COMPACTION OF AN OXISOL AND CHEMICAL COMPOSITION OF PALISADEGRASS[1]

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SUMMARY

Compaction is an important problem in soils under pastoral land use, and can make livestock systems unsustainable. The objective of this research was to study the impact of soil compaction on yield and quality of palisade (*Urochloa brizantha* cv. Marandu). The experiment was conducted on an Oxisol in the State of Mato Grosso, Brazil. Treatments consisted of four levels of soil compaction: no compaction (NC), slight compaction (SC), medium compaction (MC) and high compaction (HC). The following soil properties were evaluated (layers 0-0.05 and 0.05-0.10 m): aggregate size distribution, bulk density (BD), macroporosity, microporosity, total porosity (TP), relative compaction (RC), and the characteristics of crude protein (CP), neutral detergent fiber (NDF), acid detergent fiber (ADF) and dry matter yield (DMY) of the forage. Highly compacted soil had high BD and RC, and low TP (0-0.05 m). Both DMY and CP were affected by HC, and both were strongly related to BD. Higher DMY (6.96 Mg ha^{-1}) and CP (7.8 %) were observed in the MC treatment (BD 1.57 Mg m^{-3} and RC 0.91 Mg m^{-3}, in 0-0.05 m). A high BD of 1.57 Mg m^{-3} (0-0.05 m) did not inhibit plant growth. The N concentration in the palisade biomass differed significantly among compaction treatments, and was 8.72, 11.20, 12.48 and 10.98 g kg^{-1} in NC, SC, MC and HC treatments, respectively. Increase in DMY and CP at the MC level may be attributed to more absorption of N in this coarse-textured soil.

Index terms: crude protein, relative compaction, *Urochloa*.

RESUMO: *COMPACTAÇÃO DE UM LATOSSOLO E COMPOSIÇÃO QUÍMICA DE BRAQUIÁRIA*

*A compactação é um importante problema dos solos sob pastejo e pode levar à insustentabilidade da atividade pecuária. O objetivo desta pesquisa foi estudar o impacto da compactação do solo na produtividade e qualidade de braquiária (*Urochloa brizantha *cv. Marandu). O experimento foi conduzido em um Latossolo Vermelho no Estado de Mato Grosso.*

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Os tratamentos consistiram de quatro níveis de compactação do solo: não compactado (NC), baixa compactação (BC), média compactação (MC) e alta compactação (AC). As propriedades físicas avaliadas nas profundidades de 0-0,05 e 0,05-0,10 m foram: agregação, densidade do solo (DS), macroporosidade (MA), microporosidade (MI), porosidade total (PT) e densidade relativa (DR); na forragem, avaliaram-se o teor de proteína bruta (PB), a fibra em detergente neutro (FDN), a fibra em detergente ácido (FDA) e a produtividade de matéria seca (MS). O solo submetido à AC teve maior DS e DR e menor PT na profundidade de 0-0,05 m. A MS e PB foram influenciadas pela AC e foram correlacionadas com a DS. As maiores MS (6,96 Mg ha^{-1}) e PB (7,8 %) foram observadas no tratamento MC (DS de 1,57 Mg m^{-3} e DR de 0,91 Mg m^{-3}), na profundidade de 0-0,05 m. A maior DS de 1,57 Mg m^{-3} na profundidade de 0-0,05 m não inibiu o crescimento de plantas. A concentração de N na biomassa de braquiária diferiu significativamente entre os tratamentos e foram de 8,72; 11,20; 12,48; e 10,98 g kg^{-1} em NC, BC, MC e AC, respectivamente. As maiores MS e PB no tratamento MC podem ser atribuídas à maior absorção de N em solos de textura arenosa.

Termos de indexação: proteína bruta, densidade relativa, Urochloa.

INTRODUCTION

Brazil has a beef cattle population of about 200 million animals, and pasture is the main food production system (IBGE, 2006). The area under pastoral land use in Brazil is 172 million ha (Mha). The first model of agricultural land use was based on the replacement of natural vegetation by a perennial grass, mostly palisadegrass (*Urocholoa brinzatha*) used for extensive grazing (Costa & Rehman, 1999). However, the extensive system of beef production is unsustainable because of the widespread degradation of pastures, leading to a severe reduction in dry matter yield (DMY) of forage and negative impacts of the soil chemical and physical properties (Macedo, 2009). Soil compaction caused by animal trampling affects the soil physical quality and plant growth (Willatt & Pullar, 1983). Soil compaction caused by grazing and other land uses decreases macroporosity (Pietola et al., 2005), increases bulk density (BD) (Leão et al., 2006), and alters aggregate size distribution (Franzluebbers & Stuedemann, 2008) with subsequent changes in physical and hydrological properties and processes.

The compaction of pasture soils is determined by the amount of forage (Sarmento et al., 2008), pasture height (Flores et al., 2007), forage production system (Fidalski et al., 2009) and the soil moisture before trampling (Silva et al., 2003). Bertol et al. (2000) studied forage production in relation to physical properties of an Inceptisol in Brazil, and observed that soil compaction by animal trampling occurs primarily in the 0-0.1 m layer. In addition, specific soil depth affected by animal trampling also depends on the root system of the forage species (Fidalski et al., 2008). Greenwood & McKenzie (2001) found that the static pressure of one head of cattle grazing on the soil can be between 98 and 168 kPa, which is greater than the pressure of a tractor (92 kPa). Animals in motion can exert even greater pressure; Scholefield et al (1985) reported that the treading pressure of a cow weighing 503 kg is twice as high as the static pressure.

Compaction-induced changes of the soil physical quality can have profound adverse effects on plant growth. In cereals, compaction impedes root growth and decreases DMY (Beutler & Centurion, 2004). However, Magalhães et al. (2001) observed no reduction in palisade DMY by soil compaction. Similarly, Cavallini et al. (2010) observed that in an Oxisol the palisade DMY is more strongly related to soil moisture than to BD.

While most crops are adversely affected by soil compaction, the relative impact varies among species, level of compaction and soil properties (e.g., antecedent moisture content, texture). Rosolem et al. (2002) observed that the reduction in plant growth by compaction is higher in gramineae than in leguminous species. In contrast, Silva et al. (2006) reported that palisade is more tolerant to soil compaction than soybean (*Glycine max*) or corn (*Zea mays*).

Adverse effects of soil compaction are also attributed to reduction in availability of plant nutrients and specifically to a decline in N uptake (Gregorich et al., 2011). Nitrogen is an important nutrient in forages (França et al., 2007) in relation to DMY (Castagnara et al., 2011) and the crude protein (CP) (Lavres Junior & Monteiro, 2003). In addition to CP, soil compaction may affect the contents of acid detergent fiber (ADF) and neutral detergent fiber (NDF). Acid detergent fibers are the cell wall portions of the forages made up of cellulose and lignin, and reduce the digestibility of forages. In contrast, NDF refers to the sum of ADF plus hemicellulose. Thus, the NDF concentration shows the amount of forage an animal can consume. Cabral et al. (2012) observed a lower uptake of N and P by palisade and guinea grass (*Panicum maximum*) in a compacted Oxisol.

This project is based on the hypothesis that soil compaction limits nutrient uptake by palisade, and reduces its forage quality. Thus, the specific objective of this research is to simulate soil compaction levels and to establish a relationship between soil physical properties, DMY and nutritional quality of palisade.

MATERIAL AND METHODS

Location and treatments

The experiment was conducted on the experimental farm of the State University of Mato Grosso, in Pontes and Lacerda, MT, Brazil (26º 44’ 04” S and 83º 42’ 18” W). The climate at the site is Aw according to Köppen, with an average annual rainfall of 1275±154.0 mm. During the experiment (December 2009 to April 2010) the rainfall was 1,010 mm (Figure 1). The soils of the experimental site are predominantly Oxisol (Soil Taxonomy), or Ferrasol (FAO), or Latossolo Vermelho eutrófico (Brazilian Soil Classification System) (Table 1).

The experiment involved four levels of soil compaction: no compaction (NC), slight compaction (SC), medium compaction (MC), and high compaction (HC). All treatments were replicated five times on a 5 x 5 m plot, in a randomized block design (RBD).

Prior to establishment of the experiment, the land was used for annual crops and forages. For the last 10 years, however, the site was used no longer for crop or livestock production. The site was therefore plowed twice (depth 0-0.2 m) immediately before the establishment of the experiment.

Palisadegrass (*Urochloa brizantha*) was sown in December, 2009, at a seeding rate of 9.0 kg ha^{-1}. The soil was fertilized with 338 kg ha^{-1} of superphosphate (20 % P_2O_5) and 67 kg ha^{-1} of potassium chloride (60 % K_2O) at sowing. Additionally, soil was fertilized with 50 kg ha^{-1} of urea (45 % N) 30 days after sowing. The growing pasture was managed according to the regional recommendations.

Ninety days after sowing, all palisadegrass plots were cut 25 cm above the ground level and the treatments were applied. Different levels of soil compaction were induced by passings of a tractor [New Holland model TL 75E, weight 2.88 Mg, 12.4 R24 (width 0.32 m) front tires and 18.4 R30 (width 0.47 m) single rear tires (364 and 352 kPa), respectively, and a pressure of 51.7 kPa applied to the soil]. When the soil was at field moisture capacity (volumetric moisture content of 0.25 m^3 m^{-3}), three passings were applied for the treatment HC, 2 for MC, 1 for SC, and none for NC.

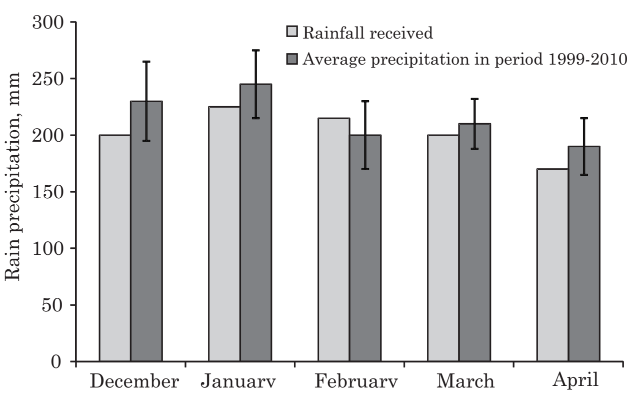

Figure 1. Rainfall measured during the experiment (December 2009 to April 2010) and average of period of 1999 to 2010.

Measurements and analyses

Soil samples (layers 0-0.05 and 0.05-0.10 m) were taken from each plot, 40 days after the treatments (April 2010). Core samples were obtained to determine soil bulk density (BD) (Grossmann & Reinsch, 2002). Bulk samples were obtained to analyze aggregate amount and stability by the wet sieving method (Nimmo & Perkins, 2002). Aggregates of 4.76 to 8.0 mm were placed on the top of a nest of five sieves (diameter 4.76, 2.0, 1.0, 0.5, and 0.21 mm). Aggregates were sieved in water for 30 min at a frequency of 30 oscillations per minute. The material retained in each sieve was washed and oven-dried at 105 ºC for 24 h. The aggregate stability was represented by mean weight diameter (MWD) and geometric mean diameter

Table 1. Average values and standard error of physical and chemical parameters of the Oxisol

Parameter	Depth (m)			
	0-0.1	0.1-0.2	0.2-0.3	0.3-0.4
pH	6.4 ± 1.4	6.5 ± 1.1	6.2 ± 1.1	5.6 ± 1.3
Clay, g kg^{-1}	180 ±13.9	180 ± 14.1	301 ± 22.3	277 ± 17.3
Silt, g kg^{-1}	68 ± 4.7	68 ± 5.4	100 ± 8.4	72 ±5.2
Sand, g kg^{-1}	752 ± 6.2	752 ± 5.9	599 ± 6.9	651 ± 4.7
Bulk density, Mg m^{-3}	1.45 ± 0.42	1.54 ± 0.44	1.44 ± 0.61	1.40 ± 0.74
Particle density, Mg m^{-3}	2.65 ± 0.13	2.62 + 0.07	2.55 + 0.10	2.50 + 0.09
Total porosity, m^3 m^{-3}	0.42 ± 0.02	0.39 ± 0.04	0.37 ± 0.04	0.39 ± 0.02
Organic carbon, g kg^{-1}	8.2 ± 0.7	6.2 ± 0.4	4.7 ± 1.1	2.9 ± 0.4
Cations, cmol$_c$ kg^{-1}	4.0 ± 0.6	3.7 ± 0.5	2.3 ± 0.3	1.9 ± 0.2
CEC, cmol$_c$ kg^{-1}	5.7 ± 0.6	5.3 ± 0.5	4.1 ± 0.4	4.5 ± 0.7

Cations: Sum of Ca + Mg + K + Na; CEC: cations + H + Al.

(GMD) and calculated according to equations 1 and 2, respectively:

$$MWD = \sum xiyi \qquad (1)$$

where yi is the proportion of each size class with respect to the total sample and xi the mean size class diameter (mm);

$$GMD = \exp\left\{\frac{\sum wi \ln xi}{\sum wi}\right\} \qquad (2)$$

where wi is the weight of the aggregates of each size class (g) and ln xi the natural logarithm of the mean diameter of size classes.

Soil BD was measured using cores of 100 cm^3 (diameter 50.4 mm, depth 50 mm) (Grossmann & Reinsch, 2002). The microporosity (pore diameter < 50 μm) was estimated for the volumetric moisture content at 0.006 MPa suction according to the method of Embrapa (1997), and the total porosity (TP) was computed using equation 3:

$$TP = 1 - \left(\frac{BD}{PD}\right) \qquad (3)$$

where BD is soil bulk density and PD, particle density (Mg m^{-3}). The PD for this Oxisol was assumed to be 2.65 Mg m^{-3} (Table 1).

The macroporosity (pore diameter > 50 μm) was estimated as the difference between total porosity and microporosity.

The maximum attainable BD was determined by the Proctor method (ASTM, 1992). Soil samples (< 2.0 mm) were wetted to different water contents, after which soil was compacted in three equal layers by 25 blows per layer using a 2.5 kg hammer dropped from a height of 0.305 m (energy of 590 kPa). The weight of the wet compacted soil in the cylinder was determined and the sample oven-dried at 105 °C for 24 h to determine the dry BD. The relative compaction was determined as the ratio of field density to the Proctor density (Håkansson & Lipiec, 2000).

Plant samples were obtained 40 days after treatment application from an area of 0.25 m^2. The biomass was cut at the ground level, and a sample was dried at 55 °C in a convection oven for 72 h. The sample was ground in a Willey mill and sieved through a 1 mm sieve. Concentration of N in the plant sample was determined by the Kjeldahl method (Silva & Queiroz, 2002) and was multiplied by 6.25 to estimate the concentration of CP. Concentrations of NDF and ADF were determined by the method of van Soest (1967), and DMY as described by Silva & Queiroz (2002).

Statistical analyses

The results of chemical composition and dry matter yield of the forage were analyzed according to the randomized block design and the results of the soil physical properties in a randomized block factorial design of 4 x 2 (four compaction levels and two soil layers); the SAS statistical package was used for all statistical analyses. The F-test was used to determine the significance of the main effects by ANOVA. Significant differences among treatments were established using the least significant difference (LSD). Simple regression equations and correlation coefficients were computed between soil properties and forage yield and chemical composition by the Least Square Method.

RESULTS

All compaction treatments had high BD and RC compared with the control, and the values of maximum BD were the same for all treatments and layers (Table 2). The TP also decreased significantly in 0-0.05 and 0.05-0.10 m for the HC treatment, which increased BD and RC, and decreased TP (Tables 2 and 3).

There were no differences in MWD and GMD between compaction treatments in the 0-0.5 m layer. However, both MWD and GMD were lower in HC than in other treatments in the 0.05-0.10 m layer (Table 4).

Soil compaction increased N concentration and total N uptake by palisadegrass, compared with the control treatment (NC). The highest N concentration (12.48 g kg^{-1}) and total N uptake (86.9 kg N ha^{-1}) were observed in the MC treatment. In the other treatments with compacted soil (SC and HC), N concentration and total N uptake were similar ($p < 0.05$) (Table 5).

The soil compaction treatments affected DMY and CP. The DMY of 6.96 Mg ha^{-1} was highest in the MC treatment, and increased by 450 % over that of NC (1.54 Mg ha^{-1}). In addition, a higher CP was also observed in MC ($p<0.05$), with 42, 11 and 14 % higher values than in NC, SC and HC, respectively (Table 5).

The magnitudes of DMY ($p<0.01$) and CP ($p<0.05$) were significantly correlated with the BD, TP and RC (depth 0-0.05 m). The correlation of DMY and CP with BD and RC was positive, and indicated a yield increase in productivity with increasing compaction to an optimal level. Therefore, the correlation of DMY and CP with TP was negative (Table 6).

The regression analysis between BD and DMY followed a quadratic function ($p<0.05$) (Figure 2a), and indicated an optimal BD of 1.56 Mg m^{-3}. Increase in DMY in the MC treatment also induced an increase of CP, also following a quadratic function with BD ($p<0.05$) (Figure 2b).

Table 2. Effects of soil compaction levels on bulk density, maximum bulk density and relative compaction in different layers

Compaction level	Bulk density		Maximum bulk density		Relative Compaction	
	0-0.05 m	0.05-0.10 m	0-0.05 m	0.05-0.10 m	0-0.05 m	0.05-0.10 m
	Mg m^{-3}					
0 (NC)	1.40 B	1.46 B	1.73 A	1.72 A	0.81 B	0.85 B
1 (SC)	1.51 A	1.50 B	1.71 A	1.70 A	0.88 A	0.88 B
2 (MC)	1.57 A	1.53 B	1.72 A	1.72 A	0.91 A	0.89 B
3 (HC)	1.62 A	1.62 A	1.71 A	1.72 A	0.94 A	0.94 A

NC: no compaction; SC: slight compaction, MC: medium compaction and HC: high compaction. Means with same letter do not differ by LSD test ($p<0.05$).

Table 3. Effects of soil compaction levels on total porosity, macroporosity and microporosity on the different layers

Compaction level	Total Porosity		Macroporosity		Microporosity	
	0-0.05 m	0.05-0.10 m	0-0.05 m	0.05-0.10 m	0-0.05 m	0.05-0.10 m
	m^3 m^{-3}					
0 (NC)	0.45 A	0.45 A	0.19 A	0.18 A	0.26 A	0.27 A
1 (SC)	0.43 B	0.46 A	0.19 A	0.19 A	0.24 A	0.27 A
2 (MC)	0.41 B	0.42 A	0.20 A	0.15 A	0.21 A	0.27 A
3 (HC)	0.39 B	0.39 B	0.16 A	0.16 A	0.23 A	0.23 A

NC: no compaction; SC: slight compaction, MC: medium compaction and HC: high compaction. Means with same letter do not differ by LSD test ($p<0.05$).

Table 4. Effects of soil compaction levels on the mean weight diameter (MWD) and geometric mean diameter (GMD) for two layers

Compaction level	MWD		GMD	
	0-0.05 m	0.05-0.10 m	0-0.05 m	0.05-0.10 m
	mm			
0 (NC)	4.67 A	5.15 A	3.69 A	3.40 A
1 (SC)	4.82 A	5.31 A	3.59 A	3.96 A
2 (MC)	4.49 A	5.18 A	3.94 A	3.97 A
3 (HC)	4.88 A	4.31 B	4.04 A	3.26 B

NC: no compaction; SC: slight compaction, MC: medium compaction and HC: high compaction. Means with same letter do not differ by LSD test ($p<0.05$).

Table 5. Effects of soil compaction levels on N concentration, total N uptake, dry matter yield (DMY), crude protein (CP), neutral detergent fiber (NDF) and acid detergent fiber (ADF) in palisadegrass

Compaction level	N concentration	Total N uptake	DMY	CP	NDF	ADF
	g kg^{-1}	kg ha^{-1}	Mg ha^{-1}	%		
0 (NC)	8.72 C	13.43 C	1.54 D	5.46 B	41.18 A	69.81 A
1 (SC)	11.23 B	52.70 B	4.71 C	7.00 B	40.45 A	67.86 A
2 (MC)	12.48 A	86.91 A	6.96 A	7.80 A	44.64 A	70.87 A
3 (HC)	10.98 B	55.03 B	5.01 B	6.86 B	41.64 A	66.16 A

NC: no compaction; SC: slight compaction, MC: medium compaction and HC: high compaction. Means with same letters did not differ by the LSD test ($p<0.05$).

Table 6. Correlation coefficient among soil physical attributes and chemical composition and dry matter yield of palisade

Parameter	BD	TP	RC	MWD	DMY	CP	ADF
				0.0-0.05 m			
TP	-1.00 **						
RC	1.00 **	-1.00 **					
MWD	0.15 ns	-0.16 ns	0.16 ns				
DMY	0.74 **	-0.74 **	0.72 **	0.31 ns			
CP	0.45 *	-0.45 *	0.41*	0.41*	0.72 **		
ADF	-0.27 ns	0.27 ns	-0.27 ns	-0.12 ns	-0.01 ns	-0.16 ns	
NDF	-0.26 ns	0.26 ns	-0.27 ns	0.04 ns	0.04 ns	0.13 ns	0.58**
				0.05-0.10 m			
TP	-1.00**						
RC	1.00**	-1.00**					
MWD	0.08ns	-0.09ns	0.07ns				
DMY	0.33ns	-0.35ns	0.33ns	0.36ns			
CP	0.13ns	-0.13ns	0.11ns	0.31ns	0.72ns		
ADF	-0.20ns	0.27ns	-0.25ns	-0.20ns	-0.01ns	-0.16ns	
NDF	0.12ns	-0.11ns	0.11ns	-0.19ns	0.04ns	0.13ns	0.58ns

BD: Bulk density, TP: total porosity, RC: relative compaction, MWD: mean weight diameter, DMY: dry matter yield, CP: crude protein, ADF: acid detergent fiber and NDF: neutral detergent fiber. **, * and ns significant at 0.01, 0.05 and non-significant, respectively.

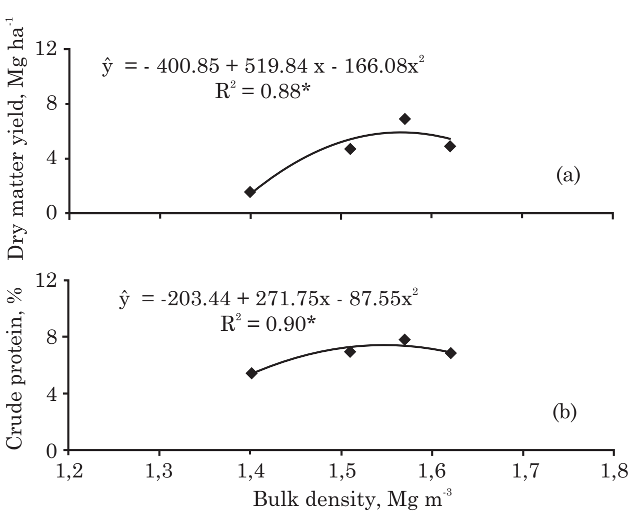

Figure 2. Relationship between bulk density (0-0.05 m depth) and dry matter yield (a) and crude protein (b). * significant p<0.05.

DISCUSSION

Because the soil had been prepared prior to the experiment, the first tractor passing resulted in the greatest BD increase, with smaller increases after the second (4 %) and third (3 %) passing. Decrease in MWD and GMD by the HC treatment were also associated with decline in TP (Tables 3 and 4). An optimal level of porosity increases microbiological activity (Haynes & Beare, 1997) which enhances formation and stabilization of macroagreggates (> 0.3 mm). In comparison, the massive structure created by HC is caused by an increase in particle-to-particle contact, and is not stable. The HC treatment created clods of low TP rather than structural aggregates consisting of inter and intra-aggregate pores (Beutler et al., 2005b).

Similar trends in DMY and BD for coarse-textured soil were reported by Martínez & Zinck (2004) who observed reductions of DMY by 50 % with an increase in BD of a coarse-textured soil. The highest DMY resulted from the MC treatment (Table 5), with a RC of 0.91 (Table 2). These results of DMY are in contrast to those reported by Håkansson (1990), who obtained higher DMY in treatments at a RC of 0.87. Beutler et al. (2005a) also reported higher soybean yield from an Oxisol in Brazil at a RC of 0.84.

Soil compaction can also alter the nutrient dynamics (transport, absorption and transformation), affecting the DMY. For example, Beutler & Centurion (2004) observed lower soybean yield on an Oxisol under a HC treatment. In other words, there is a threshold level of compaction for each soil type and cropping system, with relations to the root system development and DMY (Rosolem et al., 2002).

The regression analysis between BD and DMY followed a quadratic function ($p<0.05$) (Figure 2a), and indicated an optimal BD of 1.56 Mg m^{-3}, which is lower than the BD of 1.69 Mg m^{-3} reported by Reichert et al. (2009) for a soil with a clay content of 180 g kg^{-1}. A quadratic function between BD and DMY was also observed in Oxisols by Beutler & Centurion (2004). Well- structured Oxisols have a high TP, low saturated hydraulic conductivity, low inherent soil fertility and poll root/soil contact. Thus, the uptake of nutrients and water can be adversely affected in Oxisols with high TP. Therefore, increase in root/soil contact in the MC treatment improved crop/forage production. Kayombo et al. (1991) also suggested that a modest level of soil compaction would raise crop yields.

The increase in BD by MC enhances N availability (Table 5) by improving hydrological properties, and probably of P by increasing root/soil contact. Both N and P are important nutrients for a sustainable forage production (França et al., 2007), and the availability of these elements is low in Oxisols (Novais & Smyth, 1999).

In addition to DMY, N availability is also important to synthesize CP in forages (Silva & Monteiro, 2010). Therefore, the increase in N uptake increased the amount of CP (Table 5). Nonetheless, a supra optimal level of soil compaction (HC) reduces N uptake, raises N_2O emissions (Bhandral et al., 2007), accumulates ammonium ions (Pengthamkeerati et al., 2006), and adversely affects DMY of forages.

While palisadegrass is more tolerant to soil compaction than corn or soybean, as reported by Silva et al. (2006), the increase of BD above 1.56 Mg m^{-3} can inhibit root development and consequently decrease N uptake and other nutrients, as observed in this research (Table 5). Decrease and alterations in the root system after compaction were also reported by Kayombo et al. (1991). However, the reduced crop yield in compacted soils is attributed to reductions in water and nutrient availability.

Aside from alterations in water and nutrient supply and uptake, soil compaction also causes morphological alterations in plants. Beutler et al. (2007) and Freddi et al. (2009) showed an increase of root diameter of plants grown in compacted soils. Thus, it is probable that soil compaction in HC treatment (BD 1.62 Mg m^{-3}) increased the root diameter of palisadegrass, inhibiting plant development and nutrient uptake because of the low total porosity.

CONCLUSIONS

1. For the experimental conditions, the increase in soil compaction to a bulk density of 1.57 Mg m^{-3} did not limit the uptake of nutrients by palisadegrass, nor affect the forage quality.

2. Effects of soil compaction were more pronounced in the 0 - 0.05 m layer, but also altered properties in the 0.05-0.10 m layer. The inappropriate physical properties in the 0.05-0.10 m layer of the HC treatment adversely affected forage production and DMY.

3. The nitrogen availability was affected by soil compaction. Yet, a modest level of soil compaction of the Oxisol improved DMY and CP of palisadegrass.

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