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Microbial dynamics and enzyme activities in tropical Andosols depending on land use and nutrient inputs

Kevin Mganga (1,2), Bahar Razavi (1), and Yakov Kuzyakov (1)

(1) Büsgen Institute, University of Göttingen, Göttingen, Germany, (2) School of Agriculture and Veterinary Sciences, South Eastern Kenya University, Kitui, Kenya

Microbial decomposition of soil organic matter is mediated by enzymes and is a key source of terrestrial CO_2 emissions. Microbial and enzyme activities are necessary to understand soil biochemical functioning and identify changes in soil quality. However, little is known about land use and nutrients availability effects on enzyme activities and microbial processes, especially in tropical soils of Africa. This study was conducted to examine how microbial and enzyme activities differ between different land uses and nutrient availability. As Andosols of Mt. Kilimanjaro are limited by nutrient concentrations, we hypothesize that N and P additions will stimulate enzyme activity. N and P were added to soil samples (0-20 cm) representing common land use types in East Africa: (1) savannah, (2) maize fields, (3) lower montane forest, (4) coffee plantation, (5) grasslands and (6) traditional Chagga homegardens. Total CO_2 efflux from soil, microbial biomass and activities of β-glucosidase, cellobiohydrolase, chitinase and phosphatase involved in C, N and P cycling, respectively was monitored for 60 days. Total CO_2 production, microbial biomass and enzyme activities varied in the order forest soils > grassland soils > arable soils. Increased β-glucosidase and cellobiohydrolase activities after N addition of grassland soils suggest that microorganisms increased N uptake and utilization to produce C-acquiring enzymes. Low N concentration in all soils inhibited chitinase activity. Depending on land use, N and P addition had an inhibitory or neutral effect on phosphatase activity. We attribute this to the high P retention of Andosols and low impact of N and P on the labile P fractions. Enhanced CO_2 production after P addition suggests that increased P availability could stimulate soil organic matter biodegradation in Andosols. In conclusion, land use and nutrients influenced soil enzyme activities and microbial dynamics and demonstrated the decline in soil quality after landuse change.

Key words: Andosols, β-glucosidase, Cellobiohydrolase, Chitinase, Phosphatase, Mt. Kilimanjaro