IRRIGATION AND SWINE SLURRY APPLICATION OF TIFTON 85 GRASS: PRODUCTION AND NUTRITIONAL QUALITY

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ABSTRACT: The use of irrigation and fertilization with swine wastewater (SW) can be an excellent alternative to increase the production and pasture quality. The work was carried out from October 2013 to September 2014 in Dourados - MS, and aimed to evaluate the production and nutritional quality of Tifton 85 grass (*Cynodon* spp.) under different rates of SW, in the presence and absence of irrigation. The experiment design was randomized blocks in a split plot scheme, with irrigation and without irrigation in the plots, and four rates of SS in the subplots: 75, 150, 225 and 300 m^3 ha^{-1} cut^{-1}, with four replications. There was a significant effect of irrigation and SS rates on Total dry matter, reaching 41.4 Mg ha^{-1} y^{-1} with the highest dose tested and associated with the use of irrigation. Irrigation also provided higher levels of crude protein, increasing with linear adjustment to SS rates, reaching 17.9 % in the annual average. The neutral detergent fiber and the acid detergent fiber presented lower irrigation results and decreased linearly at the rates of SS, reaching 65.40 and 32.55% in the annual average, respectively. It was observed an inverse behavior of the "*in vitro*" digestibility of dry matter, which was higher under irrigation, reaching 69.5% in the annual average and presenting linear growth for the SS rates.

KEYWORDS: organic fertilization, botanical composition, dry matter production, forage quality, sprinkler irrigation.

APLICAÇÃO DE DEJETO LÍQUIDO DE SUÍNO E IRRIGAÇÃO DE CAPIM TIFTON 85: PRODUTIVIDADE E QUALIDADE NUTRICIONAL

RESUMO: O uso da irrigação e fertilização com dejeto líquido de suíno (DLS) pode constituir-se em uma excelente alternativa para incrementar a produtividade e qualidade das pastagens. O trabalho foi realizado no período de outubro de 2013 a setembro de 2014 em Dourados - MS e

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teve por objetivo avaliar a produtividade e a qualidade nutricional do capim Tifton 85 (*Cynodon* spp.) sob diferentes doses de DLS, na presença e ausência de irrigação. O delineamento experimental utilizado foi de blocos ao acaso com parcelas subdivididas, com e sem irrigação nas parcelas, e quatro doses de DLS nas subparcelas: 75, 150, 225 e 300 m^3 ha^{-1} $corte^{-1}$, com quatro repetições. Houve efeito significativo da irrigação e das doses de DLS na produtividade total de matéria seca, atingindo 41,4 Mg ha^{-1} ano^{-1} com a maior dose testada e associada com a utilização de irrigação. A irrigação também propiciou maiores teores de proteína bruta, crescente com ajuste linear às doses de DLS, atingindo 17,9 % na média anual. A fibra em detergente neutro e a fibra em detergente ácido apresentaram menores resultados sob irrigação e decresceram linearmente às doses de DLS, atingindo 65,40 e 32,55% na média anual, respectivamente. Foi observado comportamento inverso da digestibilidade "in vitro" da matéria seca, que foi maior sob irrigação, atingindo 69,5% na média anual e apresentando crescimento linear para as doses de DLS.

PALAVRAS-CHAVE: adubação orgânica, composição botânica, produtividade de massa seca, qualidade de forragem, irrigação por aspersão

INTRODUCTION

The climatic changes suffered in the last decades in the world have been promoting direct effects on grasses (RAZ-YASEEF et al., 2015; BARBOSA, 2016; KALAUGHER et al., 2017), Including changes in rainfall patterns that may lead to a considerable decline in agricultural production (MALL, GUPTA and SONKAR, 2017), causing the seasonality of the production of tropical plants (DANTAS et al., 2016), common in various regions of Brazil (Gomes et al., 2015th). Irrigation has been used to reduce seasonality in the Center-South regions of Brazil (GOMES et al., 2015b), but without eliminating it (SANCHES et al., 2015). In this way, we highlight the Cynodons, which has presented excellent productive results with irrigation, attenuating the seasonality with good nutritional results, especially Tifton 85 (GOMES et al., 2015b; SANCHES et al., 2015, 2016, 2017).

For the Central-South regions of Brazil, recent surveys with and without irrigation indicate average accumulation increments between 25 and 55 kg ha^{-1} day^{-1} of dry matter (DM) with irrigation in the production of Tifton 85 (QUEIROZ et al., 2012; NOGUEIRA et al. (GOMES et al., 2015a, 2015b, SANCHES et al., 2015, 2016, 2017).

Subsequent strategy to promote the intensification of pastures is the nitrogen fertilization,

with increasing linear responses in Tifton 85 (Lent et al, 2011;. GOMES et al, 2015b;. TAFFAREL et al, 2016;. SANCHES et al, 2017). However, with the high cost of mineral fertilization, producers have sought lower-cost sources such as biofertilizers (ORRICO JUNIOR, et al., 2013). Swine wastewater (SW) is among the most used, because they are produced in large quantities, need a suitable environmental destination and are rich in several elements important for the growth of grasses, such as nitrogen, phosphorus and potassium (ZHAO et al., 2009; SILVA et al., 2015).

The application of SS in the pastures occurs without adequate fertirrigation, since it requires investments in infrastructure (ANDRADE et al., 2014), prioritizing the fate of the effluent, with an increase in production below potential. The objectives of the research were to evaluate the productivity, botanical composition and nutritional quality of Tifton 85 grass under SS doses in the absence and presence of irrigation.

MATERIALS AND METHODS

This work was conducted at the Experimental Farm of the Federal University of Grande Dourados, in Dourados-MS (latitude 22º 14 'south and longitude 54º 59' west, with altitude of 434 m) from October 2013 to September 2014, corresponding to one year experimental. The climate is humid mesothermic type (Cwa), with rainy summer and dry winter. The soil of the experimental area is classified as Dystroferric Red Latosol (SANTOS et al., 2013).

In the experimental period the cumulative value of precipitation was 896 and 438.8 mm, in the wet season (October to March) and dry (April to September), respectively. The mean relative humidity was 70.3 and 71.6%, in the wet and dry season, and minimum temperature of 11.8 ºC and 4.9 ºC, respectively (Figure 1).

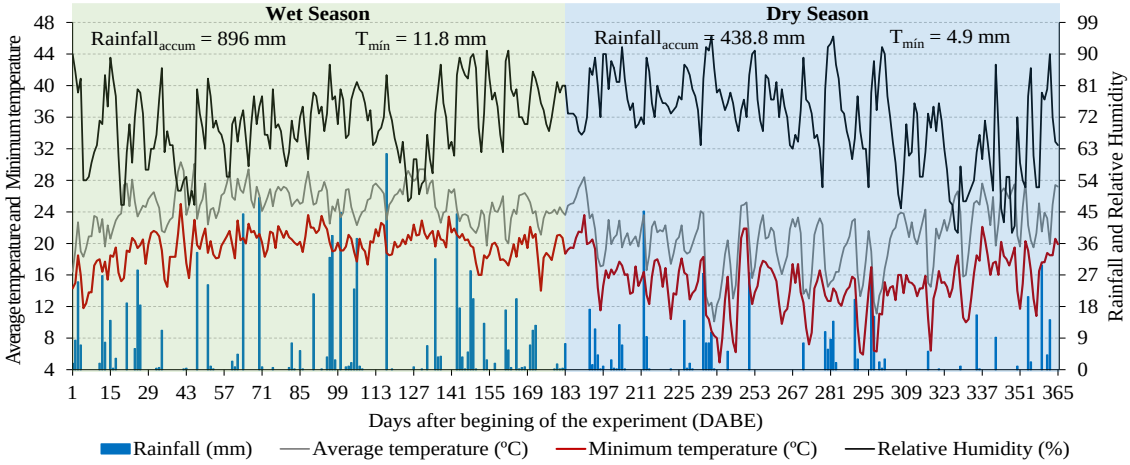

Figure 1. Precipitation values (mm), mean temperature (ºC), minimum temperature (ºC) and relative humidity (%) from October 1, 2013 to September 30, 2014. Dourados - MS.

The experimental design was a randomized complete block design with split plots, with and without irrigation in the plots, and four doses of swine wastewater (SW) in the subplots: 75, 150, 225 and 300 m^3 ha^{-1} cut^{-1}, with four Repetitions, totalizing 32 experimental plots. Each subplot was implanted with 3 m^2 (2 m x 1.5 m).

The SW was collected from the third and last decantation pond of a pig farm located near the experimental area and transported using a sealed polyethylene reservoir. DLS applications in the pasture were carried out immediately after their arrival in the experiment area and always after the collection of the Tifton 85 grass. The irrigation system installed was by conventional sprinkler, with Agropolo® NY 30 sprinklers spaced 12 m by 12 m. The intensity of application (IA) was determined locally, obtaining a value of 23 mm h^{-1} at 196 kPa of pressure.

Irrigation management was carried out by means of tensiometers installed at 0.20 m depth, being 4 in the irrigated area and 4 in the non-irrigated area. In the area without irrigation the tensiometers had a comparison purpose. Soil water tension readings were performed on Tuesdays and Fridays, with subsequent irrigation when soil water tension was equal to or greater than 20 kPa. In the dry season, the average tensions of 17.6 and 52.6 kPa with and without irrigation, respectively, were verified, and in the wet season average tensions of 18.5 and 36.2 kPa with and without irrigation (Figure 2).

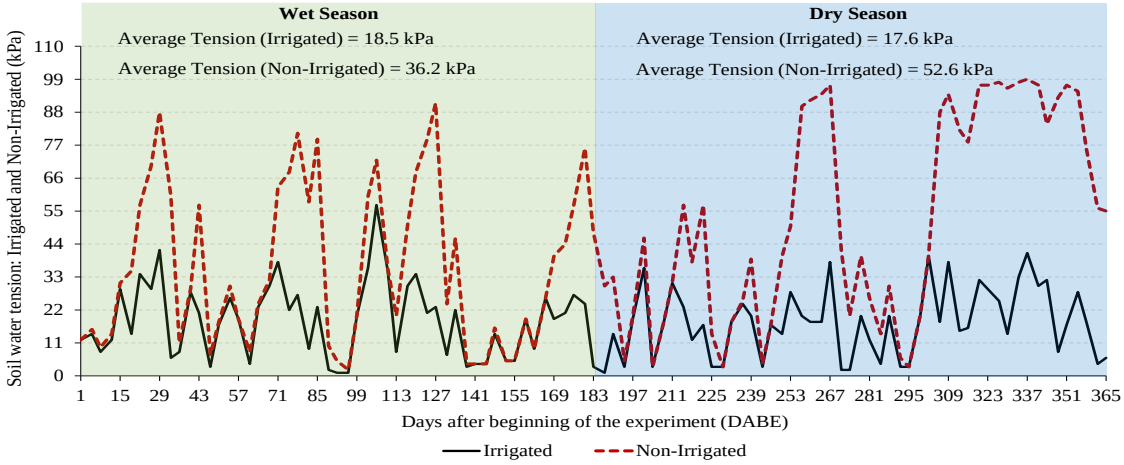

Figure 2. Water tension values in the soil during the experimental cycle, in Tifton 85 grass area with and without irrigation. Dourados - MS, 2013 - 2014.

The moisture at the field capacity (Θcc) was considered as the humidity corresponding to the value of Ψm = 10 kPa. In this way, the irrigation depth (ID) to be applied was determined by the difference between volumetric moisture in the field capacity (Θcc) and the current volumetric moisture (Θa), multiplied by the effective root depth (Z), equal to 400 mm. The time of irrigation (TI), in each event, was obtained by the ratio of ID by intensity of application (IA). The values of Θa were estimated by means of the soil water retention curve, obtained with the

aid of a Richards extractor in the Laboratory of Relations, Water, Soil, Plant and Atmosphere of the Federal University of Grande Dourados (UFGD) and adjusted by equation Of Van Genuchten (1980):

$$\theta a = 0{,}192 + \left[\frac{(0{,}391-0{,}192)}{\left[1+(0{,}0003\,\Psi_a)^{0{,}3240}\right]^{5{,}6392}}\right];(R^2=0{,}99 \text{ e } P<0{,}01)$$

Where:
Θa = current volumetric humidity ($cm^3\ cm^{-3}$).
"Ψa" = current matricial potential of water in the soil (kPa).

The accumulated irrigation depth during the experimental period was 400 mm, distributed through 29 events, with 15 events (186 mm) and 14 events (214 mm) occurring in the wet and dry season, respectively.

The cuts were performed at intervals of 30 days, with post-cut height of 10 cm (residue), by means of costal brushcutter. Before cutting, a 0.25 m2 frame was placed in the center of each plot to collect the fodder produced up to the height of the residue. The collected samples were botanically separated in dead material, stem + sheath + leaves and taken to the forced circulation oven at 65ºC for 72 hours to determine the dry matter of: Total Forage Productivity (TFP) and leaf and stem production (LSP). Subsequently, sub samples were taken to determine the bromatological components of dry matter (DM), crude protein (CP), neutral detergent fiber (NDF), acid detergent fiber (ADF), and dry matter in vitro digestibility (DivDM), According to Silva & Queiroz (2002).

The experimental data were submitted to analysis of variance at 5% probability and regression analysis when significant differences were observed between the doses of SW. The software used was Assistat 7.7 (FRANCISCO, CARLOS, 2016).

RESULTS AND DISCUSSION

Total forage productivity (TFP) and leaf and stem yield (PFC) were higher with irrigation, and responded in a linear linear manner to annual SW rates in the annual accumulation (Figures 3a and 3b).

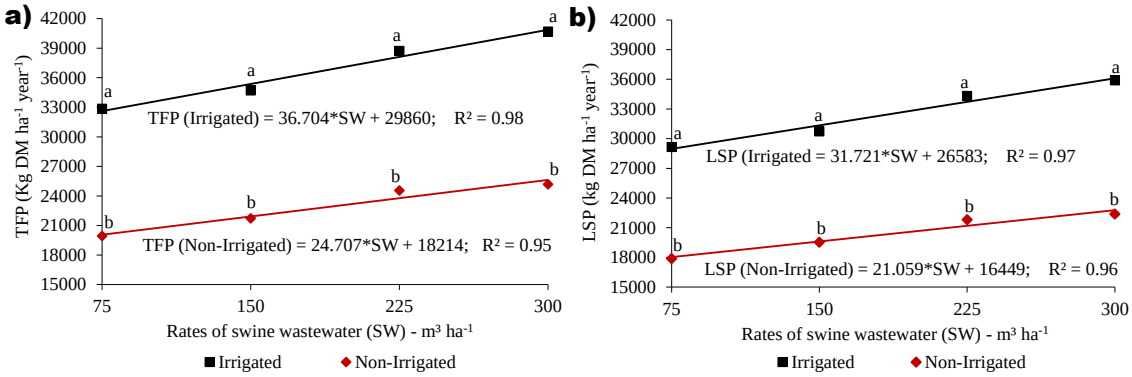

Figure 3. Total productivity (a) and yield of leaves and stems (a) of the dry matter of Tifton 85 grass as a function of irrigation and the doses SW. Dourados - MS, 2013-2014.

The maximum dry matter yields obtained without irrigation equal to 25171 kg ha^{-1} year^{-1} (69 kg ha^{-1} day^{-1}) and with irrigation equal to 40686 kg ha^{-1} year^{-1} (111.4 kg ha^{-1} day^{-1}) are corroborated by the literature, which mention for Tifton 85 grass without irrigation accumulations between 55 and 90 kg ha^{-1} day^{-1} of dry matter (RIBEIRO & PEREIRA, 2011; FAGUNDES et al., 2012; GOMES et al., 2015b, SANCHES et al., 2016). While, with irrigation the accumulated dry matter has been between 105 and 125 kg ha^{-1} day^{-1} (QUEIROZ et al., 2012; NOGUEIRA et al., 2013; TEIXEIRA et al., 2013; GOMES et al., 2015b, SANCHES et al., 2016).

In a study with Tifton 85 Sanches et al. (2016) reached 37603.1 and 25457.6 kg ha^{-1}year^{-1}of irrigated and non-irrigated, corroborating the present study. In relation to the application of SW doses in Tifton 85 grass (Figure 4A), other authors also observed the occurrence of increasing linear behavior of dry matter yield. However, it is not easy to establish a direct comparison between these surveys, since besides the distinct edaphoclimatic conditions, the presence or absence of irrigation, the chemical composition of SW, the analyzed period, the doses used and the frequency of the applications.

The levels of neutral detergent fiber (NDF) and acid detergent fiber (ADF) corresponded in a linearly decreasing manner to the doses of SW applied (Figures 4a) and 4b). The FDA responded to irrigation (Figure 4 (b)). Tifton 85 with different nitrogen doses (25, 50, 75 and 100 kg of N ha^{-1}) did not respond to the doses, however, it responded to irrigation (SANCHES et al., 2017). Argument that justifies the fact, is little increase occurred with the use of doses, not resulting in significant effect.

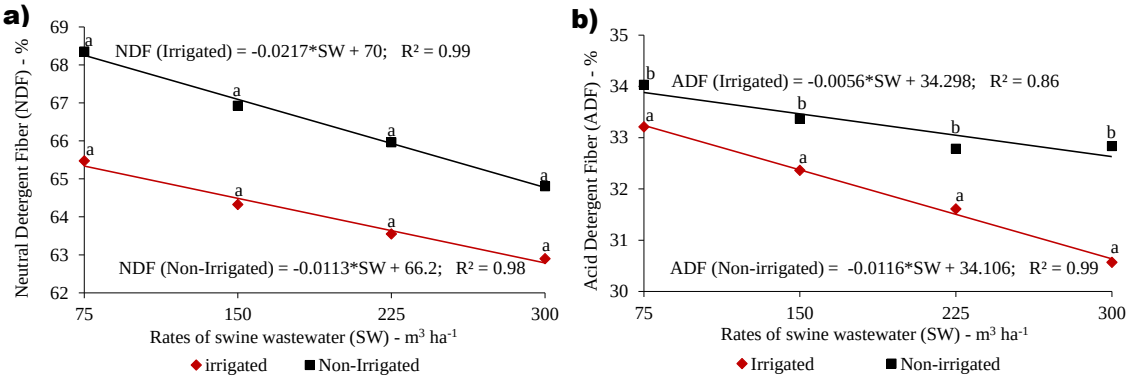

Figure 4. Neutral detergent fiber and acid detergent fiber of dry matter of Tifton 85 grass as a function of irrigation and doses of SW. Dourados - MS, 2013-2014.

The mean annual values of NDF and ADF found in the irrigated area were respectively 64.1 and 31.9% and the mean annual values of NDF and ADF found in the area without irrigation were respectively 66.5 and 33.3%. Sanches et al. (2015) conducting experiment with Tifton 85 with and without irrigation, in the Northwest of Paraná state, in Brazil, from April to November, also verified higher values of NDF and FDA in the absence of irrigation. The authors verified mean values of NDF and ADF with irrigation of 70.2 and 32.5% and 72.0 and 32.7% without irrigation, respectively.

The crude protein (CP) of pasture with irrigation was higher than without irrigation (Figure 5a), corroborating several works by Tifton 85 (GOMES et al. 2015a, 2015b, SANCHES et al. 2015, 2016, 2017). The CP also responded linearly to SW doses.

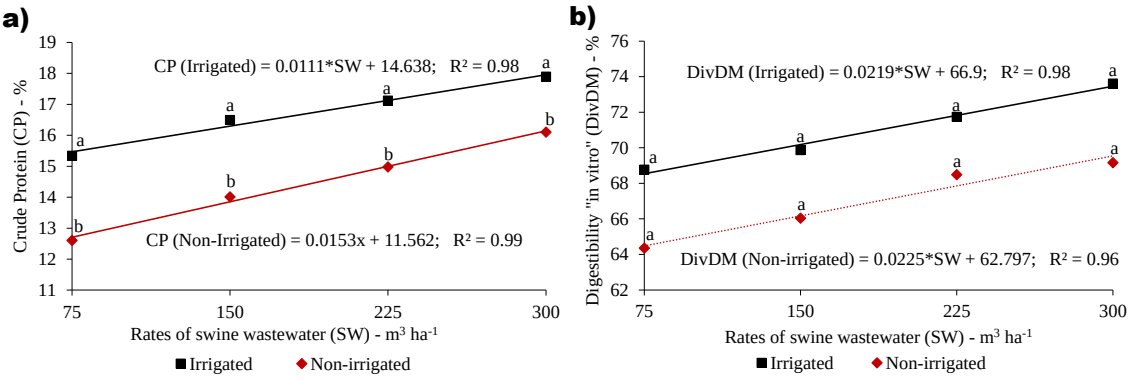

Figure 5. Gross protein levels and in vitro digestibility of Tifton 85 grass matter as a function of irrigation and SW. Dourados - MS, 2013-2014.

The in vitro digestibility of dry matter of Tifton 85 grass was higher with irrigation and responded in an increasing linear manner to the SW doses (Figures 5b). Works by Sanches et al. (2000, 2016, 2017) has shown an average increase of 2% with Tifton 85 irrigation, demonstrating that the improvement in the edaphoclimatic conditions can bring improvements

to the grass (RAZ-YASEEF et al., 2015, BARBOSA, 2016, KALAUGHER et al. , 2017), such as digestibility, which is very important for ruminant.

At SW doses of 75 to 300 m^3 ha^{-1}, annual mean CP values ranged from 15.3 to 17.9% and 12.6 to 16.1% with and without irrigation, respectively. The highest CP values under irrigation should be related to the lower soil water stresses in this condition for most of the experimental period (Figure 2).

CONCLUSION

The Tifton 85 grass presented linear behavior in relation to the SW doses applied; increasing for yield, protein and digestibility "in vitro"; decreasing for neutral detergent fiber and acid detergent fiber.

Using the sprinkler system, not only for the application of SW, but also for irrigation, it increases dry matter yield and improves the nutritional quality of Tifton 85 grass.

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