Geophysical Research Abstracts
Vol. 17, EGU2015-7937, 2015
EGU General Assembly 2015

Influence of atmospheric [CO_2] on growth, carbon allocation and cost of plant tissues on leaf nitrogen concentration maintenance in nodulated Medicago sativa

Gabriela Pereyra (1), Henrik Hartmann (1), Waldemar Ziegler (1), Beate Michalzik (2), Miquel Gonzalez-Meler (3), and Susan Trumbore (1)

(1) Max-Planck Institut für Biogeochemie, Jena, Germany (gpereyra@bgc-jena.mpg.de), (2) Friedrich-Schiller- Universität Jena, Institut für Geographie, Jena, Germany, (3) University of Illinois at Chicago, Department of Biological Sciences, IL, USA.

Plant carbon (C) allocation and plant metabolic processes (i.e. photosynthesis and respiration) can be affected by changes in C availability, for example from changing atmospheric [CO_2]. In nodulated plants, C availability may also influence nitrogen (N) fixation by bacteriods. But C allocation and N fixation are often studied independently and hence do not allow elucidating interactive effects. We investigated how different atmospheric [CO_2] (Pleistocene: 170 ppm, ambient: 400 ppm and projected future: 700 ppm) influence plant growth, allocation to nodules, and the ratio of photosynthesis-to-respiration (R:A) as an indicator of C cost in Medicago sativa inoculated with Ensifer meliloti.

M. sativa grew c. 38% more nodules at 400 ppm and 700 ppm than at 170 ppm. However, ratios of above- and belowground plant biomass to nodule biomass were constant over time and independent of atmospheric [CO_2]. Total non-structural carbohydrate concentrations were not significantly different between plants grown at 400 and 700 ppm, but were four to five-fold higher than in 170 ppm plants. Leaf level N concentration was similar across treatments, but N-based photosynthetic rates were 82% and 93% higher in leaves of plants grown at 400 and 700 ppm, respectively, than plants grown at 170 ppm. In addition, leaf R:A was greater (48% or 55%) in plants grown at 170 ppm than plants grown at 400 and 700 ppm. Similarly, the greatest proportion of assimilated CO_2 released by root respiration occurred in rhizobial plants growing at 170 ppm. Our results suggest that C limitation in nodulated Medicago sativa plants did not influence C allocation to nodule biomass but caused a proportionally greater allocation of C to belowground respiration, most likely to bacteriods. This suggests that N tissue concentration was maintained at low [CO_2] by revving up bacteriod metabolism and at the expense of non-structural carbohydrate reserves.