Geophysical Research Abstracts, Vol. 8, 01562, 2006
SRef-ID: 1607-7962/gra/EGU06-A-01562

Substrate versus enzyme controls over isoprene emission from poplar leaves grown at elevated CO2 concentration

Todd N. Rosenstiel, Ray Fall, **Russell K. Monson**
University of Colorado, Boulder, CO, USA
(Russell.Monson@colorado.edu / Phone: 001-303-492-6319

It is well known that the capacity to produce and emit isoprene is controlled by the activity of isoprene synthase enzyme in the chloroplasts. The expression of this enzyme scales positively with the expression of photosynthetic capacity. Connections between photosynthesis and isoprene synthase activity, however, cannot solely explain the decrease in isoprene emissions observed when plants are grown at elevated atmospheric CO2 concentrations. In past studies we have shown that cytosolic processes that utilize phosphoenol pyruvate (PEP) have the potential to limit the rate of isoprene emission from the leaves of poplar trees. This represents a substrate limitation, rather than a limitation by isoprene synthase activity. In recent studies, we have grown poplar trees with increased CO2 concentration provided to the roots, as opposed to the shoots. This treatment caused the trees to shift their allocation of nitrate reductase activity and PEP carboxylase activity from the leaves to the roots, enhancing leaf PEP availability and increasing both the substrate available for isoprene biosynthesis (DMAPP) and isoprene emission rate. At the same time, however, we observed a reduction in the activity and amount of isoprene synthase in the leaves. This is the first report of an increase in isoprene emission rate, despite a reduction in isoprene synthase expression, and it confirms the role of PEP substrate limitations to isoprene biosynthesis in elevated atmospheric CO2. Our results indicate that in order to understand the response of isoprene emissions to future increases in atmospheric CO2 concentration, we will need to focus on integrated aspects of plant metabolism, including the interactions of cytosolic and chloroplastic processes and the whole-plant partitioning of certain key processes that utilize carbohydrate substrates and derived products.