Growth and leaf area analysis of buffel grass subjected to salt stress

Análise do crescimento e da área foliar do capim-buffel submetido ao estresse salino

Análisis de crecimiento y área foliar del pasto buffel sometido a estrés salino

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Abstract
Buffel grass has characteristics of resistance and rapid recovery to prolonged drought, however, few studies indicate this resistance to salinity. Thus, the objective was to evaluate the relationship between salt stress and the growth dynamics, green mass production and area of Buffel grass. The experiment was conducted in an entirely randomized design, with three levels of salinity and ten repetitions, totaling 30 experimental units. Measurements of height, cutting and weighing of green mass were made in three periods, with intervals of 28 days between them, and photography of the leaves for analysis in ImageJ software in the last period. The data obtained were submitted to the Shapiro-Wilk normality test and Bartlett's homogeneity test. Kruskal-Wallis non-parametric test and Dunn's post-test was applied for data that did not follow normality, and ANOVA test and Tukey's post-test for those that followed normality and homogeneity. The results indicate that there was no significant difference in height for the treatments with or without salt, so even with the addition of salt there was no interference in growth, but when compared in relation to the periods, it can be observed that the last period was different from the others, this can be explained by the vegetative vigor of the plant, because when it is younger it has more efficient cell multiplication, but as it suffers injuries, the vigor is decreased and growth is slower. Therefore, there are some differences in the behavior of grass submitted to salinity, but they do not significantly interfere in its development.
Keywords: Plant development; Experimental statistics; Forage; ImageJ; Salinity.

Resumo

O capim-buffel possui características de resistência e rápida recuperação à seca prolongada, porém, poucos estudos indicam essa resistência à salinidade. Assim, objetivou-se avaliar a relação entre estresse salino e a dinâmica de crescimento, produção de massa verde e área de capim Buffel. O experimento foi conduzido em delineamento inteiramente casualizado, com três níveis de salinidade e dez repetições, totalizando 30 unidades experimentais. As medidas de altura, corte e pesagem da massa verde foram feitas em três períodos, com intervalos de 28 dias entre eles, e fotografia das folhas para análise no software ImageJ no último período. Os dados obtidos foram submetidos ao teste de normalidade de Shapiro-Wilk e teste de homogeneidade de Bartlett. Aplicou-se o teste não paramétrico de Kruskal-Wallis e pós-teste de Dunn para os dados que não seguiram a normalidade e teste ANOVA e pós-teste de Tukey para os que seguiram normalidade e homogeneidade. Os resultados indicam que não houve diferença significativa na altura para os tratamentos com ou sem sal, portanto mesmo com adição de sal não houve interferência no crescimento, mas quando comparado em relação aos períodos, pode-se observar que o último período foi diferente das demais, isso pode ser explicado pelo vigor vegetativo da planta, pois quando mais jovem tem a multiplicação celular mais eficiente, mas à medida que sofre injúrias, o vigor diminui e o crescimento é mais lento. Portanto, existem algumas diferenças no comportamento das gramíneas submetidas à salinidade, mas não interferem significativamente no seu desenvolvimento.

Palavras-chave: Desenvolvimento vegetal; Estatística experimental; Forragem; ImageJ; Salinidade.

Resumen

El pasto buffel tiene características de resistencia y rápida recuperación a la sequía prolongada, sin embargo, pocos estudios indican esta resistencia a la salinidad. Así, el objetivo fue evaluar la relación entre estrés salino y economía de crecimiento, producción de masa verde y área de pasto Buffel. El experimento se realizó en un diseño completamente al azar, con tres niveles de salidad y diez, totalizando 30. Como medidas de altura, corte y pesaje de masa verde se realizaron en tres periodos, con intervalos de 28 días entre ellos, y fotografía de los deja al software ImageJ en el último período. Los datos obtenidos se seleccionaron mediante la prueba de normalidad de Shapiro-Wilk y la prueba de homogeneidad de Bartlett. A los datos que no siguieron la normalidad se les aplicó el test no paramétrico de Kruskal-Wallis y el post-test de Dunn, ya los que siguieron la normalidad y la homogeneidad se les aplicó el test ANOVA y el post-test de Tukey. Los resultados indican que no hubo diferencia de altura para los demás tratamientos con o sin sal, por lo que aún con la adición de sal no hubo interferencia en las diferentes, pero al comparar en relación a los periodos se puede observar la diferencia que el período fue diferente a los diferentes. , esto se puede explicar por el vigor vegetativo de la planta, ya que cuando es más joven tiene más multiplicación celular, pero a medida que sufre lesiones, el vigor disminuye y el crecimiento es más lento. Por lo tanto, existen algunas diferencias en el comportamiento de los pastos, pero no interfieren significativamente con el desarrollo.

Palabras clave: Desarrollo vegetal; Estadística experimental; Forraje; ImagenJ; Salinidad.

1. Introduction

The scarcity of surface water and irregular rainfall in semi-arid regions promotes the reduction of the volume of freshwater, thus, the little water that exists comes from underground sources, which mostly have a high level of salts (Lima et al. 2020). Salt stress, in turn, delays germination, causes growth stunting, seedling mortality, and reduces yield (Al-Dakheel; Hussain; Rahman, 2015).

Among the forage plants used in dry regions, Buffel grass stands out because it has a series of characteristics that provide greater resistance and rapid recovery after prolonged drought (Maranhão et al. 2019). Many authors state that this grass is drought tolerant, however, few studies indicate this resistance to salinity.

Understanding the growth behavior and leaf area of a forage under salt stress is a way to expand forage options for small and medium producers in the region, potentially decreasing the loss of animals in the herd due to lack of food, especially in the dry season (Paula; Ferreira; Véras, 2020).

To understand the various characteristics related to plant growth, we use an important tool, which is the determination of leaf area. It is an indicator of productivity that helps in the processes of irrigation, pesticide application and fertilization (Carvalho et al. 2017).

With the popularization of digital cameras and image processing programs, many researchers began to use high-resolution photographs captured with these cameras and process these files with software. A software widely used in several areas is ImageJ (Broeke; Pérez; Pascau, 2015).

ImageJ uses a pixel count measurement to calculate leaf area and images can be captured using cell phone cameras with no decrease in image quality, and the time required to capture and analyze leaf area using the software is considerably shorter when compared to traditional desktop scanner methods (Easlon; Bloom, 2014).

Thus, it is proposed to evaluate the relationship of salt stress and the dynamics of growth and development of Buffel grass.

2. Methodology

The research was conducted at the Universidade Federal Rural de Pernambuco (UFRPE), in the municipality of Recife-PE. The climate is tropical, with Aw classification according to Koppen and Geiger and the average annual temperature is 25.7 ºC. It has an average annual rainfall of 988 mm.

The soil used came from the experimental area of the Universidade Federal Rural de Pernambuco (UFRPE), Academic Unit of Serra Talhada (UAST), located under the geographical coordinates 07° 57' 01" S and 38° 17' 53" O, with an approximate altitude of 523 m, situated in the municipality of Serra Talhada, Microregion of Sertão do Pajeú, Mesoregion of Sertão Pernambuco, being this, a region where normally buffel grass is cultivated.

Collected in the depth of 0-20 cm of the profile, crushed, subjected to revolving for drying in air, homogenized and packed in plastic pots, perforated at the bottom for drainage of irrigation water, the soil was classified as Cambissolo Háplico described according to the classification of Embrapa (2006).

The experiment was conducted in entirely randomized design, in three levels of salinity of irrigation water, with ten repetitions, totaling 30 experimental units.

Salinity can be divided into four classes: class C1, low risk, in which the Electrical Conductivity (EC) is less than 2.5 dS.cm-1; class C2, moderate risk, EC between 2.5 dS.cm-1 and 7.5 dS.cm-1; class C3, medium risk, EC between 7.5 dS.cm-1 and 22.5 dS.cm-1; and class C4, high risk, EC between 22.5 dS.cm-1 and 50 dS.cm-1. Irrigation with EC above 50 dS.cm-1 is already extremely difficult (Audry; Suassuna, 1995).

To obtain the salinity levels, sodium chloride salts (NaCl) were added to the water at concentrations of 0, 1 and 2 g/L, the zero concentration being without salt. For the 0 g/L concentration the risk is low, the Electrical Conductivity (EC) is less than 2.5 dS.m-1, the 1 g/L concentration has EC of approximately 7.5 dS.m-1 where the risk is moderate, and the 2 g/L concentration has EC around 22.5 dS/m of medium risk.

Buffel grass seeds were planted in 30 pots with 7 L capacity. 3.5 kg of air-dried soil was placed and sowing was performed with 10 seeds per pot. After the sprouting and growth of the plants in the average height of 60 cm, thinning was done to uniform the samples and start the treatment. A cut was made, standardizing the lengths in 10 cm. Soon after, the Buffel grass was submitted to three different levels of salinity, being level zero (available water), level 1 (1 g/L) and level 2 (2 g/L). The pots with the plants received water every other day, in the amount of 500 mL each, with the respective treatments.

Every 28 days, the height of all experimental units was measured using a tape measure, followed by cutting the plants at 10 cm. The green mass produced was weighed using a millimetric balance. The green mass was dried by an adaptive process of exsiccata, in which the leaves were wrapped in newspaper and cardboard sheets, placed in the sun for three days until they dried completely. After drying, the material was weighed again to check the amount of water lost. From the percentage of moisture, the dry mass of the grass was calculated.

The height of the plant was determined by the distance from the base of the soil in the pot to the tip of the leaves. The green mass was obtained by the sum of forage mass accumulation at each cut, and the dry mass was determined at the end of each evaluation period for leaves.

Three cuts were made during the process, therefore, three measurements. At the end, ten leaves were taken from each

experimental unit to be photographed with a 13-megapixel camera. The images in PNG format were analyzed using ImageJ software, in Windows 10 (64 bits), with Java pre-installed.

To measure leaf area from digital images in ImageJ one must follow a few steps, these are: image processing to separate the leaf image from the photo background; setting the scale using a known distance on the image; estimating the leaf area from the pixel count and calibration scale (Katabuchi, 2015).

After installation, calibration of the software was made using a 5 cm x 5 cm millimeter paper, procedure necessary to obtain a reference area, so that it is possible to know how many pixels exist there, and thus determine proportionally the area of the leaf blade. And then, a digital treatment of the images was made, to transform the photo in black and white scale and to count the black pixels to determine the area.

The results obtained were expressed by mean and standard deviation and submitted to the Shapiro-Wilk normality test and Bartlett's homogeneity test. Kruskal-Wallis non-parametric test and Dunn post-test was applied for some data that did not follow normality and ANOVA test and Tukey post-test for those that followed normality and homogeneity. A 5% probability level was adopted for rejection of the null hypothesis, and the statistical software R Development Core Team (2020) was used to process the analyses.

3. Results and Discussion

Table 1 shows the descriptive data of height and green mass of Buffel grass. The parameters mean, median, standard deviation and coefficient of variation (CV) were used, with the purpose of understanding the behavior of these variables according to the periods (1, 2 and 3) and treatments applied, being A, treatment without salt addition, B, addition of 1g/L of salt, and C, addition of 2g/L of salt. It can be observed that the mean values decreased over the periods, both for height and green mass.

Table 1. Descriptive data of height and green mass of Buffel grass.

Variable	Period	Treatment	Average	Median	Standard deviation	CV
Height	1	A	46.6	45.0	10.75	23%
	1	B	41.2	42.5	11.56	28%
	1	C	46.0	41.0	18.28	40%
	2	A	46.3	48.5	9.82	21%
	2	B	39.9	34.5	13.12	33%
	2	C	41.8	41.0	10.52	25%
	3	A	32.7	33.5	6.93	21%
	3	B	34.5	31.5	12.37	36%
	3	C	34.6	37.0	8.83	26%
Green Mass	1	A	22.2	21.5	7.66	35%
	1	B	21.3	20.0	5.89	28%
	1	C	20.7	20.0	8.86	43%
	2	A	22.0	23.5	6.38	29%
	2	B	17.3	17.0	5.10	29%
	2	C	19.6	18.0	7.72	39%
	3	A	16.7	17.0	4.71	28%
	3	B	14.2	13.5	3.49	25%
	3	C	13.9	14.5	4.20	30%

Source: Authors.

The normality test was performed for the variables studied (Table 2), it was observed that for green mass, all the values followed the normal distribution according to the Shapiro-Wilk test. However, some values of the height variable did not follow normality, thus, it is not possible to use the analysis of variance for these values, therefore, non-parametric methods are suitable for this case.

Table 2. Shapiro-Wilk normality for height and green mass data of Buffel grass.

Variable	Period	Treatment	Shapiro-Wilk	P-Value
Height	1	A	0.93949	0.547
		B	0.9718	0.907
		C	0.81503	0.022*
	2	A	0.92194	0.373
		B	0.78855	0.011*
		C	0.97317	0.919
	3	A	0.95721	0.754
		B	0.73009	0.002*
		C	0.85287	0.063
Green Mass	1	A	0.95601	0.7396
		B	0.9258	0.4079
		C	0.95968	0.7822
	2	A	0.93803	0.5313
		B	0.90789	0.2668
		C	0.91747	0.3363
	3	A	0.96799	0.8716
		B	0.91823	0.3424
		C	0.93281	0.4761

*($p<0.05$) Source: Authors.

When initially evaluating the Buffel grass height values by the Kruskal-Wallis test, it is verified, according to Table 3, that there was no significant difference in height compared to the treatments throughout all the periods, visualizing that even with more salt addition to the water, the height did not vary statistically.

Table 3. Kruskal-Wallis test for height values as a function of treatment.

Comparison	Period	H-statistic	P-Value
Height x Treatment	All	1.9707	0.3733
Height x Treatment	1	0.94836	0.6224
Height x Treatment	2	2.6911	0.2604
Height x Treatment	3	0.22253	0.8947

Source: Authors.

In a study by Ruiz and Taleisnik, (2013) the influence of salinity in a hydroponic system on the growth, yield, and germination of Buffel grass was investigated. It was observed that there is tolerance to salinity and that it does not affect the height sharply, occurring only subtle decreases in production and biomass yield. Plant germination decreased when salt was added to the water. Therefore, the persistence of Buffel grass is not limited to the development and growth in saline water, but in the germination of the plant.

When compared the height in relation to the periods for each treatment (Table 4), still by means of the Kruskal-Wallis test, a significant difference is observed in the comparison between height and period, for the treatment without salt addition.

Table 4. Kruskal-Wallis test for height values as a function of period

Comparison	Treatment	H-statistic	P-Value
Height x Period	A	10.625	0.00493*
Height x Period	B	3.4461	0.17850
Height x Period	C	2.6432	0.26670

*(p<0.05) Source: Authors.

When applying Dunn's test (Table 5), it can be seen that there was a difference between periods 1 and 3 and between 2 and 3 for treatment A (no salt added). Indicating that period 3 is different from the others. This period represents the last cut, in which, the values of height are the lowest.

Therefore, it is not possible to observe a difference in the growth of the plants when saline water was applied, but, at each new cut, the height decreased, becoming more evident in period 3. This may be explained by the fact that when the plant is younger it has a greater capacity for cell multiplication, but as it suffers damage, this capacity decreases and so the plant loses its vegetative vigor.

Although there was no significant difference in height in relation to the addition of salt in this study, it is possible that changes occur when increasing this level, as is observed in the study by Almeida et al. (2021) who reports that the accumulation of salts in the soil hindered water absorption, toxicity of specific ions in plants and by the interference of salts in physiological processes, thus decreasing plant height.

In the process of herbivory or mechanical cutting, the leaves are removed from the plant, and consequently, forage accumulation is reduced because of the need for more time for leaf recovery. It is essential to know the limits of cutting height that the plant can suffer and make its recovery easier. For Buffel grass it was recorded that the greatest yield and leaf growth occurs when cut at 10 cm in height (Beltrán-López et al. 2005).

Table 5. Dunn's post-test for height as a function of period.

	1	2
2	0.477202 0.316600	
3	3.602507 0.000200*	3.125305 0.000900*

Source: Authors.

When analyzing the values of green mass, the criterion of normality by the Shapiro-Wilk test was met. The homogeneity test of Bartlett was also performed, because the homogeneity of variances is another assumption for the analysis of variance. It is observed in Table 6, that the values of green mass in relation to the treatments and the periods are homogeneous, and with this, ANOVA can be adopted.

Table 6. Bartlett homogeneity for green mass.

Variable	Treatment	Bartlett	P-Value
Green Mass x Treatment	A	2.5893	0.274
Green Mass x Period	B	3.6901	0.158

Source: Authors.

For green mass analysis as a function of treatments (Table 7), there was no significant difference in mean green mass of grass in relation to the different levels of salinity applied, thus indicating that the treatments of available water, 1g/L of water and 2g/L of water, are statistically equal, and have no influence on plant production.

Table 7. Analysis of Variance of green mass as a function of treatments A, B and C.

Variation Factor	degrees of freedom	sum of squares	average square	F calculated	P-Value
Treatment	2	125	62.48	1.406	0.251
Waste	87	3865	44.43		
Total	89	3990			

Source: Authors.

As for the analysis of green mass as a function of the periods (Table 8), a significant difference is verified by ANOVA, requiring a post-test to identify where it occurs.

Table 8. Analysis of Variance of green mass as a function of periods 1, 2 and 3.

Variation Factor	degrees of freedom	sum of squares	average square	F calculated	P-Value
Treatment	2	670	335.1	8.782	0.000336***
Waste	87	3320	38.2		
Total	89				

*(p<0.001) Source: Authors.

When applying Tukey's test for green mass in function of the period (Table 9), it is observed that the difference is between treatments 1 and 3 and between 2 and 3. Indicating again that the last period diverges in relation to the others. Another possible explanation for the decrease in height and green mass after a sequence of cuts may be due to the soil, considering that no type of fertilization was performed, besides the fact that there is leaching of minerals caused by irrigation, promoting a nutritional deficit in the plants, and with each application of salt the soil becomes more concentrated inducing a delay in plant growth.

Table 9. Tukey test for green mass as a function of periods 1, 2 and 3.

Period	Difference	Lower bound	Upper bounds	Adjusted P-value
2-1	-1.77	-5.57	2.04	0.5119
3-1	-6.47	-10.27	-2.66	0.0003*
3-2	-4.70	-8.50	-0.90	0.0113*

*(p<0.05) Source: Authors.

For visual analysis of the data the boxplot of the area of Buffel grass submitted to treatments A, B and C was made (Figure 1). Observing the dispersion of the data, it can be seen that there was no great difference between the treatments. However, treatment A (without salt addition) has greater data variability, thus encompassing greater area values. There is considerable symmetry in the treatments, especially between A and B, since most of the values are close to the median. Treatment C is closer to a negative asymmetry, since the values are immediately below the median value. There are outliers in all treatments, but treatment B has more outliers than the others.

Figure 1. Boxplot of Buffel grass area submitted to treatments A (no salt added), B (1g/L of added), and C (2g/L of salt added).
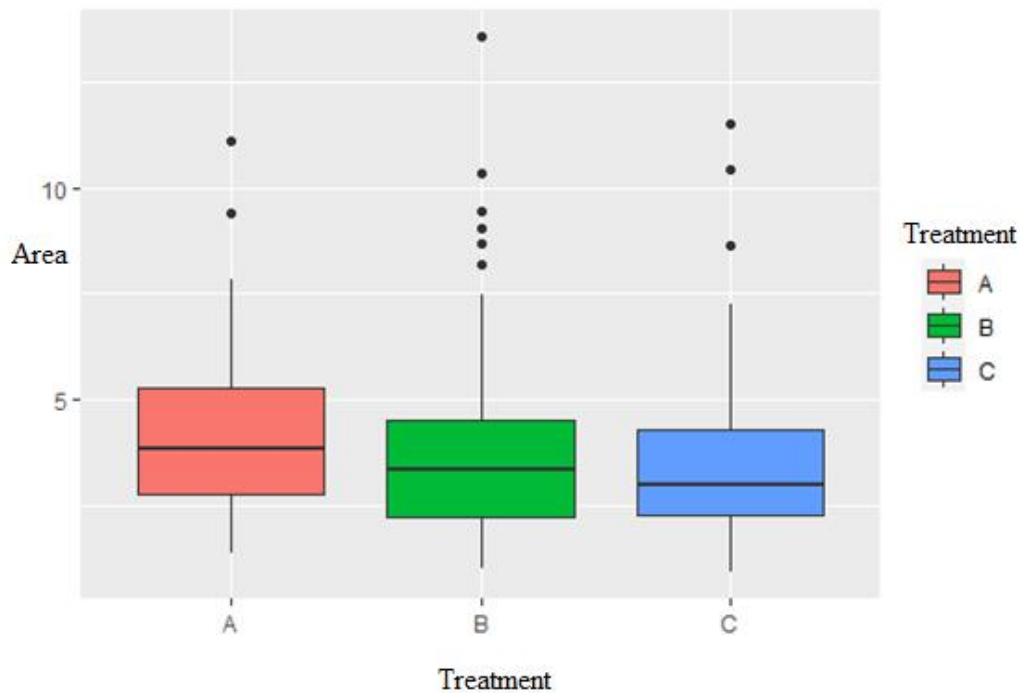
Source: Authors.

The leaf is one of the most important organs of plants, it is responsible for converting solar energy into biological energy through photosynthesis. Leaf size, quantity, functional characteristics, and photosynthetic capacity are closely related to its development (Huang et al. 2019). Therefore, the importance of analyzing leaf area.

To evaluate the leaf area of Buffel grass, leaf samples were collected from each pot in the last cutting period. In Table 10 are shown the normality values by the Shapiro-Wilk test for the data of Buffel grass area submitted to saline treatments. As a result, there is the non-normality of the data, implying the use of non-parametric statistics.

Table 10. Shapiro-Wilk normality for Buffel grass area data.

Variable	Treatment	Shapiro-Wilk	P-Value
	A	0.92846	0.000*
Area	B	0.86989	0.000*
	C	0.8704	0.000*

*(p<0.05)

Source: Authors.

Analysis of the area data by the Kruskal-Wallis test (Table 11) showed a significant difference when comparing the area in relation to the treatments applied, requiring a post-test to identify where the difference occurred.

Table 11. Kruskal-Wallis test for area data as a function of treatment.

Comparison	H-statistic	P-value
Area x Treatment	8.4554	0.01459*

*(p<0.05) Source: Authors.

As post-test, Dunn's test was applied (Table 12), and from it, it was identified that there is significant difference between treatments A and B, and A and C, thus, the treatment without addition of salt was different from the others. Thus, it is observed that when salt is applied to the irrigation water of Buffel grass, there is a slight decrease in the leaf area and that the treatment without the addition of salt has a slightly better response. This decrease in leaf area may have occurred due to osmotic stress caused by salinity and thus the plant activates this adaptation mechanism for less loss of water to the environment. The reduction of leaf area can be considered the first line of defense against drought or adversity (Gilbert; Zwieniecki; Holbrook, 2011).

Table 12. Dunn's post-test for area as a function of treatment.

	A	B
B	2.033774	
	0.021000*	
C	2.816716	0.782942
	0.002400*	0.216800

*(p<0.05) Source: Authors.

Table 13 shows the correlations of area and height for treatments A, B and C. It was identified that there is a correlation of 0.62 for comparison of the area with all the treatments applied, thus indicating moderate positive correlation, that is, as the height increases the area also increases. When compared separately the area with the height in different treatments, it was observed that only for treatment B (addition of 1 g/L of salt) there was a strong and positive correlation.

Table 13. Correlation Area and Height for treatment A, B and C.

Comparison	Spearman - rho	P-value
Area x All	0.6214445	0.0002471
Area x A	0.4863244	0.1541000
Area x B	0.8303030	0.0055570
Area x C	0.3414698	0.3342000

Source: Authors.

In Table 14 are presented the correlations of area and green mass for treatments A, B and C. It was identified that there is correlation of 0.62, for comparison of area with all treatments applied for green mass, thus indicating a moderate positive correlation, that is, green mass increases simultaneously with area.

When compared separately the area with the green mass in different treatments, it was observed that only for treatment B (addition of 1 g/L of salt) there was correlation, being this moderate and positive. Thus, it is noted that both for the

correlation of area and height and for area and green mass, the behaviour was similar. This occurs because the height is directly associated with the green mass, the taller the grass, the greener mass it will have.

According to Moreira et al. (2015), the length and width of the leaves are decisive factors in establishing the leaf area, which enables greater light interception, and consequently, obtaining greater photosynthetic rates. The height of the plant is determined by the amount of photo assimilates captured and processed by the plant, so the larger the area, the better the leaf development and the greater the amount of biomass produced.

Table 14. Correlation Area and Green Mass for treatments A, B and C.

Comparison	Spearman - rho	P-value
Area x All	0.6214445	0.0002471
Area x A	0.4680873	0.1725000
Area x B	0.6422289	0.0452600
Area x C	0.5670837	0.0873500

Source: Authors.

Table 15 shows the percentages of partial dry mass (nutrient portion of the food after removal of moisture) of Buffel grass for each treatment for the three periods. In general, the dry mass values are similar for all treatments and periods. It is noteworthy that the highest percentage of dry mass was 26.76% for treatment B in the third period and the lowest dry mass value occurred in the first period for treatment A, which was 22.73%.

Table 15. Dry mass of Buffel grass.

Treatment	Period	Dry samples	Wet samples	% Moisture	% Dry mass
A	1	55	222	75.23	24.77
A	2	50	220	77.27	22.73
A	3	39	167	76.65	23.35
B	1	53	213	75.12	24.88
B	2	43	173	75.14	24.86
B	3	38	142	73.24	26.76
C	1	51	207	75.36	24.64
C	2	46	196	76.53	23.47
C	3	32	139	76.98	23.02

Source: Authors.

Coutinho et al. (2015) conducted a study on the production characteristics of Buffel grass under different irrigation shifts and observed that the dry matter of the grass grew linearly with the increase in irrigation shifts, that is, the more days the grass spent without receiving water, the greater the dry matter was. This is due to the decrease in the amount of water in the grass, which promotes an increase in the percentage of dry material.

The highest value reached by Coutinho et al. (2015) was 37% of dry matter, with irrigation shift of 10 days. The lowest value was around 16%, with two days interval between irrigations. The higher dry matter value causes reduction in morphological, structural and productive parameters of Buffel grass. For the grass with an irrigation shift of two days, fewer are the restrictions on its development.

The values of dry mass in the present study varied from 22 to 26% and the irrigation interval was one day. Thus, even with a shorter interval between irrigations, the dry mass value was greater in comparison with the values of the above-mentioned work. Thus, the percentage of nutrients that are used by animals, such as: protein, fiber, minerals, ethereal extract and carbohydrate; that compose the dry mass, are in accordance with the values of grass in natura.

Pinho et al. (2013) conducted a study evaluating Buffel grass hay at different cutting heights. The average dry matter values of the grass in natura form varied according to the harvest height, and were from 17.31 to 20.17% for lower and higher height, respectively. The nutritional value of the grass at greater and lesser heights was evaluated, and it was observed that there was no difference in the bromatological composition. This allowed the grass to be harvested at a greater production height, so that there is no accumulation of senescent material, since this would decrease the nutritional value of the food.

Knowledge of plant height, forage mass and area are important to determine the appropriate conditions for sustainable grazing and efficient animal production. For a higher pasture productivity it is necessary to know the management, seek conservation forms for use in dry periods, as well as, insert technologies and mechanization in the field (Nunes et al. 2015). Thus, the analysis of growth and development of Buffel grass becomes an important tool for characterizing the plant production, to verify its potential in animal production.

4. Conclusion

Buffel grass submitted to salinity showed similar behaviour in growth and production for the three treatments. There was a difference only when comparing the cutting period, in which the last period showed less growth and production.

As for the determination of the area by means of image processing, there was a difference in the area for the treatment without salt, which was slightly larger.

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