EGU22-12833
https://doi.org/10.5194/egusphere-egu22-12833
EGU General Assembly 2022

How soil sodification and pH restrict microbially mediated organic carbon turnover and aggregate formation: An artificial soil microcosm study

Steffen Schweizer[1], Janosch Fiedler[1], Anne Boehm[1], Michael Dannenmann[2], Noelia Garcia-Franco[1], Jincheng Han[2], Christian Poll[3], Vanessa Wong[4], and Franziska Bucka[1]

[1]Soil Science, TUM School of Life Sciences, Technical University of Munich, Freising, Germany (steffen.schweizer@tum.de)
[2]Institute of Meteorology and Climate Research (IMK-IFU), Karlsruhe Institute of Technology, Garmisch-Partenkirchen, Germany
[3]Soil Biology, Institute of Soil Science and Land Evaluation, University of Hohenheim, Stuttgart, Germany
[4]Atmosphere and Environment, School of Earth, Monash University, Clayton Vic., Australia

Exchangeable sodium can have pronounced influences on physicochemical soil properties whereas the combined impact on microbial turnover of organic carbon (OC) remains elusive. In this work, we aimed to differentiate the effects of exchangeable sodium and soil pH on microbially mediated aggregate formation and turnover of cattle slurry. We incubated the soils under controlled laboratory conditions using artificial soil model minerals containing quartz grains, montmorillonite and goethite. The montmorillonite was pre-treated with NaCl solutions of sodium adsorption ratios (SAR) 0, 1 and 5 which resulted in exchangeable sodium percentages (ESP) of 1, 7 and 19 on average. The soil pH was adjusted within two treatments to 7.5 and 8.5 for each ESP at the start of the incubation. We incubated these six treatments with and without cattle slurry ground to < 200 µm after addition of a combined microbial inoculum, extracted from a Cambisol (pH_{H2O} 7.5, Germany) and a Calcaric Solonchak (pH_{H2O} 9.3, Spain) added to all samples. The microcosms were incubated with three replicates over a period of 30 days at constant pF of 2.2. The CO_2 emission measurements of the microcosms with exchangeable sodium indicated a delayed respiration. The respiration under ESP 19 increased rapidly within the first days of incubation, whereas it was more delayed under ESP 7 until 15 days of incubation. The delayed CO_2 respiration might be related to inhibited structural formation in treatments with higher exchangeable sodium. To test this, we are investigating the data on water-stable aggregation by wet sieving. The delayed CO_2 respiration was reflected in lower microbial biomass, extracted after the incubation. The microbial biomass under ESP 19 and pH 8.5 was highest whereas the amount of leached C after two rainfall events (at day 7 and 15) was lowest, which could be related to a higher microbially mediated OC sequestration. The composition of exchangeable cations was monitored before and after the whole incubation which might help explaining the processes of microbially mediated aggregate formation and microbial carbon turnover under different levels of exchangeable sodium.