New Faculty in Rice Biochemistry & Cell Biology

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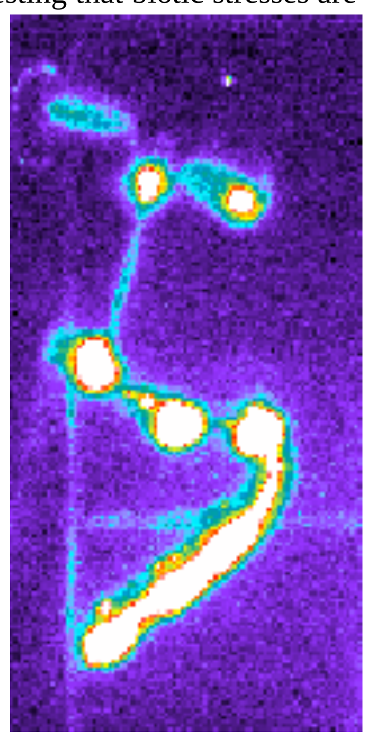
My primary interest is in using functional genomics approaches to study the physiological relevance of the plant circadian clock. Plants, which as sessile organisms are intimately tied to their environment, have evolved many ways to deal with changing local conditions. One coping mechanism is the circadian clock, which produces self-sustained rhythms with an approximately 24-hour period. Circadian clocks have been shown to contribute to fitness, presumably by enabling organisms to anticipate daily changes in the environment and to temporally separate incompatible metabolic events.

Many acute abiotic stresses are the direct result of daily light/dark cycles. As such, genes involved in the perception, signaling and/or responses related to such stresses might be expected to be under clock control. Insects and plant pathogens possess circadian systems that regulate daily activity and development, suggesting that biotic stresses are also likely to occur at predictable times of day. Clock-controlled abiotic and biotic stress perception, signaling, and/or responses are, therefore, strong candidates for a mechanism by which circadian clocks increase fitness. This hypothesis raises many interesting and fundamental questions about the role of the clock in nearly all aspects of a plant's interaction with its environment.



With an ultimate goal of understanding how circadian clocks increase fitness, I plan to use a multi-disciplinary, genome-enabled systems approach to answer the following: Which stress response pathways are clock controlled? How is circadian regulation integrated into these responses? Does circadian control of stress responses provide a competitive advantage? If so, by what mechanism is this accomplished? A mechanistic understanding could ultimately enable plant biologists to increase plant fitness, yield, and hardiness, as well as expand geographic regions of growth.

Publications:

1. Gong W, He K, **Covington** MF, Dinesh-Kumar SP, Snyder M, Harmer SL, Zhu Y, and

Deng, XW (2007) The development of protein microarrays and their applications in DNA-protein and protein-protein interaction analyses of *Arabidopsis* transcription factors, Molecular Plant, in press. • Molecular Plant is a newly founded international journal (http://mplant.oxfordjournals.orgl)

2. Walley JW, Coughlan S, Hudson ME, **Covington** MF, Kaspi R, Banu G, Harmer SL and Dehesh K (2007) Mechanical stress induces biotic and abiotic stress responses via a novel cis-element. PLoS Genet 30: el72. doi:1O.1371/journal.pgen.0030172

3. **Covington** MF, Harmer SL (2007) The circadian clock regulates auxin signaling and responses in *Arabidopsis.* PLoS Biol 5(8): e222. doi:l0.1371/journal.pbio.0050222

4. Nozue K, **Covington** MF, Duek, PO, Lorrain, S, Fankhauser, C, Harmer SL, and Maloof IN (2007) Rhythmic growth explained by coincidence between internal and external cues. Nature 448(7151): 358361

5. Harmer SL, **Covington** MF, Blasing OE, Stitt M (2005) Circadian regulation of global gene expression and metabolism. In: Hall A, McWatters HG, editors. Endogenous Plant Rhythms: Blackwell Synergy. pp. 133-165.

6. **Covington** MF, Panda S, Liu XL, Strayer CA, Wagner DR, Kay SA (2001) ELF3 modulates resetting of the circadian clock in *Arabidopsis.* Plant Cell 13:1305-1316.

7. Liu XL, **Covington** MF, Fankhauser C, Chory J, Wagner DR (2001) *ELF3* encodes a circadian clock regulated nuclear protein that functions in an *Arabidopsis* PHYB signal transduction pathway. Plant Cell 13:1293-1304.