J3–Circadian Rhythm Control in Plants

J3–001
Detecting the boundaries of one day

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Proper plant growth and development requires a robust detection of the diurnal environment. This occurs through a coupling mechanism of light detection and the circadian clock. We have been characterizing in the model plant *Arabidopsis thaliana* factors that mediate this coupling. We have genetically isolated the TIC gene required for proper detection of the dark to light transition of dawn. Our recent cloning of this gene provides molecular tools towards understanding the protein activity of the encoded locus. As well, we are working on the ELF3 and ELF4 loci required for detection of the light to dark transition of dusk. Various molecular-physiological analyses have been use to place the ELF3 and ELF4 proteins within a model framework of the clock. We have also uncovered an allelic series of elf3 and elf4 mutations. Characterization of these mutations at physiological and biochemical levels is assisting our understanding of the protein function of these pioneer proteins. The collective use of genetics and protein analyses will enhance our understanding of the biochemical mechanisms of detecting the boundaries of one day.

J3-002
Post-transcriptional control in the *Arabidopsis* circadian system

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The ATGRP7 (*Arabidopsis thaliana* glycine-rich RNA-binding protein) transcript encoding a protein with an N-terminal RNA-binding domain and a glycine-rich C-terminus undergoes circadian oscillations, peaking at the end of the day. Constitutive overexpression of ATGRP7 in transgenic plants depresses oscillations of the endogenous transcript, indicating that the transcript and the protein are pat of a negative feedback loop. The molecular mechanism of the negative autoregulation at the post-transcriptional level will be discussed as well as how ATGRP7 is involved in modulating the expression of a heterologous transcript.

J3–003
Circadian regulation of signalling in plant cells

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The circadian clock is the internal timekeeper of plants. This clock regulates most aspects of plant physiology. This includes those cellular and ion transport processes controlling responses as diverse as stomatal, leaf and floral movements, hypocotyl elongation, nutrient uptake and inter- and intracellular transport. The consensus model for plant circadian clock function is becoming refined with detail, especially at the level of molecular processes that underlie timekeeping (the circadian oscillator), and the synchronization of the oscillator with the external day-night cycle (entrainment). However, the signal transduction pathways that communicate endogenous estimates of external time from the molecular oscillator(s) to clock-controlled components of biochemistry and physiology remain poorly understood. We are investigating the hypothesis that the circadian clock regulates cellular physiology via a Ca^{2+}-based signalling cascade. We have evidence that demonstrate how the circadian clock encodes information in oscillations of cytosolic free Ca^{2+}. We have identified new components of the circadian signalling network using automated measurements of physiology and microarray analysis. These data have allowed is to demonstrate why plants have circadian clocks and to quantify and characterize the benefits of processing a circadian clock.

J3–004
The circadian clock gates shade avoidance responses in *Arabidopsis*

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The phytochromes are a family reversibly photochromic plant photoreceptors that perceive spatial and temporal informational signals and initiate appropriate adaptive developmental strategies. One such strategy involves the phytochrome-mediated perception of the far-red radiation (700–800 nm) reflected/scattered from the leaves of nearby vegetation plants, providing an early warning of potential shading, and leading to a series of developmental responses, the "shade-avoidance" syndrome, that can result in the overgrowth of those neighbours. Thus, on sensing a reflected far-red light signal, a shade-avoiding plant very rapidly exhibits enhanced elongation growth. If the rapid elongation strategy is unsuccessful and the far-red light signal persists, then other aspects of the shade-avoidance syndrome cause accelerated flowering and early production of seeds, enhancing the probability of survival. Despite its adaptive significance, little is known about the molecular events that connect light perception with increased elongation growth in shade avoidance. Using microarrays, we have shown that an early event following the perception of the far-red light signal is the altered expression of numerous genes. For several of these genes, altered expression in response to far-red light signals is gated by the circadian clock. Furthermore, the rapid shade avoidance elongation growth response is gated by the circadian clock, being most apparent around dusk. One of the rapidly far-red-responsive genes encodes a basic helix-loop-helix protein, PIL1 that is essential for the rapid elongation growth response.