Conciencia Digital

ISSN: 2600-5859
Vol. 7 No. 3.1, pp. 171 – 184, August 2024

www.concienciadigital.org

Evaluación de trampas con insecticidas para controlar picudo negro (*Cosmopolites sordidus*) y rayado (*Metamasius hemipterus*)

Evaluation of insecticide traps to control black palm weevil (Cosmopolites sordidus) and striped palm weevil (Metamasius hemipterus)

[1] Lidia Marisol Jami Caluña https://orcid.org/0009-0007-2098-3373
Master's Degree in Plant Health, Technical University of Cotopaxi, Latacunga, Ecuador.
lidia.jami2278@ut.edu.ec

[2] Kleber Augusto Espinosa Cunuhay https://orcid.org/0000-0002-5151-6301
Master's Degree in Plant Health, Technical University of Cotopaxi, Latacunga, Ecuador.
kleber.espinosa@utc.edu.ec

[3] Diego Fernando Saltos Enriquez https://orcid.org/0009-0007-8380-3712
Freelance Professional
diego.saltos6813@utc.edu.ec

[4] Olga Nohely Vera Ayala https://orcid.org/0009-0001-5157-5010
Freelance Professional
olga.vera9489@utc.edu.ec

Scientific and Technological Research Article
Sent: 06/13/2024
Revised: 10/07/2024
Accepted: 08/19/2024
Published: 08/28/2024
DOI:**https://doi.org/10.33262/concienciadigital.v7i3.1.3156**

Please quote:

Jami Caluña, LM, Espinosa Cunuhay, KA, Saltos Enríquez, DF, & Vera Ayala, ON (2024). Evaluation of insecticide traps to control the black weevil (Cosmopolites sordidus) and the striped weevil (Metamasius hemipterus). ConcienciaDigital, 7(3.1), 171-184.https://doi.org/10.33262/concienciadigital.v7i3.1.3156

DIGITAL CONSCIOUSNESS,*and*It is a multidisciplinary, quarterly journal, which will be published electronically. Its mission is to contribute to the training of competent professionals with a humanistic and critical vision who are capable of presenting their research and scientific results to the same extent that their intervention promotes positive changes in society.https://concienciadigital.org
The journal is published by Editorial Ciencia Digital (a prestigious publisher registered with the Ecuadorian Book Chamber with membership number 663).www.celibro.org.ec

Conciencia Digital

ISSN: 2600-5859
Vol. 7 No. 3.1, pp. 171 – 184, August 2024

www.concienciadigital.org

Palabras claves:
trampas, control, insecticidas, banano, picudo, plaga.

Resumen

Introducción: en Ecuador, la producción de banano se destaca en la región costera, específicamente en las provincias de Los Ríos, Guayas y El Oro. Este estudio se realizó con el propósito de evaluar trampas para el control de dos plagas importantes en el cultivo de banano ***(Musa paradisiaca)***: el picudo negro ***(Cosmopolites sordidus)*** y picudo rayado ***(Metamasius hemipterus)***. Estas plagas suelen ser controladas con insecticidas que son altamente perjudiciales tanto para la salud humana como para el medio ambiente. **Objetivo:** identificar la trampa más eficaz y el insecticida más efectivo para el control de estas plagas. **Metodología:** se empleó un diseño factorial 2x2+2 que incluyó 6 tratamientos con 4 repeticiones. Los factores evaluados fueron las trampas (factor a) y los insecticidas (factor b). Se analizó la eficacia de los insecticidas benfuracarb y permetrina, aplicados en dosis de 20 cc por trampa, tanto de tipo sándwich como dulzaina. Se evaluó el número total de insectos por trampa, así como la cantidad de insectos vivos y muertos a los 2, 4 y 6 días posteriores a la aplicación, durante 8 semanas. **Resultados**: indicaron que la trampa tipo sándwich fue efectiva para el control de picudos, capturando un total de 2.491 individuos. El benfuracarb resultó ser el insecticida más eficiente, con 2.462 individuos capturados y una tasa de mortalidad del 70.13%. **Conclusión:** la trampa tipo sándwich demostró una alta efectividad, mientras que el benfuracarb se destacó como el insecticida más eficiente para el control de picudos en el cultivo de banano en Ecuador. **Área de estudio general:** Agricultura, silvicultura y pesca. **Área de estudio específica:** Agricultura. **Tipo de estudio:** Artículo original.

Keywords:
traps, control, insecticides, banana, weevil, pest.

Abstract

Introduction: In Ecuador, banana production stands out in the coastal region, specifically in the provinces of Los Ríos, Guayas and El Oro. This study was conducted with the purpose of evaluating traps for the control of two important pests in the cultivation of bananas . banana (Musa paradisiaca): the black weevil (Cosmopolites sordidus) and the striped weevil (Metamasius hemipterus). These pests are usually controlled with insecticides that are highly harmful to both human health and the

Conciencia Digital
ISSN: 2600-5859
Vol. 7 No. 3.1, pp. 171 – 184, August 2024
www.concienciadigital.org

environment. Objective: Identify the most effective trap and the most effective insecticide to control these pests. Methodology: A 2x2+2 factorial design was used that included 6 treatments with 4 repetitions. The factors evaluated were traps (factor a) and insecticides (factor b). The effectiveness of the insecticides benfuracarb and permethrin was analyzed, applied in doses of 20 cc per trap, both sandwich and candy types. The total number of insects per trap was evaluated, as well as the number of live and dead insects 2, 4 and 6 days after application, for 8 weeks. Results They indicated that the sandwich trap was effective for the control of weevils, capturing a total of 2,491 individuals. Benfuracarb turned out to be the most efficient insecticide, with 2,462 individuals captured and a mortality rate of 70.13%. Conclusion The sandwich trap demonstrated high effectiveness, while benfuracarb stood out as the most efficient insecticide for the control of weevils in banana cultivation in Ecuador.

Introduction

The banana industry plays an essential role in economic development by contributing 2% of the total Gross Domestic Product (GDP) and 35% of the agricultural GDP, generating employment and economic benefits for more than 2.5 million people, representing approximately 6% of the country's population (Erazo et al., 2021; Quezada et al., 2021; Palacios et al., 2019). In Ecuador, banana production stands out in the coastal region, specifically in the provinces of Los Ríos, Guayas and El Oro.

According to the Public Agricultural Information System (SIPA, 2022), the cultivated area of this fruit in the country amounts to 167,893 hectares, with Los Ríos being the province with the largest extension of plantations, covering 56,936 hectares, which represents 34% of the national total. This group includes the striped weevil (Metamasius hemipterus L.) and the black weevil (Cosmopolites sordidus Germar), the latter being the most relevant, while the striped weevil is considered a pest of lesser importance (Rojas et al., 2019).

The musaceae weevil causes significant damage during its larval phase by creating galleries in the corm or rhizome of the plant, which disrupts the flow of water and nutrients, weakening it. Severe attacks can damage the root system, increasing the risk of the plant toppling. In addition, the insect can reduce the size and weight of the fruit, as well as the shelf life (Suarez et al., 2021; Tresson et al., 2021; Bortoluzzi et al., 2013). The wounds caused by the weevil allow the invasion of phytopathogenic

microorganisms.

In addition, the adult can act as a vector of important diseases such as Fusarium oxysporum, Banana Bunchy Top Virus (BBTV, BBTD) and other pathogens (Magdama et al., 2020). The weevil has caused severe damage to banana crops, resulting in significant losses for farmers, estimated at 42% (Gold et al., 2005). The objective of this study was to reduce weevil attacks on banana crops, increase farmers' income and decrease dependence on chemical inputs. The use of attractive traps with insecticides was proposed to control this pest and thus contribute to improving the productivity of banana crops in the country.

Methodology

This research was carried out at the Katty 2 Farm in the San Francisco de Chipe area, belonging to the La Maná canton, Cotopaxi province with coordinates Latitude 0º 56' 42" S and Longitude 79º 17' 34" W at an altitude of 143 masl. This research work will last 2 months. Where it has adequate agrometeorological characteristics for cultivation such as an average temperature of 30.1ºC, an average annual rainfall of 2843 mm, atmospheric pressure of 1015 hPa, altitude of 143 masl, heliophany of 11.90 hours/light/year, relative humidity of 65%, with a regular topography and a texture of a silty loam soil (Flores & Lalangui, 2022).

For this project, a 2x2+2 factorial design was used (Table 1), with six treatments and four repetitions where two plants were used for each treatment giving a total of 48 plants.

Table 1

Analysis of variance scheme

Source of variation	Degrees of freedom
r-1 repetitions	3
T-1 treatments	5
Factor A (Cheating) a-1	1
Factor B (Insecticides) b-1	1
A*B interaction (a-1) (b-1)	1
Witness 2	2
Error (r-1) (t-1)	15
Total (r*t-1)	23

Elaborated: Saltos & Vera (2022)

The variables evaluated were subjected to analysis of variance and to determine the

statistical differences between the means of each treatment, the Tukey multiple range test was used for probability (P≤0.05).

This study was carried out with 24 monitoring traps, in which the presence of weevils in the plantation was detected and the treatments were distributed. The traps, made of pseudostems of recently harvested plants, include the sandwich type, with two sections of pseudostems of 15 cm each, and the dulzaina type, with a 50 cm section with slanted cuts.

The traps are made from the pseudostem of the freshly harvested plant. The sandwich trap consists of two sections of pseudostems of about 15 cm placed one on top of the other, with a length of 30 to 50 cm. The dulzaina trap consists of a 50 cm section of pseudostem which has one or two slanted cuts.

The insecticide was applied according to the established treatments, using a dose of 20 cc by manual spraying on the cuts made in the pseudostems. The traps were covered with leaves to protect them from sunlight and water, and were placed every 10 meters, with treatments separated by 20 meters. The following variables were evaluated, such as the number of live and dead insects, carried out every two days. After a week, the traps were moved to another sector of the plantation.

The treatments were distributed in 4 sectors, repeating the trapping every two weeks in different sectors. The doses of 20 cc of insecticide were applied in six treatments: T1 and T2 with Benfuracarb in a dulzaina-type trap and a sandwich-type trap, respectively; T3 and T4 with Permethrin in dulzaina and sandwich traps; T5 and T6 with dulzaina and sandwich traps without insecticide, respectively.

Results

Two species of the Coleoptera group, belonging to the Dryophthoridae family, were identified: Metamasius hemipterus and Cosmopolites sordidus. These findings are relevant for pest management in agricultural production, since accurate species identification allows for the implementation of appropriate control measures.

Conciencia Digital
ISSN: 2600-5859
Vol. 7 No. 3.1, pp. 171 – 184, August 2024
www.concienciadigital.org

Table 2

Characterization of black weevil (Cosmopolites sordidus) and striped weevil (Metamasius hemipterus)

Sample 1 data								Entomology laboratory results					
No.	Host	Affected organ	Phenological state	GPS coordinates x	and	Altitude	Canton	Field code	Laboratory code	Order	Family	Scientific name	No. Ind.	Method
1	Banana	Stems	Production	0°56´ 42¨	74°17´ 34¨	143 mas	The Manna	VF-001-The Mana	E09-24-1583	Coleoptera	Dryophthoridae	Metamasius hemipterus	2	PEE/ E/ 05
1	Banana	Stems	Production	0°56´ 42¨	74°17´ 34¨	143 mas	The Manna	VF-001-The Mana	E09-24-1583	Coleoptera	Dryophthoridae	Cosmopolites sordidus	1	PEE/ E/ 05
2	Banana	Stems	Production	0°56´ 42¨	74°17´ 34¨	143 mas	The Manna	VF-001-The Mana	E09-24-1583	Coleoptera	Dryophthoridae	Cosmopolites sordidus	8	PEE/ E/ 05

Elaborated: Jami and Espinosa
Fountain: Entomology LaboratoryAgrocality (2024)
Analyzed by: Eng. Marjorie Plúas.
Observations: The results are applied to the sample as received.
Reviewed by: Miguel Ramirez

Discussion

Number of insects per trap

No statistically significant differences ($p>0.05$) were observed between treatments in terms of the number of weevils. The most effective treatment was the sandwich without insecticide, with an average of 24.63 weevils captured per treatment, followed by the dulzaina treatment without insecticide with 19.63 weevils captured per treatment. Other notable treatments included dulzaina+20 cc of permethrin (18.13 weevils) and sandwich+20 cc of benfuracarb with an average (14.75 weevils).

Regarding the striped weevils, the treatment Sandwich+20 cc of benfuracarb obtained the best results, with an average of 154.63 striped weevils per treatment, followed by dulzaina+20 cc of benfuracarb (126 striped weevils). In general, the insecticide treatments showed greater efficacy, while sandwich+20 cc of Permethrin was the least effective for both types of weevils.

Conciencia Digital
ISSN: 2600-5859
Vol. 7 No. 3.1, pp. 171 – 184, August 2024
www.concienciadigital.org

Table 3

Number of black weevils (Cosmopolites sordidus) and striped weevils (Metamasius hemipterus) per trap

Treatments	Black Weevil (Cosmopolites sordidus	Striped Weevil (Hemipterus metamasius)
	Captured	Captured
Sandwich without insecticide	24.63 a	75.38 a
Dulzaina without insecticide	19.63 a	65.13 a
Dulzaina + 20 cc of Permethrin	18.13 a	55.88 a
Sandwich + 20 cc of Benfuracarb	14.75 a	154.63 a
Dulzaina + 20 cc of Benfuracarb	12.38 a	126.00 a
Sandwich+20 cc of Permethrin	11.00 a	31.00 a
Cv%	57.18 a	29.93%

Note: means with a common letter are not significantly different (p> 0.05)
Elaborated: Jami and Espinosa

According to Guzmán et al. (2019), the most effective trap for capturing the black weevil was the stump type with an average of 24 insects captured. For the striped weevil, sandwich type traps were the most efficient, capturing 35 and 34 insects respectively..These results are consistent with the fact that the sandwich + 20 cc Benfuracarb treatment captured a greater number of striped weevils compared to sandwich + no insecticide, which showed the lowest capture of black weevils.

Furthermore, Lazo-Roguer et al. (2017) point out that fruit essences in sandwich traps deteriorate rapidly, resulting in less attraction of weevils. De Graaf et al. (2005) indicate that captures with pheromones turned out to be more effective than those made with pseudostems. In the research by Román et al. (2017), he mentions that the longitudinal pseudostem trap was the most effective, presenting a significantly higher capture compared to the others. This trap recorded an average of 423.3 captured specimens.

Number of live insects

Not foundThere were statistically significant differences (p>0.05) between treatments for capturing black weevils. The most effective treatment was the Sandwich without insecticide, with an average of 23.00 black weevils captured alive, followed by dulzaina without insecticide with an average of 15.25 black weevils. The treatments with insecticides showed inferior results compared to the Sandwich treatment without insecticide, which obtained a better result, with an average of 60.38 striped weevils

ISSN: 2600-5859
Vol. 7 No. 3.1, pp. 171 – 184, August 2024

captured alive, followed by dulzaina without insecticide with 52.00 striped weevils. The treatments with insecticide demonstrated a lower effectiveness in capturing live insects.

Table 4

Number of live black weevils (Cosmopolites sordidus) and striped weevils (Hemipterus metamasius) per treatment

Treatments	Black Weevil (Cosmopolites sordidus)	Striped Weevil (Hemipterus metamasius)
	Captured	Captured
Sandwich without insecticide	23.00 a	60.38 a
Dulzaina without insecticide	15.25 a	52.00 a
Dulzaina + 20 cc of Permethrin	0.50 to	5.38 a
Sandwich + 20 cc of Benfuracarb	0.37 a	10.13 a
Dulzaina + 20 cc of Benfuracarb	0.50 to	8.13 a
Sandwich+20 cc of Permethrin	0.12 to	6.00 a
Cv%	115.32%	52.44%

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

Barraza & Chavarría (2020), the V-type pseudostem trap has proven to be effective in capturing adult C. sordidus insects. This technique represents a promising alternative for the management and control of C. sordidus in banana crops, forming an essential part of a comprehensive integrated pest management strategy. The authors Farah et al. (2022), report that the V-type traps at 25 cm obtained the highest capture followed by the sandwich type at 25 cm height.Abagale et al. (2018) mention that the release of semiochemicals from fresh plant material is more attractive to the black weevil. On the other hand, the control treatments recorded the highest capture of live weevils of both species.

Number of dead insects

There were no significant statistical differences (p>0.05) between treatments for the number of black weevils captured. The Dulzaina+20 cc of Permethrin treatment obtained the best results, with an average of 16.63 dead black weevils, followed by Sandwich+20 cc of Benfuracarb with an average of 14.38 dead black weevils.

Conciencia Digital
ISSN: 2600-5859
Vol. 7 No. 3.1, pp. 171 – 184, August 2024
www.concienciadigital.org

The treatments without insecticide (Sandwich and Dulzaina) had lower results. Unlike the treatment, Sandwich + 20 cc of Benfuracarb was the most effective, with an average of 144.50 individuals, followed by Dulzaina + 20 cc of Benfuracarb and an average of 117.58 individuals in captured dead weevils. On the other hand, the treatments with Permethrin showed low results compared to the results mentioned.

Table 5

Number of black weevils (Cosmopolites sordidus) and striped weevils (Metamasiuhemipterus) killed by trap

Treatments	Black Weevil (Cosmopolites sordidus)	Striped Weevil (Hemipterus metamasius)
	Captured	Captured
Sandwich without insecticide	1.63 a	15.00 a
Dulzaina without insecticide	4.63 a	13.13 a
Dulzaina + 20 cc of Permethrin	16.63 a	50.50 a
Sandwich + 20 cc of Benfuracarb	14.38 a	144.50 a
Dulzaina + 20 cc of Benfuracarb	11.88 a	117.58 a
Sandwich+20 cc of Permethrin	10.88 a	25.00 a
Cv%	56.14%	31.72%

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

Elaborated: Jami and Espinosa

As indicated by González et al. (2022), the combination of Metarhizium anisopliae and Beauveria bassiana demonstrated greater effectiveness in reducing the population of Cosmopolites sordidus in Musa AAB plants. However, chemical control resulted in a higher number of dead individuals, while the untreated control group recorded a lower number. Castillo & Montenegro (2022), indicated that Cosmopolites sordidus was the only weevil species collected. Among the four treatments evaluated, the sandwich trap (TS) resulted in the highest average capture, with 3 individuals, while the disk trap (TD) was the least effective, with an average of 0.33 individuals, and tended to dehydrate.

Thornberryet al. (2019), mention that the most effective trapping treatments were T1 (stump plus Bauveria bassiana) and T3 (Stump plus Picudín), since they stood out for their greater capture of weevils, which indicates that the Bauveria bassiana attractant demonstrated its entomopathogenic capacity together with the Stump trap, allowing a greater number of captures. On the other hand, the treatment with Picudin, an organic product with Neem, showed its insecticidal potential by capturing a high number of weevils. The studies Rauda-Cardenas et al. (2024), indicate that the highest captures of

Cosmopolites sordidus were achieved based on the artisanal trap of pots plus pheromones.

Mortality rate

In the aforementioned results, they showed a total of 4868 insects captured between Cosmopolites sordidus and Metamasius hemipterus, in which 1454 individuals were captured alive and 3414 individuals were captured dead in both species. The mortality percentage is 70.13%, while the percentage of live insects is 29.87%. Vargas (2020) mentions that treatment 3 (Bauveria sp. Dermaptera earwig isolation) caused a 90% mortality of the population in less than five days, followed by treatment 5 (Bauveria sp. San Antonio isolation. Hypothenemus hampei isolated in coffee crops).According to Muñoz et al. (2017), it is agreed that the fungus Bauveria bassiana causes more than 90% of black weevil mortality.

Conclusions

- Among the traps used, the one that proved most effective in controlling the black weevil (Cosmopolites sordidus) and the striped weevil (Metamasius hemipterus) was the sandwich trap, with a total of 2,491 individuals captured and killed. On the other hand, the most effective insecticide for controlling these pests was the one containing the active ingredient benfuracarb, managing to capture and eliminate 2,462 individuals.

- The characterization of the black weevil (Cosmopolites sordidus) and the striped weevil (Metamasius hemipterus) is essential, since it allows us to determine their scientific name, order, family to which they belong, as well as establish effective management and control strategies.

Conflict of interest

The authors declare that there is no conflict of interest in relation to the submitted article.

Bibliographic References

Abagale, S., Woodcok, C., Chamberlain, K., Osofato-Acquaah, S., Van Emden, H., Birkett, M., Pickett, J., & Braimah, H. (2018). Attractiveness of host banana leaf materials to the banana weevil, Cosmopolites sordidus in Ghana for development of field management strategies. Pest Management Science, 75(2), 549-555.https://doi.org/10.1002/ps.5182

Agrocalidad Entomology Laboratory. (2024). Diagnostic report (Report No.: LR-GUAYAS-E-I24-0787). Guayaquil, Ecuador.

Barraza, E., & Chavarría, S. (2020). Evaluation of the efficiency of different types of pseudostem traps for capturing the black banana weevil (Cosmopolites sordidus, Germar, 1824) in Darien province, Republic of Panama. Scientia, 30, 53-59.https://www.redalyc.org/journal/6517/651769121004/html/

Bortoluzzi, L., Alves, L., Alves, V., & Holz, N. (2013). Entomopathogenic nematodes and their interaction with chemical insecticide aiming at the control of banana weevil borer, Cosmopolites Sordidus Germar (Coleoptera: Curculionidae). Arquivos do Instituto Biológico, 80(2), 183-192.https://www.scielo.br/j/aib/a/MC9P6tLHjgRw7K4cVjj9yGx/#

Castillo, H., & Montenegro, G. (2022). Evaluation of four types of traps for monitoring and control of Cosmopolites sordidus and Metamasius hemipterus (Coleoptera: Curculionidae) in banana crops in Bocas del Toro, Panama. Semilla del Este Journal, 3(1), 161-170.https://revistas.up.ac.pa/index.php/semilla_este/article/view/3211/2821

De Graaf, J., Govender, P., Schoeman, A., & Viljoen, A. (2005). Efficacy of pseudostem and pheromone seasonal trapping of the banana weevil Cosmopolites sordidus in South Africa. International Journal of Pest Management, 51(3), 209-218.https://doi.org/10.1080/09670870500228529

Erazo Berrú, M.A., Prado Carpio, E., Cervantes Álava, A., & Vite Cevallos, H. (2021). Analysis of the regulation of the price of a box of bananas in Ecuador during the period 2015-2020. Metropolitan Journal of Applied Sciences, 4 (Supplement 1), 210-217.https://doi.org/10.62452/brtj3939

Espinosa, Y., Quevedo, J., & Garcia, R. (2019). Determination of the efficiency of different traps for the control of black weevil (Comopolites sordidus G) in organic banana. Scientific JournalAgroecosystems, 7(1), 171-180. https://www.researchgate.net/publication/343523196_Determination_of_the_efficiency_of_difeferent_traps_for_the_controlof_black_weevil_Comopolites_sordidus_G_in_organic_banana

Farah, S., Bajaña, G., Amador, C., Hasang, E., & Alvarado, A. (2022). Effectiveness of ethological traps for the control of Cosmopolites sordidus in banana (Musa ssp) at Hacienda Mechita in Puebloviejo Canton in Ecuador. Revista Tecnológica - ESPOL, 34(4), 69-79.https://doi.org/10.37815/rte.v34n4.976

Flores, F., & Lalangui, Y. (2022). Evaluation of the vegetative development of banana (Musa spp.) var. williams seedlings with propagation from adventitious buds using two substrates and two growth bioreulators. Retrieved from

http://repositorio.utc.edu.ec/bitstream/27000/8565/1/UTC-PIM-%20000456.pd

Palacios, CM, Regalado, JOG, & Plaza, JAM (2019). Threats of leaf spots of Sigatoka (Mycosphaerella spp.) in sustainable Ecuadorian banana production. Revista Verde de Agroecologia e Desenvolvimento Sustentável, 14(5), 591–596.https://doi.org/10.18378/rvads.v14i5.6623

Gold, C., Ragama, P., Coe, R., & Rukazambuga, N. (2005). Selection of assessment methods for evaluating banana weevil Cosmopolites sordidus (Coleoptera: Curculionidae) damage on highland cooking banana (Musa spp., genome group AAA-EA). Bulletin of Entomological Research, 95(2), 115-23. doi:10.1079/BER2004341

González, R., Vivas, J., Tacuri, E., & Mendoza, J. (2022). Biocontrol of Cosmopolites sordidus (Germar) in Musa AAB del Carmen plantations, Manabí, Ecuador. Reciamuc, 6(4), 129-135. doi:10.26820/reciamuc/6. (4). October.2022.129-135

Guzmán, C., Quevedo, J., & García, R. (2019). Alternatives for the control of black weevil (cosmopolites sordidus g.) in conventional banana cultivation. Scientific Journal of Agroecosystems, 7(2), 103-110.https://aes.ucf.edu.cu/index.php/aes/article/view/298/324

Lazo-Roguer, Y., Nivela-Morante, P., Rojas-Rojas, J., Taipe-Taipe, M., Piloso-Chávez, K., Pedraza-González, X., Aragundi-Velarde, JG, Chávez- Solorzano, M. (2017). Evaluation of traps to capture black weevil (Cosmopolites sordidus Germar) in banana crops. El Misionero del Agro Magazine, 4(15), 3-9.https://www.uagraria.edu.ec/publicaciones/revistas_cientificas/15/055-2017.pdf

Magdama, F., Monserrate, L., Serrano, L., García, J., & Jímenez, M. (2020). Genetic Diversity of Fusarium oxysporum f. sp. cubense, the Fusarium Wilt Pathogen of Banana, in Ecuador. Plants, 9(9), 1133.https://doi.org/10.3390/plants9091133

Muñoz, LM, Cañas, GL, Urrea, AI, & Guarín, JH (2017). Effect of production for weevil control (Insecta: Coleoptera: Curculionidae), on the growth, development and production of banana. Biological News, 35(98), 21–31.https://doi.org/10.17533/udea.acbi.329205

Quezada Veliz, RX, Carvajal Romero, H., & Barrezueta Unda, S. (2021). Economic impact of banana production in Ecuador in the period 2008-2016. Metropolitan Journal of Applied Sciences, 4(2), 148-157.https://doi.org/10.62452/n8zndt33

Rauda-Cárdenas, G., Hernández-Ortega, HA, Sánchez-Rangel, JC, & Castrejón-Antonio, JE (2024). Pseudostems and pheromones in captures of Cosmopolites

ISSN: 2600-5859
Vol. 7 No. 3.1, pp. 171 – 184, August 2024

sordidus (Coleoptera: Curculionidae) in banana orchards in the municipality of Tecomán, Colima, Mexico. Advances in Agricultural Research, 28(1), 55–60.https://doi.org/10.53897/RevAIA.24.28.05

Rojas, JA, Maldonado Vargas, CE, Meza Zambrano, OS, Lazo Roger, Y., & Palacios Peñafiel, JC (2019). Use of traps with attractants for monitoring Cosmopolites sordidus and Metamasius spp. in barraganete plantain. Agricultural Center, 46(2), 58-63.http://scielo.sld.cu/scielo.php?script=sci_arttext&pid=S0253-57852019000200058&lng=es&tlng=es.

Román Posligua, VA, Rojas, JA, & Ostaiza Mendoza, KJ (2017). Evaluation of four types of traps for monitoring Metamasius hemipterus L. (Coleoptera: Curculionidae) in plantain. Agricultural Center, 44(3), 91-93.http://scielo.sld.cu/scielo.php?script=sci_arttext&pid=S0253-57852017000300013&lng=es&tlng=es.

Agricultural Public Information System [SIPA]. (2022). Territorial productive information.http://sipa.agricultura.gob.ec/index.php/cifras-agroproductivas

Suarez Quintero, L.J., Suarez Quintero, J.E., & Monzón Ruiz, V. (2021). Management of the banana weevil (Cosmopolites sordidus Germar) Coleoptera: Curculionidae) with Beauveria bassiana Bals and Vuils, Tonalá-Chinandega, Nicaragua. La Calera, 21(36), 30-35.https://doi.org/10.5377/calera.v21i36.11666

Tresson, P., Tixier, P., Puech, W., & Carval, D. (2021). The challenge of biological control of Cosmopolites sordidus Germar (Col. Curculionidae): A review. Journal of Applied Entomology, 145(3), 171-181.https://doi.org/10.1111/jen.12868

Vargas Chacón, C. (2020). Parasitic capacity of Beauveria bassiana on the palmetto weevil (Metamasius hemipterus). (Coleoptera: Dryophthoridae). Technological Scope, 13(1), 13 - 19.https://doi.org/10.35486/at.v13i1.166

Conciencia Digital

ISSN: 2600-5859
Vol. 7 No. 3.1, pp. 171 – 184, August 2024

www.concienciadigital.org