Proceedings published at http://www.m.elewa.org/econferenceIeCAB.php

Mineralogy of Africa's Soils as a Predictor of Soil Fertility

Abstract ID: IeCAB011-430

Kamau M. Nyambura[1], B. Mochoge[2] and Keith Shepherd[1]
[1]ICRAF, Nairobi, Kenya.
[2]Department of Agricultural resources Management, Kenyatta University, P.O. Box 43844-00100 Nairobi.
Corresponding author: **m.nyambura@cgiar.org**

ABSTRACT

Objective: Methods for rapid estimation of soil properties are needed for quantitative assessment of land management problems. Soil health surveillance systems can be used to achieve information on soil functional properties (SFP) at fine spatial resolution across a wide range of environmental conditions and scales. A key challenge to their implementation is how to measure soil functional properties on large numbers of geo-referenced soil samples in a consistent and cost-effective way. To solve this problem, the Africa Soils Information Services (AfSIS) provides a statistical sampling framework, which employs spectral diagnostics – low cost, high throughput analytical techniques based on reflectance of electromagnetic radiation. The data generated by these high-throughput techniques can be treated as spectra and used as input to pedo-transfer functions for prediction of soil functional properties that are expensive or time-consuming to measure. Until now infrared spectroscopy has been used as the key soil screening tool in soil health surveillance systems. However given the importance of soil mineralogy as a determinant of soil functional properties, and soil fertility and fertilizer response in particular, new developments in instrument capability for high- throughput X-ray diffraction (XRD) and steady improvements in mineral identification

databases and software could provide a powerful complementary tool and open up new opportunities for quantitative determination of mineral phases on large sample numbers. The recent launch of bench-top XRD technology opens up the technology as a routine high throughput technique in soil science. Until now use of XRD has been largely confined to detailed analysis on small sample sets and the links between soil function and soil mineralogy have remained largely descriptive. This study is evaluating the ability of X-ray diffraction (XRD) technique to rapidly predict soil functional properties, and to develop pedo-transfer functions for Africa's soils.

Methodology: This study will take advantage of the methods employed in the soil health component of the AfSIS project developed at the World Agro forestry Centre (ICRAF), and referred to as the Land Degradation Surveillance Framework (LDSF). In this work, the amounts of individual soil mineral phases and their distribution for ten sampling locations with a wide range of soil types in Africa will be measured, identified and quantified. A classification for Africa soil mineralogy in terms of weatherable and nutrient-rich soil minerals, and soil fertility potential will also be proposed. Relationships between soil mineralogy and conventional soil fertility variables will be investigated and XRD data on mineralogy will be combined with data from infrared spectroscopy and that from conventional laboratory tests, which characterizes soil mineral and organic properties, to provide powerful diagnostic capabilities. Samples will be collected by a randomization of 10 sentinel locations stratified by climate and based on the LDSF sampling design.

Key words: *Soil, spectral diagnostics, infrared spectroscopy, mineralogy, X-ray diffraction, pedo-transfer functions*