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Microbial biomass and acid phosphomonoesterase activity in soils of the Central Highlands of Kenya

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Abstract

Soil biological properties are the most sensitive soil quality indicators that respond quickly to short-term soil fertility management changes. We studied the combined effects of tillage and soil external inputs on total soil organic carbon and nitrogen, microbial biomass carbon (MBC) and nitrogen (MBN) and acidphosphomonoesterase activity (ACP). This was done in Meru South and Kandara sub-counties in Kenya for three consecutive cropping seasons. Tillage was the main factor [minimum (D_0) and conventional (D_{15})], and soil external inputs were the sub-factors: sole mineral fertiliser (F), crop residues + mineral fertiliser (RF), crop residues + animal manure + legume intercrop Dolichos *lablab* L. (RML), crop residues + mineral fertiliser + animal manure (RFM), crop residues + *Tithonia diversifolia* + animal manure (RTiM), crop residues + *Tithonia diversifolia* + rockphosphate (RTiP) and an unfertilized treatment (Control). During the study period, we experienced frequent dry spells and meteorological droughts in the two sites. We found no significant effects of the tillage systems and mineral fertilisers applied alone or combined with crop residues on the biological properties. All additional organic inputs to the soils enhanced the biological soil properties. On average, MBC in the treatments with organic inputs only was

enhanced by 51% in Meru South and 19% in Kandara. MBC-to-TOC ratio was significantly different (p = .0003) under soil external inputs in Meru South. On average, MBN in the treatments with organic inputs was enhanced by 66% in Meru South and 25% in Kandara. Compared with the control, ACP was higher under RML, RTiP and RTiM by 26%, 20% and 17%, respectively in Meru South. In Kandara, ACP was higher under RTiM and RTiP by 25% and 23%, respectively, compared with the control. The increase in microbial biomass indicates that application of organic inputs contributed to soil organic C, thereby stimulating the microbial growth and enzyme activity. Thus, use of organic inputs or in combination with mineral fertilisers are feasible alternatives for sustaining soil organic carbon through increased microbial biomass leading to soil organic matter build-up, which is a vital element of soil quality and fertility.

Keywords: Organic resources; Mineral fertilizer; Microbial biomass; Acid phosphomonoesterase; Tillage