

Which fraction of soil organic matter is more vulnerable to rhizosphere priming effect?

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Rhizosphere priming effect (RPE) is defined as the stimulation or suppression of soil organic matter (SOM) decomposition by living roots. It remains unclear which fraction of SOM is more vulnerable to rhizosphere priming. We conducted two experiments in continuous ^{13}C labeling growth chamber to compare the intensity of RPE for the active (or labile) vs. slow (or recalcitrant) SOM. A sandy loam (Alfisol) was incubated at 20°C and 80% water holding capacity for different periods, which created a gradient in the relative proportion of active vs. slow SOM in the remaining soils. We then grew sunflower (*Helianthus annuus*) and soybean (*Glycine max*) in these remaining soils for 50 days under the same environmental conditions to compare the RPE of these two plant species on the decomposition of soils that varied in the lability of SOM. In both experiments, as the incubation proceeded from 1 to 8 to 14 months (in experiment 1) and the soil changed from freshly-sampled soil to two-year-incubated soil (in experiment 2), the intensity of RPE increased significantly even after accounting for the changes in root biomass or root-derived CO_2 . This result suggests that the slow (or recalcitrant) fraction of SOM is likely more vulnerable to rhizosphere priming compared to the active (or labile) fraction of SOM. Although the underlying mechanisms of this finding await further investigation, our study clearly shows that the main component of SOM (slow or recalcitrant SOM, decadal turnover) is vulnerable to rhizosphere priming. Therefore, the RPE has the potential to substantially regulate both short-term and long-term soil carbon dynamics.

Keywords: soil organic matter decomposition, rhizosphere priming effect, labile soil carbon, recalcitrant soil carbon