EGU2020-22306
https://doi.org/10.5194/egusphere-egu2020-22306
EGU General Assembly 2020

C:N stoichiometry of stable and labile organic compounds determine priming patterns

Min Liu[1], Na Qiao[1], **Xingliang Xu**[1], Huajun Fang[1], Huimin Wang[1], and Yakov Kuzyakov[1,2]
[1]Key Laboratory of Ecosystem Network Observation and Modeling, Institute of Geographic Sciences and Natural Resources Research, Chinese Academy of Sciences, Beijing, China
[2]Department of Agricultural Soil Science, University of Göttingen, Göttingen, Germany

Approximately 50–70% of C stored in soil is derived from the roots or root-associated microorganisms, reflecting their importance for soil organic matter (SOM) formation. Microorganisms are the major driver for SOM decomposition and their activities are modified by the input of labile organics such as root exudates and low molecular weight organic substances derived from litter decomposition. Such short-term changes in the turnover of SOM caused by moderate organic additions into the soil were defined as priming effects (PE). Priming effects can influence global carbon (C) storage in soil and lead to climate feedbacks by accelerating the decomposition of organic matter (OM). In natural ecosystems, input of nitrate (NO_3^-) and ammonium (NH_4^+) into the soil can be derived from nitrogen (N) deposition and biological N fixation. Although availability N can alter the magnitude and direction of priming, it remains unclear whether additions of NO_3^- and NH_4^+ have distinct effects on the decomposition of OM. Thus, the aims of this study were to investigate the responses of OM decomposition along a decay continuum (i.e. decreasing decomposition degree) to labile C and N inputs and determine the PE induced by the two N forms. Leaf litter, wood litter, organic soil horizon, and mineral soil, with a broad range of C:N ratios were collected along a decay continuum in a typical subtropical forest and incubated for 38 days with ^{13}C labeled glucose and N (NO_3^-) additions. Based on the very broad range of C:N ratios in OM in soil and inputs of labile C and N, we demonstrated the OM decomposition within a decay continuum as well as PE intensities and the thresholds for the switch of PE directions. In contrast to NH_4^+ additions, NO_3^- generally accelerated the decomposition of all OM. Priming of plant litter was dependent on the C:N ratios of the labile inputs. However, leaf litter decomposition was more controlled by N addition than wood litter. Glucose addition greatly increased the priming of OM decomposition, demonstrating energy limitation for microorganisms. Distinct priming patterns were observed between NO_3^- and NH_4^+ additions, both for the individual OM types and for all four types of OM. The PE induced by labile C and N inputs can increase or reduce C sequestration depending on C:N stoichiometric ratios of labile inputs. Net C losses caused by PE can be observed in organic soil and plant litter with low C and N additions, but all four OM substrates increased C sequestration under high C addition. Minor differences in priming along the continuum were observed where the OM C:N ratio was below 30 when NO_3^- was added and where the labile C:N ratio was less than 55 when NH_4^+ was added. Thus, changes in the composition of deposited N (atmospheric deposition and

fertilization) may induce distinct climate feedbacks. Under future climatic conditions by global warming and elevated CO_2, more labile C inputs via root exudates could accelerate litter decomposition. Effects of N however, depend on the N form: NH_4^+ to NO_3^- due to the energy necessary for microorganisms for NO_3^- reduction.