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Testing the root-priming of soil organic matter decomposition using the isotopic signature of fossil fuel CO_2

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Plant roots provide various forms of soil labile carbon (i.e. rhizodeposition), which stimulate the growth of heterotrophic bacteria in the rhizosphere. This, in turn, provides a food source for phagotrophic protozoa and other bacterivores, whose carbon:nutrient ratios are generally higher than those of their food source. In order to maintain their stoichiometric composition, bacterivores release their extra nutrients into the rhizosphere, where they may be absorbed by plant roots. Thus, rhizodeposition should reduce carbon limitation, but increase nutrient demand, of the soil microbial biomass. We hypothesized that this shift towards nutrient deficiency would stimulate the production of microbial enzymes that depolymerise soil organic matter into microbial available forms. In other words, roots should stimulate the decomposition of soil organic matter. We report on experiment where we tested such a "root-priming" effect using 3 contrasting plant species (Achillea millefolium, Lolium perenne, Trifolium repens). An agricultural soil, with a delta-13C value of approximately -14 ‰ , was transferred into 30 pots and planted with seeds of each species. A ring was inserted in the middle of each pot, and no seeds were planted within the ring. Plants were grown in a growth chamber designed to deliver 13C-depleted air. The resulting plant biomass had a delta-13C value of approximately -52 ‰ . On 7 occasions during the growth trial, pots were sampled for the flux and delta-13C value of soil CO_2. Using similar data from control pots without plants, we compared the expected vs. observed contributions of CO_2 from roots and soil organic matter. Results from this study revealed a negative root-priming effect for all three species. We discuss the experimental conditions that could have led to this observation, as well as the novelty and potential of our experimental protocol.