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Application Of Organic Insecticides In Banana Crops For The Management Of Thrips (Chaetanaphothrips Signipennis) In El Oro-Ecuador

Aplicación de insecticidas orgánicos en el cultivo de banano para el manejo de trips (Chaetanaphothrips signipennis) en El Oro-Ecuador

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Abstract

The banana crop in Ecuador, due to its great acceptance in the international market, raises the quality standards of the fruit, looking for a product without damage caused by pests and diseases, among these pests are highlighted Chaetanaphothrips signipennis known as thrips, which affects the quality of the fruit. The use of organic insecticides for the management of thrips in banana crops was evaluated using an experimental design with completely randomized blocks (DBCA) consisting of five treatments with four replications, in the treatments different extracts were used, Neem extract plus natural casing was used for treatment T1, garlic extract plus natural casing for treatment T2, basil extract plus natural casing for treatment T3, rue extract plus natural casing for treatment T4 and Phyriplus plus Oleoplus and natural casing for treatment T5 of conventional origin. The corresponding analyses of variance were carried out and a Tukey test adjusted to a significance level of 5% was used for the comparison of means. The response variable of greatest interest was the incidence and severity of the pest, whose highest averages were obtained in treatment T3 with 17%, while the lowest was T4 with 6.25%. It is evident that the T4 treatment in comparison to the other treatments presented the best results for the control of thrips in the banana crop.

Keywords: Basil, bioinsecticides, extracts, neem, rue.

Resumen

El cultivo de banano en el Ecuador por su gran acogida en el mercado internacional eleva los estándares de calidad en la fruta, buscando un producto sin daños provocados por plagas y enfermedades, entre estas plagas se resaltan a Chaetanaphothrips signipennis conocidos como trips, que afecta la calidad de la fruta. Se evaluó el uso de insecticidas orgánicos para el manejo de los trips en el cultivo de banano, el estudio se lo realizó mediante un diseño experimental con bloques completamente al azar (DBCA) que constó de cinco tratamientos con cuatro repeticiones, en los tratamientos se utilizaron diversos extractos, para el tratamiento T1 se utilizó extracto de neem más funda natural, para el tratamiento T2 ajo más funda

natural, para el tratamiento T3 extracto de albahaca más funda natural, para el tratamiento T4 extracto de ruda más funda natural y para el tratamiento T5 de origen convencional Phyriplus más Oleoplus y funda natural. Se realizaron los análisis de varianza correspondientes y para la comparación de medias se utilizó un test de Tukey ajustado a un nivel de significancia del 5%. La variable de respuesta de mayor interés fue la incidencia y severidad de la plaga, cuyos promedios mas altos se obtuvieron en el tratamiento T3 con un 17%, mientras que el mas bajo fue de T4 con un 6,25%. Se evidencia que el tratamiento T4 en comparación a los demás tratamientos presento los mejores resultados para el control de trips en el cultivo de banano.

Palabras clave: Albahaca, bioinsecticidas, extractos, neem, ruda.

Introduction

The banana is one of the most internationally cultivated fruits, as it is a fruit with excellent nutritional properties that provide a significant amount of carbohydrates, fiber, potassium, magnesium and other nutrients (Dier, 2014). In Ecuador, banana cultivation has expanded its agricultural frontiers with the participation of small and medium-sized producers in the sector, who depend economically on the income provided by the commercialization of this fruit (Borja, 2016).

The crop is affected by several pests and diseases that develop in favorable agro-climatic conditions for their development, one of them is the thrips (chaetanaphothips signipennis), which causes the fruit lesion known as red spot, the adults are brown with wings, with blackish stripes whose female is larger than the males (Carrillo, 2007). The insect in its adult stage can measure between 1 to 1.5 mm, with elongated and very narrow wings (León, 2018)

The control of this pest has been given with different managements, but for this, it is necessary to know the biology of the insect, based on the description by Vera (2013), who observes that the insect has seven stages in its development, the first of them are the eggs, which last approximately 9 days, followed by nymph I and II which last 4 days on average, then it goes to nymph III which remains until it progresses to the adult stage where it reaches its largest size, on average they have a life of 25 days for males and 30 days for females.

The usual treatment of this pest is carried out by means of chemically treated casings in conventional banana plantations. The search for new ecological alternatives proposes the use of sheaths treated with natural extracts or active components of organic origin in the case of organic or ecologically managed plantations that implement environmental care practices within their production units.

Among the management alternatives for thrips in banana, research has been carried out to characterize the insect, to know its population dynamics and to evaluate the use of organic insecticides, intensifying good agricultural practices within the crop in various field tasks, including early sheathing, weed control, weeding and leaf removal. These practices can contribute to the control of this pest (Rojas, 2013)

This research focuses on the use of biopreparations for sustainable pest control and management, as described in the FAO (2010) publication in its guide, where biopreparations are defined as products made from materials, substances or elements present in nature that protect, improve and positively impact production systems by applying them to crops. Substances and mixtures of plant, animal or mineral origin present in nature make up this practice for sustainable agriculture (IPES / FAO, 2010)

Plant extracts, used as biopesticides, have proved positive for pest control in the cultivation of musaceae, as can be seen in the research carried out by Barrera, Fernández and Pérez (2018), which used different extracts to control colaspis sp. in plantain cv. hartón. Being a successful practice, it becomes necessary to investigate further with research and test in different agroclimatic conditions.

The extracts usually used are based on: Salvia Salvia officinalis, anamu Petiveria alliacea, basil Ocimum basilicum, garlic Allium sativum, hot bell pepper Capsicum annuum among others. Showing excellent action against pests that affect some economically important crops (Barrera, Fernández, & Pérez, 2018).

The use of plant extracts as insecticides, commonly known as bioinsecticides, has had a successful impact on thrips control, as in the case study conducted in Mexico by Ajiquichí (2013), on French bean, where it was shown that the use of extracts in different concentrations has a significant effect on thrips populations, thus protecting the quality of the product.

The present study aims to evaluate whether the use of organic insecticides based on plant extracts has an impact on the management of thrips in the banana crop in the Pasaje canton, province of El Oro, Ecuador

Methods

The present experimental research was based on a completely randomized block design (CRBD) consisting of five treatments with four replications, respectively. The statistics were carried out by means of an analysis of variance as shown in Table 1.

Table 1. The source of variation and degrees of freedom.

Source of Variation	Grades of Freedom
Treatments (t – 1) (5 – 1)	4
Repetitions (r – 1) (4 – 1)	3
Error (t – 1)(r – 1) (5 – 1) (4 – 1)	12
Total (t * r - 1) (5*4 – 1)	19

Source: Own elaboration.

The treatments were distributed according to Table 2, which consisted of different extracts, plus a conventional or commercial treatment as a significant comparison. A Tukey test with a significance level of 5% was used as a comparative mean.

Table 2. Description of treatments

Treatment	Dose /ha	Dose / plot	Dose / plant	Frequency of application
T1 Neem extract + natural casing	50cc	0.12cc	0.04cc	At sheathing At dechive
T2 Garlic extract + natural casing	600cc	1.5cc	0.5cc	At sheathing At dechive
T3 Basil extract + natural casing	600cc	1.5cc	0.5cc	At sheathing At dechive
T4 rue extract + natural casing	600cc	1.5cc	0.5cc	At sheathing At dechive
T5 Conventional (Phyriplus + oleoplus + natural sheath)	250cc + 250cc	1.25cc	0.41cc	At sheathing At dechive

Source: Own elaboration.

As for the experimental delimitation of the trial, the total area of the experiment was defined as 17,286 m2 whose plots had an area of 750 m2 distributed as shown in Figure 1.

Figure 1. Delimitation of the experimental units

Source: Own elaboration

Finally, the hypothesis to be validated in the trial is whether any of the applications will lower the incidence of thrips in the banana crop.

Results and Discussion

The efficacy of the extracts used was measured after the first application; among the treatments, a coefficient of variation (C.V) of 21.82% was obtained, finding significant statistical differences among the observations. Based on Table 3, the treatment that showed the best response was T3 with a mean of 6.00 and the highest response was shown in T4 with a mean of 19.42%.

Table 3. Efficacy of the extracts used on nymphs after the first application.

Treatments	Mean	n	E.E.
T3 Basil extract + natural casing	6.00	4	2.24 A
T1 Neem extract + natural casing	12.92	4	2.24 A B
T2 Garlic extract + natural casing	13.50	4	2.24 A B
T5 Conventional (Phyriplus + oleoplus + natural sheath)	18.50	4	2.24 B
T4 Rue extract + natural casing	19.42	4	2.24 B

Note: Means with a common letter are not significantly different ($p > 0.05$).

In the efficacy of the extracts used, Table 4 shows that with a C.V. of 31.82%, a statistical difference was found, the lowest average is attributed to treatment T3 with a value of 3.00% of adults controlled, followed by T1 with 6.46%, the treatment that obtained the greatest control of adults was T4 with 9.71% of adults controlled in the trial.

Table 4. Efficacy of the extracts used in adults after the first application.

Treatments	Mean	n	E.E.
T3 Basil extract + natural casing	3.00	4	1.12 A
T1 Neem extract + natural casing	6.46	4	1.12 A B
T2 Garlic extract + natural casing	6.75	4	1.12 A B
T5 Conventional (Phyriplus + oleoplus + natural sheath)	9.25	4	1.12 B
T4 Rue extract + natural casing	9.71	4	1.12 B

Note: Means with a common letter are not significantly different (p > 0.05).

Pest monitoring

In the sixth week, the behavior of the pest was evaluated and a C.V. of 17.90% was obtained, finding a significant statistical difference in Table 5. The highest average was that of treatment T3 with 4.18 insects, and the lowest was treatment T2 with an average of 1.85 insects.

Table 5. Monitoring of the pest in the sixth week

Treatments	Mean	n	E.E.
T2 Garlic extract + natural casing	1.85	4	0.50 A
T5 Conventional (Phyriplus + oleoplus + natural casing)	2.25	4	0.50 A B
T4 Rue extract + natural casing	2.43	4	0.50 A B
T1 Neem extract + natural casing	2.43	4	0.50 A B
T3 Basil extract + natural casing	4.18	4	0.50 B

Note: Means with a common letter are not significantly different (p > 0.05).

In the ninth week, the behavior of the pest was evaluated, having as results according to Table 6, a C.V. of 15.32% where no significant statistical difference is evident, the highest average being that of treatment T3 with 2.50 insects and the lowest obtained in treatment T4 with 1.15 insects.

Table 6. Pest monitoring in the ninth week

Treatments	Mean	n	E.E.
T4 Rue extract + natural sheath	1.15	4	0.35 A
T5 Conventional (Phyriplus + oleoplus + natural sheath)	1.23	4	0.35 A
T1 Neem extract + natural casing	1.33	4	0.35 A
T2 Garlic extract + natural casing	1.43	4	0.35 A
T3 Basil extract + natural casing	2.50	4	0.35 A

Note: Means with a common letter are not significantly different (p > 0.05).

Between weeks 12 and 13 the bunches are ready for harvest, where the behavior of the pest was evaluated, with a C.V. of 10.29%, showing a significant statistical difference. The treatment with the highest mean was treatment T3 with 1.45 insects, while the treatment with the lowest mean was treatment T4 with 0.08 insects. These results can be corroborated according to Table 7.

Table 7. Pest monitoring at harvest

Treatments	Mean	n	E.E.
T4 Rue extract + natural sheath	0.08	4	0.20 A
T5 Conventional (Phyriplus + oleoplus + natural sheath)	0.08	4	0.20 A
T1 Neem extract + natural casing	0.15	4	0.20 A
T2 Garlic extract + natural casing	0.23	4	0.20 A
T3 Basil extract + natural casing	1.45	4	0.20 B

Note: Means with a common letter are not significantly different ($p > 0.05$).

Percentage of damage caused by insects

The number of affected fingers at harvest was measured in each of the treatments, obtaining a C.V. of 15.12%, with a significant statistical difference, with the highest average in treatment T3 with 14.11 affected fingers, while the lowest average number of affected fingers was in treatment T4 with 4.94 affected fingers. As can be seen in Table 8.

Table 8. Number of affected fingers per cluster.

Treatments	Mean	n	E.E.
T4 Rue extract + natural sheath	4.94	4	3.07 A
T5 Conventional (Phyriplus + oleoplus + natural sheath)	5.00	4	3.07 A
T2 Garlic extract + natural casing	6.12	4	3.07 A B
T1 Neem extract + natural casing	6.25	4	3.07 A B
T3 Basil extract + natural casing	14.11	4	3.07 B

Note: Means with a common letter are not significantly different ($p > 0.05$).

The severity of damage according to the scale at harvest was evaluated, obtaining as a result a C.V. of 19.21%, with a significant statistical difference, that the treatment with the highest mean was treatment T3 with 17%, while the treatment with the lowest severity of damage was T4 with 6.25%. As can be seen in Table 9.

Table 9. Damage severity according to scale at harvest.

Treatments	Mean	n	E.E.
T4 Rue extract + natural casing	6.25	4	3.97 A
T1 Neem extract + natural casing	6.25	4	3.97 A
T5 Conventional (Phyriplus + oleoplus + natural casing)	6.25	4	3.97 A

T2 Garlic extract + natural casing	8.75	4	3.97 A B
T3 Basil extract + natural casing	17.00	4	3.97 B

Note: Means with a common letter are not significantly different (p > 0.05).

Finally, the bunch weight in kg was analyzed and the difference between treatments was evaluated, where results were obtained with a C.V. of 10.41%, the treatment with the lowest weight being T3 with an average of 50.16 kg. While the highest weight achieved was the T4 treatment with an average of 56.91%. This is based on Table 10.

Table 10. Bunch weight (kg)

Treatments	Mean	n	E.E.
T3 Basil extract + natural casing	50,16	4	1.25 A
T1 Neem extract + natural casing	51,37	4	1.25 A B
T2 Garlic extract + natural casing	52,36	4	1.25 A B
T5 Conventional (Phyriplus + oleoplus + natural sheath)	53,24	4	1.25 A B
T4 Rue extract + natural casing	56,91	4	1.25 B

Note: Means with a common letter are not significantly different (p > 0.05).

After evaluating pest monitoring at harvest, T3 (basil extract + natural sheath) had the highest average with 1.45 insects, while T5 Conventional (Phyriplus + oleoplus + natural sheath) and T4 (rue extract + natural sheath) had the lowest average with 0.08 insects. Rojas (2013) in his study the results obtained in T1 (sheaths with Neem-X) for number of thrips at harvest was 1. This control is probably produced by the insecticidal and nematicidal action of Neem-X, interrupting the different morphological stages of the insect, which can be corroborated with the description made by Ecuaquímica (2010), which mentions that Neem-X has azadirachtin as an active ingredient, which penetrates the body of the insect and prevents it from developing properly, interrupting the life cycle of the thrips; This treatment is also very efficient and economical to be used by producers, reducing the number of thrips in the banana crop to the total.

Conclusions

In the present study, it is evident that the extract of rue plus natural cover in relation to the other treatments evaluated, is the one that showed the best results for the control of thrips in the banana crop, being the one that presented the greatest effectiveness in the variables studied. The use of natural extracts for the control and management of pests promotes agroecological practices for organic crops that seek to

maintain the quality of the product, in order to maintain its competitiveness in the most demanding markets.

The use of rue marks a milestone in extracts as organic insecticides, from the ecological and social point of view shows great benefits, contributing to the health of workers who have to handle chemicals for pest and disease control on a daily basis. It positively favors environmental care, since the contamination generated by the residues of conventional treatments is extremely reduced with these new alternatives.

It is recommended to replicate this type of trials in different agro-climatic conditions and in banana producing regions worldwide, in order to determine the feasibility of using organic products for the management of pests and diseases in the most important crop in the world.

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Conflict of Interest

The authors declare that there is no conflict of interest.

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