Flowering and freezing tolerance linked in wheat, study shows

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(PhysOrg.com) -- New research by UC Davis wheat geneticist Jorge Dubcovsky and his colleagues could lead to new strategies for improving freezing tolerance in wheat, which provides more than one-fifth of the calories consumed by people around the world.

The new findings, published June 22 in the Online First issue of the journal *Plant Physiology*, shed light on the connection between flowering and freezing tolerance in wheat.

In winter wheat and barley varieties, long exposures to nonfreezing cold temperatures accelerate flowering time in a process known as vernalization. These exposures also prepare the wheat to better tolerate freezing, a process known as cold acclimation.

In their new study, Dubcovsky and his colleagues at UC Davis, The Ohio State University and in Hungary, demonstrated that when the main vernalization gene, VRN1, is expressed in the leaves, it initiates a process that leads to decreased expression of the freezing tolerance genes. (In genetics, “expression” refers to the process by which information carried by the gene is used to create a protein.)

“This system enables wheat and other temperate grasses to respond differently to cool temperatures in the fall than they would to cool temperatures in the spring,” said Dubcovsky, a professor in UC Davis’ Department of Plant Sciences.

Dubcovsky heads UC Davis' wheat breeding program and Wheat Molecular Genetics Laboratory. The lab coordinates a broad-based research program that aims to provide the scientific information needed to develop healthier and more productive varieties of wheat.

He noted that a cool temperature in the fall, when plants have low levels of the vernalization gene VRN1, activates the freezing tolerance genes, helping to trigger the plants' acclimation to cold temperatures. This is essential in the fall, when cool temperatures are an indication that winter's freezing temperatures are approaching.

"However the same cool temperature in the spring, when high levels of the vernalization gene VRN1 are present in the leaves, results in a weaker response of the freezing tolerance genes," Dubcovsky said. "This avoids initiating the plants' cold-acclimation response, which requires a lot of the plants' energy and is unnecessary in the spring because warmer weather is approaching."

Provided by UC Davis