Strategies for improving C_4 photosynthesis

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Recent activities to improve photosynthetic performance in crop plants have focused primarily on C_3 photosynthesis where there are clear identified targets such as improving Rubisco kinetics, installation of a CO_2 concentrating mechanism and alleviating limitations in chloroplast electron transport. However, C_4 plants that utilise the C_4 photosynthetic pathway also play a key role in world agriculture. For example, C_4 crops such as maize and sorghum are major contributors to both first and third world food production and the C_4 grasses sugarcane; miscanthus and switch grass are major plant sources of bioenergy. Strategies to manipulate and enhance C_4 photosynthesis thus have potential for major agricultural impacts.

The C_4 photosynthetic pathway is a biochemical CO_2 concentrating mechanism that requires the coordinated functioning of mesophyll and bundle sheath cells of leaves and species have evolved a complex blend of anatomy and biochemistry to achieve this. The limitations to photosynthetic flux are not as well studied in C_4 plants, but our work with transgenic *Flaveria bidentis*, a transformable model C_4 dicot, has provided gene candidates for improvement of carbon metabolism. Chloroplast electron transport in C_4 plants is shared between the two cell types, providing opportunities not only to alleviate limitations to flux through intersystem electron transport by targeting nuclear encoded proteins in the cytochrome (Cyt) b_6/f complex, but in better sharing the harvesting of light energy between mesophyll and bundle sheath chloroplasts.

We are using the model monocot C_4 species *Setaria viridis* (green foxtail millet) to generate transgenic plants with altered C_4 photosynthetic metabolism to address these questions and will report on our recent findings.