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Management of Insecticide Resistance in Q-biotype *Bemisia tabaci* Populations in U.S. Floriculture Crops

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BACKGROUND

Insecticide resistance is one of the major problems associated with the effective control of the whitefly *Bemisia tabaci*. The problem is compounded by the existence of several biotypes of this pest. Each of them has the capacity to develop its own unique form of resistance. In 2005, a new biotype (the Q-biotype) was detected in the United States for the first time. Subsequently, a survey showed that this biotype was highly pervasive (22 states). Furthermore, it exhibited resistance to insecticides known to be effective against the B-biotype. With the existence of two *Bemisia* biotypes, new approaches to improving the management of whitefly outbreaks are being evaluated. The propensity to deal with whitefly outbreaks will depend on (1) a sound knowledge of the biotype identity, and (2) the level of resistance expressed within that biotype population. Equally important, however, is the need to ensure that the insecticides chosen for whitefly management are effectively deployed. One factor that is little understood or appreciated by pest management specialists and growers is the impact that soil type or potting media can have on the uptake of drench applications. High organic content increases the likelihood of insecticide losses due to absorption: thereby, reducing the amount of insecticide taken up by the roots. This in turn increases the chances that insects will be exposed to sub-lethal doses of insecticide when they feed on the plant. In this report, we provide data on the impact of potting media on the uptake of drench treatments of imidacloprid and dinotefuran. This information can be used to improve the use of systemic insecticides for whitefly management. It allows growers to plan their treatment strategies more effectively without compromising the quality of the finished plant.

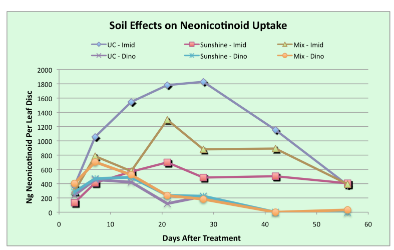
MATERIALS AND METHODS

Poinsettias (*Euphorbia pulcherima*) cv. Freedom Red were maintained in a greenhouse at Agricultural Operations on the campus of the University of California at Riverside (UCR). The plants were grown in 6-inch diameter 1-gal pots (approx. 3.7 L volume) and placed on raised greenhouse benches. Plants were 40-cm in height at the time of pesticide applications. Two soil media, Sunshine mix #4 and UC Mix #2 (Matkin and Chandler 1957), and a 50/50 mixture of the two media, were used in the experiment. Two systemic pesticides registered for ornamental use were applied to potted poinsettias. Imidacloprid (Marathon II, 21.4% AI) was applied at the highest recommended rate on the label, 50ml/1000 6-inch diameter (15.2cm diam.) pots. This is 10.7mg imidacloprid/pot. Dinotefuran (Safari 20SG, 20% AI) was applied at the same amount of Active Ingredient (AI) per pot as imidacloprid, 10.7mg dinotefuran/pot. Recommended label rates of Safari are much higher than for imidacloprid, but we standardized the amount of AI per pot for an equal comparison of the 2 insecticides. Plants were watered approximately 6 hours prior to the application to fully saturate the media. During application a small amount (≈5ml) of leaching occurred from some of the pots with the UC mix #2 due to a higher sand content. A solution of formulated product was prepared in water so that we could apply 50ml of solution by graduated cylinder and apply the same amount of AI of each product to the appropriate plants. The experimental design was a completely randomized block design using a 2 x 3 factorial (2 pesticides by 3 soil types). Pesticide treatments were applied on day 0 (June 6, 2008). On day 3, poinsettia leaf punch samples were taken with a 2 cm cork borer and the concentrations of imidacloprid and dinotefuran quantified by the ELISA technique.

RESULTS

At equivalent concentrations, the uptake of imidacloprid was higher than for dinotefuran, both in terms of rate of uptake and persistence of active ingredient within the leaves (Figure 1). Imidacloprid was absorbed by the roots most rapidly when plants were grown in the UC media compared with the Sunshine media. Intermediate levels of imidacloprid uptake were observed when plants were grown in an equal mix of the 2 potting media.
The uptake of dinotefuran was similar for plants grown in the UC and Sunshine media and for plants grown in an equal mix of the two.

Fig. 1. Uptake of imidacloprid and dinotefuran into poinsettia plants grown in two potting media and a mixture of the two. The insecticides were applied at equivalent rates. Imidacloprid and dinotefuran were measured in leaves using ELISA.



CONCLUSIONS

Imidacloprid is markedly affected by the organic matter content of potting media. This was demonstrated by the different concentrations of active ingredient measured in plants grown in high organic (Sunshine No. 4) and low organic (UC) media. Dinotefuran was not affected to the same extent. Plants grown in a mix of the 2 media types showed intermediate levels of imidacloprid. The latter result indicates that by altering the organic matter content in the potting media a grower would have the potential to improve the efficacy of a pesticide application, both in terms of rate of uptake (which permits a more rapid response to a pest outbreak) and persistence of residues within the plant (which permits prolonged protection against pest resurgence).

IMPACT TO THE INDUSTRY

The potting media is important for optimal plant growth. However, high organic matter content within the media impacts the effectiveness of drench applications of systemic pesticides such as the neonicotinoids. It is possible to improve the effectiveness of drench treatments by decreasing the organic matter content of the media. However, modifications to the potting media to promote better uptake should take into consideration potential deleterious effects on the growth of the plants.

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