Total organic carbon stock in Luvisol under natural grassland with different intensifications in Pampa biome

Leandro Bochi da Silva VOLK[1*], Teresa Cristina Moraes GENRO[1], José Pedro Pereira TRINDADE[1]

[1] Researcher in Embrapa Pecuária Sul. BR 153 km 633, Bagé/RS. Brasil.
E-mail address of presenting author*: leandro.volk@embrapa.br

Introduction

The Pampa Biome occurs in just 2.07% of Brazilian territory, but in Rio Grande do Sul state occurs in 63% (176,496 km2) of gaucho territory. Is characterized by predomination of natural grassland with shrubs and tree vegetation in mosaic (Campos). Because of the natural grasslands, livestock production is one of the main economic activities. Natural grass ecosystems of world might be responsible for an annual sink of about 0.5 Gt carbon (Scurlock and Hall, 1998). Despite of the potential of mitigation, the society has paid attention in this livestock production system, mainly in your environmental impact. In addition to the sporadic livestock exclosure and stocking rate adjustment, other alternative practice to make more productive this livestock system (in Campos) is fertilizer application, and hibernal forages sowing (Overbeck et al, 2007; Boldrini, 2009; Nabinger et al, 2009). The objective of this work was evaluating the total organic carbon stock in a Luvisol under natural grassland with different intensifications rates.

Material and Methods

The work was conducted at Embrapa Pecuária Sul (Bagé/RS, Brazil). The experimental area has 61 ha with 4 treatments (3 repetitions): natural grassland (CN); natural grassland improved by fertilization (CN + A); natural grassland improved by fertilization and introduction of exotic season species ryegrass (*Lolium multiflorum* Lam.) and

red clover (*Trifolium pratense* L.) (CN + A + F); and natural grassland with traditional management without stocking rate adjustment (CNT). The fertilization was made with 300 kg/ha of diammonium phosphate (DAP) twice a year. During all experiment time, the area was grazed by Hereford steers with forage offers of 12 kg/ 100kg of live weight. The soil is classified as a sandy clay Luvisol (Soil Taxonomy) or Luvissolo Órtico háplico típico (Brazilian System of Soil Classification – Embrapa, 2006). Soil samples for physical and chemical analysis were taken off in 2015, in the 0-5 cm, 5-10 cm, 10-15 cm, 15-20 cm, 20-30 cm, 30-40 cm and 40- 50 cm layers with three replicates for each site evaluation. Soil bunk density was determined by the core method. Total organic carbon was determined by following Costa et al. (2008) using a Total Organic Carbon Analyzer (Shimadzu TOC-VCSH) in Geochemistry Soil Laboratory (UFRGS). The data was assessed by one-way ANOVA followed by a Tukey test ($P < 0.05$).

Results and Conclusions

The soil bulk density did not differ significantly in none the layers of soil (Figure 1a). The 0-5 cm layer had the lowest values (1.22 g cm^{-3} on average) and the layer of 40-50 cm, the highest values (1.50 g cm^{-3} on average). The low values of soil bulk density, in the 0-5 cm and 5-10 cm layers, do not indicated soil compaction by traffic of steers, despite the larger stocking rate in the treatments CN + A and CN + A + F. Just as soil bulk density, soil organic matter did not differ in the different layers of soil (Figure 1b). The 0-5cm layer showed the highest values (3.5% on average) and the layer of 40-50 cm lower values (1.2% on average).

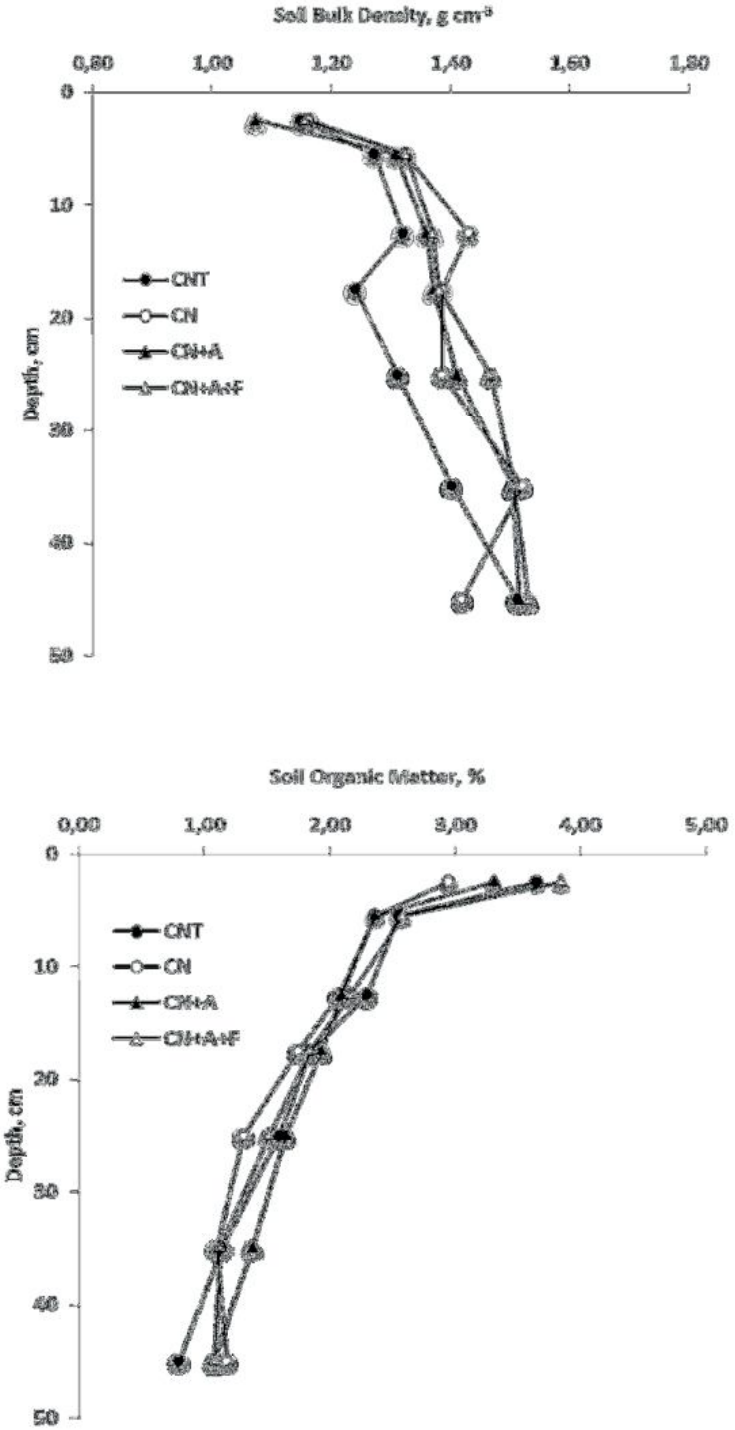

Figure 1. Soil bulk density (a) and soil organic matter (b) in a Luvisol under natural grassland with different intensifications (CNT – natural grassland with traditional management; CN – natural grassland, CN + A – natural grassland improved by fertilization; CN + A + F – natural grassland improved by fertilization and introduction of ryegrass and red clover).

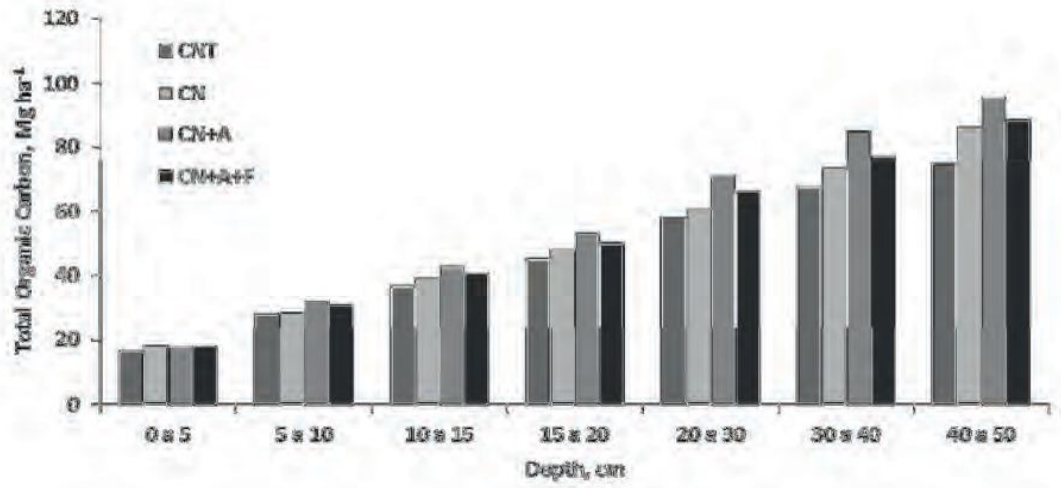

Figure 2. Soil stock of total organic carbon at different depths in a Luvisol under natural grassland with different intensifications (CNT – natural grassland with traditional management; CN – natural grassland, CN + A – natural grassland improved by fertilization; CN + A + F – natural grassland improved by fertilization and introduction of ryegrass and red clover). Columns with the same letters do not differ by Tukey test ($P < 0.05$).

The differences imposed by the treatments of different intensifications (fertilization, overseeded and stocking rate) in natural grassland were not enough to cause differences between the stocks of the total soil organic carbon. Probably because the forage offers was the same for all treatments (12 kg in dry matter/100 kg of live weight).

We conclude that the managements (fertilization and introduction of ryegrass and red clover) to improve productivity of cattle in natural grassland do not affect the stock of total soil carbon when the forage offers is proper.

References

BOLDRINI, I.I. A flora dos campos do Rio Grande do Sul. In: Pillar, V.P.; Müller, S.C.; Castilhos, Z.M.S; Jacques, A.V.A. (ed). **Campos Sulinos: conservação e uso sustentável da biodiversidade.** Brasília: MMA. 403p. 2009.

COSTA, F.S.;BAYER, C.;ZANATTA, J.A.;MIELNICZUK, J.; Estoque de carbono orgânico no solo e emissões de dióxido de carbono influenciadas por sistemas de manejo no sul do brasil. **Revista Brasileira de Ciência do Solo**, 32:323-332, 2008.

EMBRAPA - CNPS. Sistema Brasileiro de Classificação de Solos. 2.ed. Rio de Janeiro: Embrapa Solos, 2006. 306p.

GODOI, S.G.DE; NEUFELD, A.D.H.; M.A.; FERRETO, D.O.C.; BAYER, C.; LORENTZ, L.H.; VIEIRA, F.C.B. The conversion of grassland to acacia forest as an effective option for net reduction in greenhouse gas emissions, **Journal of Environmental Management,** 169: 91-102, 2016. http://dx.doi.org/10.1016/j.jenvman.2015.11.057.

NABINGER, C.; FERREIRA, E.T.; FREITAS, A.K. et al. Produção animal com base no campo nativo: aplicações de resultados de pesquisa. In: Pillar, V.P.; Müller, S.C.; Castilhos, Z.M.S; Jacques, A.V.A. (ed). **Campos Sulinos: conservação e uso sustentável da biodiversidade.** Brasília: MMA. 403p. 2009.

OVERBECK G.E.; MÜLLER S.C.; FIDELIS A.; PFADENHAUER J.; PILLAR V.D.; BLANCO C.C. Brazil's neglected biome: The South Brazilian Campos. **Perspectives in Plant Ecology, Evolution and Systematics**, 9:101-116. 2007.

SCURLOCK, J.M.O.; HALL, D.O. The global carbon sink: a grassland perspective. **Global Change Biology**, 4:229-233. 1998.

Acknowledgements

We are thankful to Cimélio Bayer, Janquieli Schirmann and Diego Fernandes de Bastos for support with COT analysis, to Clodoaldo L. Pinheiro, Marco Antônio Padilha da Silva, Amaury G. dos Santos, Josiéle G. Dutra, Graciela F. Jaskulski, Tamires R. Soares, Luiza da S. Ribeiro, David da C. Cougo, Natália Pamplona, Natalie Scherer, Otto Freitas, Helena P. Brum and Ingrid Maciel Martins for support in field activities, and to Ricardo Lopes, owner of area with CNT treatment. This work was developed with financial support of Embrapa and scholarships CNPq and FAPERGS.