BOLETIM DE INDÚSTRIA ANIMAL

FORAGE AND PASTURES

NITROGEN REQUIREMENT OF *BRACHIARIA* HYBRID CV. IPYPORÃ

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Abstract

Ipyporã grass, a *Brachiaria* interspecific hybrid was developed by crossing a genotype of *Brachiaria ruziziensis* (syn. *Urochloa ruziziensis*) and an access of *Brachiaria brizantha* (syn. *Urochloa brizantha*), which have different nitrogen requirements. Therefore, the objective with work was to verify the nitrogen requirement of the interspecific hybrid of *Brachiaria* hybrid cv. Ipyporã. Experiment was carried out in a greenhouse in a randomized block design, with twelve treatments and four replications. Treatments consisted of a 4 x 3 factorial arrangement, with four nitrogen doses (0; 100; 200 and 300 mg/dm³) and three forages (*Brachiaria* hybrid cv. BRS Ipyporã, *Brachiaria humidicola* cv. Llanero and *Panicum maximum* cv. Zuri). Each experimental plot consisted of a 3 dm³ pot with three plants. Three evaluation harvest were done. *B.* hybrid had greater response to nitrogen fertilization for number of tillers and leaves than the other forages. However, for the total dry mass, *B.* hybrid was less responsive to nitrogen than *P. maximum* grass (high demand) and more responsive than *B. humidicola* (low demand), which shows that this hybrid has medium nitrogen requirement.

Keywords

fertilization, model identity test, Urochloa hybrid

EXIGÊNCIA EM NITROGÊNIO DE *BRACHIARIA HIBRIDA* CV. BRS IPYPORÃ

Resumo

O capim Ipyporã, um híbrido interespecífico de *Brachiaria*, foi desenvolvido através do cruzamento de um genótipo de *Brachiaria ruziziensis* (sin. *Urochloa ruziziensis*) e um acesso de *Brachiaria brizantha* (sin. *Urochloa brizantha*), que possuem diferentes exigências de nitrogênio. O objetivo com este trabalho foi verificar a necessidade de nitrogênio do híbrido interespecífico de *Brachiaria hibrida* cv. Ipyporã. O experimento foi conduzido em casa de vegetação, em delineamento de blocos ao acaso, com doze tratamentos e quatro repetições. Os tratamentos corresponderam a um fatorial 4x3, sendo quatro doses de nitrogênio (0, 100, 200 e 300 mg/dm³) e três gramíneas forrageiras (B. *hibrida* cv. BRS Ipyporã, *B. humidicola* cv. Llanero e *Panicum maximum* cv. Zuri). Cada parcela experimental foi constituída por vaso de 3 dm³ com três plantas. Foram realizados três cortes de avaliação. A *B. hibrida* Ipyporã obteve maior resposta à adubação nitrogenada para número de perfilhos e de folhas em relação aos demais capins. Entretanto, para a massa seca total, observou-se que a *B. hibrida* foi menos responsiva ao nitrogênio que o capim *P. maximum* (alta exigência) e mais responsivo que *B. humidicola* (baixa exigência), o que mostra que esse híbrido é uma forrageira com média demanda em nitrogênio.

Palavras-chave

adubação nitrogenada, teste de identidade de modelos, *Urochloa* híbrida

INTRODUCTION

Forage seeds commercialization has been growing annually, due to the demand for forage options that adapt to the different production systems for grazing animals. These efforts are linked to improved pasture productivity through forage adaptation to soil condition, climate, pests and farmer management.

In this sense, the interspecific hybrid *Brachiaria* 'BRS RB331' Ipyporã was developed by crossing a genotype of *Brachiaria ruziziensis* (syn. *Urochloa ruziziensis*) and an access of *Brachiaria brizantha* (syn. *Urochloa brizantha*), in which the resistance to spittlebug was introduced in the new cultivar, in addition to maintaining the good forage yields and nutritional value present in their parents.

Ipyporã grass stands out as a promising plant for presenting some competitive advantages over other forages, such as high adaptation to tropical and subtropical conditions, great growth vigor, high dry mass yield and forage quality, spittlebug tolerance, good tolerance to prolonged periods of drought, rapid regrowth, late flowering, great shade and fire tolerance (VALLE et al., 2017).

However, for being a hybrid, whose breeding program involved *Brachiaria* of different fertility requirements, there is doubt about the fertilization recommendation for Ipyporã grass, so that it is possible to perform the rational fertilization management.

The correct fertilization management in pasture soils aims to provide adequate nutritional support for forage plants, which reduces degradation processes and consequently the costs of recovering degraded areas. Thus, fertilization has a marked effect on pasture, which improves the gain per hectare (DELEVATTI et al., 2019) and, especially, its persistence, even for species adapted to low soil fertility (MOREIRA et al., 2011).

Among the essential nutrients for forage development, phosphorus and nitrogen stand out, since phosphorus is necessary for pasture establishment and nitrogen for the maintenance of pastures productive potential (TEIXEIRA et al., 2018). Moreover, in the face of continuous nutrient extraction in grazing systems, nitrogen replacement fertilization is important for pasture perenniality and to retard degradation process.

As Ipyporã grass was improved from two forages with different nitrogen demands, this study aimed to identify the nitrogen requirement of Ipyporã grass, comparing it with other *Brachiaria* and *Panicum* forages.

MATERIALS AND METHODS

Experimental area, experimental design and treatments

The experiment was carried out in a greenhouse at the Federal University of Rondonópolis, in a randomized block design with 12 treatments and four replications. The treatments consisted of a 4 x 3 factorial arrangement with four nitrogen rates (0, 100, 200 and 300 mg/dm^3) and three forages. The forages used were Ipyporã grass (*Brachiaria* hybrid), Koronivia grass (*Brachiaria humidicola* Rendle) and Zuri Guinea grass (*Panicum maximum* Jacq.).

Each experimental plot consisted of pot with 3 dm^3 of soil with three plants. For daily irrigation, the gravimetric method (CABRAL et al., 2018) was used in order to maintain the soil moisture at the maximum field capacity. The soil used was an Oxisol, collected at 0-20 cm layer, with the following chemical and particle size characterization: pH (in calcium chloride): 6.0; phosphorus = 3.4 mg/dm^3; potassium: 119.0 mg/dm^3; calcium: 2.3 cmol$_c$/dm^3; magnesium: 2.0 cmol$_c$/dm^3; hydrogen plus aluminum: 1.7 cmol$_c$/dm^3; cation exchange capacity = 6.3 cmol$_c$/dm^3; base saturation: 73.0%; aluminum saturation = 0.0%; sand: 575 g/kg; silt: 50 g/kg and clay: 375 g/kg.

Phosphate fertilization was performed at sowing, at a rate of 200 mg/dm^3, in the form of simple superphosphate. Ten days after emergence, nitrogen and potassium fertilization were performed at rates of 100 and 50 mg/dm^3, respectively. The fertilizers used were urea and potassium chloride. Thirty days after emergence, a standardization cut was performed, followed by nitrogen fertilization, according to the treatments, with urea.

Measurements

Twenty days after the standardization cut, the number of leaves (NL) and tillers (NT) were counted and the plants were harvest. For each species, the residue height used was determined in order to do not compromise the regrowth, which corresponded to 15 cm for *B.* hybrid, 10 cm for *B. humidicola* and 25 cm for *P. maximum* (Costa e Queiroz, 2013; Euclides et al., 2014).

After each forage harvest, the plant material was separated into morphological components: leaf blades, stem (stem + sheath) and dead material, and then the nitrogen was reapplied according to treatments. In case of flowering, vegetative and reproductive stem were separated. All components were dried in a forced air circulation oven at 55 $\pm$ 5ºC for 72 hours and then, weighed.

Three evaluations were performed every 20 days, and in the last evaluation, the residual mass (RES) and root mass (RM) were quantified. The roots, after washing, and the residue were submitted to the same drying process of the shoot. For data analysis, the average number of leaves and tillers of each harvest was performed; however, for leaf mass (LeafM), stem mass (StemM) and dead material mass (DeadM), the sum of the three evaluations was performed. Shoot mass (SM) corresponded to the sum of LeafM, StemM and DeadM. Total dry mass (TDM) corresponded to the sum of RES, RM and SM.

Statistical analysis

Analysis of variance (P=0.10) was performed to verify the effect of nitrogen fertilization (isolated or interaction with forage). When there was an effect of nitrogen fertilization, linear regression analysis was performed (P = 0.10). In case of significant linear regression, *B.* hybrid was compared with *B. humidicola* and *P. maximum* using an identity test for regression models (REGAZZI, 1996; REGAZZI, 1999). Only for morphological composition (in percentage) there was no effect of nitrogen fertilization (isolated and interaction), and therefore the forages were compared by Tukey test (P = 0.10).

RESULTS AND DISCUSSION

Nitrogen fertilization influenced all evaluated variables, except for morphological composition (in percentage) (Table 1), since nitrogen is one of the nutrients most extracted by forages (SAN MIGUEL et al., 2018), which is very important in maintenance fertilization.Regarding the regression models, there was similarity between *B.* hybrid, *B. humidicola* and *P. maximum* only for NL and LeafM, which shows the difference in response pattern of this hybrid to a forage of low (*B. humidicola*) and high (*P. maximum*) requirement in nitrogen.

Table 1 – Number of tillers (NT) and leaves (NL) of forages under nitrogen fertilization.

Forages	Nitrogen doses (mg/dm^3)				P-value		Model		
	0	100	200	300	L	MIT	a	bx	R^2
		NT (tiller/pot)							
B. hybrid	18	26	35	45	<0.001		17.53	0.089	0.99
B. humidicola	23	28	25	32	0.022	0.007	23.09	0.026	0.64
P. maximum	10	20	27	25	<0.001	<0.001	13.09	0.051	0.74
		NL (leaves/pot)							
B. hybrid	29	55	64	77	<0.001		33.32	0.153	0.95
B. humidicola	44	70	78	70	0.026	0.003	52.44	0.085	0.54
P. maximum	16	37	43	43	0.023	<0.001	21.55	0.087	0.75

L: linear model; MIT: model identity test; a: intercept; b: slope.

There was greater response of *B.* hybrid to nitrogen for NT and NL, since greater slopes were observed (Table 1). The emission of leaves and tillers is fundamental for pasture perenniality, which decreases soil degradation. The greater NT and NL of *B.* hybrid in relation to *P. maximum* may be related to the growth habit, since Ipyporã grass and *P. maximum* have semi-erect and erect growth habit, respectively.

The greater intercept values for *B. humidicola* for NT and NL is because it is a cultivar that in the absence of fertilization, has a good yield when compared to medium and high demand cultivars. In addition, the organic matter mineralization process provides part of the nitrogen demanded by the forage, which might meet the demand of a low-demand forage.

There was a difference on models between *B.* hybrid and the other forages for forage mass (Table 2), as well as in the morphological composition (Figure 1). The greater intercept value of *B. humidicola* for forage mass (Table 2) shows that in the absence of nitrogen fertilization, it presents a greater forage mass. However, *B. humidicola* got the smallest slope, which shows a smaller increase in forage mass with nitrogen fertilization, which is characteristic of forage with lower nutritional requirement.

Table 2—Forage mass (g/pot), leaf mass (LeafM; g/pot); stem mass (StemM; g/pot) and dead material mass (DeadM; g/pot) of forages under nitrogen fertilization.

Forages	**Nitrogen doses (mg/dm³)**				**P-value**		**Model**		
	0	100	200	300	Linear	MIT	a	bx	R^2
		Forage mass							
B. hybrid	7.82	13.32	16.19	18.65	0.002		8.69	0.035	0.96
B. humidicola	9.56	23.59	23.71	22.53	0.001	0.009	13.99	0.039	0.53
P. maximum	6.33	19.76	20.79	24.26	<0.001	0.048	9.56	0.054	0.80
		LeafM							
B. hybrid	7.34	13.04	15.85	17.71	0.002		8.39	0.033	0.93
B. humidicola	5.64	10.79	12.76	11.35	0.054	0.067	7.27	0.019	0.62
P. maximum	6.30	17.76	19.70	20.85	<0.001	0.169	9.32	0.045	0.77
		StemM							
B. hybrid	0.40	0.01	0.03	0.00	0.808		*	*	*
B. humidicola	3.88	12.45	10.05	10.83	<0.001	**	6.53	0.018	0.40
P. maximum	0.00	0.00	0.00	0.00	0.970	*	*	*	*
		DeadM							
B. hybrid	0.07	0.26	0.31	0.94	0.272		*	*	*
B. humidicola	0.47	1.48	1.28	0.89	0.644	**	*	*	*
P. maximum	0.02	2.00	1.09	3.41	<0.001	**	0.24	0.009	0.69

L: linear model; MIT: model identity test; a: intercept; b: slope. *: model doesn't exist; **: unable to perform model identity test comparing with B. hybrid.

As for forage mass, *B.* hybrid had intermediate intercept compared to the other forages, but also presented a similar slope to that observed for *B. humidicola*. However even with a similar slope, it is not possible to affirm that Ipyporã grass responds to nitrogen fertilization similarly, due to the flowering of *B. humidicola* (Figure 2), which demands

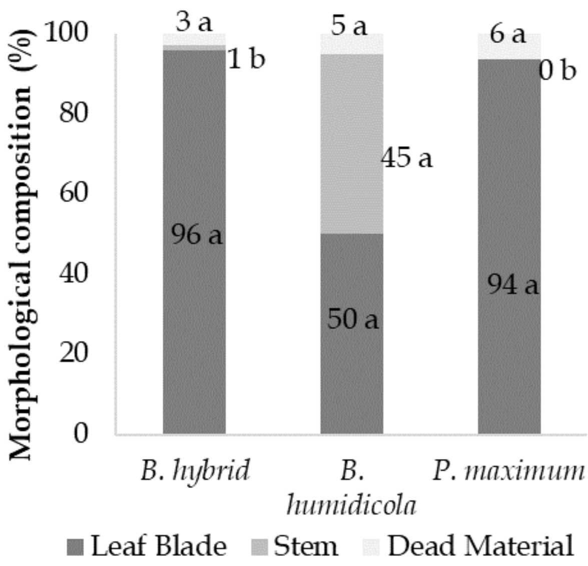

Figure 1—Morphological composition of forage fertilized with nitrogen. There wasn't stem in forage mass of *P. maximum*. Means followed by the same letter, between forages, don't differ by Tukey's test (P < 0.10).

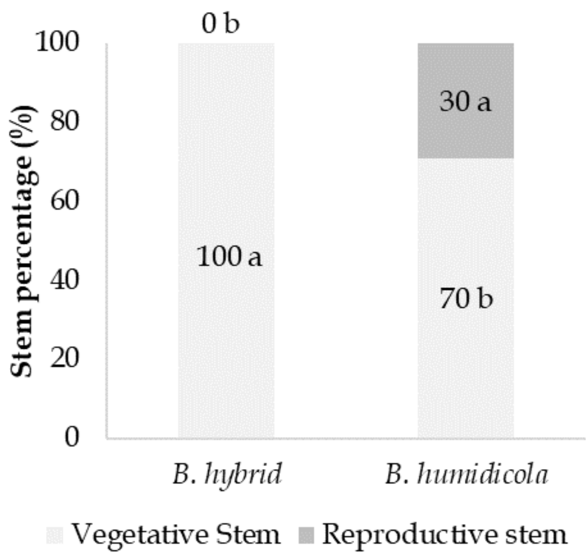

Figure 2—Vegetative and reproductive stem of forage fertilized with nitrogen. There wasn't reproductive stem for *B.* hybrid and stem in forage mass of *P. maximum*. Means followed by the same letter, between forages, don't differ by Tukey's test (P < 0.10).

nitrogen for adequate reproductive structure formation. Therefore, it is likely that in vegetative stage, there would be lower response for *B. humidicola*.

LeafM model of *B.* hybrid was equal to *P. maximum* and different of *B. humidicola*. It was noted for LeafM (Table 2) that *B.* hybrid and *P. maximum* obtained greater intercept and slope when compared to *B. humidicola*. This can be explained by the low equation adjustment (R^2) of *B. humidicola* and *P. maximum*, since the value of LeafM observed in the absence of fertilization is lesser than the intercept. Thus, *P. maximum* and *B.* hybrid is more harmed than *B. humidicola* in the absence of nitrogen.

For StemM, only *B. humidicola* obtained nitrogen response, which can be explained for two reasons. Firstly, the evaluation height of this forage was above the recommended height for grazing management (Costa e Queiroz, 2013), which favors the accumulation of stem and dead material. Another aspect was the flowering, since *B. humidicola* was the only one that emitted inflorescence, with an increase in the reproductive stem proportion (Figure 2). Nitrogen fertilizer application has significant influence on the increase of inflorescence density, number of inflorescence branches and viable pure seeds production in *Brachiaria* spp. (BENTEO et al., 2016; CATUCHI et al., 2014). However, regarding DeadM, it is noted that only *P. maximum* obtained linear increase (Table 2), once it belongs to the *Panicum* genus, which generally has fewer green leaves per tillers (PACIULLO et al., 2016; MARTUSCELLO et al., 2018) than *Brachiaria* (LARA e PEDREIRA, 2011), with accelerates senescence and increase in DeadM.

For RES, a greater slope and intercept value was observed for *P. maximum* (Table 3) when compared to *B.* hybrid, which is justified by the greater forage mass. The greater intercept value for RM in *P. maximum*, compared to *B.* hybrid, shows that without nitrogen fertilization there is a greater RM, but when nitrogen is applied, *B.* hybrid grass is more responsive, with greater slope of the linear equation. In plants of the genus *Panicum* of high demand, nitrogen is not used primarily for root system, but for the shoot accumulation and tillering (MARTUSCELLO et al., 2019), which justifies the largest slope of *P. maximum* for forage mass. This priority condition of forage mass over RM contributes to the low water

Table 3—Total dry mass (TDM; g/pot), residue mass (RES; g/pot), and root mass (RM; g/pot) of forages under nitrogen fertilization.

Forages	Nitrogen doses (mg/dm³)				P-value		Model		
	0	100	200	300	L	MIT	a	bx	R^2
	TDM								
B. hybrid	28.32	61.09	62.11	79.97	<0.001		34.48	0.155	0.87
B. humidicola	23.83	47.50	46.28	42.71	0.118	**	*	*	*
P. maximum	34.49	68.46	90.09	92.70	<0.001	0.088	42.00	0.196	0.88
	RES								
B. hybrid	9.25	22.33	17.14	30.41	0.003		11.04	0.058	0.51
B. humidicola	4.61	9.62	9.21	8.60	0.506	**	*	*	*
P. maximum	11.55	26.08	39.04	37.06	<0.001	0.033	15.01	0.089	0.83
	RM								
B. hybrid	11.25	25.44	28.78	30.90	0.002		14.75	0.062	0.82
B. humidicola	9.65	14.28	13.35	11.57	0.792	**	*	*	*
P. maximum	16.61	22.61	30.25	31.37	0.007	<0.001	17.42	0.051	0.93

L: linear model; MIT: model identity test; a: intercept; b: slope.

deficit tolerance of *Panicum* (BRANDÃO et al., 2017).

The highest slope value for TDM for *P. maximum* (Table 3) demonstrates that Ipyporã grass is less responsive to nitrogen fertilization than *P. maximum* and more responsive than *B. humidicola*, since *B. humidicola* did not show a response to nitrogen fertilization. Thus, with the exception of NL and NT, it was observed that the Ipyporã grass has intermediate requirement to the other forages, which allows it to be classified as a forage of medium nutrient demand, same framing of *B. brizantha* (CANTARUTTI et al., 1999; MARTHA JUNIOR et al., 2007), one of the forages used to improve Ipyporã grass.

In addition, when new forages are released to the market, management information is scarce, including the requirement for soil fertility, therefore, an alternative is to conduct greenhouse research comparing the new forage with forages of traditionally known soil fertility requirements, as described in this study, through identity test for regression models. Thus, these preliminary data will guide producers and the scientific community on the new forage response to fertilization, while several researches may be done in several locations to validate these results obtained under controlled conditions.

CONCLUSION

Because it differs from low and high demand fertility forages, *B.* hybrid cv. BRS Ipyporã can be considered a medium nitrogen requirement forage.

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