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Plants determine diversity and function of soil microbial and mesofaunal communities – results from a girdling experiments in a temperate coniferous forest

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The potential for carbon (C) sequestration in soils depends on the rate of humification of C inputs to soils in relation to the decomposition of old soil organic matter. Recent results indicate a close connection between the input of fresh organic matter and the decomposition of old organic matter through soil priming. We conducted a tree girdling experiment in order to better understand the interdependence of soil microbial communities and plant belowground C allocation.

A girdling experiment in a mature Western Hemlock (*Tsuga heterophylla*) stand near York (NE England) confirms the pattern observed in other girdling studies, with a reduction in total soil CO_2 efflux (R_S) to about 60% of control plots following a delay of about 2 weeks. High frequency measurements of R_S immediately after girdling show a short-lived significant increase in R_S in girdled plots between 3 and 8 hours after tree girdling, which have not been observed previously. The autotrophic flux contribution (calculated as the difference in R_S between the control and girdled plots) declined throughout autumn, but in contrast to most girdling studies, remained significantly greater than zero throughout during December and January. This result indicates that tree belowground allocation continues throughout winter, despite regular night-time frosts in the period measurement were taken. Dominant mesofauna invertebrates (Enchytraeid worms) showed a positive response to girdling and higher abundances were recorded in the girdled plots when compared to the control ones, although differences were only significant on one sampling occasion. These results suggest that, in contrast to other components of the soil food-web, these organisms appear to be underpinned by detrital decomposition rather than by recent photosynthate-C deposition. Litterbag incubations showed no significant short-term treatment effect over the 4 months period following girdling, indicating no measurable interaction of decomposition and plant activity by this method.

The results emphasise the strong influence of plants on the composition and activity of microbial soil communities. This has clear implications for our ability to predict ecosystem response to environmental change, including shifts in land use managements, and we discuss the need of incorporating these effects into current ecosystem models.