Metabolic regulation of the circadian clock of Arabidopsis

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Arabidopsis circadian clocks generate rhythmic activity of metabolism, physiology, signalling and developmental processes. Arabidopsis circadian oscillators are formed of transcription-translation feedback loops and associated cell physiological processes. To ensure that the timing of internal events is correctly matched to the local environment the phase of circadian rhythms are set by light and temperature signals at dawn, in a process called entrainment. We discovered that circadian rhythms in Arabidopsis also can be entrained to rhythmic endogenous sugar signals that are generated by daily photosynthetic activity. We have proposed that the circadian phase adjustment that occurs in response to sugar signals defines a 'metabolic dawn' which occurs approximately 4h after the physical dawn of first light. Endogenous oscillations of sugars provide metabolic feedback to the circadian oscillator through regulation of the expression of two core circadian oscillator genes that are expressed in the morning, *PSEUDO RESPONSE REGULATOR 7 (PRR7)* and *CIRCADIAN CLOCK ASSOCIATED 1* (*CCA1*). We will describe new data defining the signalling network by which sugars regulate *PRR7* expression. Incorporation of our findings in to a mathematical model of plant carbon usage suggests some of the advantages conferred by metabolic regulation of the circadian oscillator.