

Recycling carbon in photosynthesis

Scientific Achievement

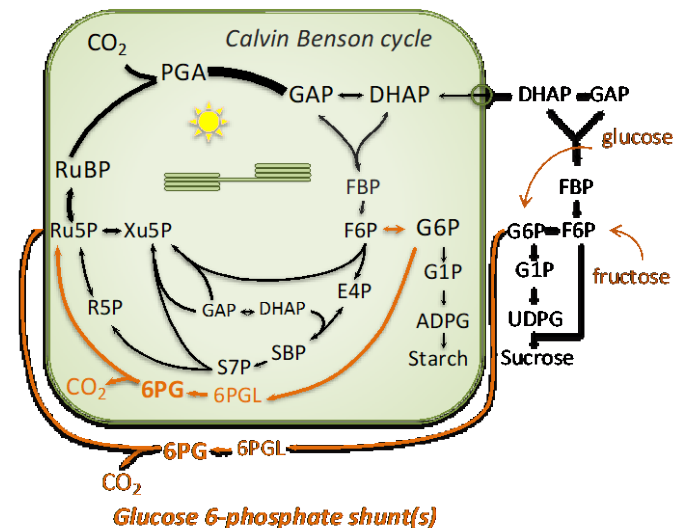
Discovered evidence that glucose is recycled back into photosynthetic metabolism.

Significance and Impact

The pathway for converting carbon dioxide to starch and sucrose in photosynthesis was discovered by labeling using isotopes of carbon. However, not all carbon in the pathway becomes labeled. A similar phenomenon was known for isoprene emission, not all isoprene is labeled when carbon isotopes are fed. We showed that these observations are linked, isoprene provides a window on photosynthesis.

Research Details

- As much as 40% of isoprene emitted from a leaf fed an isotope of carbon does not become labeled. This varies with stress.
- We showed that this is because photosynthesis metabolites do not label fully.
- Isoprene accurately reflects the labeling of photosynthesis metabolites.
- Modeling showed that this is likely caused by a flow of unlabeled glucose into photosynthetic metabolism through a shunt that bypasses part of photosynthesis.
- The amount of glucose that follows this pathway varies with stress, for example it is much higher at high temperature.
- Isoprene provides a non-destructive method for measuring this flow of carbon.



Glucose and fructose can reenter photosynthetic metabolism (the Calvin Benson cycle) through glucose 6-phosphate shunts (in orange). At normal temperature only the outer (cytosolic) shunt is active. Temperature stress speeds the outer shunt and turns on the inner (chloroplast) shunt.

Sharkey TD, Preiser AL, Weraduwege SM, Gog L,. *Biochemical Journal*; August, 2020 ([Read here](#))

Thomas D. Sharkey: University Distinguished Professor, MSU-DOE Plant Research Laboratory, tsharkey@msu.edu, 517-353-3257

