Carbon and nitrogen stocks in soil under different landscape units at the Pantanal ecosystem, Mato Grosso do Sul, Brazil

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Introduction

The soil organic matter content plays an important role in greenhouse gas emission processes and consequent global climate change. A sound understanding about C sequestration potential in soil could be crucial for the development of effective management approaches in order to reduce CO_2 concentrations in the atmosphere as well as to maintain the ecosystem sustainability. In the Pantanal ecosystem landscapes have a diversified floristic composition and structure. They are consisted by a mosaic of different phytophysionomic features, which are influenced by edaphic factors and variable flooding levels. Furthermore, they have sustained a livestock production with a low level of external inputs, especially regarding to soil management. This study aimed to evaluate the soil carbon and nitrogen storage under different landscape units in the Pantanal ecosystem.

Material and Methods

The study was carry out at the Embrapa Pantanal experimental farm, whose landscape is representative of the most part of the Nhecolandia sub-region. Four different landscape units were studied: forested savannah; arboreal savannah; grassland savannah with *Mesosetum chaseae*, and open grassland with *Axonopus purpusii* (these areas su-

ffer seasonal flooding at contrary grassland savanna with *M. chaseae* the are no flooding areas). Soil samples were collected at 0-10, 10-20, 20-30, 30-40, 40-60, 60-80 and 80-100 cm depths, in three trenches to determine soil bulk density, and in four different transects, accounting 315 samples per landscape unit (45 per depth). The C and N content were assessed by dry combustion in a CHNS analyzer equipment. The results were submitted to ANOVA, and the multiple means comparisons were performed by the Tukey test at 5% probability.

Results and Conclusions

The larger C stocks were found out at 0-10 and 10-20 cm depths in the forested savannah and in the open grassland with *A. purpusii* landscape units (respectively 10.76 and 8.33 Mg C ha^{-1} in open grassland with *A. purpusii* and 6.53 and 5.09 Mg C ha^{-1} in forested savannah) (Table 1). Taking in account the layer 0-100 cm, the C storage was significantly higher in open grassland with *A. purpusii* (33.54 Mg C ha^{-1}) and in forested savannah (33.03 Mg C ha^{-1}). Lower contents occurred in grassland savannah with *M. chaseae* (23.99 Mg C ha^{-1}) and in arboreal savannah (21.91 Mg C ha^{-1}). These landscape units are characterized by natural environments and these soils have never been submitted to any kind of management. Therefore, the results of the open grassland with *A. purpusii* unit might be related to the vegetal residue deposition provided by the annual cycle of flooding, mainly aquatic weeds. Moreover, it may be also related to the soil organic matter quality. Prevailing the presence of recalcitrant C fractions could give rise to a protected compartment, which keeps the C in more stable forms. On the other hand, the C stocks of forest savannah may be due to the higher amount of organic residue and to the litter production provided by a dense and diversified tree vegetation. The reduced soil C storage in the arboreal savannah and grassland savannah with *M. chaseae* units may be associated with a grazing pressure because they remain flood-free in the most part of the year, which allows them to be highly used by cattle.

Besides that, the presence of a dominant vegetation consisted by herbaceous plants under scattered woody plants. It leads to the addition of small organic material amounts to the soil. Regarding N stocks, variations were observed among the landscapes units and soil depths (Table 1). However, significant difference was not detected when the 0-100 cm layer was taking in account. The values were ranging from 2.41 to 3.62 Mg N ha^{-1}, which indicates low capacity of N storage in the soil. The Pantanal natural pastures are subjected to a continuous defoliation, imposed by the grazing pressure. This situation characterizes these environments as an ecosystems marked by merely biomass extraction and almost no nutrients or organic material replacement, except the animals excreta, which are deposited in specific locations. In natural low fertility and unfertilized ecosystems like Pantanal, the main source of nutrients for plants comes from the processes of soil organic matter decomposition and mineralization (MOREIRA e MALAVOLTA, 2004). The depletion of C stocks in soil could bring lower resilience level, which could result in an impairment of the productive capacity and less ecosystem services supply.

Table 1. Carbon and nitrogen stocks in soil under different landscape units at the Pantanal ecosystem, Mato Grosso do Sul, Brazil.

Landscape units*	Soil depth (cm)							
	0-10	10-20	20-30	30-40	40-60	60-80	80-100	0-100
	Soil carbon stocks (Mg C ha^{-1})							
OG	10.76Aa	8.33Ab	4.00Ac	2.52Acde	3.48Bcd	2.48Bde	1.94Be	33.54A
FS	6.53Ba	5.09Bab	3.76Aab	3.54Ab	5.08Aab	4.51Aab	4.52Aab	33.03A
AS	4.48Ca	3.90BCa	3.17Aab	2.32Ab	3.48Bab	2.28Bb	2.29Bb	21.91B
GS	3.81Cab	3.72Cab	3.09A	2.72Ab	4.29ABa	3.17Bab	3.17Bab	23.99B
	Soil nitrogen stocks (Mg N ha^{-1})							
OG	1.12Aa	0.91Aa	0.41Ab	0.25Bb	0.36Ab	0.26Bb	0.21Bb	3.53A
FS	0.62Ba	0.52Bab	0.37Aa	0.67Aa	0.51Aab	0.46Aab	0.46Aab	3.62A
AS	0.48BCa	0.43Bab	0.36Aab	0.26Bb	0.40Aab	0.27ABab	0.27Bb	2.47A
GS	0.39Ca	0.38Ba	0.31Aa	0.28Ba	0.42Aa	0.30Aba	0.32ABa	2.41A

*OG = open grassland with Axonopus purpusii; FS = forested savanna; AS = arboreal savanna; GS = grassland savannah with Mesosetum chaseae. Values followed by different upper-case letters within columns and lower-case letters within rows are significantly different by Tukey test ($p < 0.05$).

References

MOREIRA, A.; MALAVOLTA, E. Dinâmica da matéria orgânica e da biomassa microbiana em solo submetido a diferentes sistemas de manejo na Amazônia Ocidental. **Pesquisa Agropecuária Brasileira**, v. 39, pp. 1103-1110, 2004.

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