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No Cross-resistance to Nicotinoid Insecticides in Imidacloprid-resistant B Biotype Whiteflies

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BACKGROUND

Over the last 25 years insecticide-resistant biotypes of sweet potato whitefly, *Bemisia tabaci* (Gennadius), have become widespread in American greenhouses, making chemical control of whiteflies more difficult. In the last 10 years a highly resistant strain of sweet potato whitefly known as the Q biotype was found in many North American greenhouses. The Q biotype is considered a serious threat to American floriculture because of how destructive it has been in southern Europe. Fortunately, Q biotype has not developed into a devastating pest problem for North American flower growers, as many had feared. Strain identification of whiteflies collected from flower growers has confirmed that Q biotype is now widely distributed in North America, but the whiteflies in floriculture greenhouses are mostly resistant B biotype, not Q biotype. The B biotype appears to out-compete Q biotype under most

conditions, and has thus become the dominant biotype in greenhouses. An exception to this may occur in greenhouses frequently sprayed with nicotinoid, pyrethroid and other types of insecticides that Q biotype whiteflies are resistant to. Apparently the use of insecticides with different modes of action, and the ability of B biotype to develop resistance to imidacloprid has led to the current situation where the whitefly that is causing most of the problems for flower growers is the resistant B biotype.

There is still some confusion about the correct name for the resistant B biotype. B biotype was confirmed to be a different species of whitefly in the early 1990's: the silverleaf whitefly, *Bemisia argentifolia* Bellous and Perring. Although the correct name for the B biotype is **silverleaf whitefly**, many still refer to this whitefly as the B biotype of sweetpotato whitefly.

At this time, entomologists are making whitefly control recommendations to flower growers based on which products are effective against Q biotype. This means that some new nicotinoid products like Safari and Tristar are excluded from the list of recommended products. In this research project we used a colony of imidacloprid-resistant B biotype whiteflies to determine the level of cross-resistance to other nicotinoid insecticides, and

therefore improve insecticide recommendations made to flower growers.

MATERIALS AND METHODS

We started our resistant B silverleaf whitefly colony from a few infested poinsettia plants obtained from a commercial greenhouse in Michigan in September 2006. We keep this colony under constant selection pressure by treating with imidacloprid and collecting survivors. We also maintain a susceptible population provided to us by Dr. Nilima Prabhaker, at the University of California Riverside, CA. We use this culture as a reference strain. The resistant strain and susceptible strain of silverleaf whitefly were identified as B-biotype by Dr. Frank Byrne at the University of California, Riverside, CA. Adult whiteflies are selected with imidacloprid by using a systemic uptake bioassay as described by Cahill et al. (1996) and Li et al. (2000) with a slight modification. Roots and the stem of cotton seedlings in the 'two true-leaf stage' are immersed in solutions of imidacloprid mixed at the desired concentrations. After 24 h of imidacloprid uptake by the cotton seedlings, leaf discs were cut and put in scintillation vials with a 2.5 ml layer of agar (1.3%) in the bottom of the vial. Adult whiteflies were collected and added into the vials with the imidacloprid-treated leaves. After 48 hours of exposure, surviving adults were released on young

cotton plants in a new cage. Initially the selection procedure was repeated for 11 generations.

The susceptibility of the whiteflies to imidacloprid was evaluated by using the systemic uptake bioassay method as described above. Eight to ten different concentrations of imidacloprid were used for each test. Mortality was checked after 48 h. Data from the assay were used to determine the LC 50 (SAS version 9.1 software). The same systemic bioassay method was used to determine the response of the imidacloprid-resistant strain to the three neonicotinoid insecticides: thiamethoxam, acetamiprid and dinotefuran.

RESULTS

The parental generation of imidacloprid-resistant silverleaf whitefly collected from a commercial greenhouse was initially 13-fold resistant to imidacloprid compared with a susceptible strain (Figure 1). This level of resistance suggests that the grower would not get good results applying imidacloprid at the labeled rate.

This parental population increased in resistance levels to imidacloprid quickly in response to selection. After 11 generations the RR (resistance ratio, LC 50 of resistant strain / LC50 of reference strain) was 243.

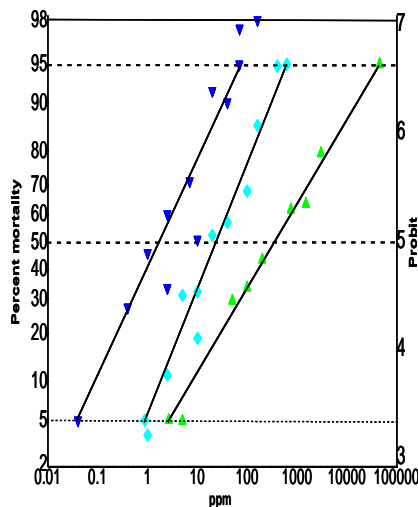
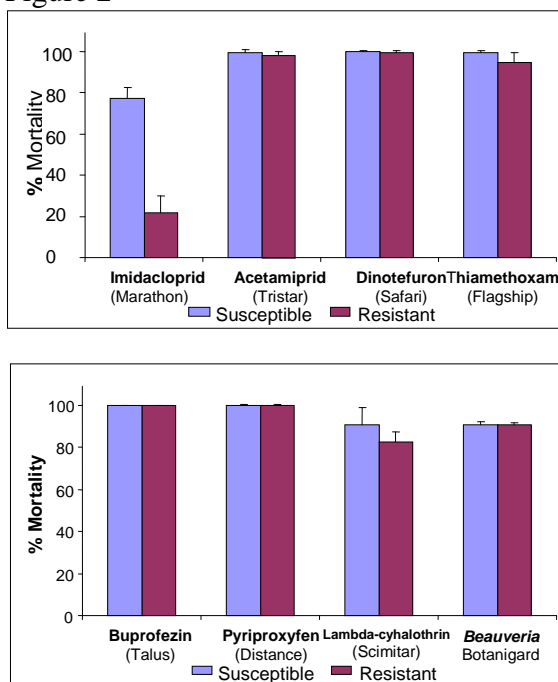


Figure 1: Log-probit dose plot for the toxicity of imidacloprid to the susceptible strain (blue triangles), the parental strain collected from a commercial greenhouse (light blue diamonds), and the F5 (green triangles) generation of B biotype after selection with imidacloprid.

Figure 2



Results of testing the imidacloprid-resistant culture of the resistant B biotype indicates the cross-resistance profile for

the B biotype is very different from the Q biotype. There is no cross-resistance to the other three neonicotinoid insecticides tested, and no cross resistance to buprofezin or pyriproxyfen, all insecticides that the Q biotype is resistant to (Figure 2).

CONCLUSIONS

The most common *Bemesia* biotype found in commercial greenhouses in the United States, the B biotype, is not cross-resistant to other neonicotinoid insecticides, buprofezin or pyriproxyfen.

IMPACT TO THE INDUSTRY

This research indicates that five widely used insecticides (Tristar, Safari, Flagship, Talus and Distance) which have been excluded from whitefly control recommendations should be very effective against the most common *Bemesia* whitefly biotype in American greenhouses, the resistant B biotype. However, growers should still avoid using these products exclusively, as it may select for Q biotype.

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