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Full Length Research Paper

Pasture quality of *Panicum maximum* cv. Tanzania subjected to different rest periods for milk production

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The objective of this study was to evaluate the effect of two defoliation intervals on the morphological characteristics of the experimental group. Chemical composition characteristics of a Tanzania grass pasture (*Panicum maximum*) and the performance of crossbred cows on intermittent grazing were examined. The digestibility of the dry matter, the digestibility of the organic matter fibrous, the voluntary dry matter intake and the voluntary intake of the organic matter fibrous were also determined. Milk production of cows was obtained in two daily milks. The levels of fat, protein, lactose, liquid energy and total milk solids were also quantified. The treatments consisted of evaluations of two pasture management strategies: 95% interception of photosynthetically active radiation and pasture managed with 30 days of defoliation interval. The study thus revealed that management causes differences in the chemical composition of Tanzania grass, but does not allow individual productive increases. Management based on IL 95% leads to higher milk production per unit area.

Key words: Cattle dung, environmental sustainability, overcoming dormancy, rumen.

INTRODUCTION

A balanced, good quality diet is a basic condition for the success of dairy farming. Traditionally, national production focused on the use of pasture-based production systems, with little planning and application of technologies, which results in low productivity and higher costs.

Thus, the nutritive value of forages is considered one of the most important factors in the evaluation of pastures, since it is the first determinant of nutrients necessary to meet maintenance requirements, besides having a high correlation with animal production; this productive response is related to the consumption, digestibility and

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metabolism of dietary nutrients. From these factors, consumption and digestibility should be of importance, since 60 to 90% of the variation observed in the intake of digestible energy between animals and diets related to their differences.

However, the recommendations of the rotational management of pastures are misleading because in rotational stocking management, the duration of the interval of successive defoliation is the variable that determines the recovery of the leaf area index and, consequently, maximizes the forage mass production.

Forage production is a continuous process both in the plant (tissue flow) and in the population (considering the population density of tillers in the area); however, extremely dependent on factors limiting photosynthesis (eg temperature, luminosity, light quality), so that in intervals of time (although short) there would be accumulation of forage (Da Silva et al., 2015).

Usually, the defoliation interval is determined according to chronological criteria such as number of days. However, due to variations in plant growth rates and the seasonality of forage production, this criterion is not the best recommendation. This is probably due to the fact that during the lowering period of pastures managed under intermittent stocking there is accumulation of forage and it is linear and inversely associated with the proportion of the leaf area removed (Diavão et al., 2017).

It is believed that management proposals that respect the phenology and physiology of each cultivar could promote improvements in productivity indexes and perennial pasture. Moreover, defoliation can reduce leaf elongation due to damage caused in part of meristems. In this sense, the magnitude and rates of removal of these structures were determined by the management criteria, by the defoliation severity and the stocking density (Gastal and Lemaire, 2015).

Thus, this study aims to evaluate forage quality and milk yield and composition of crossbred Holstein x Zebu cows in pastures of *Panicum maximum* cv. Tanzania, using two treatments of defoliation with fixed post-grazing residue.

MATERIALS AND METHODS

Geographic location

The project was conducted at EMBRAPA Gado de Leite, in the Experimental field of Coronel Pacheco (CECP), municipality of Coronel Pacheco, in the *Zona da Mata* of the State of Minas Gerais, Brazil. The CECP is located at 21° 32` 38`` South latitude and at 43° 15` 10`` West longitude and the altitude is 451 m. The climate of the region, according to Köppen classification, is mesothermal (Cw), defined as being temperate rainy in the summer and with a dry winter between June and September.

The experimental area consisted of four hectares, having 11 pickets of approximately 909 m^2 each. The pasture was fertilized with 220 $kg.ha^{-1}.year^{-1}$ of N and K_2O and 55 $kg.ha^{-1}.year^{-1}$ of P_2O_5. The distribution of fertilization was made when the animals changed pickets during the grazing cycles, so that nutrients were supplied at all pickets when the pasture presented the same physiological age (one day after grazing or post-weighed according to the smallest cycles under IL95% treatment). Thus, about 3.7 $kg.picket^{-1}.cycle^{-1}$ of N and K_2O and 0.9 $kg.picket^{-1}.cycle^{-1}$ of P_2O_5 were supplied in the commercial formula 20:05:20.

Ten freshly bred cows (Holstein x Zebu) were used per treatment, which were composed of one pasture with three years of grazing and another three months before the beginning of the experiment.

The distribution of the cows per repetition occurred according to milk production, number of lactations, live weight and genetic group, so that the groups were homogeneous. Cows were supplemented with 2 $kg.day^{-1}$ of corn meal during the experimental period and a supply of minerals was given *ad libitum*. The nutritional value of the corn meal was 86.08% of dry matter (DM), 6.63% of crude protein (CP) and 9.77% of neutral detergent fiber (NDF). The cows milked daily, at 06:30 am and at 02:30 pm, without the presence of calves in mechanical milking, and the picket exchange, when scheduled, was performed after the milking of the morning.

The treatments consisted of evaluations of two management strategies in pastures of *P. maximum* cv. Tanzania: (1) IL95 entry of the animals in the pickets when pasture reached 95% light interception (IL) with three days of picket occupation and (2) FIXED pasture managed with 30 days of defoliation interval (ID) and three days occupancy of the picket. In the IL95 treatment, there were three extra pickets, aiming to adjust the IL in the different grazing cycles, since the ID could be shorter or longer than 30 days, depending on the IL.

However, depending on the climatic conditions, the ID observed in IL95 was always less than or equal to 30 days. The pastures, in the two treatments, before the beginning of data collection, managed picket picking to establish the heights of the post-grazing residue of 30 cm. This management consisted of mechanical roughing with costal trimmer, which allowed forming an age gradient of the plants in each picket. Thereafter, picket management in the IL95 treatment followed this criterion, while the FIXED treatment pickets were managed with 30 days of ID and three days of picket occupation, regardless of the 95% IL, of the forage mass and of the height of the residue, throughout the experimental period.

The interception of light by forage canopy was monitored in the pre-grazing condition and during the period from January to May every seven days; when the IL was near to the 95% target, the monitoring frequency changed totwo days. A variation of ± 2% was considered as criterion of entry of the animals in the pickets due to the little variation observed in the forage mass of the picket. For IL evaluations, a canopy analyzer was used - AccuPAR Linear PAR / LAI ceptometer, Model PAR-80 (Decagon Devices), with which readings were taken at 10 points of the picket Carnevalli et al. (2006).

The total forage biomass under pre-grazing condition was estimated using a metallic frame with an area equal to 1 m^2 at five points representing the average canopy height in each picket. The material contained in each square was cut at ground level (5 cm) and weighed.

The height of the canopy was determined in the pre and post-grazing periods, using a ruler graduated in centimeters, being measured 20 random points per picket.

To obtain representative samples of the diet (extrusa), two animals were used. They were fistulated in the esophagus, according to the technique described by Bishop et al. (1970). Extrusa samples were collected in all grazing cycles and submitted to pre-drying; the dry matter (DM), mineral matter (MM), crude fat (CF) and crude protein (CP) were quantified according to AOAC (1990); neutral detergent insoluble protein (NDIP), acid detergent insoluble protein (ADIP), lignin (LIG), and fibrous organic matter (FOM) were quantified according to Detmann (2012). Carbohydrates were divided into fractions: non-fibrous carbohydrates (NFC) and fibrous carbohydrates (FC), and were determined according to Sniffen et al. (1992).

For estimation of the voluntary intake and digestibility, the 20 Holstein x Zebu cows from the experiment were used. The fecal production was estimated using chromic oxide (Cr_2O_3) as an external indicator. Five grams of Cr_2O_3 were given orally in pellet form, to each animal, twice a day at intervals of approximately 12 h, during 12 days. From the

Table 1. Average yield of biomass (T of DM.ha^{-1}) and mean height (m) of Tanzania grass in pre-grazing condition.

Treatment	Cycle 1	Cycle 2	Cycle 3	Cycle 4	p-value (Cycle)
Average yield of biomass					
IL95	2.04^{b}	3.27^{ab}	4.99^{a}	2.84^{ab}	0.008
FIXED	3.02^{b}	4.55^{ab}	5.65^{a}	2.81^{ab}	0.006
P-value (Treatment)	0.328	0.214	0.506	0.975	CV%= 23.42
Mean Height					
IL95	0.97^{aA}	1.01^{aA}	1.02^{aB}	0.95^{aB}	0.075
FIXED	1.01^{bA}	0.99^{abA}	1.08^{aA}	1.01^{bA}	0.006
P-value (Treatment)	0.116	0.394	0.025	0.045	CV% = 0.05

*Means followed by the same lowercase letter in the row, within each treatment, and the same capital letter in the column, within each cycle, do not differ statistically from each other for α = 0.05.

seventh day of application, period necessary for stabilization of Cr_2O_3 in the digest, fecal samples were collected manually in the rectal at the times of Cr_2O_3 delivery by the twelfth day.

At the end of the collection period, composite samples were collected from each animal over a period of six days. The composite samples were dried and processed for the subsequent laboratory determination of the fecal chromium concentration contained by atomic absorption spectrophotometry, according to the methodology described by Kimura and Miller (1957).

The effective degradability of the extrusa and the fiber mass present in the rumen were evaluated using the gas production technique described by Theodorou et al. (1994) and by the interpretation of the generated profiles, with chrome as an indicator, performed according to Vieira et al. (2008).

Samples of milk were collected and sent to the Milk Analysis Laboratory at EMBRAPA “Gado de Leite”, every 14 days, for determinations of protein, fat, lactose and total dry extract.

The production of milk per area (kg of milk.ha^{-1}) were corrected for all periods, due to the variation of the area used in the treatments according to the management adopted.

The variables measured in the present study were analyzed by means of a mixed model. The parameters were estimated using the MIXED procedure of SAS (1999), where the selection of the best model was based on the Akaike's information criterion (Akaike, 1974). The variance and covariance structures tested were as follows: components of variance, composite symmetry, first order auto-regressive correlations, Toeplitz structure, as well as unrestricted structure (Littell et al., 2006).

RESULTS AND DISCUSSION

After calculating the individual probability for each model, the results indicated that they were equivalent. Then, the model with the lowest Akaike information criterion (Akaike, 1974) was prioritized, except for the observed values for gross fat - where the best fit was the composite symmetry; for all other parameters evaluated, the profile that best fit the model used was that of the component of variance.

It is important to report that, depending on the treatments adopted, the duration of the cycles between grazing varied in the IL95 treatment, being 24, 24, 27 and 30 days while for the FIXO treatment the cycles lasted 30 days.

The biomass production and the height of the pasture (Table 1) in the pre-grazing condition had a significant effect among the grazing cycles, which shows that under these conditions, according to the results observed by Carvalho et al. (2001), the different defoliation intervals observed along the cycles provided higher biomass yields in the treatments.

The lower production of pasture biomass in Cycle 1 in relation to Cycle 3 in both treatments may be due to the grazing gradient carried out in the previous month, since in this month the areas were mechanically grazed in order to standardize a gradient to the beginning of the evaluation period. Thus, this period was the only one in which it was possible to obtain a post-grazing residue of 30 cm, and, thus, Cycle 1 was the only one where biomass residue did not occur prior to its beginning, which may have contributed to these minor values observed. In Cycles 2 and 4, no significant difference was observed in relation to the other cycles.

There was no difference in biomass production between treatments. The heights of the forage plants in the FIXED treatment cycles, in a certain way, followed the production of biomass, since in Cycle 3 the highest average of heights was verified, being higher than Cycles 1 and 4 and not differing from Cycle 2. The Cycles 1, 2 and 4 did not differ from each other.

Both the biomass production and the height of the canopy in the pre-grazing may have been influenced by the grazing efficiency of the previous cycle, since, in Cycle 2, a higher post-grazing residue and a higher pasture height were observed, which gave Cycle 3 greater amount of dead material that integrated the manual samples collected in this cycle.

Among the treatments, it was observed that in Cycles 1 and 2 there was no difference in height; however, those of Cycles 3 and 4 of the FIXED treatment were higher than those observed in IL95.

Although the intervals of leaves were shorter, they were not sufficient to control the height of the canopy that ranged from 0.95 to 1.05 m between grazing cycles. Similar responses were observed by Difante et al. (2009) and Canto et al. (2013). Thus, grass height may compromise forage quality, due to the higher lignin content observed in these grazing cycles, and may also affect dry matter intake, since, with a higher supply of forage, animals can better harvest the crop due to a broader grazing horizon (2013). Difante et al. (2009) also failed to maintain the forage canopy residue in Tanzania grass under intermittent grazing at 30 cm, observing a relatively long defoliation interval. That allowed an almost complete interception of light, as a result of the selective grazing practiced by steers and of its low grazing efficiency in a horizon inferior to that defined by the height of the stems.

The average observed in the treatments between grazing cycles (50 cm) is almost twice as high as that currently considered ideal for Tanzania grass (30 cm), and in more extreme periods the residual height was close to 60 cm.

The same effect could have occurred with the Tanzania grass in this experiment, since the stocking with five cows.ha^{-1} may not have been ideal. In addition, with a low grazing pressure exerted on the pasture the animals would then have better chance of selecting the food, which makes the losses larger and consequently increases the residual height of the pasture.

The dry matter (DM) content of Tanzania grass (mean of 150.2 g.kg^{-1} in natural matter) were observed in treatments ($p = 0.324$) and in grazing cycles ($p = 0.889$). Gonzaga Neto et al. (2015) observed higher values for DM (mean of 249.2 g.kg^{-1}).

Although the observed levels may be considered low, possibly because the samples were extruded, "addition" of saliva to the sample could have occurred and influenced on the moisture of the material. Similar results were observed in the literature (Porto et al., 2009).

The mineral matter content (MM) is relatively unimportant in forage evaluation when fertilization is used, since this condition becomes very variable. Therefore, since the treatments were the same in both situations, no significant difference was observed between treatments ($p = 0.134$) and between grazing cycles ($p = 0.291$), with mean values of 133.2 g.kg$^{- 1}$ in the dry matter. Gonzaga Neto et al. (2015) observed lower values for MM (mean of 79.7 g.kg^{-1}).

The crude fat fraction (CF) represents the most energetic fraction of the food (lipid portion); however, because forages generally present very low levels (NRC, 2001) this component becomes of little relevance for the evaluation of the ($p = 0.119$) and between grazing cycles ($p = 0.675$), with mean values of 24.4 g.kg^{-1} in the dry matter.

The essentiality of the protein for the metabolism of maintenance and animal production brings considerable importance to the analysis of crude protein content of foods. According to Van Soest (1994), 70 g/kg of CP (in DM) was needed to guarantee the fermentation of structural carbohydrates in the rumen.

A significant difference was observed in the CP content of Tanzania grass, among treatments, in all grazing cycles. In Cycles 1, 3 and 4, the IL95 treatment presented higher CP values, possibly because this treatment presented a greater amount of leaves in relation to the treatment with FIXO defoliation interval. In Cycle 2 the interpretation of p-value shows that there was little evidence of effect ($p = 0.042$), since the value is close to the limit ($p = 0.05$).

In the management where the criterion of IL95 was adopted, the “extrusa” collected in Cycle 1 presented CP content higher than in the other cycles; in Cycle 2, it presented a lower CP content than in Cycle 3 and this did not differ from Cycle 4.

In the management where FIXO defoliation interval was adopted, the “extrusa” collected in Cycle 1 presented PB content higher than in the other cycles. Cycles 2 and 3 did not differ from each other and both had CP levels higher than in Cycle 4.

These differences were expected since the environmental variables have an effect on the physiology of the grass. Thus, as one moves from a rainy season to a dry season, the decrease in temperature and the reduction in nutrient availability, which normally occurs under water limitation conditions, may be responsible for the decrease in the observed CP content.

The CP levels of tropical grasses available in the literature are variable, since they are influenced by factors such as plant age, fertilization, season, soil and climate conditions, and defoliation interval. The CP levels for Tanzania grass observed by Porto et al. (2009) and Fukumoto et al. (2010) are similar to those observed in this study.

Neutral detergent insoluble protein (NDIP) contents are important in determining the potentially digestible protein (PDP), which is characterized by slow degradation in the rumen, as it is associated with the cell wall. This potentially digestible fraction (Table 2) was obtained by subtracting the ADIP content from the NDIP content.

There is a small proportion of CP that is insoluble, as it is associated with cell wall lignin, tannins and Maillard compounds, which are highly resistant to microbial and enzymatic degradation, making it little available in the digestive process of ruminants.

In the determination of the protein fractions proposed by Sniffen et al. (1992), acid detergent insoluble protein (ADIP) corresponds to fraction C, which is insoluble in the rumen and indigestible in the gastrointestinal tract.

The IL95 treatment presented a higher content of PDP in Cycle 2, which may have provided a greater supply of dietary protein for the animals under this treatment. Among grazing cycles, Cycle 4 presented lower levels of PDP than the other cycles, possibly due to climatic

Table 2. Mean crude protein content (g.kg^{-1} DM) and the potentially digestible protein content (g.kg^{-1} DM) in Tanzania grass.

Treatment	Cycle 1	Cycle 2	Cycle 3	Cycle 4	p-value (Cycle)
Crude Protein					
IL95	117.6^{aA}	97.5^{cB}	105.2^{bA}	100.0^{bcA}	<0.001
FIXED	111.2^{aB}	101.1^{bA}	99.7^{bB}	89.6^{cB}	<0.001
P-value (Treatment)	0.002	0.042	0.006	<0.001	CV%= 1.43
Potentially Digestible Protein					
IL95	25.3^{aA}	26.4^{aA}	25.8^{aA}	15.4^{bA}	0.006
FIXED	23.1^{aA}	20.2^{aB}	23.8^{aA}	14.1^{bA}	<0.001
P-value (Treatment)	0.331	0.027	0.395	0.549	CV% = 2.08

*Means followed by the same lowercase letter in the row, within each treatment, and the same capital letter in the column, within each cycle, do not differ statistically from each other for α = 0.05.

Table 3. Average content of fibrous organic matter (g.kg^{-1} MS) and lignin content (g.kg^{-1} DM) in Tanzania grass.

Treatment	Cycle 1	Cycle 2	Cycle 3	Cycle 4	p-value (Cycle)
Fibrous Organic Matter					
IL95	746.7^{aA}	690.6^{bA}	717.0^{abA}	687.4^{bA}	<0.001
FIXED	718.9^{aB}	700.9^{aA}	701.3^{aA}	704.6^{aA}	0.383
P-values (Treatment)	0.028	0.383	0.191	0.154	CV%= 1.62
Lignin					
IL95	57.1^{aA}	66.7^{aA}	66.1^{aA}	69.3^{aB}	0.362
FIXED	59.9^{bA}	79.4^{abA}	66.0^{abA}	86.7^{aA}	0.033
P-value (Treatment)	0.691	0.172	0.983	0.045	CV% = 6.16

*Means followed by the same lowercase letter in the row, within each treatment, and the same capital letter in the column, within each cycle, do not differ statistically from each other for α = 0.05.

factors - mainly the lower rainfall - and vegetative ones, since in this cycle it occurred at the beginning of the inflorescence of the pasture and consequent mobilization of nutrients for the reproductive process.

The higher lignin content (Table 3) observed in Cycle 4 may also have contributed to this lower PDP content. The quantification of NDF contents is important because of their inverse relation with the voluntary ingestion of forage dry matter, because of the ruminal repletion effect, as reported by Mertens (1992), and with the net energy content of the feed material (Van Soest, 1994).

The fiber content (fibrous organic matter - FOM) between treatments (Table 3) varied only in Cycle 1, although this effect was just 3.72% higher in IL95 treatment in relation to FIXO treatment, and did not influence the consumption of dry matter and fiber. No difference was observed between grazing cycles in treatment with FIXO defoliation interval.

In the IL95 treatment, the fiber content varied between grazing cycles, with Cycle 1 being about 8% higher than Cycles 2 and 4, while the other cycles did not differ from each other.

The observed fiber contents can be considered high for tropical grasses and are similar to those observed by Patês et al. (2008), Porto et al. (2009) and Gonzaga Neto et al. (2015), and higher than those observed by Fukumoto et al. (2010).

The lignin content in the IL95 treatment was higher in Cycle 4 than in the FIXED treatment, which shows that the management adopted did not affect the forage lignification process when there was no water stress. However, for both treatments, there were occasional increases in lignin contents throughout grazing cycles (Table 3).

This is an expected behavior for lignin deposition, since the reduction of water content in the environment induces the formation of phenolic compounds: p-coumaric and ferulic acid that represents the fraction called lignin (Nussio et al., 2011).

The content of lignin in fodder is very variable and as its physiological maturation progresses, its lignin content increases. Thus, similar contents were reported in

Table 4. Mean of total carbohydrate (g.kg^{-1} DM) and non- fibrous carbohydrate (g.kg^{-1} DM) in Tanzania grass.

Treatment	Cycle 1	Cycle 2	Cycle 3	Cycle 4	p-value (Cycle)
Total Carbohydrate					
IL95	726.9^{A}	772.3^{A}	745.9^{A}	754.9^{A}	0.061
FIXED	730.9^{A}	742.6^{A}	690.9^{B}	750.7^{A}	0.062
P-value (Treatment)	0.704	0.083	0.019	0.741	CV%= 1.21
Non-Fibrous Carbohydrate					
IL95	137.0^{bA}	237.3^{aA}	164.8^{abA}	174.6^{abA}	0.019
FIXED	161.9^{aA}	149.5^{aB}	98.1^{aB}	88.3^{aB}	0.05
P-value (Treatment)	0.394	0.007	0.033	0.008	CV% = 18.8

*Means followed by the same lowercase letter in the row, within each treatment, and the same capital letter in the column, within each cycle, do not differ statistically from each other for α = 0.05.

management with defoliation interval between 24 and 30 days (Patês et al., 2008) and higher values were reported by Gonzaga Neto et al. (2015).

Tropical forages, as a rule, present 60 - 80% of their carbohydrates as cell wall components (Van Soest, 1994). The mean contents of total carbohydrates and non-fibrous carbohydrates are shown in Table 4.

It was expected that the carbohydrate content would decrease within the months, due to the physiological changes that occur in the drought period; however, there was no difference in the grazing cycles, even with the different biomass productions observed in pre-grazing (Table 1).

Among the treatments, in the IL95 management there was a higher total carbohydrate content. It was only in Cycle 3, despite the levels of fibrous organic matter and lignin (Table 3) observed between the cycles, that they did not differ between treatments.

Higher results were reported by Valente et al. (2010) and Gonzaga Neto et al. (2015) for Tanzania grass, in the condition of interception of photosynthetically active radiation equal to 95%.

The classification of carbohydrates in structural and non-structural refers solely to their function performed in plants. The structural carbohydrates found in the cell wall of plants and are composed of pectin, cellulose and hemicellulose. In addition, the structural components also include lignin, phenolic complexes and proteins (Mertens, 1992).

There was no difference between the treatments (p=0.133) and grazing cycles (p=0.225) for the fibrous carbohydrate content of Tanzania grass, where mean values of 589.3 g.kg^{-1} were observed in the treatments' dry matter.

Probably, this response is similar to the observed behavior of the fibrous organic matter and lignin (Table 3), due to the reduced range of defoliation applied to Tanzania grass in the experimental treatments. This indicates that these defoliation intervals do not allow the physiological maturation of the fodder, which, consequently, was not sufficient to cause thickening of the secondary cell wall. The levels reported here are lower than those reported by Valente et al. (2010).

Non-fibrous carbohydrates are located in cell contents and are found in higher concentrations in seeds, leaves and stems and represent energy reserves used for reproduction, growth and survival during periods of stress (Mertens, 1992) being degraded faster than fibrous carbohydrates, which are constituted of pectin, starch and sugars. Gonzaga Neto et al. (2015) reported lower values than the IL95 treatment; however, they are syllogical to the FIXED treatment.

Thus, in the analysis of non-fibrous carbohydrates, higher levels were observed in the IL95 treatment in comparison to the FIXED treatment in grazing Cycles 2, 3 and 4 (Table 4), for the months of March, April and May. Although lower than those recommended by the NRC (2001), they are higher than those observed by Valente et al. (2010).

In the individual observations of the treatments, in relation to the grazing cycles, no differences in FIXED treatment could be observed. However, in the IL95 treatment, similar behavior to lignin was observed (Table 3). In other words, where higher lignin levels were observed, due to longer maturation periods, the response of the cells to low amounts of cell contents were observed.

Factors such as digestibility, vegetation structure and stage of development of the plant directly and negatively alter forage quality due to changes in its chemical composition and consequent increase in the contents of structural compounds. Moreover, with a decrease in the content, this causes a reduction in voluntary dry matter intake due to ruminal repletion effects (Reis and Da Silva 2011).

In order to evaluate the dry matter intake (DMI) and

Table 5. Mean of voluntary dry matter intake (g DM.kg^{-1} of live weight) and effective fiber degradability (g.kg^{-1} DM.h^{-1}) of Tanzania grass.

Treatment	Cycle 1	Cycle 2	Cycle 3	Cycle 4	P-value (Cycle)
Voluntary Dry Matter Intake					
IL95	21.5^{a}	23.9^{a}	23.7^{a}	21.1^{a}	0.175
FIXED	21.0^{bc}	24.0^{a}	22.0^{ab}	18.8^{c}	0.019
P-value (Treatment)	0.989	0.553	0.233	0.139	CV%= 4.38
Effective Fiber Degradability					
IL95	227.3^{b}	287.0^{a}	288.9^{a}	243.2^{ab}	0.031
FIXED	226.9^{b}	285.7^{a}	291.2^{a}	242.6^{ab}	0.022
P-value (Treatment)	0.809	0.953	0.833	0.939	CV% = 13.36

*Means followed by the same lowercase letter in the row, within each treatment, did not differ statistically from each other for α = 0.05.

fiber intake (FVI), it was initially verified that the average live weight of the cows had no effect on the evaluated parameters.

Fiber represents the carbohydrate fraction of food, slow or even indigestible (Nussio et al., 2011) and its importance comes from its ability to exert a limitation on dry matter and energy consumption.

The DMI (Table 5) did not differ among the treatments studied; however, there is a difference between the grazing cycles in the treatment with FIXED defoliation interval. In Cycle 2, the highest DMI was observed in relation to Cycles 1 and 4, but did not differ from Cycle 3.

These responses probably occurred as a consequence of the average production of Tanzania grass biomass in pre-grazing, reported in Table 1, since in the cycles where there is greater forage availability, the highest DMI was also observed.

Thus, as discussed previously, the grazing efficiency that occurred in the previous cycle may have influenced the biomass production and the height of the forage canopy and, as consequence had an effect on DMI.

The DMI correlates with dry matter digestibility (DMD), because the higher the DMD, the higher the DMI, until energy demand is reached. Allison (1985) states that the passage of food by the rumen-reticulum increases with increasing digestibility, up to a maximum point. Thus, the lower the DMD, the longer the retention time of the “digesta”, and the consumption limitation due to the repletion effect.

However, despite the DMI evaluation denotes the existence effect of grazing cycles, there is no difference in the DMD between treatments (p=0.819) and between grazing cycles (p=0.588), with an average digestibility of 495.6 g.kg^{-1} in the dry matter.

Thus, it could be inferred that, despite the variation in the DMI, somehow, there was a compensation by the animals in the digestion of the food. Above all, due to the mean mass of fiber present in the rumen (4.6 kg), the equilibrium condition was similar between treatments (p = 0,808) and grazing cycles (p = 0.052).

There was no difference between fiber voluntary intake and fiber digestibility between treatments and grazing cycles evaluated.

For fiber voluntary intake, a mean of 12.8 g of FOM.kg^{-1} of live weight was observed, with p=0.614 for treatments and p=0.115 for grazing cycles, while for fiber digestibility a mean of 563.2 g.kg $^{-1}$ of NDF, with p=0.292 for treatments and p=0.17 for grazing cycles was observed.

It is possible that the grazing pressure applied to the Tanzania grass modulus was low, which may have allowed animals to select their diets composition, favoring the selection of more palatable and nutritious parts (Oliveira et al., 2007); thus, allowing the diets of the cows in both treatments to be similar in their chemical composition.

Thus, no differences were noticed in these variables even though differences were observed between forage biomass in the pre-grazing condition (Table 1).

Lignin is the indigestible fraction of fodder and, although in animal nutrition there is a high negative correlation with the digestibility of the fibrous portion of the plants, the levels observed in Table 3 did not influence fiber voluntary intake and digestibility.

No difference was observed in the effective degradability of the fiber between the treatments; however, variation occurred throughout the grazing cycles (Table 5).

In contrast to that observed by Prado et al. (2004), the higher level of cellular content in forage (non-fibrous carbohydrates) did not determine the lowest effective degradability of same. Probably, where there were lower lignin contents, greater effective fiber degradability occurred.

Dias-Salman et al. (2000) and Velásquez et al. (2009) reported higher values for effective fiber degradability than those observed in this study.

These answers affirmed that the dynamics and the quality of the forage did not change due to the adopted management, nor during the grazing cycles, since the individual production of the cows was not different from

Table 6. Monthly average of milk production (kg milk.ha^{-1}), mean values of protein in milk (g.kg^{-1} of milk) and lactose in milk (g.kg^{-1} of milk) during experimental period.

Treatment	Cycle 1	Cycle 2	Cycle 3	Cycle 4	P-value (Cycle)
Milk Production					
IL95	2745.0^{aA}	2755.2^{aA}	1979.2^{bA}	1467.1^{bA}	< 0.001
FIXED	2017.8^{aB}	1885.8^{aB}	1721.8^{abA}	1245.4^{bA}	0.006
P-value (Treatment)	0.002	0.001	0.109	0.156	CV% = 23.42
Protein in Milk					
IL95	29.4^{b}	28.6^{b}	29.6^{b}	31.7^{a}	0.012
FIXED	30.5^{b}	30.3^{b}	28.8^{b}	33.4^{a}	0.036
P-value (Treatment)	0.124	0.406	0.457	0.224	CV% = 1.27
Lactose in Milk					
IL95	42.9^{a}	43.4^{a}	43.9^{a}	40.9^{b}	0.006
FIXED	42.4^{a}	44.9^{a}	43.0^{a}	39.1^{a}	0.013
P-value (Treatment)	0.231	0.244	0.198	0.208	CV% = 2.47

*Means followed by the same lowercase letter in the row, within each treatment, did not differ statistically from each other for α = 0.05.

each other.

In the literature, it is reported that cows with access to water only at milking time have their milk production influenced negatively (Rocha, 1993) and that cows kept in an environment with temperatures above 25°C present reduced milk production (NRC, 2001). Such factors may have limited the productions observed in the present work.

Due to variation in the defoliation interval for the IL95 treatment because of the interception of photosynthetically active radiation equal to 95%, it was necessary to adjust the milk production observed in this treatment to 1 ha in order to match the productivity by area.

Thus, there was difference in mean milk yield (Table 6) between treatments and between grazing cycles. Milk production in Cycles 1 and 2 for IL95 treatment was 26.5 and 31.5% higher than for FIXED treatment. This difference is probably due to the interval of defoliation adopted in FIXED treatment (not indicated for this period of the year), since similar individual production was obtained in IL95 treatment, but in a reduced area.

Among the grazing cycles, a similar behavior was perceived in both treatments, with decreasing productivity along the cycles due to the advancement of the lactation period of the cows and with the lower availability and lower quality of the forage in the driest periods.

The production observed in the literature for Tanzania grass systems is very variable, although, in general, they are punctually smaller (Fukumoto et al., 2010; Santo et al., 2005) than those described in this paper.

There was no difference in any of the components of the milk evaluated for the experimental management; although, for some variables, grazing cycles were delayed.

The component of the milk that suffers most variation is the fat content, since the diet, the productive volume and the fiber content in the diet can influence the fat content. Fats from bovine milk are characterized as mixed triglycerides, with a large proportion of short chain fatty acids (C4 - C16), derived from glycerol-3-phosphate, derived from the glycolytic pathway or triglyceride lipolysis during the uptake of fatty acids by the mammary gland. Thus, there was no difference in fat content between treatments (p=0.601) and grazing cycles (p=0.727) over the experimental period, with mean values being 38.5 g.kg^{-1} of milk , similar to those observed by Fukumoto et al. (2010) and Porto et al. (2009).

The term "dry stratum" or "total solids" encompasses all components of milk, except water. The total solids content did not differ between the treatments (p=0.657) and the grazing cycles (p=0.52), with the average levels being 120.2 g.kg^{-1} of milk, similar to those observed by Fukumoto et al. (2010) and Porto et al. (2009).

Milk proteins synthesized in the mammary gland from amino acids absorbed into the blood, with the casein class being the major part of bovine milk proteins.

There was no difference in the milk protein content (Table 6) among the treatments studied; however, there was difference throughout the grazing cycles. In Cycle 4, higher protein content was recorded in milk in relation to the other cycles. These responses are associated with the crude protein content of the pasture, since changes in the protein intake have a discrete effect on the milk composition (Park et al., 2017). In this way, crude protein consumption may have occurred in Cycle 4.

The levels observed in the literature (Kumoto et al., 2010; Porto et al., 2009) corroborate with the levels reported in this study.

There was no effect of the average lactose content (Table 6) on cows' milk in the management, but in Cycle 4, there were lower levels in comparison to the other grazing cycles. This trend was observed in the non-fibrous carbohydrate content (Table 4), which may have provided higher amounts of glucose, the only precursor of lactose in the mammary glands.

Conclusions

The management causes certain differences in the chemical composition of Tanzania grass and these do not mean individual increases in productivity. Management based on the interception of photosynthetically active radiation equal to 95% implies greater efficiency in the use of the area, that is, higher milk production per unit area.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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