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Research Article

Effect of Chemical Fertilization with pH Correction in Acidic Soils on the Bromatological Composition and Average Yield Per Hectare of *Brachiaria brizantha* cv brs Piatã

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Abstract

The objective of the research was to evaluate the effect of chemical fertilization and soil pH correction, on the yield per hectare and the bromatological composition of the genus Brachiaria, *Brachiaria brizantha* cv brs Piatã species, subjected to four treatments and evaluated in equal cutting times, simulating a rotary grazing. It was carried out in the city of San Lorenzo, Paraguay. The cuts were made every 35 days after sowing, adjusting the pH plus fertilization according to the technical recommendations, arranged in 4 treatments per block: T1 Control without application of fertilizers or pH correction, T2 Correction of pH without fertilizers, T3 pH correction and application of fertilizers and T4 Fertilization without pH correction. In the yield of Green Matter, according to the analysis of variance (ANAVA) that was applied to the average obtained from each cut according to the treatments, following the random blocks statistical model, it showed significant differences with a confidence level of 95% and applying the Tuckey test for comparison of means ($p < 0.05$) in favor of T3 in relation to the other treatments. Regarding the bromatological composition, regarding the percentage of dry matter, significant statistical differences between treatments were evidenced. The analysis of variance of the crude protein (CP) content, showed that there were no significant differences both between the treatments with CV: 5.29%, as well as with the NDF content between the treatments with 2.81% (CV).

Keywords: *Tropical Pastures; Brachiaria brizantha CV Piatã; Chemical Fertilization of the Pasture; Bromatological Composition; Productive Behavior*

Introduction

Cattle raising in tropical countries is predominantly based on feeding livestock in the field on pastures adapted to various ecosystems. The projection of livestock farming with the incorporation of new varieties of pasture and the growing demand for meat, promote the search for alternatives for a better use of resources [1]. Basically, it aims at the transformation of the natural vegetation coverage associated with the change in the use and management of land and the implantation of new pastures [2]. The areas destined for livestock farming are those considered as non-productive for agriculture; however, in the agri-business world, they occupy a prominent place due the incorporation of technologies and the use of resources that in short time become tangible with the increase of areas intended for the implantation of pastures, tending to their productive efficiency [2]. Several are the technologies and/or own management strategies that can be used as alternatives to increase animal production; the gradual replacement of native pasture by introduced species is visualized,

mainly adapted to acidic soils of low fertility, accompanied by management techniques that include: strategic fertilization, pastureland formation, reduced days of use with breaks, as well as adjustment of animal load during the year, weeds control, use of protein banks, use of the forest resource, strategic supplementation, among others [3].

The interaction of all these factors redounds in less annual costs and higher productivity by a hectare [4]. In this sense, Orrico., *et al.* (2013) state that the productive, morphogenic, and structural characteristics of the *Brachiaria brizantha* cv Piatã respond incrementally up to a dose of 300 kg/ha-1 nitrogen, independently from the source used [5]. Similarly, the use of nitrogen fertilizers promotes increments in the production of dry matter in Tifton 85 pasture. The combination of this and the Piatã pasture partnered with pigeon pea raise the protein levels and reduce the content of neutral detergent fiber due to the participation of the leguminous plant in the foraged crop produced (Neres, 2012) [6].

The general objective of this study was to evaluate the effect of chemical fertilization and soil pH correction, on the bromatological composition and the yield per hectare of the *Brachiaria brizantha* cv brs Piatã, in the city of San Lorenzo-Paraguay.

Materials and Methods

During the autumn season until the springtime, the soil was analyzed to obtain its composition as well as the necessary recommendations for the implementation of pastures, for this, 8 subsamples were sent to the soil analysis laboratory. The recommendations performed for the study were the incorporation of agricultural lime into the soil in addition to the fertilizers to be used in each treatment (urea, triple superphosphate, potassium chloride). Treatments were divided in the following way: T1 = Control, without fertilizer application or pH correction; T2 = With pH correction (2 kg of agricultural lime), T3 = pH Correction (2 kg of agricultural lime) and fertilizers application (urea 90 g, triple superphosphate 260 g, potassium chloride 134g) and T4 = Fertilization (urea 90 g, triple superphosphate 260 g, potassium chloride 134g) without pH correction. For the sowing, seeds of a forage pasture *Brachiaria brizantha* cv BRS Piatã were used at a rate of 50 grams for each plot, dispersion in them of the 20 prepared, simulating a conventional scatter sow, after two months of the agricultural lime incorporation. Regarding the cuts carried out, the first one was done at 75 days and then every 35 days, i.e., at 75, 110, 145, 180, and 205 days completing 5 cuts in 7 months that were averaged for the yield analysis in GM, DM, CP, and NDF. The cut to obtain the sample was carried out with a weed trimmer with a conveniently sharped blade simulating rotational grazing to a 10 cm.-cut-high from the soil in each plot. The collected material was placed in a polyethylene bag to facilitate the GM field weighing. Next, the material was separated into subsamples of 500 g each that were cut and conditioned in paper envelopes and labeled by treatment and repetitions (blocks). After that, the subsamples were taken to the Bromatology, nutrition, and animal feeding laboratory to obtain data such as Dry Matter (DM), Crude Protein (CP), Neutral Detergent Fiber (NDF). The results of the analyzed variables (Green Matter, Dry Matter, Crude Protein, Neutral Detergent Fiber) were subjected to Variance (ANAVA) analysis using the statistics program INFOSTAD [7] and following the mathematical at-random block models, in addition to the Tukey's mean comparison test, to try the existing differences among the means of the treatments.

Results and Discussion

Green matter yield (GM)

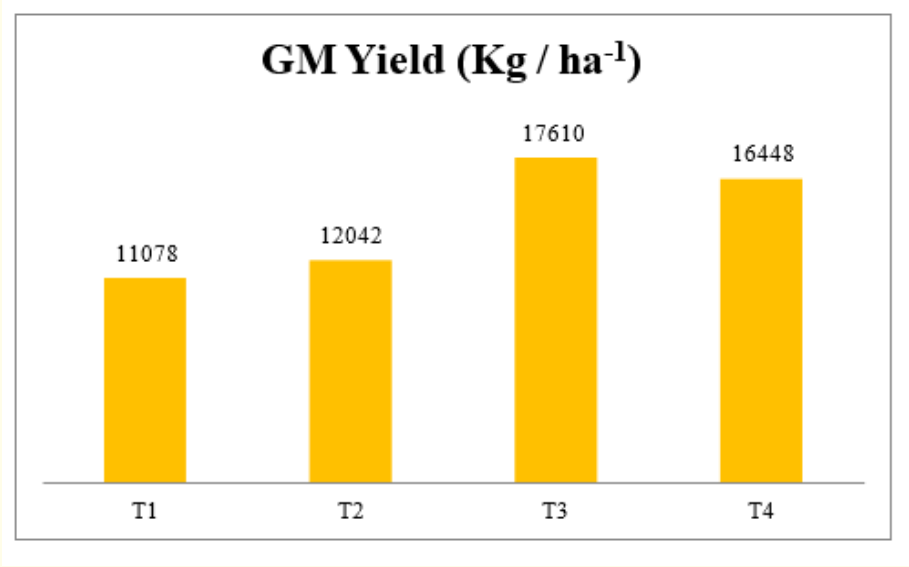
The results obtained in terms of the *Brachiaria brizantha* cv BRS Piatã yield, in combination with soil pH correction and fertilizers application as treatments, demonstrate that in an average of 5 cuts, there are statistics differences ($p < 0,01$) among treatments according to the ANAVA variance analysis, being T3 (17610 $kg.ha^{-1}$) the best, followed by T4 (17610 $kg.ha^{-1}$), T2 (12042 $kg.ha^{-1}$) and lastly T1 (11078 $kg.ha^{-1}$). Table 1 shows the mean yield in the green matter and the corresponding comparison of means according to the Tukey test at 0.05% error probability, highlighting again that the best treatments were T3 and T4.

Treatment	Mean (kg.ha^{-1})	*Tukey
Treat. 3 = With pH correction and fertilizersapplication	17610	A
Treat. 4 = Fertilizers application without pHcorrection	16448	A
Treat. 2 = With pH correction and nofertilizers application	12042	B
Treat. 1 = Control	11078	B

Table 1: *Ordered mean of green matter yield.*

C.V.8,9%.

**Values with similar letters do not vary from each other and values with different letters are statistically significant according to the Tukey Test at 0.05% error probability.*



Graph 1: *Average behavior of GM yield according to treatments.*

Graph 1 shows the performance in green matter yield in an average of 5 cuts, which indicates that treatment T1 control in this experiment presented an average of 11078 kg. ha^{-1} of GM yield. Then with a slight increase in yield, treatment T2 with 12042 kg. ha^{-1} of GM, reaching a maximum yield peak in treatment T3, which presented an average yield of 17610 kg. ha^{-1}. Subsequently, a slight decrease showed in treatment T4 with 16448 kg. ha^{-1} of GM, respectively.

It is evident that the slight yield values difference between T2 and T1 is due to the sole fact of applying a soil corrective, which in this case constitutes the calcareous applied in the treatment T2, providing a marginal yield of 964 kg. ha^{-1} of GM compared to control T1 without the use of any amendments or correctives. This shows that by regulating the pH of the soil, some elements present in it were immediately available, although not in relevant quantities.

Then a jump is observed up to a maximum value of yield in T3 treatment, with a marginal yield of 5568 kg.ha^{-1} of GM compared to treatment T2 and of 6532 kg.ha^{-1} of control, this yield jump, presumably is due to the application of the corrective to regulate soil pH and the application of NPK chemical fertilizers in treatment T3, which means that when regulating the soil pH the elements that were present in the it were already available for forage. However, with the application of the additional fertilizer already mentioned, the plants efficiently took advantage of these elements, observing the consequences of the maximum increase in yield. Finally, treatment T4, which evidenced a yield slight drop compared to treatment T3, whose difference translates to 1162 kg. ha^{-1} less, however, with a marginal yield of 4406 kg.ha^{-1} compared to treatment T2 of 5370 kg.ha^{-1} in front of the control. This phenomenon shown in the yield positioned between treatment T2 and T3 indicates that fertilizers application without a previous soil pH correction increases the production of GM compared to the treatment that presented a previous pH correction but without the application of the fertilizer. However, it still does not express its maximum potential, as occurs in the treatment that received a prior soil pH correction together with a later chemical fertilizer application, fact that demonstrates the maximum yield of green matter per hectare. This coincides with Orrico., *et al.* [5], who state that the productive, morphogenic, and structural characteristics of the *Brachiaria brizantha* cv piatã, respond incrementally up to a dose of 300 kg nitrogen, independently from the source used.

The variance analysis exhibited that the results of the dry matter content (DM) show differences statistically significant among treatments ($p < 0,05$), being of the highest percentage (T2) with 20,414% followed by T1, T4, and lastly, T3. The following table shows the existing difference among treatment means according to the Tukey test at 0.05% error probability.

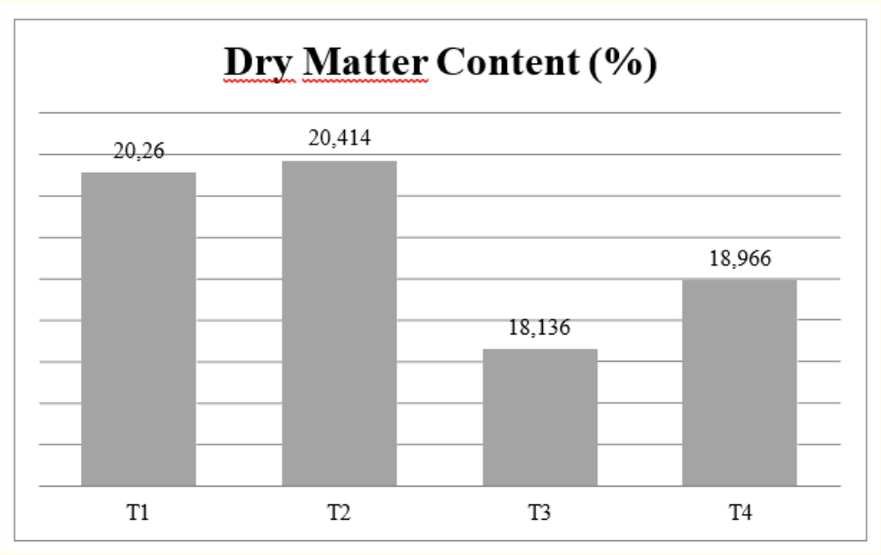
Treatment	Media (%) DM	Tukey
Treat. 2 = With pH correction and without fertilizersapplication	20,414	A
Treat. 1 = Control	20,26	AB
Treat. 4 = Fertilizers application without pH correction	18,966	BC
Treat. 3 = With pH correction and fertilizers application	18,136	C

Table 2: *Ordered mean of Dry Matter content (%).*

C.V. 3,75%.

** Values with similar letters do not vary from each other and values with different letters are statistically significant according to the Tukey Test at 0.05% error probability.*

Continuing with the analysis, in graph 2 it can be observed the tendency of the DM percentage according to the treatments, being T2 (20,414%) the one of the highest percentages, followed by T1 (20,26%), mathematically similar, then T4 and finally T1 with a low level of DM content.



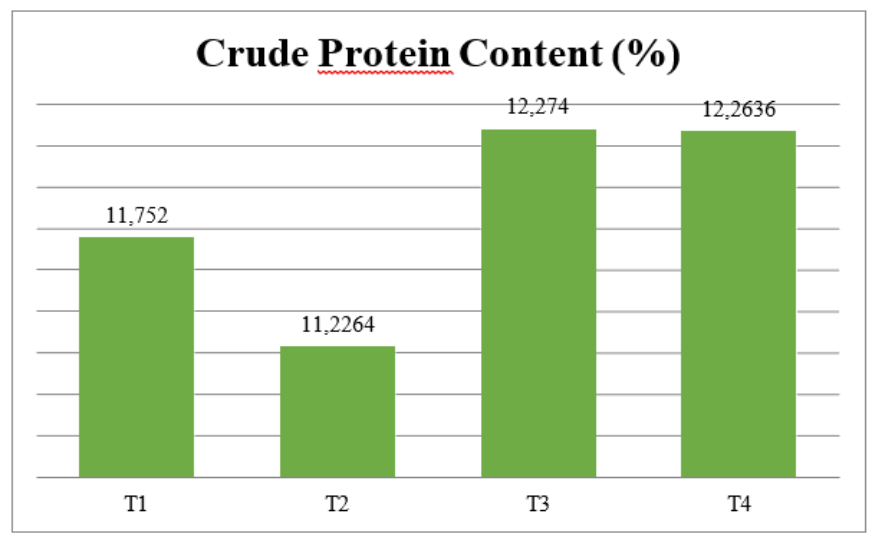
Graph 2: *Average DM content per treatments.*

Comparing results of Green Matter and Dry Matter, we can see that those treatments with good GM yield show low DM content, and the same happens with those who show high DM content but low GM yield; this signifies that: treatments with higher GM yield develop more tender forages with high humidity content in their structure, consequently providing higher weight wining per unit area; however, once the humidity has evaporated, it results in a lower percentage of DM [8].

It should be noted that the DM is expressed in percentages; however, that does not mean they present a lower weight per surface unit translated into kg. ha^{-1}.

The previous results adjust to those obtained by Navajas [9] that in a study about the effect of fertilization on biomass production and absorption of nutrients in Brachiaria decumbens and Brachiaria hybrid Mulato found that there were significant differences among treatments, generating higher dry matter content in the *Brachiaria híbrido* cv. Mulato with fertilization and cut at 15 weeks after the emergence.

Regarding the Crude Protein content (CP), the variance analysis reveals that there are no significant statistical differences among treatments with a C.V = 5,29%, being T3 the one of the highest CP content (12,274%) in average, T4 presents a similar result with 12, 263%, followed by T1 and T2 con lower contents, this is shown in graph 3.

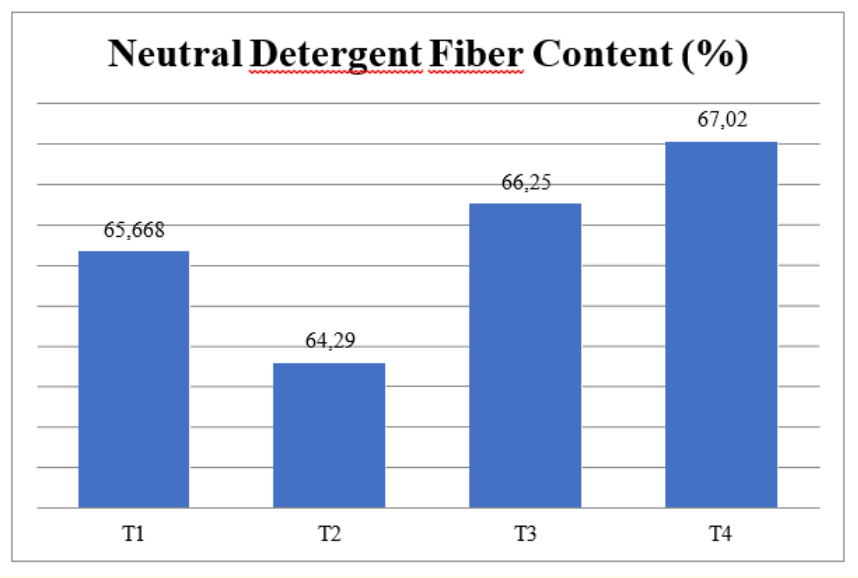


Graph 3: *Crude Protein Average Content (%) per treatments.*

Graph 3 shows that the treatment that received a previous pH correction and a later fertilizer application (T3) presented a higher content of CP, similar results were obtained with the treatment that received only the application of fertilizers (T4) without previous pH correction; this behavior is probably because the application of fertilizers with urea provided sufficient nitrogen to take advantage of the synthesis of amino acids and, consequently, increased protein content. On the other hand, treatments that did not receive the application of fertilizers presented low protein content, presumably due to the absence of enough nitrogen quantities for the synthesis of amino acids, even though statistically, they do not differ from the other treatments. In a general way, the relative composition of the crude protein is high in all treatments compared to those obtained by Gómez, Burgos, and Peralta [10]. In an experiment about the determination of the

bromatological composition of two varieties of pasture (*Brachiaria brizantha*, cv brs Piatã, and Marandú and *Brachiaria ruziziensis*), they found that the cv Piatã presented less CP content with 9,3% against the 9,9% of Marandú and 11,5% of the *Brachiaria ruziziensis* without statistical differences.

Regarding the results of the Neutral Detergent Fiber (NDF), through the ANOVA test it is demonstrated that there are no differences statistically significant among treatments with CV = 2,81%, being T4 with fertilizer application without previous pH correction the one with the highest NDF content, followed by T3 which received a previous soil pH correction and a later application of fertilizers. Finally, are T1 Control and T2, this last received the application of calcareous as a correction of soil pH, as can be seen in the following graph.



Graph 4: *Neutral Detergent Fiber Content in % (NDF).*

Even though the results in the graph do not show statistical significance, these treatments with fertilizers application showed higher NDF content than those that did not receive them.

The NDF global average content in this experiment was 65, 8%, in general terms, it can be said that is low in comparison to results obtained by Gómez; Burgos, and Peralta [10], who evidenced that the cv Piatã presented the highest NDF content with 71,4% against the 70, 7% of Marandú and 65,6% of *Brachiaria ruziziensis*.

On the other hand, forage quality is influenced by the fertilization adjustment per the needs of the crop. In this sense, Días., *et al*. [11] state that when balancing the nutrition in the perennial forage, it is possible to increase the forage quality and production, reducing costs.

Conclusion

Based on the results obtained from both the Green Matter yield and the bromatological composition (DM, CP, NDF), variations were observed in the treatments that received fertilization with and without soil pH correction. Thus, recommending that for good forage production, previous soil analyzes should be carried out to implement the appropriate fertilizers.

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