Long-term Monitoring of β-glucosidase Activity and Microbial Biomass Carbon in a Brazilian Cerrado Oxisol under No-till and Conventional Tillage

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Introduction

Long-term monitoring allows the identification of changes in the soil and could help in the prediction of future alterations. The data obtained from monitoring through time could open possibilities for the evaluation of different soil management treatments and improve soil protection measures.

In this work we present the monitoring of the microbial biomass carbon (MBC) and the activity of the enzyme β-glucosidase over a period of 13 years in two adjacent areas under no tillage (NT) and conventional tillage (CT) in a Brazilian cerrado soil classified as a clayey Typic Haplustox. An area under native cerrado vegetation was also included as a reference for the original conditions of the soil (Figure 1).

Figure 1. Google Earth image showing the three studied areas: no-tillage (NT), Conventional tillage (CT) and native cerrado vegetation.

Materials and Methods

- Location: Experiment started in 1992/93 at the Embrapa Cerrados experimental field, Planaltina, DF, Brazil.
- Soil: Clayey Typic Haplustox.
- Treatments: Adjacent areas under NT and CT systems with corn and soybean succession and a native cerrado vegetation area (Figure 1). The areas under each treatment were divided into three plots.
- Monitoring Period: from 1999 to 2012 at the flowering stage of the crops.
- Sampling depths:

  Phase I (1999-2003): 0-5 cm.

  Phase II (2004-2012): 0-10 cm.
- Parameters evaluated:

  MBC (Vance et al., 1987)

  β-glucosidase activity (Tabatabai, 1994).
- Statistics: At each sampling time, the mean and standard error were calculated for each parameter.

Results and Discussion

- The differences between the studied areas were higher in Phase I (0-5 cm) than in Phase II (0-10 cm). This effect is related to the stratification of the microbiological properties in the soil profile in the NT and native vegetation areas where there is no soil disturbance (Figures 2 A and B).
- In Phase I the difference related to the MBC between the areas under NT and CT was 1.9 times while in Phase II was 1.4 times. These results demonstrate the positive effect of the absence of soil disturbance of the NT system on the MBC (Figure 2 A).
- Regarding the native cerrado vegetation, reductions of the MBC were observed in both farming systems over the 13 years of monitoring.
- On average, at Phase I, activity levels of β-glucosidase in the area under NT were 2.8 higher than the CT. In Phase II the magnitude of these differences fell to 1.7 times. This higher activity at the NT area is related to the accumulation of plant residues in the surface layers of the soil under this management system (Figure 2 B).

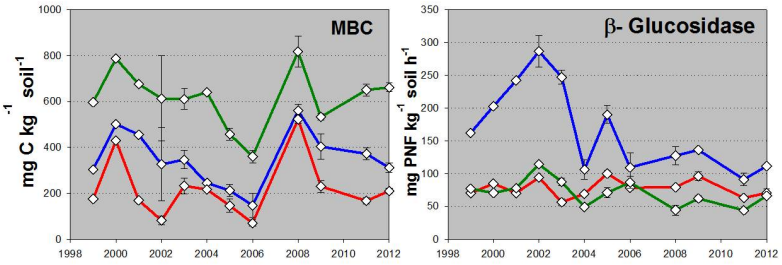

Figure 2. Microbial Biomass Carbon (A) and β-glucosidase activity (B) in soil under **no-tillage (NT)**, **conventional tillage (CT)** and **native cerrado** vegetation during 1999–2012. Phase I (1999-2003): 0-5 cm. Phase II (from 2004): 0-10 cm.

Conclusions

- The adoption of the no-tillage system causes significant changes in the biological functioning of the soil, with higher concentration of microbial activity in the surface layers.
- Due to its sensitivity, ease of measurement and low cost, β-glucosidase activity holds potential for its use as a biological indicator of soil quality

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