Synthetic biology as it relates to CAM photosynthesis: challenges and opportunities

Funding: Genomic Science Program DE-SC0008834

U.S. DEPARTMENT OF ENERGY
Office of Science

Background:

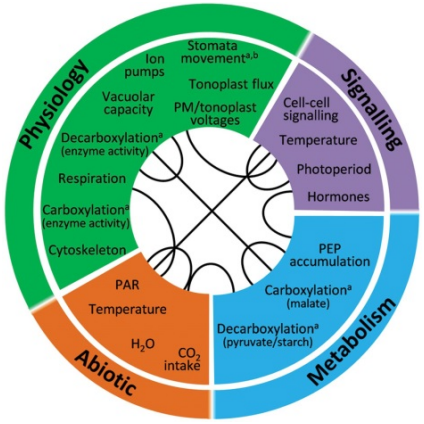
Biochemical carbon-concentrating mechanisms such as Crassulacean acid metabolism (CAM) represent a strategic target for synthetic biology to engineer more productive C3 crops for a warmer and drier world. This work reviews progress in modelling plant photosynthesis with advances in synthetic biology and proposes novel approaches to metabolic engineering efforts to improve photosynthetic efficiency.

Approach:

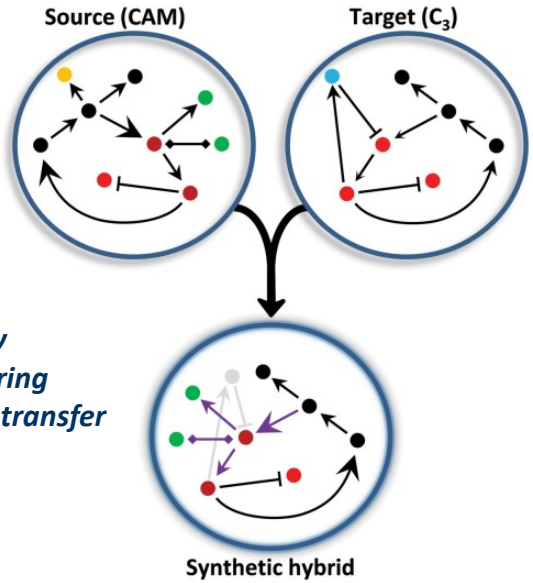
- Modelling photosynthesis will play a principal role in improving scientific understanding of regulatory mechanisms used to accelerate targeted genetic manipulation.
- The availability of synthetic elements controlling light-mediated responses, transcription factor–DNA binding, and protein domains for subcellular localization and controlled degradation; and rapid and reliable *in vitro* cloning technologies, will improve future synthetic biology endeavors.

Significance:

- Photosynthesis is potentially the most powerful and sustainable energy conversion machine on earth, and is a compelling target for improving the properties of plants as sources of food, feed, fiber, and fuel.
- The custom design, engineering, and construction of photosynthetic mechanisms through synthetic biology is now potentially achievable.
- Exploration of genomics and functional genomics into the understudied molecular and biochemical basis of the CAM domain may open a new door to genetic improvement in water use efficiency (WUE) in bioenergy crops.



Elements used to develop computational modelling



Pathway engineering for trait transfer

Citation: DePaoli HC, Borland AM, Tuskan GA, Cushman JC, and Yang X. 2014. Synthetic biology as it relates to CAM photosynthesis: challenges and opportunities J. Exp. Bot. first published online February 24, 2014 doi:10.1093/jxb/eru038.

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CAM
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