance in cereal grains. The genes lie in close proximity to these other plant traits, providing a unique target for future crop breeding programs.

"It is possible that we could tweak the JA pathway and increase yields by slowing the aging of plants and making them more resistant to diseases, drought and temperature stress," he said. "This can be done without genetic engineering."

The findings are important for grain farmers around the world.

"This year was a good example," said Rustgi. "In Washington State, we had a cold spell in May and June just when winter wheat was flowering. It actually affected the long-term grain yield by causing injury to the plants."

In India and Pakistan, he said that very hot temperatures – up to about 135 degrees Fahrenheit – cause heat injury to wheat, barley, and rice.

"It is a problem for farmers who have small plots and are very poor. Any hit causes a significant loss of income."

More information: JIP60-mediated, jasmonate- and senescence-induced molecular switch in translation toward stress and defense protein synthesis, *PNAS*, 2014: www.pnas.org/cgi/doi/10.1073/pnas.1415690111

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