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The importance of C:N stoichiometry for priming induced CO_2 and N fluxes

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Labile carbon (C) compounds exuded by plant roots can significantly 'prime' soil organic matter (SOM) decomposition, resulting in increased emissions of CO_2 from soils. There are some indications that priming increases with increasing rates of labile C input, while input of labile C in combination with available nitrogen (N) might have the opposite effect. A possible reason is that simultaneous input of C and N favors microbial 'cheaters' that do not decompose SOM, while input of C alone stimulates microbes that decompose SOM in order to meet their N demand. The objective of this experiment was to test this hypothesis and determine the effects of variations in C and N availability on the extent of priming.

Glucose additions generally resulted in positive priming manifested as increased respiration of native SOM. When high concentrations of glucose were added in combination with inorganic N priming of SOM respiration was less pronounced, supporting the hypothesis that priming can be the result of microbial N mining. Glucose additions also increased gross protein depolymerization rates, as well as microbial uptake and retention of N contained in amino acids, providing further evidence that the increased respiration of SOM was a result of microbial N mining. However, different indicators of microbial decomposition activities, i.e. SOM respiration, gross protein depolymerization and gross N mineralization, were poorly correlated. These findings suggest that priming induced decomposition of SOM is not always manifested as increased respiration of SOM. It rather appears as if an imbalanced C to N supply selects for microorganisms able to release the deficient nutrient by decomposing SOM, irrespective of whether the deficient nutrient is C or N.

Taken together our findings emphasize the need to move beyond respiration measurements when quantifying priming, since the carbocentric perspective that decomposition of SOM can be equated to respiration of SOM can lead to erroneous conclusions regarding the role of priming as a driver of SOM decomposition and nutrient release in terrestrial environments.