



Investigating shifts in nitrogen transformations in response to soil health oriented management using a new combination of stable isotope approaches

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Sustainable crop production as well as climate change mitigation require a better quantitative process understanding for nitrogen (N) transformations and their response to specific land management strategies. Here we investigated shifts in N transformations following the transition from conventional to soil health-oriented farming using a new combination of ¹⁵N stable isotope methods. Soil samples were taken from four different farms in two different regions in Lower Austria following a paired site approach, comparing a clay and a sandy textured soil under conventional vs. organic management. Soils were fertilized with single labelled NH₄¹⁵NO₃ and incubated in a fully automated incubation system, with continuous monitoring of ¹⁵N₂O. Changes in ¹⁵N enrichment in N pools were investigated by converting the N pools of interest into NO₃⁻, and further to N₂O via the Ti (III) reduction method, establishing the ¹⁵N enrichment via cavity ringdown spectroscopy (Picarro G5102-i). Changes in ¹⁵N in the NO₃⁻ pool showed that gross nitrification was higher in the clay as compared to the sandy textured soil, but did not respond to management. Gross NO₃⁻ consumption was however higher in organically managed soils, regardless of texture, and ¹⁵N enrichment in the soil microbial biomass indicated negligible assimilation of the applied ¹⁵N fertilizer under the conditions of the experiment. Combining classic ¹⁵N pool dilution and ¹⁵N tracing with Ti (III) reduction and cavity ringdown spectroscopy allowed for a timely determination of N pools and their ¹⁵N enrichment, obviating the need for costly and time-consuming analysis via isotope ratio mass spectroscopy. Further tests and analysis are needed to demonstrate the sensitivity of the approach for specific soil N pools, comparing results obtained to isotope ratio mass spectroscopy data. Analysis of the ¹⁵N₂O data together with the ¹⁵N enrichment of the soil N pools will establish the significance of specific pathways of N₂O production and their response conventional vs. soil health-oriented farming practices.