

Response of *Urochloa mosambicensis* genotypes to phosphorus fertilization in soil with low phosphorus levels

Resposta de genótipos de Urochloa mosambicensis à adubação fosfatada em solo com baixo nível de fósforo

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ABSTRACT

Phosphorus (P) is one of the main nutrients capable of increasing yields of tropical grasses. The definition of adequate P fertilizer rates can contribute to improving forage production of pastures. However, the efficiency in the response of different genotypes of *Urochloa mosambicensis* (Hack.) Dandy (Bushveld herringbone grass) to P fertilizer rates is not known. This study aimed to quantify the response of *U. mosambicensis* genotypes to P fertilizer levels and classify the genotypes as to efficiency and responsiveness. The experiment was carried out in pots, under controlled conditions, in a completely randomized design, in a 2 x 9 factorial with five replications. The factors consisted of equivalent P rates of 10 and 90 kg ha⁻¹ of P₂O₅ (triple superphosphate) and eight genotypes of *U. mosambicensis* (UmCO-1 (2), UmCO-2 (2), UmCO-4 (1), UmCO-8 (1), UmCO-11 (2), UmCO-12 (2), UmCO-13 (2) and UmCO-14 (2)), in addition to a control, *Urochloa brizantha* syn. *Brachiaria brizantha* cv. BRS Piatã. Each experimental unit consisted of one pot. Biometric attributes and dry mass yield were evaluated over

four cutting cycles. There was no effect of the P fertilization x genotypes interaction for the variables evaluated. However, the highest fertilizer rate increased dry mass yield and tiller population density in all genotypes and cuttings evaluated. The genotype UmCO-4 (1) and the cultivar BRS Piatã proved to be responsive to and efficient in P use. The highest P rate promoted greatest production of dry mass and greatest number of tillers in all genotypes of *U. mosambicensis*.

Keywords: mineral nutrition, bushveld herringbone grass, dry mass yield, nutritional efficiency, responsiveness.

RESUMO

O fósforo (P) é um dos principais nutrientes capazes de aumentar a produtividade de gramíneas tropicais. A definição de doses de P pode contribuir para aumentar a produção de forragem em pastagens cultivadas. Todavia não se conhece a eficiência na resposta de diferentes genótipos de capim-corrente (*Urochloa mosambicensis* (Hack.) Dandy) a doses de P. Este estudo objetivou quantificar a resposta de genótipos de capim-corrente a níveis de adubação com P e classificá-los segundo a sua eficiência e responsividade. O experimento foi conduzido em vasos, em condições controladas, no delineamento inteiramente casualizado, num esquema fatorial 2 x 9, com cinco repetições. Os fatores consistiram de doses equivalentes de P de 10 e 90 kg ha⁻¹ de P₂O₅ (superfosfato triplo) e oito genótipos de *U. mosambicensis* (UmCO1 (2), UmCO-2 (2), UmCO-4 (1), UmCO-8 (1), UmCO-11 (2), UmCO-12 (2), UmCO-13 (2) e UmCO-14 (2)), além da testemunha *Urochloa brizantha* syn. *Brachiaria brizantha* cv. BRS Piatã. Cada unidade experimental foi constituída de um vaso. Foram avaliados atributos biométricos e rendimento de massa seca ao longo de quatro ciclos de corte. Não houve efeito da interação entre adubação x genótipos para as variáveis avaliadas. Entretanto, a maior dose do fertilizante incrementou o rendimento de massa seca e densidade populacional de perfilhos em todos os genótipos e cortes avaliados. O genótipo UmCO-4 (1) e a cultivar BRS Piatã revelaram-se responsivos e eficientes no uso de P. A maior dose de P promoveu maior produção de massa seca e maior número de perfilhos em todos os genótipos de *U. mosambicensis*.

Palavras-chave: nutrição mineral, capim-corrente, rendimento de massa seca, eficiência nutricional, responsividade.

INTRODUCTION

Phosphorus (P) is limiting to plant growth due to the adsorption of phosphate ions onto iron and aluminum oxides and hydroxides, which are abundant in weathered soils (Novais et al., 2007). Brazilian soils, for the most part, have low P levels, thus agricultural activity in the country has a strong demand for this nutrient (Withers et al., 2018).

P influences root growth and tillering of forage grasses (Bezerra et al., 2017),

increasing forage quality and production (Dias et al, 2015; Souza et al, 2020). Increased productivity is associated with greater P availability in soils with base saturation around 40% (Costa et al., 2021; Vilela et al., 2007). Therefore, the definition of adequate P fertilizer rates can lead to increased forage production, especially in the Brazilian semiarid region (Gonçalves et al., 2022; Dias et al., 2012), where soils deficient in this nutrient prevail (Menezes et al., 2012). Supplying P to plants is generally performed using soluble rock phosphate

sources. Nonetheless, rock phosphate is a finite resource, which carries the risk of scarcity in the near future (Oliveira et al., 2021). Therefore, it is necessary to rationalize the use of soluble P sources for pasture production, increasing the yield efficiency of genotypes and optimizing fertilizer use.

A method for classifying genotypes according to nutrient absorption efficiency consists of selecting the most efficient and responsive genotypes (Fageria & Kluthcouski, 1980). Defining the yield potential of genotypes in response to P fertilization is challenging due to the variability in cropping systems and future limitations associated with climate change (Rambaut et al., 2022). Accordingly, it is necessary for breeding programs to identify genotypes that are more responsive (which can be targeted for use in more intensive production systems) and/or efficient in P use (which can stand out in soils with low P concentration).

In this study, the hypotheses are that (i) different genotypes of *U. mosambicensis* show distinct levels of response and yield efficiency to P fertilization and, (ii) differences in response and yield efficiency will allow for the definition of the genotypes suitability for cultivation in environments with different levels of P availability. The objective was to evaluate the performance of *U. mosambicensis* genotypes at two levels of P fertilization and classify them according to their efficiency and responsiveness.

MATERIAL AND METHODS

The experiment was conducted using pots in a greenhouse, between August 12, 2021, and January 21, 2022, in the facilities of Embrapa Mid-North, in Teresina, Piauí state, Brazil (5°02'21.36" S and 42°47'22.44 "W). The climate is type Aw' (Köppen) with rainy summers and dry winters (Medeiros et al., 2020). The annual mean temperature, relative humidity and precipitation are 27.4 °C, 70% and 1,325 mm, respectively (INMET, 2019).

Polyethylene pots with 7-L capacity were filled with 6.5 kg of soil and cultivated with eight genotypes of *U. mosambicensis* (UmCO-1 (2), UmCO-2 (2), UmCO-4 (1), UmCO-8 (1), UmCO-11 (2), UmCO-12 (2), UmCO-13 (2), UmCO-14 (2)) from the Embrapa Goat and Sheep breeding program, in addition to the *Urochloa brizantha* syn. *Brachiaria brizantha* cv. BRS Piatã as a control. All treatments were subjected to two fertilizer levels with triple superphosphate: (i) low (0.056 g pot⁻¹ = 10 kg ha⁻¹ of P₂O₅) and (ii) high (0.51 g pot⁻¹ = 90 kg ha⁻¹ of P₂O₅). The experimental design was completely randomized, in a 9 x 2 factorial scheme (9 genotypes and 2 levels of phosphate fertilizer), with five replicates, totaling 90 experimental units. The P levels and other fertilizer applications followed the recommendation of Vilela et al. (2007). Each experimental unit consisted of a pot containing soil collected from the experimental fields of Embrapa Mid-North, classified as Red Yellow Argisol (Melo et al., 2014). Chemical and physical characteristics of the soil are described in Table 1.

Table 1 - Result of the chemical and physical analysis of the soil used in the pot experiment, collected in the 0-20 cm layer. Teresina, Piauí, 2021.

pH	OM	P	K	Na	Ca	Mg	Al	H + Al
(CaCl ₂)	%	mg kg ⁻¹	-----			cmol _c .dm ⁻³	-----	
4.1	4.1	3.4	0.05	0.01	0.67	0.39	0.01	4.24

SB	CEC	BS	m	Coarse sand	Fine sand	Clay	Silt	Bd
-- cmol _c .dm ³ ----		----- % -----	----- g kg ⁻¹ -----			kg dm ⁻³		
1.23	5.36	21	1	214	524	175	87	1.43

OM – Organic matter; P – phosphorus; K – potassium; Na – sodium; Ca – calcium; Mg – magnesium; Al – aluminum; H + Al – potential acidity; SB – sum of bases; CEC – cation exchange capacity; BS – base saturation; m – aluminum saturation; Bd – Soil bulk density.

Initially, the soil was incubated for 15 days (August 10 to 24, 2021) with dolomitic limestone (Effective Calcium Carbonate Equivalent – ECCE: 115%), aiming to increase base saturation to 40% (Vilela et al., 2007). After this period, both P levels were applied, and 10 seeds of each genotype were sown to each pot. After germination, the pots were rearranged every fortnight, randomly changing their position to avoid interference from the microclimate inside the greenhouse. Daily irrigation of the plants was carried out with approximately 700 mL of water applied twice a day (350 mL in the early morning and 350 mL in the late afternoon) to maintain water level at field capacity of the pots throughout the entire evaluation period.

After 22 days of seed emergence (09/24), thinning was carried out, keeping two plants per pot. At this time, plants were fertilized using 0.28 g pot⁻¹ of KCl (61% K₂O = 50 kg ha⁻¹) and 0.11 g pot⁻¹ of urea (45% N = 20 kg ha⁻¹), both dissolved in 50 mL of distilled water.

At 55 days after planting (10/18), a uniformization cutting was performed 15 cm above the ground. At 7 and 14 days after the uniformization cutting, nitrogen fertilizer was applied with the same amounts used in maintenance

fertilization. The second and third cutting cycles were carried out 29 days (11/16) and 57 days (12/14) after the uniformization cutting. After each cutting cycle, maintenance fertilization was carried out following the same protocol carried out in the implementation phase. At the fourth cutting cycle (01/13), in addition to the conventional harvest of the aerial part, a residual cutting was made, which corresponded to the aerial part up to 15 cm above the ground. Also, roots were extracted.

At each cutting cycle, the following were measured: tiller population density (TPD) - by counting the number of tillers per plant; canopy height (cm) - by measuring up to the last leaf of the canopy of the tallest plant; dry mass yield (DM) - by weighing plant material dried in forced air circulation oven at 60°C for 72 h. At the uniformization cutting, only dry mass yield was evaluated.

Root extraction after the last cutting was carried out by removing soil from the pots and washing them in running water over a 5 mm mesh sieve. Dry mass was determined using root material that had been dried in a forced air circulation oven at 60°C for 72h. The accumulated dry mass yield was calculated,

considering the sum of all cuttings. To differentiate the cultivars, the methodology proposed by Fageria & Kluthcouski (1980) was used, which suggests cultivar classification in terms of P use efficiency and response to P fertilizer application. In this method, the use of the nutrient is defined by the average dry mass yield at a low level. The response to nutrient use is obtained by the difference between dry mass yield under two P levels divided by the difference between the P levels using the formula: $\alpha = (YIL - YLL) / DBL$ - Where: YIL = Yield with ideal nutrient level; YLL = Yield with low nutrient level; and DBL = Difference between nutrient levels.

Data were plotted to classify the cultivars. P use efficiency is placed on the x-axis and the plant response to P use is placed on the y-axis. The point of origin of the axes is the average efficiency (high yield at low soil P level) and the average response to phosphate fertilization of the cultivars. The method indicates that drawing a straight line originating from the average value on each axis causes the Cartesian plane to be divided into quadrants. The first quadrant represents efficient and responsive cultivars (ER), with values above the average for both Cartesian axes. The second quadrant represents non-efficient and responsive cultivars (NER), with below average values for efficiency and above average values for responsiveness. The third quadrant represents non-efficient and non-responsive cultivars (NENR), with below average values on both Cartesian axes. Finally, the fourth quadrant represents efficient and non-responsive cultivars (ENR), with above average values for efficiency and below average values for responsiveness. This methodology was used for DM of the first (uniformization), second, third and

fourth cutting cycles, in addition to the accumulated dry mass of all cuttings. We removed outliers from the dataset, eliminating those that appeared outside the box in the graphical scatterplot. Then, analysis of variance was carried out and, depending on significance, t-test was used to compare the levels of phosphate fertilizer and the Scott-Knott test was used to cluster the genotypes. Statistical analysis was performed using SISVAR software (Ferreira, 2019).

RESULTS AND DISCUSSION

Considering the uniformization cutting and the other cuttings (2C, 3C and 4C), no significant effect of the interaction between *U. mosambicensis* genotypes and P levels was observed for the variables TPD, canopy height, and dry mass yield. However, there was a significant isolated effect of genotypes for canopy height (2C, 3C, and 4C) and dry mass yield (2C, 3C and 4C), and of P levels for all attributes, except canopy height (2C and 3C) and dry mass yield of the residue cutting (4C). The genotypes of *U. mosambicensis* fertilized with the highest P level showed greater dry mass yield of the aerial part at all evaluations and higher residual dry mass of roots (8.26 g pot⁻¹) compared with the treatment with a low P level (5 g pot⁻¹; Table 2). This fact highlights the relevance of P in the initial establishment of the grass, ensuring conditions for plant development throughout successive cutting cycles. Guedes et al. (2009) demonstrated that degraded pastures of *U. brizantha* supplied with P show greater development and forage. The importance of P for forage grasses is evident from the initial stages of plant development, favoring root development and tillering (Guedes et al., 2009), in addition to the rapid growth of leaf area (Bèlanger et al., 2017).

Phosphate fertilizer at the highest level (90 kg ha⁻¹ of P₂O₅) provided higher values than the rate of 10 kg ha⁻¹ of P₂O₅, for all attributes evaluated. Despite this, the genotypes responded differently in terms of plant height. At the second cutting cycle, two distinct groups were formed (Table 2), with BRS Piatã (62.3 cm), UmCO-13 (2) (61.6 cm) and UmCO-4 (1) (55.2 cm) presenting higher averages than the other genotypes. At the third cutting cycle, the genotypes UmCO-4 (1) (58.01 cm), UmCO-11 (2) (55.70 cm) and UmCO-12 (2) (54.07 cm) stood out. At the fourth cutting cycle, the genotypes UmCO-4 (1) (56.52 cm), UmCO-12 (2) (57.49 cm) and BRS Piatã (52.08 cm) showed the greatest heights (Table 2). Plant height is associated, among other factors, with the rate of stem and leaf elongation. Bueno et al. (2017) observed a higher leaf elongation rate in UmCO-4 (1) genotype, which

highlights the growth potential of this genotype under different conditions.

As for dry mass yield, at the second cutting cycle, there was the formation of three distinct groups, with the highest yield observed for BRS Piatã (2.70), followed by UmCO-1 (2) (1.93 g pot⁻¹), UmCO-8 (1) (1.86 g pot⁻¹) and UmCO-14 (2) (1.96 g pot⁻¹). At last, a group was formed by the other genotypes, which had lower yields. At the third cutting cycle, two distinct groups were formed, with the highest dry mass yields being associated with the genotypes BRS Piatã (1.28 g pot⁻¹), UmCO-1 (2) (1.18 g pot⁻¹), UmCO-4 (1) (1.39 g pot⁻¹), and UmCO-14 (2) (1.35 g pot⁻¹). At the fourth cutting cycle, the highest yields were associated with the genotypes BRS Piatã, UmCO-1 (2), UmCO-8 (1), UmCO-14 (2), UmCO-4 (1), and UmCO-12 (2) (Table 2).

Table 2 – Average values of height (cm), tiller population density (TPD) as number of tillers per pot, and dry mass (DM in g/pot) of the aerial part, residual dry mass (RZDM) and root dry mass (RDM) of *U. mosambicensis* genotypes as a function of different phosphorus levels. Teresina, Piauí, 2022.

Genótipos (G)	UNI			CICLO (2°C)			CICLO (3°C)			CICLO (4°C)			RES	
	MS (g vaso ⁻¹)	Altura (cm)	DPP	MS (g vaso ⁻¹)	Altura (cm)	DPP	MS (g vaso ⁻¹)	Altura (cm)	DPP	MS (g vaso ⁻¹)	MSRZ	MSR	----- (g vaso ⁻¹) -----	
UmCO1	2,07	43,70b	8,05	1,93b	31,72b	8,4	1,18a	30,14b	6,75	1,90a	4,74	6,21		
UmCO2	2,11	38,91b	6,3	1,35c	27,2b	7,55	0,82b	29,86b	8,13	1,21b	3,99	7,14		
UmCO4	3,47	61,62a	9,08	1,59c	58,01a	9,7	1,39a	56,52a	6,15	1,93a	3,2	6,79		
UmCO8	2,68	51,94b	8,75	1,86b	33,05b	10,5	0,89b	47,64a	8,5	1,74a	4,07	8,7		
UmCO11	3,16	50,43b	6,97	1,18c	55,70a	9,55	1,14b	45,98a	7,8	1,39b	3,25	4,44		
UmCO12	3,07	46,51b	7,55	1,08c	54,47a	8,5	0,83b	57,49a	7,06	1,92a	4,25	5,31		
UmCO13	2,58	55,20a	7,75	1,07c	45,64a	8,05	0,77b	54,95a	6,28	1,17b	3,92	5,41		
UmCO14	3,39	45,31b	9,5	1,96b	45,98a	10,68	1,35a	42,60a	10,88	1,76a	3,48	7,91		
BRS Piatã	3,28	62,32a	7,41	2,70a	46,44a	9,3	1,28a	52,08a	7,42	2,36a	3,77	7,75		
Teste F	ns	**	ns	**	*	ns	**	**	ns	**	ns	ns		
Doses (D)														
0,06	1,77b	50,6	6,84b	1,03b	42,15	7,47	0,59b	42,81b	6,18b	0,96b	3,54	5,00b		

0,51	3,97a	50,6	9,01a	2,23a	46,33	10,79	1,55a	49,90a	9,14a	2,45a	4,17	8,26a
Teste F	**	ns	**	**	**	ns	**	**	**	**	ns	**
G x D	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
CV (%)	50,3	29,01	37,1	48,4	33,48	38,81	44,4	46,36	43,27	49,45	42,21	52,96

ns – non-significant. ** - Significant at 1% probability. ¹ Means followed by the same letter belong to the same group according to the Scott-Knott test ($P \leq 0.05$). UNI = Uniformization cutting. RES = Residual cutting.

The application of the highest P₂O₅ rate resulted in the greatest number of tillers at all cutting cycles. Similarly, Florentino et al. (2019) observed that the number of tillers differed significantly depending on P₂O₅ levels in *Megathyrus maximus* cv. Mombasa. The authors observed that increasing phosphate fertilizer rates resulted in a linear increase in the number of tillers. In forage grasses, tillering is relevant to biomass production and represents one of the most important characteristics for plant establishment and pasture productivity (Faria et al., 2015). Tillering potential of a genotype results from the emission of new leaves, which in turn arise from a new axillary bud that can generate a new tiller, ensuring continuous leaf regeneration and production of dry mass after cutting or grazing events (Gomide & Gomide, 1999). Calvière & Duru (1999) demonstrated that supplying grasses with P resulted in greater initial growth of leaves and stems, and greater biomass production. Thus, P availability may have provided the plants with a greater capacity to regenerate leaves and tillers after each cutting cycle, resulting in an increase in dry mass production capacity. There was no significant interaction effect between genotypes and P₂O₅ levels on dry mass yield, which demonstrates that both greater and lesser P availability equally affect all *U.*

mosambicensis genotypes. However, there was a significant isolated effect of both genotype and P₂O₅ levels. The genotypes BRS Piatã (9.26 g pot⁻¹), UmCO-14 (2) (8.41 g pot⁻¹) and UmCO-4 (1) (8.30 g pot⁻¹) were those with the highest means of accumulated dry mass yield (Figure 1). Furthermore, the accumulated dry mass yield among the genotypes was greatest with the application of the highest level of P₂O₅ (Figure 2). Likewise, Bavaresco (2021) reported that the increase in soil P concentrations resulting from the greater supply of this nutrient provides better productive performance and greater root growth, in addition to greater P accumulation in plant tissues of *Megathyrus maximus* cv. Mombasa and cv. Aruana. Similarly, Souza et al. (2020) also reported phosphate fertilizer increased total yield of Mombasa grass. P is a nutrient necessary for the synthesis of phosphorylated compounds during photosynthesis and the lack of this nutrient causes immediate disturbances in the metabolism and development of plants (Holford, 1997), compromising crop yield. The data from the present study suggest that greater P availability has favored physiological processes related to photosynthetic activity, leading to greater plant efficiency in biomass production.

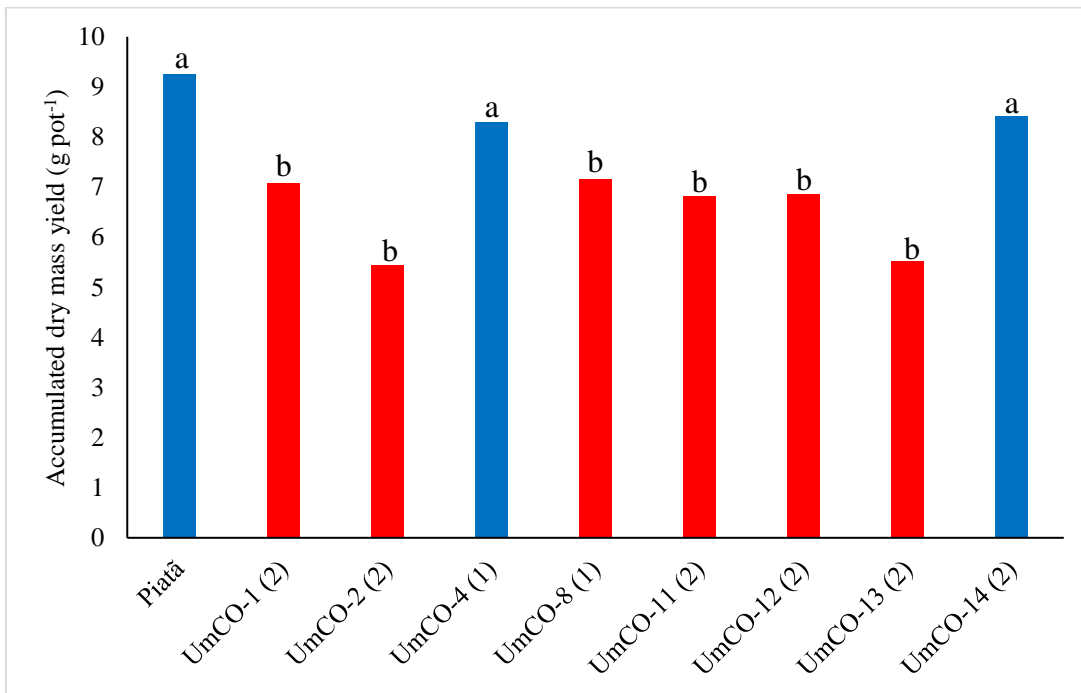


Figure 1 – Accumulated dry mass yield (g pot⁻¹) of *U. Mosambicensis* genotypes over 4 cutting cycles. Teresina, Piauí, 2022. Similar letters on the top of bars belong to the same group according to the Scott-Knott test ($P \leq 0.05$).

Regarding the response of the genotypes to phosphate fertilization, which takes into account the difference in dry mass yield between the P levels (α), it is verified, based on the methodology recommended by Fageria & Kluthcouski (1980), that UmCO-4 (1), UmCO11 (2) and BRS Piatã were most frequently classified as efficient and responsive (ER) to P₂O₅ application. UmCO-4 (1) genotype stood out at the first (uniformization), third and fourth cutting cycles, thus being the *U. mosambicensis* genotype that most often fell into ER

category. Conversely, UmCO-13 (2) genotype was classified as non-responsive and non-efficient (NENR) in all cutting cycles (Figure 3). The genotypes UmCO-4 (1), UmCO-11 (2) and BRS Piatã were classified as efficient because they achieved good yield at low P₂O₅ levels. The identification of efficient genotypes in P use is an important strategy to increase P use efficiency (Fidélis et al., 2008), especially in environments with low P availability or in low-input cropping systems.

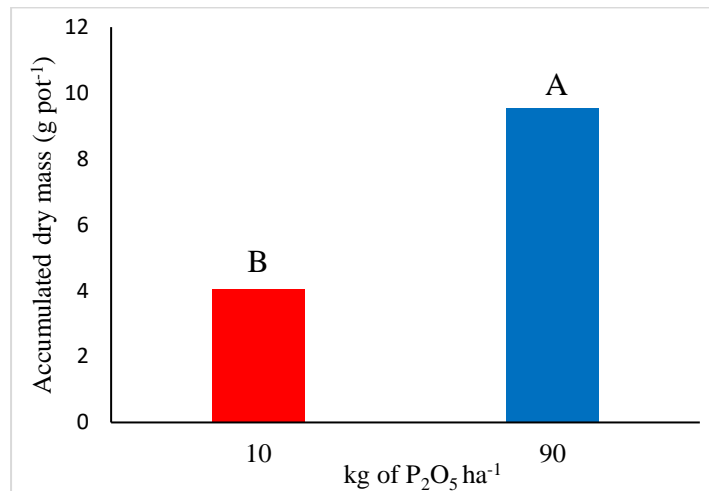
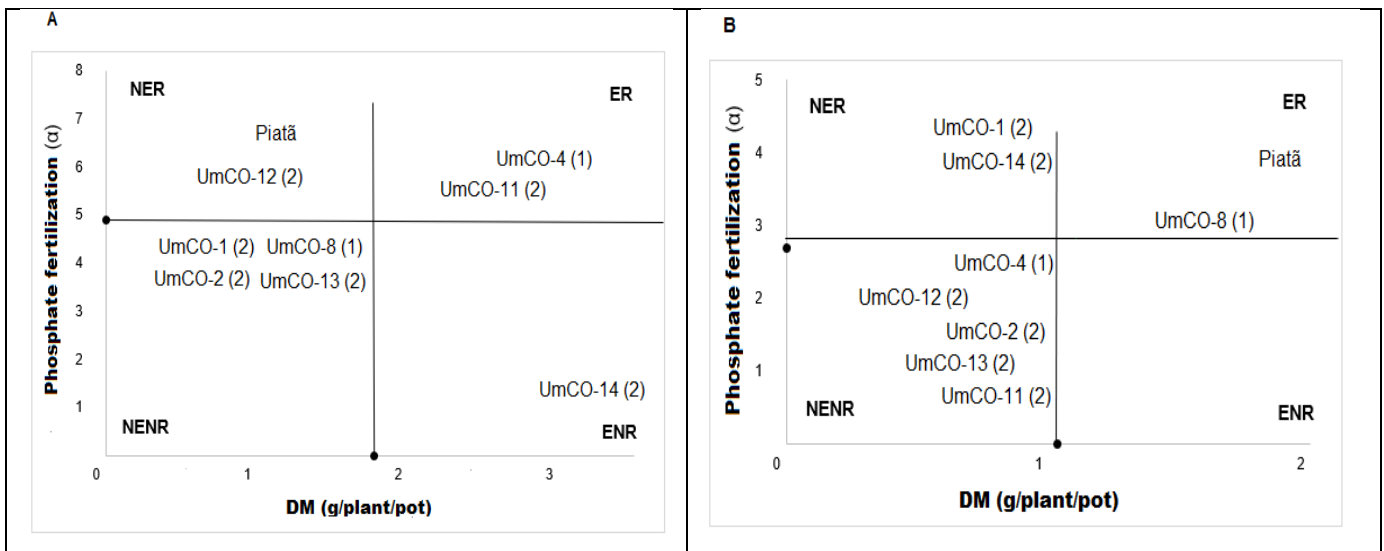


Figure 2 – Average dry mass yield (g pot⁻¹) of *U. mosambicensis* genotypes, over four cutting cycles, in response to phosphate fertilization rates. Teresina, Piauí, 2022. Different letters on the top of bars differ from each other based on the “t” test.

High P efficiency for dry mass yield in *U. brizantha* (‘BRS Piatã’) has been demonstrated in other studies (Ramos et al., 2009). However, specific data on P use efficiency of *U. mosambicensis* genotypes in terms of dry mass yield

were not found in the literature. Therefore, the results presented here constitute a fundamental starting point, allowing for the identification of UmCO-4 (1) and UmCO-11 (2) genotypes as the most efficient in P use.



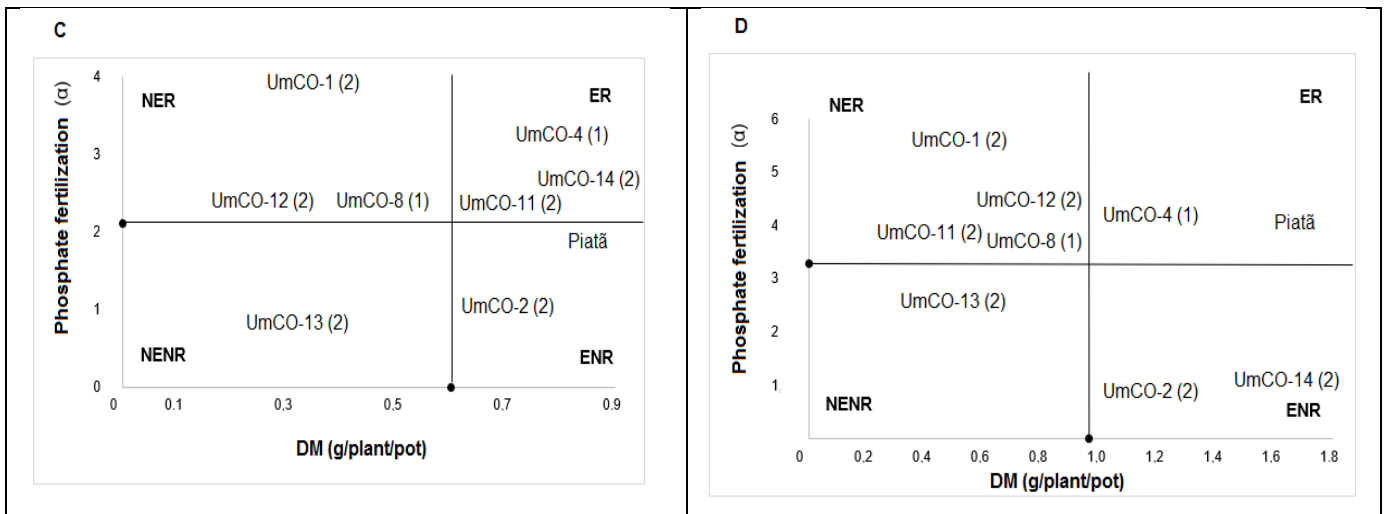


Figure 3 – Classification of *U. mosambicensis* genotypes and BRS Piatã, regarding efficiency and responsiveness in phosphate fertilizer use (α) for dry mass yield of the aerial part (DM). The letters A, B, C and D correspond to the first, second, third and fourth cutting cycles, respectively. ER = efficient and responsive; ENR = efficient and non-responsive; NER = non-efficient and responsive and NENR = non-efficient and non-responsive.

The genotypes identified as most responsive to P application were UmCO-1 (2), UmCO-4 (1), UmCO-8 (1), UmCO-11 (2), UmCO-12 (2), and BRS Piatã. These genotypes stood out for presenting the highest rates, being represented on the first (NER) and second (ER) quadrants. Responsive genotypes have a high capacity to respond to increases in phosphate fertilization, making such genotypes desirable for cultivation in soils with greater P availability (Fidélis et al., 2008) or in management systems where there is greater possibility of investment in phosphate fertilizer. Despite the

responsiveness of UmCO-1 (2) and UmCO-12 (2) to P application, these genotypes did not exhibit good productivity under conditions of low P_2O_5 availability, thereby being classified as inefficient.

Regarding accumulated dry mass yield, the genotypes BRS Piatã and UmCO-4 (1) were classified as ER, the genotype UmCO-14 (2) was classified as ENR, the genotypes UmCO-1 (2), UmCO-8 (1), UmCO-11 (2) and UmCO-12 (2) were classified as NER, and the genotypes UmCO-2 (2) and UmCO-13 (2) were classified as NENR (Figure 4).

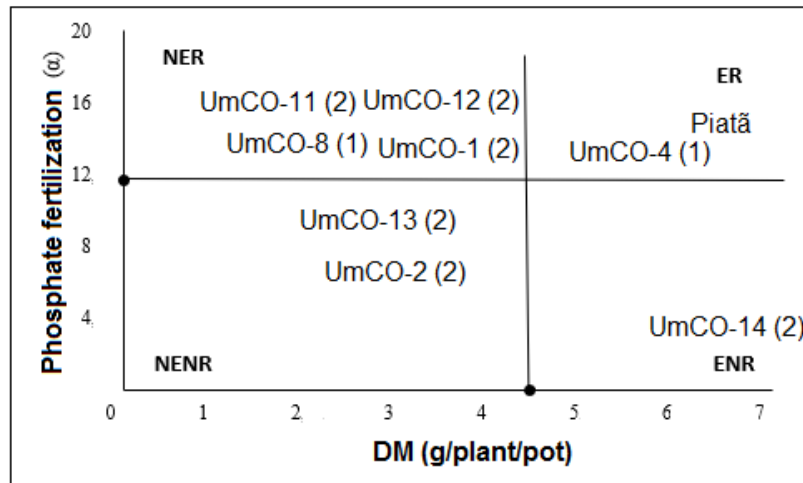


Figure 4 – Classification of *U. mosambicensis* genotypes and BRS Piatã as to efficiency and responsiveness in phosphate fertilizer use (α), for accumulated (four cutting cycles) dry mass of the aerial part (DM). ER = efficient and responsive; ENR = efficient and non-responsive; NER = non-efficient and responsive and NENR = non-efficient and non-responsive.

In plant breeding programs, the amplitude of variability is fundamental for the selection of desired traits because it allows for the identification of plants with superior performance (Hartwig et al., 2007). Thus, genetic divergence makes it possible to accelerate genetic improvement for certain traits (Cui et al., 2001). The differentiated responses of genotypes due to variation in soil P_2O_5 levels show a genetic variability in *U. mosambicensis* that can be exploited in breeding programs aiming at selecting genotypes best adapted to different conditions of P availability.

The response of the genotypes UmCO-4 (1) and ‘BRS Piatã’ in relation to the variation in P levels indicate a greater agronomic efficiency of these genotypes over the others. Based on the methodology described by Fageria & Kluthcouski (1980), these genotypes were the most efficient in P use and responsive to P application, both for dry mass yield at each individual cutting cycle and accumulated dry mass yield. This greater agronomic efficiency

allowed plants to uptake and use P more efficiently, thereby improving plant development and forage production.

Agronomic efficiency, as well as improved P uptake by plants, is related to the characteristics of the soil and the plant itself (Santos et al., 2006). The metabolic requirement of each genotype is a fundamental factor and, considering that the genotypes evaluated in this experiment were subjected to the same soil conditions, the differences found are due to their different metabolic requirement.

In summary, the data from this study demonstrated that the *U. mosambicensis* genotype UmCO-4 (1) and the cultivar BRS Piatã proved to be responsive and efficient in P use. The data also demonstrated that the highest P level promoted greatest dry mass yield and greatest number of tillers in all *U. mosambicensis* genotypes. Finally, differences in efficiency and responsiveness to P availability for dry mass yield indicate possible genetic variability among *U. mosambicensis*

genotypes, which can be exploited for the breeding of promising cultivars.

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