
# Livro de Resumos

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# Soil organic matter fractions as a short-term indicator of carbon turnover under agricultural systems

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## Abstract

Integrated crop-livestock-forest (ICLF) systems has been considered as an important strategy to enhance C sequestration. However, changes in soil C due to agricultural management practices, in general, are observed in long-term experiments. Our objective was to investigate short-term impacts on soil organic matter under different management systems in the Cerrado/Amazonia region. Treatments corresponded to ICLF, No-tillage, Pasture and Eucalyptus plantation. Soil was sampled in 2014, in the 0-5, 5-10 and 10-30 cm layers for quantification of light- and heavy-fraction C stocks as well as their C isotopic composition ($\delta^{13}C$). After three years established, all evaluated treatments showed similar values of light- and heavy-fraction C stocks to those observed under Native Forest in the 0-30 cm layer. Under Pasture and ILCF treatments, we observed that most of C of the light-fraction was substituted by pasture-derived C in the uppermost soil layer (0-5 cm). Despite no differences in heavy- and light-fraction C, the application of $^{13}C$ stable isotope technique seems to be an important tool to evaluate short-term C turnover under agricultural systems.

**Keywords:** conservation agriculture, integrated crop-livestock-forest, soil carbon, light-fraction, heavy-fraction

## Introduction

Sustainable management practices that contribute to the increase of residues inputs and soil C stocks are important alternatives to mitigate global warming (Bayer et al., 2006). Integrated crop-livestock-forest (ICLF) systems have been proposed as a sustainable alternative to improve crop and pasture productivities as well as to restore degraded soils contributing to increase soil C stocks.

Soil organic matter dynamics has been investigated through the use of the C isotopic composition technique in different ecosystems (Diels et al., 2004; Roscoe et al., 2001). The $^{13}C/^{12}C$ isotopic ratio can be measured for the bulk soil C as well as for C fractions. Changes in the $\delta^{13}C$ values of soil organic C in areas where the vegetation shifts from $C_3$ to $C_4$ plants could provide important information on soil organic matter turnover rate (Bernoux et al., 1998). The aim

of this study is to investigate short-term impacts of agricultural management systems in soil organic matter fractions.

**Material and Methods**

The sampling areas were located on experimental field at the Embrapa Agrosilvopastoral Research Center (11°51'S, 55°35'W; 384 m asl) in Sinop, State of Mato Grosso, Brazil. The experiment was established in 2011 and comprised the following treatments: 1) Eucalyptus - eucalyptus plantation (*E. urograndis*, clone H13); 2) No-tillage – no-tillage system with soybean followed by corn (*Zea mays*) intercropped with *U. brizanta;* 3) Pasture – *Urochloa brizanta* 'Marandu' pasture; and 4) ICLF – integrated crop-livestock-forest system, comprising of three rows of eucalyptus (*Eucalyptus urograndis)*, soybean followed by corn (*Zea mays*) intercropped with *U. brizanta* cultivated between tree rows. An area under Native Forest was used as a reference.

Soil samples were taken in 2014 in the 0-5, 5-10, 10-30 cm layers and four repetitions. Each replicate was obtained of 20 subsamples bulked together. Light-fraction was isolated by flotation in sodium iodide (NaI) solution, with a 1.8 g $cm^{-3}$ density as proposed by Sohi et al. (2001). The C content in the light fraction ($C_{LF}$) was determined by dry combustion (Vario Macro Elementar Analyzer). The soil residue remained after light-fraction isolation was considered as heavy fraction, which was ground by hand with mortar and pestle. The C content in the heavy-fraction ($C_{HF}$) was also determined by dry combustion (Vario Macro Elementar Analyzer).

**Results and Discussion**

Values of heavy-fraction C stocks ($C_{HF}$) varied from 66.5 to 80.1 Mg $ha^{-1}$ in the 0-30 cm layer. (Figure 1). $C_{HF}$ stocks represented, on average, to 75% of the total soil C stocks. After three years establishment, all evaluated treatments showed similar values to that observed under Native Forest. However, Eucalyptus had the lowest $C_{HF}$ stocks values. Light-fraction C stocks ($C_{LF}$) varied from 12.3 to 16.6 Mg $ha^{-1}$. Despite $C_{LF}$ has been considered more sensitive to changes caused by management systems, no differences were observed after 3 years establishment on the $C_{LF}$ stocks in the 0-30 cm layer.

**Figure 1**. Heavy- and light-fraction carbon stocks in the 0-30 cm layer. Vertical bars represent the standard error (n = 4).

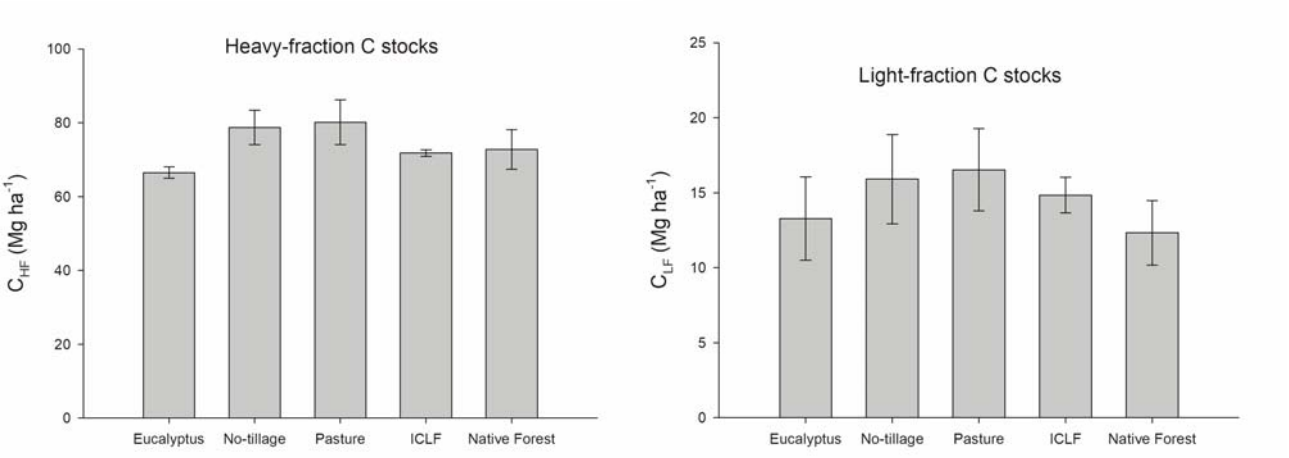
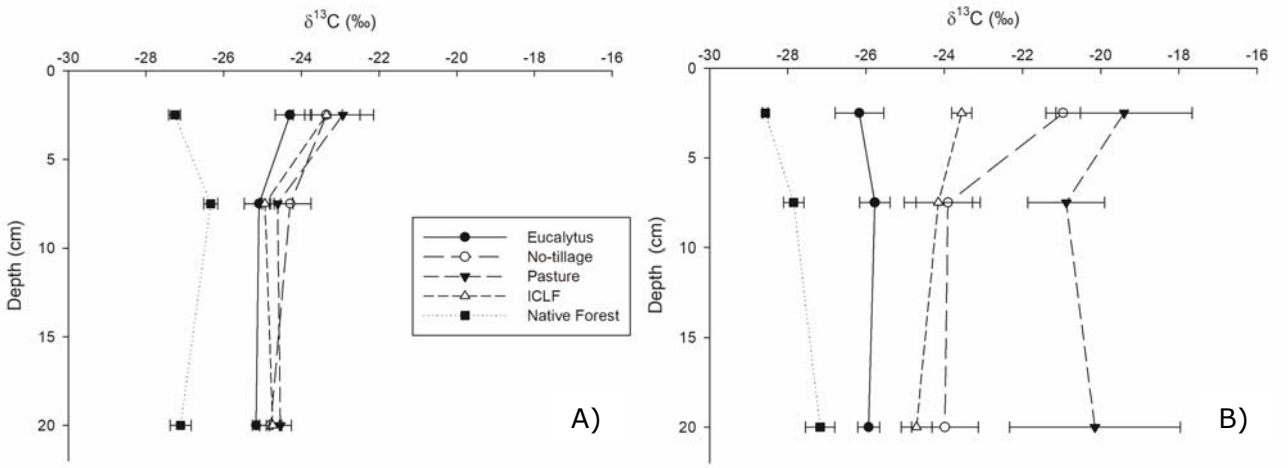



**Figure 2**. Carbon isotopic composition ($\delta^{13}C$) of heavy- and light-fraction in the 0–5, 5-10 and 10-30 cm layers. Horizontal bars represent the standard error (n = 4).




The application of $^{13}C$ stable isotope technique has been used to better understand the soil C dynamics under different management systems (Ares, Burner e Brauer, 2009; Diels et al., 2001; Oelbermann et al., 2006). In our study, the $\delta^{13}C$ values of light-fraction provided important information concerning the effects of different management system in the SOM turnover rate. We observed significant changes caused by the management system, especially, the substitution of C by C-derived pasture (Figure 2). In the pasture treatment, we estimated that around 80% of light-fraction C was pasture-derived C in the uppermost soil layer (0-5 cm).

**Conclusions**

After three years establishment, heavy- and light-fraction C stocks were not sensitive to changes caused by agricultural management systems. However, application of $^{13}C$ stable isotope technique showed that most of C in the light-fraction from Pasture and ICLF were substituted by pasture-derived C.

**References**

ARES, A. et al. **Agrofor Syst**, v. 76, n. 2, p. 317–325, 2009.
BAYER, C. et al. **Soil Tillage Res**, v. 86, n. 2, p. 237–245, 2006.
BERNOUX, M. et al. **Geoderma**, v. 82, n. 1–3, p. 43–58, 1998.
DIELS, J. et al. **Soil Biol Biochem**, v. 33, n. 9, p. 1245–1251, 2001.
DIELS, J. et al. **Soil Biol Biochem**, v. 36, n. 11, p. 1739–1750, 2004.
OELBERMANN, M. et al. **Geoderma**, v. 130, n. 3–4, p. 356–367, 2006.
ROSCOE, R. et al. **Geoderma**, v. 104, n. 3–4, p. 185–202, 2001.
SOHI, S. P. et al. **Soil Sci Soc Am J**, v. 65, n. 4, p. 1121–1128, 2001.