L01.2_O.09

Soil Carbon Storage in Silvopasture in comparison with planted and native forests and pasture in a Brazilian Oxisol

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In Brazil, silvopastoral systems (SPS) are practiced in about 2 million hectares with Eucalyptus hybrids as the main tree species, and the area is increasing because of governmental incentives. To understand the influence of such systems on soil organic carbon (SOC) storage, we studied C content in three aggregate size classes in four land-use systems (LUS) on Oxisols in Prudente de Morais, Minas Gerais, Brazil. The LUS were 8-year-old SPS, planted forest (Eucalyptus hybrid), native (Cerrado) secondary forest, and managed pasture. The SPS had three tree-planting configurations: i) trees 3 m apart in double rows, 20 m between rows (SPS 20); ii) trees 2 m apart in double rows, 9 m spacing (SPS 9D); and iii) trees 2 m apart in single rows, 9 m spacing (SPS 9). The grass in SPS and pasture treatments was *Urochloa decumbens.* Cattle had been introduced 3 years after planting trees. The native forest was semi-deciduous degraded forest, with > 10 tree species, ~ 10 m height. From each treatment, composite soil samples were collected from each of the depth-classes (0–10, 10–30, 30–60, and 60–100 cm), three replications, and from two sites each in SPS: NT (near trees, 1.5 m from trees) and MR (middle of two rows). In the laboratory, each soil sample was manually fractionated (wet sieving) into three aggregate-size classes: macroaggregates, MA (2000 to 250 µm), microaggregates, MI (250 to 53 µm), and silt + clay, SC (<53 µm). The SOC contents in each fraction size class were determined and reported as stock (Mg ha^{-1} per cm) in various soil layers, and compared using *R* and ANOVA in a completely randomized design and Tukey's studentized range test (significant at $p < 0.05$). The results showed that pasture had higher SOC in the whole soil and MA fraction. The MI fraction had higher SOC under pasture than forest and SPS 20 (NT and AT). For the SC size fraction, no difference was found between the treatments. Comparing the depths, SOC in MA was higher in the top soil layers. For the MI and SC size fractions, the SOC decreased with depths and were similar at the depths of 30 – 60 and 60 – 100 cm. Down to 1 m, total SOC stock ranged from 260 Mg ha^{-1} under pasture to 167 Mg ha^{-1} under native secondary forest; 174 Mg ha^{-1} for Eucalyptus plantation; and the three SPS had values in the 190 to 200 Mg ha^{-1} range. The SPS had higher C stock than the native forest and Eucalyptus plantation, and the highest stock was under pasture. The lowest amount of SOC under forest was a reflection of the poor state of the degraded secondary forest. It will be worthwhile to study if incorporating the native nitrogen-fixing trees (NFT), several of which are available, in SPS would lead to better C storage in soils comparable to or exceeding that under pasture. The relative distribution of C in different soil fraction sizes under SPS with native NFTs is another important line of future investigation, especially considering the status of the Cerrado biome as a biodiversity hotspot.

Keywords: Agroforestry, Climate Change, Tree Management, Livestock, Soil Organic Matter.