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Rhizosphere priming effects in two contrasting soils

Davidson Lloyd, Guy Kirk, and Karl Ritz
School of Energy, Environment & Agrifood, Cranfield University, Cranfield, United Kingdom
(davidson.lloyd@cranfield.ac.uk)

Inputs of fresh plant-derived carbon may stimulate the turnover of existing soil organic matter by so-called priming effects. Priming may occur directly, as a result of nutrient 'mining' by existing microbial communities, or indirectly via population adjustments. However the mechanisms are poorly understood. We planted C4 Kikuyu grass (Pennisetum clandestinum) in pots with two contrasting C3 soils (clayey, fertile TB and sandy, acid SH), and followed the soil CO_2 efflux and its δ13C. The extent of C deposition in the rhizosphere was altered by intermittently clipping the grass in half the pots; there were also unplanted controls. At intervals, pots were destructively sampled for root and shoot biomass. Total soil CO_2 efflux was measured using a gas-tight PVC chamber fitted over bare soil, and connected to an infra-red gas analyser; the δ13C of efflux was measured in air sub-samples withdrawn by syringe. The extent of priming was inferred from the δ13C of efflux and the δ13C of the plant and soil end-members.

In unclipped treatments, in both soils, increased total soil respiration and rhizosphere priming effects (RPE) were apparent compared to the unplanted controls. The TB soil had greater RPE overall. The total respiration in clipped TB soil was significantly greater than in the unplanted controls, but in the clipped SH soil it was not significantly different from the controls. Clipping affected plant C partitioning with greater allocation to shoot regrowth from about 4 weeks after planting. Total plant biomass decreased in the order TB unclipped > SH unclipped >TB clipped > SH clipped.

The results are consistent with priming driven by microbial activation stimulated by rhizodeposits and by nitrogen demand from the growing plants under N limited conditions. Our data suggest that photosynthesis drives RPE and soil differences may alter the rate and intensity of RPE but not the direction.