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Soil Organic Matter Turnover in Pasture Sites Following Deforestation in the Humid Central Amazon of Brazil

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Abstract

We studied the organic matter cycling characteristics in the humid central Amazon of Brazil. Total C and natural ¹³C abundance ($\delta^{13}\text{C}_{\text{V-PDB}}$) in the whole soil and in the microbial biomass (labile pool) was followed along a chronosequence of pasture sites of 6 months up to 60 years after deforestation.

The $\delta^{13}\text{C}$ natural abundance in the whole soil decreased from -27‰ under undisturbed forest sites to -23‰ in the 60-year-old pasture site, and from -30‰ to -19.4‰ in the microbial biomass.

An increase of total soil organic C in the whole soil occurred during the first 2 years of pasture establishment and was due to an increase in grass-derived C (C_4). After this 2 years, $\text{C}_3\text{-C}$ decreased by 25% and remained at this level up to 8 years following deforestation. Thereafter, $\text{C}_3\text{-C}$ declined steadily. Grass derived carbon was similar at all sites ($\sim 8 \text{ g kg}^{-1}$) once the pastures were established after 2 years. In the microbial biomass, $\text{C}_3\text{-C}$ declined by 60% during the first 2 years of pasture establishment. From 2 to 4 years following forest cutting $\text{C}_3\text{-C}$ increased for a short period and declined then steadily with pasture age. Contrary to the whole soil, $\text{C}_4\text{-C}$ in the microbial biomass increased during the first 6 years following pasture establishment. Thereafter, it decreased continuously. The overall decrease of total C in the pastures with time following deforestation was due primarily to the loss of $\text{C}_3\text{-C}$ derived carbon. The loss of $\text{C}_3\text{-C}$ from the system started much earlier in the microbial biomass compared to the whole soil. Sixty years following deforestation and pasture establishment the loss of $\text{C}_3\text{-C}$ was 60% in the whole soil and 80% in the microbial biomass.

Keywords: Amazon, microbial biomass, organic matter transformation, pasture sites, whole soil