Original Research Article

EVALUATION OF SHEEP TRAMPIN IN DIFFERENT PERIODS OF GRAZING ON SOIL ATTRIBUTES

ABSTRACT

With the objective of evaluating the possible deterioration in some physical and chemical attributes of the soil, caused by trampling sheep in grazing areas compared to preserved areas. The study was carried out at the Federal Institute of Education, Science and Technology of Paraíba – Campus Sousa, located in the Irrigated Perimeter of São Gonçalo, between the geographic coordinates 06 o 50` 22”S; 38 o 17 ` 42” W; at an altitude of 220 meters. The statistical design was in Randomized Blocks (DBC), with 3 treatments consisting of: T1= without animals (preserved); T2= sheep grazing rainy season; T3= sheep grazing during the dry season, with six repetitions each. To determine the chemical attributes, soil samples were collected at a depth of 0 - 20 cm to determine (pH, phosphorus, potassium, sodium, calcium, magnesium, aluminum and organic and physical matter (sand, silt, clay, soil density, total porosity) , clay dispersed in water) except for apparent density was taken from undisturbed samples at a depth of 0 – 10 cm of the soil. The permanence of the animals grazing promoted a reduction in the chemical quality of the soil, notably for the contents of phosphorus, calcium, magnesium and SOM in sheep grazing during the dry season and an increase for sodium and PST, compared to the area without grazing (preserved).

Keywords: compaction, nutrients, animals, organic matter

1. INTRODUCTION

In this historical process, the Brazilian Northeast, specifically the semi-arid region, is characterized by its process of occupation and use of land, the agricultural sector, for example, played an important role in the level of national production during the colonial period, standing out as a the country's economic development hub with sugar, tobacco, leather and cotton (Gomes; Alcantara Filho and Scalco 2012.). Today, agriculture in Brazil contributes directly and indirectly to the formation

of 26% of the Gross Domestic Product - GDP, and is responsible for 36% of exports and about 40 million jobs (Ministry of Agriculture, Livestock and Supply, 2012) .

In Brazil, some trials carried out by Embrapa and by individual producers showed that it was possible to grow sheep in peach areas (region of Pelotas, RS), with cattle in coconut groves (northeast coast) and with sheep in irrigated mango and vine orchards (Vale do São Francisco, PE/BA) (Guimarães Filho and Soares, 2000).

Animal production, based on the use of pastures, is one of the most competitive and profitable alternatives for Brazilian livestock, however, the degradation of cultivated pastures has represented a threat to the sustainability of the meat production system in Brazil (SANTOS et al., 2010). Most of the studies that approach the problem relate the degradation process with the interactions between zootechnical factors (animal stocking rate), the plant (loss of vigor, morphological alteration) and the soil (chemical attributes), while the problem of physical soil degradation has been left in the background (LEÃO et al., 2004).

Understanding how the physical and chemical attributes of soils respond to intense grazing pressures demystifies several practical questions and can explain the main causes of pasture degradation. Animal trampling promotes changes in these attributes when the minimum soil pre-consolidation pressure is not respected, which usually happens and causes soil compaction.

Soil compaction is a topic of growing importance in view of the increase in agricultural mechanization and animal trampling in agricultural activities, which lead to changes in the arrangement of soil particles. In grazing systems, the intensity of trampling and/or the time the animals stay in the area also determine the degree of structural degradation that can occur in the soil (JÚNIOR, 2006).

Based on this, a research and study will be carried out on the impacts of animal trampling on the soil, thus favoring support for the development of adequate soil, animal and vegetation management practices.

In recent times, environmental degradation has become evident, with the increasing number of degraded areas or areas in a state of desertification. It is known that overgrazing is considered a management factor that most affects the persistence of pastures, soil compaction and changes in soil attributes, expressed in practice by

animal stocking (EMBRAPA, 2005), characterized as one of the main factors for degradation. Still in this context, there is a lack of planning or good agricultural practices, which can aggravate this problem mainly in areas of the semiarid region.

Based on this reality, cattle and sheep grazing in different areas of pasture and agroecosystems can be seen in the Paraíba hinterland, as a way of using pastures as food and controlling the growth ofsame, however,

this practice, well known as sheep and goat farming, has shown some changes in soil attributes described in research carried out in other regions, thus, this study is necessary to understand the behavior of sheep trampling in soil attributes, within our soil and climate conditions.

The main consequence of excessive animal trampling is soil compaction, characterized by an increase in soil density as a result of applied loads or pressures (Leão et al., 2004). In this way, evaluating the impacts of animal trampling on the soil will enable better management of native or improved pastures, in order to harm the environment as little as possible.

In the current context, the consortium of animals in areas cultivated with fruit is being a more viable way for the development of the semiarid region. Knowledge relevant to soil structure is of great importance for sustainable development and greater efficiency in land use, by using the same area with two activities, incorporating another source of income and mitigating the problem of seasonality in the flow of resources observed in the fruit growing (Pereira Junior et al. 2013)

The objective of evaluating the possible deterioration in the physical and chemical attributes of the soil, caused by sheep trampling in grazing areas compared to preserved areas.

2. MATERIAL AND METHODS

Experiment location

The study was carried out at the Federal Institute of Education, Science and Technology of Paraíba – Campus Sousa, located in the Irrigated Perimeter of São Gonçalo, between the geographic coordinates 06 o 50` 22”S; 38 o 17 ` 42” W; at an altitude of 220 meters. The climate is characterized as semi-arid, hot, of the Bsh type of the Koppen Classification. The average annual rainfall is 654 mm, with rains concentrated in the period from January to June. The average annual temperature

is 27 °C, with a maximum of 38 °C, while the average relative humidity is 64%. The predominant vegetation in the region is the caatinga.

Installation and conduct of the experiment

For the execution of this work, the structure that is being developed in a research in the veterinary area that started on 04/14/2021 was used. The experimental unit consisted of two areas measuring 38m x 148m each, totaling 5,624 m2, grazing 20 animals of two breeds daily, 14 of the santas Inês breed and 6 of the morada nova breed of the same age group. The group of animals were grazing in the paddock for 180 days, distributed in the rainy season (04/14/ to 07/14/2021) and dry season (07/15 to 10/15/2021). The area without animals (preserved) located in the same institution, preserved for more than 60 years, absent from agricultural activities and animal grazing, with herbaceous plants in its floristic composition, with a predominance of the thrush (Mimosa caesalpiniaefolia).

Statistical design and analyzed variables

The experiment was in Randomized Block Design (DBC), with 3 treatments consisting of: T1= no animals (preserved); T2= Sheep grazing during the rainy season; T3= Sheep grazing during the dry season, with six repetitions each. To determine the chemical attributes, soil samples were collected at a depth of 0 - 20 cm to determine (pH, phosphorus, potassium, sodium, calcium, magnesium, aluminum and organic and physical matter (sand, silt, clay, soil density, total porosity) , clay dispersed in water) except for apparent density was taken from undisturbed samples at a depth of 0 – 10 cm from the soil (EMBRAPA 1997).

Soil samples were air-dried, sieved through a sieve (2 mm mesh) and analyzed at the Soil, Water and Plant Laboratory (LASAP) at the Instituto Federal da Paraíba (IFPB) Campus Sousa.

Statistical analysis

The results will be submitted to Analysis of Variance (ANOVA) and the means, compared by Tukey's test, at 0,01 of probability, through the computer program - SISVAR (FERREIRA, 2014).

3. RESULTS AND DISCUSSION

It is observed in the granulometric composition studied, that there was a significant effect between the fractions of sand, silt and clay, compared to the area without grazing (preserved) (T1), showing no difference when compared between the periods T2 and T3 (Table 1) . Such behavior can be understood by the period of six months of stay, and can be considered small to the point of not causing changes. According to Klepker and Anghinoni (1995), changes between granulometric fractions are difficult to occur and, when they occur, they are detected after varying periods of use.

Different results were observed by Prado and Natale (2003), who in soil with medium texture did not find significance in the contents of sand, silt and clay, under a dystrophic Red Latosol.

Table 1. Mean values of sand, silt and clay (textural analysis) of the soil under different periods of grazing with sheep, compared to an area preserved at a depth of 0 - 20 cm, in the municipality of Sousa - PB, 2021..

treatments	----------g Kg-¹----------			-
	Sand	**silt**	**Clay**	**Texture Class**
T1	643 b	220 to	134 to	sandy franc
T2	700 to	192 b	110 b	sandy franc
T3	700 to	193 b	108B	sandy franc
F	*	*	*	-
CV (%)	4.2	8.9	01.14	-

T1= no grazing (preserved) T2= sheep grazing rainy season; T3= sheep grazing during the dry season, CV= Coefficient of Variation. Means followed by the same letter in the column do not differ, by Tukey's test, ** = (p<.01) of probability, * = (p<.05) of probability, ns= not significant.

Pereira Junior et al. (2010), evaluating soil physical attributes in different agroecosystems (native forest, guava orchard, cashew orchard and irrigated rice), found a significant effect only for the sand fraction, under a Fluvic Neosol.

Soil density reflects on the arrangement of particles, which in turn defines the characteristics of the porous system, reflecting the degree of soil compaction. In this

reality, we can observe in Table 2, a significant effect ($p<0.01$) for soil density. Treatment T1 showed lower soil density, probably due to the absence of human action and the presence of litter, statistically differing from the others T2 and T3, which showed higher values influenced by the different grazing periods of the sheep. It is worth noting that the values of soil density were above 1.65 kg dm-3, a value considered to impede the good root development of the plants.

Ferreira et al. (2017), evaluating the impact of sheep and cattle trampling, found an increase in soil density caused by sheep grazing in a coconut grove area, under a Fluvic Neosol.

The effect of cattle trampling on pastures, according to Carneiro et al. (2009) and Figueiredo et. al. (2009), was also found to contribute to higher soil density in relation to the native environment in the Cerrado.

Carassai et al. (2011), in research on grazing intensity and grazing methods with lambs in crop-livestock integration, that the highest values of soil density were recorded in the deepest layers (5–10 cm).

Total porosity (Table 2) had a significant effect ($p<0.01$). Higher soil densities reflect lower values for total porosity (LISBÔA & MIRANDA, 2014). Such behavior was observed in T2 and T3 with higher density, inferring a lower total porosity. This must have occurred because the area was used intensively for 60 days with sheep patejo, to the point of not differing in the different periods. Pereira Junior et al. (2014) found that compaction caused by sheep trampling induced an increase in soil density, a decrease in total porosity and a change in the pore size distribution in the 0–5 cm layer, under a Fluvic Neosol.

Still in table 2, clay dispersed in water (ADA), in grazing systems T2 and T3, expressed lower results, differing from T1, indicating a better accumulation of clay particles, influenced by the soil organic matter content that acts as an aggregate of these particles (Table 5). Approximate result was found by Ferreira et al. (2017), when influenced by the high levels of organic matter, it provides greater aggregation of soil particles, comparing areas grazed by cattle and sheep with native forest in the Sertão of Paraíba. While Pereira Junior et al. (2006) also found a reduction in water-dispersed clay (ADA) submitted to management practices in different

agroecosystems, in an area with the introduction of animals for grazing, in a Neosol in the Municipality of Sousa/PB.

TABLE 2. Mean values of soil density (DS), total porosity (PT) and clay dispersed in water (ADA), under different periods of grazing with sheep, compared with preserved area at a depth of 0 - 20 cm, in the municipality of Sousa - PB , 2021

treatments	**DS** kg dm^{-1}	**EN** m^3 m^{-3}	**ADA** g kg^{-1}
T1	1.49 b	0.44 to	80 to
T2	1.69 to	0.40 b	65 b
T3	1.68 to	0.41 b	63B
F	**	**	**
CV (%)	2.42	3.80	14.71

T1= no grazing (preserved) T2= sheep grazing rainy season; T3= sheep grazing during the dry season, CV= Coefficient of Variation. Means followed by the same letter in the column do not differ, by Tukey's test, ** = (p<.01) of probability, * = (p<.05) of probability, ns= not significant.

For soil pH, there was no significant difference (p<0.01), between treatments, ranging from slightly acidic (T1 and T2) to neutral (T3), sheep grazing in different periods did not induce any impediment to use for different crops. (table 3). Evaluating soil attributes under different conditions of use through cattle grazing in mountain areas, rotational cattle grazing, sheep grazing in coconut groves, rotational sheep grazing, Ferreira et al. (2017), found little change in soil pH, which ranged from 6.3 to 7.2 compared to native forest area.

Bandeira et al. (2020), analyzing soil attributes and edaphic macrofauna in different covers, showedarea reforested with sabiá showed the lowest pH value (6.7), different from those cultivated with fruit (7.3), vegetables (7.5) classified as weak alkalinity, but from the burned area (8.4) already considered high alkalinity.

Also in table 3, phosphorus (P) levels differed between treatments (p<0.01). They ranged from high T1 and T3 to very high T2, probably in this rainy season it provided the solubility of this element, to the point of increasing availability of phosphorus in the soil. Pereira Júnior (2006), in a research with sheep, found that as the number of animals per area increased, phosphorus levels decreased, clearly

indicating that phosphorus was exported through the consumption of palatable species consumed by the animals.

For K+ contents, there was no significant difference for grazing in the rainy season (T2) and in the dry season (T3), compared to the area without grazing (T1), however the values present high values (Table 4). According to Williams and Haynes (1995) the urine and feces of sheep are very rich in potassium. Assuming that sodium can be a limiting factor for the growth of most cultures. The results for sodium (Na+), in table 3, also showed a significant difference ($p<0.01$), being high in treatments (T2 and T3) compared to T1.

Santos et al. (2010), analyzing physical and chemical soil attributes of Areas under Grazing in the Brejo Paraibano Micro Region, found that replacement of native forests by agricultural use led to generalized soil impoverishment, including Ca , Mg , K and Na.

Table 3- Average values of pH, phosphorus (P), potassium (K+) and sodium (Na+)of the soil, under different periods of grazing with sheep, compared to an area preserved at a depth of 0 - 20 cm, in the municipality of Sousa - PB, 2021.

	pH	PK+	Na+	
treatments	H2O	mg dm-3	----------cmolc dm-3----------	
T1	6.8 to	480 b	0.73 to	0.15 b
T2	6.8 to	1001 to	0.71 to	0.69 to
T3	7.0 to	434 b	0.65 to	0.63 to
CV(%)	2.4	11.2	29.5	25.1
F	us	*	us	*

T1= no grazing (preserved) T2= sheep grazing rainy season; T3= sheep grazing during the dry season, CV= Coefficient of Variation. Means followed by the same letter in the column do not differ, by Tukey's test, ** = ($p<.01$) of probability, * = ($p<.05$) of probability, ns= not significant.

The values of Ca^{+2} and Mg^{+2} showed a significant difference ($p<0.01$), with high levels between treatments, tending to decrease from grazing in the dry season (T3), compared to sheep grazing in the rainy season. (T2) and without grazing-preserved (T1), Mg^{+2} followed the same trend when comparing T2 with T3 (Table 4). It is worth noting that despite thecalcium and magnesium expressed high values and even higher than T1, there were reductions, probably due to the removal of pastures for animal consumption, number and a greater permanence of animals and

not returned by vegetable cycling and animal waste, considering that calcium it is largely excreted in the feces of animals, in which it is poorly soluble in water, making the release very slow, also observed by Pereira Junior (2006). Corroborating this study, Santos et al (2010) , in grazing areas, found a reduction in calcium and magnesium in three soil depths (0-10, 10-20 and 20-30), in semi-degraded pasture (PSD) , degraded pasture (PD) compared in native forest (MN).

Table 4- Average values of calcium (Ca+2), magnesium (Mg+2), Sodium saturation (PST) and soil organic matter (SOM) of the soil, under different grazing periods with sheep, compared with preserved area at a depth of 0 – 20 cm, in the municipality of Sousa - PB, 2021

treatments	Ca+2	Mg+2	PST	MOS
	---------- cmolc dm-3 ---------- %			g.kg
T1	11.3 to	1.8 c	1.0 b	39.0 to
T2	13.3 to	8.8 to	3.0 to	3.1 b
T3	7.9 b	5.7 b	4.0 to	1.0 c
CV (%)	14.1	23	8.4	19
F	**	**	**	**

T1= no grazing (preserved) T2= sheep grazing rainy season; T3= sheep grazing during the dry season, CV= Coefficient of Variation. Means followed by the same letter in the column do not differ, by Tukey's test, ** = (p<.01) of probability, * = (p<.05) of probability, ns= not significant.

Sodium saturation (PST) differed statistically between treatments (Table 4). It can be seen that grazing between the rainy season (T2) and the dry season (T3) did not change statistically, indicating no restriction in relation to sodium contents in the soil, being within the limit range lower than 7(Richards, 1954)considered as trouble-free soils within the studied environments.

There was a significant difference for soil organic matter (SOM), it is possible to identify that T1 has a high level of organic matter, due to being a place of preservation without human intervention, on the other hand, the reduction of SOM from T2 to the T3, with the end of the rainy season and the beginning of the dry season, there was a reduction in the availability of green pasture, inducing the sheep to take advantage of the decomposing pasture residues, as well as the permanent period of 60 days in the area, which probably contributed to this reduction. Analyzing animal grazing, Ferreira et al. (2017), found that in environments with grazing with sheep, they influenced the reduction of soil organic matter, compared to cattle grazing and native forest.

4. CONCLUSION

Sheep grazing in different periods promoted soil compaction expressed by increased soil density, reduced total porosity and lower aggregate clay content.

The permanence of the animals grazing promoted a reduction in the chemical quality of the soil, notably for the contents of phosphorus, calcium, magnesium and SOM in sheep grazing during the dry season and an increase for sodium and PST, compared to the area without grazing (preserved).

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