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New research alters concept of how circadian clock functions

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Scientists from the University of Cambridge have identified a molecule that may govern how the circadian clock in plants responds to environmental changes.

The researchers have discovered that a signalling molecule, known to be important for environmental stress signalling in plants, also regulates their circadian clock. They believe that the molecule may therefore incorporate information about environmental changes into the biological clock that regulates the physiology of plants. The research dramatically changes our current understanding of the circadian clock and may have important implications for the agricultural community.

In both plants and animals the operation of the circadian clock within the cell consists of feedback loops of gene expression, whereby a series of genes activate or repress one another in a cyclical manner that takes 24 hours.

However, researchers were surprised to find that rather than a protein or a gene, a small cellular signalling molecule called the cyclic adenosine diphosphate ribose (cADPR) plays an important role. This finding changes our current concept of the construction of circadian clocks from being just loops of gene expressions in the cell nucleus, to signalling networks that include components throughout the cell.

Understanding how the plant circadian clock functions could assist with increasing agricultural output for both food as well as new demands for

biofuels. Experiments have shown that correct operation of the plant circadian clock may double plant productivity by increasing the rate of photosynthesis. The circadian clock also regulates the seasonal timing of flowering and seed production.

The study found that interfering with cADPR signalling caused incorrect timing of the circadian clock. For example, eliminating cADPR made the clock run slow. The researchers concluded that cADPR signals are therefore part of this timing system that helps optimize plant growth.

Additionally, the onset of environmental stresses such as drought and salinity are communicated within plant cells by the molecule cADPR. These signals cause cellular responses that allow the plant to survive the stress. The integration of this molecule into the circadian clock could therefore provide a system to change or stabilize the timing of biological events in order to ensure that cells survive the environmental alteration.

Dr Antony Dodd with the Department of Plant Sciences at Cambridge University explained, “The biological clock is thought to be essential for plant life and so it is essential to discover how it works. In our study we have identified a new type of circadian clock component that alters the concept of circadian clock architecture.”

Source: University of Cambridge