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Chemical composition and carbon stocks of organic matter in subtropical Leptosol under pasture affected by fire

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Introduction

In the pastures of the *Campos de Cima da Serra*, South Brazil, burning of vegetation residues at the end of the winter season is a common and ancient practice, which aims to accelerate the pasture re-growth. The goal of the present study was to evaluate the effect of periodic fire on carbon stocks, soil organic matter (SOM) distribution in physical compartments and its composition in profiles of a Leptosol (1200 m.a.s.l, 28°36´S, 49°58'W) under pasture submitted to periodic burning. The SOM of the same soil under native forest was also analyzed for comparison purpose. Soil samples (triplicates) were collected in three layers (0-5 cm, 5-10 cm, 10-15 cm) of a native pasture that was biennially burned and last affected by fire 240 days ago and grazed by 0.5 animal ha^{-1} (1NB), native pasture without burning in the last 23 years and grazed by 2 animals ha^{-1} (23NB), and Araucaria forest (AF). Carbon (TOC) and nitrogen contents were determined by dry combustion and carbon stocks were calculated. Physical fractionation was performed by the densimetric method using politungstate solution (ρ = 2 g cm^{-3}) resulting in free light fraction (FLF), occluded light fraction (OLF) and heavy fraction (HF).

SOM in physical fractions was investigated by thermo-gravimetric analyses (TGA) between 40 and 800°C under synthetic air and a chemical recalcitrance index was calculated: $\Delta m_{(3^o)} / \Delta m_{(2^o)}$.

Results and Discussions

The periodic burning of vegetation (1NB) increased the C stocks in the subsurface. In comparison to the site not fire-affected in the last 23 years (Table 1). The 1NB site presented a greater proportion of C in the OLF in the 0-5 cm layer. This result can be related to the occurrence of a more recalcitrant SOM originated during the fire that concentrates in this fraction and is more resistant to decomposition than other residues. In opposite, the 1NB site presented a greater C proportion in the HF in subsurface layer, what can be a consequence of the wider root system usually found in fire affected soils. In both depths, the OLF from 1NB showed a greater value for the TGA index (Table 2), evidencing the occurrence of a more recalcitrant SOM produced by periodic burning, that remained protected in this fraction.

Table1. Carbon stocks and C/N ratio in soil layers of a Leptosol.

Site	**TOC,** Mg ha^{-1}			
	0-5 cm	5-10 cm	10-15 cm	0-15 cm
1NB	33.1 ± 2.9[a]	32.8 ± 1.1	32.0 ± 3.1	97.8 ± 6.9
23 NB	31.2 ± 3.3	28.0 ± 1.2	26.2 ± 1.1	85.4 ± 4.0
AF	52.0 ± 5.1	43.7 ± 4.4	41.7 ± 2.0	137.4 ± 10.6
	C/N			
1NB	14.9 ± 0.6	15.5 ± 0.8	15.7 ± 2.3	15.4 ± 0.7
23 NB	14.6 ± 2.0	13.1 ± 1.0	15.1 ±1.8	14.2 ± 1.1
AF	15.2 ± 0.3	14.9 ± 0.6	14.1 ± 1.2	14.8 ± 0.5

Table 2. Proportion of soil carbon in the physical fractions and TGA index in soil layers of a Leptosol. N.d.: not determined.

Site	0-5 cm			5-10 cm		
	FLF	OLF	HF	FLF	OLF	HF
	$C_{fraction}$/TOC					
1NB	2.0 ± 0.0	25.6 ± 3.6	72.4 ± 3.6	0.8 ± 0.2	13.6 ± 0.2	85.6 ± 0.2
23 NB	4.6 ±0.2	15.1 ± 1.9	80.3 ± 2.0	3.2 ± 0.9	19.3 ± 1.5	77.5 ± 2.3
AF	20.8 ±1.6	26.3 ± 2.0	52.9 ± 3.4	2.0 ± 0.4	24.0 ± 4.9	74.0 ± 5.2
	$\Delta m_{(3^o)}$ / $\Delta m_{(2^o)}$					
1NB	0.76	1.33	1.29	n.d	1.40	1.36
23 NB	0.99	0.65	1.24	n.d.	0.61	1.30
AF	0.73	1.54	1.31	n.d.	1.24	1.75

Conclusions

Periodic burning of subtropical pastures after the winter promotes the carbon sequestration until 15 cm soil depth. The more recalcitrant SOM produced during fire remains protected in the occluded light fraction.

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