Tropentag, September 17-19, 2014, Prague, Czech Republic

"Bridging the gap between increasing knowledge and decreasing resources"

Soil Attribute Changes and Effect on Plant Production in the Littoral Wetland of Lake Naivasha

Christian Dold, Mathias Becker

University of Bonn, Inst. Crop Sci. and Res. Conserv. (INRES), Germany

Abstract

Lake Naivasha is a freshwater lake in the East African Rift Valley, which was affected by a continuously declining water level from 1980 to 2011. The newly exposed littoral land area has been gradually put under agricultural use by pastoralists and small-scale farmers, forming chronosequences of land use with distance to the lake shore (space-for-time approach). Transects representing land use durations of 0 – 30 years were established on pasture and cropland comprising soils of both alluvial and lacustrine origin. We assessed changes in soil moisture, carbon and nutrient content in a field study (November 2010 to December 2011) and additionally assessed the responses of kikuyu grass and maize in potted topsoil in a greenhouse experiment. With distance from the lake shore and increasing duration of land use there was a significant decline ($p < 0.05$) in soil organic carbon (SOC), permanganate oxidised and non-oxidised carbon as well as N contents under both pasture and cropland uses, following a model of exponential decay. Additionally, carbon in particulate organic matter (POM C) in all fractions decreased, revealing that both labile sand-bound and stable silt- and clay-bound carbon were affected. The decay rates did not differ between soil and land use types. Observed changes in plant-available Olsen P were not related to the duration of land use. Only the resin adsorbed P fraction decreased significantly with land use duration on lacustrine pasture and was associated with changes in SOC and soil moisture. On chronosequence positions ≥ 20 years the topsoil dried up temporarily. In croplands, this water deficit could be partially compensated by supplementary irrigation. The dry matter accumulation of both kikuyu grass (proxy for pasture vegetation) and maize (proxy for crops) in potted soil declined with duration of land use and was significantly related to soil nitrogen. The continuous agricultural use of the littoral wetland zone of Lake Naivasha is likely to entail declining production potentials for both pastures and food crops. The chronosequence model provides a suitable tool to study edaphic and hydrological change processes and their impact on plant production.

Keywords: Carbon, chronosequence, nitrogen, phosphorus, soil moisture content

Contact Address: Christian Dold, University of Bonn, Inst. Crop Sci. and Res. Conserv. (INRES), Karlrobert-Kreiten-Strasse 13, 53115 Bonn, Germany, e-mail: s7chdold@uni-bonn.de