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Melanised endophytic fungi may increase stores of organic carbon in soil

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The processes underlying the carbon cycle in soil, especially sequestration of organic carbon (OC), are poorly understood. Hydrolysis and oxidation reduce organic matter. Hydrolysis degrades linear organic molecules in aerobic and anaerobic conditions, though it is slower in anaerobic conditions. Aromatic compounds are only degraded by oxidation. Oxygen is by far the most common electron acceptor in soil. Anaerobic conditions preclude oxidation in soil and will result in the preservation of aromatic compounds so long as the conditions remain anaerobic. We experimentally tested this model using melanised endophytic fungi. Melanin is a polyaromatic compound that can be readily visualised, though is difficult to quantify. An endophytic association provides the fungus with an ongoing source of energy. Fungal hyphae elongate considerable distances in soil where they may colonise aggregates, the core of which may be anaerobic. The hypothesis we tested is that melanised endophytic fungi increase OC in soil. Seedlings of subterranean clover inoculated with single isolates were grown in split pots where the impact of the fungus could be quantified in the hyphal chamber, separated from the roots by a steel mesh. We found that melanised endophytic fungi significantly increased OC and aromatic carbon in a well-aggregated carbon-rich soil. OC increased by up to 17% within 14 weeks. Twenty out of 24 isolates statistically significantly increased and none decreased OC. Increases differed between fungal isolates. Increases in the hyphal chamber were independent of any change in OC associated with the roots of the host plant. The storage of OC in field soils is being explored. Inoculation of plant roots with melanised endophytic fungi offers one means whereby OC may be increased in field soils.