Geophysical Research Abstracts,
Vol. 11, EGU2009-5478-1, 2009
EGU General Assembly 2009

Enhanced utilization of labile substrate in the soil in absence of plant C input through roots and ectomycorrhizal fungi

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Soils form a significant store of carbon (C) in terrestrial ecosystems, and hold the potential to mitigate or enforce global environmental change. The direction of such climate driven feedbacks depends on the way in which processes of C sequestration and release from soils are affected by changes in environmental conditions. There is an increasing realization that complex interactions between plants and soil organisms are crucial for the stability of soil organic matter (SOM). However, we still lack a good understanding of the nature of this interdependence and its likely environmental responses. The aim of this study is to investigate how ^{13}C labeled glucose is utilized in the presence or absence of inputs from plants through roots. Specifically we aim to investigate the importance of EM fungi in the control of carbon cycling in forest ecosystems and the influence of EM fungi on the activity of rhizospheric soil microorganisms.

We installed four replicates each of three different collar treatments in a 18-year old Lodgepole pine (*Pinus contorta*) stand near York (NE England). These consisted of deep soil collars with four windows just below surface level covered either by 1μm mesh in order to exclude both roots and hyphae (treatment S) or 41μm mesh to exclude just roots (treatment M). The third set of collars was inserted to a shallow depth of c. 1.5 cm, thus allowing natural access by roots and hyphae (treatment R). Soil moisture levels were controlled through the exclusion of natural throughfall using PVC shields above the collars. Throughfall collectors were positioned in the experimental plot and an average amount of throughfall was added to each of the soil cores weekly. Six months following collar insertion, we applied ^{13}C-labelled glucose to all collars. CO_2 flux (R_S) from all collars as well as its isotopic composition was measured continuously using a field-deployed mass spectrometer, and we estimate microbial utilization of the glucose using the return flux of $^{13}CO_2$.

The results show a significantly higher R_S and δ^{13}C from collars excluding any plant derived C input. Respiration of glucose derived CO_2 was of similar magnitude for the other two treatments, but was more sustained in treatment R (i.e. including both roots and mycorrhizal hyphae). It is likely that the increase in R_S observed were from the increased activity of saprotrophic fungi and other soil microorganisms. EM fungi and associated bacteria might not be expected to respond in the same way to the introduction of a simple C substrate since they receive this predominantly from their plant hosts. Therefore one interpretation of these results is that under normal conditions in this EM dominated system, saprotrophs are suppressed by the presence of EM fungi. These results highlight the potential for plants, through their C inputs to influence the level of decomposition taking place in terrestrial ecosystems, and highlight the importance of EM fungi and competition between soil microorganisms in this process.