world congress on integrated crop-livestock-forest systems

3rd International Symposium on Integrated Crop-Livestock Systems
towards sustainable intensification • brasilia • brazil • 2015

Trees and grass contribution to soil organic carbon in agroforestry systems

Rafael TONUCCI*[1], P.K.R. NAIR[2]; Rasmo GARCIA[3]; Vimala NAIR[4]

[1]Embrapa Caprinos e Ovinos, [2]SFRC Univ. of Florida, Gainesville; [3]Animal Science Dep. Federal Univ. of Viçosa; [4]Soil and Water Science Dep. Univ. of Florida, Gainesville. *email address of presenting author: rafael.tonucci@embrapa.br

Introduction: Agroforestry systems have the potential to enhance carbon (C) sequestration in soil compared with treeless (agricultural) systems (Montagnini & Nair, 2004). When one type of vegetation is replaced with another, stable isotope contents (δ^{13} C) values can be used to identify soil organic carbon (SOC) derived from residues in the native vegetation and the new vegetation based on discrimination between C3 and C4 plants. The present study aimed to assessing the impact of difference land-use systems on C3 and C4 contribution to SOC.

Material and Methods: The experimental area is located inside the Cerrado biome. Soil samples were taken from six different land-use sites: (i) native local forest; (ii) Eucalyptus forest (EF) established in 1985 (OEC); (iii) EF established in 2004 (NEC); (iv) pasture of *B. decumbens*; (v) Agroforestry System (AF) established on 1994 (OAF); and (vi) AF established on 2004 (NAF). The establishment on AF was placed first with the eucalyptus planted and rice (*Oryza sativa*), soybean (*Glycine max*) and braquiaria grass (*B. Brizantha* cv. Marandu) in between trees rows. Soil was collected from four depths (0-10; 10-20; 20-50 and 50-100 cm). For stable C isotope analysis, whole soil was analyzed mass spectrometer. The percentage of SOC derived from the *Brachiaria* ssp., a C4 plant, or from the eucalyptus or native forest, a C3 plant, was estimated based on the equations: % C4-derived SOC = $(\delta - \delta_T)/(\delta_G - \delta_T)$ x 100 (1); % C3-derived SOC = 100 - % C4-derived SOC (2) Based on the equations 1 and 2 were calculated the contributions of each C3 and C4 species in SOC C-derived, as follows: C3-devived SOC (Mg ha^{-1}) = (% C3-derived SOC) x (SOC content, Mg ha^{-1}) (3); C4-derived SOC (Mg ha^{-1}) = (% C4-derived SOC) x (SOC content, Mg ha^{-1}) (4). A complete randomized design was used with Tukey's studentized. Statistical differences were considered significant at $p < 0.05$.

Results and Conclusions:

Table 1 – C4 and C3-derived soil organic carbon (SOC) in the whole soil in different depths of six different land-use systems in the Brazilian Cerrado, MG.

Depth (cm)	C4-devived SOC (Mg ha^{-1})					
	Site					
	Pasture	OEC	NEC	OAF	NAF	Forest
0–10	5.50 a	1.83 c	0.86 d	2.48 b	1.98 bc	0.97 d
10–20	4.99 a	2.39 b	1.14 c	2.59 b	2.21 b	1.43 c
20–50	4.61 a	3.17 b	1.04 d	2.96 b	2.13 c	1.78 c
50–100	3.65 a	2.98 ab	1.28 c	2.73 b	2.29 b	2.56 b
	C3-derived SOC (Mg ha^{-1})					
0–10	0.35 d	3.61 b	3.78 b	2.81 c	2.71 c	4.82 a
10–20	0.38 d	1.72 c	4.28 a	1.89 c	2.90 b	3.75 a
20–50	0.41 d	0.82 d	3.08 a	1.34 c	2.46 b	2.20 b
50–100	0.40 c	0. 58 c	2.50 a	0.88 bc	1.51 b	1.31 bc

Lowercase letters in the same row indicate significant differences in SOC at a given depth and site. OEC, old eucalyptus; NEC, new eucalyptus; OAF, old agroforestry; NAF, new agroforestry.

We conclude that most of the carbon in the cerrado soil came from grasses (C4) even when above ground vegetation is composed by trees (C3).

References

Montagnini et al. (2004). Agroforestry Systems, 61:281-298.