A soil carbon index to gauge soil health in England and Wales

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Soil organic carbon (SOC) is a key indicator of soil health, however, guideline values which indicate degradation and good status have been difficult to define. For soils in England and Wales, indicative management ranges were developed using ranges of SOC from the National Soil Inventory of England and Wales (NSI) for precipitation and clay content classes (Verheijen et al., 2005). Soils with higher clay content are often expected to have higher SOC content and this was evident in the management ranges. SOC interacts with clay particles through surface interactions and this, alongside occlusion in aggregates, is suggested to help protect SOC from decomposition and loss (Dungait et al., 2012). The management ranges, however, lacked a mechanistic perspective such that these might not be optimal ranges for soil physical properties and soil structure.

We have used the NSI to investigate how thresholds of clay/SOC might be used to assess SOC status. A clay/SOC ratio of 10 was proposed as a clay-SOC association capacity derived from correlations with soil physical properties (Dexter et al., 2008) and a further two thresholds (clay/SOC = 8 and 13) were proposed to indicate very good and degraded soil structural quality alongside the original threshold (Johannes et al., 2017). Comparing the distribution of soils under different land uses with the clay/SOC threshold ranges gave an increasing quality trend of arable << ley grassland < permanent grassland ≈ forest. The results suggested that 37% of arable soils would be considered degraded compared with 6% for grassland soils.

We have used the thresholds to define an index on a scale where negative values indicate degraded soils, and positive values (up to 1) suggest increasing quality beyond which a soil is considered very good. Data from the Woburn ley-arable rotation experiment (Johnston et al., 2017) have also been evaluated with this index to see how the index value might change with time under different managements. As a quantitative metric for SOC, this could form a monitoring framework and feed into other soil health schemes to assess a soil with respect to a clay-interaction capacity and expected soil quality.

References

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