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Short-term effects of natural and NH4+-enriched chabazite zeolitite amendments to soil microbial biomass

Giacomo Ferretti (1), Katharina Maria Keiblinger (2), Dario Di Giuseppe (1), Barbara Faccini (1), Nicolò Colombani (3), Sophie Zechmeister-Boltenstern (2), Massimo Coltorti (1), and Micòl Mastrocicco (4)

(1) University Of Ferrara, Physics and Earth Sciences, Ferrara, Italy (frrgcm@unife.it), (2) Institute of Soil Research, Department of Forest and Soil Sciences, University of Natural Resources and Life Sciences Vienna (BOKU), Vienna, Austria, (3) Department of Biological, Geological and Environmental Sciences. University of Bologna. Via Zamboni 67, Bologna, Italy., (4) Department of Environmental, Biological and Pharmaceutical Sciences and Technologies. Second University of Naples, Caserta, Italy

Natural zeolite-bearing rocks (zeolitites) are known to be a suitable material for agricultural purposes by improving soil physicochemical properties and nitrogen use efficiency (NUE). However, little is known about their effects on soil microbial biomass. Aim of this work is to evaluate short-term effects of different chabazite-zeolitite amendments on soil microbial biomass (and activity). To this purpose a silty-clay agricultural soil was amended in three different ways, by the addition of 5 and 15 wt% of natural chabazite zeolitites (NZ) and 10 wt% of NH4+-enriched chabazite zeolitites (CZ). Soil pH, water content, dissolved organic carbon (C), total dissolved N, NH4+, NO_3-, NO_2-, microbial biomass C and N and ergosterol were periodically measured over a time course of 16 days in a laboratory incubation experiment. In order to verify the immobilization of N derived from CZ into microbial biomass, the δ15N signature of microorganisms was evaluated by the Extraction-Fumigation-Extraction method followed by EA-IRMS analysis. This latter investigation was possible because zeolitites were enriched with NH4+ derived from pig-slurry, which have a very high 15N natural abundance that allow to trace microbial incorporation.
Soil amended with 5 wt% of NZ showed increased ergosterol content as well as microbial C/N ratio starting from day 9 of incubation, suggesting that fungal biomass was probably favored, although the same behavior was not found in the soil amended with 15 wt% of the same material.
On the other hand, the NH4+-enriched CZ showed strong interactions with soil microbial biomass N. Isotopic measurements supported microbial assimilation of the N introduced with CZ since the second day of incubation. The high dissolved organic C and microbial biomass N suggested an increase of mineralization and immobilization processes. In addition, in CZ amended soil, microbial biomass N was related to NO_3- production over time and inversely related to NH4+, suggesting high nitrification processes especially from day 7 of incubation. Low microbial C/N ratio support bacterial prevalence in the soil amended with CZ for N-assimilation and ammonia oxidation. This confirm that CZ is an efficient soil amendment providing an immediately available N pool to soil microbial biomass.