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QUANTIFICATION OF LITTER AND ORGANIC CARBON IN FRAGMENT OF CERRADO SENSU STRICTO IN TOCANTINS

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ABSTRACT - This study aimed to quantify the accumulated litter of a fragment of cerrado *sensu stricto*, besides estimating the organic carbon stored from the organic matter. We conducted the study in a *sensu stricto* cerrado fragment in the municipality of Formoso do Araguaia, State of Tocantins, where samples of litter were collected in six random plots of 10 m x 50 m (500m^2) using a 0.5 m x 0.5 m iron template by throwing it into the ground to collect the material. We separated the collected litter into two fractions, dry and green litter. Those collected were conditioned in paper containers for oven drying at 70°C for 48 h. It was weighed 1.5 g of the biomass ground in porcelain crucibles, which were dried in an oven at 105°C for 24h, then in the muffle at 550°C for 3h, at the Madeira Laboratory from the Federal University of Tocantins. For the litter, it was quantified 4.36 t ha^{-1} (value below the ones found in the literature), 69.08% of organic matter for the dry material, 95.42% of organic matter for the green material, 0.546 t ha^{-1} of organic carbon in the dry material, 0.769 t ha^{-1} of organic carbon in the green material.
Keywords: biomass, nutrient cycling, organic matter.

QUANTIFICAÇÃO DE SERAPILHEIRA E CARBONO ORGÂNICO EM FRAGMENTO DE CERRADO SENSU STRICTO NO TOCANTINS

RESUMO - Objetivou-se quantificar a serapilheira acumulada de um fragmento de cerrado *sensu stricto*, além de estimar o carbono orgânico armazenado a partir da matéria orgânica. A pesquisa foi realizada em uma região de cerrado *sensu stricto* no Município de Formoso (TO), onde foram coletadas amostras de serapilheira em seis parcelas aleatórias de 10 m x 50 m (500 m^2) utilizando um gabarito de ferro de 0,5 m x 0,5 m, o qual era lançado sobre o piso da floresta para coleta do material. A serapilheira coletada foi separada em duas frações, serapilheira seca e verde. Os coletados foram condicionados em embalagens de papel para secagem em estufa a 70°C por 48 h. Posteriormente foram levados ao Laboratório de Tecnologia da Madeira da Universidade Federal do Tocantins, onde pesou-se 1,5 g da biomassa moída em cadinhos de porcelana e secou-a em estufa a 105°C por 24 h, na sequência foram novamente seco, dessa vez na mufla a 550°C por 3h. Os valores encontrados de serapilheira depositada (4,36 t ha^{-1}) e carbono orgânico seco (27,29%) foram considerados baixos quando comparados a outros estudos em mesma fitofisionomia florestal. Isto indica que a área encontra-se alterada.
Palavras-chave: Biomassa, ciclagem de nutrientes, matéria orgânica.

INTRODUCTION

The cerrado corresponds to the second largest Brazilian phytogeographic domain (FERREIRA et al., 2016) and it is considered a hotspot of global biodiversity (STRASSBURG et al., 2017), covering about two million km^2, only behind the Amazon Forest, occupying about 23% of the national territory. The domain has as one of its main characteristics the great variation of its phytophysiognomies, formed mainly by savanna vegetation (WALTER et al., 2008).

Low, sloping, tortuous trees with irregular and twisted branches and a tree cover ranging between 5% and 70% without canopy formation are the main characteristics of this vegetation (FERREIRA et al., 2015). Sunlight hits the soil surface intensifying a stunning herbaceous community with some shrubs (TEIXEIRA et al., 2016).

Regardless of forest formation, litter production represents the first stage of transferring nutrients and energy from vegetation to soil, because most of the nutrients absorbed by plants return to the forest ground through the litterfall (CALDEIRA et al., 2008).

Litter can be determined as all types of biogenic material at various stages of decomposition, material that represents a potential source of energy for consuming species (BRUN et al., 2001). Also, it corresponds to the entire organic layer, which falls from the aerial part of the plants: leaves, branches, flowers, fruits and seeds that together with the roots, come into decomposition process,

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being responsible for a large part of the nutrients cycling (COSTA et al., 2010).

The main litter functions are: to protect the soil against high temperatures, to store in its content a large amount of capable germinating seeds or in a dormant state, to shelter an abundant fauna composed of small and large invertebrates that act in the decomposition of these materials, naturally fertilizing the soil, in addition to work as a thermal insulator, improving the conditions of the deepest horizons (SANTOS, 1989; VITAL et al., 2004).
Generally, litter accumulation is variable according to the ecosystem considered, and its successional stage (BRASIL et al., 2013). Notably, the leaf fraction is the one that most contributes to returning nutrients to the soil, however, the speed of decomposition varies between different ecosystems according to biotic and abiotic factors (LIMA et al., 2015).

To seek a better understanding of the nutritional dynamics in the ecosystem, it is important to know the formation of litter, because it is through its formation that part of the process of returning organic matter and nutrients to the soil occurs, as long as its constitutes a fundamental means of transferring essential elements from vegetation to the soil (VITAL et al., 2007).

At this juncture, the objective was to quantify the accumulated litter of a fragment of cerrado *sensu stricto*, in addition to estimating organic carbon from organic matter.

MATERIAL AND METHOD

Characterization of the study area

The study was conducted in a fragment of cerrado *Sensu Stricto* in the municipality of Formoso do Araguaia, State of Tocantins. The region's climate is *Aw*, according to the Köppen classification, with two well-defined climatic seasons: dry, between May and September, and rainy, between October and April. Furthermore, has an average annual temperature of 26.7ºC and an average annual rainfall of 1719 mm as characterize (TOCANTINS, 2009).

Collection and determination of litter mass

The study area was delimited in six plots of 10 m x 50 m (500 m^2), randomly, inside a fragment of cerrado sensu stricto with a total size of 20.2 ha. We collected the litter in June 2017, with the aid of a 0.50m x 0.50m iron template, placed on the forest floor randomly (SPERANDIO et al., 2012).

In this way, we separated the collected material into paper packaging made of green material, which comprises grasses and small shrubs found in the area, and dry material, consisting of branches, leaves, barks, seeds, and fruits, already decomposing. The litter was collected and packed in paper packaging, duly identified, and transported to the Ecology Laboratory of the Federal University of Tocantins, where it was weighed on an analytical balance to quantify the wet mass (Mu). Subsequently, we deposited the material in the shade to maintain its characteristics.

Then the material was taken to the oven with forced air circulation, at 70°C, for a period of 48 h. To obtain the dry mass values of each fraction of the litter, an analytical balance was used, with precision to two decimal places (TEIXEIRA et al., 2016). The methodology used in the present work was the same used by Witschoreck and Schumacher (2000), to facilitate the discussion, an average of the results obtained in each repetition was used to obtain the final result.

Muffle Method

The litter, previously dried, was ground in a knife mill with a 20-mesch sieve. The quantification of the organic matter content was performed using the muffle method, being carried out according to the methodology proposed by Goldin (1987), with the following adaptations: 1.5 g of the ground biomass were weighted in porcelain crucibles and dried in an oven at 105°C for 24 h, to eliminate all water present in the residues. We placed the ceramic crucibles in a desiccator and waited until the sample reached room temperature, and then we used an analytical balance to weight the biomass and obtain the dry weight.

Soon after, we incinerated the materials in a muffle at 550°C for 3 h. As a result, the set (crucible + waste) was again packed in a desiccator and then weighed. The percentage of organic matter (MO) was obtained using the ratio of the MO content found in the incinerated waste and the material lost in the burning, when taken at a temperature of 105 to 550ºC, according to the formula (Equation 1).

$$MO\% = (P - (C - T) \times 100)/P \qquad \text{(Equation 1)}$$

Where:
MO% = organic matter in percentage,
P = weight of the sample heated in an oven at 110°C,
T = crucible tare and
C = weight of ash + crucible.

Finally, the CO (carbon monoxide) content was estimated as a function of the MO (organic matter) content determined by the muffle method, using Equation 2, described below, according to Lopes and Silva (2012).

$$CO\% = 0{,}425\ MO\% - 2{,}064 \qquad \text{(Equation 2)}$$

Where:
CO% = organic carbon in percentage and
MO% = organic matter in percentage.

RESULTS AND DISCUSSION

Accumulated litter

The value of 4.36 t ha^{-1} of deposited litter was found in a fragment of cerrado *Sensu Stricto* in the south of the state of Tocantins. There was less litter production in the area when compared to other biomes or phytophysiognomies, due to the fact of having semi-open vegetation.

Teixeira et al. (2016), in his studies in Southern Tocantins, says that litter deposition in the cerrado *Sensu*

Stricto physiognomy was higher in the dry season, May to October 2012 (177.38 kg ha^{-1}), and lower in the season rainy, November 2012 to April 2013 (47.48 kg ha^{-1}).

Paiva et al. (2011) and Silva et al. (2009), found average values of serrapilheira biomass higher than that found in this study, equivalent to 7.11 t ha^{-1} and 8.99 t ha^{-1}, respectively, the first considering a phytopharmacy of cerrado sensu stricto near Brasilia and the second a transition area of Amazonian-Cerrado forest.

Cianciaruso et al. (2006), in a cerradão of the Estação Ecológica de Jataí in São Paulo, found a monthly average production of 500 kg ha^{-1}. According to him, the litter production found in cerradão, which is the forest physiognomy of the Cerrado, seems to be close to the production found in other Brazilian forest formations.

Organic Carbon

About the organic carbon present in the burlap of the stand under study, we found the following data (Table 1). The organic carbon values were also lower than those found in the literature. Scolforo et al. (2008), affirm that the organic carbon content in burlap is in the range of 48%.

Morais et al. (2013) found an average carbon content of 45.94% in a cerradão fragment in Minas Gerais. The knowledge of carbon cycles in the cerrado ecosystem is still rudimentary, in particular, it is stock and flow patterns, due to the scarcity of opportune and accurate estimates. These authors also point out that the available literature regarding the Brazilian cerrado is scarce and fragmented.

CONCLUSION

We considered the founded values for deposited litter (4.36 t ha^{-1}) and dry organic carbon (27.29%) low when compared to other studies in the same forest phytophysiology. This indicates that the area is altered.

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