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Interactive effects of biochar and polyacrylamide on decomposition of maize rhizodeposits: implications from ^{14}C labeling and microbial metabolic quotient

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Abstract

© 2016, Springer-Verlag Berlin Heidelberg.Purpose: The applications of biochar (BC) and polyacrylamide (PAM) may have interactive effects on carbon (C) dynamics and sequestration for improving the soil quality and achieving sustainable agriculture. Relative to BC and PAM, rhizodeposits act as C and energy source for microorganisms and may change the mineralization dynamics of soil organic matter (SOM). No attempt has been made to assess the effects of BC, anionic PAM, or their combination on the decomposition of different aged 14C-labeled rhizodeposits. The objective of this study was to investigate the effects of the treatments mentioned above on the decomposition of different aged 14C-labeled maize rhizodeposits. Materials and methods: biochar (BC) at 10 Mg ha−1 or anionic PAM at 80 kg ha−1 or their combination (BC + PAM) was applied to soils with/without 2-, 4-, 8-, and 16-day-aged 14C-labeled maize rhizodeposits. After that, the soil was incubated at 22 °C for 46 days. Results and discussion: After 2 days of incubation, the total CO2 efflux rates from the soil with rhizodeposits were 1.4–1.8 times higher than those from the soil without rhizodeposits. The cumulative 14CO2 efflux (32 % of the 14C input) was maximal for the soil containing 2-day-aged 14C-labeled rhizodeposits. Consequently, 2-day-aged rhizodeposits were more easily and rapidly decomposed than the older rhizodeposits. However, no differences in the total respired 14CO2 from rhizodeposits were observed at the end of the incubation. Incorporation of 14C into microbial biomass and 66–85 % of the 14C input remained in the soil after 46 days indicated that neither the age of 14C-labeled rhizodeposits nor BC, PAM, or BC + PAM changed microbial utilization of rhizodeposits. Conclusions: Applying BC or BC + PAM to soil exerted only minor effects on the decomposition of rhizodeposits. The contribution of rhizodeposits to CO2 efflux from soil and MBC depends on their age as young rhizodeposits contain more labile C, which is easily available for microbial uptake and utilization.

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Keywords

Biochar, Decomposition of rhizodeposits, Polyacrylamide, Responsible editor: Yu Luo, Soil organic matter

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