Nitrogen stabilization in soil organic matter after continuous organic fertilizer application

Introduction: Nitrogen (N) plays a critical role in agriculture, ensuring high yields and food security. However, N is prone to environmental losses through various pathways such as ammonia volatilization, nitrate leaching, and denitrification, contributing to nitrogen excess in ecosystems. In Switzerland alone, nitrogen excess reaches 93 kg N/ha per year, with most of it at risk of environmental loss (Spiess and Liebisch, 2020). Therefore, optimizing Nitrogen-Use-Efficiency (NUE) is essential to protect sensitive ecosystems and enhance agricultural productivity.

Project Overview: The Recycle4Bio project investigates yield and NUE of organic fertilizers such as slurry and anaerobically digested slurry from biogasplants in an organically managed field trial. Biogas slurry tends to have a higher proportion of plant-available (NH_4-N) nitrogen, which on the one hand increases the possible NUE, on the other rises the risk of losses such as NH_3 volatilization. The project is located in Wallbach (AG) and runs together with the FiBL Switzerland since 2018.

Experimental Approach: We set up a stable isotope experiment to track the fate of NH_4-N from organic fertilizers in the plant-soil-fertilizer system. NH_4-N in organic fertilizers was labelled with $(^{15}NH)_2SO_4$ during two fertilizer applications per year over four years (2018, 2019, 2023 and 2024). After fertilizer application, plants take up and simultaneously soil microbes immobilize a portion of the applied N, of which some N is permanently stabilized in soil organic matter. Every harvest, ^{15}N and total Nitrogen is measured in plant, microbial pool and soil in order to understand the fate of N of the different organic fertilizers in the plant-soil-fertilizer system.

Student Work: At the end of the experimental trial, we would like to investigate, how much of the applied ^{15}N tracer is still present in the soil and stabilized in soil organic matter. Soil samples are collected after the winter barley harvest (Beginning of July) to assess the presence of $^{15}NH_4$-N in the microbial pool and stabilized in soil organic matter.

The student will assist in soil sample collection in the field. Chloroform-fumigation extraction (CFE) will be performed to assess the amount of N immobilized by microorganisms. Soil samples will undergo soil fractionation to measure N stabilization in soil organic matter. Samples will be analyzed for ^{15}N signature using IRMS. Definitive tasks may be assigned based on the student's interest and start of thesis. Finally, the student will analyse the data and write up the thesis.

Requirements and Contact Information: We seek a motivated student interested in soil N dynamics, willing to work in both field and lab settings. Prior knowledge of lab methods is advantageous but not mandatory. The student will work at Agroscope Reckenholz in Zurich, supervised by Matthias Diener and Dr. Jochen Mayer. An additional supervisor (e.g Dr. Astrid Oberson) from ETH will be determined with the student at the beginning of the thesis.

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