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GROWTH AND PRODUCTIVITY OF FORAGE GRASSES UNDER PHOSPHORUS SOURCES OF DIFFERENT SOLUBILITIES[1]

CRESCIMENTO E PRODUTIVIDADE DE GRAMÍNEAS FORRAGEIRAS SOB FONTES DE FÓSFORO DE DIFERENTES SOLUBILIDADES

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ABSTRACT

The objective of this study was to evaluate the growth and productivity of BRS Capiaçu and BRS Kurumi cultivars in function of phosphorus sources in the semiarid region of Piauí. The work was conducted in the experimental area of the State University of Piauí, in Picos-PI. The completely randomized design was adopted, in a factorial scheme (4x2), formed by three sources of phosphorus (rock powder, single superphosphate and triple superphosphate) and the witness and two cultivars of elephant grass (BRS Capiaçu and BRS Kurumi), with four replicates, making up 32 experimental units. The planting occurred by means of vegetative propagation. Three cuts were made: the first, of standardization, and the others, of evaluation. After the cuts, evaluation of the variables was performed: plant height, stem diameter, number of tillers, number of leaves per tiller, total number of leaves, green leaf mass, green stem mass, green shoot mass, dry leaf mass, dry stem mass, aerial dry mass and productivity. Phosphate fertilization provided positive results in growth and productivity of the BRS Capiaçu and BRS Kurumi cultivars. Simple superphosphate fertilization is recommended for the production of first cut grass. The positive result in the second cut with the use of rock powder indicates residual effect of this fertilizer, being the same recommended in this study. It is recommended to produce the cultivar BRS Capiaçu under study conditions.

Keywords: Capiaçu; Kurumi; Rock dust; Simple superphosphate; Triple superphosphate.

RESUMO

Objetivou-se avaliar o crescimento e a produtividade das cultivares BRS Capiaçu e BRS Kurumi em função de fontes de fósforo no semiárido piauiense. O trabalho foi conduzido na área experimental da Universidade Estadual do Piauí, em Picos-PI. Foi adotado o delineamento inteiramente casualizado, em esquema fatorial (4x2), formado por três fontes de fósforo (pó de rocha, superfosfato simples e superfosfato triplo) e a testemunha e duas cultivares do capim-elefante (BRS Capiaçu e BRS Kurumi), com quatro repetições, perfazendo 32 unidades experimentais. O plantio ocorreu por meio de propagação vegetativa. Três cortes

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foram realizados: o primeiro, de uniformização, e os demais, de avaliação. Após os cortes, foi realizada a avaliação das variáveis: altura de planta, diâmetro do colmo, número de perfilhos, número de folhas por perfilho, número total de folhas, massa verde da folha, massa verde do colmo, massa verde da parte aérea, massa seca da folha, massa seca do colmo, massa seca da parte aérea e produtividade. A adubação fosfatada propiciou resultados positivos no crescimento e produtividade das cultivares BRS Capiaçu e BRS Kurumi. A adubação com superfosfato simples é recomendada para produção dos capins no primeiro corte. O resultado positivo no segundo corte com o uso do pó de rocha indica efeito residual desse adubo, sendo o mesmo, recomendado nesse estudo. Recomenda-se a produção da cultivar BRS Capiaçu nas condições de estudo.

Palavras-chave: *Capiaçu, Kurumi, Pó de rocha, Superfosfato simples, Superfosfato triplo.*

INTRODUCTION

Cattle farming in Brazil is one of the pillars of agribusiness and national economy, standing out for its large-scale production and its role in global meat market. The country has the largest commercial cattle herd in the world and is leader in beef exports, serving markets such as China, European Union and United States (ABIEC, 2023).

In Brazil, a significant portion of cattle farming occurs in pasture (CHOTOLLI, 2023). In this context, pastures emerge as main alternative for supplying bulk to cattle, becoming essential factor for increasing production in Brazilian agribusiness (SVERSUTTI; YADA, 2019).

Raising animals on pasture is an activity with high productive potential and easy adaptation to the different climates of Brazil (KIRCHNER *et al*., 2019). In addition, the use of pastures contributes to the reduction of environmental impacts often associated with raising animals in confinement, such as greenhouse gas emissions (RÖÖS *et al*., 2016).

In the semi-arid region of Piauí, several grasses have been introduced with the aim of intensifying livestock activity in the region, among them is elephant grass (*Pennisetum purpureum* Schum.), which has high production potential (RODRIGUES *et al*., 2018; TEIXEIRA *et al*., 2022), good adaptability to different types of climate and soil (GRASEL *et al*., 2016), high nutritional value and good acceptance by animals (GOMIDE *et al*., 2015).

Among elephant grass cultivars, BRS Capiaçu stands out for its vegetative growth vigorous and rapid leaf expansion (PEREIRA, 2021), high biomass yield and versatility of use, can be used for the production of high-quality silage or supplied to animals in the form of fresh forage (PEREIRA *et al*., 2016). In addition, it is adapted to water deficit (PEREIRA; LEDO; MACHADO, 2017), making it a viable option for semi-arid conditions.

BRS Kurumi, known for its small stature, is widely used in rotational grazing systems, standing out for its continuous production of leaves and tillers (FERNANDES *et al*., 2016). The nutritional value, combined with the lower rate of stem elongation, has provided good results in the weight gain of animals on pasture (GOMIDE *et al*., 2015).

In terms of soil fertility, according to Liebig Law, the productivity of a crop will be limited by the nutrient that is lower available in the soil (FERNANDES; SOUZA; SANTOS, 2018). In this sense, phosphorus is one of the main obstacles to the production of forage grasses in Brazilian soils (DIAS *et al.*, 2015). According to Prado (2021), phosphorus perform an essential role in photosynthesis, respiration, energy storage and transfer, cell division and increased crop production performance, requiring the use of phosphate fertilizers (SILVA *et al.*, 2018).

Among the phosphate fertilizers used in elephant grass (*Pennisetum purpureum*) cultivation, simple superphosphate and triple superphosphate stand out, providing readily available phosphorus to plants, especially at planting time (SOUZA *et al.*, 2021). According to Silva *et al.* (2014), the application of simple superphosphate in the establishment of grass contributes to the adequate establishment of the forage plant.

In a study conducted by Cardoso *et al.* (2023), it was observed that phosphorus replacement using simple superphosphate promoted a linear increase in dry matter production in BRS Kurumi elephant grass, demonstrating the importance of this type of fertilizer for forage performance. Similarly, Oliveira *et al.* (2013) recorded improvements in productive characteristics with the application of simple superphosphate in elephant grass crops, confirming the efficiency of this phosphate source in the rapid release of phosphorus to plants.

However, these mineral fertilizers, despite increasing the availability of nutrients for crops, contribute little to improving the physical and biological attributes of the soil (COSTA; SILVA; RIBEIRO, 2013; SEDIYAMA *et al.*, 2016), making it necessary to use alternative sources of nutrients in agriculture.

In this context, the use of rock dust can be an excellent soil fertility management strategy (BRITO *et al.*, 2019). The use of this fertilizer represents a form of intelligent and low-solubility fertilization, where its residual effect can last for four to five years, due to the slow release of nutrients, making it a beneficial source for crops, since the roots of the plants absorb the released nutrients gradually, according to their needs (COLA; SIMÃO, 2012). In addition, rock dust is an alternative source fertilizer and soil amendment of low-cost, which results in an agricultural practice with less environmental impact (ALOVISI *et al.*, 2020). Therefore, since forages are perennial plants, the application of this type of fertilizer, with a high residual effect, seems viable.

However, although the importance of phosphate fertilization is widely recognized, there is still lack of information on the influence of fertilizers of different solubilities on the structural characteristics of forage grasses. Therefore, it is essential to carry out research that offers more technical answers in relation to the productivity and quality of forage (PIMENTEL *et al.*, 2016).

Therefore, the objective of this research was evaluate the influence of phosphorus sources on the growth and productivity of the BRS Capiaçu and BRS Kurumi cultivars in the semi-arid region of Piauí.

MATERIAL AND METHODS

The experiment was carried in protected environment with dimensions of 4 x 9 x 2 m (l x c x h), with roof and sides closed with shade at 75%, located out in the experimental area of the State University of Piauí - UESPI (latitude 07° 04` 37" S and longitude 41° 28' 01" W, altitude of 195 m a.s.l.) in the municipality of Picos-PI, from October 2023 to June 2024. The climate, according to the Köppen climate classification, is semiarid, very hot, with distinct dry and wet seasons and average annual rainfall ranging from 600 to 700 mm (ALVARES *et al.*, 2013).

The experimental design adopted was completely randomized, with four replicates, and treatments arranged in a (4 x 2) factorial scheme, composed of the combination of three phosphorus sources (simple superphosphate, triple superphosphate and rock dust) and the control and two grasses of the species *Pennisetum purpureum* Schum. (BRS Capiaçu and BRS Kurumi), totaling 32 experimental plots, each unit comprising a pot with a capacity of 18.0 dm^3.

Before the experiment was implemented, simple soil samples were collected in area of native vegetation, belonging to the State University of Piauí in the 0-20 cm layer, and a composite sample is formed which was and sent to the laboratory for chemical and grain size characterization, according to Teixeira *et al.* (2017). The results are shown in table 1.

Table 1 - Chemical and grain size characterization of soil.

pH H_2O	P	K^+	Ca^{2+}	Mg^{2+}	K^+	Al^{3+}	H+Al	SB	CEC	m	V	O.M.
	------mg dm^{-3}------		------------------------------cmoldm^{-3}------------------------------							------------%------------		
5.71	55.20	48.00	3.48	0.93	0.12	0.00	3.67	4.53	8.20	0.00	55.20	0.15

pH in H_2O, phosphorus (P), potassium (K^+), calcium (Ca^{2+}), magnesium (Mg^{2+}), aluminum (Al^{3+}), hydrogen+aluminum (H+Al), sum of bases (SB), cation exchange capacity (CEC), aluminum saturation (m), base saturation (V) and organic matter (O.M). Sand: 71.8%; Silt: 9.1%; Clay: 19.1%
Fonte: Soil Analysis Laboratory (CPCE/UFPI)

Based on soil analysis, 60 days before planting, dolomitic lime was applied (PRNT 69%), with the aim of increasing soil base saturation to 60% (PEREIRA, 2021), using a quantity of 5.13 g. pot^{-1}.

As phosphorus sources, simple superphosphate (18% P_2O_5, 12% S and 20% Ca), triple superphosphate (41% P_2O_5 and 12% Ca) and rock dust (16% P_2O_5 and 16% Ca) were used. Phosphate fertilization was carried out based on the chemical analysis of the soil and recommendation for each grass, with 100 and 120 kg ha^{-1} of P_2O_5 indicated for BRS Kurumi and BRS Capiaçu, respectively, according to Pereira *et al.* (2021). Subsequently, the quantity per pot was calculated, according to the P_2O_5 content of each type of fertilizer (Table 2).

Table 2 - Amount of fertilizer applied in each treatment in planting fertilization.

Phosphorus sources	BRS Capiaçu (g pot^{-1})	BRS Kurumi (g pot^{-1})
Simple superphosphate	5.94	4.95
Triple superphosphate	2.61	2.16
Rock dust	6.75	5.58

Source: Author Construction

The Capiaçu and Kurumi grass stalks were acquired from Fazenda Nobre, located in the city of Dom Expedito Lopes, 18 km from the State University of Piauí, *Campus* Professor Barros Araújo. Each stem, approximately 8 cm long and with two nodes, was planted directly in the pot, at a density of three stems pot^{-1}, at a depth of 10 cm, in soil fertilized with different sources of phosphorus (PEREIRA *et al*., 2016).

25 days after planting, thinning was performed, leaving one plant pot^{-1}. Once day, manually, a volume of 607 mL of water per pot was applied, which corresponded to 70% of pot capacity. Weeds were removed manually experiment during.

With the identification of caterpillars (*Spodoptera frugiperda*), in the two species of grass, biological control was carried out, using the product Boveril WP PL63 at dosage of 0.25 g per liter of water, together with Matarril WP E9, at concentration of 0.4 g per liter of water. Applications were carried out at 10 day intervals (MAPA, 2024).

30 days after planting, uniformity cut was carried out at 5 cm above the ground. Subsequently, the second and third cuts were for evaluation e were performed after 50 days between both (ROSA *et al*., 2019).

In addition, topdressing fertilization was carried out. For BRS Kurumi, 0.88 g of urea was applied as nitrogen source and 0.67 g of potassium chloride as potassium source 60 days after planting (GOMIDE *et al*., 2015). For BRS Capiaçu, 3.6 g of NPK fertilizer 20-00-20 was applied as source of nitrogen and potassium and 1.0 g of simple superphosphate, 0.44 g of triple superphosphate and 1.12 g of rock dust as sources of phosphorus after the first evaluation cut (PEREIRA *et al*., 2016).

After the second and third cuts, following variables were evaluated: plant height (PH, cm), stem diameter (SD, mm), number of tillers (NT), number of leaves (NL), number of leaves per tiller (NLT), leaf fresh mass (LFM, g pot^{-1}), stem fresh mass (SFM, g pot^{-1}), aerial fresh mass (AFM, g pot^{-1}), leaf dry mass (LDM, g pot^{-1}), stem dry mass (SDM, g pot^{-1}), aerial dry mass (ADM, g pot^{-1}) and productivity (PD, kg ha^{-1}).

To determine PH, a tape measure graduated in centimeters was used, measuring from the ground to base of the last expanded leaf. For SD, a digital caliper was used at a height of 5 cm to soil. For NT and NL, count was carried out. The NLT was determined by the division of the NL/NT. For LFM and SFM, aerial part was cut close to the soil, separated the leaves from the stem, and placed in paper bags and weighed on semi-analytical balance with accuracy of 0.01g. For AFM, LFM and SFM were added. Subsequently, they were dried in an oven with air circulation at 65°C for 72 hours and after drying, plants were weighed on semi-analytical balance with accuracy of 0.01g to determine LDM, SDM and ADM. The ADM was transformed to kg ha^{-1} to determine PD.

Data were submitted to analysis of variance by the F test (P≤0.05). Phosphorus sources and forage grasses means, when significant, were compared by the Duncan test (P≤0.05).

RESULTS AND DISCUSSION

In the first cut, there was an isolated effect of the cultivar on plant height (PH), number of tillers (NT) and number of leaves (NL). For phosphorus sources, individual effect was observed for number of tillers (NT) and number of leaves (NL) (Table 3).

Table 3 - Resume of analysis of variance, for plant height (PH), stem diameter (SD), number of tillers (NT), number of leaves (NL) and number of leaves per tiller (NLT) of the Capiaçu and Kurumi cultivars according to the phosphorus sources, in the first cut.

Variation sources	p-value				
	PH	SD	NT	NL	NLT
	--cm--	--mm--			
Cultivate (C)	0.000^{*}	0.116^{ns}	0.000^{*}	0.000^{*}	0.137^{ns}
Phosphorus sources (P)	0.053^{ns}	0.870^{ns}	0.045^{*}	0.028^{*}	0.871^{ns}
C x P	1.000^{ns}	0.138^{ns}	0.575^{ns}	1.000^{ns}	0.067^{ns}
CV(%)	19.67	14.87	24.76	25.96	17.70

*Significant at the level of 5%; ^{ns}Not significant by F-test. CV - Coefficient of variation.
Source: Author Construction

For the production variables, in the first cut, there was isolated effect of the cultivar for leaf fresh mass (LFM) and leaf dry mass (LDM). There was effect of interaction between cultivars and phosphorus sources on stem dry mass (SDM) and productivity (PD) (Table 4).

Table 4 - Resume of analysis of variance, for leaf fresh mass (LFM) stem fresh mass (SFM), aerial fresh mass (AFM), leaf dry mass (LDM), stem dry mass (SDM), aerial dry mass (ADM) and productivity (PD) of the Capiaçu and Kurumi cultivars according to the phosphorus sources, in the first cut.

Variation sources	p-value						
	LFM	SFM	AFM	LDM	SDM	ADM	PD
	---------------	-------	-------	g	-------	---------------	kg ha^{-1}
Cultivate (C)	0.009^{*}	0.179^{ns}	0.419^{ns}	0.011^{*}	0.030^{*}	0.717^{ns}	0.030^{*}
Phosphorus sources (P)	0.229^{ns}	0.620^{ns}	0.440^{ns}	0.279^{ns}	0.113^{ns}	0.192^{ns}	0.112^{ns}
C x P	0.956^{ns}	0.222^{ns}	0.427^{ns}	0.878^{ns}	0.008^{*}	0.098^{ns}	0.008^{*}
CV(%)	7.83	9.90	6.81	14.66	30.31	8.81	8.26

*Significant at the level of 5%; ^{ns}Not significant by F-test. CV - Coefficient of variation.
Source: Author Construction

For PH, BRS Capiaçu presented the highest value (Table 5). This can be explained by the genetic characteristics of cultivars. BRS Capiaçu has a cespitose growth and tall stature, reaching 4 m height (MOURA *et al*., 2024). The BRS Kurumi has short stature and has semi-open clumps (PEREIRA, 2021). Leal *et al*. (2020) obtained similar results, where Capiaçu stood out in relation to Kurumi.

Table 5 - Means plant height (PH), number of tillers (NT), number of leaves (NL), leaf fresh mass (LFM) and leaf dry mass (LDM) of the Capiaçu and Kurumi cultivars, in the first cut.

Cultivars	Variables				
	PH	NT	NL	LFM	LDM
	--cm--			--g--	--g--
BRS Capiaçu	59.300 a	3.400 b	27.400 b	72.410 b	10.780 b
BRS Kurumi	28.535 b	6.928 a	65.500 a	114.524 a	16.735 a
CV(%)	19.67	24.76	25.96	7.83	14.66

Means followed by the same letter in the column are not significantly different according to Duncan test (P<0.05).
Source: Author Construction

However, BRS Kurumi expressed highest value for the variables NT, NL, LFM and LDM (Table 5).

BRS Kurumi has rapid leaf expansion and high basal and axillary tillering, desirable characteristics of forage crop (ROSA *et al*., 2019).

Fernandes *et al*. (2016) demonstrated the high production capacity of leaves and tillers of this cultivar, with higher production in the second and third grazing cycles, compared to the clone CNPGL 00-1-3. In study carried out by Paciullo *et al*. (2015), BRS Kurumi presented greater leaf density, in relation to the clone CNPGL 00-1-3 and the cultivar Napier.

According to Rosa *et al*. (2019), the small stem elongation of the BRS Kurumi cultivar results in a denser clump with a greater number of leaves, resulting in high forage production and excellent pasture structure. The higher proportion of leaves results in higher values of fresh and dry leaf mass. These results confirm the cultivar's potential, even though it is smaller.

When comparing phosphorus sources, higher values of NT and NL were observed when the plants were fertilized with simple superphosphate compared to rock dust, not differing from the other treatments (Table 6).

Table 6 - Means number of tillers (NT) and number of leaves (NL) of the Capiaçu and Kurumi cultivars according to the phosphorus sources, in the first cut.

Variation sources	NT	NL
Simple superphosphate	7.000 a	63.000 a
Triple superphosphate	5.714 ab	49.142 ab
Rock dust	3.857 b	38.428 b
Soil	5.500 ab	50.000 ab
CV(%)	24.76	25.96

Means followed by the same letter in the column are not significantly different according to Duncan test (P<0.05).
Source: Author Construction

Simple superphosphate provides calcium, sulfur and phosphorus, and because is a highly soluble source, releases phosphorus in the early stages (BEZERRA; SOUSA, 2023), which is observed in the first cut. In grasses, phosphorus, in addition to influencing productivity, perform an important role in the initial stage of plant development (BULEGON *et al*., 2016).

Carneiro *et al*. (2017) found that phosphate fertilization provided greater tillering and production of fresh and dry mass. Florentino *et al*. (2019) observed that grass tillering is positively influenced by phosphate fertilization.

According to Table 6, the control did not differ from the other treatments, which can be explained by the soil characteristics observed in the analysis (Table 1), especially the phosphorus content, classified as very high (CANTARUTTI *et al*., 2007).

Regarding the interaction between cultivar and phosphorus sources, simple superphosphate provided higher SMD and PD values for the BRS Capiaçu grass. However, there was no difference between the phosphorus sources for the BRS Kurumi grass (Table 7). Regarding the cultivar, BRS Capiaçu provided greater dry mass of stem and productivity, compared to BRS Kurumi, when both were fertilized with simple superphosphate (Table 7).

Table 7 - Means stem dry mass (SDM) and productivity (PD) of the Capiaçu and Kurumi cultivars according to the phosphorus sources, in the first cut.

Variation sources	**Cultivate**			
	BRS Capiaçu	**BRS Kurumi**	**BRS Capiaçu**	**BRS Kurumi**
	SDM (g pot^{-1})		PD (kg ha^{-1})	
Simple superphosphate	23.700 aA	5.275 aB	2633.333 aA	586.111 aB
Triple superphosphate	8.133 bA	4.750 aA	903.703 bA	527.777 aA
Rock dust	6.325 bA	7.333 aA	702.777 bA	814.814 aA
Soil	2.800 bA	4.700 aA	311.111 bA	522.222 aA
CV(%)	30.31		8.26	

Means followed by the same lowercase letter in the column and the same uppercase letter in the row do not differ significantly according to Duncan's test ($P<0.05$).
Source: Author Construction

Phosphate fertilization has positive effect on the structural of forage grasses, contributing significantly to growth and productivity (Costa *et al*., 2016). This is especially evident when using a highly soluble source, such as simple superphosphate, which stood out in increasing Capiaçu production in the first cut.

However, rock dust has slow release of phosphorus, maintaining good crop productivity in the long term (OLIVEIRA; ROCHA; MARTINS, 2023).

Although triple superphosphate has higher concentration of phosphorus than single superphosphate, the latter offers advantages in specific situations, especially by providing calcium in higher concentrations and sulfur. This characteristic makes simple superphosphate more efficient in improving crop productivity (BROCH *et al*., 2011).

The more effective response of Capiaçu to fertilization with simple superphosphate shows that this grass is more responsive to this type of fertilizer, compared to Kurumi.

In the second cut, there was an individual effect of the cultivar and phosphorus sources for the plant height (PH) and an interaction effect for the number of leaves per tiller (NLT) (Table 8).

Table 8 - Resume of analysis of variance, for plant height (PH), stem diameter (SD), number of tillers (NT), number of leaves (NL) and number of leaves per tiller (NLT) of the Capiaçu and Kurumi cultivars according to the phosphorus sources, in the second cut.

Variation sources	p-value				
	PH	SD	NT	NL	NLT
	--cm--	--mm--			
Cultivate (C)	0.000^{*}	0.175^{ns}	0.095^{ns}	0.065^{ns}	0.319^{ns}
Phosphorus sources (P)	0.006^{*}	0.171^{ns}	0.201^{ns}	0.436^{ns}	0.421^{ns}
C x P	1.000^{ns}	0.182^{ns}	0.325^{ns}	0.111^{ns}	0.008^{*}
CV(%)	20.39	14.87	24.76	8.17	14.25

Means followed by the same letter do not differ significantly by the Duncan test (P<0.05).
Source: Author Construction

For the production variables, there was isolated effect of the cultivar for stem fresh mass (SFM), stem dry mass (SDM), aerial dry mass (ADM) and productivity (PD), in the second cut (Table 9). However, there was no isolated effect of phosphorus sources or interaction for the variables evaluated (Table 9).

Table 9 - Resume of analysis of variance, for leaf fresh mass (LFM) stem fresh mass (SFM), aerial fresh mass (AFM), leaf dry mass (LDM), stem dry mass (SDM), aerial dry mass (ADM) and productivity (PD) of the Capiaçu and Kurumi cultivars according to the phosphorus sources, in the second cut.

Variation sources	p-value						
	LFM	SFM	AFM	LDM	SDM	ADM	PD
	--------------------------------g pot^{-1}--------------------------------						kg ha^{-1}
Cultivate (C)	0.803^{ns}	0.032^{*}	0.224^{ns}	0.267^{ns}	0.000^{*}	0.028^{*}	0.028^{*}
Phosphorus sources (P)	0.328^{ns}	0.573^{ns}	0.411^{ns}	0.531^{ns}	0.111^{ns}	0.358^{ns}	0.358^{ns}
C x P	0.280^{ns}	0.426^{ns}	0.313^{ns}	0.141^{ns}	1.000^{ns}	0.328^{ns}	0.328^{ns}
CV(%)	7.83	9.90	6.81	14.66	30.31	8.81	8.86

*Significant at the level of 5%; ^{ns}Not significant by F-test. CV - Coefficient of variation.
Source: Author Construction

Comparing the cultivars in the second cut, higher values of the variables PH, SFM, SDM, ADM and PD were observed in Capiaçu (Table 10).

Table 10 - Means plant height (PH), stem fresh mass (SFM), stem dry mass (SDM), aerial dry mass (ADM) and productivity (PD) of the Capiaçu and Kurumi cultivars, in the second cut.

Variation sources	PH	SFM	SDM	ADM	PD
	--cm--	------------------g pot^{-1}------------------			kg ha^{-1}
BRS Capiaçu	48.230 a	120.840 a	16.830 a	39.470 a	4385.555 a
BRS Kurumi	28.928 b	76.392 b	7.357 b	25.478 b	2830.952 b
CV(%)	20.39	9.90	30.31	8.81	8.86

Means followed by the same letter in the column are not significantly different according to Duncan test (P<0.05).
Source: Author Construction

The greater production of BRS Capiaçu can be justified by its genetics and the greater capacity to recover the biomass input between the first and second cut, compared to BRS Kurumi. Accordingly to Retore *et al*. (2021), the dry mass of BRS Capiaçu grass increases as the cutting age advances, because with the plant's maturation process, the proportion of leaves in relation to stems decreases. Laranja *et al*. (2022) reported an increase in the dry matter content of Capiaçu in the second cut. Accordingly to Pereira, Ledo, Machado, (2017) the BRS Capiaçu cultivar stood out for presenting dry mass production around 33% higher than Cameroon and Mineiro, considered the most productive of the species.

According to table 11, rock dust provided a higher average pH, compared to simple superphosphate, without differing from the control (Soil) and triple superphosphate.

Table 11 - Means plant height (PH) of the Capiaçu and Kurumi cultivars according to the phosphorus sources, in the second cut.

Variation sources	PH
	cm
Simple superphosphate	27.966 b
Triple superphosphate	36.885 ab
Rock dust	45.428 a
Soil	35.825 ab
CV(%)	20.39

Means followed by the same letter in the column are not significantly different according to Duncan test (P<0.05).
Source: Author Construction

The absence of a significant difference between rock dust and the control can be attributed to the low solubility of this input, which promotes a gradual release of phosphorus, limiting its immediate availability to plants. Although triple superphosphate releases phosphorus quickly, part of the nutrient can be rapidly fixed in soil colloids, especially in acidic tropical soils (NASCIMENTO *et al*., 2024), as the soil in the experimental area, this reduces its immediate efficiency and causes the treatment to behave similarly to the control and rock dust.

When available in adequate quantities, phosphorus promotes better development of the aerial parts of forage grasses (OLIVEIRA; ROCHA; MARTINS, 2023).

Nalbile and Galbiate (2023), when studying the effect of rock dust, concluded that the use of this fertilizer contributed to increased corn production. Similarly, Nagatani *et al*. (2023) emphasize that the use of rock dust promoted satisfactory grain production in long-term corn crops, being a recommended source for providing controlled phosphorus release. These results suggest that rock dust can improve the quantity and quality of grasses.

For the BRS Capiaçu cultivar, there was no difference in the phosphorus sources for NLT. For the BRS Kurumi cultivar, rock dust provided a higher NLT value (Table 12).

Table 12 - Means number of leaves per tiller (NLT) of the Capiaçu and Kurumi cultivars according to the phosphorus sources, in the second cut.

Variation sources	Cultivate	
	BRS Capiaçu	BRS Kurumi
	NLT	
Simple superphosphate	8.060 aA	7.363 bA
Triple superphosphate	8.907 aA	7.680 bA
Rock dust	7.284 aB	10.429 aA
Soil	6.235 aA	8.310 bA
CV(%)	14.82	

Means followed by the same lowercase letter in the column and the same uppercase letter in the row do not differ significantly according to Duncan's test ($P<0.05$).
Source: Author Construction

Cunha and Neto (2015) observed that Mombaça grass plants cultivated with rock dust showed similar agronomic efficiency to those cultivated with commercial fertilizer, demonstrating the potential use of this byproduct in forage production. Costa *et al*. (2021) observed that rock dust met the demand of Mombaça grass, in relation to the management adopted, and can thus be used in pasture areas, aiming at financial return and sustainable agriculture.

The greater efficiency of simple superphosphate compared to rock dust in the first cut, and the superiority of rock dust in the second cut in relation to more soluble sources, show that the use of industrial fertilizers is recommended for the initial cycles of pastures, while rock dust offers positive results over time.

FINAL CONSIDERATIONS

Fertilization with simple superphosphate is recommended for grass production in the first cut.

Positive result of using rock dust in the second cut indicates a residual effect of this fertilizer, which is recommended in this study.

The production of the BRS Capiaçu cultivar is recommended under the study conditions.

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