Abstract

Wise decision-making on resource allocation and intervention targeting for soil management cannot rely solely on trial and error methods and field observations used by small-scale farmers: cost-effective soil fertility survey methods are needed. This study aimed to test the applicability of infrared spectroscopy (IR) as a diagnostic screening tool for making soil fertility recommendations in small-scale production systems. Soil fertility survey of 150 small-scale groundnut farms in western Kenya was conducted using a spatially stratified random sampling strategy. Soil properties examined were pH in water (pHw), total carbon (C), total nitrogen (N), extractable phosphorus (P), exchangeable potassium (K), calcium (Ca), magnesium (Mg) and texture. These properties were calibrated to mid-infrared (MIR) diffuse reflectance using partial least square regression (PLSR). Cross-validated coefficient of determination (r2) values obtained from calibration models were > 0.80 for all properties, except P and K with 0.66 and 0.50 respectively. Soil nutritional deficiencies were evaluated using critical nutrient limits based on IR predictions and composite soil fertility indices (SFIs) developed from the soil properties using principal component analysis. The SFIs were calibrated to MIR soil spectral reflectance with cross-validated r2 values > 0.80. The survey showed that 56% of the groundnut farms had severe soil nutrient constraints for production, especially exchangeable Ca, available P and organic matter. IR can provide a robust tool for farm soil fertility assessment and recommendation systems when backed up by conventional reference analyses. However, further work is required to test direct calibration of crop responses to spectral indicators and to improve prediction of extractable P and K tests.