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Soil C dynamics under intensive oil palm plantations in poor tropical soils

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Oil palm cultivation mainly takes place on heavily-weathered tropical soils where nutrients are limiting factors for plant growth and microbial activity. Intensive fertilization and changes of C input by oil palms strongly affects soil C and nutrient dynamics, challenging long-term soil fertility. Oil palm plantations management offers unique opportunities to study soil C and nutrients interactions in field conditions because 1) they can be considered as long-term litter manipulation experiments since all aboveground C inputs are concentrated in frond pile areas and 2) mineral fertilizers are only applied in specific areas, i.e. weeded circle around the tree and interrows, but not in harvest paths. Here, we determined impacts of mineral fertilizer and organic matter input on soil organic carbon dynamics and microbial activity in mature oil palm plantation established on savanna grasslands. Rates of savanna-derived soil organic carbon (SOC) decomposition and oil palm-derived SOC net stabilization were determined using changes in isotopic signature of in C input following a shift from C4 (savanna) to C3 (oil palm) vegetation. Application of mineral fertilizer alone did not affect savanna-derived SOC decomposition or oil palm-derived SOC stabilization rates, but fertilization associated with higher C input lead to an increase of oil palm-derived SOC stabilization rates, with about 50% of topsoil SOC derived from oil palm after 9 years. High carbon and nutrients inputs did not increase microbial biomass but microorganisms were more active per unit of biomass and SOC. In conclusion, soil organic matter decomposition was limited by C rather than nutrients in the studied heavily-weathered soils. Fresh C and nutrient inputs did not lead to priming of old savanna-derived SOC but increased turnover and stabilization of new oil palm-derived SOC.