# Directing Traffic in the Rhizosphere: How Microbes Shape the Flow and Fate of Root Carbon

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Stimulated by exudates and root decay, rhizosphere organisms control the critical pathways that move C from root tissue to mineral surfaces, and ultimately regulate how soil C is sequestered and stabilized. Yet we have a poor understanding of how roots affect the molecular ecology of microbial decomposers, and how this translates into altered rates of organic matter breakdown. We have examined the effects of live and dead roots on decomposition in a grassland soil and quantified characteristics of relevant bacterial and fungal communities using gene arrays, transcriptomics, isotope tracing and proteomics. The presence of live roots consistently suppressed rates of dead root litter decomposition and significantly altered the abundance, composition and functional potential of microbial communities. Plant-influenced soils had relatively more genes involved in low molecular weight compound degradation (e.g. polysaccharides) whereas unplanted soil microbes had more macromolecule degradation genes. Higher abundances of proV and proW genes (glycine betaine transport) in planted soils suggest microbes experience more severe water stress in planted soils. RNA-seq and stable isotope probing analysis showed that living roots in the presence of decaying root material had differential effects on soil food webs and organisms participating in co-metabolism of exudates and decaying biomass. We found significant differences between the microbial community composition associated with different mineral types for both bacteria and fungi, and nanoscale secondary ion mass spectrometry (NanoSIMS) imaging of these minerals suggests fungal hyphae may be moving C directly from roots to mineral surfaces. In sum, we find microbial functional potential is the primary factor driving rhizosphere litter decomposition and that microbial functional capacities differ in rhizosphere versus bulk soils.