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CARBON STOCK CHANGE DUE TO LAND USE IN ARGISOLS ON PERNAMBUCANO-BRAZILIAN SEMIARID

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ABSTRACT

Carbon stored in soils depends on the type of vegetation and management applied. Native vegetation removed for the installation of pastures and grassland affects carbon stocks in the soil. Argisols are one the most used type of soils in agriculture, due its excellent physical and chemical characteristics. Asses carbon stored in these soils under different land uses and understand the dynamics of the C element in ecosystems is important. In this study we examined four types of vegetation cover in three sites on interior of Pernambuco state in Brazil. Trenches of 0.7 x 0.7 m with 0.4 m deep were open and soil samples were collected at 0-10, 10-20, 20-30 and 30-40 cm layers to determine carbon content and soil density. Carbon concentrations were determined by dry combustion using a CHN elemental analyzer (CN TruSpec LECO® 2006, St. Joseph, USA). Land use change altered carbon stocks in soil, dense caatinga presented higher stocks than open caatinga, grassland and agriculture. In the 0-10 cm layer expressed biggest difference in C stocks in different vegetation cover.

Key words: vegetation cover; soil management; Caatinga, grassland, agriculture.

INTRODUCTION

Land cover change, conversion of native forests for cattle pasture and agricultural areas, can alter the physical, chemical and biological soil properties, leading to changes in the natural carbon stocks (Ferreira et al., 2007). In natural carbon cycle this element is transfered to the atmosphere through burning, respiration and chemical reactions, returning to soil through photosynthesis and stored as organic compounds and carbonates (Rosendo and Rosa, 2012).

Carbon stocked in soils depends on species and cultivation systems used. The loss of carbon occurs by the release of CO_2 in respiration, by microbial decomposition of residues and soil organic matter as also by erosion and leaching losses. The magnitude of these processes depends

directly or indirectly on soil management (Mielniczuk, 2008). Soils can act as source or sink of carbon to the atmosphere, depending on the management applied on the field (Carvalho et al., 2010).

Caatinga is among the most vulnerable biomes to the effects of climate change because increasing temperature and low rainfall severely limit the biogeochemical processes in ecosystems of the region. Besides these factors the intensification of human actions in removing the native vegetation of Caatinga increases pressure on soils and the biota of the semi-arid northeast, increasing the risk of desertification in some areas (Noble, 2011).

Among the classes that compose edaphic cover soil semiarid are the argisols, representing 14,7% of the soil, its main feature is the sandy texture on the surface and the gradual increase of clay along the profile. The pH range varies from 5,0 to 6,5, and by good physical condition and medium to high fertility, these soils are widely used in the formation pastures and agricultural areas (Araújo Filho, 2013). According to the last agricultural census the Northeast, which has the largest area of Caatinga, has about 22 million hectares devoted to agriculture, 32 million for pasture and 25 million hectares of native forests (IBGE, 2006). The aim of this study was to evaluate the effect of different land uses in carbon stocks in argisols in the semiarid of Pernambuco-Brazil.

MATERIALS AND METHODS

The study was conducted in the towns of Ipubi and Bodocó, located in northwestern hinterland of Pernambuco. The soil in the study area was classified as an argisol. This soil order represents 25% of the soils in the study region (Araújo Filho et al, 2000). Argisols areas were selected by program Zoneamento Agroecológico do Estado de Pernambuco - ZAPE. Satellite imagery and direct verification in field were used to select sampling sites with different land uses, open caatinga, dense caatinga, grassland and agriculture.

In each selected point were opened trenches of 0.7 x 0.7 m and 0.4 m deep, sampled layers were 0-10, 10-20, 20-30, 30-40 cm. In each single layer samples for the determination of carbon and three soil samples were collected to determine density by the method of volumetric ring (EMBRAPA, 1997), for further processing of the volumes of soil, and the concentration of C in amounts by area C. The samples were placed in plastic bags and taken to the laboratory.

For the determination of carbon, the soil was homogenized and passed through a 100 mesh sieve. Carbon concentrations were determined by dry combustion method using CHN elemental determiner (CN TruSpec LECO® 2006 St. Joseph, USA). C stocks were obtained by the expression: C content ($g.kg^{-1}$) x bulk soil density ($g.cm^{-3}$) x thickness of the soil layer (cm).

Descriptive statistics was used, which use the average to characterize central tendency and the standard error as a measure of variability.

RESULTS AND DISCUSSION

Carbon stocks in soil are controlled by the difference between the addition of organic residues and their decomposition. When changes occur in land use and carbon stock suffers modifications to reach a new equilibrium (Boddey et al, 2012).

Among layers studied the largest stock of carbon was observed at a depth of 0-10 cm, where we find values of 20,26; 15,12; 17,20 and 15,58 Mg $ha^{-1}C$, respectively, for dense caatinga, open caatinga, grassland and agriculture (Figure 1). Kauffaman (1993) found similar values for 0-10 cm, 18 Mg $ha^{-1}C$ layer in argisols under hyperxerophilic caatinga in semiarid Pernambucano. Different results were reported by Giongo et al. (2011), who analysed different land uses in argisol located in

Petrolina-PE, they found 10,77; 7,03; 6,83; 4,51 Mg ha^{-1}C in 0-10 cm for preserved caatinga, changed caatinga, buffelgrass pasture and mango cultivation, respectively.

In the 0-10 cm layer grazing showed higher C stock relative to agriculture and degraded caatinga. According to Costa et al. (2009) this may be related to the large contribution of roots in the surface layer, which provides a greater accumulation of organic matter.

There was decrease in C stocks over the sampled layers. Carbon stock in the first layers is greater because the surface soil presents a higher C concentration due to the deposition of organic residues. At all depths carbon stock in dense caatinga remained higher compared to other land uses (Figure 1). Native forest tend to store and keep more carbon in the soil, due to the continuous supply of biomass belowground (Fracetto et al., 2012). Depths of 10-20, 20-30 and 30-40 cm was observed that the carbon stock in agriculture was higher than grassland and open caatinga. These datas differ from those found by Giongo et al. (2011), where agriculture showed the lowest C stocks at all depths.

Input carbon in semiarid via photosynthesis depends primarily on the type of cover and land use, as these directly influence in the amount of organic residue and microbial activity in the soil.

Inadequate management soil leads to higher degradation of organic matter in the soil, reducing the amount of carbon stored and altering the physical, chemical and biological soil properties, affecting the diversity and sustainability of natural systems (Carvalho et al., 2010).

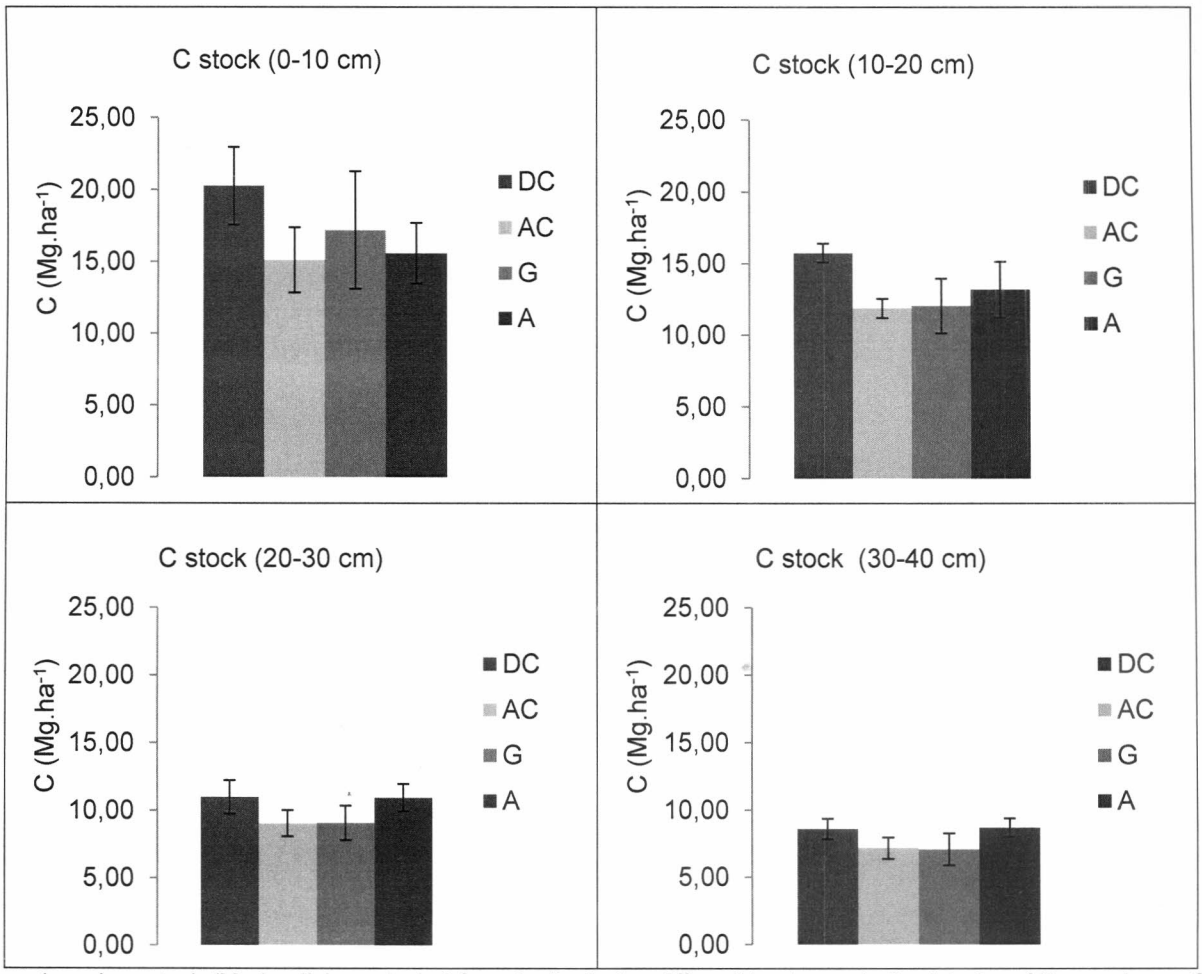

Figure 1. carbon stock (Mg ha-1) in argisol at four depths in the different land uses in the interior of Pernambuco. CD - dense Caatinga; CA-open Caatinga; P-Grassland; A-Agriculture.

CONCLUSIONS

Land use change affect carbon stocks in argisols on semiarid region of Pernambuco-Brazil. The intensity of the impact of this change can be best evidenced in the topsoil.

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