CONTROL OF BLACK APHID (*ALPHIS CRACCIVORA)* IN COWPEA (VIGNA *UNGUICULATA (L.) WALP* WITH THE USE OF NEEM EXTRACT AND MANIPUEIRA

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ABSTRACT

The black aphid *Aphis craccivora* Koch (Hemiptera: Aphididae) is pointed out as one of the main pests of cowpea, causing injuries through the suction of sap on the plants. Conventional control involves the use of systemic chemical pesticides, which, from indiscriminate use, can cause contamination of the environment, applicators and other people, causing the selection of resistant insect populations. In view of this scenario, this study proposes to evaluate the toxicity, repellency and impact on population growth of *A. craccivora* when exposed to neem and manipueira extract. Leaf discs of cowpea plants were made, which were immersed in the concentrations of extract and volume of cassava, using the residual effect methodology for these experiments. Toxicity tests were performed to determine the sublethal concentrations LC20 and LC30 of neem extract and manipueira volume. In addition, tests were conducted to evaluate the repellency of the treatments, observing the behavior of the insects in relation to the previously determined concentrations. The study also analyzed the impact of the lethal concentration (CL) of neem

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extract and cassava extract on the population growth of *A. craccivora,* calculating the growth rate of the insect. The results showed that neem has a higher lethal concentration, both in LC50 and LC90, showing to be more toxic, with 0.99 times and 1.69 times, compared to cassava, in relation to the repellent effect, only neem in CL30 was repellent, while in the other concentrations, LC20 of neem itself and CL20 and LC30 of manipueira, had a neutral classification. In the population growth the CL20 concentrations of neem and manipueira extracts there was no difference, however, it was evident that manipueira has a higher population growth rate in relation to neem.

Keywords: Bioinsecticide. Alternate control. Natural products. Toxicity. Repellency.

INTRODUCTION

Cowpea (*Vigna unguiculata* L.), also known as cowpea or jack bean, is a legume of the Fabaceae family, traditionally cultivated as a subsistence crop. However, due to its rusticity, precocity and adaptation to edaphoclimatic conditions, it has been gaining commercial and productive value. According to Freire Filho (2005), technological advances have allowed its production in more technical areas, with soil correction, fertilization and irrigation practices.

Concentrated in the North and Northeast regions of Brazil, cowpea production generates employment and income due to its high content of proteins, minerals and fibers (Neves *et al.,* 2011). From the 2000s onwards, the crop expanded to states such as Mato Grosso and Goiás, supplying regions with a production deficit, driven by the development of upright/semi-upright cultivars, which enabled mechanization and increased productivity (Rocha *et al.,* 2017). According to Vale *et al.* (2017), cowpea has superior nutritional properties to common beans, in addition to being highly productive, even without fertilization.

Despite the growth of the crop in the national scenario, several factors limit its productivity, such as soil preparation, fertilization, pest management, weeds, choice of cultivars and abiotic factors (Freire Filho, 2017; Rodrigues *et al.,* 2018). Among the pests, the black aphid (*Aphis craccivora* Koch) is one of the most damaging, attacking several crops of agricultural importance, such as cotton and cashew trees. This insect reproduces quickly and, if not controlled, can cause curling and drying of plants by sucking the sap and disseminating viruses (Rodrigues *et al.,* 2009). According to Oliveira (2011), *A. craccivora is a* vector of the *Cowpea aphid-borne mosaic virus* (CABMV), which significantly reduces productivity, and can cause losses of up to 87%, especially when the plants are infected when they are still young.

Pest control is usually done with synthetic insecticides, which are effective in the short term, but carry environmental impacts and risks to human health. Since 2008, Brazil has been the world's largest consumer of pesticides, using more than 700 thousand tons annually (Pedlowski *et al.,* 2012). The excessive use of pesticides compromises the ecosystem, causes resistance in pests and can cause poisoning and chronic diseases in humans (Michereff Filho *et al.,* 2013). Therefore, the demand for food free of toxic residues and sustainable practices is growing (Serra *et al.,* 2016; Lopes, 2018; Carneiro *et al.,* 2015).

In this context, alternative insecticides gain relevance in sustainable agriculture, as they control pests without causing severe environmental impacts. Oliveira and Santos (2022) highlight that biological and natural insecticides are as effective as conventional ones, preserving biodiversity. Azadirachtin, extracted from neem, interferes with the metabolism of insects, causing repellency, sterility, and growth inhibition (Oliveira, 2016).

Another promising alternative is cassava, a byproduct of cassava pressing, which contains hydrocyanic acid and can be used as an insecticide, nematicide and fertilizer (Araújo *et al.*, 2015). Its improper disposal is harmful to the environment and animals, but, when correctly used, it improves soil properties and helps control pests (Silva *et al.,* 2023). Thus, the present research proposes to evaluate the toxicity, repellency and impact on population growth of *A. craccivora* when exposed to neem extract and cassava, aiming at sustainable alternatives for the management of cowpea crop.

OBJECTIVES

GENERAL OBJECTIVE

To evaluate the insecticidal effect of neem and cassava extract on *Aphis craccivora.*

SPECIFIC OBJECTIVES

- Determine the lethal concentrations of CL_{50} and LC90 neem extract and the volume of manipueria capable of killing 50% and 90% of individuals;
- Determine the sublethal concentrations of CL_{20} and LC30 neem extract and the volume of manipueria capable of killing 20% and 30% of the individuals;
- To evaluate the repellent effect of neem and manipueira extract on *A. craccivora*;
- To observe the population growth of *A. craccivora* after application of neem and manipueira extracts.

METHODOLOGY

The present work was developed in the Multidisciplinary Laboratory of the Federal Institute of Education, Science and Technology of Maranhão / Codó, with monitored temperature and relative humidity and 12 h photophase.

CREATION OF *A. CRACCIVORA*

In the rearing of *Aphis craccivora*, cowpea seeds were planted in pots (Figure 7A) with a capacity of 5 liters. These pots were filled with a mixture of soil and humus in a 3x1 ratio. After a period of 10 days, the pots were transferred to a greenhouse, where they were placed in individual "greenhouses", each measuring

50 x 50 centimeters and covered by white voile fabric. These greenhouses play a crucial role by functioning as protective cages, keeping out unwanted pests and creating a safe environment for aphids.

Finally, the colonies (Figure 7B) of *Aphis craccivora* were created, which were collected in cowpea plantations in the municipality of Codó – MA.

Figure 7: Cowpea planted in pots:

Figure 8: *Alphis craccivora breeding* in the field:

Source: Author, 2024.

PLANT MATERIAL (NEEM AND MANIPUEIRA)

For the production of neem extract (Figure 8), the leaves and branches of the tree were acquired in the municipality of Codó, MA, and were initially dried in a shaded place. This method of drying in the shade is crucial to preserve the active compounds present in the plant parts. After the drying process, the materials were crushed into a fine powder. Then, this powder was mixed with water to obtain an aqueous extract.

The standard solution was prepared from 1 litre of water, using a specific and known amount of the crushed material, such as to prepare a 10% solution. This concentrated solution served as the basis for creating different concentrations of the extract as needed. For this, the initial solution was diluted in different proportions, allowing a series of varied concentrations of neem extract to be obtained. These concentrations have been tested and adjusted as needed to ensure the effectiveness of the extract in its intended applications.

The manipueira (Figure 8) was stored in glass containers inside a refrigerator to preserve its integrity. Before each test in the laboratory, the manipueira was removed from the refrigerator and left at room temperature for a minimum period of 12 hours, ensuring that it is in ideal conditions for the experiments. Different volumes of manipueira were used in each test, allowing a comprehensive analysis of its effects. This careful preparation and storage process ensured the quality and reliability of the results obtained in subsequent experiments.

Figure 9: Products used in the tests (neem and manipueira).

Source: Author, 2024.

CONTACT TOXICITY TESTS

The evaluation of the toxicity of Neem and Manipueira on *A. craccivora* was carried out using the residual method with predetermined solutions. For the neem extract, a 15% mother solution was used and diluted in 12.5%, 10%, 7.5%, 5% and 2.5%. For Manipueira, a 50% mother solution was used, which was diluted in 40%, 30%, 20%, 10% and 5%, the dilution of both solutions was carried out with the use of distilled water.

Discs of cuapi bean leaves (5.0 cm Ø) were immersed in the prepared solutions under light shaking for five seconds, and after 30 minutes of drying they were infested with 10 adult females (4-5 days old) of *A. craccivora*.

The infested leaf discs were placed in Petri dishes, ensuring ideal conditions during the observation period. To allow for proper ventilation, the plate covers were perforated and the holes lined with voile fabric. This coating ensured the necessary air circulation while keeping the insects confined inside the container.

Figure 10: Patch test being performed.

Source: Author 2024.

To reduce locomotion and improve the monitoring of the insects, a small tube, with the same diameter as the leaves, was placed over each of them. This measure ensured that the insects remained in the designated area, making it easier to observe and evaluate the results. After 48 hours, the mortality of the insects was recorded. From the data obtained, lethal and sublethal concentrations were calculated, which served as the basis for the present study, also allowing the evaluation of the impact of these compounds on pest control.

REPELLENT EFFECT OF BOTANICALS

The cowpea leaf discs were made according to the same methodology used in the toxicity test. The sublethal concentrations LC20 and CL_{30} of neem extract were applied, together with the volume of manipueira indispensable to eradicate 20% and 30% of the insects, respectively, as determined in the toxicity tests with five replicates for each lethal concentration. The individual repellency tests followed the same methodology as the toxicity test.

In each Petri dish, leaf discs were arranged, with half of each disc treated with the concentration of the compound applied through its vein, while the other half remained without the compound (used as a control), where a strip of filter paper was placed. On the central plate, 10 insects were released (Figure 10).

Figure 11: Repellency test being performed.

Source: Author, 2024.

After 48 hours, the insects attracted in each container were counted. The Repellency Index (RI) was calculated by the formula: IR = 2G / (G + P), where G = % of insects attracted in the treatment and P = % of insects attracted in the control. The RI values vary between zero and two, with IR = 1 indicating similar repellency between the treatment and the control (neutral treatment), RI > 1 indicates lower repellency of the treatment in relation to the control (attractive treatment) and IR < 1 indicates the highest repellency of the treatment in relation to the control (repellent treatment).

The safety interval used to consider whether or not the treatment was repellent was obtained, using the mean RI and the respective standard deviation (SD), i.e., if the mean RI is less than 1 - SD, the oil is repellent; if it is greater than 1 + DP the oil is attractive and if it is between 1 - DP and 1 + DP the oil is considered neutral. Ten adult insects were inserted into leaf discs, and 50% of all discs were treated with the products (neem and manipueira), while the other 50% of the leaf discs remained without any application of the products. For the treatments, the concentrations LC20 (lethal concentration for 20% of the insects) and LC30 (lethal concentration for 30% of the insects) were used. To determine the impact of the products on the insect populations present in the leaf discs, an evaluation of the test is done after 48 hours.

EFFECT OF BOTANICALS ON POPULATION GROWTH OF *A. CRACCIVORA*

Cowpea leaf discs were made following the same methodology used in the toxicity test. These were immersed in the concentration LC20 and LC_{30} of the neem extract and the volume of manipueira needed to kill 20% and 30% of the individuals, following the same methodology of application of the oils carried out in this test. After drying the discs for 30 minutes, ten insects were transferred to the discs in petri dishes (Figure 11). The plates were sealed laterally with plastic wrap and stored in an air-conditioned room.

The evaluations were carried out by counting the number of insects in the discs over ten days. From these data, the instantaneous growth rate (ri) was calculated, according to the equation: $ri = \ln(Nf/No)/\Delta t$ Where: Nf is the number of aphids (nymphs and adults) present in each disk in the final evaluation, 10 days after the bioassay assembly; No is the initial number of aphids transferred to each disc at the start of the bioassay and Δt is the duration of the bioassay. According to the equation, if the estimated value for ri=0, there is balance in population growth; on the other hand, if > 0, population growth remains in an ascending state and if <0, the population is suffering a decline that may lead to extinction, when Nf = 0.

Figure 12: Pollulinear growth test being performed.

Source: Author, 2024

STATISTICAL ANALYSIS AND EXPERIMENTAL DESIGN

For the tests of toxicity, repellent effect and population growth, a completely randomized design with five replications was used. The lethal (LC50 and CL_{90}) and sublethal (LC20 and CL_{30}) concentrations of neem extract and the lethal volumes of manipueira were determined using the PROC PROBIT of the SAS version 8.02 program (SAS institute, 2001). For the repellency tests, the number of insects attracted was compared by the Chi-square test through the PROC FREQ of the SAS computer program (SAS Institute, 2001). For population growth, instantaneous growth rates were submitted to analysis of variance and means were compared by Tukey's test at 5% probability, also using SAS software.

RESULTS AND DISCUSSION

TOXICITY OF NEEM AND MANIPUEIRA EXTRACT TO ADULTS OF *A. CRACCIVORA*

The slope of the concentration-mortality line showed values ranging from 2.19 to 3.62, indicating that, in this toxicity test for the oils, small variations in the concentration did not promote large variations in the mortality of *Aphis craccivora*. This suggests a relative stability in the aphid's response to the concentrations tested. No significant difference was observed between the toxicity of the two products tested, since there was no overlap in the confidence intervals of the CLs obtained. The Probit model proved to be adequate for analyzing concentration-mortality data, with chi-square values ($\chi^2 < 5.0$) and P values ranging from 0.18 to 0.29. These results confirm the reliability of the Probit model in describing the concentration-response relationship, as shown in (Table 1).

In addition, the lethal concentrations LC20 and CL30 were determined for both plant compounds, ranging from 5.55 to 7.87 µL/mL for CL20 and from 7.74 to 9.62 µL/mL for CL30, both for manipueira and neem. These solutions were used in subsequent repellency and population growth tests in the present study. The estimation of these lethal concentrations enabled a more accurate assessment of the efficacy of the compounds in controlling aphid populations, contributing to the development of more effective and sustainable management strategies.

Table 1: Toxicity of neem and manipueira on *A. craccivora*

Essential oil	n	GL	Tilt (±EP)	CL50 (95%CI)	RT50	CL90 (95%CI)	RT90	X2	*P*
Neem	300	4	3.62 ± 0.39	13,43 (11,93 – 15,47)	0,99	30,35 (24,52 – 41,51)	1,69	6,16	0,2
Manipireia	250	3	2.19 ± 0.36	13,42 (9,53 – 16,61)	-	51,44 (39,96 - 79,62)	-	3,71	0,3

Legend: n = number of insects used in the test; GL= degree of freedom; EP = standard error of the mean; CI= confidence interval; RT = toxicity ratio; χ2 = Chi-squared; P = probability.

When evaluating the toxicity of neem and manipueira, it was observed that neem presented a higher lethal concentration (LC50), with a value of 13.42 µl/mL and a range between 11.93-15.47 µl/mL, within a confidence interval (CI) of 95%. This indicates that neem is more toxic, with a toxicity ratio (RT) of 1 times, when compared to the LC50 of manipueira. In addition, when analyzing the concentrations needed to kill 90% of the population (LC90), neem also demonstrated greater toxicity, being 1.69 times more toxic by toxicity ratio (RT) compared to LC90 from manipueira.

Abdelaal *et al.* (2021) tested the toxicity of essential oils against *A. craccivora* and observed that the toxicity of essential oils encapsulated in nanoemulsions was also effective against *A. craccivora*, with LC50 values varying significantly between the oils tested, such as 45 mg/L for the basilicão nanoemulsion and 188 mg/L for marjorana, showing that different formulations can have varying impacts on aphid mortality. In the present study, the Probit analysis demonstrated a stability in the response of the aphid *A. craccivora* to the variations in concentration of neem and manipueira extracts, since the two extracts tested did not result in major differences in mortality, thus not demonstrating a difference in toxicity.

Studies show that the effect of neem can be efficient in the control of various pest insects, both on adults and for prevention, as in the work carried out by Carvalho (2009) who, when analyzing the effects of the aqueous extract of neem leaves and seeds on stink bugs (*Podisus nigrispinus*), observed positive toxicity for the use of this extract as a biocide. In the present work, neem leaf extract was also toxic to *A. craccivora* , an insect of the same order (Hemiptera).

Venzon *et al*. (2007), when studying the lethal and sublethal toxicity of neem seed extract on adults of the aphid *M. persicae*, observed mortality of 55.0 and 59.1%, at concentrations of 0.5 and 1.0%, respectively. Other studies show that the effects of neem (Natuneem®) on soybean plantation (cultivar BRS 232) are positive in relation to protection against various diseases Gouvea *et al.* (2011). In this work, both neem and manipueira caused 50% mortality with solutions at 13%, but for another aphid species, *A. craccivora.*

There are still few studies on cassava as insecticides, however, according to (Ponte, 1999), manipueira can cause phytotoxic effects depending on the concentration used. Other studies show that after the application of cassava there can be a reduction in the number of insects and such a reduction can be explained by the presence of toxic compounds in the cassava tree, such as hydrocyanic acid and cyanide ion (CN-) (Fonseca *et al.,* 2016). The hydrocyanic acid present in cassava was probably responsible for the toxicity to *A. craccivora*, however, this chemical component did not provide a greater toxic effect than the azadirachtin present in neem, as evidenced in the results of the patch test.

REPELLENT EFFECT OF BOTANICALS

Based on the average number of aphids attracted by each treatment (%) and the Repellency Index (RI) of both products (neem and manipueira), it was observed that only the LC30 concentration of neem extract had a repellent effect. The concentrations of CL20 from the neem extract itself and CL20 and CL30 from the manipueira had a neutral result.

The Repellency Index (RI) was calculated using the formula IR = 2G / (G + P), where G represents the number of aphids in the treated area and P represents the number of aphids in the control area. To determine whether a treatment could be classified as repellent or not, the standard deviation of the calculated Repellency Index was considered. After classifying the neem extract and manipueira based on the mean RI, it was found that the concentrations used presented results between 1 - SD and 1 + SD. Therefore, only the neem extract at the CL30 concentration had a repellent effect, while the other concentrations presented neutral results (Table 2).

Table 2: Repellent activity of neem extract and cassava

Compostos	Concentração	IR (M ± DP)	Classificação
Extrado de Nim	CL_{20}	(1,09 ± 0,10)	Neutro
	CL_{30}	(0,72 ± 0,10)	Repelente
Manipueria	CL_{20}	(0,96 ± 0,32)	Neutro
	CL_{30}	(0,84 ± 0,43)	Neutro

IR (Índice de repelência) = 2G/G+P, G= número de ácaros atraídos no tratamento;

P=número de ácaros atraídos na testemunha;

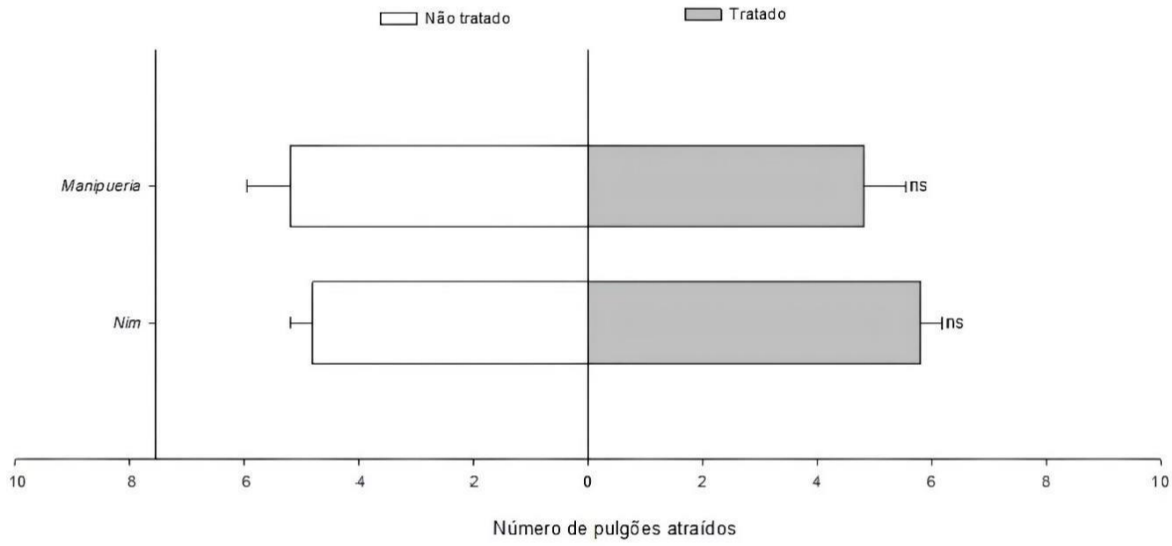
M= média; DP= desvio padrão.

Regarding the number of aphids attracted by the treatments used in this test ($P>0.05$), it was found that there was no statistically significant difference in the concentrations that presented neutral results. For the evaluation, the chi-square test was used, whose results show equality between the treatments. Thus, there was no difference in the number of aphids attracted between the treated and untreated sides with both products (neem and manipueira) used. The only exception was the LC30 concentration of neem, which showed a statistically significant difference ($P<0.05$), demonstrating its repellent effect at this concentration (Graphs 1 and 2).

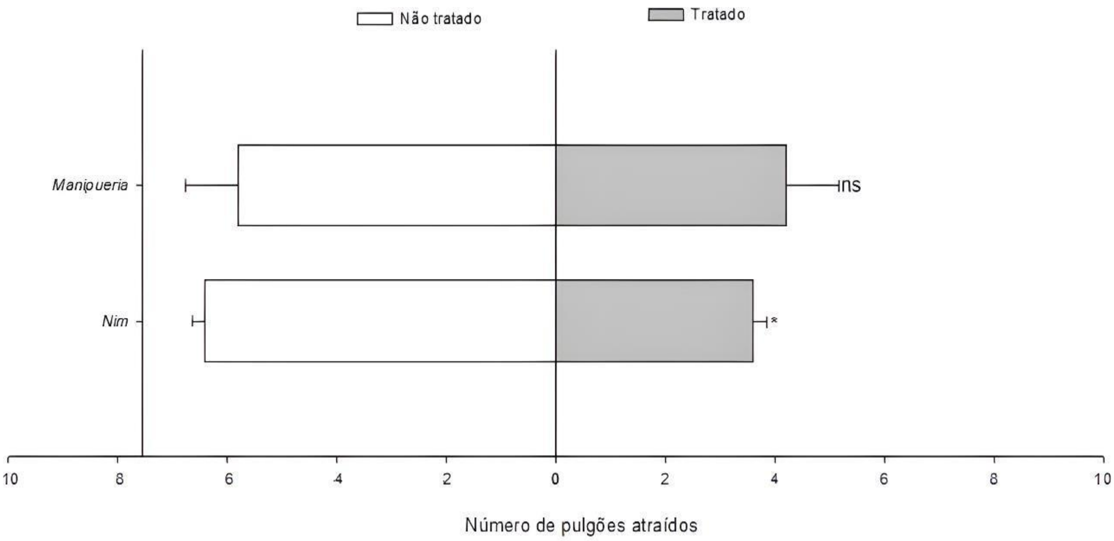
According to the results of this study, neem extract has been shown to have a repellent effect against the pest, unlike cassava, which has not shown any repellent effect. Neem (*Azadirachta indica*) is a plant widely recognized for its complex composition of bioactive compounds, which play distinct roles in interacting with the environment. According to Silva *et al*. (2019), these bioactive compounds can be classified into two main groups. The first group is composed of substances with toxic properties that act as herbivore repellents, protecting the plant against attacks by predators. The second group is formed by substances that induce the synthesis of defense compounds in the plant, reinforcing its natural barriers against stressors. These mechanisms demonstrate the ecological importance of neem, both in its direct defense and in the activation of adaptive responses, highlighting its potential as a source of bioactive compounds for applications in various areas, such as agriculture and medicine.

The ongoing study and exploration of the properties of neem's bioactive compounds not only broadens our knowledge of this extraordinary plant, but also encourages innovation in multiple sectors. Integrating these findings into sustainable practices and technological applications can result in effective and environmentally responsible solutions to a variety of global challenges (Singh *et al.,* 2013). The results of the present study reinforce the importance of neem in pest control, in relation to toxicity and especially in terms of repellent effect, such as that obtained against *A. craccivora*.

Graph 1: Number of aphids in discs of cowpea leaves treated and not treated with LC20 from manipueira and neem extract.



Graph 2: Number of aphids in cowpea leaf discs treated and not treated with LC30 from manipueira and neem extract.



Other studies show that neem can be efficient in controlling various pests that plague crops, as in the studies carried out by Darolt (2015), who concludes that the leaves repel insects and the seed extract inhibits the development of insects. Kuster (2010) says that the plant has an active principle against moths, caterpillars, aphids and grasshoppers. The present research corroborates the results obtained by these two researchers, as the aqueous extract of neem was prepared from the leaves, being repellent and toxic to the black aphid *A. craccivora*.

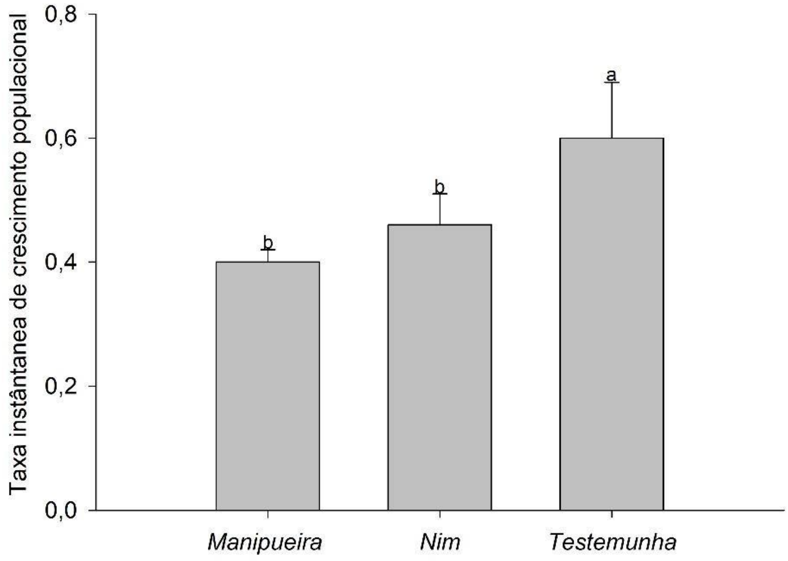
Shannag *et al.* (2014), investigated not only the effectiveness of neem but also the environmental impact of its use at different concentrations. The study pointed out that neem, in higher concentrations, had negative effects on beneficial insects, which suggests the need for a balance between effectiveness and environmental impact. The present study focused only on the specific efficacy against aphids, showing that both neem and manipueira were efficient in controlling *A. craccivora* and the LC30 concentration of neem was effective in terms of repellent effect, without investigating side effects.

In addition, Shannag *et al.* (2014), also emphasized the importance of alternative and sustainable pest control methods, such as combining neem with other integrated pest management (IPM) techniques, something that could be explored in future studies to maximize the effectiveness of neem and negative impacts such as those found against beneficial insects.

4.3 EFFECT OF BOTANICALS ON POPULATION GROWTH OF *A. CRACCIVORA*

When evaluating the LC20 of neem and manipueira extract, it was found that there was no significant difference between them. It is important to emphasize that the control showed a significant difference when compared to the two treatments (Graph 3).

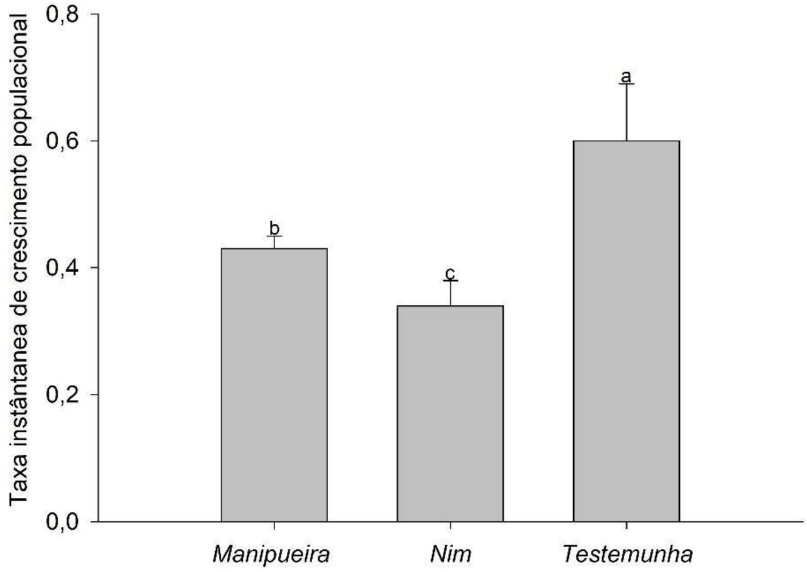
Graph 3: Instantaneous rate of population growth of *Alphis Craccivora* after receiving LC20 from manipueira and neem extract.



When analyzing the LC30 of neem extract and cassava, a clear distinction was observed between the two treatments, with manipueira showing a higher population growth rate compared to neem. However, it is important to emphasize that, despite this difference, the control showed a significant difference in relation to neem and manipueira extracts (Graph 4).

Azadirachtin, the main active component of neem, interferes with the hormonal system of insects, inhibiting protein synthesis and affecting fundamental processes such as ecdysis (molting) and reproduction, which can prevent the development of resistance in pests. Likewise, the hydrocyanic acid present in cassava acts as a potent toxic agent, capable of interrupting the cellular respiration of insects, leading to their death (Fonseca *et al.,* 2016). These compounds act not only in the elimination of adults and larvae, but also have sublethal effects that compromise the development and reproduction of pests, thus affecting their population growth and increasing the effectiveness of control in the long term. The combination of these characteristics makes manipueira and neem promising alternatives to synthetic pesticides, contributing to more sustainable and especially low-cost agricultural practices.

Graph 4: Instantaneous rate of population growth of *Alphis Craccivora* and after receiving LC30 from manipueira and neem extract.



In the study carried out by Santos (2024), the efficacy of neem extract in controlling the pest *Spodoptera frugiperda* in corn crops was investigated. The experiment included the following treatments: control (without application of natural or chemical insecticide), aqueous extract of neem fruits, aqueous extract of neem leaves, combination of aqueous extracts of neem fruits and leaves, commercial neem oil and a conventional chemical insecticide. The results indicated that the aqueous extract of neem fruits was more effective in controlling the caterpillar *Spodoptera frugiperda* compared to the other neem-based treatments. In the present work, the aqueous extract of neem leaves showed greater potential to be used as a control tool for *A. craccivora*, obviously without differing in toxicity to cassava.

Studies related to the use of neem extract leaves show that its leaves have a lower efficiency among natural products based on it, this can be mainly attributed to the lower amount of azadirachtin present in the leaves (Viana *et al*., 2010). However, even with a lower amount of bioactive compound in the leaves, the aqueous extract of neem was effective against the black aphid *A. craccivora*.

In the present study, neem extract demonstrated significant efficacy when compared to control in relation to the effect on population growth , especially when applied to LC30, suggesting that the increase in extract concentrations is associated with a progressive reduction in the pest population. The increase in neem concentration should not have a negative impact on the environment, since the natural insecticides derived from this plant are biodegradable, leaving no toxic residues or causing environmental contamination (Martinez *et al.,* 2001).

Research indicates that neem seeds are particularly notable for their high concentration of oil, which contains a significant amount of azadirachtin, a compound widely recognized for its effects on insects (Viana *et al.,* 2005). The insecticidal potential of several plant essential oils is mainly related to their repellent properties, their ability to reduce oviposition, and their action against various species of pests (Barros *et al.,* 2010). In the present research, in fact, the aqueous extract of neem stood out in relation to cassava, taking into account the repellent effect and the reduction of the population growth of *A. craccivora*.

CONCLUSION

After the analysis of the toxicity of neem and manipueira, it was found that there was no difference between them. Regarding the repellent effect, only neem in LC30 had a repellent effect. In the other concentrations, CL20 of neem and CL20 and LC30 of manipueira, there was a neutral classification.

When studying the impact of botanical products on the growth of the A*. craccivora population*, it was observed that there was no significant difference in the LC20 concentrations of manipueira and neem extracts, but in LC30 neem provided a greater reduction in aphid population growth. However, it is important to note that both neem and manipueira were efficient in controlling the aphid population when compared to the control.

The importance of studies on the use of insecticidal products of botanical origin such as donim and manipueira for the management of agricultural pests is especially due to the management of resistance of these organisms, the lower environmental impact and, in the case of the two products tested, efficient and low-cost control alternatives.

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