EGU2020-14449
https://doi.org/10.5194/egusphere-egu2020-14449
EGU General Assembly 2020
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Soil available resource C:N ratio regulates the priming effect by maintaining microbial C:N stoichiometric balance in long-term fertilized paddy soils

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Fertilization practices can influence the soil nutrients and fertility status, which subsequently induce changes in soil carbon (C):nitrogen (N) ratio and rebuilt C:N stoichiometric balances between microbial biomass and resources. In this study, we investigated how available resource C:N ratio can regulate the priming effect (PE) to maintain microbial C:N stoichiometric balance by adding ^{13}C-labeled glucose to four long-term fertilized paddy soils [Control (no fertilization), NPK (fertilized with mineral NPK fertilizers) , NPKS (NPK combined with straw), NPKM (NPK combined with manure)]. Glucose addition significantly increased SOC mineralization and subsequently induced a positive priming effect at day 2 of incubation, whereas the PE became negative after 20 days. DOC contents were increased by more than 1000% with glucose addition at day 2, whereas they rapidly decreased to -10% to -50% compared with those in soils without glucose addition. With the changes in available and biomass C and N, the microbial C:N imbalance initially increased to 3.3–6.8, and then reduced to the level as that in the soils without glucose addition. At the end of incubation, the microbial C:N imbalance in the glucose-treated soils was ranked as Control < NPK < NPKM < NPKS. This suggested that, without organic fertilization, soils were highly susceptible to labile C and increased SOC mineralization, leading to C limitation. The PE was positively related to DOC and NH_4^+ ratio, but negatively associated with microbial C:N imbalance, suggesting that the labile C supplied stimulated microbial stoichiometric decomposition of SOM. Glucose addition modified enzyme activities after 20 days, to allow the microorganisms to break up complex C compounds for C source. Our findings suggested that soil microorganisms could regulate extracellular hydrolytic enzyme production and their relative stoichiometric ratios to obtain necessary elements, thereby adjusting the microbial biomass C:N to the resource stoichiometry.