Newly Cloned Gene Key to More Adaptable Wheat Varieties

December 5 2006

In a research discovery that has practical implications for improving wheat varieties, a team of scientists at the University of California, Davis, and the U.S. Department of Agriculture have cloned a gene that controls the flowering time of barley and wheat.

Differences in this gene, called VRN3, are essential for adapting these two important crop species to different climates.

The findings of the study, conducted by Professor Jorge Dubcovsky, a wheat breeder and leader of the UC Davis research group, and by plant geneticist Ann E. Blechl of the USDA's Agricultural Research Service in Albany, Calif., will appear the week of Dec. 4 in the online issue of the *Proceedings of the National Academy of Sciences of the U.S.A*.

One of the critical differences that help wheat and barley adapt to different environments is the existence of winter and spring forms. Winter wheat and barley varieties are planted in the fall but wait until the very cold winter weather passes before flowering. This requirement for a long-term exposure to low temperatures to flower is called the "vernalization requirement."

In contrast, spring wheat and barley varieties do not have this vernalization requirement and can be planted in the spring. This is essential for regions of the world where winter weather is so severe that cereals cannot be planted in the fall.

The vernalization requirement in barley and wheat is very flexible, Dubcovsky noted.

"During the domestication of these species, the different mutations that occurred in the vernalization genes were selected by humans, resulting in spring varieties better adapted to certain regions," he said. "This flexibility has helped wheat to become one of the world's most important crops."

The Food and Agriculture Organization of the United Nations estimates that wheat now provides 23 percent of the food available for daily human consumption around the world.

The vernalization requirement in wheat and barley is controlled by three major vernalization genes designated VRN1, VRN2 and VRN3. The first two genes were cloned two years ago by the same group of researchers.

The cloning of VRN3 now completes a 10-year research project to understand the genetic regulation of the vernalization requirement in barley and wheat. Results from this new study show that mutations in regulatory regions of the VRN3 gene are responsible for the evolution of several barley and wheat spring lines.

To confirm that they had identified the correct gene, the researchers transformed, or genetically altered, the winter wheat variety Jagger with the VRN3 gene from the spring variety Hope. The genetically modified plants showed the early flowering characteristic of the spring wheat varieties, whereas the control non-transgenic plants failed to flower in the absence of vernalization. This result confirmed that the gene cloned by this research team was the correct one.

"The VRN3 mutation we discovered in the wheat variety Hope can now

be used to accelerate flowering time of other wheat varieties," Dubcovsky said. "The VRN3 molecular markers developed in this study will help breeders to detect the mutations present in their breeding lines and to study their effects on the adaptability of wheat and barley varieties to particular environments."

Source: UC Davis