Application of carbon isotopes in photosynthetic research

Susanne von Caemmerer

Plant Science Division, Research School of Biology, The Australian National University, ACT 0200, Australia

There are two naturally occurring stable isotopes of carbon, $^{12}\text{C}$ and $^{13}\text{C}$. Most of the carbon is $^{12}\text{C}$ (98.9%), with 1.1% being $^{13}\text{C}$. It has been known for decades that the stable carbon isotope ratios ($^{13}\text{C}/^{12}\text{C}$) of the organic matter of terrestrial plants vary amongst plant species and with environment. These variations can be explained by carbon isotope fractionations occurring during photosynthetic CO$_2$ fixation which are caused by fractionations occurring during diffusion of CO$_2$ and during enzymatic carboxylation reactions [1, 2]. Discrimination during photosynthesis has a significant effect on isotope composition of atmospheric CO$_2$ at the regional and global levels which are relevant to studies of the global carbon cycle.

New optical isotope analysers (lasers and Fourier transform infrared spectroscopy) now allow for rapid measurement of carbon isotope ratios in air which allows us to combine conventional measurements of leaf CO$_2$ uptake with measurements of carbon isotope discrimination to probe photosynthetic mechanisms [3]. This is being used to provide better mechanistic understanding of photosynthetic processes and as a breeding tool for crop improvement.

