Geophysical Research Abstracts
Vol. 16, EGU2014-5372, 2014
EGU General Assembly 2014

Soil C and N availability determine the priming effect: microbial N mining and stoichiometric decomposition theories

Ruirui Chen (1), Mehmet Senbayram (2), Sergey Blagodatsky (3), Klaus Dittert (2), Xiangui Lin (1), Evgenia Blagodatskaya (4), and Yakov Kuzyakov (4)

(1) State Key Laboratory of Soil and Sustainable Agriculture, Institute of Soil Science, Chinese Academy of Sciences, Nanjing 210008, China (rrchen@issas.ac.cn), (2) Institute of Applied Plant Nutrition, Georg-August University Goettingen, Goettingen 37075, Germany, (3) Institute for Plant Production and Agroecology in the Tropics and Subtropics, University of Hohenheim, Stuttgart 70593, Germany, (4) Department of Soil Science of Temperate Ecosystems, Georg August University of Goettingen, Goettingen 37077, Germany

The increasing input of anthropogenically derived nitrogen (N) to ecosystems raises a crucial question: how does available N modify the decomposer community and thus affects the mineralization of soil organic matter (SOM). Moreover, N input modifies the priming effect (PE), that is, the effect of fresh organics on the microbial decomposition of SOM. We studied the interactive effects of C and N on SOM mineralization (by natural ^{13}C labelling adding C4-sucrose or C4-maize straw to C3-soil) in relation to microbial growth kinetics and to the activities of five hydrolytic enzymes. This encompasses the groups of parameters governing two mechanisms of priming effects – microbial N mining and stoichiometric decomposition theories. In sole C treatments, positive PE was accompanied by a decrease in specific microbial growth rates, confirming a greater contribution of K-strategists to the decomposition of native SOM. Sucrose addition with N significantly accelerated mineralization of native SOM, whereas mineral N added with plant residues accelerated decomposition of plant residues. This supports the microbial mining theory in terms of N limitation. Sucrose addition with N was accompanied by accelerated microbial growth, increased activities of β-glucosidase and cellobiohydrolase, and decreased activities of xylanase and leucine amino peptidase. This indicated an increased contribution of r-strategists to the PE and to decomposition of cellulose but the decreased hemicellulolytic and proteolytic activities. Thus, the acceleration of the C cycle was primed by exogenous organic C and was controlled by N. This confirms the stoichiometric decomposition theory. Both K- and r-strategists were beneficial for priming effects, with an increasing contribution of K-selected species under N limitation. Thus, the priming phenomenon described in 'microbial N mining' theory can be ascribed to K-strategists. In contrast, 'stoichiometric decomposition' theory, that is, accelerated OM mineralization due to balanced microbial growth, is explained by domination of r-strategists.