Prediction of Field-Measured Infiltration Rates Using Diffuse Reflectance Spectroscopy.

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Abstract

Soil infiltration rate is one of the most sensitive input variables in hydrological models and is an important soil quality indicator. Rapid methods for characterizing soil infiltration properties are needed for large area applications. Our previous work has demonstrated the use of diffuse reflectance spectroscopy (DRS) for rapid characterization of a number of soil properties. This study tested the use of DRS for prediction of steady rate infiltration. Infiltration rate at the soil surface was estimated using duplicate ring infiltrometer tests at three locations in 120 plots (30 x 30 m) in a 51 square km catchment in Kenya. Soil reflectance (350-2500nm wavelength) was measured on air-dried 2-mm sieved samples (0-20 cm depth) taken at each ring location. A nonlinear mixed effects model (NLME) was used to fit Horton's function to the entire cumulative infiltration data set and estimate steady infiltration rate at the plot level, accounting for within-plot random effects. The plot-level NLME estimates of steady rate infiltration (range 0.0068 to 38 cm/h) were then calibrated to first derivative reflectance spectra using partial least squares regression. Steady rate infiltration (log scale) was predicted quite well from spectral reflectance, with a cross-validated r-squared of 0.67 for NMLE-estimates versus spectrally-predicted values. This level of prediction performance is as good as those commonly reported for pedotransfer functions based on conventional soil properties. Visible-near-infrared spectroscopy is a valuable tool for rapid assessment of infiltration properties in watersheds

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