Journal of Soils and Sediments 2016 vol.16 N1, pages 191-203

Contrasting effects of aged and fresh biochars on glucose-induced priming and microbial activities in paddy soil

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Abstract

© 2015, Springer-Verlag Berlin Heidelberg.Purpose: The understanding of soil organic matter (SOM) decomposition to biochar (BC) addition in paddy soil remains limited. This study was to examine the glucose-induced priming effects of paddy soil as affected by aged and/or fresh BCs. Materials and methods: Soil samples were collected from the paddy fields without and with BC applied 1 year before the laboratory incubation. The control without BC, the soil with BC applied in the field (aged BC), aged BC and the additional fresh BC applied (A/F-BC), and the soil with fresh BC (fresh BC), each with glucose (14C) addition or not were incubated under either moist or flooding conditions. Totally, 16 treatments were established. Results and discussion: The aged-BC group treatments had greater carbon dioxide (CO2) efflux (averagely 26 %) compared to the control group, while CO2 efflux was reduced following fresh BC addition by 23 and 21 % in the A/F-BC and fresh-BC groups, respectively. In the presence of aged BC, microbial biomass and the potential activities of ß-glucosidase, xylanase, cellobiohydrolase, and chitinase were increased under both moist and flooding conditions, but they were decreased in the fresh-BC group under flooding conditions. For the control group, positive priming of 58 and 102 μg C g−1 were observed after glucose addition under moist and flooding conditions, respectively. Positive priming was also observed in the fresh-BC group amounting to 34 and 19 μg C g−1 under moist and flooding conditions, respectively. However, negative priming was found in the soil samples with aged BC, especially under moist conditions, which was possibly due to the preferential use of glucose over the more recalcitrant organic C in both SOM and BC and SOC stabilization via either organic matter sorption on BC or the BC-induced organic-mineral interaction. Conclusions: BC effects on CO2 efflux and microbial activities depend strongly on its age. Aged BC improves soil microbial parameters and also contributes to C sequestration in soil by negative priming. In contrast, fresh BC addition depresses microbial activities but stimulates the mineralization of SOM and itself following glucose addition.

http://dx.doi.org/10.1007/s11368-015-1189-0

Keywords

Carbon cycle, Climate change, Extracellular enzyme activity, Microbial dynamics, Pyrogenic organic matter, Rice field