

Pasture Height of A Tropical Erect Grass Affecting Young Lamb Herbage Intake And Performance

Lívia Raymundo Irigoyen

Universidade Federal do Rio Grande do Sul (UFRGS)

Cesar Henrique Espírito Candal Poli (✉ cesar.poli@ufrgs.br)

Universidade Federal do Rio Grande do Sul (UFRGS) <https://orcid.org/0000-0002-8469-0779>

Gladis Ferreira Corrêa

Universidade Federal do Pampa (UNIPAMPA)

Jalise Fabíola Tontini

Universidade Federal do Rio Grande do Sul (UFRGS)

Ignacio Fernando López

Massey University

Joseane Anjos da Silva

Universidade Federal do Rio Grande do Sul (UFRGS)

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Abstract

Tropical erect grass pastures have high forage production potential in subtropical and tropical regions of the world. However, in this kind of pasture, the body weight gain of weaned lambs is usually below of their potential. We determined the effect of pasture height of an erect tropical grass, consequently its structure, on intake and performance of young lambs. The experiment was repeated in two years. Thirty young weaned lambs (4-5 months) were assigned, each year, to three *Panicum maximum* pasture heights: 1) Tall-75 cm; 2) Medium-50 cm and 3) Short-25 cm. Herbage mass, pasture height, plant morphological composition, pasture nutritional quality, lamb's average daily gain, gain per hectare and herbage intake were measured. The experiment was installed in a completely randomized design, evaluated in two periods each year. The Short treatment presented, on average and for longer, the highest leaf:stem ratio (1.3 ± 0.23) and average daily gain (91 ± 10 g/day) in relation to the Medium and Tall treatments (68 ± 10 and 40 ± 13 g, respectively). There was a significant interaction between treatment*period for herbage intake. The Tall treatment showed a marked decrease in intake from the first to the second period. The pasture height management interferes in the speed at which the number of stems increases of a tropical erect grass, in relation to leaves. For a better performance of weaned young lambs during summer-autumn period, it is important to manage tropical erect grass pastures at lower height than is generally recommended, lower than 25 cm.

1. Introduction

The use of tropical pasture species with high forage production has a great potential to increase meat production in subtropical and tropical regions (Emerenciano Neto et al., 2014; 2018). Sheep production on pasture can be an important alternative for farmers in this region due to the low costs and the high growth rate of pastures and lambs (Barros et al., 2009; Poli et al., 2013). However, there is a lack of knowledge of how to manage young weaned lambs on erect C4 grasses. Poli et al. (2008) commented that tropical pastures may limit the intake of lambs due to the difficulty in handling the pasture structure. Westwood (2011) explains that in fact the pasture height and density of tropical pasture species have important effect on sheep intake, greatly affected by the proportion of green leaf:stem mass present. This occurs because tropical swards, unlike many temperate ones, have large vertical heterogeneity in density, plant-part proportion and nutritive value (Sollenberger and Burns, 2001). Therefore, the way the green leaf is offered to lambs is highly important to generate a win-win system, making the best of the high growth rate of young animals and erect C4 grasses.

There is no clear threshold of leaf:stem ratio to maximize sheep performance on tropical pasture. However, Carvalho (2013) explains that when a domestic herbivores reaches a threshold of 40% of the proportion of leaf lamina in *Sorghum bicolor* (Fonseca et al., 2012) and *Cynodon* sp. (Mezzalira, 2012) pastures, there is a clear reduction on animal intake rate. These studies provide relevant information that increasing the proportion of leaves and reducing the proportion of stems are very important for grazing animals on tropical pasture.

The low quality, due to the high growth speed and the reduced leaf:stem ratio when a tropical grass reach the reproductive stage make farmers either to avoid the use this kind of sward with lambs, or to increase their costs supplementing the animals with concentrate. The supplementation can also be deleterious to the pasture physical characteristics, mainly reducing the leaf:stem ratio (Fajardo et al., 2015). According to Simioni et al. (2014), the barriers of animal production based on the use of tropical forage plants can be reduced through management practices that increase the production and the efficiency of pasture use.

It is important not only maximize pasture production, but also to adjust the pasture management according to the type of animal. Poli et al. (2008), for example, observed that young lambs did not have a satisfactory growth when grazing Italian ryegrass in a recommended pasture height. For the erect tropical pasture formed by guinea grass (*Panicum maximum* cv. IZ-5), Zanini, Santos and Sbrissia (2012) recommend to maintain a pasture height of 30 cm in order to maximize the leaf light interception and plant growth. However, it may not be the best pasture height for young lambs due to its high stem growth during summer-autumn period as observed by Fajardo et al. (2015).

According to the animal demand and the pasture quality given by NRC (2007), it is expected an average daily gain from weaned young lambs grazing guinea grass of above 100 g/day. However, these results have not been observed in different research works done with lambs grazing this type of pasture. Fajardo et al. (2015) and Tontini et al. (2019b), for example, showed average daily gains (ADG) of weaned lambs on guinea grass of as low as 26 and 69 g/day, respectively. Therefore, we hypothesized that an erect tropical pasture managed with lambs at a lower height causes a great leaf availability, which enhance daily intake and result in productive improvement. The objective of this study was to evaluate the effect of guinea grass pasture structures, managed at different heights, on the performance of young weaned lambs.

2. Material And Methods

The experiment was carried out at the Agronomic Experimental Station, Universidade Federal do Rio Grande do Sul (UFRGS), located 46 m above sea level in southern Brazil (29°13'26" S, 53°40'45" W). The climate is subtropical humid 'cfa' according to the Köppen (1948) classification. This study was approved by the Ethics Committee on the Use of Animals of UFRGS (CEUA - project 27830).

The study was repeated in two consecutive years (2018 and 2019). The experimental area was 0.7 ha, subdivided into three paddocks of guinea grass (*Panicum maximum* cv. IZ-5) pasture. The animals were submitted to swards of different heights (treatments): 1) Tall - 75 cm; 2) Medium - 50 cm and 3) Short - 25 cm. In order to have a height differentiation between treatments, strategic mowing at 5 cm of residual height was conducted before the beginning of the experiment. The paddocks were mowed 7, 14 and 28 days before the beginning of the experiment for the treatments Short, Medium and Tall, respectively. The animals were submitted to a continuous grazing method and the stocking rate was adjusted every 28 days using the 'put and take' technique (Mott and Lucas, 1952). In each year, the experiment consisted of two subsequent periods: a) Period 1 represented the initial stand offered to the animals in summer (from

late January to February); b) Period 2 represented pasture closer to the end of the cycle, late summer-early autumn (from late February to April). Each period lasted 28 days.

The experiment was set out in a completely randomized design, in which the effect of each year was considered random. The experimental unit was the animal. Each year, 30 contemporary weaned and castrated lambs (10 per paddock), 4-5 months of age, were used as testers. These weighed initially an average of 15.9 ± 0.52 kg in year 1, and 26.7 ± 0.45 kg in year 2. In order to keep the sward heights, five put-and-take lambs were used in the first year and eight in the second year.

Groups of 10 tester lambs in each treatment were randomly distributed ensuring that the initial weight were uniform among treatments.

2.1 Pasture assessments

The different pasture structures were characterized by weekly measurements of the sward height. Fifty-two points, using random sampling, per paddock were measured, using a sward stick (Barthram, 1985), measuring the highest point of the leaf from the ground. The actual average heights along the experimental periods are shown in Table 1.

Table 1

Average height (mean \pm standard error of the mean, cm) of guinea grass pasture, grazed by young weaned lambs, over the different subsequent experimental periods (year 1 - 2018 and year 2 - 2019)

Year of study	Period	Treatments			P value
		Tall	Medium	Short	
1	1	74.3 \pm 2.12	32.1 \pm 3.86	20.2 \pm 3.61	0.0001
	2	70.5 \pm 1.73	49.2 \pm 2.52	22.9 \pm 1.48	
2	1	84.5 \pm 2.55	57.3 \pm 3.16	27.4 \pm 3.10	
	2	64.6 \pm 5.09	52.9 \pm 7.88	27.7 \pm 4.51	
	Means ^a	73.5 \pm 1.28 a	47.9 \pm 1.45 b	24.6 \pm 0.56 c	
^a Numbers followed by different letters differ between treatments according to Bonferroni test (Dunn) ($P < .05$).					

The herbage mass and botanical composition were assessed three times in each period: in the first day, one week after the beginning, and in the last day of each 28-day period. At the beginning and at the end of each period, six samples were taken: three samples with the average pasture height of the paddock and three random samples. One week after the first day of each period, six more random samples for forage mass and botanical composition were randomly taken, summing eighteen sampling points cut to a ground level, in a 0.25-m² square in each period. The samples were collected and weighed on a 0.1-g precision scale. The samples were individually homogenized and two sub-samples were taken, one was

used to determine the percentage of dry matter (DM), and the other was used to performed the botanical separation in leaf blade, stem + sheath, and senescence material. The samples were placed in a forced air oven, to determine the DM percentage, at an average temperature of 60 °C until constant weight, and weighed on a 0.1-g precision scale.

2.2 Nutritional quality of forage

Samples were collected by grazing simulation technique, following the procedure described by Euclides, Macedo and Oliveira (1992), every 14 days, to evaluate the forage nutritional composition. This technique is based on collecting representative samples of the herbage eaten by the lambs. A trained person follows and observes the animals during a grazing period, collecting “parts” of the pasture similar to what was consumed by them. Subsequently, chemical analyzes of forage samples were carried out to estimate the content of dry matter (DM), crude protein (CP), ethereal extract (EE) according to the AOAC methodology (1995), apparent *in vitro* digestibility of organic matter (IVDOM) according to Tilley and Terry (1963), neutral detergent fiber (NDF) according to Van Soest, Robertson and Lewis (1991), acid detergent fiber (ADF) and acid detergent lignin (ADL) according to Goering and Van Soest (1970), neutral-detergent insoluble nitrogen (NDIN) and acid-detergent insoluble nitrogen (ADIN) according to the methodology described by Licitra, Hernandez and Van Soest (1996) (Table 7).

Table 7

Nutritional quality of forage (means \pm standard error of the mean, % DM) of different guinea grass (*Panicum maximum*, cv. IZ-5) pasture heights (Tall - 75 cm, Medium - 50 cm, Short - 25 cm) grazed by young weaned lambs, averages of the two evaluation years (2018-2019)

Variables ^a	Treatments			P Value
	Tall	Medium	Short	
ASH	9.9 \pm 0.17	11.9 \pm 0.20	10.8 \pm 0.13	0.1320
NDF	66.6 \pm 0.98	70.0 \pm 0.75	65.6 \pm 0.38	0.4893
ADF	35.8 \pm 0.35	36.7 \pm 0.26	35.2 \pm 0.59	0.7464
CP	15.9 \pm 0.44	17.3 \pm 0.40	18.0 \pm 0.24	0.5743
EE	2.2 \pm 0.03 b	2.6 \pm 0.03 ab	2.7 \pm 0.02 a	0.0435
NDIN	1.7 \pm 0.09	2.0 \pm 0.06	2.3 \pm 0.06	0.3273
ADIN	0.3 \pm 0.01	0.3 \pm 0.01	0.3 \pm 0.01	0.9700
ADL	3.8 \pm 0.12	4.7 \pm 0.02	4.0 \pm 0.09	0.1753
IVDOM	63.1 \pm 1.48	62.3 \pm 1.80	63.6 \pm 1.33	0.8087

^aASH: mineral matter; NDF: Neutral detergent fiber; ADF: Acid detergent fiber; CP: crude protein; EE: ethereal extract; NDIN: neutral-detergent indigestible nitrogen; ADIN: acid-detergent indigestible nitrogen; ADL: acid detergent lignin; IVDOM: *in vitro* digestibility of organic matter.

2.3 Animal Assessments

Animal weighing was performed three times every year, at the beginning and at the end of each period of 28 days. The animals were weighed with a 12-hour fasting of solids and liquids. The weight difference of each tester animal between two successive weighs was divided by the number of days to calculate the average daily gain (ADG, kg/lamb.day) in each period. The weight gain per hectare of each period was obtained by multiplying the ADG of the testers of each treatment by the total number of animals in the paddock (testers + put-and-take) and the number of days, divided by the area. At weighing, body condition score was evaluated, using the technique described by Thompson and Meyer (1994), with scores ranging from one (very thin animal) to five (very fat animal).

At the beginning of the experiment, all the animals were dosed with anthelmintic (Zolvix®, monepantel active ingredient - 2.5 mg/kg body weight) in order to minimize the burden of gastrointestinal parasites. During the experiment, the parasitic infection was accompanied by the FAMACHA method (Malan and Van Wyk, 1992) every 14 days. This method assesses the degree of anemia through the evaluation of the ocular mucosa color. The counting of eggs per gram of feces (EPG) was also performed every 28 days using the technique described by Gordon and Whitlock (1939). The animals that presented anemia grade 4 or 5, according to the FAMACHA method, and EPG above 800 were drenched with anthelmintic Albendazole (0.38 mg/kg body weight).

The daily herbage intake of the animals was measured using the total feces collection technique (Penning, 2004). Such evaluation took place in the third week of periods 1 and 2, in both years. Total feces were collected for five consecutive days, using collection bags on five animals per treatment. Feces were removed from the bags twice a day, in the morning and afternoon. After removing and weighing the feces, a 60 g sample was taken, per animal, and deposited in aluminum containers, identified and dried in an oven at 60°C until constant weight to obtain the dry matter content.

The daily intake of the animals was estimated using the following formula:

Intake (g/day) = Fecal production (g/day) / (1 - Digestibility)

2.4 Statistical analysis

The data were subjected to analysis of variance (ANOVA) to determine the effects of treatments on the pasture and on the animal variables by repeated measures over time, using Proc Mixed of SAS version 9.4 (SAS Institute Inc., Cary, NC, USA). The means were compared by Tukey test at 5% probability using LSMEANS adjusted mean (\pm standard error of the mean). Pearson correlations were also calculated.

The ANOVA model included treatments and period, as a repeated measure, and the treatment x period interaction as a fixed effect. The year effect was considered a random effect.

The leaf:stem ratio, leaf/ha, stem/ha, mineral matter/ha and pasture accumulation rate were not normal (Shapiro-Wilk; $P \leq 0.05$) and they were transformed by square root (leaf/ha and stem/ha) and logarithmically (Leaf:stem ratio, inflor/ha and MM/ha). The results are presented as LSMEANS adjusted means.

The variables accumulation rate, body condition score (BCS) and FAMACHA degree were not susceptible to transformation, being analyzed using the nonparametric Nparway Procedure test. In this case, the Bonferroni test (Dunn) was used to compare the means.

3. Results

The different pasture heights, as well as, the evaluation periods provided differences in the animal performance ($P = 0.0024$ and $P = 0.0007$, respectively - Table 2). The animals of the Short treatment showed higher weight gains than the animals of the Tall treatment. When the values were analyzed by experimental period, independent of the treatment, it was possible to observe that in the first period, the animals showed greater average daily gain. However, there is a 0.1 probability of a significant interaction between Treatment and Period. This difference reflects the variations that occurred in the Tall treatment that had the greatest reduction of ADG from period 1 to period 2.

Table 2

Average daily gain (mean \pm standard error of the mean, g/day) of young weaned lambs at different pasture heights (Tall = 75 cm; Medium = 50 cm; Short = 25 cm) of guinea grass (*Panicum maximum* cv.IZ-5) and at subsequent periods (middle and end of plant cycle), averages of the two evaluation years (2018-2019)

Period	Treatment			Means	P value		
	Tall	Medium	Short		Treat.	Per.	Treat*Per
1	72 \pm 16	97 \pm 12	94 \pm 13	88 \pm 0.008	0.0024	0.0007	0.1078
2	8 \pm 18	40 \pm 14	89 \pm 14	44 \pm 0.010			
Means ^a	40 \pm 13 b	68 \pm 10 ab	91 \pm 10 a				

^a Numbers followed by different letters differ ($P \leq .05$) statistically using Tukey test.

The results of animal weight gain per hectare (WGH) showed a significant interaction between treatment and period effects ($P < 0.0001$, Table 3). The Medium treatment in the first period showed the greatest WGH. This gain was similar to the Short treatment in the second period. The lowest gain per area was recorded from the animals of the Tall treatment in the second period.

Table 3

Weight gain per hectare (kg/ha \pm standard error of the mean), during 28 days-period, of young weaned lambs at different heights (Tall = 75 cm; Medium = 50 cm; Short = 25 cm) of guinea grass pasture (*Panicum maximum* cv. IZ -5) and at two subsequent periods (Per; middle and end of plant cycle), averages of the two evaluation years (2018-2019)

Per	Treatment			Pvalue ^a		
	Tall	Medium	Short	Treat	Per.	Treat* Per
1	106.8 \pm 16.63 c	160.9 \pm 23.85 a	128.5 \pm 3.74 bc	<.0001	<.0001	<.0001
2	47.6 \pm 5.73 d	134.0 \pm 13.63 b	148.2 \pm 17.81 ab			

^a Numbers followed by different low case letters differ ($P \leq .05$) statistically using Tukey test.

In addition to the higher ADG of the animals in the Short treatment, these animals had a higher BCS at the end of the experiment, as well as, a probability of $P= 0.08$ to have the lowest degree of anemia with a mean FAMACHA of 2.6 (Table 4). Throughout the experiment, in the first year, the number of treated animals with anthelmintic was lower in the Short treatment. In total, 8, 14 and 13 animals were dosed in the Short, Medium and Tall treatments, respectively. In the second year, there was no need to treat animals with anthelmintic.

Table 4

Averages of degree of anemia (FAMACHA \pm standard error of the mean) and body condition score (BCS \pm standard error of the mean) of young weaned lambs submitted to different pasture heights (Tall = 75 cm; Medium = 50 cm; Short = 25 cm) of guinea grass (*Panicum maximum* cv. IZ-5), averages of the two evaluation years (2018-2019)

Variable	Treatment			PValue ^a
	Tall	Medium	Short	
FAMACHA	3.0 \pm 0.10	2.8 \pm 0.11	2.6 \pm 0.12	0.0782
BCS	1.9 \pm 0.08 b	2.0 \pm 0.07 ab	2.2 \pm 0.08 a	0.0231

^a Numbers followed by different letters differ ($P \leq .05$) statistically using Bonferroni test (Dunn).

For the daily herbage intake (Table 5), there was a significant interaction between the treatment and period effects ($P= 0.0453$). The interaction showed a significant difference within the Tall treatment, such that the animal intake during the first period was significantly greater than that one in the second period.

Table 5

Daily herbage intake (mean \pm standard error of mean; % live weight) of young weaned lambs at different heights (Tall = 75 cm; Medium = 50 cm; Short = 25 cm) of guinea grass (*Panicum maximum* cv. IZ- 5) pastures and at two subsequent periods (Per; middle and end of plant cycle), averages of the two evaluation years (2018-2019)

Per	Treatment			P Value ^a		
	Tall	Medium	Short	Treat	Per	Treat*Per
1	2.9 \pm 0.11 a	2.3 \pm 0.06 ab	2.4 \pm 0.07 ab	0.5770	0.0159	0.0453
2	1.9 \pm 0.03 b	2.4 \pm 0.03 ab	2.1 \pm 0.05 ab			

^a Numbers followed by different letters differ ($P \leq .05$) statistically using Tukey test.

The productivity characteristics of guinea grass pasture with three different sward heights during the experimental period are shown in Table 6. The Tall treatment showed the highest ($P < 0.0001$) herbage mass compared to other treatments. This high production is a reflection of the greater presence of stems ($P < 0.0001$). The Tall sward had 84% and 191% higher stem mass compared to Medium and Short treatments, respectively.

Table 6

Productive characteristics (means of dry matter \pm standard error of the mean) of guinea grass (*Panicum maximum*, cv. IZ-5) pasture grazed by young weaned lambs, managed at different heights (Tall - 75 cm, Medium - 50 cm, Short - 25 cm) and at two subsequent periods (Per; middle and end of plant cycle), averages of the two evaluation years (2018-2019)

Variables ^a	Per	Treatment			Means Per	<i>P Value</i> ^b		
		Tall	Medium	Short		Treat	Per	Treat*per
Herbage Mass	1	4167 \pm 111	2681 \pm 130	1639 \pm 37	2864 \pm 149			
	2	5513 \pm 143	3820 \pm 85	2919 \pm 205	4117 \pm 153	< .0001	0.0008	0.8127
	Means	4840 \pm 144 a	3251 \pm 117 b	2288 \pm 120 b				
L:S ratio	1	1.5 \pm 0.31	1.5 \pm 0.02	3.8 \pm 0.30	2.1 \pm 0.17 A			
	2	0.3 \pm 0.08	1.4 \pm 0.19	1.5 \pm 0.17	1.1 \pm 0.11 B	0.0211	< .0001	0.2326
	Means	0.9 \pm 0.11 b	1.4 \pm 0.09 ab	2.6 \pm 0.27 a				
Leaf	1	1455 \pm 24 a	1143 \pm 66 ab	806 \pm 26 b	1147 \pm 44			
	2	1016 \pm 15 ab	1553 \pm 120 a	1223 \pm 23 ab	1282 \pm 55	0.1386	0.4977	0.0293
	Means	1235 \pm 40	1348 \pm 75	1014 \pm 41				
Stem	1	1964 \pm 72	1080 \pm 93	564 \pm 39	1219 \pm 88 B			
	2	3685 \pm 191	1992 \pm 24	1378 \pm 88	2367 \pm 145 A	< .0001	< .0001	0.5934
	Means	2824 \pm 177 a	1536 \pm 85.69 b	971 \pm 87 b				
SM	1	323 \pm 12	305 \pm 29	168 \pm 7	271 \pm 14.78			
	2	517 \pm 8	167 \pm 10	284 \pm 11.05	316 \pm 20.93	0.3811	0.1765	0.0924
	Means	420 \pm 18	236 \pm 18	225 \pm 12				

^a Herbage Mass (kg/ha); L:S ratio: leaf:stem ratio; Leaf (kg/ha); Stem (kg/ha); SM: senescent matter (kg/ha). ^b Numbers followed by different letters differ ($P \leq .05$) statistically using Tukey test.

There was a significant difference between treatments for leaf:stem ratio of the pasture (Table 6). The Short pasture had higher ($P = 0.0211$) leaf:stem ratio than the Tall, and the Medium pasture showed an intermediate level. The leaf:stem ratio decreased over the experimental period ($P < 0.0001$). The leaf mass increased from the first to the second period in the Medium and Short treatments, but the plant's maturity led to a greater ($P < 0.0001$) stem mass in the second period for all treatments. Although initially there was a greater amount of leaf mass per area in the Tall than in the Short treatment, this amount was similar in the second period. However, there was a greater increase of stem in the Tall treatment, which made this treatment to have, on average, a smaller leaf:stem ratio.

The correlation analysis showed a significant correlation between the dry matter intake of the animals and the leaf:stem ratio ($r = 0.54309$, $P < 0.0001$).

Despite the pasture structural differences among treatments, no significant differences were observed for the most nutritional compounds. Ethereal extract was the only one that was higher in the Short than in the Tall treatment (Table 7). There was a significant positive correlation between the forage protein concentration and the ADG ($r = 0.47173$, $P < 0.0001$).

4. Discussion

The results of this study showed the relevance of the physical structure of erect tropical grasslands on the performance of young weaned lambs, which was highlighted since there were no significant differences for the nutritional forage quality between pastures, but on the contrary for the ADG and WGH. The guinea grass pasture with an average height of 25 cm allowed the greatest ADG and WGH. In other words, the Short treatment provided the animals greater availability of leaves in relation to the amount of stems in the pasture. The pasture structure of Short treatment might have facilitated the animal selection and intake of leaves as described by Carvalho (2013), and, thus, positively influenced the ADG of these animals.

The growth cycle of perennial tropical grasses, such as guinea grass, comprises different stages of development. The speed that the plant increases the number of stems is highly dependent on the pasture grazing management (Fajardo et al., 2015). In this study, it is possible to observe that the evaluation periods had important influence on the productive characteristics of the pasture and on the dry matter intake of the animals. All treatments showed greater leaf:stem ratio in the first period. With the advancement of the experimental period, those pastures with greater height allowed a rapid appearance of stems, characterizing the reproductive stage of the plants. During the reproductive stage, the plant reduces the energy invested on the appearance of new leaves and increases the amount of stems (Simioni et al., 2014). At that time, there is an increase in senescent material. Fajardo et al. (2015), in a similar climate condition and pasture species of this study, found at the end of summer-beginning of autumn a reduction of around 50% in the leaf:stem ratio, characterizing the beginning of the pasture reproductive period. This plant physiological change was observed mainly in the Tall treatment from the first to the second period.

The Short treatment, on average, showed the highest leaf:stem ratio when compared to the other treatments. This result is a reflection of the lowest stem production and the greatest appearance of new leaves from period 1 to period 2. The continuous emission of leaves and tillers are important processes for the restoration of the leaf area after grazing (Santos et al., 2006; Simioni et al., 2014). These results demonstrated the maintenance of greater weight gain of the animals over time in the treatment of 25 cm. The treatments with higher pasture height and greater amount of stem, Tall and Medium, showed satisfactory gains only in the first period. In the second period, these animals obtained lower gains than the Short treatment.

The result of lamb performance disagrees with the pasture management recommendation for higher herbage mass accumulation. Zanini et al. (2012) found that 30 cm was the most appropriated pasture height to graze guinea grass (*Panicum maximum*, cv. IZ-5). This pasture height corresponded to 95% of light interception. This recommendation was also verified with *Panicum maximum*, cv. Mombaça (Carnevali et al., 2006). Sbrissia et al. (2017) explained that pasture management should aim to maximize the leaf area index, optimizing the assimilation of energy production and supply for plant growth. However, in the present study it was found that for the use of small and young animals, such as young weaned lambs, better results were obtained when the pasture height was lower (25 cm). At higher pasture height, lambs were not able to maintain the same amount of leaves over time and the pasture had a higher proportion of stems, especially at the end of the grass production cycle. Taller pastures favor greater competition between structural components in the capture of light, significantly increasing the amount of stems (Zanini et al., 2012). The pasture structural changes in the Tall treatment probably imposed increasing difficulties to the animal to encounter the preferred leaves to graze and the nutrient harvesting in each bite decreased (Carvalho, 2013). Lamb plant consumption was probably not fast enough to reduce the stem growth (Fajardo et al., 2015). The marked difference in plant structure can also be seen in this study by the reduction in the animals' weight gain over time.

The gastrointestinal infection assessments showed that there was some probability ($P=0.08$) for the Short treatment to present healthier animals, although this response is relatively small. This result contradicts what was found in other studies (Skinner and Todd 1980; Vlassoff, 1982; Pegoraro et al., 2008; Gazda et al., 2012). The difference between these studies and our results is that in temperate grasses the infective larvae of gastrointestinal parasites are close to the soil and the animals are more easily contaminated in low height pastures. The structure and climate of tropical pasture in a subtropical region, according to Tontini et al. (2015, 2019a); Santos, Silva and Amarante (2012) and Amaradasa, Lane and Manage (2010), allows a uniform distribution of the infectious larvae throughout the pasture height. This behavior of vertical migration of the larvae explains why sward heights greater than 25 cm, as the Medium and Tall treatments of this study, did not limit the animals' contact with the infecting larvae. Therefore, tall guinea grass pastures do not mean less animal contamination. On the other hand, adequate management can possibly reduce the effect of the parasitic infection by improving the animals' nutrition.

When assessing the daily intake of young lambs, there was an important intake reduction in Tall treatment from the first to the second period. The Tall treatment seems to have been greatly influenced by the morphological change of the pasture from period 1 to period 2. The increase of stems and the variation of the amount of leaves due to the management of tropical sward height has an important influence on the animals' intake. The period 1 allowed the animals to consume more DM compared to the second period. This result shows that the structure of the pasture can have a significant effect in reducing the herbage intake of lambs, emphasizing plant structure as a factor that determines lamb performance. Carvalho et al. (2001) identifies that the pasture structure has a strong influence on quantity and quality of forage consumption maximization, hence animal performance.

The significant correlation between dry matter intake and leaf:stem ratio indicates that leaf:stem ratio is one of the main characteristics of an erect tropical grass that determines herbage intake by young lambs. Cardoso et al. (2019) explains that the use of a tropical grass pasture with sheep at a low initial height (25 cm) reduces stem elongation, phyllochron and sheath length, and has a higher leaf:stem ratio than taller (35 and 45 cm) pastures. These authors mentioned that the use of 45 cm pasture height increases the percentage of stem and dead matter, causing less intake of leaves by the animals.

The alteration of herbage intake due to the pasture structure is a consequence, among other factors, of the process of choosing the feeding station (Stuth, 1991). In very high forage masses, sheep starts to choose areas with less biomass but of higher quality (Carvalho et al., 2001). According to Dumont et al. (2007), herbivores express adjustments to maintain the intake of a high-quality diet. Bremm et al. (2008) shows that sheep have the ability to select leaves and seek them, even when the availability is limited. However, the high selectivity characteristic of lambs, resulting in searching for more nutritious parts, may have required the animals to graze for longer and, consequently, greater energy expenditure (Carvalho et al., 2005) in the treatments with taller swards.

In the present study, the results of animal performance agree with the findings of other studies (Fajardo et al., 2015; Tontini et al., 2019b). The relatively good nutritional quality presented by guinea grass, with protein values above 17%, is not enough to guarantee good weight gains by the young weaned lambs. According to the lamb requirements given by NRC (2007), it could be expected an ADG above 100 g/day. The creation of grazing opportunities, through pasture height management, can allow grazing animals to consume quantity and quality of herbage material that effectively fulfills their nutritional requirements and strongly influences animals' performance and ensures good productive results.

Thus, pasture structure might be even more important for young animals. In addition to the nutritional quality, the way that herbage components are available for the animal, influences its grazing capacity, especially for lambs that have a small mouth area (Carvalho et al., 2001).

Therefore, it is relevant to determine the erect tropical pasture height for young lambs at the beginning of a grazing period. It is expected that by this management, the increase of the proportion of stems and senescent matter be reduced and a better animal performance be promoted over time. In the present study, pasture height strongly influenced the material offered, i.e. leaf and stem, and thus animal

performance, which was evident when period 1 with period 2 were compared. This shows that stem growth control under grazing lambs is challenging, especially when the forage mass is high. When the stem growth is not interrupted, it is observed that even at frequent grazing intervals, accumulation of lignified stems and dead parts of the plant occurs, (Pompeu et al., 2010). This low digestibility of the plant components is capable of impairing the consumption and use of the forage (Simioni et al., 2014).

The pasture heights of an erect tropical grass managed with young grazing lambs affect its structure, mainly leaf:stem ratio. An erect tropical pasture managed at a low height of 25 cm allows greater persistence of herbage intake and daily weight gain of young lambs from summer to autumn period in a subtropical region. Therefore, in order to obtain a better gain of young grazing lambs, there is a need to prepare and manage an erect tropical pasture as short as 25 cm in height.

Declarations

Authors Contributions

LRI, CHECP and JAS conceived and designed research. LRI and JAS conducted experiments. JFT, CHECP and LRI analyzed data and wrote the manuscript. CHECP, GFC, JFT, IFL and JAS have worked on corrections to the manuscript. All authors read and approved the manuscript.

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Statement of Animal Rights

This study was approved by the Ethics Committee on the Use of Animals of UFRGS (CEUA - project 27830).

Conflict of Interest Statement

The authors declare no conflict of interest.

Data Availability

All data generated or analyzed during this study are included in this published article.

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