Single Tree-Effects on Denitrification and Soil Microbial Biomass in Agroforestry Systems and Natural Forests of the Amazon Region

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Soil microorganisms are the dominant processors of soil C and N as well as dominant global sources of N_2O and major sources of CO_2. Variation of soil microbial biomass and its activity may to a large extent control actual emission of greenhouse gases. In order to predict fluxes of greenhouse gases from soils, knowledge of the microbial biomass will be of importance. Tropical forest ecosystems are one of the main natural source of CO_2 and N_2O. Whereas enhanced N_2O and CO_2 fluxes after conversion of tropical forests to grassland were reported by many authors, the effect of conversion to agroforestry an plantation forestry is much less studied. The aim of the present study was to find the effect of tree species used in agroforestry system in Amazonian region and natural forests on the total biomass of heterotrophic microorganisms (BH), which is mainly responsible for CO_2 emission, and on the biomass of denitrifiers (BD), which control N_2O emission. Both biomasses were studied using the kinetic method. Using trees-mediated soil changes we intended to explain variation of microbial biomasses by variation of soil properties.

Conversion of tropical forests to agroforestry in Amazonian region caused changes in different groups of soil microbial community. Most commonly used fruits species cupuaçu (*Theobroma grandiflorum*) and annatto (*Bixa orellana*) 2-3 times increased BD. Development of secondary forests with the dominant species *Vismia spp* also increased BD. The difference between woody species *Andiroba* and *Ceiba pentandra* was not significant, and these species did not significantly change BD compared to the primary forest species.

The BH was also affected by tree species. The highest BH was found in soil samples beneath *Ceiba pentandra* compared to all other tree species ($P < 0.05$). The lowest BH was found in soil samples beneath cupuaçu, annatto and *Eschweilera.* Cupuaçu and annatto did not differ significantly in their effect on the both biomasses studied. The effect of *Eschweilera* on BH was significantly different from that of *Andiroba* ($P < 0.03$) and *Vismia* ($P < 0.05$).

We also wanted to find relationships between the biomasses studied and soil microbial activities. The BD was negatively related to the net N mineralization and basal respiration rates, and positively to net nitrification and denitrification rates ($P < 0.05$). BH was positively related to the net N mineralization, basal and substrate-induced respiration rates. As the two measured biomasses were oppositely related to the processes related to the production of greenhouse gases, we calculated the ratio of BD to BH (D/H ratio) and made all further calculations with this ratio. The D/H ratio has shown stronger relationships to almost all of the microbiological activities. The D/H ratios were negatively related to the net N mineralization, basal and substrate-induced respiration rates. Also significant relationship was found between D/H ratios and denitrification, the relationship was even stronger than between denitrification and BD. The latter suggested that the D/T ratio should be taken into account for modeling or predicting greenhouse gases emission from the studied soils.