

Exploring the potential of proximal soil sensing for predicting soil fertility parameters

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Proximal soil sensing is an emerging technique having a potential to generate covariates for the digital soil mapping over time in a cost effective manner. This study investigates the potential of DUALEM-1S electromagnetic induction based proximal soil sensor to predict fertility determining soil properties in a Rhodustalf. The apparent electrical conductivity (EC_a) survey was performed in a commercial banana cultivation (4 ha) in Pelwehera (DL1b) using a DUALEM-1S sensor. The survey resulted in 8507 measurements of horizontal and perpendicular coplanar (HCP-subsoil and PRP-topsoil sensitive, respectively) EC_a measurements. Topsoil (0-30 cm) samples were collected from 43 locations. Soil samples were analyzed for texture, organic carbon, plant available (Av.) nutrients: N, K, P, Ca, Mg, Zn, Cu, Fe, Mn, pH, effective cation exchange capacity (ECEC) and electrical conductivity (EC). EC_{aHCP} and EC_{aPRP} data showed a high correlation ($r = 0.9$) indicating comparable top and subsoil properties. EC_{aPRP} measurements showed strong correlations with clay % ($r = 0.6$), sand % ($r = -0.6$), Av. Mg ($r = 0.7$) and Ca ($r = 0.7$). Spatial variability of properties was investigated using variogram analysis. Available Mg, N, Fe, Mn, P, K and Ca in the topsoil showed a strong spatial dependence with a relative nugget effect less than 25%. Principal component analysis (PCA) was used to assess the potential of EC_a to serve as a covariate to predict other soil physiochemical properties. The PCA reduced the dimensionality of the data set into five principal components (PC). PC1 attributed 32% of the variability which highlighted the relationships among EC_{aHCP} , EC_{aPRP} , sand, clay, ECEC, Av. Ca and Mg. PC2 attributed 19% of the variability highlighting the relationships among Av. Zn, P, Cu, Fe and EC.

This study revealed a strong spatially structured variability of soil fertility parameters which can be used to optimize soil management practices. Proximal soil sensing can be used as a promising tool to predict a majority of soil properties: sand, clay, organic matter, Av. Mg, Ca, Fe, P, Cu and Zn in Rhodustalf, the most prevalent soil great group in the dry zone.