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Is litter decomposition ’primed’ by primary producer-release of labile carbon in terrestrial and aquatic experimental systems?

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It is possible that recalcitrant organic matter (ROM) can be ‘activated’ by inputs of labile organic matter (LOM) through the priming effect (PE). Investigating the PE is of major importance to fully understand the microbial use of ROM and its role on carbon (C) and nutrient cycling in both aquatic and terrestrial ecosystems.

In aquatic ecosystems it is thought that the PE is triggered by periphytic algae release of LOM. Analogously, in terrestrial systems it is hypothesized that the LOM released in plant rhizospheres, or from the green crusts on the surface of agricultural soils, stimulate the activity and growth of ROM decomposers. Most previous studies on PE have utilised pulse additions of single substrates at high concentrations. However, to achieve an assessment of the true importance of the PE, it is important to simulate a realistic delivery of LOM. We investigated, in a series of 2-week laboratory experiments, how primary producer (PP)-release of LOM influence litter degradation in terrestrial and aquatic experimental systems. We used soil (terrestrial) and pond water (aquatic) microbial communities to which litter was added under light and dark conditions. In addition, glucose was added at PP delivery rates in dark treatments to test if the putative PE in light systems could be reproduced.

We observed an initial peak of bacterial growth rate followed by an overall decrease over time with no treatment differences. In light treatments, periphytic algae growth and increased fungal production was stimulated when bacterial growth declined. In contrast, both fungal growth and algal production were negligible in dark treatments. This reveals a direct positive influence of photosynthesis on fungal growth. To investigate if PP LOM supplements, and the associated fungal growth, translate into a modulated litter decomposition, we are using stable isotopes to track the use of litter and algal-derived carbon by determining the δ13C in produced CO_2. Fungi and bacteria are the fundamental microbial decomposers and thus the main agents involved in respiration, ROM mobilisation and carbon cycling. By describing if and how litter decomposition is primed by primary producer-release of labile carbon we gain a better understanding of how microbial communities degrade OM in terrestrial and aquatic systems.