

Doses of acidity corrective in some chemical attributes to build the fertility of concretionary soils.

Abstract—With the increase of agriculture in the state of Tocantins, especially with the soybean cultivation, areas with concrete have been increasingly applied to high doses of limestone, even though they do not know the dynamics of the reaction of these correctives in the soil conditions of the Tocantins. The experiment was conducted at the Federal University of Tocantins (UFT), Campus of Gurupi - TO. For the study, concrete soil with different soil/gravel ratio was used. We selected the 01:02, 01:05, and 01:10 ratios of fine earth/gravel. The incubation assay was installed under a greenhouse, in a completely randomized experimental design (DIC), with three replicates. The 15 treatments were obtained in a 3X5 factorial scheme, combining three fine earth/gravel (01:02, 01:05 and 01:10) and five limestone (0; 1.0; 2.0; 4, 0 and 6.0 t ha⁻¹). The soil acidity correction was the Pure Analytical (PA) (CaCO₃ + MgCO₃) in the stoichiometric Ca: Mg ratio of 2.5: 1. The incubation was performed over 30 days. A sampling of the incubated soil was performed within 30 days. Soils were prepared as TFSA and sent to the soil laboratory - LABSOLO, for the analysis of Ca + Mg, Ca, Al, potential acidity (H + Al), and pH (H₂O). Al levels and potential acidity (H + Al) were reduced and the Ca and Ca + Mg contents were significantly increased with increasing limestone dose at gravel ratios. The pH of the 1:5 ratio decreased until reaching its lowest value in the dose of 3.31 t ha⁻¹, increasing the dose rate higher than 3.31 t ha⁻¹. The pHs of the ratio 1:2 and 1:10 increased as the limestone dose increased. The levels of Ca, Ca + Mg and the pH value are already at adequate levels at the 0t ha⁻¹ dose of limestone, and it is not necessary to recommend correctives for gravel ratios.

Keywords: Cerrado, soil fertility, limestone.

1. Introduction

The Cerrado biome dominates about 90% of the state territory. Comprised of the Cerrado biome, the region, composed of the states of Maranhão, Tocantins, Piauí, and Bahia, called the most recent Brazilian agricultural frontier, accounts for 11.96% of the soybean-planted area in the country [1].

The soils of the Cerrado are characterized by low fertility, shallow and thick, shallow, low water infiltration capacity, and restriction to water percolation. These characteristics make the region not as favorable to agricultural activity, which can increase the cost of production from the need for more inputs and the adoption of more appropriate management practices to preserve soil's physical properties [2].

When using soil for agricultural purposes, it is indispensable to correct soil acidity, due to the high activity of Al³⁺ ions (toxic to plants) maintained in soil solution at pH values below 5. Therefore, there will be a certain increasing limit in productivity with the rise of soil pH. Another factor to be considered is that acidic soils are almost always synonymous with a deficit in Ca²⁺ and Mg²⁺, thus the correction of

soil acidity made with salts of these cations ends up supplying their deficiencies to a greater or lesser degree.

The lack of correction of acidic soils makes it impossible to use nutrients by plants, consequently impairing economic responses to investments with mineral fertilization [3]. For more productive agricultural systems on the main soils of Tocantins, it is necessary to build fertility with practices such as liming, gestation, and fertilization. Liming corrects acidity, provides calcium and magnesium nutrients, and builds a chemical balance that favors the availability of other nutrients. Plaster does not have the action of correcting soil acidity, it acts by favoring the movement of cations along with the soil profile, and through the formation of aluminum, sulfate reduces aluminum toxicity levels [4]. Fertilization consists of the supply of fertilizers or fertilizers to the soil, to recover or maintain its fertility, and to meet the nutritional need [5].

The process of correcting soil acidity can be divided into two stages the first by dissolving carbonate in bicarbonate and the second by the dissolution of bicarbonate in carbon dioxide and water. As a product, hydroxyls, nutrients, calcium, and magnesium excess limestone is as harmful as the lack. One of the problems of super liming is the chemical imbalance of the soil system affecting the availability of nutrients essential for the development of plants. With the addition of Ca, Mg, and OH^- in excess the cationic nutrients will tend to form molecules with hydroxyl and anionic sums with calcium and magnesium nutrients [6].

The incubation curve method simulates soil natural conditions during the incubation period with increasing doses of limestone. Neutralization curves are elaborated with the determination of acidity indexes, such as pH and active acidity as a function of limestone doses. Due to its increased reliability, this method is considered standard, therefore indicated for calibration of other methods [7]. Thus, despite its accuracy is not used as a routine, given the prolonged time of its realization.

With the expansion of agriculture in the state of Tocantins, especially with soybean cultivation, more and more areas with concretionary soils applying high doses of limestone have been used, even though we are unaware of the dynamics of the reaction of these correctives in the conditions of the concretionary soils of the Tocantins. Therefore, and the absence of scientific studies on the effect of snowing doses of the acidity concealer in concretionary soils of the region, studies of the dynamics of chemical attributes in these soils are of paramount importance for the development of agriculture in the state. Research in this sense can avoid problems such as the super liming of limestone in soil with stony. Therefore, the objective of such a study was to assess the effects of acidity corrective doses on some chemical attributes for the construction of the fertility of concretionary soils.

2. Materials and methods

The experiment was conducted at the Federal University of Tocantins (UFT), Gurupi University

Campus, located in the southern region of the state of Tocantins. For the study, concretion soil was used with different relationships of thin earth/gravel. The relationships were selected: 01:02, 01:05, and 01:10 fine land/gravel, collected at Fazenda Boa Esperança. The property is located in the municipality of Formoso do Araguaia in the State of the Tocantins, whose geographical coordinates of reference are 09° 12' 36.36" S and 45° 21' 34.10" W, with an average altitude of 266 m. As per the Koppen and Geiger classification, the climate of the region is defined as Aw (Tropical Climate). The average temperature of 26.7 °C and the average annual rainfall is 1719 mm, with the rainy season from October to April.

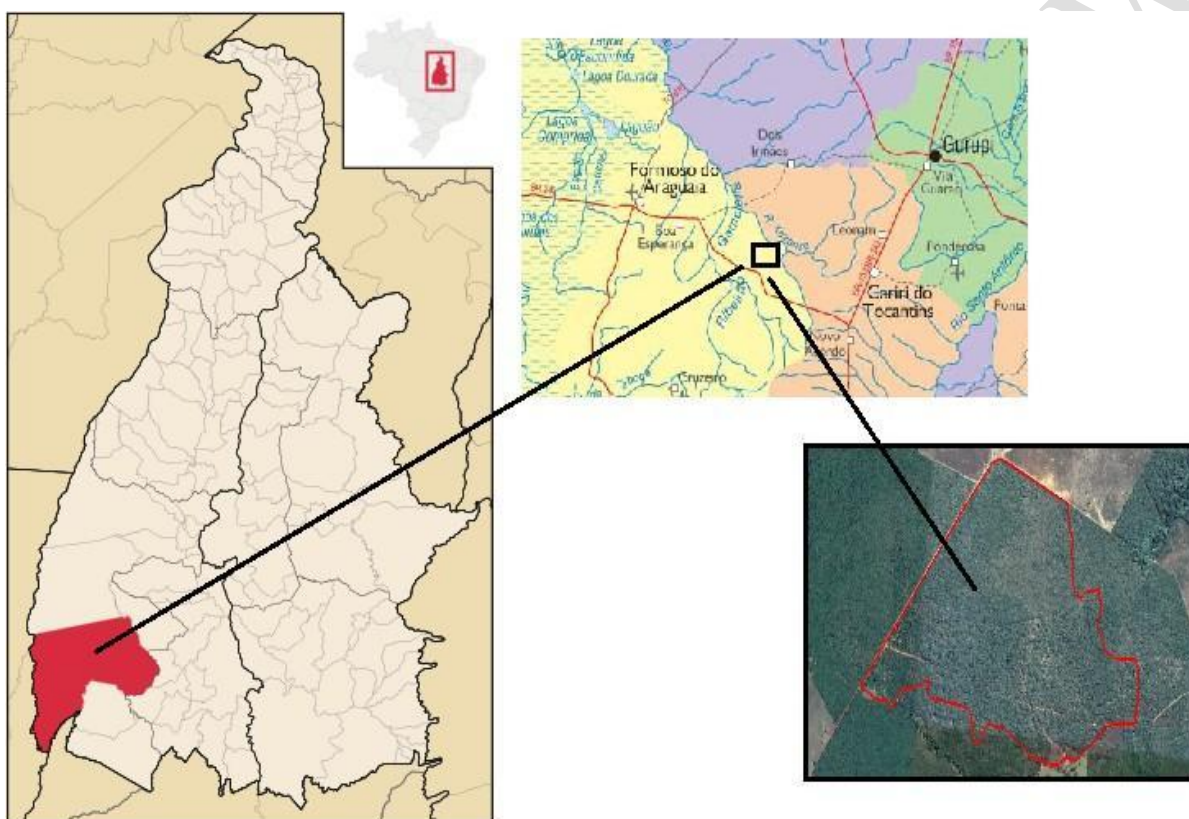


Figure 1. Location of the area under study.

The incubation assay was installed under a greenhouse, in a completely randomized experimental design (IHD), with three replications. The 15 treatments were obtained in a 3×5 factorial scheme, combining three thin earth/gravel ratios (01:02, 01:05 and 01:10) and five doses of limestone (0; 1.0; 2.0; 4.0 and 6.0 t ha⁻¹). Each treatment consisted of 0.3 kg of soil, plus the equivalent corrective dose. The soil acidity concealer used was Pure Analytical (PA) (CaCO₃+MgCO₃) in the Stoichiometric ratio Ca: Mg of 2.5:1. Then, it was added to each of these samples, with water volume equivalent to 70% of the field capacity. The plastic bags were closed, the moisture content was replenished every two days, and the soil returned so that it was uniform. Incubation was performed over 30 days.

The sampling of the incubated soil was performed at 30 days. The soils were prepared as TFSA and referred to the Soil Laboratory - LABSOLO, for the analysis of the contents of Ca + Mg, Ca, Al, potential acidity (H+Al), pH (H₂O). pH in water: The pH was obtained pot was connected 30 minutes before the start of testing and standards were calibrated with buffer solutions of pH 4.00 and pH 7.00. In labeled

plastic cups were placed 10 cm³ of soil and 25 ml of distilled water. Was stirred with a glass rod and after one hour rest was carried out with the pH readings.

Calcium, Magnesium, and Aluminum exchangeable: these attributes were determined by titration made in a digital burette. To determine these attributes, it was initially extraction solution 1,0 mmol l⁻¹ KCl as follows: 10 cm³ were measuring spoon TFSA in labeled cups 300 mL and then was added 200-ml of KCl 10 mol l⁻¹s stirred with a glass rod and allowed to stand for 16 hours. A blank test (only KCl) is also left to stand simultaneously. After the rest period, the determination of calcium was pipetted up to 50 ml of supernatant, to which is added 2.0 mL of 50% triethanolamine, 2,0 mL of 10% KOH, and the pinch murexide indicator. The solution was titrated with 0.0125 mol l⁻¹ EDTA to shift from purple to pink color. The volume of EDTA spent in the solution corresponds to the exchangeable calcium content in cmolc dm⁻³. The content of (Ca+Mg) in cmolc dm⁻³ was made by pipetting 50 mL of the supernatant, to which 6.5 ml of the cocktail cap is added (cap pH 10 + 67.5 of NH₄Cl dissolved in 200 mL distilled water + 600 mL of concentrated NH₄OH + 0.0616 g MgSO₄.7H₂O and 0.930 g disodium EDTA) and 4 drops of Eriochrome

Black indicator and titrated immediately with EDTA 0,0125 mol l⁻¹ L to turn color red-purple to blue-green. The volume of EDTA spent in the solution corresponds to the exchangeable (Ca + Mg) content in cmolc dm⁻³. For the reading of the exchangeable aluminum, 50 ml of the supernatant was added to 3 drops of the blue bromothymol indicator. The sample was titrated with 0.025 mol l⁻¹ solution of NaOH until persistent bluish-green staining. The volume of NaOH 0.025 mol l⁻¹ spent on titration corresponds to the al content in cmolc dm⁻³. Titration is made with the use of a digital burette [1].

Potential Acidity (H+Al): this attribute was determined by titration made in a digital burette. The potential acidity extraction solution was made with 0.5 mol l⁻¹ calcium acetate at pH 7.0. Was measured with a measuring spoon 5 cm³ of TFSA in labeled plastic cups of 200 ml and added to 75 ml of the calcium acetate solution. Was stirred with a glass rod and allowed to stand for 16 hours. A blank test (calcium acetate only) is also left to stand simultaneously. After the break, pipetted 25 mL of supernatant which was added 5 drops of phenolphthalein indicating 3%. The sample solution was titrated with 0.025 mol l⁻¹ NaOH until the appearance of a persistent pink color.

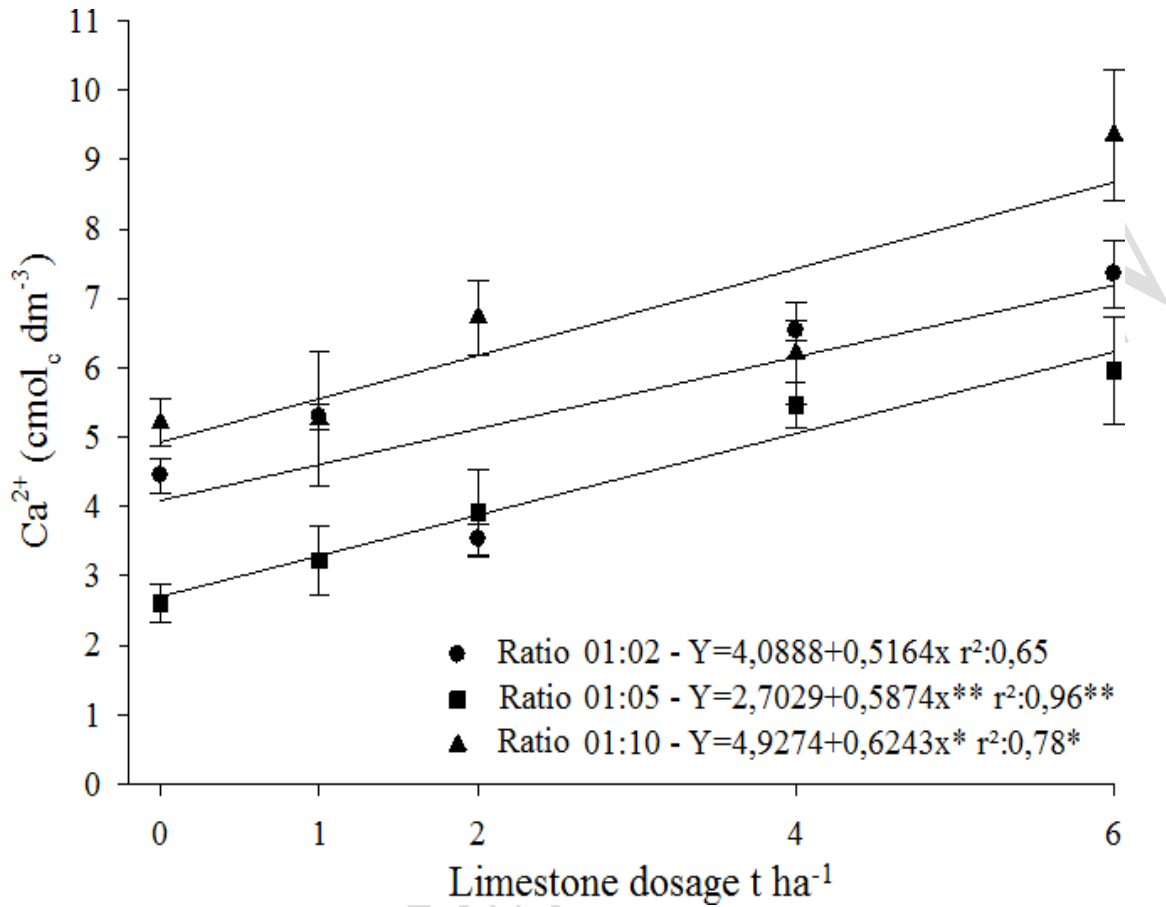
The data obtained were submitted to regression analysis, evaluating the significance of betas and determination coefficients using the Statistics version 7.0 program [8]. The regression graphs were plotted using the statistical program Sigma Plot version 10.0[®], being the model chosen based on the best significance of betas [9].

3. Results and Discussion

At about 01:02, the pH attribute showed adjustment to the increasing linear regression model ($P \leq 0.01$), and the ratios 01:05 and 01:10 presented adjustment to the quadratic regression model as a function

of the application of growing doses of the acidity corrective (Figure 2).

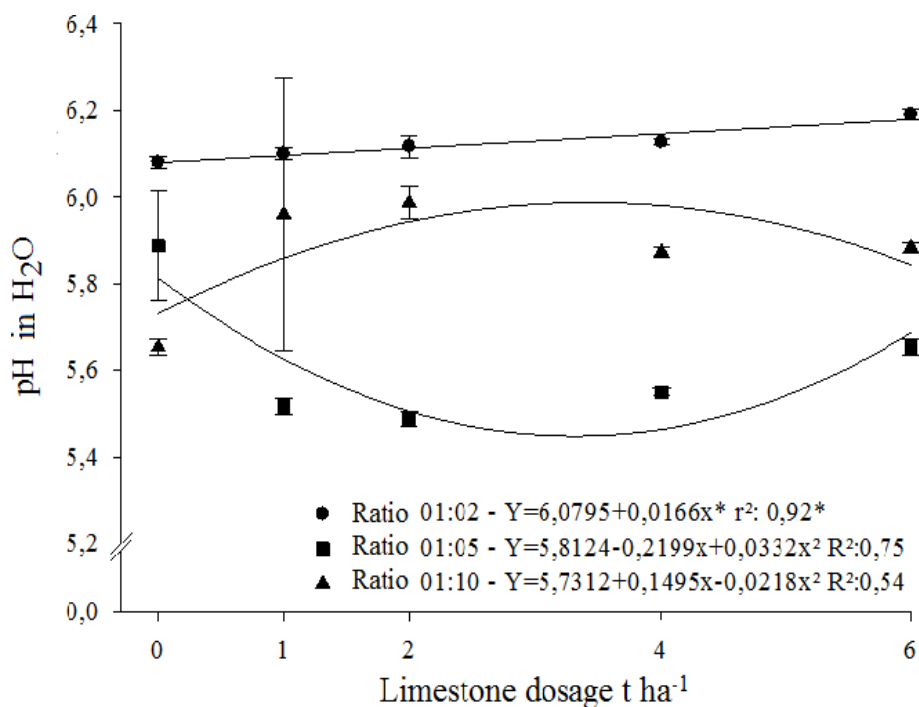
Figure 2. Ca^{2+} content of three fine earth/gravel ratios as a function of increasing doses of acidity concealer. Gurupi - TO, 2018.



At 30 days of incubation, the relationships already had a pH value within the agronomic range considered acceptable (5.5-6.0) from the dose of 0 t ha⁻¹, but for a ratio of 01:05, the pH decreased until reaching its lowest value at the dose of 3.31 t ha⁻¹ returning to increase the part go from that dose. As the soil was already with a pH value within the agronomic range considered acceptable it was not necessary to correct the pH, but the highest pH value was reached at the dose of 6 t ha⁻¹ in the ratio 01:02 with a pH value of 6.2.

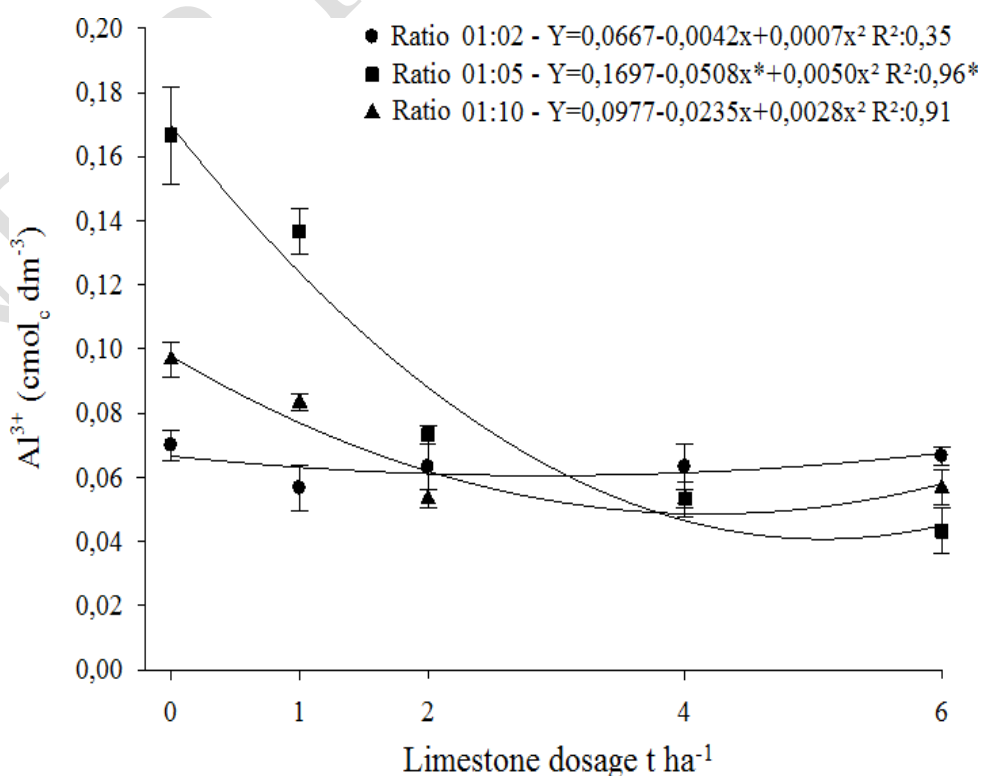
The contents of exchangeable acidity were reduced with the increase in the recommended dose of the soil acidity corrective (Figure 3).

Figure 3. pH in H₂O of three fine earth/gravel ratio as a function of increasing doses of the acidity concealer. Gurupi - TO, 2018.



The elevation of pH negatively influenced the Al contents of the relationships. Figure 2 shows that dose elevation contributes to the reduction of Al contents. Al values tend to be zero since the solubility of this cation is negligible in pH greater than 5.5 (BRESSAN et al., 2013) [10]. Potential acidity contents were reduced with an increase in the recommended dose of soil acidity concealment (Figure 4).

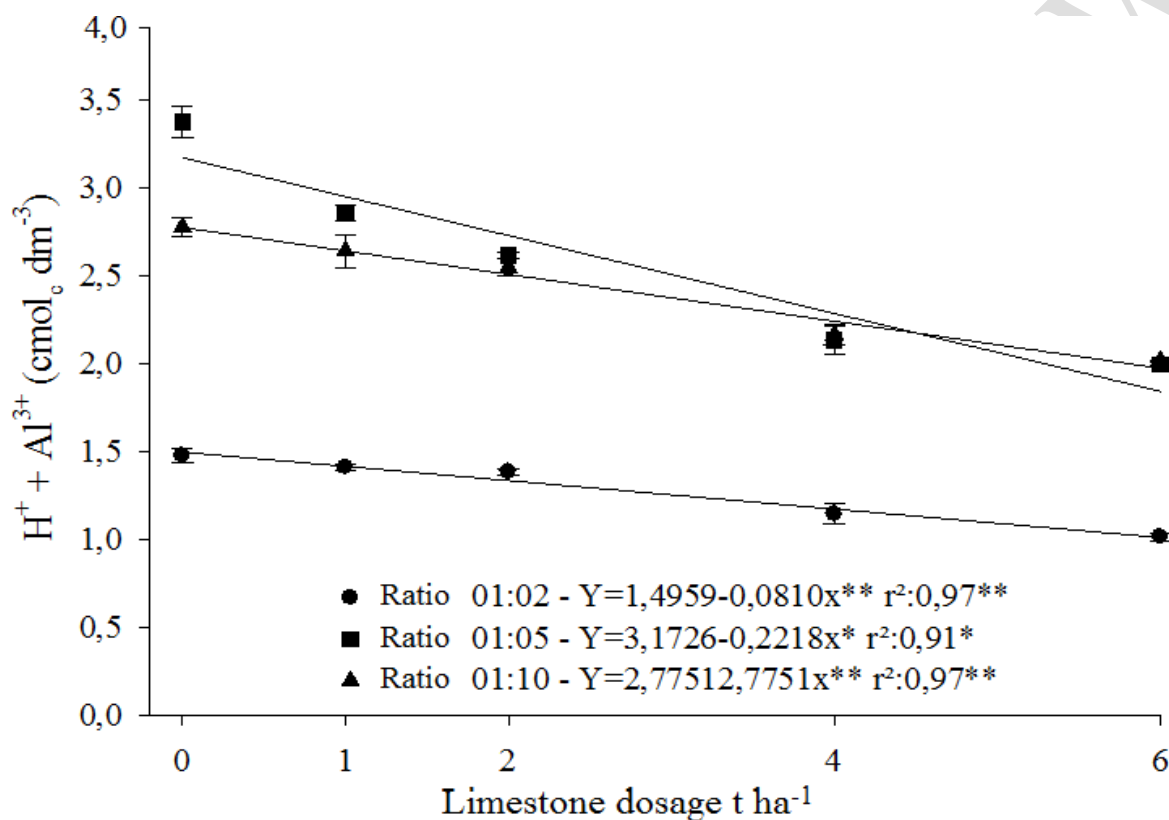
Figure 4: Al³⁺ content of three fine earth/gravel ratio as a function of increasing doses of acidity concealer. Gurupi - TO, 2018.



Potential acidity alone does not impair the development of crops, as this H^+ belongs to the covalently linked fraction, that is, it is not available for exchanges, and Al is practically null in pH conditions above 5.5 as discussed previously [11].

The calcium + magnesium ($Ca^{2+} + Mg^{2+}$) levels of the ratios 01:05 and 01:10 according to increasing doses of the acidity corrective, showed significant adjustment to linear regression models, while the ratio 01:02 did not present significant adjustment (Figure 5).

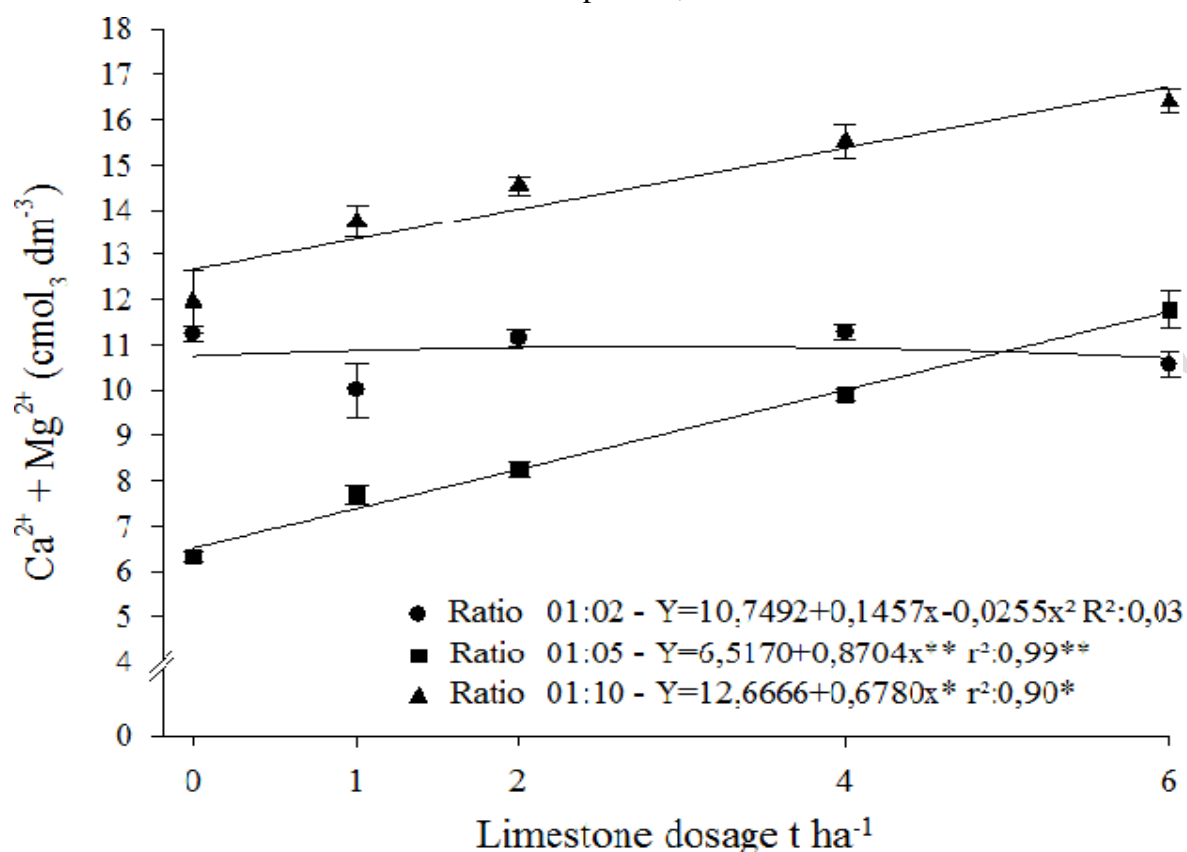
Figure 5. $H^+ + Al^{3+}$ content of three fine earth/gravel ratio as a function of increasing doses of acidity concealer. Gurupi - TO,2018.



Regardless of the dose of the applied corrective, the contents of $Ca^{2+} + Mg^{2+}$ increased in the ratio of 01:05 and 01:10 levels of 11.74 and 16.73 $cmol_c\ dm^{-3}$ respectively at the dose of 6 $t\ ago^{-1}$ of the corrective. The relationships were already with $Ca^{2+} + Mg^{2+}$ content above the ideal range of 3.32 to 5.5 $cmol_c\ dm^{-3}$ as is possible to observe in the $t\ ha^{-1}$ dosage of limestone [12].

The Ca presented adjustment to the increasing linear model for the three relationships due to the incubation of limestone doses (Figure 6).

Figure 6: $\text{Ca}^{2+} + \text{Mg}^{2+}$ content of three fine earth/gravel ratio as a function of increasing doses of acidity concealer. Gurupi - TO, 2018.



Regardless of the dose of the applied corrective, the Ca contents were higher than the value considered ideal ($\geq 2.41 \text{ cmolc dm}^{-3}$) for most cultures [12].

4. Conclusion

Al's tenors and potential acidity (H+Al) diminished and Ca contents, and Ca + Mg powder were significantly elevated with increased limestone dose in gravel ratios. The pH of the ratio 01:05 decreased until reaching its lowest value at the dose of 3.31 t ha^{-1} again increasing the dose of doses greater than 3.31 t ha^{-1} . The pH of the ratio 01:02 and 01:10 increased as the dose of limestone increased.

The contents of Ca, Ca + Mg and the pH value are already at adequate levels at dose 0 t ha^{-1} of limestone, and it is not necessary to recommend correctives for gravel relation.

COMPETING INTERESTS DISCLAIMER:

Authors have declared that no competing interests exist. The products used for this research are commonly and predominantly use products in our area of research and country. There is absolutely no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any litigation but for the advancement of knowledge. Also, the research was not funded by the producing company rather it was funded by personal efforts of the authors.

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