Geophysical Research Abstracts, Vol. 8, 08985, 2006
SRef-ID: 1607-7962/gra/EGU06-A-08985

Fractionation of ^{13}C in maize is affected by assimilate partitioning

M. Werth (1) and **Y. Kuzyakov** (1,2)

(1) Institute of Soil Science and Land Evaluation, University of Hohenheim, 70593 Stuttgart, Germany, (2) Institute of Landscape Matter Dynamics, ZALF, Muencheberg, Germany (kuzyakov@zalf.de)

The ^{13}C natural abundance is a common tool for partitioning of CO_2 fluxes from soils and ecosystems. One of the limitations of the ^{13}C natural abundance approach is high variation of the $\delta^{13}C$ values of CO_2 compared to the difference between the end members used for the CO_2 partitioning. Also ^{13}C isotopic discrimination, which depends on the process reversibility and rates, may strongly affect the results of the CO_2 partitioning. Especially the ^{13}C fractionation in the below-ground processes such as root respiration, exudation and rhizomicrobial respiration may shift the partitioning results.

We investigated ^{13}C fractionation by root and rhizomicrobial respiration depending on assimilate partitioning between shoots, roots, exudates, and CO_2 respired by maize roots. To estimate the contribution of recently assimilated C to the root respiration and exudation, maize plants were pulse labelled in $^{14}CO_2$ atmosphere. The amount of recently assimilated C in shoots, roots, exudates, and respired CO_2 was controlled by three different levels of nutrient (N, P, K) supply and was traced by ^{14}C after pulse labelling of shoots.

Increasing amounts of recently assimilated C in the shoots (from 69 to 76% of recovered ^{14}C) and increasing shoot biomass led to a 0.2‰ ^{13}C depletion in the shoots. The opposite relationship was determined in the roots, where an increasing amount of recently assimilated C (from 8 to 10% of recovered ^{14}C) led to a 0.3‰ ^{13}C enrichment. This enrichment rose by additional 0.3‰ when C allocation in the roots was further increased (from 10 to 13% of recovered ^{14}C).

$\delta^{13}C$ of CO_2 evolved by root respiration was similar to that of the roots. However, if the amount of recently assimilated C in root respiration was reduced, ^{13}C fractionation between roots and respired CO_2 increased up to 0.7‰. Increasing amounts of recently assimilated C in roots and root respiration led to δ^{13}C increase in both pools. Nutrient deficiency led to increase of δ^{13}C of respired CO_2 for 1.6‰ compared to full nutrient supply. Strong nutrient deficiency also led to doubling of exudation amount accompanied by strong ^{13}C depletion of 6.9‰ compared to the full nutrient supply treatment. Nutrient deficient plants showed the same δ^{13}C of roots and exudates, whereas high-nutrient supply decreased the amount of recently assimilated C in exudates and led to fractionation between roots and exudates of 5.3‰.

We conclude that ^{13}C discrimination between plant pools and within processes such as exudation and root respiration cannot be accepted as fixed and strongly depends on the C amount in the pool and on partitioning of recently assimilated C. Therefore, by the CO_2 efflux partitioning based on ^{13}C natural abundance the ^{13}C discrimination should be estimated for specific environmental and nutrient supply conditions.