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Dynamics of density fractions of macro-organic matter after forest conversion to sugarcane and woodlots, accounted for in a modified Century model

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Abstract

Soil organic matter (SOM) is the major controlling factor of soil fertility for low external input agriculture. However, most models describing SOM dynamics are based upon pools which are not directly measurable. We developed a SOM submodule for the CENTURY model based on Ludox particle size density fractions. The turnover rates of these easily measurable fractions were determined by assessing their ^{13}C isotope signatures in a chronosequence under surgane after rainforest conversion.

The net monthly decomposition rates of light (L), intermediate (I) and heavy (H) fractions of macro-organic matter (150 μm – 2 mm size) under sugarcane cultivated for 2–10 years following forest removal ranged from 0.0162 and 0.0154 month^{-1} for forest-derived L and I fractions to 0.0118 month^{-1} for H fractions, while for unfractionated forest soil organic matter it was 0.0068 month^{-1}. The soil carbon of the CENTURY model was reconstructed and the 'slow' (SOM2) pool was divided into L, I, H and R fractions, where the R (resistant) fraction represents the 50–150 μm size fraction. The modified CENTURY model simulated the dynamics of L, I and H fractions as well as total organic carbon (C%) under sugarcane with a coefficient of determination (R^2) of 0.90, 0.95 and 0.98, respectively. Without further adjustments the model was applied to woodlots of *Gliricidia sepium* and *Peltophorum dasyrrachis*. The model accounted for 60% of the variation in measured light (L) fraction in the 0–5 cm layer under *Gliricidia* and *Peltophorum*, but only for 40% of the variation in the I and H fraction data. Results thus show some progress in linking SOM models to measurable soil organic matter fractions, but are not yet satisfactory for the heavier fractions, more strongly associated with mineral particles. Experimental data for these fractions show a considerable spatial variability, possibly linked to activity of soil fauna, not covered by the model.

Keywords: Model, light fraction, density fractionation, soil organic matter, SOM, CENTURY, sugarcane, forest