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# EVALUATION OF PEST INCIDENCE IN YELLOW IPÊ (TABEBUIA SERRATIFOLIA) SEEDLINGS UNDER THE EFFECT OF BASE SATURATION IN A DYSTROPHIC YELLOW LATOSOL MEDIUM TEXTURE

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## ABSTRACT
The yellow Ipê (Tabebuia serratifolia) is a forest species found in several regions of Brazil, in addition to having economic importance for the market for the production of seedlings, hardwood and urban landscaping. This research aims to evaluate the incidence of pests in seedlings of yellow Ipê (Tabeluia serratifolia), in order to identify the main pests that occur in the crop and their correlation with different levels of base saturation. The work was carried out in a greenhouse in a completely randomized experimental design (DIC), and the respective amounts of dolomitic limestone with PRNT of 98% were applied in the 5 treatments (V0% - initial soil saturation (without lime application); V20% (0.5 g), V40% (4.0

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g), V60% (7.5 g) and V80% (11.0 g) and 5 replicates. After 30 years of soil incubation with the application of limestone, seedlings of yellow Ipê were transplanted and the nutrient solution (with macro and micronutrients) was applied and during the development of the plant, five inspections were carried out, analyzing five leaves at random per treatment, with the function of verifying the study of variables such as: attacked leaf area (use of the calculation of base x height in the lesions),  average attack, type of pest (identification, through Embrapa's identification guide) and leaf area damage levels (low (0 to 15%), medium (15 to 30%) and high (greater than 30%)). Regression analyses were performed on the variables using Microsoft Office Excel 2013 and hierarchical cluster and Euclidean distance model analyses using the IBM SPSS Statistics 25.0 software. It was observed that the area of the plants that suffered the greatest attack by pests was the foliar, and no attacks on the stem of the plants were observed. The treatment that suffered the least from pest attack was V20%= 0.5g of limestone, where there was almost no incidence of pests analyzing the five inspections carried out during the experiment. Showing that this level of soil correction (0.5g of limestone) raised the base saturation index to 42.99%, increasing the concentration of nutrients in the seedlings to adequate levels according to literature recommendations, favoring resistance to pest attack. On the other hand, the treatment where the most attack occurred was V40% = 4.0g of limestone, where the levels of damage in the leaf area were higher, demonstrating that base saturation levels equal to or greater than 44.28% do not favor the crop in terms of resistance to pest attack. It was concluded that base saturation levels lower than 42.99% reduce the incidence of pests in the Ipê-amarelo crop, and values above this can favor pest attack. The pests that affect this crop in the Northeast region of Pará, according to the study, were the grasshopper (Orthoptera, Acrididae, Leptysminae) and the caterpillar of the species Anartia jatrophae. High rates of attack on the leaf area of the seedlings cause a drop in photosynthetic power and thus decrease energy gain, harming their development.

**Keywords:** Ipê-Amarelo. Base Saturation. Incidence of Pests.

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## INTRODUCTION

The yellow trumpet (*Tabebuia serratifolia*) is a tall plant, which can reach up to 30 meters in height. A hermaphrodite species that occurs naturally in the rain forest of the Atlantic Forest and the semideciduous broadleaf forest and also in the interior of the dense primary forest. There is no region of the country where there is not at least one species of ipê. However, its existence in natural habitat nowadays is rare among most species (Loureiro, 1997).

It is one of the best known and most cultivated Brazilian trees, due to its great beauty. They provide a spectacle with their beautiful flowering in the trees of streets and cities, promoting a color at the end of winter.

It has great economic importance because it is widely used in landscaping parks and gardens due to its beauty and size, and is also commonly used in urban forestation. In addition to having high commercial value in carpentry and carpentry, it is used in the manufacture of bridges, poles, wheel axles, garden clotheslines and etc. (Rizzini, 1971).

There is a lack of research on the pests that affect this crop, so it is vitally important to identify such pests in the different regions, so that the necessary measures can be taken to solve this problem. In addition to the lack of technical information about liming, what is its relationship with the incidence of pests, considering the importance of correcting acidic soils for the availability of nutrients at the seedling stage in forest species that allows resistance to pest attack.

According to Ferreira (1988), the presence of pests in a crop can lead to great economic losses, especially in the case of a crop with potential for wood production, as is the case of the yellow Ipê.

In general, forest species have distinct behavioral characteristics, especially in terms of nutritional requirements. And when the different nutritional behaviors of each plant are known, it becomes possible to increase its productivity and economy (Ferreira, 1989).

With regard to ipê-amarelo seedlings, the nutritional requirements of the plant are not fully known, leading to the use of standardized fertilizers from studies carried out with other forest essences (Fonseca, 2004).

The practice of liming promotes an important modification in the root environment, reducing soil acidity, providing Ca and Mg and increasing the availability and efficiency in the use of various nutrients, which improves the development and growth of seedlings (Van

Raij, 1991), also generating stimuli to increase the extension of the root system, benefiting the use of water and nutrients in the soil.

As Santos (1996) states, soil correction refers to the proportion of CEC (percentage rate, V% = 100) in relation to the exchange capacity determined at pH 7. In the case of a dystrophic Latosol (low fertility), this process should benefit the seedlings in terms of nutrient availability in the soil. However, some pests can be attracted by higher levels of certain nutrients, causing a high level of soil correction to become harmful to seedlings (Caixeta, 2004).

According to Vale et al. (1996), it is important to emphasize that the response to the practice of liming may or may not occur, depending on the characteristics of each of the species that is intended to be produced, aiming at the issue of acidity.

In this scenario, the importance of studying the incidence of pests that occur in the Ipê-amarelo crop, in the northeast region of the state of Pará – Brazil, is recognized, and also on the best levels of saturation by soil bases that favor the growth and strengthening of seedlings, as well as resistance to pest attack, so this work aims to evaluate the incidence of pests in seedlings of yellow ipê (*Tabeluia serratifolia*)), aiming to identify the main pests that occur in the crop and their correlation with different levels of base saturation.

## LITERATURE REVIEW

### THE CULTURE OF THE IPÊ-AMARELO

The yellow ipê, *Tabebuia serratifolia*, also commonly known as pau-d'arco-amarelo, piúva-amarela, ipê-ovo-de-macuco, tamurá-tuíra, ipê pardo, ipê-do-cerrado and opa, is a tree species belonging to the Bignoniaceae family, found in almost the entire national territory (Lorenzi, 1992).

According to Carvalho (1994), it occurs in Bolivia, Colombia, Ecuador, Guyana, French Guiana, Peru, Suriname, Trinidad & Tobago, Venezuela and Brazil, where it is found in almost all states.

According to Lorenzi (1992), it is a deciduous, heliophytic plant, characteristic of dense rain forest, being widely dispersed in secondary formations, such as capoeiras and capoeirões; However, both in the forest and in the capoeira, it prefers well-drained soils located on the slopes.

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The foliage of the yellow trumpet is renewed annually, characteristic of deciduous plants; its leaves fall in winter and appear soon after flowering, which occurs in the period from July to October (Lorenzi, 1992).

Because it is widely used in urban environments, it is important to emphasize that the yellow ipê is considered tolerant to urban pollutants (Carvalho, 1994; Biondi, 1995). However, it is still subject to pests, an aspect that justifies the need to produce good quality seedlings, avoiding possible problems with pests.

## PESTS IN THE YELLOW IPÊ CROP

No studies were found in the literature regarding pests that preferentially attack the Ipê-amarelo crop. However, in the present work, two types of pests were found.

It is the grasshopper (Orthoptera, Acrididae, Leptysminae), of the most numerous family of the order, with approximately 10 thousand species, which comprises the grasshoppers themselves, which are phytophagous insects, generally very harmful to vegetation. Even though it has a high rate of proliferation, this species is not capable of promoting damage that reaches levels that are harmful to crops and feeds on the external parts of the leaves (Buzzi & Miyazaki, 1999).

In addition to the caterpillar of the species *Anartia jatrophae* that according to Blanco (2005) can be found along the banks of rivers, swamps and clearings, but also in anthropic environments; occurring mainly in secondary forest habitats in fields, pastures, gardens, squares, roads and orchards, at altitudes of up to 1500 meters or more. The caterpillars of this species feed on a wide spectrum of plants, causing perforations throughout the leaf area.

According to Picanço et al. (2010), the amount of injury caused by an insect to a plant depends on the feeding habit of the former, the size of its population and the plant's ability to withstand the type and amount of injury inflicted by the insect. As for the resistance of the host plant to insects, it refers to the properties inherited and associated with the ability of the host plant to overcome or withstand and recover from injuries caused by pest insects.

Thus, plant resistance to insects is a hereditary characteristic that enables the plant to repress the growth of insect populations or recover from injuries caused by insect populations (OLIVEIRA, 2010).

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## MINERAL NUTRITION AND SOIL FERTILITY IN IPÊ-AMARELO

The lack of information about the nutritional requirements of native forest species leads to the need to carry out tests to obtain more accurate information so that better quality seedlings can be produced (Cruz et al., 2004).

Soil acidity is recognized as one of the main factors that lead to low crop productivity in the country. This is due to the high levels of aluminum and in some cases manganese, as well as the low levels of calcium and magnesium (Van Rail, 1991). Thus, the correction of soil acidity is of vital importance for a good development of the plant (Smith, 1995), which consequently reduces the incidence of pests.

In the case of the SMP index method, which is based on the correlation between the SMP index and the potential acidity of the soil (H++Al+3). The lower the SMP index, the greater the amount of (H++Al+3) in the soil and, therefore, the greater the amount of limestone to be applied to achieve an adequate pH in this soil (Tomé Junior, 1997).

According to Vieira (2017), the morphological characteristics and nutrition of Ipê-amarelo seedlings are influenced by the increase in saturation by soil bases. Also according to Vieira (2017), the increase in base saturation increases the concentration of N, K, Ca, Mg and S in seedlings, demonstrating that it is a demanding species in soil fertility during nursery growth.

According to Pritchett (1979), experiments in pots are a fast and safe instrument in forest fertilization and nutrition programs. However, the extrapolation to the field of results obtained under greenhouse conditions must be done with due caution, since the environmental conditions may be quite divergent, decisively influencing the results (Mcclung et al., 1958).

According to Vale et al. (1996), it is important to emphasize that the response to the practice of liming may or may not occur, depending on the characteristics of each of the species that is intended to be produced, aiming at the issue of acidity.

## DYSTROPHIC YELLOW LATOSOL MEDIUM TEXTURE

Latosols and Ultisols represent about 70% of the surface of the Amazon region, being mostly acids with low phosphorus availability, contributing to the limitation of plant production, on the other hand they present conditions of soil resistance to penetration, soil density, soil moisture and degree of clay flocculation (Uchôa et al., 2009).

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The types of Oxisols are characterized by being in an advanced stage of weathering, very evolved as a result of energetic transformations in the constituent material. The soils are virtually devoid of primary or secondary minerals less resistant to weathering and have the capacity to exchange cations of the low clay fraction. They range from strongly to well-drained. They are usually very deep, and the thickness of the soil is rarely less than 1 m. Latosols are strongly acidic with low base saturation, dystrophic or aluminic (Embrapa, 2013).

## MATERIAL AND METHODS

### LOCATION AND EDAPHOCLIMATIC CHARACTERIZATION OF THE EXPERIMENTAL AREA

The experiment was carried out in a galvanized iron arch greenhouse, whose footage was 16 x 30 m, totaling an area of 480 m2 (Figure 1), at the Igarapé-Açu School Farm (FEIGA), belonging to the Federal Rural University of the Amazon (UFRA), located in the municipality of Igarapé Açu (PA), northeast of the state of Pará, located at latitude 01º 07' 44" South and longitude 47º 37' 12" West, at 47 meters of altitude. The climate of the region is classified according to Köppen (1931) as "Am", with a maximum temperature of 32.2°C and a minimum temperature of 21.4°C, it has a rainy climate, with a small dry season (Bastos; Pacheco, 1999)

Figure 1: Greenhouse used in the experiment.

Source: Diocléa Silva (2017)

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## SOIL COLLECTION, DRYING, ANALYSIS AND INCUBATION

The soil was collected at the School Farm, at a depth of 0-30 cm, after that, it was sieved in a 2.0 mm mesh sieve and dried for a period of one week in plastic tarpaulin (TFSA). Subsequently, 500 g of soil were collected, placed in a previously labeled plastic bag and sent to the IBRA laboratory in Sumaré – São Paulo, which performed the chemical and physical analysis, including: pH in water, organic matter (OM), P, K, Ca, Mg, Al and H++Al+3.

Table 1- Result of the chemical analysis of the soil of the Igarapá-Açú School Farm (FEIGA), 2018.

| pH | MO | P | S | Mn | Fe | Cu | Zn | B | K | Ca | Mg | Na | CTC | V |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CaCl2 | g/dm³ | ---------------mg/dm³-------------- | | | | | | | ------------mmol/dm³------------------ | | | | | % |
| 5,2 | 25 | 12 | 13 | 7,5 | 92 | 0,8 | 2,9 | 0,84 | 0,9 | 23 | 7 | 0,3 | 55,2 | 57 |

With the results of the soil analysis, the soil was incubated, which consists of the method of applying the different levels of saturation by bases V0%= without liming, V20%= 0.5 g of limestone, V40%= 4.0g of limestone, 60%= 7.5g of limestone, 80%= 11.0g of limestone, for a period of 45 days, always moistening, so that a reaction occurred.

**Tabela 2** - Resultado da análise de solo da área experimental da Fazenda Escola de Igarapé Açu após a retirada do experimento.

| TRAT. | PROF. | MO | pH | | Ca | Mg | K | Na | P | S | B | Mn | Fe | Cu | Zn | C | CTC | SB | SATURAÇÃO | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| V% | (cm) | g/dm³ | (CaCl2) | SMP | mmolc/dm3 | | | | mg/dm³ | | | | | | | g/dm | mmolc/dm | | Base V% | Alumínio m% |
| V0% | 0-30 | 16 | 4,6 | 6,06 | 24 | 6 | 2,3 | 3,6 | 12,7 | 37 | 0,69 | 19,2 | 62 | 0,2 | 5,1 | 9 | 75,9 | 35,9 | 47,29 | 0 |
| V20% | 0-30 | 23 | 4,5 | 5,92 | 23 | 7 | 2,5 | 2,2 | 9,7 | 28 | 0,47 | 19,8 | 59 | 0,4 | 5,3 | 13 | 80,7 | 34,7 | 42,99 | 0 |
| V40% | 0-30 | 21 | 4,6 | 6,08 | 21 | 7 | 1,8 | 1,7 | 6,5 | 29 | 0,53 | 17,9 | 56 | 0,5 | 3,7 | 12 | 70,5 | 31,5 | 44,68 | 0 |
| V60% | 0-30 | 20 | 5 | 6,47 | 36 | 17 | 4,6 | 5,7 | 12,1 | 50 | 0,95 | 19 | 41 | 0,4 | 3,9 | 12 | 89,3 | 63,3 | 70,88 | 0 |
| V80% | 0-30 | 18 | 5 | 6,43 | 30 | 14 | 4,2 | 4,8 | 11,4 | 51 | 0,5 | 17,8 | 45 | 0,1 | 4,7 | 10 | 80 | 53 | 66,25 | 0 |

Trat. = Tratamento; Prof. = Profundidade; MO. = Matéria Orgânica; CTC= Capacidade de Troca de Cátions; SB= Soma de Bases; V0%= sem calagem; V20%= 0,5g de calcário; V40%= 4,0g de calcário; V60%= 7,5g de calcário; V80%= 11,0g de calcário.

**Fonte**: IBRA (2018).

## DISTRIBUTION AND CONDUCT OF THE EXPERIMENT

The work was carried out in a greenhouse in a completely randomized experimental design (DIC), and the respective amounts of dolomitic limestone with PRNT of 98% were applied in the 5 treatments (V0% - initial soil saturation (without lime application); V20% (0.5 g), V40% (4.0 g), V60% (7.5 g) and V80% (11.0 g) and 5 replicates.

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After 30 years of soil incubation with the application of limestone, seedlings of yellow Ipê were transplanted and the nutrient solution (with macro and micronutrients) was applied and during the development of the plant, five visits were made, analyzing five leaves at random per treatment, with the function of verifying the study of variables such as: attacked leaf area (use of the calculation of base x height in the lesions), average attack, type of pest (identification, through the Embrapa key) and leaf area damage levels (Low (0 to 15%), Medium (15 to 30%) and High (greater than 30%)).

The levels of leaf area damage were calculated by measuring base x height in the lesions caused by pest attack on the leaves of the seedlings, to find the size of the total attack area in each plant.

Regression analyses were performed using Microsoft Office Excel 2013 and hierarchical cluster and Euclidean distance model analyses were performed using IBM SPSS Statistics 25.0.

## RESULTS AND DISCUSSION

It was observed that the area of the plants that suffered the greatest pest attack was the foliar. According to Ferreira (1989), possibly because it is a more herbaceous area of the plant and susceptible to attacks by cutting and sucking insects, which generate lesions that open doors to pathogens such as fungi and bacteria.

No attacks on the stem of the plants were found, according to Carvalho (2013), probably because they have a woodier structure and, therefore, it is assumed that the levels of cellulose were not satisfactory to the point of pest incidence.

Two types of pests were found in the experimental area, the locust (Orthoptera, Acrididae, Leptysminae), which caused injuries in the leaf area, feeding on the lateral parts of the leaf. And the caterpillar of the species *Anartia jatrophae* which, in turn, caused perforations in the entire leaf area of the seedlings. It was observed in this work, in Figure 2, that the treatment that suffered the least from pest attack was V20%, at a dose of 0.5g of dolomitic limestone, which represents in practical terms an applied amount of 0.2 tons per hectare, when related to the five inspections carried out during the experiment with Ipê-amarelo seedlings.

Showing that this level of soil correction mentioned above raised the base saturation index to 42.99%, which provided an increase in the concentration of nutrients in the soil solution to adequate levels according to the recommendations of the literature, favoring

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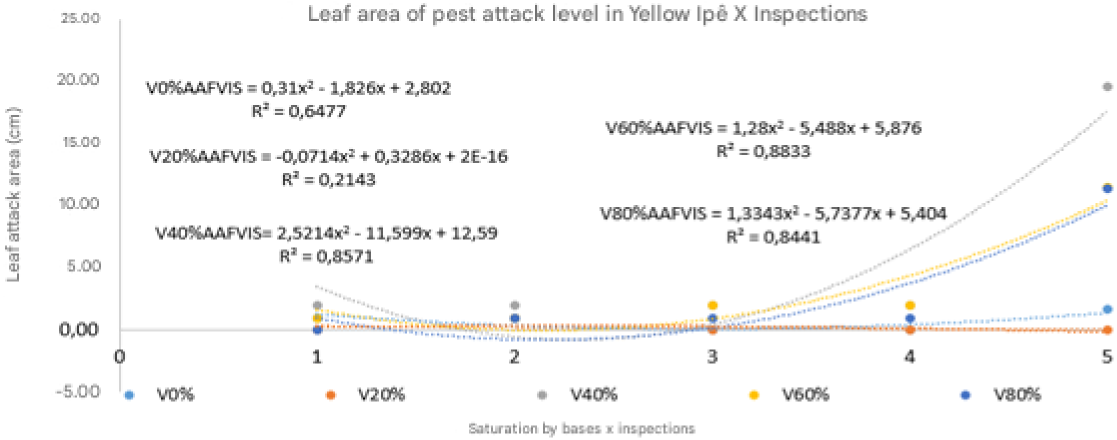
resistance to pest attack. This fact can probably be attributed to the action of liming applied in the dystrophic Yellow Latosol medium texture. Also in this context, pH analysis was performed in both CaCl2 and pH SMP.

The pH in CaCl2 aims to reduce changes due to dilution because it is not necessary to measure the volume of the solution with high precision. However, it has a more reliable index than pH in water, being used through a saline solution avoiding variations attributed to salts, and usually have acidity levels. While the pH SMP studies the correlation between the SMP index and the potential acidity of the soil (Hydrogen and aluminum). This type of pH is intended to achieve an adequate pH according to the dose of limestone to be applied, which depending on the crop to be worked on, it is in the range between 5.5; 6 or 6.5. So it is a more efficient pH when working with liming, because there is a buffer solution that will read the soil that received limestone, having a more efficient reading, while the CaCl2 method will cause turbidity in the reading by estimating the pH of the soil, which would not be a real pH (TOMÉ JUNIOR, 1997). This explains in this work why V20% saturation is more efficient at pH SMP (5.92).

Figure 2. Level of pest attack in the leaf area in relation to the level of base saturation (V0%= 0.0g, V20%= 0.5g, V40%= 4.0, V60%= 7.5g and V80%= 11.0g of limestone) and number of inspections (VIST1, VIST2, VIST3, VIST4 and VIST5), UFRA Capanema (PA), 2018.




On the other hand, the treatment where the most attack occurred was V40%, which corresponds to 4.0g of limestone, which in practical terms represents an amount of 1.6 T/ha of dolomitic limestone, where the levels of damage in the leaf area were higher.

Demonstrating that, according to the regression analyses (figure 2), base saturation levels equal to or greater than 44.28% do not favor the crop in terms of resistance to pest attack. Possibly due to the fact that insects/pests have preferences for this treatment, due

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to the occurrence of the super liming process, which occurred in a pH range SMP of 6.08. When this happened, there was an increase in base saturation at 44.68% and neutralization of aluminum saturation at 0%. However, due to the soil texture (average), there was a high buffering power, so that, although there was an increase in pH SMP from 6.08, the plant will not respond to the terrors of nutrients absorbed efficiently, presenting as we will see below future interactions.

Some authors report in their research that some forest plants have a cell juice in the root greater than the soil concentration, resulting in their selectivity in the absorption of certain nutrients, since overliming would limit this process. The absorption of nutrients by the root, due to overliming, will decrease the concentration of ions in this region and favor diffusion towards the root surface. When diffusion is slow, a zone of nutrient depletion is created near the root surface. Normally, diffusion is important for nutrients found in low concentrations in the soil solution, such as phosphorus (NUNES, 2019). This explains, in this work, the fact that phosphorus was lower with 6.5 mmolc/dm³. It is assumed that the phosphorus in the soil solution was rapidly absorbed by plant roots through a symport transporter and was incorporated by a variety of organic compounds including sugars, phosphates, phospholipids and nucleotides. In addition, glucose was probably incorporated into the inorganic phosphate according to Taiz and Zeiger (2009), which would justify the attack of pests on the leaf, due to high amounts of sugars.

According to Caixeta (2004), these nutrients were absorbed by the root, reducing pest attack. Marschner (1995) reports that the pest does not attack the branches of some plants, due to the formation of mechanical barriers, causing a process of lignification and synthesis of toxins (phytoalexins). This probably explains the fact that they attacked the leaves (leaf area in the V40% treatment, Figure 3), and thus led to a drop in chlorophyll.

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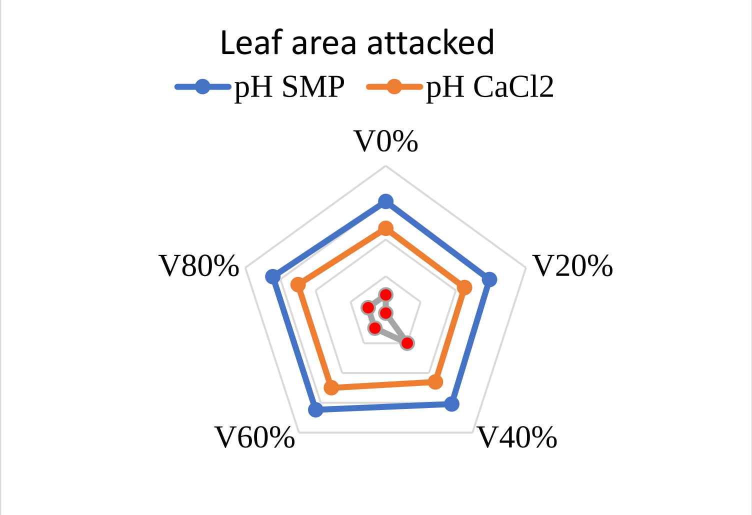
Figure 3. Leaf area attacked in relation to pH SMP and pH CaCl2




Even with the increase in the levels of Ca, Mg, K and S available in the soil, the treatments V40% (4.0 g of dolomitic limestone – 1.6 t/ha) and V60% (7.5 g of dolomitic limestone – 2.99 t/ha) obtained, respectively, the highest averages for pest attack, according to the regression analyses (Figure 4). Indicating that these base saturation rates may have influenced the production of sugars that are directly linked to plant defense. Evidencing what was found by Cruz et al. (1996) when the levels of base saturation do not benefit the plants in relation to the availability of nutrients in the soil, aiming at development and resistance to pest attack. This does not mean that most nutrients are not available due to overliming, characterizing an average attack higher than V40%, such as phosphorus. However, lime saturation doses greater than 40% cause a decline in the average pest attack, but also provide interactions between nutrients, because sugar levels in the leaves drop (Figure 5).

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Figure 4. Average attack on Ipê-Amarelo plants in relation to the level of base saturation (V0%= 0.0g, V20%= 0.5g, V40%= 4.0, V60%= 7.5g and V80%= 11.0g of limestone) and number of inspections (VIST1, VIST2, VIST3, VIST4 and VIST5), UFRA Capanema (PA), 2018.

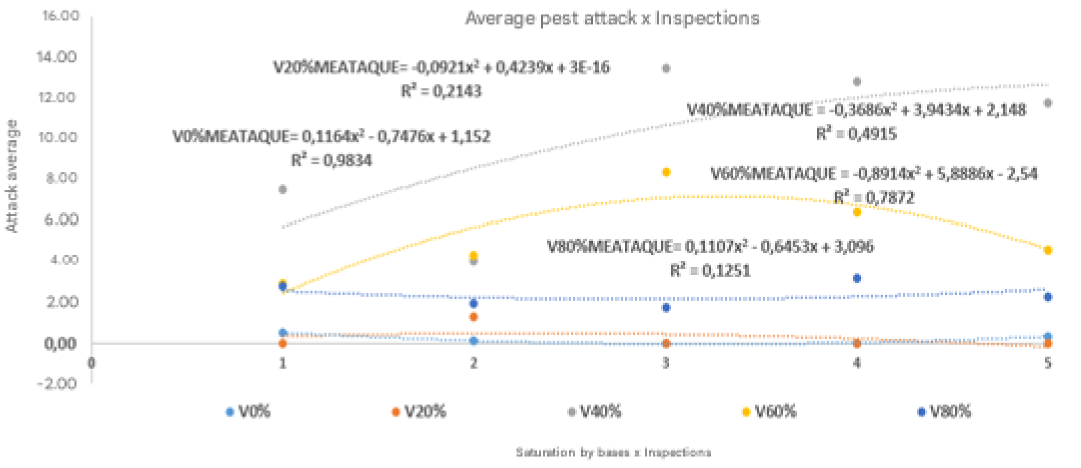
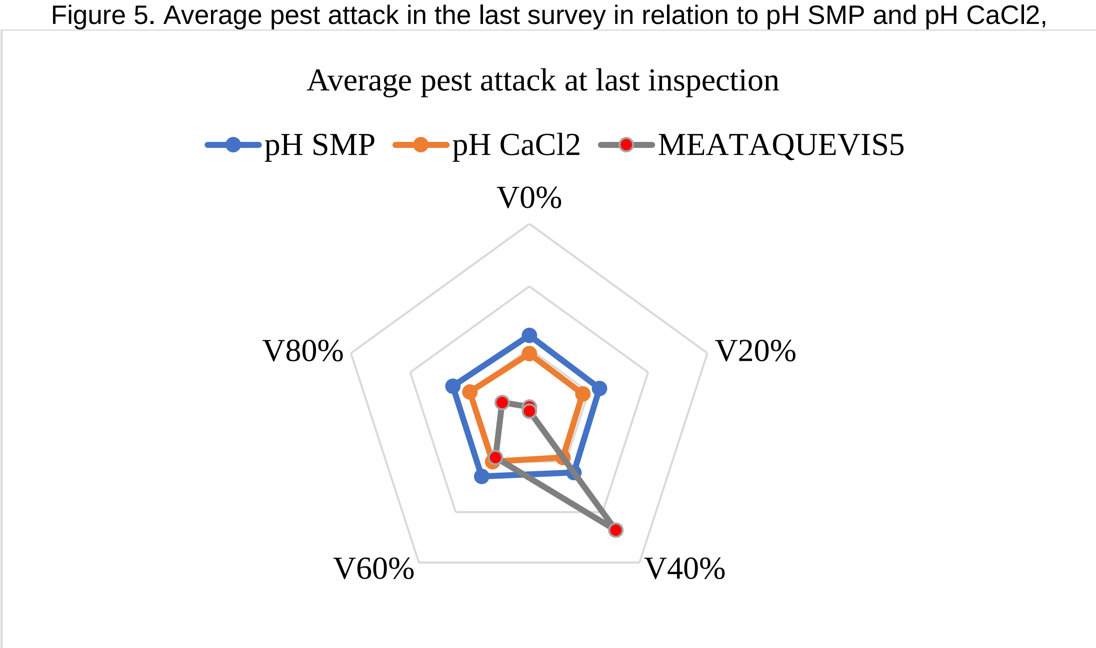



Figure 5. Average pest attack in the last survey in relation to pH SMP and pH CaCl2,




It was not possible to identify precisely which nutrients favored the attack of pests on the seedlings in the plant tissue of the plant, for this it would be necessary to carry out analyses of plant tissue, as well as biochemistry, which would also be a probable explanation for a better interpretation. However, when we look at Table 2 that expresses the final result of the soil analysis, it can be inferred that the concentration of nutrients in the soil depends a lot on the water content, the pH, the biological activity, which will consequently reflect on the attack of pests on the leaves, because if there is a certain content of nutrients in the soil solution,  it is expected that the plant can absorb it, due to

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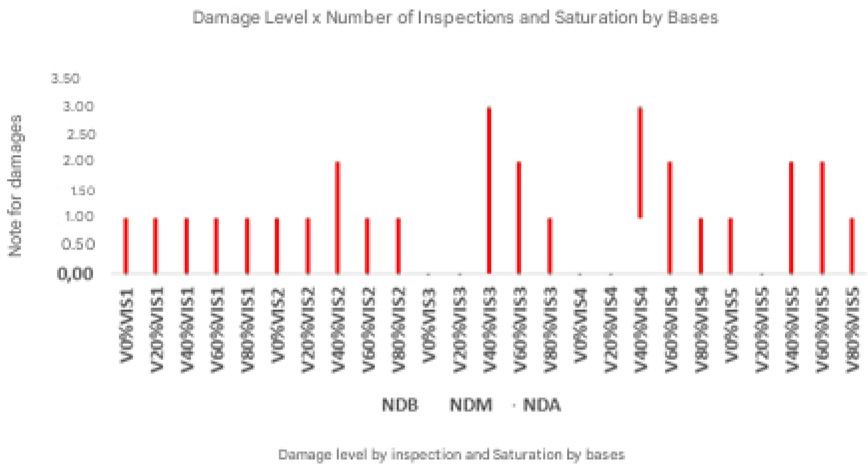
the action of liming in inspection five, which justifies the lower level of damage, while if we compare all inspections as shown in Figure 6. Therefore, with the completion of the work to explain the interactions between the nutrients that provided the pest attack by base saturation treatment, the fifth inspection will be chosen, due to the liming having already shown some effect.

Figure 6. Damage levels (NDB – low damage level; NDM – medium damage level; NDA – high damage level) in Ipê-Amarelo plants compared to the levels of base saturation (V0%, V20%, V40%, V60% and V80%) and number of inspections (VIST1, VIST2, VIST3, VIST4 and VIST5).




We observed in the dendrogram (Figure 7) that there was the formation of two distinct groups, and group 1 formed 2 subgroups. Group 1 was formed by the treatments that presented the lowest rates of pest attacks and lowest levels of damage in leaf area, by inspections. According to Figure 7, subgroup 1 starts at number 17 (V20% VIS4) and goes up to number 5 (V80%VIS1). Subgroup 2, on the other hand, starts at number 4 (V60%VIS1) and goes up to number 24 (V60%VIS5). Demonstrating that the V20% treatment, which represents 42.99% of base saturation (Table 2), was the one that least favored the incidence of pests, due to the action of liming, justifying once again that the pH SMP was ideal for the plant to have all its nutrients balanced.

In group 2, there was the formation of treatments that obtained the highest levels of pest attacks in the leaf area, according to the inspections carried out. 2 subgroups were also formed within this group (subgroup 3 and subgroup 4), subgroup 3 is formed by the number 18 (V40%VIS1), 23 (V40%VIS5) and 13 (V40%VIS3), this was the subgroup where there were the highest rates of pest attack and highest levels of damage per leaf area. And subgroup 4 starts at number 3 (V40%VIS1) and ends at number 14 (V60%VIS3);

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Figure 7, showing saturation by base (V%) equal to or greater than 44.68% characterizing overliming, where the plant will form interactions between nutrients, which will often hinder their availability.

Figure 7. Dendrogram showing the five inspections in relation to treatments for pest attack on plants of Ipê Amarelo, Capanema (PA), 2018.

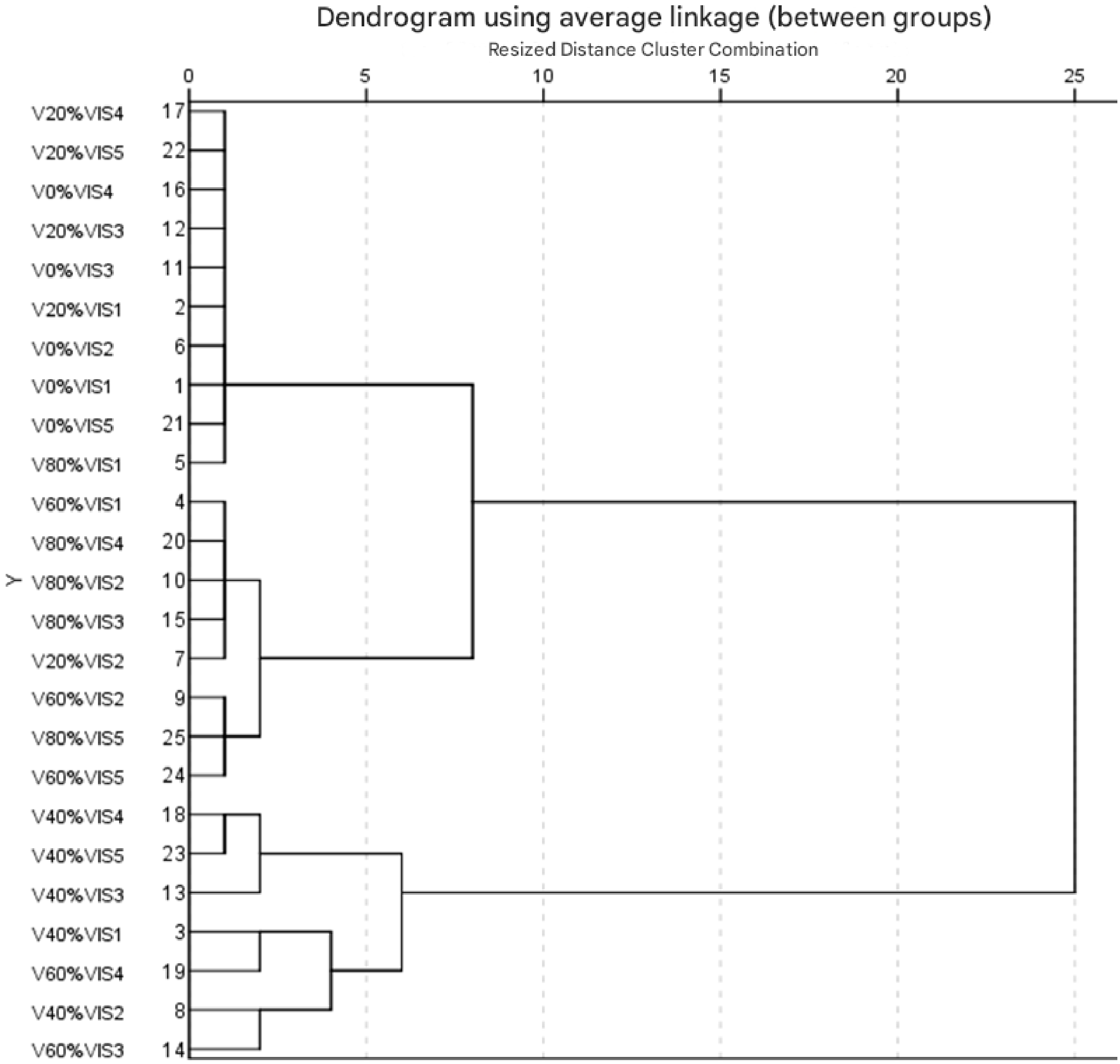
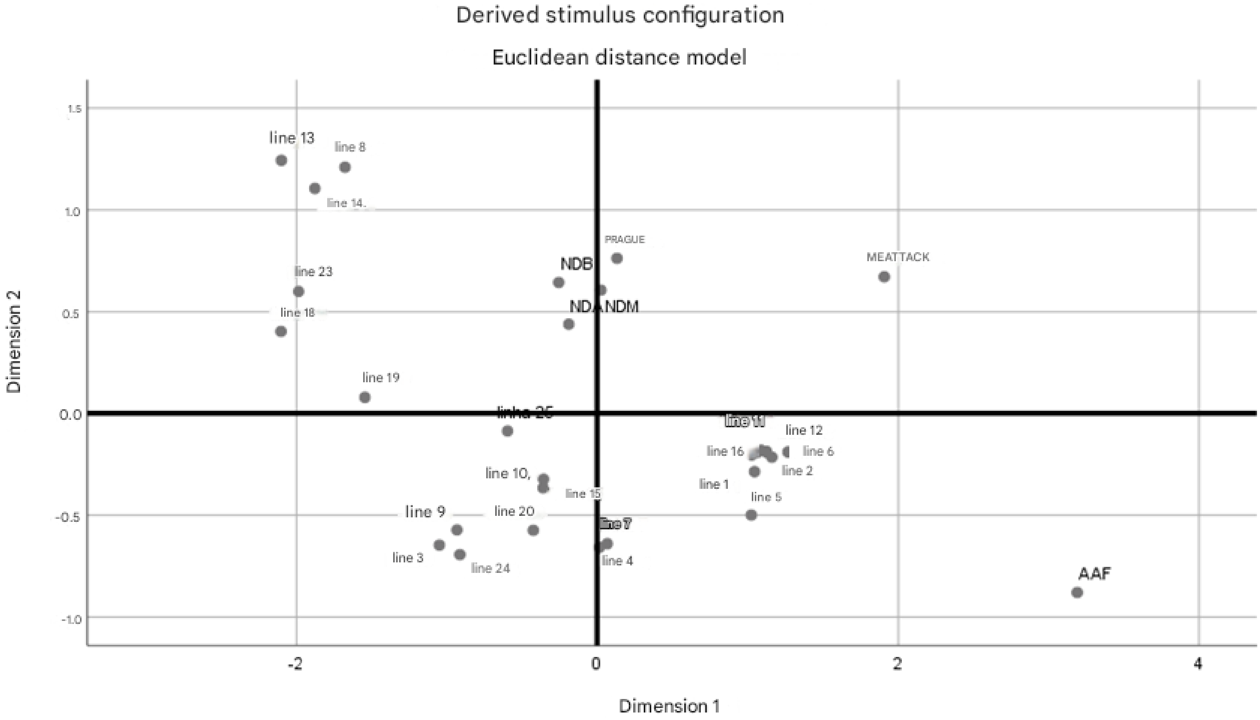



Figure 8 expresses the Euclidean Distance model referring to the variables analyzed in the experiment, and shows that the main problem found was the attack on the leaf area, which causes damage to the leaves, reducing the photosynthetic potential of the plant and impairing its energy gain, so if there is no leaf, there will be no seedlings.

Figure 8. Euclidean distance from the sizing of pest attack by surveys.




EFFECT OF NUTRIENTS CONTAINED IN THE SOIL IN THE FINAL TABLE OF SOIL ANALYSIS (TABLE 00) X TREATMENTS BY BASE SATURATION (V0%, V20%, V40%, V60% AND V80%)

The effect of antagonism that, according to Malavolta (2006), means that the presence of one element eliminates the toxic effect of another, as occurs in the V20% treatment, where calcium has a content of 23 mmolc/dm-3, canceling the deleterious effect of copper, which is found in the content of 0.4 mg/dm-3 in yellow Ipê plants, as shown in Figure 9. This fact happens because the element copper is trapped by the organic matter of the soil, which is 23 g/dm3. In the other treatments: V0%, V40%, V60% and V80%, the amount of organic matter found is lower, respectively, with 16 g/$^{dm-3}$, 21 g/dm-3, 20 g/dm-3 and 18 g/dm3, not being sufficient to eliminate copper toxicity. On the other hand, from the V20% treatment onwards, the other treatments characterize a specific case of overliming. Calcium eliminates the toxic effect not only because of the presence of organic matter, but also because it has the necessary amount of limestone, applied in this treatment.

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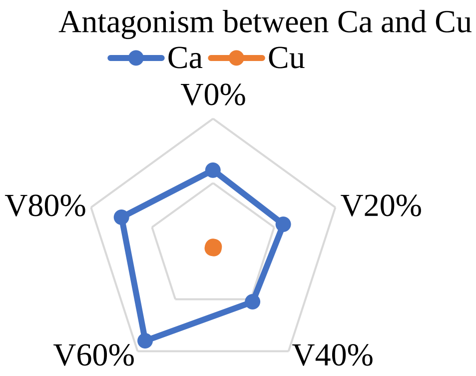
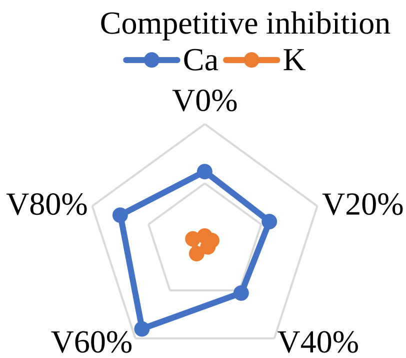
Figure 9. Antagonism between Ca x Cu in the soil, in plants of yellow Ipê (*Tabebuia serratifolia*), Capanema (PA), 2018.




Competitive inhibition effect that, according to Malavolta (2003), is when an element and its inhibitor combine, with the same site of the carrier to cross the membrane, as is the case of Ca+2 (24 mmolc/$^{dm-3}$) x K+ (2.3 mmolc/dm-3) in the V0% treatment; Ca+2 (21 mmolc/dm-3) x K+ (1.8 mmolc/dm-3) in the V40% treatment; Ca+2 (36 mmolc/dm-3) x K+ (4.6 24 mmolc/dm-3) in the V60% treatment and Ca+2 (30 mmolc/dm-3) x K+ (4.2 mmolc/dm-3) in the V80% treatment. This occurs in all treatments, but in the V20% treatment, despite not having high calcium values in relation to the other treatments, it manages to trap potassium because it has a greater amount of organic matter in the soil (Table 02 and Figure 10), characterizing a process of competitive inhibition by the same site as the carrier.

Figure 10. competitive inhibition between Ca x K.




A non-competitive inhibition effect that, according to Malavolta (2003), occurs when the element and its inhibitor do not attach to the same site as the carrier, the most classic example found in the literature is the "phosphorus-induced zinc deficiency. As observed in

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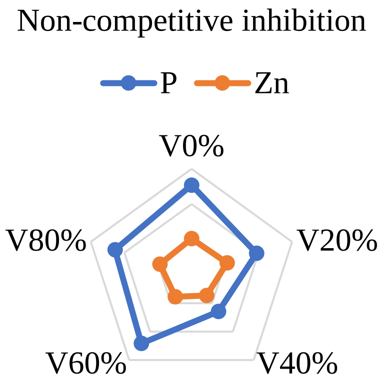
the V40% treatment, where the Zn+ contents were lower (3.7 mmolc/dm-3), the highest pest attack occurred, which also occurred in the V60% treatment, which obtained levels of (3.9 mmolc/dm-3). Possibly explained by: less EIA and RNA for the growth and "escape" of pathogens, less phenols and lignin; sugars and free amino acids, as observed by (BERETTA et al., 1986). Unlike the V20% treatment, which obtained the highest zinc levels (5.3 mmolc/dm-3).

Figure 11. Non-competitive inhibition between P x Zn.




The synergism effect occurs when the presence of one element increases the absorption of another element that, according to Malavolta (2003), magnesium has a broader synergistic effect because it participates in the phosphorylation reactions in which ATP enters, bridging it and the substrate, which can be a carrier, as is the case of B x Zn in this work (Figure 12).

Also according to Lima Filho (1991), studying the coffee crop, he observed that there is a case of synergism between B and Zn, where the dry matter increased with the doses of Zn only when the boron content in the soil increased.

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Figure 12. Synergism between B X Zn in the soil in yellow Ipê plants (Tabebuia serratifolia), Capanema (PA), 2018.

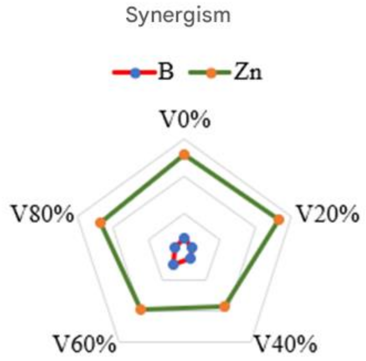


Table 3 - Illustration of pest attack in leaf area among the treatments during the 5 inspections.

| VIST No. | V0% | V20% | V40% | V60% | V80% |
|---|---|---|---|---|---|
| VIST 1 |  |  |  |  |  |
| VIST 2 |  |  |  |  |  |
| VIST3 |  |  |  |  |  |
| VIST 4 |  |  |  |  |  |
| VIST 5 |  |  |  |  |  |

## CONCLUSION

Base saturation equal to (V 20%) increases the concentration of nutrients in the soil to adequate levels and decreases the incidence of pests in the Ipê-amarelo crop in an amount of 0.2 t/$^{ha-1}$;

Liming at saturation at V40% can favor the attack of pests, such as the grasshopper (Orthoptera, Acrididae, Leptysminae) and the caterpillar of the species *Anartia jatrophae*.

Base saturation values in the treatments of V60%, V80% characterizes the supercalage.

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