Morphogenesis of Marandu brachiaria under different nitrogen rates in the brazilian savannah

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Abstract: Nitrogen fertilization contributes to grass growth and, for this reason, the objective was to evaluate the morphogenic characteristics of *Urochloa brizantha* cultivar Marandu subjected to different nitrogen rates (0, 50, 100 and 150 kg $N.ha^{-1}$) in the Brazilian savannah through the variables number of $leaves.tiller^{-1}$, leaf growth, leaf average size, senescent $leaf.tiller^{-1}$ number and stem+pseudostem average size. The experiment was established in the Forage and Pastures Sector of Jatai Federal University (UFJ) and, after the soil correction and fertilization, the Marandu grass plots were installed in a randomized blocks experimental design, with four treatments and four replications. When the forage canopy reached the cutting height (30 cm) it was homogenized with pruning shears and four tillers per plot were identified with colored tape and a locating stake. Morphogenesis data was collected every two days, measuring the leaves size and stem+pseudostem size, and leaves were classifying according to their physiological state. Marandu cultivar showed increasing response in leaves number and in leaf growth in nitrogen doses from 50 to 100 kg $N.ha^{-1}$. The number of senescent $leaf.tiller^{-1}$ decrease when nitrogen fertilization increase from 0 to 100 kg $N.ha^{-1}$. Marandu showed a morphogenic response to nitrogen fertilization and up to 100 kg $N.ha^{-1}$ can be used.

Introduction

The morphogenic characteristics represent the genetic species characteristics modified by environmental factors such as light, temperature, humidity and others (Lemarie & Chapman 1996) and determine the forage canopy structure, representing the generation and expansion dynamics of plant organs in time and space (Martuscello 2015) and it is described by four basic characteristics: stem+pseudostem elongation, leaf appearance, leaf elongation (Schnyder et al. 2006) and leaf lifespan. The interactions of these morphogenic characteristics determine the main forage canopy structural aspects such as leaf:stem ratio, final leaf size, tiller population density and the live leaves number per tillers that directly establish the canopy leaf area index (Chapman & Lemaire 1993) and the regrowth is the results of the new leaves and tillers emission which are determining factors for the pasture productivity and perenniality.
Understanding the forage development process, based on morphogenesis, allows adapting pasture management strategies where fertilization being decisive to enhance forage production, especially nitrogen fertilization which alters the plant growth rate by modifying the growth processes of these since it is a component of the protein and, consequently, determinant in mass production (Duru & Ducrocq 2000). The objective with this study was to evaluate the morphogenic characteristics of *Urochloa brizantha* cv. Marandu subjected to different nitrogen doses in the Brazilian savannah through out the leaves number per tiller, senescent leaves number per tiller, leaf and stem+pseudostem elongation and size.

Materials and Study Site

The experiment was set up in year 2021 in the Forage and Pasture Sector area of Jatai Federal University, Goias State, Brazil (51°430S, 17°530W and 670 m asl) which presents a latosol red soil (Santos et al. 2018). The climate is classified as mesothermal with dry winters and is a Aw according to the Köppen classification. The average annual rainfall is 1,534 mm occurring from October to April, with 23.2ºC of average temperature, ranging from 21 to 25.1ºC. After the area desiccation, the liming and fertilizing were made, based on soil analysis results and included calcitic limestone (3000 $kg.ha^{-1}$), super triple phosphate - SPT (130 $kg.ha^{-1}$) and – potassium chloride - KCl (40 $kg.ha^{-1}$), plots were divided in four blocks separated by 0.50 m wide corridors to provide the ground slope control, in a 17,75 x 17,75 m area.

The *Urochloa brizantha* cv. Marandu was planted in 4 x 4 meter plots and the four different nitrogen doses were randomly applied in the plots inside the blocks, subdivided in three nitrogen applications which was realized in December, February and April. The quantity of seeds planted looked for the waited initial population of 20 plants.m^{-2}.

Between January to May 2021, six cycles were evaluated and the beginning of cycles happed when four tillers per plot were identified with a colored tape and located with a stake inside the plot when it presented 15 cm canopy height. End of cycle was defined by the canopy average height of 30 cm. The morphogenesis data was collected every two days, measuring the length of leaf blades of expanding and expanded leaves and the length of the stem+pseudostem (distance from the soil to the ligule of the youngest leaf).

Data were evaluated by regression using SISVAR statistical program, considering collects and nitrogen dose.

Results and Discussion

The number of leaves.tiller^{-1} is genetically determined but nitrogen fertilization increased the growth rate of the grass and provided an increase in the number of leaves produced in the total evaluated period. In the Marandu grass it was observed an increased number of leaves.tiller^{-1} when the nitrogen doses rise from 50 to 100 kg N.ha^{-1} (Fig. 1).

Also, there was an increase of daily leaf growth (Fig. 2), but the higher leaf size was observed when nitrogen doses were lower than 50 kg N.ha^{-1} (Fig. 3).

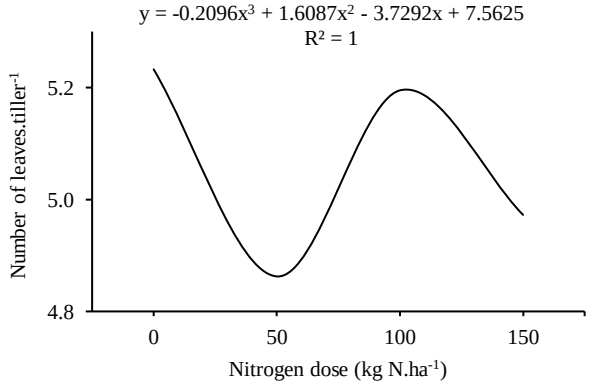

Figure 1. Number of leaves.tiller^{-1} in Marandu subjected to different nitrogen doses

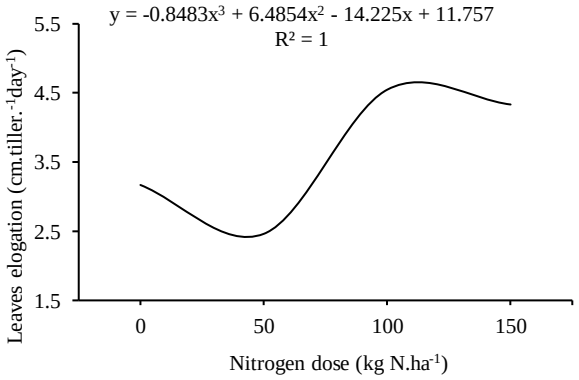

Figure 2. Leaves elongation (cm.tiller^{-1}.day^{-1}) in Marandu subjected to different nitrogen doses

The number of leaves and their growth rates were directly proportional to the dose of nitrogen fertilizer in the range of 50 to 100 kg N.ha^{-1}. The productivity of forage depends on the constant emission of leaves and tillers, a process that ensures the restoration of the leaf area after grazing and the perenniality of the pasture (Fagundes et al. 1999).

Paciullo et al. (2011) studied the effects of four nitrogen doses (0, 50, 100 and 150 mg N.dm^{-3} of soil) on the morphogenetic characteristics of *Brachiaria* genus related that the mean leaf elongation rate observed for Marandu cultivar was 19.4 mm.tiller^{-1}.day^{-1}, and in this study were observed values above 23 mm tiller^{-1}.day^{-1}. Paciullo et al. (2011) still showed that leaf elongation rate increased linearly with nitrogen dose, confirming the results found in the literature but in this study it was observed only in the interval between 50 and 100 kg N.ha^{-1}.

In the same study Paciullo et al. (2011) observed that the mean number of leaves per tiller to the Marandu cultivar was 3.9 leaves which was exactly the same value observed here.

The lower number of senescent leafs occurred when Marandu receives the nitrogen dose of 100 kg N.ha^{-1} (Fig. 4) which was accompanied of smaller stem+pseudostem sizes (Fig. 5).

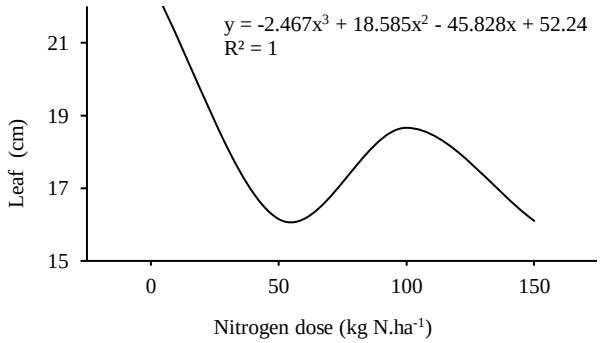

Figure 3. Average leaf size (cm) in Marandu subjected to different nitrogen doses

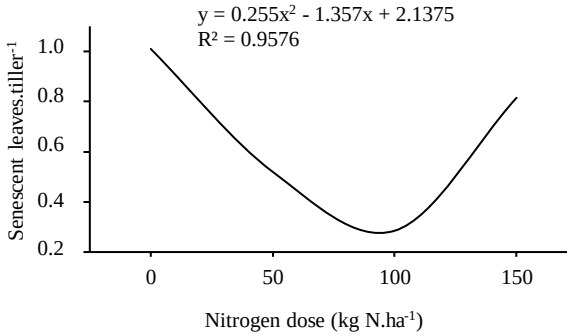

Figure 4. Senescent leaves.tiller^{-1} in Marandu subjected to different nitrogen doses

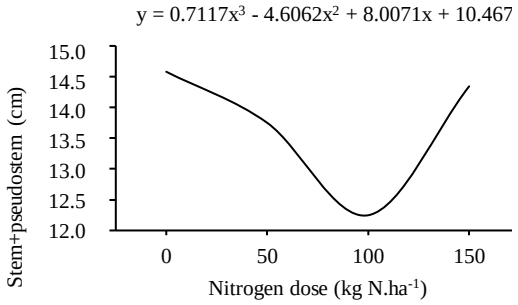

Figure 5. Stem+pseudostem size (cm) in Marandu subjected to different nitrogen doses

Costa et al. (2016) studied the effect of nitrogen levels (0, 60, 120, 180 and 240 kg N.ha^{-1}) on morphogenetic characteristics of *Brachiaria brizantha* cv. Marandu and concluded that the maximum leaf length was obtained with application of 180,5 kg N.ha^{-1} (26.7 cm) while in this study the maximum leaf length was 18.50 cm.

Alves et al. (2019) observed that the leaf senescence rate (LSR) was significantly influenced by the N dose. The levels were higher in Marandu grass fertilized with high N dose (1.0 ± 0.10 cm.tiller^{-1}.day^{-1}). Nitrogen increases the flow of tissues in the plant, so that, concurrently with the higher generation and growth of foliar tissue, the senescence of plant accelerates (Martuscello et al. 2005; Fagundes et al. 2006). In this study was observed number lower than 1.0 senescent leaf.tiller^{-1}.

Paiva et al. (2011) observed up to 18 cm increase in stem+pseudostem length for tillers to Marandu palisadegrass, value approximated of those observed in the present study of 14.5 cm.

Conclusions

Marandu showed a morphogenic response to nitrogen fertilization and up to 100 kg N.ha^{-1}.year^{-1} can be used.

References

Alves, L.C., Santos, M.E.R., Pereira, L.E.T., Carvalho, A.N. de, Rocha, G. de O., Carvalho, B.H.R., Vasconcelos, ; K.A., Ávila, A.B. Morphogenesis of age groups of Marandu palisade grass tillers deferred and fertilised with nitrogen. 2019. *Semina:* Ciências Agrárias, 40(6): 2683-2692.

Chapman, D.F.; Lemaire, G. 1993. Morphogenetic and structural determinants of plant regrowth after defoliation. In: Baker, M.J. (Ed.*) Grasslands for our world*. Wellington: SIR Publishing, p.55-64.

Costa, N. de L., Townsend, C.R., Fogaça, F.H. dos S., Magalhães, J.A., Bendahan, A.B., Santos, F.J. de S. 2016. Produtividade de forragem e morfogênese de *Brachiaria brizantha* cv. Marandu sob níveis de nitrogênio. *PUBVET*, 10(10): 731-735.

Duru, M.; Ducrocq, H. 2000. Growth and senescence of the successive grass leaves on a tiller. Ontogenic development and effect of temperature. *Annals of Botany*, v.85, n.5, p.635-643, May.
Fagundes, J.L., Fonseca, D.M., Mistura, C., Morais, R.V., Vitor, C.M.T., Gomide, J.A., Nascimento Junior, D., Casagrande, D.R., Costa, L.T. 2006. Características morfogênicas e estruturais do capim-braquiária em pastagem adubada com nitrogênio avaliadas nas quatro estações do ano. *Revista Brasileira de Zootecnia*, 35(1): 21-29.
Lemaire, G.; Chapman, D. 1996.Tissue flows in grazed plant communities. In: Hodgson, J.; Illius, A. W. *The ecology and management of grazing systems.* Wallingford: CAB International, p. 3-36.
Martuscello, J.A.; Da Silva, L.P.; Da Cunha, D. de N.F.V., Batista, A.C. dos S., Braz, T.G. dos Santos, Ferreira, P.S. 2015. Adubação nitrogenada em capim-massai: morfogênese e produção. *Ciência Animal Brasileira*, Goiânia, v.16, n.1, p.1-13, Mar.
Martuscello, J.A., Fonseca, D.M., Nascimento Júnior, D., Santos, P.M., Ribeiro Júnior, J.I., Cunha, D.N.F.V. e Moreira, L.M. 2005. Características morfogênicas e estruturais do capim xaraés submetido à adubação nitrogenada e desfolhação. *Revista Brasileira de Zootecnia*, 34: 1475-1482.
Paciullo, D.S.C., Fernandes, P.B., Gomide, C.A. de M., Castro, C.R.T. de, Souza Sobrinho, F. de, Carvalho, C.A. B. de 2011. The growth dynamics in Brachiaria species according to nitrogen dose and shade. *Revista Brasileira de Zootecnia*, 40(2): 270-276.
Paiva, AJ., da Silva, S.C., Pereira, L.E.T., Caminha, F.O., Pereira, P. de M., Guarda, , V.D.Á. Morphogenesis on age categories of tillers in marandu palisadegrass. 2011. *Scientia Agricola*, 68(6): 626-631.
Santos, H.G. dos, Jacomine, P.K.T., Anjos, L.H.C. dos, Oliveira, V.Á. de, Lumbreras, J.F., Coelho, M.R., Almeida, J.A. de, Araújo Filho, J.C. de, Oliveira, J.B. de, Cunha, T.J.F. 2018. *Sistema brasileiro de classificação dos solos.* 5.ed., rev. e ampl. Brasília, DF: Embrapa, 356p.
Schnyder, R.; Schäufele, R.; Visser, R. de, Nelson, C.J. 2000. An integrated view of C and N uses in leaf growth zones of defoliated grasses. In: Lemaire, G.; Hodgson, J.; Moraes, A. et al.(Eds.) *Grassland ecophysiology and grazing ecology*. CABI Publishing, CAB International, Wallingford, Oxon OX10 8DE, UK, p.41-60.