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Estimation of soil clay and organic matter using two quantitative methods (PLSR and MARS) based on reflectance spectroscopy

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A rapid and inexpensive soil analytical technique is needed for soil quality assessment and accurate mapping. This study investigated a method for improved estimation of soil clay (SC) and organic matter (OM) using reflectance spectroscopy. Seventy soil samples were collected from Sinai peninsula in Egypt to estimate the soil clay and organic matter relative to the soil spectra. Soil samples were scanned with an Analytical Spectral Devices (ASD) spectrometer (350–2500 nm). Three spectral formats were used in the calibration models derived from the spectra and the soil properties: (1) original reflectance spectra (OR), (2) first-derivative spectra smoothened using the Savitzky–Golay technique (FD-SG) and (3) continuum-removed reflectance (CR). Partial least-squares regression (PLSR) models using the CR of the 400-2500 nm spectral region resulted in R2 = 0.76 and 0.57, and RPD = 2.1 and 1.5 for estimating SC and OM, respectively, indicating better performance than that obtained using OR and SG. The multivariate adaptive regression splines (MARS) calibration model with the CR spectra resulted in an improved performance (R2 = 0.89 and 0.83, RPD = 3.1 and 2.4) for estimating SC and OM, respectively. The results show that the MARS models have a great potential for estimating SC and OM compared with PLSR models. The results obtained in this study have potential value in the field of soil spectroscopy because they can be applied directly to the mapping of soil properties using remote sensing imagery in arid environment conditions.

Key Words: soil clay, organic matter, PLSR, MARS, reflectance spectroscopy.