Abstract
Measurement of sodium in soils by near infrared spectroscopy

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Introduction

Natural water has different salt concentrations and qualities, and contains principally salts of high solubility like sodium, calcium, magnesium and potassium chlorides and sulphates, thus salinisation and sodication could limit the soil productivity, leading to fertility reduction. Advances in spectroscopy have provided new methods to determine concentration of elements in a diverse range of arable soils, where the use of ultraviolet (UV), visible (vis), near infrared (NIR) reflectance and mid infrared (MIR) spectroscopy techniques have been found to be successful for determination of the concentration of several chemical and physical properties in plants and soils. The aim of this study was to evaluate the effect of soil particle size on the measurement of exchangeable sodium by NIR reflectance spectroscopy.

Materials and methods

Three hundred and thirty two ($n = 332$) top-soil samples (0–10 cm) were collected from different locations across Uruguay, in different years (1997–99), having different physical and chemical characteristics due to different soil types and management. Dried soil samples were scanned for reflectance in a NIRSystems 6500 monochromator instrument (NIRSystems, Laurel, MD, USA). Calibration models between reference and NIR data were calculated using partial least squares (PLS) regression.

Results and discussion

Table 1 shows the NIR cross validation statistics for exchangeable sodium, using PLS as regression method, after second derivative and SNV as pre-processing. This study has shown that soil of different particle characteristics can lead to different NIR calibration for the measurement of

Table 1. Cross validation statistics for the measurement of exchangeable sodium using near infrared reflectance spectroscopy in different soil of different particle characteristics.

Samples	R^2	*RMSECV*	*LV*	*SD*	*RPD*
Clay and lime ($n=285$)	0.42	0.12	5	0.14	1.1
Sand ($n=47$)	0.77	0.08	3	0.14	1.8

n: The number of samples; R^2: Coefficient of determination in calibration; *RMSECV:* Root mean standard error in cross validation; *LV*: Latent variables; S*D*: Standard deviation; *RPD*: ratio of standard deviation of reference data in validation set to *SECV.*

exchangeable sodium in arable top-soils. The highest loadings for the PLS calibration models were observed around 1400 nm and 1900 nm wavelength regions related with O-H (water). Although the calibrations developed are not accurate enough to provide a reliable analytical method, they can be used with caution for large scale screening of sandy soil samples for exchangeable sodium content.