Decoupled relationship between diffusive fluxes and concentrations of nitrogen in soil

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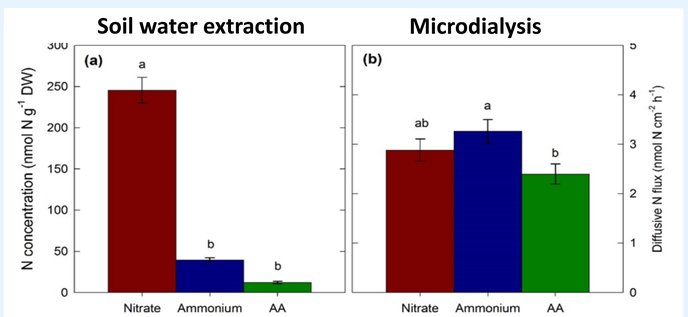
Objectives

Synchronizing soil nitrogen (N) supply and crop N demand has the potential to minimize N pollution from inefficient use of fertilizers by agricultural crops. However, assessing how much and in which form N arrives at the root surface remains a major challenge. Microdialysis can be used to face this challenge, but is of limited suitability for studying field-scale N dynamics due to its miniature design. The objective of this study was to test the possibility of upscaling results from small-scale microdialysis sampling by a combined microdialysis – soil water extraction approach.

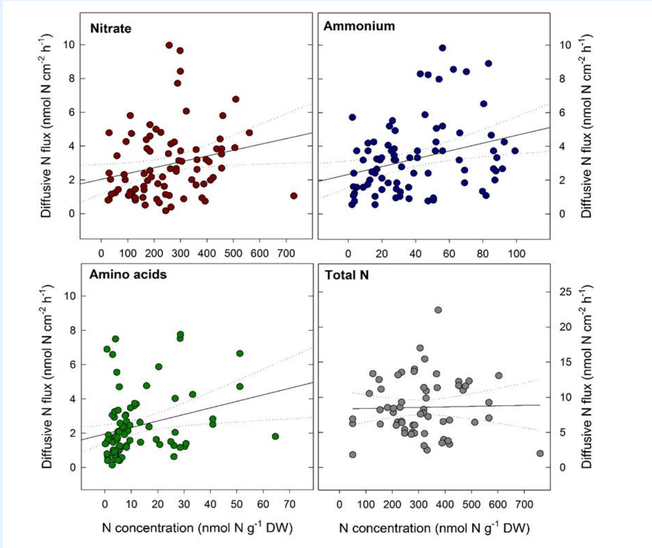
Study site and sampling

We estimated diffusive fluxes and water-extractable concentrations of NH_4^+, NO_3^- and amino acids in an agricultural field in Lower Austria (48°07'35.8"N 15°26'39.3"E) used for corn production. The soil is classified as Gleyic Cambisol (FAO) with 38% clay, 25% silt and 37% sand, with a pH (H_2O) of 7.67, a C:N-ratio of 8.8, a CEC_p of 1.715 $mmol_c$ kg^{-1} and an EC of 0.627 mS cm^{-1}. Diffusive N fluxes were estimated by *in situ* microdialysis and N concentrations by soil water extractions.

Diffusive fluxes of NO_3^-, NH_4^+ and amino acids were similar (38, 34 and 28%, respectively), while NO_3^- was the dominant N form (~80%) in water extracts.

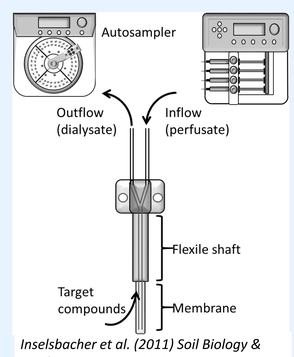


Diffusive N fluxes were decoupled from extractable N concentrations, i.e. no clear correlation between these two parameters could be found.



The microdialysis system

The microdialysis system consists of a high-precision pump providing a continuous flow of perfusate, microdialysis probes equipped with flexible, semi-permeable membranes (20 kDa molecular weight cut-off), and a refrigerated autosampler.



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Highlights

1) Soils supply **similar amounts of NO_3^-, NH_4^+ and amino acids** for root uptake.

2) Results from soil extractions **do not correlate** with *in situ* diffusive N fluxes.

➡ Diffusive soil N fluxes are decoupled from soil N concentrations.

➡ Soil physical and biological factors overrule concentration gradients of N in soil.

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