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"Resilience of agricultural systems against crises"

Near Infrared Reflectance Spectroscopy (NIRS): Prediction of Chemical Properties in Cuban Soils

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Abstract

Soil chemical properties are important factors for soil fertility, successful plant growth and land management. Conventional methods to determine chemical fertility are often too difficult, costly, and time-consuming, therefore economic and environmental drivers have promoted the development of new techniques of management agricultural systems. For that reason this research investigates the potential of Near Infrared Reflectance Spectroscopy (NIRS) as a cost- and time-effective technique to determine the fertility of a soil as an input for to optimise the fertilisation for this field. NIRS in the context of precision agriculture might be an alternative to the conventional analysis methods employed in Cuba for determining organic matter (OM), phosphorus (P and P_2O_5) and potassium (K_2O) using a single spectrum per sample. The whole process included sampling of Cambisols from different agricultural fields of Villa Clara province located at the central part of Cuba, chemical traditional analysis and soil reflectance measurements. Samples were air dried before scanning by means of a diode array spectrophotometer covering the wavelength range from 399 to 1697 nm. Calibration models were built using Partial Least Squares Regression (PLSR) and Support Vector Machine (SVM). The prediction performance of the calibration models was evaluated based on the calibration statistics R^2 (the square of the correlation coefficient), RMSEP (root mean square error of prediction) and Bias (systematic deviation). The best prediction results were obtained for organic matter (R^2>0.90; RMSEP≤0.11) and in the other properties were variably acceptable, so K_2O (R^2≥0.80; RMSEP≤2.90); P (R^2≥0.80; RMSEP≤0.55) and P_2O_5 (R^2≥0.75; RMSEP≤3.00). It was concluded that NIR spectroscopy has potential to rapidly determine the fertility of Cuban soils as an input to optimise the fertilisation.

Keywords: Calibration models, near infrared reflectance spectroscopy, soil chemical properties

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