

Management and Resistance Monitoring of Avocado Thrips and Persea Mite

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Persea mite was discovered attacking avocados in southern California in 1990. Avocado thrips was found in two isolated avocado groves, one in Orange Co. and the other in Ventura Co., in June 1996. Since then, these have become the two major arthropod pests of avocados in California although populations of each can vary in severity a good deal from year to year. Although it was an unusual year, according to Witney (2009), estimates of direct losses from avocado thrips damage to fruit and control costs for this insect combined to exceed \$50 million in 2006.

Abamectin (Agri-Mek and several generic formulations) has been the major pesticide used for control of both avocado thrips and persea mite since it was first made available for use on avocados in 1999. Delegate was registered for use against avocado thrips in 2007 and Danitol in 2010. Movento was registered in May 2011 but we are still learning how to use this material on avocados effectively. Envidor was registered for use against persea mite in 2011, Zeal will be ca. April 2012, and FujiMite ca. August 2012. We are concerned about the heavy reliance on abamectin over the past 13 years because both thrips and mite species are notorious for their ability to develop pesticide resistance. Starting many years ago, we realized that we were putting a lot of selection pressure on abamectin and working with Steve Peirce and Guy Witney, we started evaluating new chemistries for use against avocado thrips and persea mite. Soon, we will have 6 different chemistries (i.e. we would not expect cross resistance between them, note however that Movento and Envidor are in the same class of chemistry and that there may be, cross resistance potential between abamectin and Delegate), 3 each for use against avocado thrips (abamectin/Delegate, Danitol, Movento; Veratran D is a fourth possible chemistry) and persea mite (Envidor, Zeal, FujiMite). With proper rotation, i.e. not overusing any one material, we hope that the avocado industry will be set for the next 15 years or more years with respect to chemical control of avocado thrips and persea mite.

The objectives of our research are three-fold: (1) screen new pesticides potentially useful in control of avocado thrips and persea mite so as to find, and help move towards registration, products with chemistries different from the effective products we currently have available; (2) monitor for possible resistance of avocado thrips and persea mite to current products and newer materials once they are introduced; and (3) other research as needed to optimally manage these and other pests of avocado (e.g., a small amount of proactive work on armored scale chemical control anticipating one or more species may be introduced into California in the future).

Brief Summary of Recent Research Results

Screening for New Avocado Thrips Control Materials

We have developed a fairly efficient means of screening new products for potential use against avocado thrips. Many products show limited efficacy against avocado thrips and screening trials rapidly eliminate them from the need for future testing. New chemistries that have shown promise in recent experimental trials and warrant further testing include cyazypyr, pyrifluquinazone, tolfenpyrad, and sulfoxaflor.

Movento Registered – More Studies Needed

Movento is in a relatively new class of chemistry (but the same as Envidor that was recently registered for perse mite control) and this material shows an unusually broad spectrum of activity against various pest species (thrips, mites, scale insects, mealybugs, psyllids, whiteflies, aphids, and some Lepidoptera); it may prove quite useful should one or more of these types of insects show up on California avocados. Registration of this product on CA avocados was recently obtained (May 2011) but we still have some work to do to figure out how to use it effectively. Movento is an interesting material in that the formulation that is sprayed on the plant has almost no toxicity but it is taken up into the plant and converted to the toxic enol derivative. Thus, only plant feeding species should be impacted by this pesticide or possibly natural enemies that derive a toxic dose by feeding on poisoned prey or hosts. A second unique attribute of Movento is that it may be used on avocados during bloom, and in fact, this may be when plant uptake is the best. After a number of frustrating trials using foliar treatments, which work well on citrus but not on avocado, we started bloom studies after consulting with Dr. Carol Lovatt regarding when during avocado bloom uptake might be best. Field studies done in 2010 appeared to show plant uptake and avocado thrips control was better when Movento was applied at full bloom rather than at the cauliflower stage; there also appeared to be little difference between using 0.5% NR-415 spray oil and 0.25% Dynamic as additives (these were the two surfactants suggested by Bayer based on past work we and others have done on citrus and avocado). We were encouraged by spring 2011 field trials with 10 fl oz Movento (done at bloom, 1% NR-415 oil added) – whereas past trials using traditional foliar applications have failed to yield good results, we saw 100% mortality of second instar avocado thrips placed on treated leaves 14 days after treatment, 99.2% when this was repeated 21 days after treatment, and 73.3% at 35 days. The third unique feature about Movento is that it is quite systemic (moves through the plant readily) and it may be an ideal material for helicopter applications. Now that the product is registered, a field trial on commercial avocados is the next step and we are planning such work during bloom of 2012.

Spring PCA Cooperator Field Trials with Agri-Mek vs. Delegate vs. Danitol

Danitol is a pyrethroid insecticide that was registered in 2010 for use on avocados. Delegate was registered in 2007 but relatively few pest control advisors have used this material to date. We believe Agri-Mek (and generic abamectins) is being overused and because of resistance concerns, wanted to develop comparative data on how Delegate and Danitol might work in control of avocado thrips.

With the assistance of 6 PCAs, we set up 6 field avocado thrips field trials in spring 2009, 3 in the south (Escondido, Valley Center, Irvine) and 3 in the north (2 in Somis, Goleta). 2009 trial data was reported at the spring CAC-CAS meetings in SLO, Ventura, and Temecula in April 2010 and a fruit scarring summary was reported in our June 2010 progress report. Similar trials were run at two field sites in spring 2010 and fruit scarring data are shown in Table 1 below.

Table 1. Percent of fruit with economic or sub-economic (any) avocado thrips scarring at 2010 field trial sites.

<u>Location</u>	<u>Treatment</u>	<u># of fruit evaluated</u>	<u>% sub-economic thrips scarring</u>	<u>% economic thrips scarring</u>
Escondido	Control	600	33.3	4.0
	Agri-Mek	600	2.8	0.0
	Danitol	600	5.7	0.7
	Delegate	600	4.0	0.5
Somis	Control	181	95.0	68.5
	Agri-Mek	300	8.0	0.0
	Danitol	300	0.0	0.0
	Delegate	300	7.0	0.0

What did we learn from the 2009 and 2010 field trials? First, each of these 3 materials (Agri-Mek/generic abamectins, Delegate, and Danitol) are quite effective in controlling avocado thrips, even when applied under the challenging circumstances of helicopter application (Escondido; ground application was used at Somis). Each material has its strengths and weaknesses and we encourage PCAs and growers to try both Delegate and Danitol (also Veratran D; and Movento once we know how to use it) as possible alternatives to abamectin so as to lessen the pressure for resistance evolving to this class of chemistry. Ideally, growers should rotate between different classes of chemistry so that ALL of these products will remain effective.

Four Reports of High Thrips Levels Following Abamectin Treatment Investigated

We were contacted by two PCAs after spring 2011 abamectin helicopter applications at a total of four field sites failed to yield as strong a control of avocado thrips as would have been desired. Two reports were from the “north” and two from the south; in both cases, the PCA indicated that high thrips levels after treatment were quite possibly the result of unusually high avocado thrips pressure this year. It is a common problem to be unsure after treatment whether high pest levels are due to high levels of the pest, ideal environmental and cultural conditions (e.g., high levels of flush for avocado thrips to build up on before they move to fruit), problems with the application, or due to pesticide resistance. We investigated all four reports by doing bioassays of avocado thrips at the field sites in comparison with baseline abamectin data we developed in past years at field sites prior to heavy abamectin use. We also did a field bioassay using thrips from a field site with limited past use of abamectin. Results at all four field sites reporting concerns failed to show abamectin resistance. We have no doubt that abamectin resistance may be starting to evolve at field sites where this material has been used repeatedly over past years (in the past, we confirmed perseia mite loss of susceptibility at a single field where abamectin was used heavily, often for avocado thrips control in the spring and perseia mite control in late summer) but if resistance is starting to evolve at these field sites, it has not proceeded very far. Obviously, to be safe, it might be wise to rotate other chemistries at these field sites over the next year or two.

Evaluation of Persea Mite Control Materials

We have also developed a fairly good means of screening new products for efficacy against perseia mite and to date, have run 6 field trials. As a result, 3 new and effective materials are moving towards registration on avocado (Envidor registered in 2010, Zeal registration is expected by April 2012, and FujiMite registration expected ca. Aug. 2012). These 3 materials all are different chemistries and each

is different from Agri-Mek, making the likelihood of cross-resistance low (although Envirdor and Movento are the same chemistry).

Fall 2010 PCA Cooperator Persea Mite Trials

We report below on our 2010 persea mite field trials because such studies typically take 4 months or more to complete and we have not yet completed our three 2011 PCA-cooperator field persea mite trials. Two persea mite field trials were applied by PCA cooperators in fall 2010. Unfortunately (from the perspective of the field trials), a major heat event occurred late September and drastically reduced persea mite levels at both sites. At one of the sites in Saticoy, we obtained useful data showing that control via abamectin versus Envirdor was similar (Table 2 below). Both products were effectively reducing persea mite levels until the >105°F temperatures on 27 September also contributed to population decline (thus, evaluation during the latter portions of the trial was compromised somewhat).

Table 2. Results of a fall 2010 persea mite trial in Saticoy (100 gpa application of both products on 12 September 2010; Epi-Mek 0.15 EC applied at 15 fl oz/a + 3% NR-415 oil; Envirdor 240 SC at 20 fl oz/a without oil)

Date of count	9-8	9-20	9-28	10-7	10-22	11-5
Days pre or post-treatment	-4	+8	+16	+25	+40	+51
<u>Mean number of motile persea mite per leaf (half-vein method)</u>						
Untreated control	38.2	69.1	35.7	17.9	26.3	3.6
Epi-Mek + oil	57.2	22.4	8.2	2.1	0.4	0.0
Envirdor	49.0	26.7	2.3	0.6	0.0	0.0

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