Journal of Entomology and Zoology Studies

Available online at www.entomoljournal.com

E-ISSN: 2320-7078
P-ISSN: 2349-6800
www.entomoljournal.com
JEZS 2024; 12(4): 27-31

Received: 17-04-2024
Accepted: 25-05-2024

Author's details are given below the reference section

Toxicity of *Jatropha curcas* extract for alternative control of *Maconellicoccus hirsutus*

Kristiélen Jeniffer Abreu Mageste, Johnatan Jair de Paula Marchiori, Anderson Mathias Holtz, Ronilda Lana Aguiar, Bruno Silva Bruni, Marcos Delboni Scárdua, Gustavo Pazolini Stein, Ana Clara Bayer Bernabé, Camila Groner Milbratz and Thayne da Rocha Braz

DOI: https://doi.org/10.22271/j.ento.2024.v12.i4a.9344

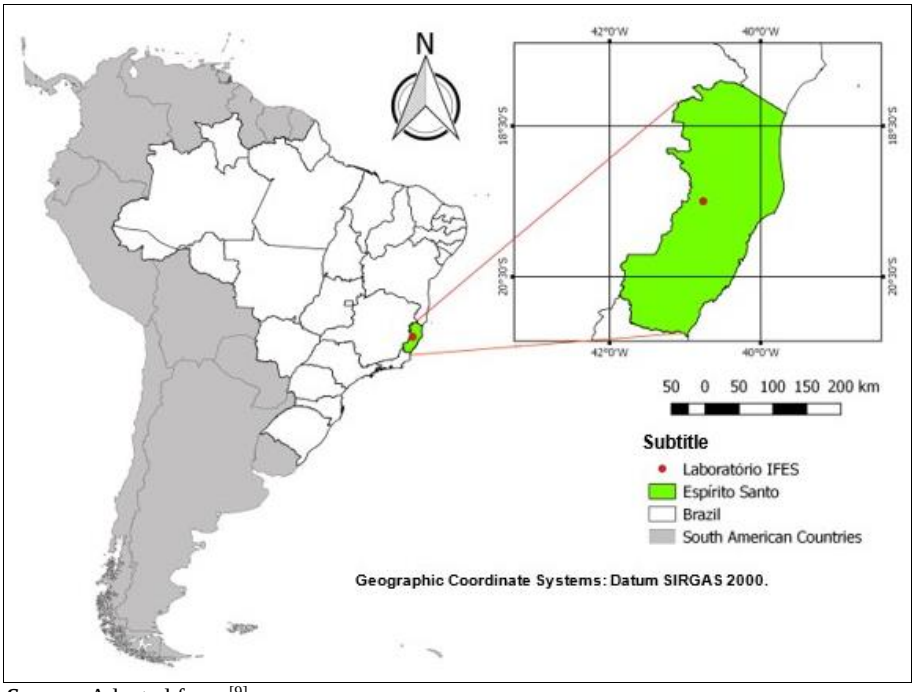
Abstract
Maconellicoccus hirsutus causes serious damage to fruit production, plant ornamentals, and vegetables. This damage is caused by toxic saliva released by the insect that causes malformation of shoots and leaves, and wrinkling of apical growth. It is controlled by products synthetics that have effects harmful to animals, the environment, and beings humans, so The immense search for extracts of vegetables to control pests. This job demonstrates This work demonstrates the effectiveness of Jatropha plant extract against *M.* hirsutus. The concentration lethal rate of 50% (LC 50) was estimated at 14.11%. It was observed that mortality increased as the extract concentration increased. The form of application used, the direct one, can affect the individual one since it feeds on the leaf disc used in the experiment, as also, the fact that the insect possesses one carapace powdery that facilitates absorption of toxins via the dermis, causes an impact negative in the insect.

Keywords: Alternative management, synthetics, pink mealybug, toxicity

Introduction
Pest control is a challenge constant in agriculture, and pink mealybug (*Maconellicoccus hirsutus*) stands out as one threat substantial to productivity. *M. hirsutus* he was found in more than 350 species of plants, is a pest that threatens the production of fruits, plant ornamentals, and vegetables in the country [1,2]. When feeding, the cochineal pink, injects toxic saliva, causing malformation of leaves and shoots, and wrinkling of apical growth [3].
Due to the single control method registered by the agent microbiological *Cryptolaemus montrouzieri Mulsant* [4] are used inappropriately products synthetics not registered have an impact negative on organisms beneficial and cause imbalance to the quite environment, contaminating water and air [5, 6]. An efficient alternative satisfactory, for pest control is the use of herbal products.
Among the plants used for alternative control, jatropha stands out, it has acaricidal and insecticidal potential, the effectiveness of J. curcas leaf extract was proven in tests on whiteflies [7] and that of the oils from its fruits in controlling of cabbage aphid [8].
With the need to develop methods for managing pink mealybug, the use of jatropha extract meek can be seen as a way to control it. Therefore, this article aims to study the potential pine nut insecticide tame in the alternative management of *M. hirsutus.*

Materials and Methods
The experiment was carried out in the Entomology Laboratory Agricultural and Acarology of the Federal Institute of Education, Science and Technology of Espírito Santo-Campus Itapina (IFES-Campus Itapina), located in the municipality of Colatina, in coordinates 19°29'52.7" S40 °45'38.5" W (Figure 1).

Corresponding Author:
Kristiélen Jeniffer Abreu Mageste
Instituto Federal do Espírito Santo, Campus Itapina, Colatina, ES, Brasil



***Source*:** Adapted from [9]

Fig 1: Map of the location where the experiments were carried out

Cochineal breeding pink

The creation technique carried out follows the methodology of Sanches & Carvalho [10] being adapted in the IFES-Campus Itapina laboratory, using pumpkins in internship initial maturation as a source of food for mealybugs (figure 2), at the beginning of the pumpkin infestation, the individuals they were collected in the field, from plants hostesses infested, after fixation initial beginning of the colony, the beginning to the process of multiplication of mealybugs, when there was need to change the pumpkins, new fruits of this curcubitaceae they were collected from own planting of the institute, aiming at the use of fruits without pesticides, and placed in contact with those already infested about two hours, like approximation favoured the transfer of nymphs newly hatched fruit mealybug old to new, due to its mobility in this phase, creation he was maintained in living room air-conditioned at 25±2ºC, RH 70±10% and 12 h photophase.

Photo: Entomology laboratory

Fig 2: Breeding *Maconellicoccus hirsutus*

Obtaining aqueous extracts from Jatropha leaves

To prepare the extracts, jatropha leaves were collected in the experimental area of the institute. The leaves were submitted there is a washing process, after harvesting, in which they were immersed in one water solution distillate and sodium dichloroisocyanurate, in proportion of 1:10 and left without rest for 5 minutes. Soon after, the leaves were gently washed with water distilled to remove the solution and dried with cotton sponges. After washing, the leaves they were placed to dry in a greenhouse with air circulation forced at a temperature of 40ºC for 72 hours. After drying, they were subjected to grinding with the aid of a knife mill to obtain a powder thin. The procedure accomplished was one adaptation of the methodology described by Marchiori *et al*., [9].

Bioassays

To obtain J. curcas extract, the powder of crushed plant material (10 g) was transferred to an Erlenmeyer flask (100 mL) containing water distillate and adhesive spreader Tween® 80 (0.05%), for the obtaining 100 mL of the solution initial 10% (m/v). Subsequently, this solution he was kept under homogenization in transversal shaker (240 rpm) for 24 hours. After this time, the mixture he was filtered with fabric type voil and transferred to a balloon volumetric, and the volume was measured to 100 mL. The treatment was composed of 10 repetitions and 10 cochineals pink per repetition, with a total of 100 insects. The repetitions they were maintained in Petri dishes (10.0 x 1.2 cm) on coffee leaf discs measuring approximately 4 cm in diameter. This sheet disc was fixed to the Petri dish with a 0.5 cm layer of agar-agar and petroleum jelly solution solid to your around to prevent insects from escaping. The spraying was made using an airbrush with a pressure of 15 lb /in² and 2mL of solution each formulated for each repetition. As a witness water was used distilled spirit and the adhesive spreader Tween® 80 (0.05%). The effect of insecticide was evaluated 24, 48, and 72 hours after spraying. The experiment he was conducted in design entirely randomized. Such a technique used for obtaining J. curcas extract was one adaptation of the

methodology proposed by Marchiori *et al*., [9].

Concentration estimation lethal (CL 50)

Equivalent to the method used by Marchiori *et al*., [9] 2 mL of the extract was sprayed in each repetition, the sprays were made using an airbrush with a pressure of 15 lb/in², where the treatments were composed of 5 concentrations of aqueous leaf extract jatropha, spaced on a logarithmic scale, limits from 0.01% to 10% m/v). The dosages they were obtained using the formula C 1. V1 = C2. V2. The solvent used was water distilled and added with Tween® 80 (0.05%). In the witness, he was used water distilled added with Tween® 80 (0.05%). The experiment was conducted in chamber air-conditioned (25±10 °C, RH of 70±10%, and photophase of 12 h) and evaluated 24, 48, and 72 h after spraying the solutions. The concentrations lethal they were estimated using The Probit analysis. In the face of these results, he was estimated the ideal dosage. To this end, it was used the program PoloPc and the graph he was generated in the R environment version 4.2.3 (R CORE TEAM, 2023).

Results and Discussion

CL 50 is the concentration of the agent needed to kill 50% of the population target in a specific period specific, for the data analysis was using the Probit model, and its inclination was estimated at 1.0670±0.3377, indicating the relationship between the concentration of the extract pine nut juice tame and the mortality response of the mealybug Concentration lethal from CL 50 he was calculated at 14.11%, being your confidence interval between 9.12%-27.68%, as introduced at figure 3.

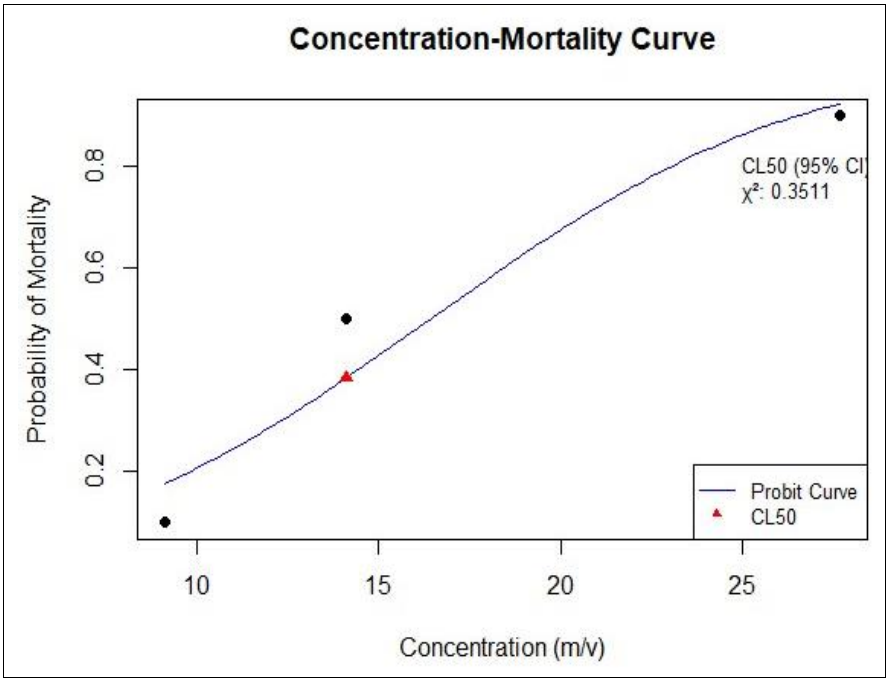


Photo: From the author himself

Fig 3: Mortality in relationship to the increasing concentration of the extract

Such data provide an integral range for the concentration of jatropha aqueous extract necessary to cause the expected mortality in the target population. The chi-square test (x^2) with a value of 0.3511 indicates adequacy satisfaction of the Probit model to experimental data, providing information crucial for possible control methods in cultivars agricultural.

The results obtained in this work demonstrate that as the concentration of pine nut extract meek increased (Figure 3), there was an increase at mortality of individuals. Similar data also they were found in Holtz *et al*., [11] test extracts from the same plant with individuals rosette mealybug adults. This was also notable when analyzing the efficiency of the aqueous extract of chili peppers in the management of pink hisbiscus cochineal [9].

This trend suggests that high concentrations of the extract substance are associate with one elevated efficiency at the drop in the insect population. This was corroborated by Holtz *et al*., [12], highlighting the efficiency of jatropha cake extract in spider mite mortality, which is related to the increase in concentration. This was also validated when testing Jatropha extract to control Ceratitis capitata larvae [13].

As the concentration of an extract increases, more compounds and chemicals are gifts in that extract, in the case of *J. curcas* extract, its toxicity is attributed to the presence of flavonoids, glycosides, steroids, and some types of alcohols [14], highlighting the flavonoids, which are considered detergents food [13]. When applied to organisms, these compounds behave similarly to jatropha oil [15].

The application method adopted, directly, may also have affected the individual, since, when sprayed, the extract reaches the plant discs used in the experiment, that is, when trying to feed the insect will also be impacted by the Jatropha extract [16]. This fact is what we diagnose in our tests carried out in the laboratory, corroborating with Holtz *et al*., [16] who state that the body of *M. hirsitus* is composed of a carapace powdery, which can have facilitated the absorption of toxins via the dermis.

Mostly, the toxicity of *J. curcas* comes from phorbol esters and curcin, a protein ribosome inactivator gift in the seeds, which prevents protein synthesis This one last, similar to ricin found at castor [15].

Phorbol esters (diterpenes) are the most toxic substances in jatropha, among their various functions, their ability to repel, anti-feed, attract, and act as a toxin, among others, stands out

[15]. The diterpenes also have a character lipophilic, which facilitates their passage to the middle intracellularly, which increases your is made toxic [18].

The toxicity of phorbol esters can be corroborated by Torres *et al*., [18] in which they tested the toxicity of *Jatropha gossypiifolia*, a plant that, like jatropha, also has diterpenes as one of its most toxic compounds, on weevils. beans, and obtained satisfactory results in mortality.

Conclusion

In short, the extract pine nut water meek is favourable for the management of *M. hirsitus*, being one alternative to reduce the use of products chemicals, a once in proportions appropriate within the management, tends to provide one agriculture more sustainable and more socioeconomic preserving the environment and its collaborators.

Acknowledgments

We thank the Federal Institute of Espírito Santo (IFES), Campus Itapina, for the availability of infrastructure and resources to develop this study.

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Author's details

Kristiélen Jeniffer Abreu Mageste
Instituto Federal do Espírito Santo, Campus, Itapina, Colatina, ES, Brasil

Johnatan Jair de Paula Marchiori
Universidade Federal Rural do Rio de Janeiro, (UFRRJ), Campus Seropédica, Seropédica, RJ, Brasil

Anderson Mathias Holtz
Instituto Federal do Espírito Santo, Campus Itapina, Colatina, ES, Brasil

Ronilda Lana Aguiar
Instituto Federal do Espírito Santo, Campus Itapina, Colatina ES, Brasil

Bruno Silva Bruni
Instituto Federal do Espírito Santo, Campus Itapina, Colatina, ES, Brasil

Marcos Delboni Scárdua
Instituto Federal do Espírito Santo, Campus Itapina, Colatina, ES, Brasil

Gustavo Pazolini Stein
Instituto Federal do Espírito Santo, Campus Itapina, Colatina, ES, Brasil

Ana Clara Bayer Bernabé
Instituto Federal do Espírito Santo, Campus Itapina, Colatina, ES, Brasil

Camila Groner Milbratz
Instituto Federal do Espírito Santo, Campus Itapina, Colatina, ES, Brasil

Thayne da Rocha Braz
Instituto Federal do Espírito Santo, Campus Itapina, Colatina, ES, Brasil