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Fungal-to-bacterial dominance of soil detrital food-webs: Consequences for biogeochemistry

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Resolving fungal and bacterial groups within the microbial decomposer community is thought to capture disparate microbial life strategies, associating bacteria with an $r-$selected strategy for carbon (C) and nutrient use, and fungi with a K-selected strategy. Additionally, food-web models have established a widely held belief that the bacterial decomposer pathway in soil supports high turnover rates of easily available substrates, while the slower fungal pathway supports the decomposition of more complex organic material, thus characterising the biogeochemistry of the ecosystem.

Three field-experiments to generate gradients of SOC-quality were assessed. **(1)** the Detritus Input, Removal, and Trenching – DIRT – experiment in a temperate forest in mixed hardwood stands at Harvard Forest LTER, US. There, experimentally adjusted litter input and root input had affected the SOC quality during 23 years. **(2)** field-application of 14-C labelled glucose to grassland soils, sampled over the course of 13 months to generate an age-gradient of SOM (1 day – 13 months). **(3)** The Park Grass Experiment at Rothamsted, UK, where 150-years continuous N-fertilisation (0, 50, 100, 150 kg N ha-1 y-1) has affected the quality of SOM in grassland soils. A combination of carbon stable and radio isotope studies, fungal and bacterial growth and biomass measurements, and C and N mineralisation (^{15}N pool dilution) assays were used to investigate how SOC-quality influenced fungal and bacterial food-web pathways and the implications this had for C and nutrient turnover.

There was no support that decomposer food-webs dominated by bacteria support high turnover rates of easily available substrates, while slower fungal-dominated decomposition pathways support the decomposition of more complex organic material. Rather, an association between high quality SOC and fungi emerges from the results. This suggests that we need to revise our basic understanding for soil microbial communities and the processes they regulate in soil.