Prediction of Carbon Mineralization Rates from Different Soil Physical Fractions Using Diffuse Reflectance Spectroscopy.

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Abstract

Soil carbon mineralization rate is a key indicator of soil functional capacity but it is time consuming to measure using conventional laboratory incubation methods. Recent studies have demonstrated the ability of visible-near infrared spectroscopy (NIRS) for rapid non-destructive determination of soil organic C and N concentration. We investigated whether NIRS (350–2500 nm) can predict C mineralization rates in physically-fractionated soil aggregates (bulk soil and 6 size fractions, n = 108) and free organic matter (2 size fractions, n = 27) in aerobically incubated samples from a clayey soil (Oxisol) and a sandy soil (Psamment). Incubation reference values were calibrated to first derivative reflectance spectra using partial least squares regression.

Prediction accuracy was assessed by comparing laboratory reference values with NIRS values predicted using full hold-out-one cross-validation. Prediction r-squared (RSQ) for average rate of C respired (500 days) in soil aggregate fractions was 0.88. RSQ for average rate of C mineralized (300 days) in organic matter fractions was 0.89. Soil fractions could be spectrally discriminated with a 97% success rate using a 50% random holdout sample. NIRS is a promising technique for rapid characterization of potential carbon mineralization in soils and aggregate fractions. Further work should test spectral mixture models.

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