

# *Megathyrus Maximus* cv. Massai at different cutting frequencies<sup>1</sup>

## *Megathyrus Maximus* cv. Massai submetido a frequências de corte

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### Abstract

We evaluated the growth dynamics and forage production of Massai grass subjected to different cutting frequencies during the rainy season, with the aim to determine the most suitable cutting frequency to increase grass productivity. A randomized block design with four treatments (four cutting frequencies, 24, 32, 48, and 96 days) was used. The morphological characteristics were evaluated weekly in seven random tillers. Leaf appearance rate, phyllochron value, foliar elongation rate, leaf senescence rate, and stem elongation rate were influenced ( $p < 0.05$ ) by the cutting frequency, while no effect was found for leaf life span. The number of live leaves per tiller, mean length of leaf blades, population density of tillers (DPP), and sheath length were influenced by the cutting frequency, along with plant height, dry mass of harvested leaf blade, dry mass of harvested stem, dry mass of harvested dead material, and leaf/stem ratio, while there was no effect on dry mass of forage harvested. The rates of leaf blade accumulation, stem accumulation, forage loss, and forage production were not affected by cutting frequency. A cutting frequency of 24 days resulted in the highest productivity values of Massai grass during the rainy season.

**Key words:** Defoliation frequency. Morphological responses. Plant height.

### Resumo

Objetivou-se neste trabalho avaliar a dinâmica de crescimento e produção de forragem do capim Massai submetido as frequências de desfolhação, durante o período chuvoso, com intuito de elucidar a melhor frequência de desfolhação no manejo do pastejo, para garantir maior produtividade do capim. Foi utilizado o delineamento experimental em blocos casualizado, com quatro tratamentos (quatro frequências de desfolhação do dossel, sendo 24; 32; 48 e 96 dias de intervalo de corte). As características morfogênicas foram avaliadas após o corte de uniformização, em sete perfilhos ao acaso por repetição. Estas avaliações foram feitas semanalmente. A taxa de aparecimento foliar, o filocrono, a taxa de alongamento foliar, a taxa de senescência foliar e a taxa de alongamento do colmo foram influenciados ( $p < 0,05$ ) pelas frequências de corte do capim Massai, não havendo efeito ( $p > 0,05$ ) na duração de vida da folha. O número de folhas vivas por perfilho, o comprimento médio de lâminas foliares, a densidade populacional de perfilhos (DPP) e o comprimento da bainha foram influenciados pelas frequências de corte do capim Massai. A altura da planta, a massa seca de lâmina foliar colhida, a massa seca do colmo colhida, a massa seca de material morto colhida e a relação folha/colmo foram influenciados pelas frequências de corte, não havendo resposta na massa seca de forragem colhida. As taxas de acúmulo

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de lâmina foliar, o acúmulo de colmo, a perda de forragem e a produção bruta de forragem não foram influenciadas pelas frequências de corte. A frequência de desfolhação no período de 24 dias, apresentou os melhores valores de produtividade do capim Massai durante o período chuvoso.

**Palavras-chave:** Altura da planta. Frequência de desfolhação. Respostas morfológicas.

## Introduction

Among the main grasses used for beef cattle in Brazil, the cultivars of the species *Megathyrsus maximus* stand out because of their good adaptation to tropical climates and their high productivity (GOMES et al., 2011). In particular, the cultivar Massai presents a high soil cover and, consequently, impedes the growth of invasive plants in the pasture; it is therefore a promising cultivar for intensive production systems (EUCLIDES et al., 2008; VALLE et al., 2009).

However, inadequate pasture management can alter its quantitative and qualitative characteristics. Higher cut intervals increase total forage mass, but tend to reduce the nutritional value (COSTA et al., 2007). In this way, for the correct morphogenic knowledge and characteristics of tillering, it is necessary to observe the cut interval, in order to allow better interaction of the plant with the medium (MARANHÃO et al., 2010).

According to Lopes et al. (2014), the right moment of defoliation characterizes correct pasture management. Due to the importance of this grazing management tool, several studies have evaluated the effect of cut frequency on forage grass cultivars such as Xaraés (COSTA et al., 2007), Basilisk (MARANHÃO et al., 2010), and Tanzania (SOUZA et al., 2007), highlighting the importance of using cut-off intervals that favor production characteristics.

For Massai grass, there are varying recommendations in terms of cutting frequency, especially from the northern region of Brazil, where research is scarce. In this context, we evaluated the growth dynamics and forage production of Massai grass subjected to different defoliation frequencies

during the rainy season, with the aim to determine the most suitable frequency of defoliation for maximum grass productivity.

## Material and Methods

The study was carried out in an experimental site of the Sector of Bovinoculture, School of Veterinary Medicine and Animal Science, Federal University of Tocantins, Brazil. The area is located at latitude 07°13'40 "S and longitude 48°14'25", BR 153, Km 112 - Zona Rural de Araguaína - TO.

The soil is classified as typical Quartzeneic Neosol (EMBRAPA, 2013). Soil analyzes were carried out at the ESALQ/DEPARTMENT OF SCIENCE OF THE SOIL, Laboratory of soil microbiology. The 0-20-cm layer showed the following characteristics: pH (CaCl<sub>2</sub>) = 4; MO colorimetry = 25 mmol dm<sup>-3</sup>; P (resin) = 13 mg dm<sup>-3</sup>; K (resin) = 0.8 mmol dm<sup>-3</sup>; Ca<sup>2+</sup> (resin) = 5 mmol dm<sup>-3</sup>; Mg<sup>2+</sup> (resin) = 2 mmol dm<sup>-3</sup>; H + Al<sup>3+</sup> (SMP) = 20 mmol dm<sup>-3</sup>; SB = 7.8 mmol, dm<sup>-3</sup>; CTC = 27.8 mmolc dm<sup>-3</sup>, and V = 28%.

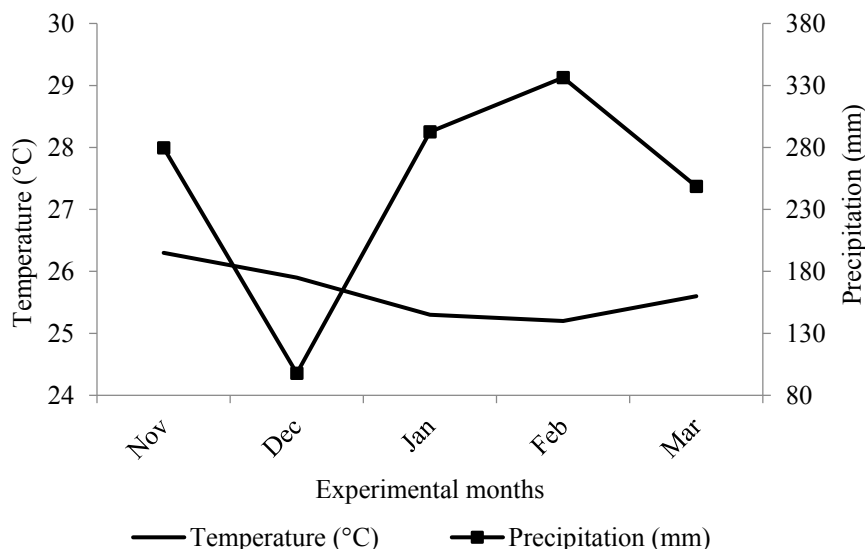
According to the Köppen classification, the climate is Aw-Tropical with wet summers; maximum and minimum temperatures are 40 and 18°C, respectively, with an average relative humidity of 76% and an average annual rainfall of 1,746 mm. The area has a well-defined rainy season and a dry season (winter). During the experimental period, accumulated precipitation was 1,254.9 mm, registered at the station of the National Institute of Meteorology, 900 m away from the area (Figure 1).

The area was cultivated with *Megathyrsus maximus* cv. Massai; the experimental plots measured 3 x 3 m (9 m<sup>2</sup>) each, with a total area of 144 m<sup>2</sup>. The experiment ran from November 25, 2016 to March 1, 2017.

The experimental treatments were arranged in a randomized block design (DBC) with four treatments and four blocks, totaling 16 experimental

units. The treatments consisted of four frequencies of canopy defoliation, namely 24, 32, 48, and 96 days after the start of the experiment.

**Figure 1.** Mean values of temperature (°C) and precipitation (mm) referring to the experimental months.



Source: Estação do Instituto Nacional de Meteorologia (2016).

At the beginning of the experiment, the soil was corrected with the application 2 t ha<sup>-1</sup> of dolomitic limestone (PNRT = 89%), plow, and fertilized with 40 kg ha<sup>-1</sup> of P<sub>2</sub>O<sub>5</sub> (single superphosphate). For the application of N and K, the formulation N: P: K 20:00:20 was used.

The production cycles were associated to the frequent fertilization with nitrogen and potassium, which allowed the monitoring of the morphogenetic and structural variables of the pasture according to Table 1. Fertilization was always performed after defoliation, according to the quantities established for each treatment and formulated separately for each experimental plot.

**Table 1.** Cutting frequency, number of cycles, amount of nitrogen applied per cycle, and total amount of nitrogen applied during the experimental period.

Cutting frequency (days)	Number of cycles	Nitrogen per cycle (kg ha <sup>-1</sup> of N)	Nitrogen and K <sub>2</sub> O applied (kg ha <sup>-1</sup> of N)
24	4	26.4	105.6
32	3	35.2	105.6
48	2	52.8	105.6
96	1	105.6*	105.6

\*In two applications of 52.8 kg ha<sup>-1</sup> of N, the first application was at the beginning of the experiment and the second one 48 days later.

For the evaluation of the morphogenic characteristics, the tiller technique was used (DAVIES, 1993), using seven random tillers per repetition, totalizing 28 treatment-tagged tillers, which were evaluated every 7 days.

The data were recorded in spreadsheets according to Alexandrino et al. (2004), estimating the following parameters:

✓ foliar appearance rate (TApF) - representing the number of fully expanded leaves that appeared during the rest period (leaves/tiller/day);

✓ foliar elongation rate (TAIF) - corresponding to the increase in total leaf length during the resting period (mm/leaf/day);

✓ foliar senescence rate (TSF) - representing the loss in leaf length of a tiller during the resting period (mm/leaf/day);

✓ stem elongation rate (TAIC) - representing the increase in the pseudostem during the resting period (mm/tiller/day);

✓ filocron (Filocr) - representing the inverse of the foliar appearance rate and corresponding to the time in days for the appearance of two successive leaves in the tiller (days/leaf/tiller);

✓ average length of leaf blades (CMLF) (mm/leaf);

number of live leaves per tiller (NFV);

✓ lifespan of leaf (DVF) - days/leaf and length of sheath (CB) - mm.

The agronomic characteristics were evaluated based on the dry mass of harvested forage (MSFC), leaf mass harvested (MSLFC), dry mass of harvested stem (MSCC), and dry mass harvested (MSMMC).

The collection points were established according to the average height of the plants in the plots, obtained through the measurement of five random points, measured directly in the forage canopy of the area. The height of the canopy at each point corresponded to the average height of the curvature of the leaves around the ruler.

At this point, a sampling frame of 0.6 m<sup>2</sup> was allocated, and all forage contained in this area was collected at 50% of the height. With this procedure, a representative aliquot of each sample was taken to determine the dry mass of the morphological components leaf blade, stem, dead material, and the sum of them; these parameters were used for the calculation of the mass of forage harvested.

After each separation, all components were oven-dried at an average temperature of 55°C for 72 hours for dry mass estimates. Based on leaf dry matter and stem mass data, the leaf/stem ratio (F/C) was determined.

Tiller population density (DPP) (m<sup>2</sup> tiller) was measured at each cut by direct counting in a 0.15 x 1.0 m (0.15 m<sup>2</sup>) sampling frame, allocated at the average height of the plot. The estimated population density of the tillers represented the average of the four plots per treatment.

To determine the gravimetric factors of each morphological component, 80 tillers from each treatment were used, which were randomly collected. Samples of leaf blades (top leaf) and adults (leaf base) and shoots were measured and subsequently oven-dried at 55°C to determine the gravimetric indices, i.e., the conversion factor between lengths and the dry weight of the leaf blade (mm mm<sup>-1</sup>).

Leaf and stem elongation rates were transformed into foliar and stem yield rates, respectively, and forage loss senescence rate, according to the following equations adapted from Cândido et al. (2006) and Davies (1993):

$$TPLF = [(TAIF \times \alpha 1) \times DPP]$$

$$TPerF = [(TSF \times \alpha 2) \times DPP]$$

$$TPC = [(TAIC \times \alpha 3) \times DPP]$$

$$TPBF = TPLF + TPC,$$

where TPLF = leaf blade production rate (kg DM ha<sup>-1</sup> day<sup>-1</sup>); TAIF = leaf elongation rate (mm tiller day<sup>-1</sup>);  $\alpha 1$  = gravimetric index of emergent leaf

blades ( $\text{g mm}^{-1}$ ); TPerF = rate of forage loss ( $\text{kg DM ha}^{-1} \text{ day}^{-1}$ ); TSF = foliar senescence rate ( $\text{mm tiller day}^{-1}$ );  $\alpha 2$  = gravimetric index of adult leaflets ( $\text{g mm}^{-1}$ ); TPC = high yield rate ( $\text{kg MS ha}^{-1} \text{ day}^{-1}$ ); TAIC = stem elongation rate ( $\text{mm tiller day}^{-1}$ );  $\alpha 3$  = stem gravimetric index ( $\text{g mm}^{-1}$ ); DPP = population density of tillers ( $\text{tiller m}^{-2}$ ); TPBF = crude forage production rate ( $\text{kg MS ha}^{-1} \text{ day}^{-1}$ ).

The data were submitted to normality and homogeneity tests, followed by analysis of variance; when necessary, Tukey's test was applied at 5%

error probability for comparison of means and evaluation of the effects of treatments.

## Results and Discussion

Cutting frequency impacted all morphogenic characteristics, such as leaf appearance rate (TApF), phyllochron level, foliar elongation rate (TALF), foliar senescence rate (TSF), and stem elongation rate (TALC), but had no impact on leaf life span (DVF) (Table 2).

**Table 2.** Leaf appearance rate (TApF), phyllochron value, foliar elongation rate (TALF), leaf senescence rate (TSF), stem elongation rate (TALC), and leaf life span (DVF) of *Megathyrus maximus* cv. Massai at different cutting frequencies.

Variables	Cutting frequency (days)				CV <sup>1</sup>	P > F <sup>2</sup>
	24	32	48	96		
TApF	0.08 <sup>b</sup>	0.07 <sup>b</sup>	0.06 <sup>a</sup>	0.05 <sup>a</sup>	8.31	0.0001
Philocron	14.13 <sup>a</sup>	16.74 <sup>ab</sup>	19.04 <sup>bc</sup>	21.04 <sup>c</sup>	9.71	0.0006
TALF	21.68 <sup>b</sup>	24.83 <sup>b</sup>	16.25 <sup>a</sup>	26.54 <sup>b</sup>	11.18	0.0004
TSF	8.44 <sup>a</sup>	7.22 <sup>a</sup>	9.64 <sup>a</sup>	16.27 <sup>b</sup>	19.14	0.0001
TALC	1.64 <sup>a</sup>	2.05 <sup>a</sup>	1.41 <sup>a</sup>	4.07 <sup>b</sup>	37.18	0.0057
DVF	52.66	59.94	49.56	65.83	16.60	0.1190

<sup>1</sup> Coefficient of variation (%)

<sup>2</sup>Significance of the "F" Test of the analysis of variance.

Averages followed by the same letter within the same row do not differ significantly by the Tukey test at 5% probability.

TApF = leaves/tiller/day; phyllochron = days/leaf/tiller; TALF = mm/leaf/day; TSF = mm/leaf/day; TALC = mm/tiller/day; DVF = days/sheet.

In relation to the leaf appearance rate (TApF), the highest values observed for the frequencies of 24 and 32 days were possibly due to the higher light exposure of the plant base (CÂNDIDO et al., 2005), which probably influenced the structural components and the leaf area index of the pasture (DIFANTE et al., 2011). Another explanation would be that at higher defoliation frequencies, a reduction of the sheath cartridge length occurred, with a decrease in the distance required for new leaf appearance and, consequently, a higher leaf appearance rate (ALEXANDRINO et al., 2010).

The highest phyllochron values were observed at the lower cutting frequencies. The rapid leaf

reestablishment is related to lower values of this variable. Similar results have been found by Marcelino et al. (2006), who observed higher values of phyllochron at lower defoliation frequencies due to variations in the leaf appearance rate and changes in the development stage of the plant.

The lowest leaf elongation rate (TALF) was found at a cutting frequency of 48 days. According to Marcelino et al. (2006), modifications in this variable may arise from the use of higher cutting intensities and frequencies, which did not occur in this experiment, since the defoliation intensities were similar for all treatments.



The cutting frequency of 96 days resulted in the highest values for leaf senescence rate (TSF); this factor determines the net accumulation of forage mass (IWAMOTO et al., 2015).

These results are in agreement with those found by Cutrim Júnior et al. (2010), who observed that the leaf senescence rate at lower cutting frequencies tended to increase as a reflection of the greater shading of the basal leaves within the canopy.

The highest value for stem elongation rate (TALC) was found for a cutting frequency of 96 days, most likely as a result of the higher shading levels (CUTRIM JÚNIOR et al., 2010).

Lopes et al. (2013, 2014) observed no variation in the elongation rate of the Massai grass stem at high nitrogen fertilization doses and emphasized the ability of Massai grass to increase foliar biomass production by increasing the leaf elongation rate. This shows the high growth potential of the Massai grass leaf area when compared to other forages; while other grasses usually alter the stalk elongation

rate, Massai grass maintains its mechanism of stretching is different, explaining the absence of any effects of the three highest cutting frequencies on stem elongation rates.

Leaf life span (DVF) was not affected by cutting frequency. According to Martuscello et al. (2015), to better evaluate leaf life span (DVF), the data should be analyzed together with leaf senescence (TSF) values. According to the authors, plants in the absence of nitrogen (N) tend to have a low rate of leaf senescence, enabling them to stay alive. In the present study, nitrogen supply was maintained in relation to cutting frequencies, which can explain the absence of any effect on leaf life span in all evaluated treatments, irrespective of the cutting frequency.

The number of live leaves per tiller (NFV), mean length of leaf blades (CMLF), population density of tillers (DPP), and sheath length (CB) were influenced by the different cutting frequencies (Table 3).

**Table 3.** Number of live leaves per tiller (NFV), mean length of leaf blades (CMLF), tiller population density (DPP), and sheath length (CB) of *Megathyrsus maximus* cv. Massai at different cutting frequencies.

Variables	Cutting frequency (days)				CV <sup>1</sup>	P > F <sup>2</sup>
	24	32	48	96		
NFV	3.79 <sup>b</sup>	3.82 <sup>b</sup>	2.86 <sup>a</sup>	3.23 <sup>ab</sup>	8.90	0.0018
CMLF	207.73 <sup>a</sup>	247.12 <sup>a</sup>	258.79 <sup>a</sup>	415.50 <sup>b</sup>	11.67	0.0001
DPP	2,278.75 <sup>c</sup>	2,286.11 <sup>c</sup>	1,686.67 <sup>b</sup>	1,120.00 <sup>a</sup>	6.86	0.0001
CB	111.56 <sup>a</sup>	157.82 <sup>a</sup>	201.47 <sup>a</sup>	424.54 <sup>b</sup>	24.28	0.0001

<sup>1</sup> Coefficient of variation (%); <sup>2</sup>Significance of the Test "F" of the analysis of variance; NFV = number of live leaves; CMLF = mm/sheet; DPP = tillers/m<sup>2</sup>; CB = mm.

Averages followed by the same letter within the same row do not differ significantly by the Tukey test at 5% probability.

The number of live leaves per tiller (NFV) at a cutting frequency of 48 days was lower when compared to the frequencies of 24 and 32 days. According to Pena et al. (2009), the number of live leaves per tiller (NFV) is influenced by the leaf appearance rate and the leaf life span and can be obtained from the balance between these two variables. What gives the variable is the most stable

connotation of the plant, which may have favored the results found in the present work.

The highest average length of leaf blades (CMLF) was observed at a cutting frequency of 96 days. This variable is dependent on plant height, with higher values being observed at greater heights. Martins et al. (2014) emphasized the sheath length and leaf

elongation rate as determinants of the mean leaf blade length, with the sheath cartridge determining variations in the time available for leaf growth. In this way, the leaf length must be adapted to the limits imposed by these characteristics (SBRISSIA; SILVA, 2008). According to Santos et al. (2011), these changes constitute morphological adaptations that characterize the phenotypic plasticity of the grass.

Tiller population density (DPP) increased with increasing defoliation frequency, which was observed in the treatments with lower post-defoliation cutting intervals. These results can be explained by the higher light exposure at the base of the plants (CÂNDIDO et al., 2005). The continuous renewal of dead tillers, increasing the availability of biotic and abiotic factors, guarantees the persistence and perenniality of the pastures (COSTA et al., 2016).

According to ALEXANDRINO et al. (2011), higher canopy heights due to lower cutting frequencies are associated with the reduction in

tiller density and adjustments in relation to tiller size, which may explain the results found in the present study.

The behavior of the foliar appearance rate (TApF) is associated with the existence of the tillering mechanism; each leaf that emerges introduces a new basal bud, which allows the emergence of new tillers (SANTOS et al., 2013).

The longer sheath length (CB) observed at the 96-day cutting frequency may be related to the increase in the stalk elongation rate observed in this treatment. Martins et al. (2014), in a study with increasing levels of artificial shading, also observed a longer sheath length in plants that presented a higher stalk elongation rate.

Plant height (ALT), dry mass of harvested leaf blade (MSLFC), dry mass of harvested stem (MSCC), dry mass of harvested dead material (MSMMC), and leaf/stem ratio were influenced by the cutting frequency cut, while dry mass of forage harvested (MSFC) showed no response (Table 4).

**Table 4.** Plant height (ALT), dry mass of harvested forage (MSFC), dry mass of harvested leaf blade (MSLFC), dry mass of harvested stem (MSCC), dry mass of harvested dead material (MSMMC) (F/C) in *Megathyrus maximus* cv. Massai at different cutting frequencies.

Variables	Cutting frequency (days)				CV <sup>1</sup>	P > F <sup>2</sup>
	24	32	48	96		
Height	44.93 <sup>a</sup>	55.64 <sup>b</sup>	69.73 <sup>c</sup>	83.25 <sup>d</sup>	3.73	0.0001
MSFC	6,330.96	6,432.79	6,030.51	7,348.01	17.95	0.4530
MSLFC	6,132.20 <sup>b</sup>	5,938.13 <sup>b</sup>	5,144.57 <sup>ab</sup>	3,954.45 <sup>a</sup>	15.19	0.0094
MSCC	118.64 <sup>a</sup>	436.93 <sup>a</sup>	713.08 <sup>a</sup>	2,255.15 <sup>b</sup>	62.80	0.0007
MSMMC	80.12 <sup>a</sup>	57.73 <sup>a</sup>	172.86 <sup>a</sup>	1,138.42 <sup>b</sup>	37.17	0.0001
F/C	131.40 <sup>b</sup>	94.56 <sup>ab</sup>	20.36 <sup>ab</sup>	1.96 <sup>a</sup>	93.02	0.0248

<sup>1</sup> Coefficient of variation (%).

<sup>2</sup>Significance of the “F” Test of the analysis of variance.

Averages followed by the same letter within the same row do not differ significantly by the Tukey test at 5% probability.

Height = cm; MSFC, MSLFC, MSCC, MSMMC = kg ha<sup>-1</sup>; F/C = g/g.

Increasing cutting frequencies resulted in increased height (ALT) and sheath length of the Massai grass; in a previous study, an increasing cutting frequency triggered the elongation of the

stem, with the production of new leaves at the top of the canopy (MACEDO et al., 2017).

The cutting interval did not influence the dry mass of harvested forage (MSFC), most likely

because of the compensation of higher cycles at lower cutting frequencies, even with lower amounts of total dry matter produced per cycle, compensated the higher values observed in the other treatments. Another explanation may be the standardization of phosphate and potassium fertilization in the treatments. According to Gama-Rodrigues et al. (2002), potassium fertilization increases forage accumulation, and Oliveira et al. (2012) have reported that phosphate fertilization provides increased tillering and forage yield.

The highest values of dry matter of harvested leaf blade (MSLFC) were observed at the highest cutting frequency. Divergent results have been found by Cutrim Júnior et al. (2011), who determined a higher amount of dry leaf mass at a lower defoliation frequency for Tanzania grass. However, Reynoso et al. (2009) verified that the higher frequency of defoliation in Mombasa grass controlled the accumulation of undesirable morphological components and provided a higher proportion of leaves in the accumulated forage.

Cutting frequency influenced the dry matter of the harvested stem (MSCC), with the highest values for the frequency of 96 days. The increase in the stem elongation rate had a positive effect on stem growth and development, which increased the size and, consequently, the dry matter yield of the stem (SANTOS et al., 2012). Likewise, Dim et al. (2015) observed changes in the morphological component of the Piatã grass stem at the highest cutting intervals and suggested the need to develop thicker stalks to support the weight of the tiller.

The highest dry mass values of the dead material were observed for a cutting frequency of 96 days. This treatment reached the plateau of the growth

curve, which led to an increase in the amount of stalk and dead material. Similarly, Rodrigues et al. (2007) studied two cultivars of *Megathyrsus maximus* (Aries and Atlas) and observed that an increased resting period increased the accumulation of dead material due to light competition.

The structural component of pastures plays an important role in the use of grazing fodder; thus, increases in the contents of stalk and dead material can compromise searching and foraging by animals (EUCLIDES et al., 2008).

The cutting frequency influenced the leaf/stem ratio. These results were different from those found by Souza et al. (2007), who observed no effects on the leaf/stem relationship with increased cutting age of Tanzania grass. Different results were obtained by Bhering et al. (2008), who showed that the cutting age affected the leaf/stem ratio in elephant grass in the rainy season.

Leaf accumulation rate (TAcF), stem accumulation (TAcC), forage loss (TperdF), and forage production (TPBF) in *Megathyrsus maximus* cv. Massai were not influenced by cutting frequency (Table 5), most likely because of the differences in tiller density, foliar elongation rate, stem height, and foliar senescence rate, according to the methodology used to compensate for differences between these values and to obtain similar rates of loss and accumulation of forage (SANTOS et al., 2004).

When studying the forage accumulation rates of Tanzania grass subjected to two heights and three cutting intervals, Pena et al. (2009) observed no large variations in the accumulation of stalks for the different heights and cutting intervals; in addition, there was no effect on the dead material.



**Table 5.** Leaf production (TPLF), tillering (TPC), forage loss (TperdF), and forage production (TPBF) in *Megathyrus maximus* cv. Massai at different cutting frequencies.

Variables	Cutting frequency (days)				CV <sup>1</sup>	P > F <sup>2</sup>
	24	32	48	96		
TPLF	40.02	38.42	26.47	48.25	87.42	0.9457
TPC	10.75	13.60	10.31	46.48	113.55	0.3677
TperdF	11.05	3.09	8.11	12.33	154.96	0.8490
TPBF	50.77	52.02	36.78	94.73	71.72	0.6760

<sup>1</sup> Coefficient of variation (%).

<sup>2</sup>Significance of the “F” Test of the analysis of variance.

Averages followed by the same letter within the same row do not differ significantly by the Tukey test at 5% probability.

TPLF; TPC; TperdF; TPBF = (kg DM ha<sup>-1</sup> day<sup>-1</sup>).

Emerenciano Neto et al. (2013) studied the three grass cultivars Aruana, Marandu, and Massai, and observed that the Massai grass had a higher forage accumulation efficiency; 70% of the forage consisted of leaves, indicating the high potential of this cultivar for use in different pasture management systems.

## Conclusions

A cutting frequency of 24 days resulted in the highest productivity values for Massai grass during the rainy season. However, further studies are needed to more explicitly determine the ideal management strategies for this grass cultivar.

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