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Effect of Wavelength Reduction on the Prediction of Soil N and C Using Visible and Near-infrared Diffuse Reflectance Spectroscopy

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The visible and near infrared diffuse reflectance spectroscopy (Vis-NIR DRS) was used for the measurement of total N (TN), total C (TC), organic C (OC) and inorganic C (IC), emphasizing on the effect of wavelength reduction on the prediction accuracy of these soil properties. A total of 122 soil samples with five soil texture classes were collected in May, 2010 from a Silsoe experimental farm, Bedfordshire, The United Kingdom. These were divided into a calibration set of 92 samples (75%) and an independent validation set of 30 samples (25%). A LabSpec 2500 spectrometer (ASD Inc., Boulder, CO, The USA) with a spectral range of 350-2500 nm at 1-nm interval was used to scan dried soil samples. The partial least squares (PLS) regression with one-leave-out cross validation was carried out based on different spectral ranges of Vis (400-700 nm), SWNIR (700-1100 nm), LWNIR (1100-2500 nm), Vis-SWNIR (400-1100 nm), NIR (700-2500 nm) and Vis-NIR (400-2500 nm). Wavelength reduction factors of 2, 5, 10, 20, 50, 100 and 200 were considered before the PLS calibration. Results showed that PLS calibration based on different spectral sub-ranges at original 1-nm interval achieves different performance for each soil property in the cross-validation and independent validation sets. The best predictions were achieved for TN with r2=0.94 and RPD=4.37 using the Vis range; for TC with r2=0.92 and RPD=3.53 using the Vis-NIR range; and for OC with r2=0.91 and RPD=3.36 using the Vis-SWNIR range. The PLS model performance was found insensitive to the degree of wavelength reduction. With the vis-NIR range subjected to the variable reduction factor of 100, the prediction of PLS models developed using 22 wavelengths was achieved with RPD values of 3.49, 3.23 and 2.97 for TN, TC, and OC, respectively. These RPD values are only marginally less than those reported when using 1-nm interval spectra. It can be concluded that a large wavelength reduction can be done without losing accuracy, which allows for the manufacturing of a simpler and cost effective spectrophotometer for practical application of vis-NIR spectroscopy in precision farming.