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Soil processes as affected by replacement of natural mesquite ecosystem with maize crop

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Abstract In the central highlands of Mexico, the vegetation is dominated by mesquite (*Prosopis* spp.), a leguminous tree or shrub. An experiment was carried out to investigate how cultivating the land and the disappearance of the natural ecosystem affected the biological functioning of the soil. Soil was sampled from under the canopy of isolated (MESQ treatment) and densely growing mesquite trees (DENS treatment), from the surrounding soil not covered by the canopies of the trees (BARE treatment) and from adjacent land cultivated with maize (ARABLE treatment). Soil was characterized and then incubated aerobically for 39 days at $22 \pm 1^\circ\text{C}$ and CO_2 , N_2O production, microbial biomass C and inorganic N concentrations were monitored. The organic C content was 2.3 times and 1.1 times greater in the MESQ and the BARE treatments, respectively, than in the ARABLE treatment, while microbial biomass C was 3.5 times and 1.3 times greater. The microbial biomass activity as expressed by CO_2 production was 5.9 times and 3.9 times greater in the MESQ and the BARE treatments, respectively, than in the ARABLE treatment, while N mineralization, as witnessed by the increase in NO_3^- concentrations, was 3.4 times and 1.7 times greater. No significant amounts of N_2O were produced in any of the treatments. It was found that cultivating land characterized by the presence of mes-

quite changed its characteristics profoundly, and even soil not covered by tree canopies had higher microbial biomass C, and C and N mineralization than soil cultivated with maize and beans.

Key words Mesquite · Carbon dioxide production · Nitrogen mineralization · Microbial biomass carbon · Nitrous oxide production

Introduction

The mesquite (*Prosopis* spp.) is a leguminous shrub or tree from the arid and semiarid regions of Mexico. Different products are derived from it: the sheaths of the fruits are used for human consumption, the leaves are used as fodder, the wood for carpentry, the flowers for honey production, while the leaves and sheaths of the fruits provide natural antibiotics. The canopy under the N_2 fixing mesquite maintains a highly diverse vegetation and is a refuge for fauna and pioneering plants. Clearing mesquite for agricultural purposes dramatically decreases the organic matter content in soil and consequently the nutrient supply to the crop, increasing the need for more and more inorganic fertilizer applications (Frias-Hernandez 1997). The disappearance of the natural vegetation and the subsequent drop in soil organic material increases the loss of the fertile top soil through erosion, thereby further decreasing soil fertility.

As part of a study into the sustainability of the natural ecosystem of mesquite, soil was sampled from under the canopy of densely growing mesquite trees (DENS treatment) and isolated ones (MESQ treatment), from soil not covered by the canopy of the mesquite (BARE treatment) and from adjacent soil cultivated with maize and beans (ARABLE). The soil was characterized and the production of CO_2 , microbial biomass C, N_2O production and dynamics of inorganic N (NO_3^- , NO_2^- , and NH_4^+) were monitored in an aerobic incubation at $22 \pm 1^\circ\text{C}$ for 39 days.

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