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Impact of Pinus Afforestation on Soil Chemical Attributes and Organic Matter in South Brazilian highlands

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The region known as Campos de Cima da Serra, located at 800 to 1400 m above sea level in the northeas of Rio Grande do Sul State, Brazil, is covered by a mosaic of natural grassland and Araucaria forest. Cattle raising, introduced by the first European settlers about 200 years ago, is the traditional economic activity in the region, occurring extensively and continuously on the natural pasture. In the last 30 years, while seeking for higher profits, local farmers have introduced agricultural crops and Pinus Taeda plantations in the original pasture lands. Pinus plantations are established in this area as dense monocultures and not as a sylvipastoral system, representing, thus, a severe threaten to the Campos' biodiversity. The soils are shallow, though very acidic (pH 4.2) and rich in exchangeable Al (28 to 47% of Al saturation), and present high contents of SOM in the surface layer (in general, higher than 4 %), which shows a low decomposition degree, as indicated by its high proportion of C-O alkyl groups (51 to 59 %). Considering that the biome sustainability of this region is being progressively affected by the change of land use and that systematic studies about exotic trees afforestation in that region are very scarce, our main objective was to investigate the impact of the introduction of Pinus on the SOM composition and chemical attributes of highland soils in 8 (Pi8) and 30 (Pi30) years old plantations, using as reference the original condition under native pasture (NP). In each studied Leptosol, soil samples were collected from three layers down to 15 cm (0-5 cm, 5-10 cm and 10-15 cm). Contents of exchangeable cations and of micronutrients and soil pH were determined. The SOM composition was investigated by means of elemental analyses, FTIR and fluorescence spectroscopy (three replicates). Prior to the spectroscopic analyses, samples were demineralized with 10% HF solution and organic matter loss was monitored. From the FTIR spectra, an aromaticity index 1 and the relative intensities (RI) of the main peaks2 were calculated and from the fluorescence spectra an humification index3 was obtained. The samples under NP showed the greatest C contents (13,7%) and a sharp decrease with soil depth was observed. The Pinus sites showed lower C contents than NP sites, in particular in the 0-5 cm layer (7 to 8%), and its decrease was comparatively smoother. In comparison to NP samples, both exchangeable Ca and Mg contents were considerable lower in the Pinus samples ($\leq$ 0.02 cmloc kg-1), while exchangeable K tended to decrease in the order NP>Pi8>Pi30. It follows, that in addition to N and C, afforestation also caused a depletion of exchangeable nutrients. The index RI1070, which informs about the relative carbohydrate content, varied broadly among the studied samples and decreased with depth in the NP environment. In the 0-5 cm NP sample, the higher content of carbohydrate structures, together with the high SOM loss due to HF treatment (57%) in comparison to the other samples corroborates the presence of less recalcitrant structures in the surface layer under pasture. In the Pi8 and Pi30 samples, the index RI1070 decreased slightly with depth, but was always smaller than in the NP samples, in each layer. These results evidence the more recalcitrant nature of the SOM under Pinus. The correlation of the FTIR index with the proportion of N/O-alkyl structures, determined by 13C NMR CPMAS in the same samples4 are significant ($p< 0,01$, $r=0,96$). Hence, the index RI1070 might be a promising tool in comparative studies of the SOM composition. The other calculated FTIR indexes, RI2920, RI1720, RI1630 and RI1540, showed small variation and no information regarding differences of the SOM composition could be obtained from them. Our results evidenced the greater cycling effect of the pasture in comparison to the Pinus environments, that depleted the soil regarding the nutrients and organic matter. The SOM in pasture soils showed a higher content of carbohydrate and of structures derived from microbial metabolism. The SOM in the Pinus soils gets gradually enriched

in chemical recalcitrant structures and remains poorer in N-containing groups. References: 1Chefetz et al., 1996. Environ. Quali., 25: 776 ; 2Gerbazek et al., 2006, Eur. J. Soil Sci., 57: 485 ; 3.Milori et al., 2002. Soil Science, 167: 739 ; 4Wiesmeier, M. et al., 2009,Eur. J. Soil Sci. Accepted