

## Abstract

Three soil fertility management practices relevant to smallhold farming systems in the East African Highlands were tested in an 18 yr-old experiment on a humic nitisol (Kikuyu Red Clay) under a maize-bean rotation. These practices were the addition of mineral fertilizers (120 kg N and 52 kg P ha<sup>-1</sup> yr<sup>-1</sup>), application of cattle manure (10 t ha<sup>-1</sup> yr<sup>-1</sup>) and retention of maize stover. Eight treatments arranged as a 2×2×2 factorial were examined for their effects on crop yield, soil organic matter (SOM) fractions and soil chemical properties. Total crop yields of maize and beans ranged between 1.4 t ha<sup>-1</sup> yr<sup>-1</sup> when maize stover was retained without external inputs to 6.0 t ha<sup>-1</sup> yr<sup>-1</sup> when stover was retained and fertilizers and manure applied. Soil organic C contents to a depth of 15 cm ranged between 23.6 t ha<sup>-1</sup> (14.3 mg g<sup>-1</sup>) with combined addition of mineral fertilizers and stover removal to 28.7 t ha<sup>-1</sup> (17.4 mg g<sup>-1</sup>) with chemical fertilization, manuring and stover retention. Differences in particulate organic matter and microbial biomass among treatments were proportionately larger than changes in total soil organic carbon. All land managements resulted in an overall decline in SOM over time and the greatest average rate of loss, 557 kg C ha<sup>-1</sup> yr<sup>-1</sup>, was observed with fertilization and crop residue removal. Addition of manure and retention of maize stover reduced this loss by 49%. Carbon balances suggest that particulate organic matter is more efficiently restocked by manure than maize stover. Particulate organic matter is a key fraction for understanding soil fertility changes in humic nitisols of the Kenyan Highlands and has potential for use as an indicator of soil quality.