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Effects of assimilate supply on root and microbial components of soil respiration in a mountain grassland.

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Soil respiration is the main source of carbon emitted from terrestrial ecosystems. Soil CO_2 originates from multiple processes, comprising respiration by plant roots, mycorrhizae and microbes in the rhizosphere, as well as respiration due to soil organic matter (SOM) decomposition. Thus, components of soil respiration have different controls and show varying responses to changing environmental conditions and to the supply of fresh assimilates from photosynthesis. For grasslands there is still little information available as to what extent root and microbial respiration respond to reduced or enhanced assimilate supply. The aim of this study was to assess effects of assimilate supply on root and microbial components of soil respiration in a temperate mountain grassland. Root and microbial components were separated and quantified by applying the Substrate Induced Respiration method (SIR) in situ using a δ13C labelled sucrose solution, and analysing δ13C of the subsequently respired CO_2. Assimilate supply was modified by clipping and shading treatments, which strongly reduced photosynthetic C supply, and by applying a sucrose solution 8 days after clipping and shading. We tested the hypotheses that (1) due to a reduction of assimilate supply, soil respiration would be lower in the clipped and shaded than in the control treatment, that (2) the microbial contribution to soil respiration would be lower in the assimilate-limited than in the control treatments, and that (3) priming effects following the addition of sucrose would be stronger in shaded and mowed treatments than in control plots. Our results showed that clipping and shading reduced soil respiration significantly. Whilst the microbial contribution to soil respiration was 61% in control plots, it amounted to only 50-48% in clipped and shaded plots, respectively. Sucrose application did not affect root respiration in any of the plots, but generally stimulated microbial respiration. The measured priming effect in our experiment was markedly higher in the control than in the substrate limited treatments. It was likely related to an increase in microbial biomass turnover and not to SOM degradation, which suggests an apparent priming effect. Our results indicate that substrate limitation through lower or no photosynthesis generated by clipping and shading lead to a reduction of soil respiration, which was reversed by application of a labile C source. We conclude that short-term variations in fresh organic carbon availability may have more pronounced effects on microbial, than on root respiration. This needs to be accounted for when modelling soil C fluxes in highly dynamic environments.