Toxicity of Different Insecticides against Franklinellia invasor (Thysanoptera: Thripidae), a Mango Pest in Central America

Authors: Tita Walter, Ndonkeu, Josué Ortiz Rojas, Royner, Strzyzewski, Iris, Funderburk, Joe, and Martini, Xavier

Source: Florida Entomologist, 103(2) : 296-298

Published By: Florida Entomological Society

URL: https://doi.org/10.1653/024.103.0223

Toxicity of different insecticides against *Franklinellia invasor* (Thysanoptera: Thripidae), a mango pest in Central America

Ndonkeu Tita Walter[1], *Royner Josué Ortiz Rojas*[1], *Iris Strzyzewski*[2], *Joe Funderburk*[2], *and Xavier Martini*[2,*]

Mango (*Mangifera indica* L.; Anacardiaceae) is one of the most widely grown and exported tropical fruits in Costa Rica, with about 53,288 metric tons produced annually (http://www.fao.org/faostat/en/#data/QC). One of the major constraints affecting mango production in Central America is the constant presence of thrips on mango blossoms and young leaves. The dominant species present on blossoms is *Frankliniella invasor* Sakimura whereas young leaves are mostly affected by *Scirtothrips citri* (Moulton) (both Thysanoptera: Thripidae) (Mound & Hoddle 2016). It has been reported that a single mango inflorescence may contain more than 600 adults plus the immature stages of *F. invasor* (Rocha et al. 2012), and may lead to significant yield reduction, as observed by Gehrke (2008). *Frankliniella invasor* is native to the Caribbean–Central American region and was reported for the first time feeding on mango in Hawaii (Sakimura 1972).

Regular use of insecticides, especially the organophosphate malathion to control pestiferous thrips populations on flower inflorescences has not yielded much success for farmers. In fact, malathion has been proven to be an insecticide with low efficacy for some thrips species in Central America (Walter et al. 2018), even though it is known as an efficient compound against the western flower thrips, *Frankliniella occidentalis* Pergande (Thysanoptera: Thripidae) (Helyer & Brobyn 1992). We report here on laboratory toxicity studies of chlorfenapyr, spinetoram, chlorpyrifos, and thiamethoxam against *F. invasor* populations on mango in Costa Rica. This assay was conducted as a first step towards the development of an integrated pest management program for thrips management in mango in Costa Rica and Central America.

Samples of mango inflorescences infested with thrips were collected from the field during late Jan and early Feb of 2017 (10.6376190°N, 85.5213268°W; 25 masl). Samples were placed in a labeled plastic bag and transported to the laboratory. Ten adult *F. invasor* were aspirated into glass tubes (6 mm diam) from the samples and emptied into individual 35 mL plastic diet cups (Fill-Rite Corporation, Newark, New Jersey, USA) with uncoated paper tops.

Insecticides were purchased from local agrochemical stores for bioassays (Table 1). Eight concentrations of each insecticide were prepared using distilled water at 0, 128, 0, 64, 32, 16, 80, 400, 2,000, and 10,000 ppm. Fresh snap bean pods (*Phaseolus vulgaris* L.; Fabaceae) were rinsed with 1% bleach then flushed thoroughly with tap water and allowed to air dry on paper towels. Beans were cut into 20-mm long sections and the excised pods were sealed at either end with a thin layer of paraffin (Fisherfinest™ Histoplast Paraffin Wax, Fisher Scientific, Waltham, Massachusetts, USA). After bean pods were sealed, they were immersed in the different insecticide concentrations for 5 min in 50 mL glass containers then air-dried on paper towels for about 15 min. For the control, bean pods were immersed only in distilled water. Pods previously treated with an insecticide were placed individually inside 35 mL transparent plastic cups (3 cm diam) with uncoated paper tops. Ten adults of *F. invasor* were placed inside each cup. Each treatment consisted of 10 replicates plus a control. Individual cups were placed into a sealed plastic rearing container (5.7 L) with the bottom lined with a paper towel to reduce condensation. Containers were kept in a controlled-environment chamber maintained at 26 ± 2 °C,

Table 1. Insecticides used in laboratory bioassays to determine the LC_{50} and LC_{95} estimates of *Franklinellia invasor* toxicity of treated bean pods (*Phaseolus vulgaris* L.) after 24 h exposure previously collected from mango.

Brand name	Active ingredient	Insecticide class	Supplier
Sassex®	Chlorpyrifos 48 EC	1B	Agrotico
Agromart malathion®	Malathion 60 EC	1B	Colono Agropecuario
Arrivo®	α-Cypermethrin 25 EC	3A	Colono Agropecuario
Muralla Delta®	Imidacloprid 19 OD	4A	Agrotico
Actara®	Thiamethoxam 25 WG	4A	Cafesa
Winner®	Spinetoram 6 SC	5	Colono Agropecuario
Spintor®	Spinosad 12 CS	5	Centro Agrícola Guácimo
Sunfire®	Chlorfenapyr 24 SC	13	Agrotico

[1]Earth University, San José, Costa Rica; E-mail: nwalter@earth.ac.cr (N. T. W.), rjortiz@earth.ac.cr (R. J. O. R.)
[2]University of Florida, Department of Entomology and Nematology, North Florida Research and Education Center, Quincy, Florida, USA; istrz228@ufl.edu (I. S.), jef@ufl.edu (J. F.), xmartini@ufl.edu (X. M.)
*Corresponding author; E-mail: xmartini@ufl.edu

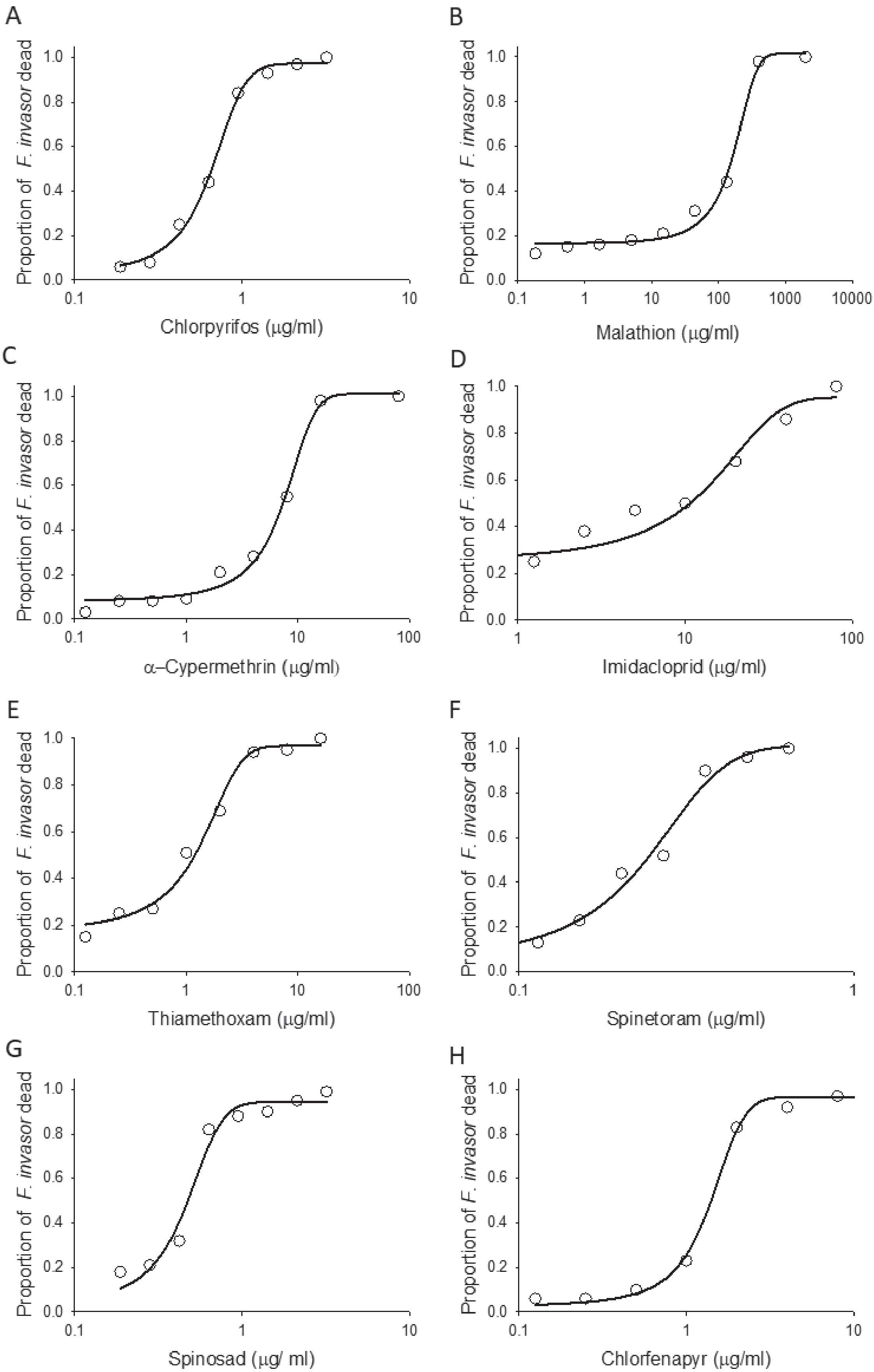

Fig. 1. Logistic mortality curves for the thrips *Franklinellia invasor* for 8 selected insecticides with the dip method. (A) Chlorpyrifos, (B) malathion, (C) α-cypermethrin, (D) imidacloprid, (E) thiamethoxam, (F) spinetoram, (G) spinosad, (H) chlorfenapyr.

Table 2. The LC_{50} and LC_{95} estimates for 8 selected insecticides after 24 h exposure to control *Franklinellia invasor* previously collected from mango. CI = confidence interval.

Insecticide	*n*	χ^2 (df)	Slope ± SE	LC_{50} µg per mL (95% CI)	LC_{95} µg/mL (95% CI)
Chlorpyrifos	80	12.23 (6)	3.790 ± 0.315	0.609 (0533 – 0.696)	1.651 (1.345 – 2.205)
Malathion	80	77.25 (6)*	0.625 ± 0.0.178	68.755 (13.450 – 6.7 × 10^3)	2.9 x 10^4 (1.0 x 10^3 – 1.5 × 10^{12})
α-Cypermethrin	80	59.67 (6)*	1.498 ± 0.316	5.047 (2.591 – 15.423)	63.244 (18.96 – 2.1 × 10^3)
Imidacloprid	80	15.831 (6)	1.250 ± 0.134	5.428 (3.660 – 7.921)	112.91 (56.323 – 350.668)
Thiamethoxam	80	17.434 (6)*	1.720 ± 0.175	0.846 (0.606 – 1.161)	7.645 (4.631 – 26.596)
Spinetoram	80	28.788 (6)*	4.182 ± 0.532	0.211 (0.177 – 0.250)	0.522 (0.403 – 0.819)
Spinosad	80	28.799 (6)*	2.879 ± 0.389	0.454 (0.341 – 0.578)	1.690 (1.185 – 3.188)
Chlorfenapyr	80	58.87 (6)*	2.403 ± 0.430	1.22 (0.730 – 2.078)	5.903 (3.126 – 23.944)

*Distribution of the data differed significantly from the probit model (Pearson χ^2 test; α = 0.05).

60% RH, and a photoperiod of 16:8 h (L:D). Thrips mortality was evaluated after 24 h and were considered dead when they were unable to move after being probed for a couple of s.

Following this first trial, a second toxicology assay was conducted where concentration ranges were chosen to have at least 5 data points between 20 to 80% mortality in order to create a reliable concentration response curve (Yu 2015). Concentration ranges of the second assay varied between 0.05 and 0.64 µg per mL for spinetoram and between 0.18 to 400 µg per mL for malathion.

The LC_{50} and LC_{95} estimates with associated 95% confidence intervals were determined for data from the second toxicological assay using the probit model (Finney 1971). Concentration-mortality data were then modeled using the LOGISTIC option in PROC PROBIT (SAS Institute 2011) to determine the intercept and slope. The *P*-values for the goodness-of-fit tests (Pearson chi-square) were used to indicate an adequate fit of the log concentration-response regression line. Treatment mortality was automatically corrected for that in controls by the PROBIT software. Logistic mortality curves for each insecticide were generated with SigmaPlot version 14 (SYSTAT, San Jose, California, USA).

Our results indicated that spinosad, spinetoram, chlorpyrifos, α-cypermethrin, and chlorfenapyr were highly effective, while malathion and imidaclopid were weakly active to control *F. invasor* (Fig. 1; Table 2). Infante et al. (2014) reported similar results for spinosad, malathion, imidacloprid, and α-cypermethrin to control *F. invasor* Mexican populations. However, in our study the neonicotinoid thiomethoxam showed a higher level of toxicity compared with imidacloprid. Unfortunately, there are a number of limited rotational choices with respect to the modes of action available for insecticidal control of *F. invasor*. Because of this situation, there is a risk that insecticide resistance will increase in this species (Bielza 2008). We believe that additional investigations to identify potential insecticides to control *F. invasor* should be continued for managing this pest as well as exploration of biological control agents.

We thank Joaquín Calderón of the Natural Science Laboratory of Earth University for helping with the data collection in the field. Funding for the project was provided by Mangarica Costa Rica.

Summary

Frankliniella invasor is an important pest of mango in Central America; however, information is limited concerning the activity of insecticides with different modes of action. Eight insecticides representing 5 different chemical classes were assayed for control of *F. invasor* in Costa Rica. The spinosyns, spinetoram, and spinosad were highly active, whereas malathion and α-cypermethrin were the least active. The neonicotinoids imidacloprid and thiamethoxam resulted in intermediate toxicity to this thrips pest.

Key Words: mango; spinosyns; neonicotinoids; Central America

Resumen

Frankliniella invasor es una plaga importante del cultivo de mango en Costa Rica. Sin embargo, hasta la fecha se han publicado muy pocos ensayos de toxicología en esta especie de trips. Se eligieron ocho insecticidas con diferentes modos de acción. Se realizaron dos ensayos toxicológicos consecutivos. Entre los insecticidas probados, las espinosinas (spinetoram y spinosad) fueron las más eficientes. El malatión, α-cipermetrina, fue el menos eficiente. Los neonicotinoides mostraron resultados diferentes con imidacloprid que no logró controlar la plaga *F. invasor*, y el tiametoxam dio un resultado toxicológico aceptable para esta especie.

Palabras Claves: mango; espinosinas; neonicotinoides; América Central

References Cited

Bielza P. 2008. Insecticide resistance management strategies against the western flower thrips, *Frankliniella occidentalis*. Pest Management Science 64: 1131–1138.

Finney DJ. 1971. Probit Analysis, 3rd edition. Cambridge: Cambridge University Press, Cambridge, United Kingdom.

Gehrke VMR. 2008. Reflexiones sobre problemas de biología reproductiva del mango Ataulfo en el Soconusco, Chiapas. Revista Tecnología en Marcha 21: 174–183.

Helyer NL, Brobyn PJ. 1992. Chemical control of Western flower thrips (*Frankliniella occidentalis* Pergande). Annals of Applied Biology 121: 219–231.

Infante F, de Leon J, Valle-Mora J, Funderburk JE. 2014. Toxicity of insecticides to *Franklilniella invasor* (Thysanoptera: Thripidae) under laboratory conditions. Florida Entomologist 97: 626–630.

Mound L, Hoddle M. 2016. Scirtothrips species (Thysanoptera: Thripidae) described from *Mangifera indica* (Anacardiaceae) in Mexico. Florida Entomologist 99: 759–765.

Rocha FH, Infante F, Quilantán J, Goldarazena A, Funderburk JE. 2012. 'Ataulfo' mango flower contains a diversity of thrips (Thysanoptera). Florida Entomologist 95: 171–178.

Sakimura K. 1972. *Frankliniella invasor*, new species, and notes of *F. gardeniae* and the *Frankliniella* spp. in Hawaii (Thysanoptera: Thripidae). Proceedings of the Hawaiian Entomological Society 21: 263–270.

SAS Institute Inc. 2011. SAS/STAT® vers. 9.3 User's Guide, Cary, North Carolina, USA.

Walter NT, Adeleye VO, Muthomi PK, Ortiz RJ, Strzyzewski I, Funderburk J, Martini X. 2018. Toxicity of different insecticides against two thrips (Thysanoptera: Thripidae) pests of concern in Central America. Florida Entomologist 101: 627–633.

Yu SY. 2015. The Toxicology and Biochemistry of Insecticides. Taylor and Francis Group, Boca Raton, Florida, USA.