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Effectivity of three botanical crude extracts on immature of whitefly (*Bemisia tabaci* Genn.) under enclosure conditions

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ABSTRACT

Pest management of habanero chili (*Capsicum chinense* Jacq., Solanaceae) the sweetpotato whitefly *Bemisia tabaci* Genn. (Hemyptera: Aleyrodidae) is a key plague insect as a virus-vector, capable of causing serious economic loss. Their control is broadly based on Imidacloprid, a neonicotinoids product. *B. tabaci* have resistance to imidacloprid now. Some plants extracts are suggest in the literature how insect repellent properties over whiteflies, including allspice [*Pimenta dioca* (L.) Merrill, (Myrtaceae)], sweet basil [*Ocimun basilicum* L. (Lamiaceae)] and wild feverfew [*Parthenium hysterophorus* L. (Asteraceae)]. The preliminary screening under controlled conditions for evaluating the repellent effect of crude aqueous extracts, in a 1:1 ratio based on mass weight foliage moisture; was evaluate for each one of above-mentioned plants, against nymphs and eggs of whitefly. Results show that basil and feverfew extracts was significantly effective in preventing oviposition by adult whiteflies on habanero chili foliage, with allspice showing the lowest effect. Fields studies have to be carried out in this regards.

Keywords: Alternative pest management, habanero chili, whitefly, Campeche, México.

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INTRODUCTION

Sweetpotato whitefly (*Bemisia tabaci* Genn., Hemyptera: Aleyrodidae) is the most problematic pest in neotropical chili and many other plants. In case of habanero chili (*Capsicum chinense* Jacq.: Solanaceae), an economically important crop from Southeast Mexico (Tucuch-Haas *et al*., 2012); this tiny insect showing trends of high population growth due to climate change and irrational chemical management practices. The potential damage to the chili crops and the cost of management has been exceptionally high (Cuellar and Morales, 2006). Imidacloprid has been effective against whiteflies until now, but the insect have slowly acquired resistance against it (Dennehy *et al*., 2005). Hence, new management strategies must carried on for efficient pest control in the future. Plant based natural phytochemicals can prove to be effective in controlling the pest. Search for natural products with biological activities that minimize the environmental impact, including biopesticides, are important for modern, sustainable, ecofriendly agricultural practices. Biopesticides can be obtained from living organisms like plants (Briones-Dahlin, 2009).

Many plants mentioned in literature does show potential to serve as biopesticide or repellent for whiteflies or for other insects (Buttler *et al*., 1990, González-Acosta *et al*., 2006, Jafarbeigi *et al*., 2012, Aragón-García *et al*., 2014). Allspice (*Pimenta dioica* L. Merrill, Myrtaceae), wild feverfew (*Parthenium hysterophorus* L., Asteraceae) and sweet basil (*Ocimun basilicum* L., Lamiaceae) are tropical aromatic plants that have potential for controlling whitefly pest problem. Whiteflies as vector are the main problem (Cuéllar and Morales, 2006). Avoiding whiteflies infestation helps to reduce viral damage to the crops, which has more impact than *per se* insect control.

To ascertain the application of these plants to resolve the viruses-whitefly complex problem, crude aqueous extracts from flesh foliage of the above three species was used to prepare three biopesticides to closely monitor whitefly oviposition behavior and in the selective tendencies of adults under greenhouse conditions. This preliminary screening approach is necessary to conduct specific experimental assay, before formal field trials. This is the principal objective of the present research, testing three species of plants recognized because their repellent properties: sweet basil, *Ocimun basilicum* L. (Pascual-Villalobos *et al.*, 2004), wild feverfew, *Parthenium hysterophorus* (Saucedo-Hernández *et al.,* 2009), and allspices, *Pimenta dioica* (L.) Merr. (Hilje, 2001).

MATERIALS AND METHODS

Location of confining experiment

Experimental work was carried on the Agroecological, Integrate Management Pest and Organic Agriculture Research Unity from the Instituto Tecnológico de Chiná, from Campeche State, Mexico, from August to September 2016, a time of moderate sweet potato whitefly activity. During these months, the temperature ranged from 24 to 34 °C with 27 °C average, and an average rainfall of 239 mm.

Preparation of extracts

The sweet basil and allspices foliage did obtain from plants cultivated into ITCh´s garden of aromatic plants and, wild fewerfew from wild population growing beside the ITCh´s garden. Plants extracts with insecticidal activity required for the experiment was obtain preparing a mixed 50-50% weight fresh foliage biomass - water ratio, to prepare three different plants species extracts. Then, the previously washed foliage with clean water, macerated, then immerse in water for a 48 hours period in plastic containers. Following that process, aqueous crude extract result was obtained and filtered, and stored in a cool place for 24 hrs before use. This procedure systematically was repeated three times per week, throughout the study period.

Tested whiteflies

Twenty adult whitefly (*B. tabaci*) collected from chilli crops fields located in coordinates 19°46´21.00’’N and 90°30´10.00’’O and were introduced into twelve cages. Adult *B. tabaci* introduced was repeated twice to ensure a minimal number of breeding pairs inside the cages.

Bioassay management and experimental testing

The experimental bioassay included a set of confinement cages constructed with PVC pipes, all having the following dimensions: 1.10 m x 0.9 m x 0.6 m. Twelve of these cages, covered entirely by tulle netting, including two ducts designed to the controlled manipulation of insects, thus avoiding their escape, were used in this experiment. Inside each cage, two pair of pods, one of which with chilli plants receiving treatment and the other no so. Chilli plants used for this bioassay were obtained by protected greenhouse and growing free of virus infection are used for this bioassay. Completely randomized design is conducted with four repetitions for each of these three experimental treatments. Three times per week, botanical aqueous extracts was applied using 100 ml spray bottles to two pods, while the other two were used as control. Ten ml of extract were spraying by plant. Application was repeated for six consecutive weeks.

Data collection

Sixty days after the experiment was tarted, all foliage was removed and the immatures stages (eggs and nymphs) were counted with the help of a VELAB VE-S1 microscope, and subsequently organized in Excel data sheet (Microsoft Excel®). The variable results were in each case, the average of immatures.

Repellence effect measure

The botanical extracts repellence is determined based on the hypothesis that whitefly that avoid the plants treated with extracts and moved on to untreated plants. Differences between the immature whitefly density numbers and between pairs of treated and untreated plants inside the cages were uses to establish the repellency effects of the three botanical extracts tested. Following to Ail-Catzim *et al*. (2015), the repellence index (IR) did calculate using the formula proposed by Lin *et al*. (1990):

IR = 2G / (G+P).

Where

G is the number of insects perched in the treatment, and

P is the number of insects perched in the control.

To classify the effect of the extracts, the criterion taken was that if RI = 1 the effect is neutral, if RI < 1 the effect is repellent and if RI > 1 the effect is attractant.

Statistical analysis

Data prior normalization with (√ x + 1)1/2 (Zar, 1999), were analyzed by paired mean test analysis applied with t-Student module of Infostat (Balzarini *et al*., 2008) to show the statistical differences ($p<0.05$).

RESULTS AND DISCUSSIONS

The repellent effects produced by the botanical extracts on *B. tabaci* immatures are summarized in Tables 1 and 2. From the analysis of data in table, we infer that the two biopesticides tested produced a repellent effect, changing significantly the behavioral oviposition among sweet potato whitheflies significantly. However, the sweet basil (*O. basilicum*) extract showed better action, compared to feverfew (*P. hysterophorus*). Repelence index (IR= 0.39) determinate using Lin *et al.* (1990) model approach, show that allspices have IR lightly minor that sweet basil (0.06) or wild *P. hysterophorus* (IR= 0.23). In the experiment, allspices (*P. dioica*) showed the lowest effect. One probable cause of failure in allspice can be found in a possible low does for this crude extract. The botanicals extracts can be act in different intensity biopesticide way over target pest how a function of active principles concentration (Venkat Reddy *et al*., 2012, Khan and Qamar, 2015). Variations in active components concentration could causes different control pets action (El Kamali, 2009).

The null appearance of sweet potato whiteflies eggs over chili plants leaves under sweet basil extracts (Table 1), indicate a strong effect of this plant in the oviposition change routine from adults in enclosure. Feverfew extract too cause modification in the behavior in whiteflies oviposition pattern. Allspice show a mean low presence of egg in leaves, however the differences respect to control treat was not significant level. Excepting allspice, the extracts cause average egg presence for plant below the critical threshold (one egg) level. A probable cause is the more volatile aromatic constituent in foliage of *Pimenta dioica*, like eugenol (De Oliveira *et al*., 2008, Vázquez-Cahuich *et al*., 2013), which could volatilize quickly and then diminish the botanical extract persistence and, decreasing pesticide action.

Similar to eggs, sweet basil act as the best repellent against nymphs on leaves, respect to other two treatments (Table 2). Wild feverfew in second place, although preventing the density of nymphs exceeds the allowed threshold (one nymph for plant), indicate for *B. tabaci* by Trabanino (1997) and Nunes *et al*. (2005). Allspice newly did not prevent the immature density from exceeding the acceptable threshold for this pest. As Pascual–Villalobos *et al.* (2004) claim, the sweet basil was effective in repelling the whitefly. The pronounced effect of sweet basil extract on whitefly oviposition may be due to the content of Germacrene C and D (sesquiterpene hydrocarbons) among other secondary metabolites, which, according to Stranden *et al*. (2002) and Nurzyńska–Wierdak *et al*. (2012), exhibit insecticidal activity.

In the case of feverfew, it is possible to assume that the repellent effect is due to its high content in sesquiterpenes lactones derivatives of parthenin, which can provoke ovicidal and larvicidal effects (Datta and Saxena, 2001; Patel, 2011, Chandra and Shaik, 2013). In contrast, the efficacy of allspice on whitefly reported by Hilje (2001), in the present study its extract showed

Table 1. Repellence effects of three botanical extracts on sweetpotato whitefly (*Bemisia tabaci* Genn.) measured by eggs counting over chili pepper foliage plants under greenhouse conditions.

Treatment	Egg counting (Mean egg/plant)	F	p
Sweet basil	0.00	7.453	0.034 *
Control	1.58		
Fewerfew	0.04	13.084	0.011 **
Control	1.40		
Allspices	0.35	0.442	0.531 ns
Control	0.81		

* Significant differences; ** Very significant differences; ns non different

Table 2. Repellence effects of three botanical extracts on sweetpotato whitefly (*Bemisia tabaci* Genn.) measured by nymphs counting over chili pepper foliage plants under greenhouse conditions.

Treatment	Nymphs counting (Mean nymphs/plant)	F	p
Sweet basil	0.04	12.400	0.012 **
Control	5.19		
Fewerfew	0.12	9.438	‘.022 *
Control	6.50		
Allspices	2.25	0.862	0.389 ns
Control	6.60		

* Significant differences; ** Very significant differences; ns non different

insufficient activity on whitefly oviposition, which seems to correspond more to the effect on mites or microbes than on insects, as described by Martinez–Velazquez *et al.* (2011).

Based on the results we can recommend sweet basil and wild fewerfew for field experimental tests to evaluate its control effects on sweetpotato whitefly. In future, concentration of foliage extracts could be increases to improve the repellence effectiveness from botanical biopestices testing in this research.

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