Optimization of Systemic Chemicals for the Management of Avocado Pests

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Project Overview

We are evaluating systemic insecticides for the management of current and newly emerging pests of California avocados. Current management practices for avocado thrips are centered on the use of foliar insecticides. Several foliar treatments are available (Agri-Mek, Delegate and Danitol) for the control of avocado thrips. However, the number of products is limited, the mode of application can be difficult (helicopter use on steep hillsides, applications near urban regions), and there are risks of resistance development, particularly to Agri-Mek due to it also being used against persea mite during the summer, and to Danitol (based on its use in other systems). Systemic neonicotinoid insecticides are relatively easy to apply (via established sprinkler irrigation systems or by modern trunk injection systems), and have a mode of action that has not been in use for the management of avocado thrips. A new mode of action would substantially lower the resistance risk associated with Agri-Mek (and generics), and alleviate operational difficulties in the use of foliar treatments. In this project, we are evaluating 3 modes of application for systemic neonicotinoids – soil drench, trunk injection and basal trunk applications (trunk sprays or trunk paints). Our major focus during the current year of the project will be to evaluate basal trunk sprays of imidacloprid (not registered for grower use due to the method of application) and clothianidin (not registered on avocados as yet). Our research has shown that both chemicals are toxic to avocado thrips and the purpose of this research is to determine whether basal trunk sprays can deliver the required amounts of insecticide to the leaves to kill the insects.

To measure insecticide uptake, we are using two techniques. First, we collect leaves that are attractive to avocado thrips for feeding and conduct bioassays by exposing the insects to these leaves for a pre-determined period of time. And second, leaf punches from these bioassay leaves are used to quantify the levels of pesticide present within the leaves. In this way, we are able to compare the levels of mortality in our bioassays with the quantity of insecticide that is present in those same leaves. With this information, we can establish effective concentrations for the insecticides, and subsequently evaluate the capacity of different application strategies at achieving these required concentrations. Insecticides that fall short of the activity thresholds will not be recommended for use to control avocado pests.

Studies for 2011

Field Trial

In spring 2011, we will conduct a field trial at a commercial grove in Ventura Co. The trial at the Ventura grove has already been designed, with treatments at that site planned for May. The details of the trial are summarized in Table 1.

Table 1. Summary of insecticide treatments for basal trunk applications trial				
Treatment	**Active Ingredient**	**Application Type**	**Rate (g ai/tree)**	**Post-Treatment Evaluations**
Belay 2.13 SC	Clothianidin	Basal trunk spray	0.75 g (max label rate)	Leaf Residues Avocado Thrips Bioassays
Confidor 200 SL	Imidacloprid	Basal trunk spray	1.88 g (max label rate)	Leaf Residues Avocado Thrips Bioassays

The principle behind the basal trunk sprays is that after application to the trunk, the pesticide are absorbed through the trunk into the cambium layer. The addition of a surfactant helps the pesticide to penetrate the bark. If the pesticide can penetrate the bark and enter the cambium, it will then be picked up by the water moving within the vascular system and distributed to all parts of the tree. In our 2010 trial, we showed that dinotefuran could move into leaves in this manner.

We have had detailed discussions with Valent (the chemical company that markets clothianidin in the U.S.) regarding the use of basal trunk sprays of clothianidin. Valent has optimized a trunk spray method that will allow efficient uptake of clothianidin when it is applied at standard agricultural rates. Most basal trunk sprays, including dinotefuran, require substantially larger amounts of active ingredient (than permitted on an agricultural use label) in the application mix in order for sufficient uptake to occur. With applications at agricultural use rates, the adoption of trunk sprays could be a major cost-saving and efficient means of pest control for avocado growers. Our study represents the first evaluation of clothianidin as a trunk spray on avocados.

For the 2011 trial, Valent has provided us with the standard clothianidin formulation (Belay 2.13 SC) and a non-ionic surfactant (NIS) that is to be mixed with the Belay 2.13 SC prior to the application to the tree trunk. Valent has had excellent results with Belay 2.13 SC in their internal studies. They have provided the ratio of Belay:NIS required per tree, and the volume that needs to be applied to the trunk. Treatments can be applied the day after the trees have been irrigated, and once the applications are completed, irrigation can continue according to standard practice.

We have also arranged with Bayer CropScience (BCS) to test their basal trunk spray formulation of imidacloprid. BCS have provided us with Confidor 200 SL, which is an imidacloprid formulation that they have used for basal trunk sprays. They have provided guidelines on how the material should be applied to the trunks. We will do a direct comparison of the clothianidin and imidacloprid formulations this year. Based on the results from those trials, we will design additional trials to optimize this technique for use in avocados.

Publications

We are writing a paper on the trunk injection work that was funded by the CAC. In the first paper we are summarizing work with acephate, imidacloprid, dinotefuran (experimental formulation developed by ARBORjet) and a proprietary avermectin formulation (ARBORjet trunk injection product). The paper will be submitted for publication later in the year to Pest Management Science, a journal where we have already published 3 papers on our CAC-funded studies with the systemic neonicotinoids (listed below in the Publications section).

Benefits of the Research to the Industry

The payoff for the avocado industry for supporting this research will be a thorough evaluation of systemic insecticides for the management of important avocado pests. While we have already established from bioassays that acephate, dinotefuran, imidacloprid and clothianidin are inherently toxic to avocado thrips, the mode and timing of application will be the key element that ensures proper delivery and optimized performance. Upon completion of this research, the industry will know what chemicals will work for them, and how they need to be applied. The neonicotinoids will be a valuable addition to the arsenal of chemicals available to growers, and because they are a new mode of action for avocado thrips control, they will lessen the resistance risk faced by other products currently in use. In addition, several of these products may have applications for control of other pest species (armored scales and/or weevils if they were to be introduced into CA). We do not anticipate that every chemical we evaluate will work for the industry. Our ultimate goal is to present to growers practical solutions with respect to their pest problems, and guidelines for improved pest management in a climate of increasing pest pressure.

SELECTED REFERENCES

Byrne FJ, Toscano NC, Urena AA and Morse JG, 2005. Quantification of imidacloprid toxicity to avocado thrips *Scirtothrips perseae* Nakahara (Thysanoptera: Thripidae), using a combined bioassay and ELISA approach. *Pest Management Science* **61:** 754-758.

Byrne FJ, Toscano NC, Urena AA and Morse JG, 2007. Toxicity of systemic neonicotinoid insecticides to avocado thrips in nursery avocado trees. *Pest Management Science* **63:** 860-866.

Byrne FJ, Humeres EC, Urena AA, Hoddle MS and Morse JG, 2010. Field evaluation of systemic imidacloprid for the management of avocado thrips and avocado lace bug in California avocado groves. *Pest Management Science* **66:** 1129-1136.