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How soil carbon and nutrient availability in an integrated crop-livestock-forest system are related?

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Cropping systems integrated with trees and livestock is a potent mitigation strategy in tropical agriculture by increasing soil C stock and producing food, fiber and energy on the same area. In integrated systems, nutrient cycling is more complex and behave differently from monoculture due to the increment in biodiversity. In a previous study (Oliveira et al., 2018), we found up to 30% increment of soil organic C (SOC) stock in a 3-year old integrated crop-livestock-forest (iCLF) system compared to a 20-year old pasture under continuous grazing, especially in samples of the 30-100 cm soil depth located at the tree lines. We believe that such fast increment in total C stock was due to healthy conditions of soil chemical properties, since synthetic fertilization and liming were applied for establishment of the iCLF system. Therefore, in this study we aimed to check the correlations between SOC and nutrient availability at the 0-100 cm soil depth of an Oxisol cultivated with the iCLF system. The iCLF system was established in 2009, with rows composed by three lines of eucalyptus spread at each 20 m in a 4.7 ha, under real farm conditions. Details about field design and data collection can be found in Oliveira et al. (2018). The area is located in the southern Amazon ecosystem, North of Mato Grosso State, Brazil. The SOC and nutrient availability were quantified in the same soil samples collected from 15 trenches, each splitted in eight soil layers from 0-100 cm soil depth. Status of nutrient availability in soil was given by the following variables: pH (water), Ca, Mg, P, K, Cu, Zn, Fe and Mn. Correlations between measured SOC and soil nutrient availability variables within 0-100 cm soil depth (n = 120) were determined with Pearson's correlation coefficient. Analyses were performed using the linear mixed model procedure (Proc Mixed) and the correlation procedure (Proc Corr) of the SAS software (SAS Institute Inc., Cary, NC, USA). Results show that there was no significant correlation between SOC and soil pH in water (R^2: 0.15, p-value: 0.09). However, a positive correlation was observed for all other nutrients, wherein (R^2 and p-value) in order of magnitude: Mg (0.78, $p < 0.001$), Ca (0.76, $p < 0.001$), Zn (0.73, $p < 0.001$), P (0.70, $p < 0.001$), K (0.67, $p < 0.001$), Mn (0.65, $p < 0.001$), Fe (0.59, $p < 0.001$), Cu (0.54, $p < 0.001$). Results confirm that the increment of SOC was favored by soil nutrient availability in the iCLF system.

Keywords: Fertility, cropping systems, agrosilvopastoral system (iCLF)

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