Geophysical Research Abstracts
Vol. 18, EGU2016-17585, 2016
EGU General Assembly 2016

Can Crops with Greater Rooting Systems Improve Nitrogen Retention and Mitigate Emissions of Nitrous Oxide?

Charlotte Decock (1), Juhwan Lee (1), Matti Barthel (1), Chris Mikita (1), Benjamin Wilde (1), Elizabeth Verhoeven (1), Andreas Hund (1), Samuel Abiven (2), Cordula Friedli (1), Franz Conen (3), Joachim Mohn (4), Benjamin Wolf (5), and Johan Six (1)

(1) ETH-Zurich, Agricultural Sciences, Environmental Systems Science, Zurich, Switzerland (charlotte.decock@usys.ethz.ch), (2) Soil Science and Biogeography, Department of Geography, University of Zurich, Zurich, Switzerland, (3) Institute of Environmental Geosciences, University of Basel, Basel, Switzerland, (4) Laboratory for Air Pollution & Environmental Technology, EMPA, Dübendorf, Switzerland, (5) Institute for Meteorology and Climate Research (IMK-IFU), Karlsruhe Institute of Technology, Garmisch-Partenkirchen, Germany

It has been suggested that crops with deeper root systems could improve agricultural sustainability, because scavenging of nitrogen (N) in the subsoil would increase overall N retention and use efficiency in the system. However, the effect of plant root depth and root architecture on N-leaching and emissions of the potent greenhouse N2O remains largely unknown. We aimed to assess the effect of plant rooting depth on N-cycling and N2O production and reduction within the plant-soil system and throughout the soil profile. We hypothesized that greater root depth and root biomass will (1) increase N use efficiency and decrease N losses in the form of N leaching and N2O emissions; (2) increase N retention by shifting the fate of NH4+ from more nitrification toward more plant uptake and microbial immobilization; and (3) increase the depth of maximum N2O production and decrease the ratio of N2O:(N2O+N2) in denitrification end-products. To test these hypotheses, 4 winter wheat cultivars were grown in lysimeters (1.5 m tall, 0.5 m diameter, 3 replications per cultivar) under greenhouse conditions. Each lysimeter was equipped with an automated flux chamber for the determination of N2O surface fluxes. At 7.5, 30, 60, 90 and 120 cm depth, sampling ports were installed for the determination of soil moisture contents, as well as the collection of soil pore air and soil pore water samples. We selected two older and two newer varieties from the Swiss winter wheat breeding program, spanning a 100-year breeding history. The selection was based on previous experiments indicating that the older varieties have deeper rooting systems than the newer varieties under well watered conditions. N2O fluxes were determined twice per day on a quantum cascade laser absorption spectrometer interfaced with the automated flux chambers. Once per week, we determined concentrations of mineral N in pore water and of CO_2 and N2O in the pore air. For mineral N and N2O, also natural abundance isotope deltas were determined, to obtain in situ process-level information on N-cycling. Preliminary results show lower soil moisture content and higher subsurface N2O and CO_2 concentrations for the old varieties compared to the new varieties. Currently, we are performing isotope analyses, surface flux analyses, and we are harvesting the plants for determination of root- and aboveground biomass, and C and N contents therein. Results from these analyses are expected before April 2016, and will allow us to reconstruct the N budget and further explore to what extent our hypotheses are corroborated.