

T H E P L A N T C E L L

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ON THE COVER



Climate change predictions point to an increased frequency and severity of drought in many of the most productive agricultural regions of the world. Plant scientists are therefore seeking novel methods to enhance plant water use efficiency. One option being explored is that of Crassulacean acid metabolism (CAM), a water-wise adaptation of photosynthetic CO₂ fixation. Research is underway to decipher the molecular-genetic blueprint for CAM in order to generate the parts list to facilitate CAM engineering into C₃ crops. CAM separates primary and secondary CO₂ fixation between the dark and light periods, respectively. Primary fixation in the dark is catalyzed by phosphoenolpyruvate carboxylase (PPC), followed by secondary CO₂ fixation by RuBisCO in the light. Boxall et al. (pages 1136-1160) generated transgenic RNAi lines of *Kalanchoe laxiflora* with reduced levels of the CAM-specific primary carboxylase PPC1. The most strongly silenced line lacked all detectable PPC activity, failed to fix atmospheric CO₂ in the dark period, and thus reverted to C₃-like photosynthetic metabolism. This had knock-on consequences for the operation of the core circadian clock and the regulation of guard cell signaling genes that are revealed as candidates for mediating the inverse pattern of stomatal opening and closing, relative to C₃ photosynthesis, which is characteristic of CAM. The cover image shows wild type *Kalanchoe laxiflora* in flower, along with the CAM performing succulent leaves below. In *K. laxiflora*, the endogenous circadian clock not only coordinates and optimizes CAM relative to the 24 h light/dark cycle, but also measures the changing seasons and signals flowering in response to short days. Photo by James Hartwell.

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