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Research Article

Alternative Control with Oils and Plant Extracts of the Pulgon (*Lipaphis erysimi*) (Kaltenbach, 1843) on Couve (*Brassica oleracea L. var. acephala*), in the Municipality of Cruzeiro Do Sul, Acre

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Abstract

With the crisis and the increase in agricultural pests, there was a need for evolution in the correct management of insects in major crops. Biological control provides for the use of natural inputs as toxicological agents against existing enemies in organic farming. In this way, the use of botanical insecticides regulates the natural balance of species. To obtain new methods of control and management, essential oils were used to eliminate aphids present in cabbage specimens, thus allowing the continuity of vegetable production away from pests. In this study, we will be able to evaluate the viability of different vegetable oils as natural insecticides on aphids of cabbage. It was concluded that the mortality rate showed 100% efficiency on aphids at concentrations of 10%, 25%, 50% and 100% in the different oils tested. According to what was observed, the mortality time showed that *Mauritia flexuosa* obtained the shortest time as being the best to kill the aphids, followed by the other oils. It is worth noting that for use on leaf specimens, only the concentrations 10% and 25%, regardless of the oils, offered no commercial damage.

Keywords: Bioinsecticide • Natural • Analysis • Pests • Product

Introduction

The certification of the quality of organic production in the country is through Federal Law 10.831 of December 2003, which encouraged sustainability and the search for biological control methods, favouring quality to the environment and the health of the population and minimizing the use of agrotoxics, herbicides, pesticides and fungicides [1].

With the crisis and the increase in agricultural pests, there was a need for evolution in the correct management of insects in major crops [2].

According to Bueno, biological control provides the use of natural inputs as toxicological agents against existing enemies in organic farming. Thus, the use of botanical insecticides regularizes the natural balance of species [3].

According to Andrade, the irrational, uncontrolled use of pesticides, without inspection, will continue to cause irreversible damage to the environment, providing an aggravating factor to the health of the population. For this, one seeks initiatives of low impact and rational and ecological use, providing a better quality to the consumer [4].

According to Kaltenbach, these aphids belong to Kingdom: Animalia; Phylum: Arthropoda; Class: Insecta; Order: Hemiptera; Suborder: Sternorrhyncha; Family: Aphididae; Genus: *Lipaphis*; Species: *L. erysimi*, obtained from the taxonomic and scientific classification [5].

They are wingless individuals with an oval body (Figure 1A). The few winged females are responsible for the dispersal of the offspring, which have two pairs of membranous and transparent wings (Figure 1B).

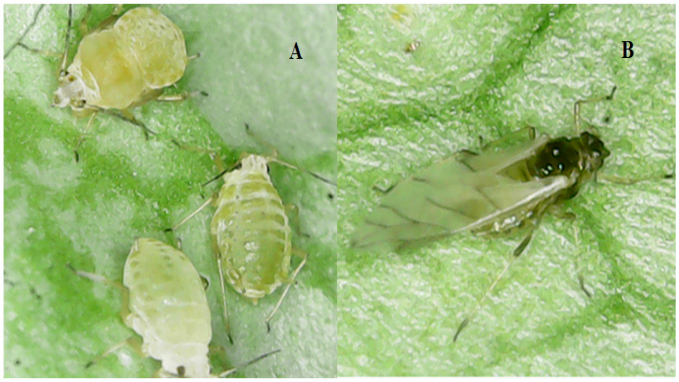

Figure 1. (A) *Lipaphis erysimi*, known as the green cabbage aphid, (B) *Lipaphis erysimi*, a green aphid with two pairs of membranous wings.

According to Filgueira, the corn *Brassica oleracea L.* is known worldwide, especially in Brazil. It is part of the food and nutrition of the population [6].

Its morphology is herbaceous with a firm and erect stem, and the leaves are rosette-shaped and alternate around the stem. They reproduce throughout the year. They are capable of providing clones through lateral buds, where they are transplanted to generate new plants.

To obtain new methods of control and management, essential oils were used to eliminate aphids present on cabbage specimens, thus allowing the continuity of vegetable production away from pests while maintaining the use of natural raw materials.

Thus, the objective of this study was to deepen management studies against the aphid *Lipaphis erysimi* in cabbage *Brassica oleracea L. var. acephala*, in the municipality of Cruzeiro do Sul, Acre, aiming to provide a better quality in vegetable planting, making it impossible to approach insect pests, which hinders the farmer from producing all year round, even trying to destroy them with defenders that do not harm his production and planting, keeping the framework of his input as organic as possible and away from pesticides harmful to health, reducing environmental impacts.

Materials and Methods

Mauritia flexuosa belongs to the Arecaceae family, popularly known as buriti throughout the Northern region and Cerrado. They are easily found in

swampy places and water springs. It is a palm tree that has a robust and tall stem; its leaves are palmate, arranged in a fan shape, and its roots are pneumatophoric for better oxygen absorption [7].

The babassu belongs to the Arecaceae family and is found in the Amazon, Atlantic Forest, Cerrado and Caatinga. It can be found in invasion regions and grasslands, measuring 30 to 40 meters tall, its stem varies from 30 to 40 cm in diameter, its leaves are arched, and its fruits are arranged through the peduncle, with a capacity of 300 to 500 coconuts [8].

Belonging to the Arecaceae family, patauá is found in humid forests with adequate light. It is common in Acre, Amazonas, Rondônia, Pará, central-western Brazil, Peru, Bolivia, Colombia, Ecuador and Venezuela. In Acre, it can be found in open or closed forests, flooded areas, or grasslands [9].

According to Batista, buriti oil is composed of tocopherol, carotenoids, fatty acids, palmitic acid, and oleic acid, with oxidative capacity due to the high rate of oleic acid, tocopherol and pigments. *Oenocarpus bataua* and *Attalea speciosa* oils are composed of lipids, fatty acids, oleic acids, palmitic acid, linoleic acid, stearic acid, palmitic acid, and α-linolenic acid. Due to the high oleic acid content, comparison with olive oil is possible. Therefore, these offer qualities to consumer health, bringing security because they have in their composition healthy molecules [10,11].

Control and evaluation of treatments

Infested leaf specimens were collected from the Organic Garden, taken to the Entomology Laboratory of UFAC, inserted with a soft brush in clean cabbage leaves, dried with paper towels and placed in petri dishes (90 × 13 mm) covered with paper film with perforations for oxygen ingress.

The evaluations were divided into three stages: the first was performed every 24 hours for 7 days after application of the bioinsecticides, initially observing the presence of dead aphids and subsequently counting the number of live and dead pupae the second was done through the evaluation of the mortality time to the exposure of essential oils, performed with a USB digital microscope magnifier (1000×); and the third step consisted of evaluating the damage viability of the concentrations in plants. Each treatment was composed of 4 different concentrations: One treatment (distilled water) and the others subdivided according to their respective concentrations. For a significant and correct result, 3 repetitions were made for each treatment, and each plot consisted of 15 aphids for each plate observed. For each plate, three cotton discs were moistened with water, and a piece of cabbage with a square size (7 × 7 cm) was placed [12,13].

Each treatment contained concentrations of essential oils of buriti, patáua and babaçu of 0, 10, 25, 50 and 100%. The results were subjected to variance analysis, and the means were compared by the Tukey test at a significance level of 5% probability and the regression test. Data analysis was performed using SISVAR® software [14].

Results

When checking the tests after 48 hours, it was noted that all concentrations were effective for the control. Delimiting the results, it was impossible to continue the observations for seven days.

For the control treatment with spraying only with distilled water, the survival of all aphids was observed after 48 hours. A total of 60 live adult aphids and 18 live nymphs were recorded.

1st Stage of assessment mortality rate

The essential oils of *M. flexuosa*, *A. speciosa* ex Spreng, *O. bataua*, at concentrations of 10%, 25%, 50% and 100% were effective in aphid mortality, making it possible to observe the deaths at a maximum of 2'52" after spraying. No nymphs were recorded for these treatments.

When observed under a USB microscope, it was found that when the essential oils were sprayed, they left the aphids disoriented. Soon afterwards, it was observed that the oil is easily absorbed through the cuticle without breaking it, leaving the aphids unable to move. After 24 hours (Figure 2A), they were all desiccated and rubbery, turning dark after 48 hours (Figure 2B).

Figure 2. (A) Light coloration and desiccation are observed, (B) After 48 hours, its coloration is already dark and rubbery.

Among the concentrations at 10%, 25%, 50% and 100% in different types of oils, there were no differences when compared by the Tukey 5% test, and both were effective in eliminating the aphid *L. erysimi* (Table 1).

Table 1: Mortality rate of oils against the aphid *L. erysimi*.

Oils	Dose (mg/ml)	Number of individuals	Mortality efficiency (%)
M. flexuosa	10	60	100
M. flexuosa	25	60	100
M. flexuosa	50	60	100
M. flexuosa	100	60	100
A. speciosa	10	60	100
A. speciosa	25	60	100
A. speciosa	50	60	100
A. speciosa	100	60	100
O. bataua	10	60	100
O. bataua	25	60	100
O. bataua	50	60	100
O. bataua	100	60	100

2nd stage of assessment by mortality time

The comparisons made and visualized through the microscopic table magnifier usb showed a significant index in the efficiency accounted for by the chronometer for the oil of *M. flexuosa*, with a minimum time of 28" and a maximum of 50" (Figure 3A). For the *A. speciosa* oil, there was a maximum of 2'20" and a minimum of 1'10" (Figure 3B). For *O. bataua* oil, the maximum time was 2'52" and the minimum was 1'40" (Figure 3C).

3rd Stage of the viability capacity

When testing the viability of the oils on cabbage plants in the field, it was observed that there was no lesion or drying of the leaves at concentrations of 10% and 25%, and the oils were only able to attack the aphids. However, in the 50% and 100% concentrations, the cabbage leaves were damaged, making them unviable for consumption.

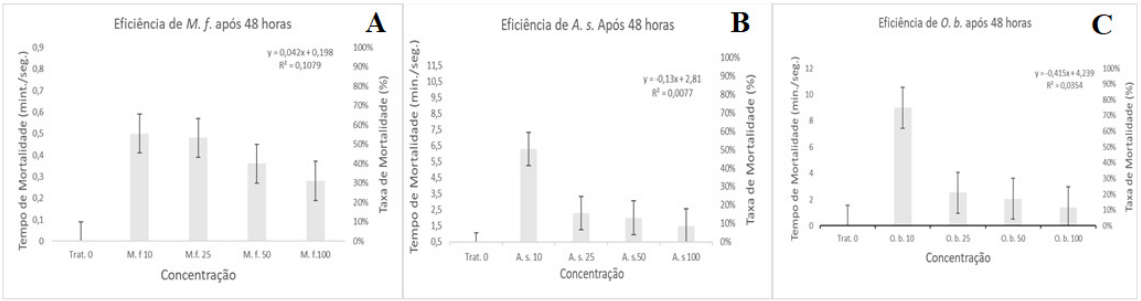

Figure 3. (A) Concentrations of M. flexuosa, (B) Concentrations of A Speciosa ex Spreng, (C) Concentrations of *O. bataua*

Discussion

For Ataide, the evaluations carried out on the toxicity of the essential oils of Citrus limon and Citrus aurantium dulce have elimination activities on the strawberry caterpillar, with 100% efficiency [15,16].

According to Rodrigues, when selecting 22 essential oils for anthracnose in fruits, a positive response was obtained with 100% efficiency, maintaining sufficient elimination in different oils tested [17-19].

According to Carmo and Vieira, the essential oils have insecticidal activities on the coffee berry borer, aphid and potato aphid, thus being efficient for its control, obtaining the framework of 100% mortality in organic crops. Therefore, the use of Neem oil has proven and registered eliminatory action in various agricultural pests [20-21].

Conclusion

It can be concluded that the mortality rate showed 100% efficiency on aphids at concentrations of 10%, 25%, 50% and 100% in the different oils tested, thus defining their ability to kill. According to what was observed, the mortality time showed that *Mauritia flexuosa* had the shortest time to kill the aphids, followed by the other oils. The efficiency of the other oils at different concentrations was noted, but the mortality time was longer.

Therefore, due to their high solubility and affinity with the oils, the insects died instantly and quickly when in contact with the agent that caused their elimination. Despite the complexity of the components found in the essential oils, these favoured their efficiency against pest insects.

It is worth noting that for use on leaf specimens, only the concentrations 10% and 25%, regardless of the oils, did not offer commercial damages.

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Ethics Approval

Not applicable.

Competing Interests

The authors declare that they have no conflicts of interest.

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Availability of Data Material

All data generated or analysed during this study are included in this paper.

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