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The chemical and physical stability soil organic carbon in the top 1 m of the soil profile under different land uses in the UK

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Soils are the largest terrestrial pool of organic carbon and it is now known that as much as 50% of soil organic carbon (SOC) can be stored below 30 cm. Therefore, knowledge of the mechanisms by which soil organic carbon is stabilised at depth and how land use affects this is important.

This study aimed to characterise topsoil and subsoil SOC and other soil properties under different land uses to determine the SOC stabilisation mechanisms and the degree to which SOC is vulnerable to decomposition. Samples were collected under three different land uses: arable, grassland and deciduous woodland on a silty-clay loam soil and analysed for TOC, pH, C/N ratio and texture down the first one metre of the soil profile. Soil organic matter (SOM) physical fractionation and the extent of fresh mineral surfaces were also analysed to elucidate SOM stabilisation processes.

Results showed that soil texture was similar among land uses and tended to become more fine down the soil profile, but pH did not significantly change with soil depth. Total C, total N and C/N ratio decreased down the soil profile and were affected by land use in the order woodland > grassland > arable. SOM fractionation revealed that the free particulate organic matter (fPOM) fraction was significantly greater in both the topsoil and subsoil under woodland than under grassland or arable. The mineral associated OC (MinOC) fraction was proportionally greater in the subsoil compared to topsoil under all land uses: arable > grassland > woodland. Clay, Fe and Mn availability play a significant role (R^2=0.87) in organic carbon storage in the top 1 m of the soil profile.

It is evidently clear from the findings that land use change has a significant effect on the dynamics of the SOC pool at depth, related to litter inputs to the system.