C, N AND P STOCKS AND FLUX THROUGH THE MICROBIAL BIOMASS UNDER DIFFERENT SOIL MANAGEMENT

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Resumo - The objective of this study was to determine the effects of different crop systems on soil microbial properties and C, N and P stock after 22 years of cropping on an Oxisol (Typic Haplorthox) at Londrina, Brazil. Soil samples were taken at 0-5, 5-10 and 10-20 cm depths and evaluated for microbial biomass C, N and P. The cultivated sites presented lower microbial biomass and C and N stock than Forest site. While the total P stock presented under crop sites were higher than Forest site. The annual N and P flux through the soil microbial biomass means respectively about 65% and 45% for Coffee, about 50% and 70% for maize and 65% and 60% for wheat of the annual N e P needs. Those results evidence that the microbial biomass represents a substantial reserve of nutrients in the soil and may contribute substantially to the nutrients requirements of crops.

Palavras-Chave: microbial biomass, soil management, nutrient flux.

ESTOQUES DE C, N E P E FLUXO ATRAVÉS DA BIOMASSA MICROBIANA SOB DIFERENTES SISTEMAS DE MANEJO DO SOLO

Abstract- O objetivo do estudo foi avaliar o efeito de diferentes sistemas de culturas nas propriedades microbianas e estoques de C, N e P depois de 22 anos de cultivo em um Latossolo Roxo em Londrina, PR, Brasil. Amostras foram coletadas nas profundidades de 0-5, 5-10 e 10-20 cm e avaliadas o C, N e P da biomassa microbiana. As áreas cultivadas apresentaram menor biomassa microbiana e maior estoque de P que a floresta. O fluxo anual de N e P pela biomassa microbiana representa, respectivamente, 65% e 45% no cafeeiro, 50% e 70% no milho e 65% e 60% no trigo da necessidade anual de N e P. Estes resultados evidenciam que a biomassa microbiana representa reserva considerável de nutrientes no solo e pode contribuir de maneira significativa para suprir as necessidades das culturas.

KeyWord: biomassa microbiana, manejo do solo, fluxo de nutrientes.

1. INTRODUCTION

Nowadays there is needed to produce crescent amount of food and fiber due to high increase of world population. For satisfy this need many forest area have been converted into intensive cultivated land. It is known that intense management causes soil erosion and depletion of organic matter, nutrient soil stocks and microbial activity, decreasing soil quality. Depending on the level of soil disturbance and carbon inputs, the management system can have varying levels of impacts on soil quality. So the degree of tillage is an important disturbance factor because it alters soil structure stability resulting in a considerable loss of soil organic matter and microbial activity.

Microorganisms have a central role in soil nutrient fluxes. The total microbial biomass is a small but labile source of major soil nutrients and drives soil nutrient mineralization through organic matter decomposition (Dick, 1992). So fluctuations in microbial biomass size and activity can significantly influence nutrients content and crop productivity (Brookes et al. 1984).

The objectives of the present study was to evaluate how soil management practices had affected the microbial biomass of C, N and P, its soil stocks and nutrient fluxes through microbial biomass in the soil after 22 years of cropping.

2. MATERIAL AND METHODS

A study was conducted at the Experimental Station of Agronomic Institute of Paraná (IAPAR), district of

Londrina, State of Paraná, Brazil on an Oxisol (Typic Haplorthox) with 85% clay, 12% silt, 3% and with slope about 6%. Four adjacent areas were selected:

Forest: The forest site is a remnant of primary tropical semi-deciduous forest used to cover all north of Parana state, which have been intensely devastated in the last century. Leguminosae, Myrtaceae, Euphorbiaceae and Lauraceae are the main families of flowering plants of area and the forest canopy height ranges about 15 m.

Coffea: the site is situated about 100 m from Forest area and is a coffee plantation (Coffea arabica L.), "Mundo Novo" cultivar, that has been cultivated with 2200 trees/ha (4.0 x 2.0 m of spacing) since 1977.

Conventional Tillage (CT): this area is from experiment established in 1976 with two-crop-year under wheat (Triticum aesativum L.) in the winter season and soybean (Glycine max L.) in one year and maize (Zea maize L.) in another year as summer crop.

No-Tillage (NT): this area is from the same experiment described above.

From each site three soil samples (five sub-samples each) were taken at 0-5, 5-10 and 10-20 cm depths in August 97 and March 98 (at the end of the winter and summer crop, respectively). The fresh soil samples were sieved through a 4 mm screen with large plant material removed and determined for microbial (microbial biomass C, N and P), chemical and physical characteristics. Annual C, N and P flux through the biomass was estimated based on the microbial biomass contents assuming a turnover of 1.25 per year as suggested by Jenkinson & Ladd (1981) for warmer countries by assuming that decomposition was twice as fast in the warmer environmental than in the cold environmental.

Data were averaged across the two sampling years and were analyzed using the SAS statistical package (SAS Inst., 1998).

3. RESULTS AND DISCUSSION

Comparison of C, N and P stocks among different management systems indicates that soil management has an important effect on soil C, N and P storage. The estimates of pool sizes for microbial C, N and P suggest that these pools are large enough to have significant impacts on plant nutrient availability. By assuming a turnover time of 1.25 years for microbial nutrients (Jenkinson & Ladd, 1981) the annual N flux through the soil microbial biomass means about 65% for Coffee, 50% for maize and 59% for wheat under CT, and 46% for maize and 70% for wheat under NT of the annual N needs. In relation to annual P flux through the soil microbial biomass it means about 45% for Coffee, 28% for maize and 55% for wheat under CT, and 125% for maize and 63% for wheat under NT of the annual P needs.

The soil properties alteration due to system management shown that the loss in the microbial nutrients were higher than that in the C and N soil stocks. However the total P stock increased while organic P stock declined due to crop system after 22 year of cultivation

4. CONCLUSION

Different soil management had strong effect on the soil biological activity and C, N and P stocks of soil. In general reduced tillage like Forest and NT promotes soil quality as indicated by amounts of microbial biomass and activity, stocks and annual C, N and P flux through the soil microbial biomass. The annual flux of N and P estimated through microbial biomass evidenced that the microbial biomass represents a substantial reserve of nutrients soil and may contribute substantially to the nutrients requirements of crops.

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