Progress report for CDFA contract number 08-0172

Project Title
Understanding the Dynamics of Neonicotinoid Insecticidal Activity Against the GWSS – Development of Target Thresholds in Grapevines

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Reporting Period
The results reported here are from work conducted March 1 – July 31, 2009.

Objective
Determine target thresholds for systemic neonicotinoids against glassy-winged sharpshooters in grapevines

Activity
At this time, we are evaluating the efficacy of systemic dinotefuran against the egg stage of the GWSS. The method we use to do this is based on a published method (Byrne and Toscano, 2007) where we defined the lethal concentrations of imidacloprid to the 1st instar nymphs as they emerged from the egg mass. GWSS adults are allowed to lay eggs on cotton plants in cages. The leaves containing the eggs are excised from the plant and the petiole placed in a vial containing a known concentration of insecticide. The uptake of insecticide into the leaves is quantified gravimetrically, and then the progress of nymph development is monitored until emergence (timed according to nymph development on control leaves without pesticide pressure). The development of eggs is determined for different pesticide concentrations, so that a dose-mortality line can be developed (as for imidacloprid).

A new member of staff is currently being trained to conduct the final experiments for this study. She collects GWSS on Monday mornings to set up oviposition cages. Each day, she checks the leaves for egg masses and when eggs are present, she sets up a bioassay.

Results

The process by which dinotefuran affects the GWSS egg is similar to what we observed for imidacloprid. The dinotefuran does not penetrate the chorion of the egg. However, if the concentration of dinotefuran is high enough in the leaf, the nymph will contact the insecticide during emergence. We have observed death at all stages during emergence. Some nymphs succumb immediately they break through the chorion, while others manage to emerge fully, allowing the cuticle to dry and form the typical darkened color. While the latter may look normal, they are sluggish and die within a few days.

The new staff member has just begun to evaluate the effects of dinotefuran against the emerging 1st instars. She is evaluating additional doses to those tested in the previous reporting periods. All the data will be combined to conduct a probit analysis using POLO PC. At this time, we have insufficient data to generate an accurate LC_{50} for dinotefuran. However, there was 100% survival of emerging nymphs at 4.5 ng/cm^2 leaf, and 0% survival at 44 ng/cm^2 leaf, indicating a very steep dose response (which we observed for imidacloprid against the 1st instar GWSS and adult *Gonatocerus ashmeadi* parasitoids). The results indicate that dinotefuran is more toxic to emerging nymphs than imidacloprid (LC_{50} = 39 ng/cm^2 leaf).

REFERENCES

Byrne, F.J., Toscano, N.C., 2006. Uptake and persistence of imidacloprid in grapevines treated by chemigation. Crop Protection 25: 831-834.

Byrne, F.J., Toscano, N.C., 2007. Lethal toxicity of systemic residues of imidacloprid against *Homalodisca vitripennis* (Homoptera: Cicadellidae) eggs and its parasitoid *Gonatocerus ashmeadi* (Hymenoptera: Mymaridae). Biological Control 43: 130-135.

Toscano, N.C., F.J. Byrne and E. Weber. 2007. Laboratory and field evaluations of neonicotinoid insecticides against the glassy-winged sharpshooter. In Proceedings of the Pierce's Disease Research Symposium, pp 98-100, The Westin Horton Plaza, San Diego, California, Dec 12-14, 2007.

Benefits of work to solving the PD problem in California

In previous work, we showed that the rate of uptake of dinotefuran into grapevines was faster than imidacloprid. Also, concentrations of dinotefuran at peak uptake were higher. The results we are generating from this project are encouraging from two standpoints. First, we have shown that dinotefuran is highly toxic to GWSS adults, indicating that it will be an effective product for the control of the insect in vineyards. The use of dinotefuran will provide growers with a product that acts effectively against sharpshooters, particularly in situations where growers must respond quickly to an infestation to prevent the potential transmission of PD. When we conclude our bioassays, we will generate a threshold level of dinotefuran necessary to kill a sharpshooter quickly once it feeds from the xylem. We will then be able to determine the level of persistence that a treatment will provide. And second, dinotefuran is highly toxic to emerging 1st instars (results provided in this progress report). Systemic treatments exploit the xylophagous feeding behavior of the GWSS adult and immature stages. We now know that these treatments have an additional impact on emerging 1st instars, even before they begin feeding.

The systemic neonicotinoids imidacloprid and dinotefuran are effective insecticides that growers can use for long-term management of GWSS populations. Because of the contrasting chemical properties of these insecticides, growers can now choose the most suitable product to meet their pest management needs. Both products are highly effective against adults and we have shown in this study that dinotefuran is at least equally effective against the emerging nymphs.