TITLE: SOIL ACIDITY CORRECTION AS A MODULATOR OF METHANE CYCLING MICROORGANISMS IN THE AMAZON FOREST-TO-PASTURE CONVERSION

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ABSTRACT:

Deforestation in the Amazon region is followed by the immediate establishment of cattle pastures in 60-80% of the cases. Of these pasture areas (10-30 Mi ha), over half of them are degraded. One of the first steps to recover a degraded area is the use of liming to counter soil acidity, but little is known about the impacts of liming on methane cycling in tropical soils. Methane is a greenhouse gas 30 times more potent than CO_2 and its production and consumption in soils is provided by methanogenic archaea and methanotrophic bacteria, respectively. This study evaluated the effects of acidity correction on methane fluxes and on the structure of the active methanotroph community under controlled conditions. Soil samples from forests (pH 3.5-5.0) and pastures (pH 4.5-5.5) were collected in southwestern (Ariquemes-RO) and northeastern (Santarém-PA) regions of the Amazon. Greenhouse experiments (mesocosms) included soils non limed and limed to a pH value of 6.5 with $CaCO_3$. Soils were maintained at 70% of their water holding capacity for 180 days. CH_4 and CO_2 fluxes were evaluated during the experiments, and the microbial community structure was established based on 16S rRNA sequences (Miseq 600c sequencing - 515F/806R). In a second experiment, Stable Isotopic Probing technique was used to identify the active methanotrophic community after 21 days of incubation with $^{13}CH_4$. Our results suggest that the sink activity of soils for CH_4 is reduced by 25-50% after pH correction under atmospheric CH_4 conditions (~1.8 ppm) on both forest and pasture soils. However at high CH_4 concentrations (10000 ppm) the sink activity is increased from 0-15% under acidic conditions, and up to 20-90% under conditions of higher pH values. Specifically, the methane cycling community in acidity corrected soils after 180 days under atmospheric CH_4 concentrations exhibited a 20% reduction of the methanogenic archaea *Methanocellaceae* in Pasture soils, and a 50% reduction of the methanotrophic candidate *Beijerinckiaceae* in forest soils. Surprisingly, the active methanotroph community under high $^{13}CH_4$ incubation conditions showed a 4-fold increase in respiratory activity (measured as $^{13}CO_2$) with higher pH in forest soils, but no significant changes with higher pH in pasture soils. These results strongly suggest that the CH_4 sink capacity of tropical forest soils is modulated by soil pH, and also that a pH value of 6.5 in pasture soils affects the methanogenic archaea, indicating a potential impact of soil management on methane emissions from pasture soils.

Keywords: climatic changes, methane, SIP, microbial ecology

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