Engineering crassulacean acid metabolism to improve water-use efficiency

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Background:

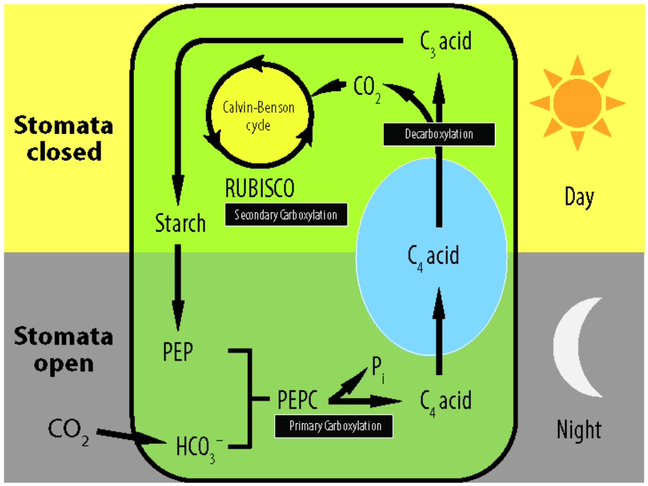
Crassulacean acid metabolism (CAM) is a temporally controlled plant inorganic CCM that maximizes water-use efficiency (WUE) by shifting all or part of the CO_2 uptake to the nighttime, when evapotranspiration rates are reduced compared with the daytime. This report assesses the progress that has been made in defining the genetic requirements and strategies for the assembly and operation of CAM in C_3 plants *via* synthetic biology.

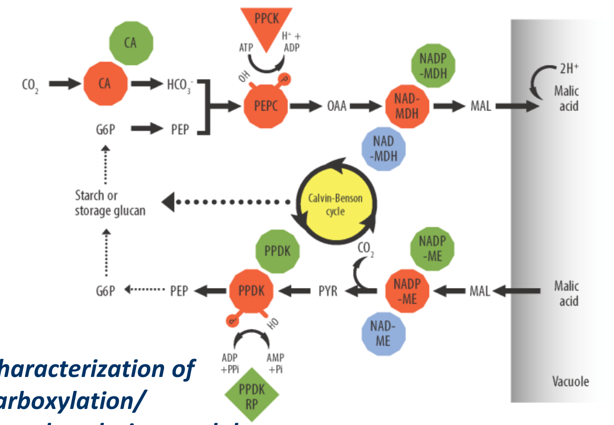
Approach:

- The development of bioenergy feedstocks and food crops engineered with the improved WUE of CAM plants complements the direct use of CAM species to supply human needs.
- A fundamental requirement for engineered CAM is a detailed understanding of the minimal set of genes and proteins required for its efficient establishment and operation through the genomic sequences and transcriptome atlases available from cycling, facultative, or obligate CAM species sampled from diverse phylogenetic origins.

Significance:

- The successful engineering of CAM into C_3 plant species will depend upon a complete understanding the temporal regulatory events controlling the core carboxylation–decarboxylation of C_4 acids and metabolic fluxes through glycolysis–gluconeogenesis and storage carbohydrate synthesis and breakdown, as well as stomatal control.





Characterization of carboxylation/ decarboxylation modules

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