Tropentag, October 7-9, 2008, Hohenheim

"Competition for Resources in a Changing World:
New Drive for Rural Development"

Development of a Generic Model to Quantify Soil Organic Matter Applying Infra-Red Spectroscopy and Thermal Stability of Soil

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Abstract

Soil organic matter (SOM) plays an important role in improving soil fertility, mitigating land degradation and sustaining livelihoods in tropical regions through food production. Measurement of SOM is therefore important in monitoring soil health. Conventional, frequently used physical and chemical methods for quantification of soil carbon, and hence SOM are very time consuming. Therefore, faster, cheaper and in particular non-destructive approaches are required to quantify and to assess SOM. Diffuse Reflectance Fourier-transform Infrared spectroscopy (DRIFT-IR) offers this possibility. However, due to the presence of both mineral and SOM fractions within soils, superimposition of the mineral signatures with those of the SOM occur when presenting graphical output of absorbance IR spectra. Therefore, DRIFT-IR spectroscopy still requires the development of specific prediction models for each soil dataset in order to link the spectral signatures with quantitative information for the soil components to be predicted (e.g. carbon). This paper aims at assessing/evaluating efficient alternatives to overcome the effect of the mineralogical interference on the spectra to finally develop a new generation of generic models for SOM quantification. For the present study, Luvisols and Lixisols from different geographical locations worldwide were selected from the ICRAF-ISRIC soil world collection. A sub-sample of each selected soil was subjected to sequential heating until 550°C, and another similar sub-sample to wet-oxidation using hydrogen peroxide (H_2O_2). Both procedures were used independently to remove SOM in order to separate IR spectra from mineral and organic fractions. All soil samples were analysed by Diffuse Reflectance Fourier-transform Mid-Infra Red spectroscopy (DRIFT-MIRS) before and after soil treatment. Quantitative prediction of SOM and nutrients were based on partial least squares (PLS) analyses. The potential of DRIFT-MIRS to develop generic models applicable for the prediction of total soil carbon from soils of the same classification but of different geographical origin was tested, and both advantages and limitations of this technique discussed.

Keywords: Generic model, lixisols, luvisols, mid-infra red spectroscopy, soil organic matter

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