Evaluation of agronomic characteristics and productivity of elephant grass (pennisetum Purpureum schum) cv. Brs Capiaçu in different dosages of phosphate fertilization

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ABSTRACT

Elephant grass BRS capiaçu is a new cultivar in the forage area, having productive potential both in the form of silage and in chopped green form, however this plant requires good availability of phosphorus in the soil to obtain this productive potential, due to the P deficit. in soils and the lack of information about it, given the need for new studies related to phosphorus and its productivity. The objective of this work was to evaluate agronomic characteristics and productivity at different levels of phosphorus (P) in elephant grass cv. BRS Capiaçu. The experimental design used was randomized blocks (DBC), with four treatments and four replications, totaling 16 experimental units. The treatments were composed of four doses of P2O5, T1=0, T2=100, T3=250 and T4=400 kg/ha. Each block contained 4 lines and 7 plants per line, with a spacing of 0.75 m between plants and 1 m between lines, totaling an area of 60 m2. The experiment was conducted in the agricultural experimentation area of the Centro Universitário Tocantinense Presidente Antônio Carlos – UNITPAC, in the municipality of Araguaína Tocantins between the months of October 2023 and June 2024.

Keywords: Elephant Grass, Phosphor, Silage.

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INTRODUCTION

The BRS Capiaçu cultivar, originally from elephant grass (Pennisetum purpureum Schum), has become one of the most widely used cultivars today, was obtained by the elephant grass improvement program conducted by Embrapa Dairy Cattle, for a higher production of biomass and nutritional value, becoming a viable animal supplementation alternative, especially in periods of food scarcity [1].

With a large dry matter production (DM), they observed yields of around 50 t/ha/year of dry matter in Minas Gerais, which placed the cultivar as the most productive among the others of the genus [1].

Elephant grass cv. BRS Capiaçu was developed with the objective of being used for the production of silage or offered chopped green in the trough. Its propagation occurs through culms and presents buds with high budding power. It is characterized by having dense clumps and erect culms, which facilitates mechanical harvesting; Leaves long, broad, green in color. The cultivar has good tolerance to water stress, but is susceptible to grassland leafhoppers.

For the supply of BRS Capiaçu forage in the form of green chopped in the trough, it is recommended that the cut be carried out when the plant reaches 2.5 to 3.0 m in height, approximately 50-70 days, in the rainy season [1]. For silage production, it is recommended when the plants reach approximately 3.5 to 4 m in height or 90 to 110 days of regrowth age [1].

In the implementation of BRS Capiaçu, three buds/m² or per row are used, with a spacing of 80 cm to 1.20 m [1]. In addition, it should be made in furrows 20 to 30 cm deep next to the fertilizer [1].

Establishment fertilization should be based on the results of soil analysis. In most tropical soils, the main limitations are related to acidity and low phosphorus contents, which must be corrected with the use of liming and fertilizers. When planting, it is recommended to apply only phosphate fertilization, distributed at the bottom of the furrows. For most soils, 120 kg/ha of P2O5 is required, which corresponds to 600 kg/ha of simple superphosphate. Potassium should be applied when the potassium content in the soil is less than 50 ppm, at a dose of 80 to 100 kg/ha of KCl[8].

This cultivar reproduces vegetatively, from the buds of the stems, with high budding power, and with approximately 30 tillers per m², it is an erect and tall plant, with thick stems, wide leaves, late flowering and good resistance to damping-off and water stress. Cultivar, which is one of the alternatives that cattle ranchers are looking for in recent times to supplement their herd in times when there is a lack of forage on the property.

Elephant grass cv. BRS Capiaçu, as well as other forages for weeding production, needs good availability of phosphorus in the soil for its growth and development. However, the soils of the Amazon region, for the most part, have low availability of phosphorus, and therefore, it is necessary to apply it so that the soil is not degraded and that production is efficient. However, there is still a lack of studies on phosphate fertilization for BRS Capiaçu elephant grass in the state of Tocantins.

SUPPORTING

Due to the drought that occurs every year, where with it comes the low supply of forage, cattle ranchers are currently looking for less expensive and more efficient alternatives for supplementing their herd.

One of the alternatives is the production of silage using elephant grass cv. BRS Capiaçu, but in order to have a quality silage and thus meet the demand of the animals, it is necessary to balance the production of biomass and the nutritional quality of the grass. Thus, the crop should be implanted at the beginning of the rainy season [1].

OBJECTIVES

General Objective

To evaluate the influence on the development of elephant grass cv. BRS Capiaçu, submitted to increasing doses of phosphate fertilization, under edaphoclimatic conditions in the municipality of Araguaína – TO.

Specific Objectives

To evaluate plant height (AP), tiller number (NP), distance between nodes (DE), stem diameter (DC), dry matter (DM) and green matter (MV) of stem and leaf, dry matter production per hectare (SMP), green matter production per hectare (PMV) and leaf:stem ratio, when subjected to increasing doses of phosphate fertilization.

THEORETICAL FRAMEWORK

ORIGIN AND CHARACTERISTICS OF ELEPHANT GRASS CV. BRS CAPIAÇU

Elephant grass belongs to the African continent, as well as the vast majority of the forages we grow in our country, more specifically from Tropical Africa, with its coordinates approximately between: Latitude 10°00'00.0"N and Longitude 20°00'00.0"E.

Its discovery was by Colonel Napier in the year 1905. With this, this cultivar spread throughout Africa and was introduced in Brazil in 1920, coming from Cuba. Today it is widespread in the five Brazilian regions.

Nowadays, this cultivar has spread in the five Brazilian regions [2]. For better germination and tillering, the use of inputs for good productivity per hectare is highlighted [1].

The BRS Capiaçu elephant grass is characterized by its tall size, broad, long and dark green leaves, yellowish green leaf sheath and stem with a thick diameter, yellowish internodes, absence of joçal (hairs), late flowering, white midrib, with a high density of tillers per m² (clump), and good resistance to damping off and water stress [6].

LIVESTOCK IN TOCANTINS

The state of Tocantins has a tradition of beef cattle raising. According to the State Secretariat of Agriculture and Livestock, since the state's inception, beef and dairy cattle breeding has grown by 95%, from about 4.2 million head of cattle in 1988 to more than 8.12 million in 2013.

In a trend scenario, the state would reach, in 2031, a total herd of 11.9 million head, producing 6.24 @/ha with a stocking of 1.05 AU/ha.

The state could slaughter about 326,000 head of males from intensive systems, representing about 25% of the total number of males slaughtered. A reduction in the slaughter age is estimated with the elimination of the 4-year category from 2027 and a production of approximately 27 million arrobas in 2031[10].

Tocantins is one of the Brazilian states with the greatest tradition in beef cattle breeding, currently having a herd of 8 million animals, distributed in all regions of the state. The Tocantins herd stands out not only for the quantity, but also for the quality of the animals and meat produced.

For 18 years, Tocantins has been internationally recognized as an area free of foot-and-mouth disease with vaccination, surpassing the mark of 99% of the herd immunized in each campaign.

In addition, the State produces the so-called "green cattle", which are pasture-fed animals, free of animal feed, which meets the preferences of the most demanding consumer markets [11].

PHOSPHATE FERTILIZATION

In Brazilian soils, forage cultivars are commonly implanted in soils of low fertility, and mainly for the availability of P, with this deficit of P in the soil, together with the non-application of P in the soil, leads to low tillering and low dry matter production [4].

The phosphorus available in the soil and the non-available phosphorus is corrected with liming to become a greater amount of P available for the plant's consumption, thus making it more feasible to increase the availability of P, which has the advantage of its dissolution by the acidity of the soil itself, being economically viable, with the reduction of expenses with the use of acids in the manufacture of water-soluble fertilizers [12].

Most Brazilian soils have a high phosphorus fixation in the soil.

The intensity of phosphorus fixation in the soil is due to issues that intervene in the availability of P in plants, one of these issues is the types of soil, such as clay, time of application, soil aeration, temperature and the level of N may interfere directly [13].

In the plant, phosphorus is absorbed in the form of an orthophosphate ion ($H_2PO_4^-$), which is either simple superphosphate or triple superphosphate.

Phosphorus is important in the formation of ATP (adenosine triphosphate), being one of the main ones for the process of photosynthesis having as a source of energy for its realization. Energy is used in the transport of assimilates, in the storage and transfer of energy, in cell division, in the enlargement of cells and in the transfer of genetic information [14].

The sources of P come from phosphate rocks, where the predominant mineral is apatite. The most common rock is fluorapatite, however, in order to make this P more soluble and available to plants, acid and temperature treatments are needed in these rocks [5].

One of the main sources of phosphorus are triple superphosphate, simple superphosphate, monoammonium phosphate (MAP), and diammonium phosphate. Triple superphosphate (41 to 46% P and 10 to 12% Ca), although it contains calcium, is a source intended to provide phosphorus. It is a relatively inexpensive source, when considering only phosphorus, simple superphosphate and acidulated phosphates contain 18 to 21% of P and 10 to 12% of S. In addition to providing the element as a nutrient, it improves the soil profile with prolonged use [15].

Phosphorus is mobile in the plant, it can move through the phloem. For the identification of deficiency symptoms, it usually occurs in the older leaves. These symptoms stand out with a yellowish or bluish green color, little brightness and even stiffness. In corn, the absence of phosphorus is manifested by the purplish color of the leaves due to the accumulation of sugars that favor the production of anthocyanin (vegetable purple pigment). Due to the symptoms on the older leaves, automatically on the first leaves of the plant after its emergence, this causes a deficiency in the growth of the plant being an irreversible problem [5].

MATERIALS AND METHODS

The experiment was carried out between November 2023 and June 2024, in the agronomy experimental field, located within the Presidente Antônio Carlos University Center – UNITAPC, in the municipality of Araguaína – TO, with the following coordinates: Latitude - 7°12'38.5" S and Longitude - 48°14'14.5" W.

Rainfall throughout the experiment was collected in the field, using a rain gauge installed between the blocks, as shown in the following table.

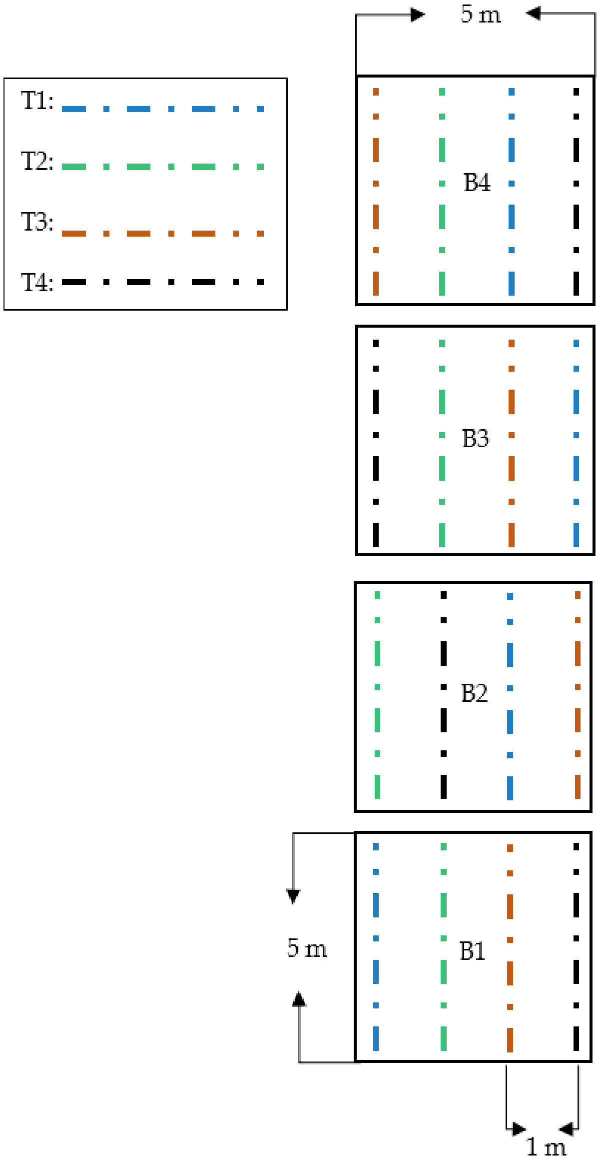
Table 1. Precipitation.

Precipitation Table	
Months	Overall (mm)
NOV	110
DEC	210
JAN	292,5
FEB	272,5
MAR	252
APR	265
MAY	5

Source: Authors, 2024.

The experimental design was in randomized blocks (Figure 1), with four treatments and four replications, totaling 16 experimental units. The treatments consisted of a control and 3 doses of P: 0, 100, 250 and 400 kg/ha of P_2O_5.

Figure 1. Sketch of the area.



Source: Authors, 2024.

Each block had 4 rows and 7 seedlings per row, using 28 seedlings per block, in total 112 seedlings were needed to continue the experiment.

They were prepared using propagative material from the institution itself, where they were kept in an environment protected by a 50% shade screen, on a 3x1.20 m galvanized steel countertop, along with a layer of dry grasses to maintain humidity. Irrigation was done automatically 3 times a day with an average of 5 mm/day.

Manual liming was performed according to the chemical analysis (Table 1), in order to increase the pH, and thus reduce the proportion of exchangeable Al^{3}+ [9]. After 60 days of liming, the planting was carried out.

Table 1. Chemical analysis of the soil in the 0-20 cm layer.

pH	Pmeh	Towards	Ca	Mg	H+Al	SB	CTCt	V %
CaCl2	mg.dm-3	cmolc.dm-3						
5,6	3,1	0,08	1,5	0,8	1,50	2,38	3,88	61

Source: Authors, 2024.

The fertilizer used was super simple, the same inserted in furrows, made in the format of rows, with a spacing of 1 m, followed by incorporation into the soil, at a depth of 20 cm.

Then, 3 buds per m² at 75 cm between plants were planted by hand with 3 buds per plant of the BRS Capiaçu elephant grass on the fertilizer, in the appropriate treatments of 0, 100, 250 and 400 kg/ha of P2O5.

When the plant reached 60 DAP, urea and KCl topdressing was carried out with application of 100 kg/ha. After 180 days of germination, when the cultivar reached the cut-off point for silage, the agronomic characteristics of BRS Capiaçu Elephant Grass were evaluated.

For data collection and sectioning, 1.5 m of the borders of each treatment line were discarded, using only the central portion. Height was measured using a measuring tape, graduated in centimeters, measuring from the base of the plant to the tip of the leaves, and counting the number of tillers.

To determine the green mass, the plant stems were cut close to the ground, mechanically, using a machete. Where leaves were separated from the stem and weighed separately.

After cutting, the material was weighed completely to determine the green matter. Then, the stems and leaves were chopped separately in a branch shredder with a particle size of 2 to 4 cm.

Of this total weight, 4 subsamples of 100 g of green matter of the stem and leaves were used, where an average was made to determine the percentage of dry matter, which was obtained by drying in a forced circulation oven at 65°C for 72 hours.

After the kiln process it was weighed on a semi-analytical balance. And after data collection, a general cut of all blocks and treatments was carried out to standardize the forage.

The data were submitted to analysis of variance, at 5% probability of error, and when a significant effect was found, regression analysis was performed. The statistical analysis software used was SISVAR 5.8.

RESULTS AND DISCUSSION

The height of the BRS Capiaçu elephant grass, in the treatments present in the study, all with the same amount of DBH, had the highest efficiency at the dose of 250 kg/ha with 3.87 m, being higher than the other doses, 100 kg/ha with 3.85 m, control with 3.81 m and 400 kg/ha with 3.72 m (Figure 2A).

The number of tillers was more efficient at dose 0 and 400 kg/ha at the dose according to the collection of 2 central m in the planting rows, with 30 tillers, being higher than the other dosages, 100 kg/ha with 26 and 250 kg/ha with 29 tillers (Figure 2B).

In the distance between nodes, the highest efficiency point was the dose of 100 kg/ha with 112.63 mm, surpassing the other dosages, where from then on the remainder hears a gradual reduction in the distance between nodes (Figure 2C).

In the stem diameter, the 100 kg/ha dose was the most efficient, with 17.45 mm in diameter, with an increase of 5.2% in relation to the 0 dose, where from 250 kg/ha, there was a reduction in the stem diameter (Figure 2D).

Figure 2. Plant height (Figure 2A), tiller number (Figure 2B), distance between nodes (Figure 2C) and stem diameter (Figure 2D) at different P2O5 dosages.

Figure 2A

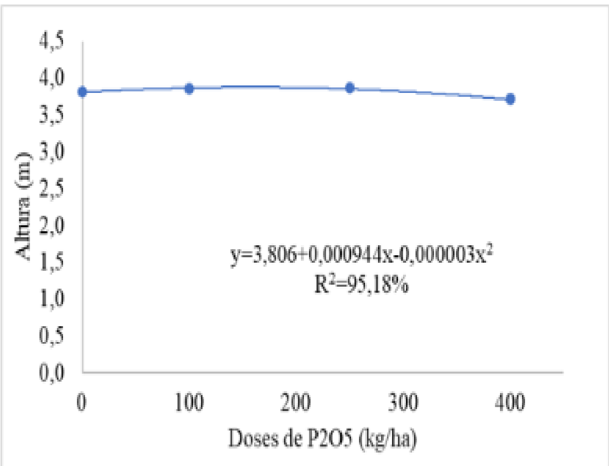


Figure 2C

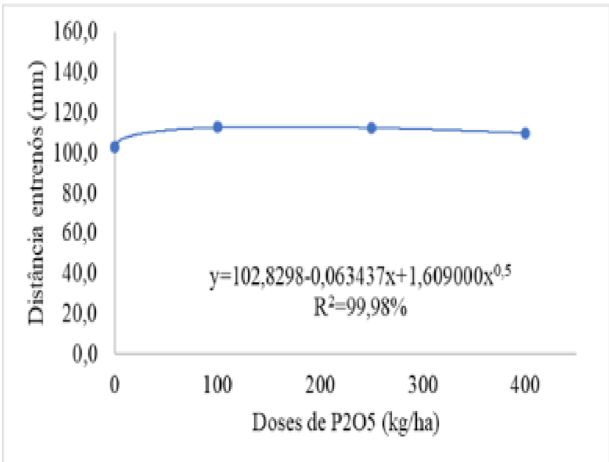


Figure 2B

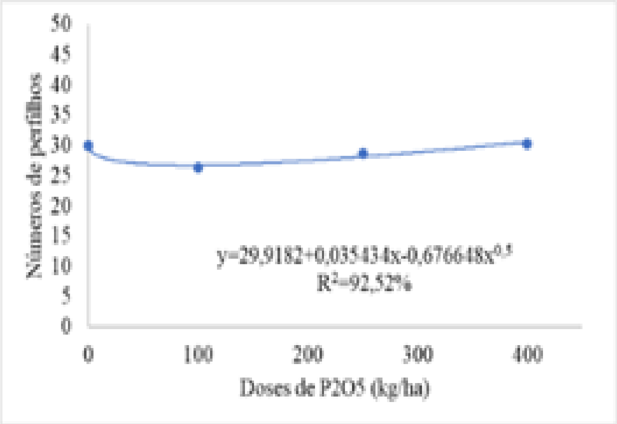
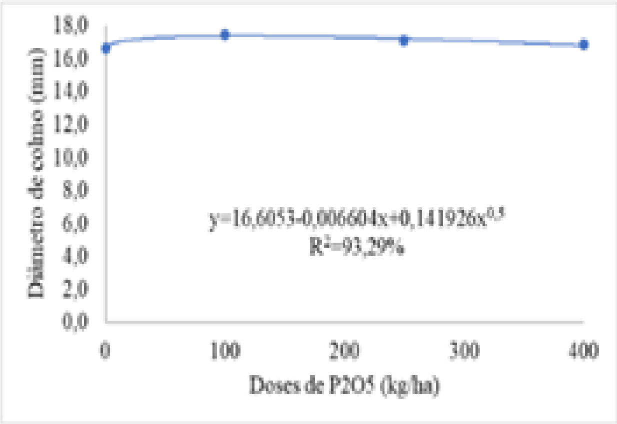


Figure 2D



Source: Authors, 2024.

The stem dry matter variable (%), had a higher result at the 100 kg/ha dose with 24.6% of average, resulting from the collection of the central 2 m in the planting rows. As a result, it exceeded all other dosages, but with a small difference from one dose to another (Figure 3A).

The variable green stem matter had its greatest influence on dose 0, with an average of 12.80 kg in the central 2 m collected in the planting rows, with a linear regression from this dose, with a negligible result (Figure 3B).

Leaf dry matter had dose 0 as the highest result, with an average of 34.5%. As a result, the other doses did not show significant differences in relation to dose 0, with a reduction in percentage (Figure 3C).

The green matter of the leaf had quadratic regression, with dose 0 being the most influential, with a considerable decrease in the dose of 100 kg/ha and an increase in the dose of 250 kg/ha, which was not significant in the result compared to dose 0 (Figure 3D).

Figure 3. Stem dry matter (Figure 3A), green stem matter (Figure 3B), leaf dry matter (Figure 3C) and green leaf matter (Figure 3D) at different P2O5 dosages.

Figure 3A

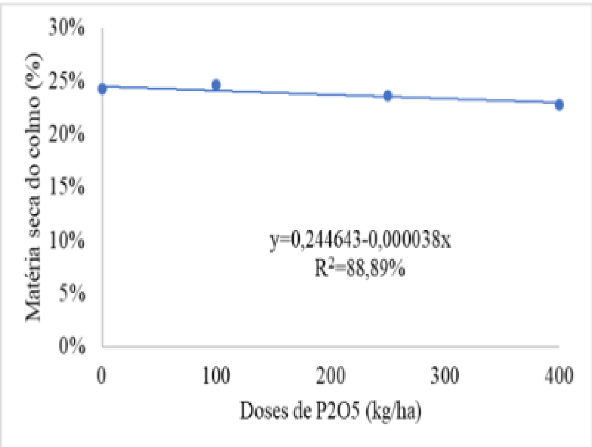


Figure 3C

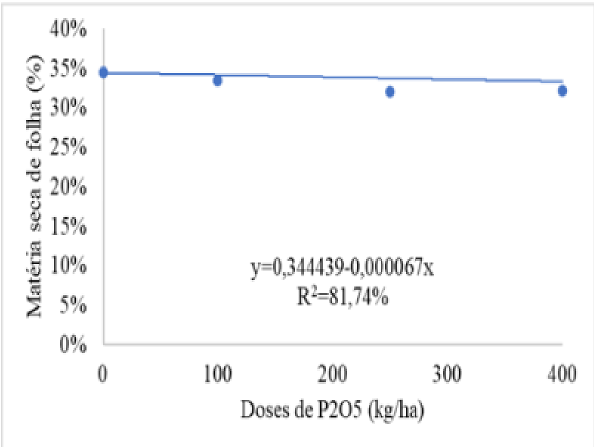


Figure 3B

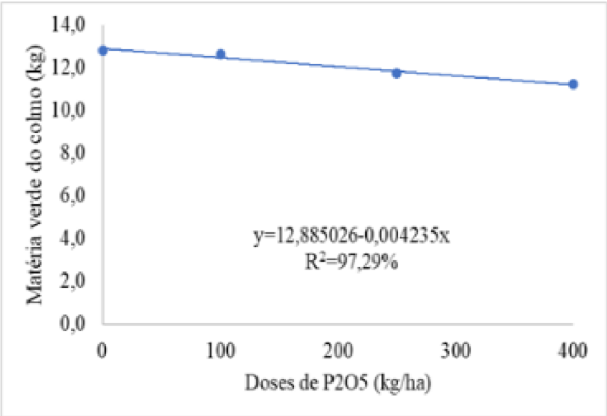
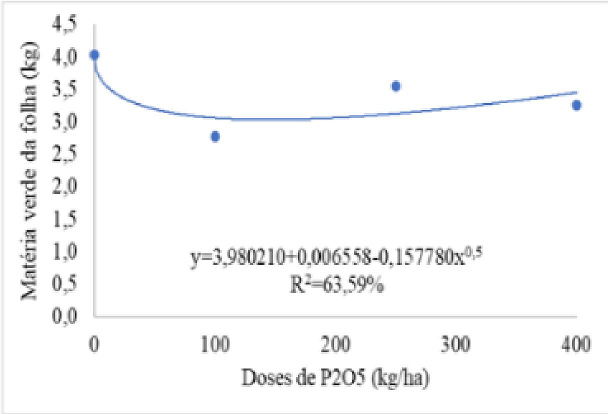


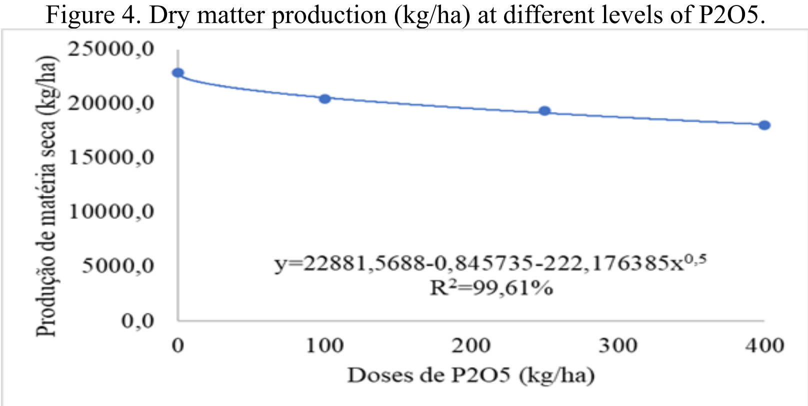
Figure 3D



Source: Authors, 2024.

Dry matter production (SMP) was adjusted to the quadratic model (Figure 4). The point where the maximum efficiency occurred was at dose 0, in which there was an estimated production of 22t/ha, an increase of 111% in relation to the second treatment, with 20t/ha. As in the PMV, we observed that the highest average production was observed in the control of the analyzed variables.

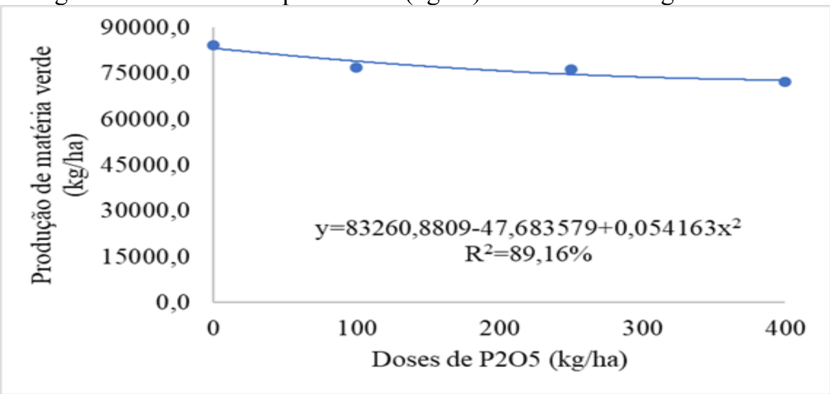
Figure 4. Dry matter production (kg/ha) at different levels of P2O5.



Source: Authors, 2024.

The production of green matter (PMV) was adjusted to the quadratic model (Figure 5). We can observe that the PMV decreases as the doses of P2O5 increase, to a certain extent where it begins to stabilize. With its maximum efficiency point at dose 0, where it obtained an average of 84 t/ha, an increase of 109% in relation to the dose of 100 kg/ha, which had an average of 77 t/ha. Consequently, the doses of P2O5 had a negligible effect on the production of green matter.

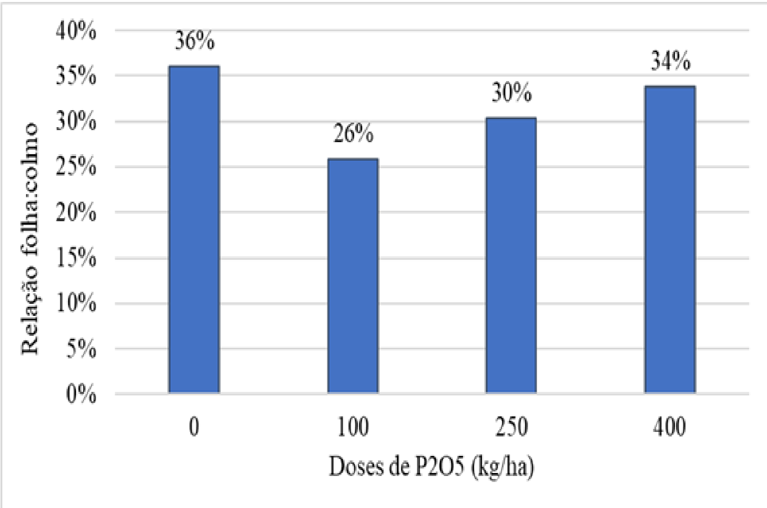
Figure 5. Green matter production (kg/ha) at different dosages of P2O5.



Source: Authors, 2024.

The leaf:stem ratio showed a better performance on average at 0, 250 and 400 kg/ha. The dose of 100 kg/ha showed a lower result than the other doses of P2O5 (Figure 6).

Figure 6. Leaf:stem ratio (%) at different dosages of P2O5.



Source: Authors, 2024.

CONCLUSION

At the end of the experiment, it was concluded that the control stood out among the other P2O5 dosages. This result may be associated with a better experimental conduction.

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