ID ≠ 04 – 29

SATURATED FIELD HYDRAULIC CONDUCTIVITY VARIATION IN INTENSIVELY MANAGED TROPICAL PASTURES[1]

O. Primavesi[2]; A.C. Primavesi[2]; Vieira, S.R.[3]

[1]Financial support: EMBRAPA; [2]EMBRAPA - CPPSE, C.P. 339, São Carlos, SP, Brasil, 13560-970, odo@cppse.embrapa.br; [3]Instituto Agronômico de Campinas, C.P. 28, Campinas, SP, Brasil, 13011-970.

Abstract

Saturated field hydraulic conductivity was measured, using a Guelph permeameter, at the depths of 10, 20 and 60 cm, to verify the effect of intensively managed, compared to extensively managed ones, beef cattle production systems on pastures grown on three soils (Hapludox, Eutrudox, Paleudalf), in São Carlos, SP, Brazil, under tropical altitude climate. Significant differences occurred within depths ($P<0.05$). However, differences decreased with years and, therefore, differences among soils and between management systems were also reduced. Highest mean conductivity values occurred at 60-cm depth and at the extensively managed sward on the sandy Hapludox. Intensively managed Paleudalf showed high resistance to reduction of conductivity at 10-cm depth. A general year effect appeared claiming for more studies on this matter.

Keywords: Beef cattle, *Brachiaria decumbens, Brachiaria brizantha*, Management, Soil permeability

Introduction

Increase of pasture productivity per area, with decrease in production costs to allow greater competitiveness, is possible for beef and dairy cattle farmers in the tropics. However, increases of intensive limestone applications and in stocking rate can lead to soil compaction and reduction in rain water infiltration rate, therefore decreasing subsoil water and aquifers replenishment. Preliminary data showed that adequate soil surface management of organic materials, in an intensively managed dairy cattle production system (Primavesi et al., 1998), can reduce or avoid this problem. This case study was carried out in order to evaluate saturated field hydraulic conductivity in intensive tropical pasture beef cattle production systems, since no such data are available in literature.

Material and Methods

The case study was carried out from November 1997 to 1999 on *Brachiaria decumbens* and *Brachiaria brizantha* pastures. The pastures of the former species, extensively managed, with a stocking rate of one animal-unit (450 kg live weight) per hectare per year, were grown on red-yellow latosol (LVe) and dusky red latosol (LRe) (both Hapludox), with 23 and 46% clay, respectively, and the pastures of the latter species, intensively managed, with three (in dry season) to eight (in rainy season) animal-units per hectare, on LVi (Hapludox), LRi (Eutrudox), dark red latosol (LEi; Hapludox; 20% clay), and terra rossa (TEi; Paleudalf; 50% clay), in São Carlos, São Paulo State, Brazil (latitude 22^{o}01´ S, longitude 47^{o}54´ W and altitude of 836 m), under a tropical altitude climate. No limestone or fertilizer was applied on the extensively managed pastures, as commonly happens in these areas. On the intensively managed pastures, lime was applied to raise soil base saturation to 70% of the cation exchange capacity (around

1,500 kg ha^{-1} per year), and fertilizer was added at the level of 250 kg ha^{-1} of the formula 25-05-25 (NPK), four times in the rainy season (November to March).

Saturated field hydraulic conductivity was measured after Reynolds et al. (1992) and Lombardi et al. (1993), using a Guelph permeameter. In each area, 25 points were measured, arranged in a 5 x 5 rectangle, spaced 10 m in length and 5 m in width; in each point, at depths of 10, 20 and 60 cm. Measurements were done in the dry season, from July to October, in three consecutive years.

Althought there was no experimental design, data were analysed using a split-plot model, with soils (plot) in time (years; split-plot) for each depth. Analysis of variance was used to calculate the F-test and the Tukey test, to compare the mean values (SAS Institute, 1993). There were two similar soil types (LV and LR) under extensive and intensive management, allowing spatial comparison, and the others mainly for temporal comparison.

Results and Discussion

Differences occurred within depths ($P<0.05$), however decreased with years. Therefore, differences among soils and between management systems also decreased (Table 1). All interaction effects were significant. Highest mean hydraulic conductivity values occurred at 60cm depth and on the extensively managed sward on LVe. Intensively managed TEi showed high resistance in reducing the relative conductivity at the 10- and 20-cm depth.

No clear reason could be found to explain the decreasing values in all monitored areas, hindering a time related comparison for all soil types. The season in which the measurements were done, the equipment used and the operator were the same, but little decrease in mean temperature and relative air humidity were recorded in the consecutive years. More studies are needed to clarify their influence on this method using water flow.

It could be concluded that: 1. hydraulic conductivity can be affected by pasture management depending on soil type; 2. intensive management does not necessarily affect conductivity in a negative manner; and 3. an unexplained year effect in the hydraulic conductivity occurred, claiming for more studies on this matter.

References

Lombardi Neto, F., Dechen S.C.F., Castro O.M.de, Vieira S.R. and De Maria I.C. (1993). Manual de coleta de amostras e análises físicas para fins de experimentação em conservação do solo. Campinas: IAC, Seção Conservação do Solo. 78p.

Primavesi, O., Vieira S.R. and Primavesi A.C.P.A. (1998). Permeabilidade do solo: indicador sensível para manejos diferenciados. Resumos expandidos da 12ª Reunião Brasileira de Manejo e Conservação do Solo e da Água, 1998, Fortaleza-CE, SBCS/Univ.Fed.Ceará, Brazil. pp.147-148.

Reynolds, W.D., Vieira S.R. and Topp G.C. (1992). An assessment of the single-head analysis for the constant head well permeameter. Can. J. Soil Science **72**: 489-501.

SAS Institute. (1993). SAS/STAT User's guide: statistics. Release 6.4. Cary, Sas Inst. 1686p.

Table 1 - Field hydraulic conductivity of soils under different management intensities.

Depth	Field hydraulic conductivity			Standard deviation		
	--------------------(m d^{-1})-------------			--------------------(m d^{-1})-------------		
	1997	1998	1999	1997	1998	1999
			Dusky red latosol (LRe), extensively managed			
10 cm	5.89	7.05	1.11	2.84	5.41	1.01
20 cm	20.89	15.03	0.94	12.66	9.90	0.99
60 cm	69.90	27.29	2.36	52.87	23.99	3.16
			Red-yellow latosol (LVe) . extensively managed			
10 cm	7.39	6.53	1.93	3.04	4.76	1.95
20 cm	12.13	13.59	5.57	6.82	7.37	6.11
60 cm	84.05	44.07	1.56	49.21	21.34	2.17
			Red-yellow latosol (LVi). intensively managed			
10 cm	5.67	3.57	1.12	2.79	1.37	0.87
20 cm	7.89	1.11	1.82	5.08	0.78	1.40
60 cm	52.33	11.63	6.36	29.58	6.70	8.69
			Dusky red latosol (LRi). intensively managed			
10 cm	11.85	5.23	0.74	5.33	4.12	0.46
20 cm	16.46	5.37	1.47	7.07	3.37	1.12
60 cm	41.25	29.35	4.16	25.52	15.96	3.19
			Terra rossa (TEi). intensively managed			
10 cm	7.35	7.29	1.56	3.42	3.43	1.26
20 cm	13.72	8.49	1.19	6.63	6.24	0.90
60 cm	55.32	9.12	1.61	27.20	4.35	1.04
			Dark-red latosol (LEi). intensively managed			
10 cm	3.64	1.42	1.27	5.09	0.52	1.04
20 cm	7.47	2.33	0.80	3.19	1.14	0.61
60 cm	53.22	10.46	2.17	24.37	7.32	1.44
Tukey critical range:						
Soil	3.35					
Year and Depth	1.94					