Introduction

- Cation exchange capacity (CEC) is very important in agronomic, environmental and geotechnical applications.
- However, laboratory determination of CEC is time consuming, expensive and hazardous, and new methods are required.
- Visible-near-infrared spectroscopy (vis-NIRS) is a simple, rapid and non-destructive technique for determining several soil properties (e.g. CEC, clay content and organic carbon (OC) etc.)

Objectives

- To evaluate the potential of vis-NIRS (spectral range from 400 to 2500 nm) to predict CEC for soils from different geographic regions.
- To compare the predictive ability of vis-NIRS and pedotransfer functions (PTFs) for CEC.

Methods

Soils

- 235 soil samples from 21 countries
- Particle-size distribution
  - Wet-sieving/hydrometer
- CEC (0.1-83 cmolc kg⁻¹)
  - Ammonium acetate at pH 7
  - Barium chloride at pH 8.2
- OC (0.03-8.42 %)
  - Elemental analyzer

![Figure 1. USDA texture of soils](Image)

![Figure 2. Vis-NIRS (DS2500)](Image)

![Figure 3. Visible-near-infrared spectra of three representative soil samples](Image)

![Figure 4. Regression coefficients for spectra wavelengths for calibration model](Image)

![Figure 5. Comparison of CEC predicted by vis-NIRS and PTFs (PTF-1 & PTF-2; PTF-3). (RPIQ)](Image)

Results

- Peaks from 429 to 650 nm related to both iron oxide and soil organic matter (SOM).
- Peaks at 1400, 1412, 1907 nm linked to OH-bond and clay mineral.
- Peaks at 2200-nm linked to Al-OH and at 2307-nm significant for OC.
- CEC is directly linked with OC, clay type and content, which directly affects the ability of soil to absorb water and nutrients.

![Table](Image)

- Reference CEC (cmol (+) kg⁻¹)
- vis-NIRS predicted CEC (cmol (+) kg⁻¹)
- PTF-1 predicted CEC (cmol (+) kg⁻¹)
- PTF-2 predicted CEC (cmol (+) kg⁻¹)
- PTF-3 predicted CEC (cmol (+) kg⁻¹)

Conclusions

- Vis-NIRS successfully predicted CEC for a large variety of soil samples.
- The CEC prediction performance of the vis-NIRS model was superior to that of the existing and the calibration dataset-based PTFs.

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References