Toxicity of Imidacloprid to *Bemisia tabaci* Type Q Collected from Florida

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Introduction

The sweetpotato whitefly, *Bemisia tabaci* (Gennadius), (Homoptera: Aleyrodidae), is an important pest in many cropping systems throughout the world. Currently two biotypes of this species are present in Florida, the B-biotype discovered in Florida in 1986 and the recently introduced Q-biotype. As of November 1, 2006, the Q-biotype has been detected in 5 counties in Florida. B-biotype has been successfully managed with neonicotinoid insecticides, especially imidacloprid. However, with the introduction of Q-biotype, which has characteristically shown resistance to a number of neonicotinoids (Nauen and Denholm 2005), it is feared that effective management of *B. tabaci* will be compromised. Therefore, knowing the susceptibility to insecticides of the Q-biotype in Florida would be valuable in developing management strategies. The objective of this study was to determine the toxicity of two neonicotinoids, imidacloprid and dinotefuran, and a pyrethroid, cyfluthrin, to a sample of Q-biotype collected from Florida.

Methods

Bioassay

A leaf-dip bioassay (adapted from IRAC Test Method 8, Version 2-http://www.irac-online.org/) was used to determine concentration-mortality responses (Figures 1&2). Insecticide formulations used were: Provado®1.6 Flowable Insecticide, Safari™20 SG, and Decathlon®20 WP. POLO-PC (LeOra Software, Berkeley, CA) was use to analyze data. Bioassays were prepared as follows: 1) Select uninfested cotton leaves and cut petioles to a length of approximately 4-6 cm. Trim the lamina to give an approximately square area (2 x 2 cm). 2) Prepare test concentrations and dip laminae of prepared leaves for 5s. Prepare three replicates for each concentration. Let leaves air dry (approximately 20 min) before inserting stem into bottom of test chamber. 3) Collect 30-40 whitefly adults using a hand vacuum pump (Nalgene® Mityvac®) with a 2-ft long, rubber tubing with inner dia. 0.8 mm. Aspirate each batch of whiteflies into a 1-ml plastic pipette tip fitted into the tubing with a piece of netting to prevent whiteflies from entering the tubing. When done, remove pipette tip and seal both ends with Parafilm®. Quickly remove Parafilm®, press the pipette tip into a piece of plasticine on the inside of the bioassay chamber and close cup quickly. Place test cup inside the second cup and anchor into position with a drinking plastic straw between the two cups, allowing the leaf petiole to dip into the water. 4) Collect 20-30 whiteflies and preserve in 95% ETOH for confirmation of biotype. 5) Hold for 48 h at 25-27°C and then record live and dead whiteflies. Count moribund whiteflies as dead.

Figure 1

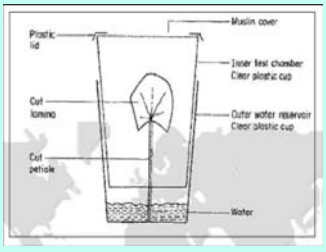

Figure 2

Methods

Whiteflies

MREC-Q. This strain was collected from Hibiscus on August 2006 from a retail garden center in Orange Co., FL and maintained on cotton plants in a greenhouse located at the Mid-Florida Research and Education Center (MREC), Apopka. Molecular typing indicated that it was Q-biotype. The MREC culture was maintained on plants sprayed with a commercial, ready-to-spray mixture of imidacloprid (0.012% AI) and cyfluthrin (0.003%) to minimize contamination by B-biotype. Squash plants were maintained in cage to detect "silvering" due to possible contamination by B-biotype.

MREC-Q+B. In October 2006, another culture of MREC-Q was established from the original culture for conducting bioassays. This culture was maintained on unsprayed Henderson bush bean plants. Molecular typing of samples from December 3, 2006 indicated that this culture had become contaminated with the B-biotype and was subsequently designated MREC-Q+B. Subsequent typing of samples from March 2 and April 5, 2007 indicated that this culture was still mixed.

MREC-QP. This culture was established from MREC-Q+B on December 20, 2006 and maintained on bean plants sprayed with the mixture of imidacloprid and cyfluthrin to remove the B-biotype. Typing of samples from March 22 and April 5 2007 indicated that the culture was pure Q-biotype.

MREC-B-Sus. This culture has been maintained at MREC since the late 1980's without exposure to insecticides and was considered the reference culture for insecticide-susceptible B-biotype. Typing of samples from July 2007 confirmed that this was B-biotype.

MREC-B-BifR. This culture has been maintained at MREC since the early 1990's on bifenthrin-treated Henderson bush bean plants and was considered highly resistant to bifenthrin. Typing of samples from July 2007 confirmed that this was B-biotype.

Results and Discussion

As might be expected for Q-biotype (Nauen & Denholm 2005), results indicated that MREC-Q was resistant to imidacloprid compared to the susceptible reference B-biotype (MREC-B-Sus). MREC-Q was shown to be resistant to cyfluthrin when compared to MREC-B-Sus. Resistance to cyfluthrin MREC-Q could be considered very high because, even though MREC-B-Sus is relatively susceptible to cyfluthrin when compared to MREC-B-BifR, MREC-B-Sus could be considered somewhat resistant to cyfluthrin based on results reported in Elbert and Nauen (2000). Dinotefuran was about 100x more potent than imidacloprid to MREC-Q, indicating a lack of cross-resistance. The dinotefuran results are consistent with those reported in Prabhaker et al. (2005) for several populations of imidacloprid-resistant B-biotype from southwestern USA and one from Guatemala.

The necessity of continuously exposing MREC-Q to insecticide to prevent contamination by the B-biotype illustrates the increased complexity that could be encountered in managing a population of *B. tabaci* composed of both biotypes. As suggested by the toxicity of cyfluthrin to MREC-QP compared to MREC-Q+B, a rapid loss of efficacy might simply be due to removing the B-biotype from a mixed population and not the development of resistance to a particular insecticide. Therefore, the routine typing of populations should provide useful information for integrating insecticides into a management program for *B. tabaci*.

Table 1. Toxicity of imidacloprid, dinotefuran, and cyfluthrin to a *B. tabaci* Q-biotype collected from Florida (MREC-QP) with comparisons to laboratory strains of the B-biotype.

Strain	Compound	Date of bioassay	LC_{50} (PPM)	(95% CI)	Slope± SE	Resistance Factor[1]
MREC-QP	Imidacloprid	7/11/07	8,927	537-30,131	0.524+-0.154	8,190
	Dinotefuran	7/11/07	75.1	20.8-176.3	0.779+-0.149	---
	Cyfluthrin	7/13/07	>10,000	---	---	>20
MREC-Q+B	Cyfluthrin	6/21/07	1,328	591-3,013	0.591+-0.089	2.6
MREC-B-Sus	Imidacloprid	3/2/07	1.1	0.69-1.55	1.311+-0.165	---
	Cyfluthrin	6/29/07	507	240-906	0.800+-0.115	---
MREC-B-BifR	Cyfluthrin	7/13/07	>10,000	---	---	>20

[1]LC_{50} divided by LC_{50} of MREC-B-Sus for same insecticide.

Literature Cited

Elbert, A., and R. Nauen. 2000. Resistance of Bemisia tabaci (Homoptera: Aleyrodidae) to insecticides in southern Spain with special reference to neonicotinoids. Pest Management Science 56:60-64.

Nauen, R., and I. Denholm. 2005. Resistance of Insect Pests to Neonicotinoid Insecticides: Current Status and Future Prospects. Archives of Insect Biochemistry and Physiology 58:200–215.

Prabhaker, N., S. Castle, T.J. Henneberry and N.C. Toscano. 2005. Assessment of cross-resistance potential to neonicotinoid insecticides in *Bemisia tabaci* (Hemiptera: Aleyrodidae). Bulletin of Entomological Research 95: 535-543.