**Technical note**

# Use of plant extracts for the protection of the plantain bunch (*Musa* AAB) against insects, Sucre municipality, Zulia State

Uso de extractos vegetales para la protección del racimo de plátano (*Musa* AAB) contra insectos, municipio Sucre, estado Zulia

Uso de extratos vegetais para proteção do cacho de bananeira (*Musa* AAB) contra insetos, município de Sucre, estado de Zulia

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Rev. Fac. Agron. (LUZ). 2025, 42(1): e254201
ISSN 2477-9407
DOI: https://doi.org/10.47280/RevFacAgron(LUZ).v42.n1.I

Received: 24-09-2024
Accepted: 07-11-2024
Published: 18-12-2024

**Crop production**
Associate editor: Dra. Lilia Urdaneta
University of Zulia, Faculty of Agronomy
Bolivarian Republic of Venezuela

**Keywords:**
Ecological alternative
*Capsicum* spp.
*Allium sativum*
Damage

## Abstract

Plantain producers from the Sucre municipality of Zulia state, Venezuela, have expressed concerns about improving or maintaining the quality of the bunch, seeking to protect it from damage caused by insects, thus harming its appearance for marketing. It was proposed to evaluate the effect of aqueous plant extracts from the 100 % water-plant organ mixture for the protection of the plantain bunch. A completely randomized experimental design was used with 5 treatments and 20 repetitions. The treatments were: T1: cluster without product application; T2: cluster sprinkled with garlic bulb extract (*Allium sativum*); T3: cluster sprinkled with hot pepper fruit extract (*Capsicum* spp.); T4: bunch sprayed with lemongrass (*Swinglea glutinosa*) leaf extract and T5: bunch sprayed with eucalyptus (*Eucalyptus* spp.) leaf extract. The variable that was studied was: bunch fruits without damage from insects attack. T2 and T3 presented a higher percentage of fruits without insect damage (94 and 96 % respectively), with better quality in the bunch for commercialization.

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## Resumen

Los productores de plátano del municipio Sucre del estado Zulia, Venezuela, han presentado la inquietud de mejorar o mantener la calidad del racimo, buscando la protección del mismo del daño ocasionado por insectos, que perjudican su aspecto para la comercialización. Se planteó evaluar el efecto de extractos vegetales acuosos de la mezcla agua-órgano de la planta al 100 % para la protección del racimo de plátano. Se utilizó un diseño experimental completamente aleatorio con 5 tratamientos y 20 repeticiones. Los tratamientos fueron: T1: racimo sin aplicación de producto; T2: racimo asperjado con extracto de bulbos de ajo (*Allium sativum*); T3: racimo asperjado con extracto de frutos de ají picante (*Capsicum* spp.); T4: racimo asperjado con extracto de hojas de limoncillo (*Swinglea glutinosa*) y T5: racimo asperjado con extracto de hojas de eucalipto (*Eucalyptus* spp.). La variable que se estudio fue: frutos del racimo de plátano sin daños por ataque de insectos. Los T2 y T3 presentaron mayor porcentaje de frutos sin daños de insectos (94 y 96 % respectivamente), con mejor calidad en el racimo para la comercialización.


**Palabras clave:** alternativas ecológicas, *Capsicum* spp., *Allium sativum*, daños.


## Resumo

Os produtores de banana do município de Sucre, estado de Zulia, Venezuela, têm manifestado preocupação em melhorar ou manter a qualidade do cacho, buscando protegê-lo de danos causados por insetos, prejudicando assim sua aparência para comercialização. Propôs-se avaliar o efeito de extratos vegetais aquosos provenientes da mistura 100 % água-órgãos vegetais na proteção do cacho de bananeira. Foi utilizado delineamento experimental inteiramente casualizado com 5 tratamentos e 20 repetições. Os tratamentos foram: T1: cacho sem aplicação de produto; T2: cacho polvilhado com extrato de bulbo de alho (*Allium sativum*); T3: cacho polvilhado com extrato de pimenta (*Capsicum* spp.); T4: cacho pulverizado com extrato de folhas de capim-limão (*Swinglea glutinosa*) e T5: cacho pulverizado com extrato de folhas de eucalipto (*Eucalyptus* spp.). A variável estudada foi: frutos de cacho de banana sem danos por ataque de insetos. T2 e T3 apresentaram maior percentual de frutos sem danos por insetos (94 e 96 % respectivamente), com melhor qualidade no cacho para comercialização.


**Palavras-chave:** alternativas ecológicas, *Capsicum* spp., *Allium sativum*, dano.

## Introduction

In the subtropical and tropical regions of Latin America, Asia, and Africa, where high temperatures and relative humidity prevail, bananas (*Musa* spp.) are among the main cultivated plants; therefore, in many countries such as Ecuador, Colombia, and Brazil, they are strategic crops that ensure food security (Martínez and Rey, 2021). In Venezuela, the crop constitute a social, nutritional, and economic importance (Nava, 2019).

A problem that arises is that different insects attack the banana crop with greater or lesser incidence, being evident that the control of these harmful agents must be based on a set of sanitary practices properly applied to keep it below the critical economic level.

As for the insects that cause damage to the bunch, there are the banana fruit scarring beetle (*Colaspis* spp.), which makes irregular scrapings on the entire surface of the fruit, and the stingless bee (*Trigona* spp.), which damages only the edges of the epicarp, in both cases, on young fruit (Nava, 2019). It is possible to differentiate in the field the type of lesion caused by *Colaspis* spp. from that caused by *Trigona* spp.

In this sense, Barrera *et al*. (2018) indicated that *Colaspis* spp. is causing economic losses; highlighting that quality standards do not allow the presence of chemical residues in fruits. The abuse and misuse of these products has caused contamination and pest resistance to the active ingredients. According to Lichtemberg (2024), research on plantain bunch management practices should be continued in order to improve the appearance thereof.

In this context, Villaseñor and Lata (2024) pointed out that producers should be provided with other management strategies to reduce the cost associated with agrochemicals and their harmful effects on human health and the environment. Palomeque *et al*. (2023) stated that a situational analysis with planning and control should be carried out in each production unit, reviewing the different tasks. On the other hand, there are practices to protect the bunch, such as bagging, with the objective of avoiding damage from rubbing, insect attacks and improving the appearance of the fruit, but this has an impact on the environment, as the bags, after being used, remain in disuse and have a terrible final disposal.

Villasmil *et al*. (2022) emphasized that production with ecological alternatives is a system that seeks to improve environmental conditions and maintain a healthier agroecosystem over time. For Nascimento *et al*. (2020), the intensive use of agrochemicals is an available option for the general management of plantain crops; however, other strategies should be provided to producers to reduce the cost associated with chemicals and their harmful effects on human health and ecosystems. Jaramillo *et al*. (2022) pointed out that it is necessary to evaluate ecological alternatives in musaceae, in order to provide options that can be used in the management of the crop.

In the search to improve or maintain the quality of the plantain bunch, it is necessary to use natural, environmentally friendly alternatives such as the use of vegetable extracts of hot pepper fruits (*Capsicum* spp.); garlic bulbs (*Allium sativum*); lemongrass leaves (*Swinglea glutinosa*) and eucalyptus leaves (*Eucalyptus* spp.), to protect the plantain bunch from insects that cause damage to the fruits, thus damaging their appearance for marketing. Therefore, the objective of this research was to evaluate the effect of aqueous plant extracts for bunch protection in plantain crops in the Sucre municipality of Zulia state, Venezuela.

## Materials and methods

### Study area description

The research was carried out in the Macondo production unit, located in the Asociacion de Productores de Cacao y Plátano (ASOPROCASUZU), Sucre municipality, Zulia state, Venezuela, located in the southern sub-region of Lake Maracaibo; geographical coordinates 9° 8’ 29’’ S and 71° 4’ 57’’ W, bordered to the north by Lake Maracaibo; to the south by the state of Merida; to the east by the state of Trujillo; and to the west by the municipality of Francisco Javier Pulgar. The soils are medium-textured and well-drained. The average annual temperature is 28 °C, the predominant altitude is 6

masl and rainfall is 1,700 mm.year$^{-1}$ (Corporación para el Desarrollo de la Región Zuliana [CORPOZULIA], 2022).

**Experimental unit**

The experimental unit was the bunch of a Harton plantain (*Musa* AAB) plant.

**Experimental design**

The experimental design was totally randomized with 5 treatments and 20 replications for a total of 100 Harton plantain plants, 24 months old, with a planting distance of 3 m between rows x 2 m between plants, for a total of 1,667 plants.ha$^{-1}$.

**Treatments**

T1: control plant, bunch without product application; T2: bunch sprayed with garlic bulb extract; T3: bunch sprayed with hot pepper fruit extract; T4: bunch sprayed with lemongrass leaf extract; T5: bunch sprayed with eucalyptus leaf extract.

**Variable**

Plantain bunch fruit without damage by insect attack. The fruits of each bunch were counted, then it was verified how many showed damage, identifying the causal agent, and then the percentage was obtained.

**Extracts**

1 kg of garlic bulbs; 1 kg of hot bell pepper fruits; 4 kg of lemongrass leaves and 4 kg of eucalyptus leaves, liquefied separately (Black Decker blender, model BLBD21OPR, United States of America), washed with soap and water after each use, with concentrations of each aqueous extract of 100 % in 5 liters of water, with a rest of 72 hours for all extracts (Nava, 2019).

**Management**

A tour of the plantation was made, locating the plants that had one week old bunches, identifying them with colored tape according to the treatment. The bunches were then sprayed with plant extracts using a 100 % water-organ plant mixture, so that the effect would act as a repellent against the different insects that approached the bunches. It was evidenced in the productive unit after 20 visits in periods with and without rain, that different insects approach the plantain bunch producing damages to it (during all the months the insects were present). The applications were carried out weekly with a back sprayer with a capacity of 18 L, Carpi brand, model carpi18, Brazil, for four weeks, then the epicarp of the plantain fruit thickens and the insects do not produce damage.

The practices of desuckering, defoliation and sanitary defoliation were carried out. Undergrowth weed management was carried out weekly, manually with a machete. Eleven weeks after the treatments were identified, all the marked bunches were harvested. A total count of the fruit was made, checking for damage. The incidence of insects was estimated by counting the lesions produced by each genus in each bunch harvested.

**Data processing and analysis techniques**

The results were processed through the Statistical Analisys System (SAS®) statistical package (SAS, 2014); an analysis of variance (ANOVA) was performed on the variables under study to demonstrate the effect of the application of the different treatments, and if significant, Tukey's mean comparison test was performed.

## Results and discussion

There was a significant difference ($p<0.05$) for the variable fruit without damage by insect attack, since there was a difference between the means of T2 (94 %) and T3 (96 %) with respect to the other treatments with values for T1; T4 and T5 of: 2 %; 28 % and 31 % respectively (table 1). Therefore, the use of garlic bulbs and hot pepper fruits as aqueous plant extracts at a concentration of 100 % is recommended, being viable for optimal management of the bunches in the plantation.

**Table 1. Percentage of fruit without insect damage in the plantain bunch, Sucre municipality, Zulia state.**

| Treatment | Fruit average | Fruits without damage (%) | Coefficient of variation |
|---|---|---|---|
| Without product | 0,6 c | 2 | 2,38 |
| Garlic bulbs | 28,2 a | 94 | 0,05 |
| Hot pepper fruits | 28,2 a | 96 | 0,06 |
| Lemongrass leaves | 8,4 b | 28 | 1,06 |
| Eucalyptus leaves | 9,3 b | 31 | 1,00 |

Different letters indicate significant differences obtained by Tukey's mean comparison test ($p<0.05$).

With the use of aqueous extracts obtained from garlic bulbs and hot pepper fruits as repellents, a high percentage of clean fruits can be obtained, without using agrochemicals, promoting alternatives that are adapted to the production units.

Barrera *et al*. (2018), evaluated the effect of bags impregnated with garlic on the incidence and severity of lesions caused by *Colaspis* spp. In that work the aqueous extract of garlic at a concentration of 100 %, was the one that caused the greatest repellency of insects and a decrease in fruit damage of 98 %.

In this context, Claros *et al*. (2019) indicated that biodiversity is threatened by the spread of insects, so there is a need to develop environmentally friendly management strategies. Villasmil *et al*. (2022) emphasized that organic production is a system that seeks to improve environmental conditions through ecological management. This assertion is confirmed by the results of this research.

Centanaro and Nava (2021) stated in their publication on musaceae that 58.34 % of producers made an uncontrollable use of agrochemicals, reflecting the lack of monitoring, control in the application of products and high possibility of intoxication, with a lack of knowledge of producers of the new trends in integrated pest management and cultural controls. With the results of this research, the alternative of using aqueous plant extracts at 100 % concentration is now presented, being viable in an ecological management.

The insects collected during this research and which caused the damage observed in the plantain bunches were *Colaspis* spp. (31 %) and *Trigonas* spp. (69 %); the greatest amount of damage was observed on the edges of the epicarp, with lesions that affected the quality of the bunch.

Plantain producers should identify the insects that visit their plantations, knowing the damage they can cause, with a permanent review in the search for minimizing the environmental impact. In this sense, based on these results, the quality and appearance of the fruit can be maintained in the marketing process.

Therefore, according to what has been presented, it is possible to work with new trends in integrated insect management, with the aim of reducing the application of chemical products in plantain cultivation with production units that are more sustainable.

## Conclusions

With the use of plant extracts, it was possible to obtain a low percentage of damage caused by insects in the plantain bunch, maintaining the quality of the bunch.

The most effective extracts for the protection of plantain bunches from damage caused by *Colaspis* spp. and *Trigonas* spp. insects were those obtained from garlic bulbs at a concentration of 100% and from hot pepper fruits at the same concentration, which are recommended for inclusion in biological control programs to prevent the appearance of damage that affects the commercial quality of the fruits.

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