Study identifies circadian clock gene that strengthens crop plant

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Dartmouth researchers and their colleagues have identified a circadian clock gene that helps a key crop plant, *Brassica rapa*, to withstand extreme cold and salty conditions, which could help to develop hardier crops with improved yield. Credit: Wikipedia Creative Commons

Dartmouth researchers and their colleagues have identified a circadian

clock gene that helps a key crop plant to withstand extreme cold and salty conditions, which could help to develop hardier crops with improved yield. The next step is to extend these studies to corn, rice, wheat and soybean, the world's four major crops.

The study appears in the journal *PNAS*.

The circadian clock coordinates the timing of many aspects of plant growth and performance. The researchers identified a gene called GIGANTEA as responsible for natural variation in the circadian clock in Brassica rapa, a species of field mustard from which turnips, cabbages and other vegetables have been developed. Specifically, they identified the nucleotide (individual letter in the DNA encoding GIGANTEA) responsible for this alteration in circadian clock function. The researchers showed that different versions of the GIGANTEA gene affect many aspects of plant performance, including flowering timing, seedling development and resistance to environmental stresses like extreme cold and high salt.

Increases in agricultural productivity have greatly reduced the number of people worldwide without enough food, but one billion remain underfed and twice that many suffer from nutrition deficiencies. Predicted growth in population will require an estimated doubling of crop production by 2050, but yield trends for corn, rice, wheat and soybean, which currently produce nearly two-thirds of global agricultural calories, are insufficient to achieve this doubling. One strategy to increase yield is to identify genetic variation in plant regulatory networks that limit yield in order to define targets for molecular breeding. One such target is the circadian clock, which affects influences plant development in both natural and cultivated settings.

"Our results show that different forms of the GIGANTEA gene can affect many aspects of plant performance, so our findings will enable

plant breeders to select for improved stress tolerance or improved flowering characteristics by deliberately choosing a specific form of the GIGANTEA gene," says senior author Rob McClung, a professor of biological sciences at Dartmouth. "We propose that our results can be generalized to other crops: Natural variation of clock genes in general offers an attractive target for breeders to develop crops with enhanced stress tolerance and improved yield."

More information: Allelic polymorphism of GIGANTEA is responsible for naturally occurring variation in circadian period in Brassica rapa, www.pnas.org/cgi/doi/10.1073/pnas.1421803112

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