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PRODUCTIVE PERFORMANCE OF TIFTON 85 GRASS (Cynodon spp.), WITH SHEEP MANURE

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Abstract: Organic fertilization is an alternative form of fertilization that not only takes advantage of the internal resources available on rural properties, but also raises environmental concerns through the contamination of soils and bodies of water due to the inadequate handling of industrial fertilizers and their high costs. The experiment was carried out at the Experimental Farm of the Vale do Acaraú State University - UVA, Sobral, CE-Brazil, with the aim of evaluating the production of Tifton 85 grass *(Cynodon spp.)*, harvested at 30 and 62 days after planting. Organic fertilizer was applied on 01/08/2022 in the furrow of each row and incorporated into the soil, followed by planting with stolons of Tifton 85 grass (*Cynodon spp*.). During the experimental period, the grass was irrigated twice a day one hour per shift via a sprinkler irrigation system. Plant height, number of tillers and green mass weight were measured on the days the Tifton 85 grass was cut. When measuring plant height, a ruler graduated in centimeters was used, based on the level of the ground at leaf height, measuring the plants within the frame. On the same day, the density of the tillers was estimated by counting them inside the 0.25 m frame^2. The grass material collected was placed in a plastic bag, identified and sent to the FAEX/UVA laboratory to be weighed for its green mass (g). After weighing the green mass, the samples were placed in paper bags and dried at 65°C for 72 hours in a forced ventilation oven, followed by weighing the dry mass (g). The yield of green and dry mass per hectare was calculated by a rule of three between the green and dry mass obtained in the frame (0.25 m$^{2)}$ in relation to one hectare (10,000 m^2), converting the units (g) into tons (t). The design used in the experiment was a randomized block, arranged in a simple scheme, with five doses of sheep manure incorporated into the soil (0; 4.22; 8.44; 12.67 and 16.89 t ha^{-1}) in four replications. The doses of sheep manure incorporated into the soil had no significant influence (P> 0.05) on plant height, tiller number, green mass and dry mass of the aerial part of the plants in the first cut at 30 days. The doses of sheep manure had a significant influence (P< 0.05) only on the green mass productivity of the Tifton 85 grass in the second cut at 62 days. In the third cut at 92 days, there was no significant effect of the sheep manure doses on PA and NP, but there were linear responses of MV and DM yields to the sheep manure doses. In the fourth cut at 122 days, there was no significant effect of the sheep manure doses on the parameters assessed in the Tifton 85 grass plants.
Keywords: Organic fertilizer, tillering, productivity.

INTRODUCTION

Tifton 85 grass is a plant of the genus (*Cynodon spp*.), whose origin is the result of crossing Tifton 68 grass with a South African introduction called PI-290884. Among pastures, Tifton 85 grass is used prominently because it is a forage plant with a high potential for producing quality forage for animal feed (PEREIRA et al., 2012). According to BURTON et al. (1993), Tifton 85 grass (Cynodon spp.) is a hybrid selected in Georgia, United States, which has different characteristics to other cultivars, such as being taller, having longer stalks, more extensive leaves with a darker green color, large rhizomes, fewer in number, and stolons with rapid expansion.

Tifton 85 grass stands out among the forage grasses used in animal feed because it is highly responsive to nitrogen fertilization, as it has a high dry mass production, greater nutritional value and a high support capacity for animals. Increasing the availability of N in the soil increases forage production. However, the efficiency of N absorption by the plant at higher levels depends on the water content in the soil through irrigation or rainwater (ALVIM et al., 1999; MARCELINO et al, 2001).

The semi-arid northeast of Brazil has low rainfall and irregular distribution of rainfall throughout the year, with great climate variability and vulnerability, with an average rainfall of around 800 mm, distributed irregularly throughout the year. Given the climatic conditions, livestock farming in the Brazilian semi-arid region has been affected by the supply of bulky feed, especially during periods of drought. In addition to region's climatic conditions, the edaphology is mostly shallow, stony soils with reduced permeability and problems of salinity and sodicity, providing unsuitable conditions for growing fodder plants

BERTON (1997) considers organic fertilization to be an alternative for increasing the production of plant biomass in forage plants. As well as making mineral nutrients readily available in the soil for plants to absorb, organic fertilizers improve the soil's physical, chemical and biological conditions by incorporating organic matter into the soil through the use of organic fertilizers, especially animal manure.

The use of organic fertilizer in the soil can replace the use of mineral fertilizers, as it improves the physical and biological characteristics, making a positive contribution to soil fertility and plant nutrition and facilitating plant development (MIYASAKA et al., 1997). When BRITO et al. (2005) studied various manures in the soil, they found that sheep manure was the residue that caused the main changes in the soil's chemical properties

Due to the constant loss of nutrients in the soil, organic fertilization is an important strategy to study, due to its gradual release of nutrients and the contribution of organic matter to the soil, promoting improvements in chemical physical properties and in the activities of beneficial microorganisms, favoring the productivity of plant biomass. The aim of this study was to evaluate the height and number of tillers and the productivity of Tifton 85 grass (*Cynodon spp.*) with different doses of sheep manure applied to the soil.

MATERIALS AND METHODS

The experiment took place at the Experimental Farm of the Vale do Acaraú State University (FAEX/UVA), located in the municipality of Sobral, in the northern region of Ceará, from July 2, 2022 to November 3, 2022. The municipality is located in the semi-arid region of northeastern Brazil, with geographical coordinates (3º41'S and 40º20'W), and an altitude of 69m. The region's climate is of the BSw'h' type, according to the Köppen classification, with a rainy season from January to May.

The average annual temperature and rainfall are 30ºC and 821.6 mm, respectively. The soil in the area studied has characteristics similar to the Planossolo class. The experiment was set up in a gently undulating area with Tifton 85 grass (*Cynodon spp.*), as shown in Figure 1.

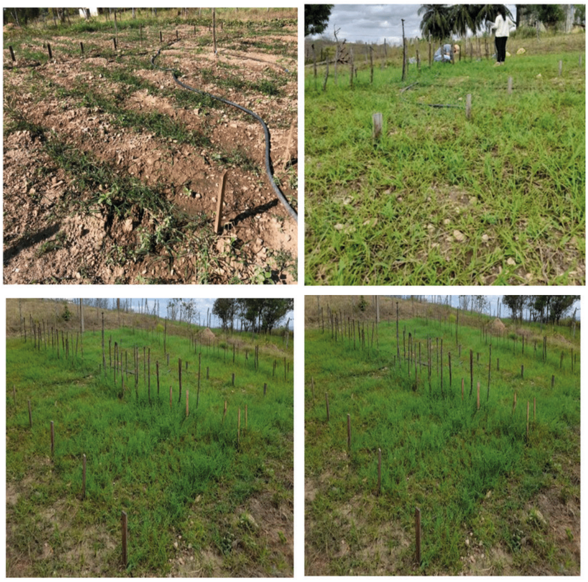

Figure 1. Overview of the Tifton 85 grass experiment at FAEX/UVA, Sobral, CE, 2022.

The experimental design used was randomized block design (RBL) in a simple scheme, testing five doses of sheep manure (0; 4.22; 8.44; 12.67 and 16.89 t ha^{-1}), four replications, making a total of 20 experimental units. Each experimental plot was 1m wide and 5m long. The doses of sheep manure were calculated according to the recommended doses (0, 100, 200, 300 and 400 kg of N ha^{-1}) available in the literature. The Tifton 85 grass (*Cynodon spp.*) was planted on July 1, 2022 in a furrow 15 cm deep. The vegetative part of the Tifton 85 grass was obtained from the pasture already established on the FAEX/ UVA experimental farm (Figure 2).

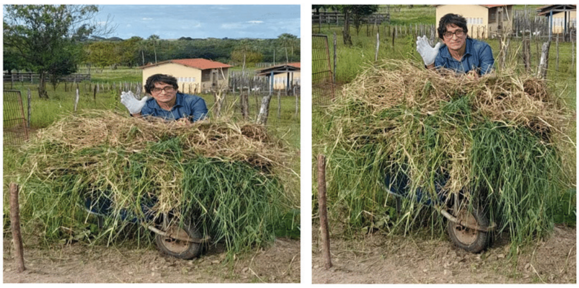

Figure 2 - Tifton 85 grass seedlings used to plant the experiment.

The soil was prepared by manually weeding out the weeds with a hoe. The sheep manure, used as an organic fertilizer source of N and other nutrients, went through a process of controlled decomposition, watered and turned over for a period of 20 days before being applied to the soil. The manure was collected from sheep of different ages, kept in an extensive system and fed on native pasture made up of herbaceous plants, grasses and shrubs during the rainy and dry periods. The sheep manure used was collected in the Sheep Farming Sector at FAEX. Six single samples of sheep manure were taken by walking in a zigzag pattern at different points in the manure house (Figure 3A). After homogenizing the simple samples, a composite sample of 0.5 kg was obtained and then sent to the Soil and Water Analysis Laboratory at IFCE/Campus Sobral - CE. The samples were dried in the open air and passed through a 2 mm mesh sieve for analytical determinations, according to TEIXEIRA et al. (2017). For soil sampling, the same methodology was followed, but 8 simple samples were taken from the experiment area (Figure 3B) to obtain a composite sample of 0.5 kg of soil.

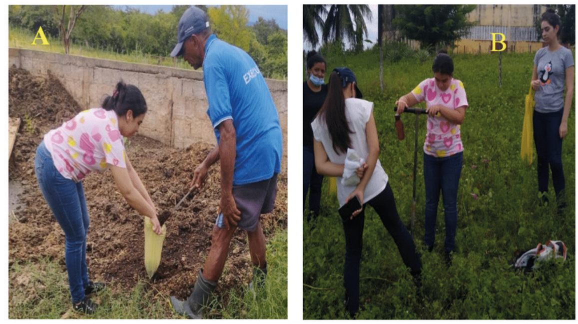

Figure 3. Sampling of the sheep manure in the manure house (A) and the soil in the experiment area (B).

Organic carbon (OC), MOS, total nitrogen (NT), pH (H_2O), available P, K, Ca, Mg, Na and electrical conductivity (EC) were determined from the soil and sheep manure samples sent to the Soil Fertility Laboratory of the Federal Institute of Education, Science and Technology of Ceará, Sobral Campus. The pH was determined at a soil/water ratio of 1:2.5 by potentiometry. Potential acidity (H+Al) was extracted with calcium acetate at 0.5 mol L^{-1} and quantified by titration with NaOH 0.025 mol L^{-1}.

The exchangeable Ca, Mg and Al contents were extracted together with KCl 1 mol L^{-1}, titrating Al^{3+} in one fraction of the extract with NaOH in the presence of bromothymol blue as an indicator. In another fraction of the extract, calcium and magnesium were titrated by complexometry using EDTA and T-eriochrome black as an indicator. In a third aliquot, calcium was determined by complexometry using EDTA and carbonic acid as an indicator. The exchangeable Na and K contents were extracted with Mehlich-1 and determined using a flame photometer. P was extracted with the Mehlich-1 extractant solution, consisting of HCl 0.05 mol L^{-1} + H_2SO_4 0.0125 mol L^{-1} and determined by visible spectrophotometry, with transmittance readings using an 880 nm filter (TEIXEIRA et al., 2017).

soil								
NT	CO	MOS	P		K	Ca	Mg	In
dagkg^{-1}	------dagkg$^{(-1)}$------		-----mgdm$^{(-3)}$-----		---------cmol$_c$dm$^{(-3)}$---------			
0,34	3,93	6,78	5,67		0,153	4,80	2,70	0,70
	Al^{3+}	(H+Al)	SB	T	V	PST	m	CEes
(H_2O)	---------------cmol$_c$dm$^{(-3)}$-----------------				---------------%--------------			dSm^{-1}
6,4	0,00	1,73	8,35	10,08	83	6,9	0,00	0,38
Sheep manure								
NT	CO	MOS	P	K	Ca	Mg	In	
dagkg^{-1}	------dagkg$^{(-1)}$----		-----mgdm$^{(-3)}$-----		----------cmol$_c$dm$^{(-3)}$--------			
1,59	15,554	31,886	2.467,14	30,94	14,00	5,20	5,74	

Table 1. Results of the chemical analysis of the soil and sheep manure

PH (H_2O); NT = total nitrogen; CO = organic carbon; MOS = soil organic matter; T = cation exchange capacity at pH7; V = base saturation; PST = percentage of exchangeable sodium; m = aluminum saturation; ECes = electrical conductivity of the soil saturation extract. % = dag kg^{-1}.

The electrical conductivity of the soil saturation extract (ECes) was determined using 15 g of sample (dry basis) plus 30 mL of deionized water, stirring for 30 min. After resting for 16 hours, the samples were filtered and determinations were made on the aqueous extract using a conductivity meter calibrated with a 0.01 mol L^{-1} KCl standard solution (EC = 1.412 dS m^{-1} at 25°C).

The organic carbon (OC) of the sheep manure was quantified by wet oxidation of the organic matter, using a solution of potassium dichromate in a sulphuric medium, with an external heat source. Based on the organic carbon content, the organic matter of the sheep manure was determined by multiplying it by a factor of 2.05, according to PASCUAL et al. (1997), who consider this factor to be the most appropriate for calculating organic matter in organic waste.

Total nitrogen (NT) was calculated using the organic matter content multiplied by a factor of 0.05, since the organic matter in the soil is considered to contain 5% nitrogen (TOMÉ JR, 1997). The results issued by the laboratory for both the soil and the manure are shown in Table 1.

Organic fertilizer was applied on 01/07/2022 in a furrow in each row and incorporated into the soil, followed by planting with stolons of Tifton 85 grass (*Cynodon spp.*) acquired from the pasture already established at FAEX/UVA, in furrows 15 cm deep (Figure 4). No soil acidity correction or fertilization with mineral fertilizers was used. During the experimental period, the Tifton 85 grass (*Cynodon spp.*) was irrigated twice a day (morning and afternoon) for one hour per shift, resulting in two hours of irrigation per day, via a sprinkler system

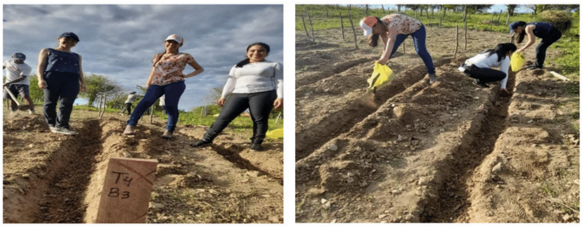

Figure 4 Organic fertilization with sheep manure incorporated into the furrows of the rows with the treatments.

Cuts were made every 30 days after planting to assess the variables related to plant height, number of tillers, MV and DM production and productivity per area of Tifton 85 grass. The first cut (uniformization cut) of the Tifton 85 grass (*Cynodon spp.*) was carried out on 01/08/2022. On 02/09/2022 the second cut, on 03/10/2022 the third cut and on 03/11/2022 the fourth cut at 10 cm from the ground, using pruning shears. The crop was collected per plot in a sampling square or frame measuring 0.5 m x 0.5 m, corresponding to an area of 0.25 m^2. The area of each plot was 5 m^2 (1 m x 5 m). Each block had an area of 25 m^2 (made up of five rows 5 m long with a row spacing of one meter). Plant height was measured on the day of the first cut of Tifton 85 grass 30 days after planting, using a ruler graduated in centimeters, based on the soil level at leaf height, measuring the plants within the frame. On the same day, the density of the tillers was estimated by counting them inside the sampling square or frame (0.25 $m^{2)}$ (Figure 5A). The height and number of tillers were measured in a similar way in the cuts after the uniformization cut.

The Tifton 85 grass plant material collected from the plots was packed in plastic bags, identified and sent to the FAEX/UVA laboratory for weighing and determination of the green mass (VM). The samples were then placed in paper bags, dried at 65°C for 72 hours in a forced air ventilation oven and weighed on a scale to obtain the dry mass (DM), as shown in Figure 5B. The values (g) of MV and DM obtained from the sampling in the frame (0.25 m^2) were converted to tons (t) per hectare (10,000 m^2) and using a rule of three, the productivity per area of green mass and dry mass was obtained .

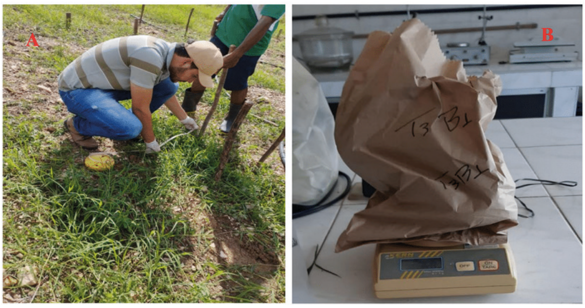

Figure 4: Area of the frame (0.5 m x 0.5 m) (A) and weighing of dry matter (g) in the FAEX/UVA laboratory, Sobral, CE (B).

The statistical evaluation of the data was carried out using SISVAR (FERREIRA, 2005) and the data obtained was submitted to analysis of variance using the F test. Tukey's test was used to compare means at 5% probability and regression models were used for doses.

RESULTS AND DISCUSSION

RESPONSE TO THE ORGANIC FERTILIZATION OF PLANTS IN THE UNIFORMITY CUT CARRIED OUT 30 DAYS AFTER PLANTING

The doses of sheep manure incorporated into the soil had no positive influence ($P>0.05$) on the plant height (PH) and tiller number (NP) of Tifton 85 grass cut at 30 days after planting. The plants had an average height of 30.52 cm and 78 tillers (Table 2). The responses obtained are explained by the fallow soil having a high humified organic matter content of 6.78 dag kg^{-1} and not differing with the amounts of sheep manure applied to the soil compared to the soil in its natural fertility conditions and with the doses of sheep manure based on the recommended doses of 100, 200, 300 and 400 kg of N ha^{-1}.

ANDRADE (2017), when evaluating the PA of Tifton 85 grass and NP, observed a positive effect of nitrogen fertilization with a dose of 300 kg ha^{-1} of N, the fertilizer used being urea. However, the average PA of 24.7 cm determined at 35 days was lower when compared to the PA obtained in this experiment at 30 days. PEREIRA et al. (2012), when assessing the growth of Tifton 85 grass under doses of N and cutting heights, also found no significant effect on the growth of Tifton 85 grass, obtaining an average height of 30 cm of the plants harvested at 30 days in the uniformization cut with the application of 100 kg of N ha^{-1}, using urea fertilizer. SILVA (2007), when evaluating the response of Tifton 85 grass to doses of N associated with doses and sources of boron in a greenhouse, observed that the dose of N had a significant effect on the partial number of tillers in the first cycle, with an average partial and total number of tillers of 43.7 and 26.1 respectively. This response shows that the nutrient supply stimulated tillering in this growth cycle during the pasture establishment phase. NASCIMENTO (2019), when evaluating doses of nitrogen applied to soil in a greenhouse using urea fertilizer when growing Tifton 85 grass, found no significant effect of the doses of N applied to the soil on plant height. However, the author observed higher PH values as a function of nitrogen doses, with averages of 26.84 cm and 26.58 cm when 225 and 300 kg of N $ha^{(-1)}$ were applied to the soil, respectively, in the cut carried out 20 days after the grass was uniformed.

SOUSA, (2017) when evaluating the height of Tifton 85 grass plants grown in pots with soil from a depth of 20 cm from a Typical Orthic Chromic Luvissolo fertilized with poultry litter used as a source of N, in the first cut carried out 35 days after planting, also observed no significant effect with the doses of N evaluated on plant heights, obtaining an average height of 26.58 cm with the dose of 60 kg of N ha.

SILVA (2007) when evaluating the response of Tifton 85 grass to doses of nitrogen, associated with the doses and source of boron grown on a typical dystrophic Red Latosol A moderate medium texture, corrected with calcium and magnesium carbonates, evaluated doses of N supplied by ammonium nitrate in the greenhouse and observed a significant effect of the doses of N on the partial and total number of tillers of the Tifton grass in the first cycle. The application of N increased the value of the variable, indicating that the supply of the nutrient stimulated tillering in this growth cycle, which represents the establishment phase of the pasture. Compared to the control (no N application), the doses of 100 and 200 mg kg^{-1} of N increased the partial number of tillers by 98% and 108%, respectively, and the total number of tillers by 52% and 56%, respectively. However, there was no significant effect of the N doses on the initial number of tillers.

LUZ et al (2021), when evaluating the tiller population density of Marandu and Piatã grasses grown in soil that had been fertilized with chicken litter and cattle manure at doses of 0 and 2.5 t ha^{-1}, found no statistical difference in the tiller population density of the grasses with the fertilizers or organic fertilizers studied after the uniformization cut carried out at 45 days.

		Mean Square	
Source of Variation	GL	AP	NP
Doses of manure	4	38.637500	263.450000
Block	3	223.245833	1333.200000
Error	12	36.120833	460.616667
Total	19		
CV (%)	19,69	Number of observations 20	27,66
Averages of dependent variables			
Sheep manure doses (t ha^{-1})		AP (cm)	NP
0		26,62	79,25
4,222		34,75	77,75
8,4470		30,00	76,25
12,670		29,00	66,00
16,894		32,25	88,75
Average		30,52	77,60

Table 2. Summary of the analysis of variance for plant height (PH) and number of tillers (NP) of Tifton 85 grass plants fertilized with doses of N via sheep manure at 30 days.

The doses of sheep manure evaluated had no significant effect (P>0.05) on the weight of green mass (g 0.25 m^2), dry mass (g 0.25 m^2), green mass productivity and dry mass productivity in tha^{-1} of the Tifton 85 grass in the first cut at 30 days (Table 3). The plants showed an average MV production of 63 g and 74.75 g in the area of a 0.25 m^2 sampling square or frame, in the soil under conditions of natural fertility and fertilized with the highest dose of sheep manure respectively (Table 4). Dry DM production varied from 13.25 g in the absence of sheep manure fertilization to 13.75 g in the area of a 0.25 m^2 sampling square or frame, compared to the Tifton 85 grass plants fertilized with the highest dose of sheep manure. MV and DM yields in tha^{-1} ranged from 2.55 to 2.99 tha^{-1} and 0.53 to 0.57 tha^{-1}, respectively, from the absence of sheep manure fertilization to the highest dose of sheep manure incorporated into the soil used in the experiment (Table 3)

The results obtained are corroborated by NASCIMENTO (2019), when evaluating the DM of Tifton 85 grass subjected to nitrogen fertilization (urea source), who also observed no significant difference in the DM results obtained, whose averages were 47.11 and 46.51 g pot^{-1} with the application of doses of 225 and 300 kg ha^{-1} of N in the cut carried out 20 days after the uniformization cut. In the cut 40 days after the uniformization cut. NASCIMENTO (2019) obtained the highest average MV value of 24.49 g pot^{-1} with the application of 300 kg ha^{-1} of N to the soil. These results were lower than the green mass production averages obtained in this study, which evaluated the amounts of sheep manure applied to the soil according to the recommendations for doses of 0, 100, 200, 300 and 400 kg of N ha^{-1} in the first cut carried out 30 days after planting the Tifton 85 grass. For the DM of the Tifton 85 grass. NASCIMENTO (2019) also no significant difference, whose average DM values were 20.28 g pot^{-1} and 19.99 g pot^{-1}, at 20 days after the uniformization cut with the doses of 225 and 300 kg of N ha^{-1} respectively applied to the soil, nor in the cut carried out at 40 days after the uniformization cut, whose average value was 8.18 g $pot^{(-1)}$) with the dose of 300 kg $ha^{(-1)}$) of N applied to the soil. In a study carried out by AMARAL (2014) on the management of nitrogen fertilization in a greenhouse, the average DM production of the aerial part of Tifton 85 grass was 5.48 g pot^{-1} in the first uniformization cut at 21 days. GALZERANO et al. (2008) when fertilizing Tifton 85 grass during the establishment phase with doses of 0, 50, 100 and 150 kg of N ha^{-1}, without installments, observed that the doses of N influenced the average height of the plants, obtaining values between 2.0 and 21.3 cm at 30 days after planting.

SOUSA, (2017) when evaluating the green mass production and dry mass production of Tifton 85 grass plants grown in pots with soil from the 20 cm depth of a Typical Oritic Chromic Luvissolo fertilized with poultry litter used as an N source, in the first cut carried out 35 days after planting, there was also no significant effect of the doses of N evaluated on the production of green mass and dry mass, the averages of which were 46.51 g and 19.99 g pot^{-1} respectively with the dose of 60 kg of N ha.

RESPONSE TO ORGANIC FERTILIZATION OF THE PLANTS IN THE FIRST CUT CARRIED OUT AFTER THE UNIFORMIZATION CUT AT 62 DAYS AFTER PLANTING (SECOND CUT)

In the cut carried out 62 days after planting the Tifton 85 grass, there was also no significant effect of the amounts of sheep manure incorporated into the soil on plant height and the number of tillers of the Tifton 85 grass. The average plant height was 42.50 cm and the number of tillers was 91 when the grass was cut at 62 days after planting (Table 4)

FV GL		Mean square			
		PMV	PMS	MV Product	Prod.MS
Doses of manure	4	412.300	15.4250	1.16512	0.02852
Block	3	619.86666	15.383333	0.85554	0.028027
Error	12	508.533333	17.758333	0.953013	0.031293
Total	19				
CV (%)		37,71	36,49	42,19	37,96

Doses of manure (t ha^{-1})	PMV (g)	PMS (g)	Prod.MV (tha^{-1})	Prod.MS (tha^{-1})
0	63,75	13,25	2,55	0,53
4,222	56,75	10,50	2,27	0,42
8,447	47,50	9,00	1,51	0,36
1,.670	56,25	11,25	2,25	0,45
16,894	74,75	13,75	2,99	0,57
Average	59,80	11,55	2,31	0,46

Table 3. Green mass production (PMV), dry mass production (PMS), green mass productivity (Prod.MS tha^{-1}) dry mass productivity ha^{-1} (Prod.MS tha^{-1}) of Tifton 85 grass plants subjected to different doses of irrigated sheep manure at 30 days.

The absence of a positive effect of fertilization via sheep manure on the PA and NP of Tifton 85 grass can be explained by the fact that the soil has been fallow for many years, with a high enough organic matter content to promote height and tillering similar to the doses of sheep manure tested at 62 days, according to the recommended doses of N for obtaining the amounts of sheep manure applied to the soil. Another probable explanation comes from the percentage of conversion to macronutrients, which indicates an approximation of the rate of conversion of nutrients from organic to mineral form over the years, where only 50% of the N is available to plants in the first year through the application of organic fertilizers to the soil, provided that the conditions are ideal for the mineralization process (RIBEIRO et al., 1999). GALZERANO et al. (2008) when fertilizing Tifton 85 grass during the establishment phase with doses of 0, 50, 100 and 150 kg of N ha^{-1}, without installments, observed that the doses of N influenced the average height of the plants, obtaining values between 4.0 and 45.8 cm, at 64 days after planting

NASCIMENTO (2019), when assessing the height of Tifton 85 grass plants in response to the application of different doses of nitrogen and cutting frequency, did not observe any significant differences between the doses of nitrogen (0, 75, 150, 225 and 300 kg ha^{-1}) applied to the soil in the greenhouse at 60 days after the uniformization cut. The author observed a higher average AP value of 19.08 cm at 60 days in the soil in its natural fertility condition compared to when 225 and 300 kg ha^{-1} of nitrogen were applied to the soil. These results are corroborated by the observations of PRIMAVESI et al. (2001) who observed losses of 15 to 40% when the doses of N applied to the soil were increased from 25 to 200 kg ha^{-1} in the first cut. The losses observed by the authors are explained by volatilization of N-NH_3. Therefore, the application of sheep manure as an organic fertilizer in the cultivation of Tifton 85 grass is recommended

SOUSA, (2017) when evaluating the height of Tifton 85 grass plants grown in pots with soil from a depth of 20 cm from a Typical Orthic Chromic Luvissolo fertilized with poultry litter used as a source of N, in the cut carried out 70 days after planting, also observed no significant effect with the doses of N evaluated on the heights of the plants, obtaining an average height of 20, 85 cm with the dose of 60 kg of N ha.

SILVA (2007), when evaluating the response of Tifton 85 grass to doses of nitrogen, associated with the doses and source of boron cultivated in a typical dystrophic red latosol A moderate medium texture, corrected with calcium and magnesium carbonates, evaluated doses of N supplied by ammonium nitrate in a greenhouse and observed a significant effect of N doses on the initial, partial and total number of tillers of Tifton grass in the second growth cycle.

For SILVA (2007), N increased the initial value of the tillers when the doses of 100 and 200 mg kg^{-1} of N were evaluated in relation to the control, with an increase of 50% in both doses and for the partial numbers of tillers, which were 66% and 109% higher respectively when compared to the number of tillers obtained from plants not fertilized with nitrogen fertilizer. The total number of tillers in the Tifton grass increased by 59% and 77% respectively with the doses of 100 and 200 mg kg^{-1} of N compared to the total number of tillers in plants not fertilized with N.

PREMAZZI et al., (2003) when evaluating tillering in Bermuda grass cv Tifton 85 in response to doses and timing of nitrogen application after cutting cultivated on a Quartz Neossolo, observed that the application of N, in addition to increasing the number of tillers, increased the mass of each tiller of the Tifton 85 grass. The authors increased the weight of individual tillers up to nitrogen doses of 201 and 185 mg kg^{-1} of soil in the first and second cuts, respectively, obtaining correlation coefficients of 0.92

		Mean Square	
Source of Variation	GL	AP	NP
Doses of manure	4	47.131750	90.125000
Block	3	167.153833	396.666667
Error	12	87.918417	282.958333
Total	19		
CV (%)		22,06	18,49
Averages of dependent variables			
Sheep manure doses (t ha^{-1})	AP (cm)	NP	
0	44,00	83,00	
4,222	37,02	92,25	
8,447	41,62	90,75	
12,670	43,87	94,50	
16,894	46,00	94,50	
Average	42,50	91,00	

Table 4 Summary of the analysis of variance for plant height (PH) and number of tillers (NP) of Tifton 85 grass plants fertilized with doses of N via sheep manure at 62 days

In the cut carried out 62 days after planting, there was a significant effect ($P< 0.05$) of the doses of sheep manure evaluated only for green mass productivity, which grew linearly, with values varying from 2.23 t ha^{-1} to 5.01 t ha^{-1} with the greater amount of sheep manure incorporated into the soil (Table 5). There was no significant effect on dry mass productivity ($P< 0.05$). However, there was an upward trend with the highest dose of sheep manure incorporated into the soil, with values varying from 1.09 t ha^{-1} to 1.6 t ha^{-1} (Table 5). According to POCZYNEK, (2015) the mass production of a forage grass refers to the successive emission of leaves and tillers, a significant factor in the recovery of leaf area under different conditions. However, various characteristics related to the quality of the grass can be affected by the age at which it is cut and the environmental conditions in which it is grown

NASCIMENTO (2019), when evaluating the DM of Tifton 85 grass subjected to nitrogen fertilization (urea source), also observed no significant difference in the DM results obtained, the averages of which were 21.51 and

FV GL		Mean square			
		PMV	PMS	MV Product	Prod.MS
Doses of manure	4	3791.00000	85.3250000	4.312080	0.133320
Block	3	13293.6500	172.400000	3.513780	0.192107
Error	12	8091.23333	49.691667	1.312747	0.089107
Total	19				
CV (%)		73,28	21,11	28,96	22,01

Doses of manure (t ha^{-1})	PMV (g)	PMS (g)	Prod.MV (tha^{-1})	Prod.MS (tha^{-1})
0	175,00	27,25	2,23	1,09
4,222	99,00	34,75	3,96	1,39
8,447	105,00	32,00	4,20	1,38
12,670	109,50	33,00	4,38	1,32
16,894	125,25	40,00	5,01	1,60
Average	122,75	33,40	3,95	1,35

Table 5. Green mass production (PMV), dry mass production (PMS), green mass productivity (Prod.MS tha^{-1}) dry mass productivity $ha^{(-1)}$) (Prod.MS tha^{-1}) of Tifton 85 grass plants subjected to different doses of irrigated sheep manure at 62 days.

22.20 g pot^{-1} with the application of doses of 225 and 300 kg ha^{-1} of N in the cut carried out 60 days after the uniformization cut. NASCIMENTO (2019) also found no significant difference between the doses of N and the DM of the Tifton 85 grass plants, whose average DM values were 7.46 g pot^{-1} and 7.81 g pot^{-1} at 60 days after the uniformization cut with the doses of 225 and 300 kg of N ha^{-1} respectively applied to the soil

SOUSA (2017), when evaluating the green mass production and dry mass production of Tifton 85 grass plants grown in pots with soil from a depth of 20 cm in a Typical Orthic Chromic Luvissolo fertilized with poultry litter used as a N source, in the first cut carried out 70 days after planting, there was also no significant effect of the doses of N evaluated on the production of green mass and dry mass, the averages obtained being 24.49 g and 8.18 g pot^{-1} respectively with the dose of 60 kg of N ha.

RESPONSE TO ORGANIC FERTILIZATION OF THE PLANTS IN THE SECOND CUT CARRIED OUT AFTER THE UNIFORMIZATION CUT AT 92 DAYS AFTER PLANTING (THIRD CUT)

Table 6 shows the summaries of the analysis of variance for the PA and NP of Tifton 85 grass as a function of the doses of sheep manure applied to the soil. The results obtained for AP and NP of the cut carried out at 92 days after planting showed no significant differences when relating the doses of sheep manure to the variables evaluated. However, there were average values of 37.2 cm AP and 28.90 tillers with the doses of manure applied to the soil (Table 6).

SOUSA, (2017) when evaluating the height of Tifton 85 grass plants grown in pots with soil from a depth of 20 cm from a Typical Orthic Chromic Luvissolo fertilized with poultry litter used as a source of N, in the cut carried out at 105 days after planting, also observed no significant effect with the doses of N evaluated on plant heights, obtaining an average height of 18.69 cm with the dose of 60 kg of N ha

SILVA (2007), when evaluating the response of Tifton 85 grass to doses of nitrogen, associated with the quantities and source of boron applied to a typical dystrophic red latosol A moderate medium texture, corrected with calcium and magnesium carbonates, assessed the doses of N supplied by ammonium nitrate in a greenhouse, and observed a significant effect of the doses of N on the initial, partial and total number of tillers of the Tifton grass in the third growth cycle. The author observed that N increased the partial number of tillers when the plants were fertilized with 100 and 200 mg kg^{-1} of N compared to the control, which increased by 156% and 169%. On the other hand, the total number of tillers in Tifton grass increased by 94% and 105% with the doses of 100 and 200 mg kg^{-1} of N, respectively, compared to the total number of tillers in plants not fertilized with N.

		Mean Square	
Source of Variation	GL	AP	NP
Doses of manure	4	225.456250	39.325000
Block	3	135.866667	341.933333
Error	12	98.731250	57.891667
Total	19		
CV (%)		26,71	26,33
Averages of dependent variables			
Sheep manure doses (t ha^{-1})	AP (cm)		NP
0	24,62		31,25
4,222	37,25		28,75
8,447	43,75		28,50
12,670	42,00		32,00
16,894	38,37		24,00
Average	37,20		28,90

Table 6. Summary of the analysis of variance for plant height (PH) and number of tillers (NP) of Tifton 85 grass plants fertilized with doses of sheep manure at 92 days.

Table 7 shows the summaries of the analysis of variance for MV, DM, Prod. MV and Prod. DM of Tifton 85 grass as a function of the doses of sheep manure applied to the soil. The results obtained from the cut carried out 92 days after planting showed linear responses of MV and DM yields to the doses of sheep manure. The highest dose of manure applied (16.89 t $ha^{-1)}$ resulted in the highest MV (40.5 t ha^{-1}) and DM (18.0 t ha($^{-1)}$) yields.

SOUSA (2017), when evaluating the green mass production and dry mass production of Tifton 85 grass plants grown in pots with soil from a depth of 20 cm in a Typical Orthic Chromic Luvissolo fertilized with poultry litter used as an N source, in the first cut carried out at 105 days after planting, there was also no significant effect of the doses of N evaluated on the production of green mass and dry mass, the averages obtained being 22.20 g and 7.81 g pot^{-1} respectively with the dose of 60 kg of N ha.

RESPONSE TO ORGANIC FERTILIZATION OF THE PLANTS IN THE THIRD CUT CARRIED OUT AFTER THE UNIFORMIZATION CUT AT 122 DAYS AFTER PLANTING (FOURTH CUT)

The analysis of variance for the PA and NP of the Tifton 85 grass as a function of the doses of sheep manure in the cut carried out 122 days after planting (Table 8). According to the results obtained, there were no significant differences in the PA and NP of the Tifton 85 grass plants with the doses of sheep manure applied to the soil. Average values were 41.40 cm AP and 30.55 cm NP (Table 8). The growth of forage plants is directly related to the availability of N in the soil, and it is important to manage organic fertilization correctly, such as the amount to be applied to the soil and the form of application, in order to increase the efficiency of the plant's growth rate, restoring the leaf area and increasing the production of biomass with nutritional quality. In addition, other factors that influence the growth and production capacity of pastures, such as the morphophysiological mechanisms of plants and soil and climate conditions, are also important to take into consideration.

FV GL		Mean square			
		PMV	PMS	MV Product	Prod.MS
Doses of manure	4	282.950000	35.800000	0.452720	0.057280
Block	3	127.650000	13.400000	0.204240	0.021440
Error	12	58.816667	9.566667	0.094107	0.015307
Total	19				
CV (%)		26,31	21,63	26,31	21,63

Doses of manure (t ha^{-1})	PMV (g)	PMS (g)	Prod.MV (tha^{-1})	Prod.MS (tha^{-1})
0	18,50	11,50	0,74	0,46
4,222	23,75	12,00	0,95	0,48
8,447	31,00	17,00	1,24	0,68
12,670	32,00	13,00	1,28	0,52
16,894	40,50	18,00	1,62	0,72
Average	29,15	14,30	1,16	0,57

Table 7. Green mass production (PMV), dry mass production (PMS), green mass productivity (Prod.MS tha^{-1}) dry mass productivity ha^{-1} (Prod.MS tha^{-1}) of Tifton 85 grass plants subjected to different doses of irrigated sheep manure at 92 days.

Although the doses of goat manure applied to the soil did not increase the height of the Tifton grass plants at 122 days after planting, it is very worthwhile comparing the PA values obtained in this experiment with those obtained by QUARESMA et al. (2011) who, when evaluating the height of Tifton 85 grass subjected to different doses of nitrogen, despite observing a linear increase in plant height, estimated values ranging from 36.85 to 49.40 cm, for the doses of 0 and 240 kg ha^{-1} of N, applied to the soil via urea, during the four cuts with an interval of 30 days, there being no difference with the average height obtained in this work.

SOUSA (2017), when evaluating the height of Tifton 85 grass plants grown in pots with soil from a depth of 20 cm in a Typical Orthic Chromic Luvissolo fertilized with poultry litter used as a source of N, in the cut carried out 140 days after planting, also observed no significant effect with the doses of N evaluated on plant heights, obtaining an average height of 19.23 cm with the dose of 60 kg of N ha.

ROCHA et al. 2021 evaluated the effects of fertilizing with cattle manure on the tillering and plant biomass of vetiver grass in a Cambissolo háplico at 15, 30 and 45 days after fertilizing with cattle manure, for all cutting heights, and found no differences (95% CI) between the effects of the 5.4 and 10.8 t ha^{-1} doses of cattle manure on the number of tillers per vetiver plant. However, on average, for plants cut at a height of 10 cm, at 15 to 45 days after fertilization, there were increases of 9.1 and 5.2 tillers per plant, respectively, for the 5.4 and 10.8 t ha^{-1} doses. Fertilizing with the experimental doses did not affect the tillering of vetiver grass plants. However, the authors found that the 5.4 t ha^{-1} dose performed better than the 10.8 t ha^{-1} dose over the course of the evaluations. The initial effects of the experimental doses of manure resulted in an unfavorable effect, and it was observed that the plants, although constantly developing, were still unable to fully re-establish themselves in the experimental area. The explanation for the fact that the doses of cattle manure (5.4 and 10.8 t ha^{-1}) applied to the vetiver grass did not differ (CI=95%) for the variables analyzed is partly explained by the results of the soil analysis, which showed available phosphorus (above 30 mg $dm^{(-3)}$)) and potassium (above 135 mg $dm^{(-3)}$)) levels, adequate calcium and magnesium levels, and low aluminum levels (ROCHA et al. 2021). These results corroborate those obtained in this experiment.

EDVAN et al. (2010), when evaluating organic fertilization with bovine manure and bovine rumen digestate in buffel grass pasture on soil at the Experimental Station of the National Semi-Arid Institute, Campina Grande PB, observed that there was a statistical difference for tillering at the different cutting times, where the highest number of tillers was observed in the third cut. The authors observed the highest number of basal and aerial tillers (139 NP) per cut at the highest dose of digestate (13 tha$^{-1)}$. For cattle manure, the highest number of tillers (107 NP) was obtained with the highest dose of cattle manure (11 tha$^{-1)}$. The authors' explanation comes from the high amount of available phosphorus present in rumen digesta (2%), since this nutrient makes up the ATP molecule, a source of energy for tissue formation, which participates directly in the structuring of DNA, acting in the structuring of plant tissue. Therefore, the high phosphorus content found in the digesta stimulated tillering.

The analysis of variance for PMV, PMS, prod MV and prod MS of Tifton 85 grass as a function of the doses of sheep manure in the third cut at 122 days after the uniformization cut is shown in (Table 9).

Table 9 shows the summaries of the analysis of variance and the average values for the green mass production of Tifton 85 grass in response to the application of different doses of nitrogen and the cutting frequency of Tifton 85 grass. According to the results obtained for PMV and PMV, MV productivity and DM productivity of Tifton 85 grass, there was also no significant effect of the doses of goat manure applied to the soil. The average MV and DM yields tended to be 15.88 tha^{-1} and 7.32 tha^{-1} respectively. Thus, after 122 days of application, sheep manure does not promote greater productivity of Tifton 85 grass (Table 9). As nitrogen is the nutrient that most increases pasture dry matter production, the inorganic nitrogen found in the soil and made available with the doses of sheep manure applied to the soil was not enough for the plant to express its full productive potential during the cycle evaluated. These results are important for research to be carried out in order to study the correct management of fertilization, with the aim of increasing the productivity of Tifton 85 grass fertilized with organic fertilizers.

SOUSA (2017), when evaluating the green mass production and dry mass production of Tifton 85 grass plants grown in pots with soil from the 20 cm depth of a Typical Oritic Chromic Luvissolo fertilized with poultry litter used as an N source, in the first cut carried out 140 days after planting, there was also no significant effect of the doses of N evaluated on the production of green mass and dry mass, the averages of which were 32.08 g and 11.91 g pot^{-1} respectively with the dose of 60 kg of N ha.

ALVIM et al. (1999), when conducting experiments at Embrapa-National Dairy Cattle Research Center in Juiz de Fora, MG, evaluated doses of zero, 100, 200, 400 and 600 kg ha^{-1} of N, when growing Tifton 85 grass on lowland soil, at three cutting intervals: two, four and six weeks during the rainy season, and four, six and eight weeks in the dry season, except for the zero dose of N, they observed that the other doses evaluated increased the dry matter produced per kg of N applied to the soil up to the cutting interval of four weeks in the rainy season and six weeks in the dry season. The authors observed that at all the cutting intervals evaluated, the efficiency of N application was higher at doses of 100 and 200 kg ha^{-1} year^{-1} and lower at the other doses. As a result, the most efficient management for Tifton 85 grass (43 kg of dry matter per kg of N applied) was observed in the cutting interval of four weeks in the rainy season and six weeks in the dry season, with the application of 100 kg ha^{-1} year$^{(-1)}$ of N, while the least efficient (18.5 kg of dry matter per kg of N applied) corresponded to the shortest cutting interval and the application of 600 kg ha^{-1} year$^{(-1)}$ of N.

		Mean Square	
Source of Variation	GL	AP	NP
Doses of manure	4	16.262500	33.300000
Block	3	8.366667	87.916667
Error	12	153.845833	42.000000
Total	19		
CV (%)		29,96	21,21
	Averages of dependent variables		
Sheep manure doses (t ha^{-1})	AP (cm)	NP	
0	38,87	30,75	
4,222	40,62	30,25	
8,447	41,12	27,75	
12,670	42,00	35,25	
16,894	44,37	28,75	
Average	41,40	30,55	

Table 8. Summary of the analysis of variance for plant height (PH) and number of tillers (NP) of Tifton 85 grass plants fertilized with doses of sheep manure at 122 days.

FV GL		Mean square			
		PMV	PMS	MV Product	Prod.MS
Doses of manure	4	233.925000	27.075000	37.428000	4.908000
Block	3	35.800000	8.933333	5.728000	1.674667
Error	12	122.258333	17.641667	19.561333	2.961333
Total	19				
CV (%)		27,85	22,83	27,85	23,51

Doses of manure (t ha^{-1})	PMV (g)	PMS (g)	Prod.MV (tha^{-1})	Prod.MS (tha^{-1})
0	34,00	15,00	13,60	5,80
4,222	35,50	19,50	14,20	7,80
8,447	37,25	17,25	14,90	6,90
12,670	53,00	22,00	21,20	8,80
16,894	38,75	18,25	15,50	7,30
Average	39,70	18,40	15,88	7,32

Table 9. Green mass production (PMV), dry mass production (PMS), green mass productivity (Prod.MS tha^{-1}) dry mass productivity ha^{-1} (Prod.MS tha^{-1}) of Tifton 85 grass plants subjected to different doses of irrigated sheep manure at 122 days.

EDVAN et al. (2010), when evaluating organic fertilization with bovine manure and bovine rumen digesta in buffel grass pasture on soil at the Experimental Station of the National Semi-Arid Institute, Campina Grande, PB, observed that there was a statistical difference in VMP and SMP, the highest production of which was obtained with chemical fertilization in relation to the production obtained from plants grown in unfertilized soil. However, there was no statistical difference between the VMP and SMP obtained with chemical fertilization (7.8 tha^{-1} and 1.7 tha$^{(-1)}$)), respectively, and the VMP and SMP obtained with the highest dose of bovine rumen digesta (7.7 tha$^{(-1)}$ and 1.8 tha^{-1}) and the highest dose of bovine manure (7.7 tha$^{(-1)}$ and 1.8 tha$^{(-1)}$)) during 123 days of the experiment. For EDVAN et al. (2010), the higher dry matter production with the different types and dosages of fertilizers, especially with the organic fertilizers bovine rumen digesta and bovine manure at the highest dosages when compared to the treatment without fertilization, is explained in the case of digesta, due to the high number of tillers obtained, favoring an increase in dry matter production.

With regard to manure, the high dry matter production was due to the minerals found in its chemical composition. The higher dry matter yields in the organic fertilizer treatments may have been due to the longer contact time with the nutrients found in the fertilizer, or even to the amount of nutrients available, given that both fertilizers were composed of high amounts of nitrogen and phosphorus. In the case of chemical fertilizer, the effect seems to have been more immediate, considering its availability (EDVAN et al., 2010). However, considering the entire experimental period, the residual effects of organic fertilizers may have ensured a greater supply of nutrients to the plants, thus resulting in a greater accumulation of dry matter. DIM et al. (2010), when evaluating different doses (0, 60, 120 and 180 t ha- [1]) of solid waste from cattle slaughterhouses as an organic fertilizer in the cultivation of Mombasa grass, observed an increase in DM production, the number of tillers and plant height of Mombasa grass.

Comparing the yield data from this experiment with the results obtained from some experiments with nitrogen fertilization via urea, we can see the production potential of this forage in this experiment under these soil and climate conditions and under irrigation. This is explained by the light intensity which favors the development of the Tifton 85 cultivar, revealing the great potential of this forage in tropical conditions. Also noteworthy is the high fertility of the soil in the experimental area, showing high levels of organic matter and availability of phosphorus, potassium, calcium and magnesium.

CONCLUSIONS

The doses of sheep manure did not increase the plant height, number of tillers or productivity of the Ttifton 85 grass in the first 30 days.

Fertilizing with sheep manure led to higher green mass productivity of Tifton 85 grass in the second cut at 62 days.

At 92 days, there was no significant effect of sheep manure doses on PA and NP, but there were linear responses of MV and DM yields to sheep manure doses.

At 122, there were no significant differences in the PA and NP or in the MV and DM yields of the Tifton 85 grass plants with the doses of sheep manure applied to the soil.

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