plot, perhaps due to the organic material decomposition returned to the soil after cutting (before each N application). This increase was stronger at the fertilized areas, with greater dry matter production and higher N fertilizer residues, mainly at the higher rates of ammonium nitrate.

Mello et al. (1984) mention NO_3 levels higher than 100 mg kg^{-1} at the surface layers of agricultural soils. Values higher than 100 mg kg^{-1} occurred in this experiment only when the whole 160-cm profile was considered (Table 1). The low nitrate contents could be explained partially by the high N extraction potential of the grass used, due to its high dry matter production potential. In intensively managed pastures also occurs an intense renewal of roots, with a greater consumption of soil N. Well managed pastures also, when intensively managed, seem to present a positive environmental impact (Boddey at al., 1996).

In the studied conditions, nitrate levels in the soil varied with tested N sources and rates, and no environmental risk seems to exist.

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Saturated field hydraulic conductivity variation in intensively managed tropical pastures[1]

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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%

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	4.30	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				

clay), and terra rossa (TEi; Paleudalf; 50% clay), in São Carlos, São Paulo State, Brazil (latitude 22°01´S, longitude 47°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.

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Alfalfa response to phosphorus sources associated with the application of liming and gypsum – shoot numbers[1]

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ABSTRACT

Alfalfa (*Medicago sativa* L.) was grown in a Typic Mapluolox soil with triple superphosphate (TS), Gafsa phosphate (GP) and GP with gypsum (GP + G). Three rates of phosphorus application were used 50, 100 and 200 mg P dm^{-3}, before and after liming. Alfalfa was harvested three times. Basal and axillary shoot numbers in alfalfa increased with increasing phosphorus rates. Shoots were produced in higher number with GP in comparison with TS. GP + G resulted in higher basal shoot number than GP. However, there was no gypsum effect on axillary shoot numbers. Liming before or after TS, GP and GP + G application had similar responses on shoot numbers.

KEYWORDS: Gafsa phosphate, *Medicago Sativa* L., shoot, triple superphosphate

INTRODUCTION

Shoot number in alfalfa is highly dependent on soil phosphorus availability (Sanderson and Jones, 1993). Shoot number in alfalfa is an important component to forage production (Fick et al., 1988) and it is used as an indicator of the vigor and pasture persistence (Da Silva and Pedreira, 1997). Several phosphorus sources are available in the market and Gafsa phosphate (GP) is considered as efficient to plant production [illegible] phosphates. This could indicate a more economical phosphorus source [illegible] production. GP needs soil acidity to become more soluble, therefore this phosphorus source needs to be applied before liming followed by an incubation period. The use of GP associated to gypsum may be an alternative to correct soil [illegible] in depth and to reduce soil phosphorus fixation. The study aimed to [illegible] the effects of triple superphosphate (TS), GP and GP associated or not with gypsum, applied before or after liming, on alfalfa basal and axillary shoot [illegible]

MATERIAL AND METHODS

The study was conducted in a glasshouse located at Centro de Biotecnologia Agrícola at ESALQ/USP. Plants were grown in pots containing six kg of a Typic Mapluolox soil collected in Nova Odessa, State of São Paulo. The experimental design was a complete randomized block with three replications. Treatments were: a) TS before and after liming (TSBL; TSAL); b) GP before and after liming (GPBL; GPAL); c) GP before and after liming combined with gypsum (GPBLG; GPALG). Phosphorus was used at rates of 50; 100 and 200 mg P dm^{-3}. Alfalfa (cv. XAI32) was harvested three times: 90 days of growth after seeding (07/10/98) and 30 days of regrowth (08/09 and 09/08/98). Seeds were inoculated with *Rhizobium meliloti* SEMIA 116. Potassium and micronutrients were applied and lime used to increase soil base saturation to 85%. When gypsum (1/3 of Ca applied as lime) was associated with GP the rate of lime was 2/3 of that applied in the treatment without gypsum. Elementary sulfur was applied in treatments without gypsum to maintain sulfur supply. Basal and axillary shoots were evaluated through the use of colored wires fitted every other day, during the three periods of growth. Responses evaluated were basal and axillary shoot numbers in alfalfa. The statistical procedures used were the SANEST/USP (Sarriés, 1993).

RESULTS AND DISCUSSION

Basal and axillary shoot numbers increased ($P<0.05$) with phosphorus rates from 50 to 200 mg dm^{-3} (Table 1) as observed by Sanderson and Jones (1993).

Axillary shoot numbers were produced in higher ($P<0.05$) number with GP in comparation to TS at therate of 100 mg P dm^{-3} in the second and third harvests, and at 50 mg P dm^{-3} in the third harvest (Tables 1 and 2). Basal shoots were produced in higher number with GP ($P<0.05$) than TS, with 50 and 100 mg P dm^{-3} (Tables 1 and 2). These results may be due to phosphorus fixation from the soluble source