Manipulating organic matter stabilisation in soil through the addition of nutrients

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Increasing the accumulation of organic carbon (OC) in soil is an important tool to mitigate climate change. Achieving the optimal rate of OC accumulation requires increased supply and stability of organic matter (OM) in soil. Recent research supports the theory that stable OC in soil is largely composed of microbial detritus, and indicates that where adequate OM and soil nutrients are available, microbial detritus may accumulate irrespective of soil type and OC concentration. The purpose of this 146 day incubation experiment was to determine if stable OC accumulated under optimum decomposition conditions with carbon (C), nitrogen (N), phosphorus (P) and sulfur (S) applied in the ratios of C 1000 :N 90 :P 19 :S 14. Soil samples were collected from six permanent pasture sites with high OC concentration: three Phaeozems and three Acrisols (0 to 0.10 and 0.40 to 0.50 m). Treatments included: soil only (control), soil and nutrients only (nutrients), and soil with high OM and nutrients (12.4 Mg DM/ha; HOMN) and very high OM and nutrients (31.1 Mg DM/ha; VHOMN). Nutrient rates were calculated to achieve 30 % retention of C added. Treatments were applied 3 times over the 146 day incubation, while 13C labelled OM was only applied once at the beginning of the incubation experiment. There was a significant ($P<0.05$) increase in stable OC for the HOMN and VHOMN treatments for both soil types and depths. The substantial 13C recovery despite increasing microbial activity (soil respiration; $P<0.001$ and microbial biomass carbon; $P<0.001$) , as well as a significant ($P<0.001$) narrowing of the C:N ratio indicate that the increases in OC accumulation were at least partly due to the conversion of plant residues into microbial detritus. This study demonstrated that with sustained C and nutrient inputs, the stable OC can increase linearly.