Management and Resistance Monitoring of Avocado Thrips and Persea Mite

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Project Overview

It will still be another year or two before new pesticides are available to assist in control of avocado thrips and persea mite. At present, we are depending heavily on the use of abamectin (Agri-Mek and generic abamectins) and there is strong potential for resistance to develop in situations where this material is overused. Once resistance develops, it is likely to spread (via thrips flying around and to some degree, being moved via human traffic), it may or may not revert slowly, and could likely confer cross resistance to the spinosyn class of chemistry (Delegate, Success, and Entrust). Abamectin is a remarkably good fit for avocado pest management because of its strong efficacy, even when applied under the challenging conditions of a helicopter application on a hillside, the persistence of control, and its limited negative impact on important natural enemies, which hold other pest species in check. However, part of the reason why resistance is so likely with abamectin is specifically because of the long persistence of abamectin inside leaf and fruit tissues. In addition, high populations of avocado thrips and persea mite can be exposed to selection for resistance over multiple generations. Each grower and pest control advisor has the ability to minimize the chance of abamectin resistance developing in his or her own grove by not over-using this material (i.e. use no more than one application of Agri-Mek or any generic abamectin per year; considering possible cross-resistance, try to reduce concurrent use of Delegate, Entrust, or Success in groves where abamectin has been used). Based on past research with citrus thrips and other pests, it appears that what happens in a particular grove is most likely to affect resistance in that grove (i.e. worry more about what you apply than what your neighbor applies). Once you have resistance in your grove, management of avocado thrips and persea mite could become problematic. Registration of replacement products for abamectin and the spinosyns are some ways off and even when they become available, they do not appear to be as ideal a fit for avocado pest management as is abamectin, especially in regards to avocado thrips control.

The present focus of our research is two-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 different chemistries from abamectin and the spinosyns; and (2) Monitor for possible resistance of avocado thrips and persea mite to current products such as abamectin (Agri-Mek and generics), spinosad (Success, Entrust), spinetoram (Delegate), and sabadilla (Veratran D).

Brief Summary of Research Results

1. Screening for 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. We summarize below (1) products that are already available and (2) possible future products (i.e. unregistered at present) that have been identified and when they are likely to become available. For each, we list the IRAC (Insecticide Resistance Action Committee) Class – note that use of products in the same class should be avoided because cross resistance within a class is almost certain to occur.

Pesticide	Company	IRAC Class	Notes
Avocado Thrips - Presently available products			
abamectin (Agri-Mek) & generic abamectins	Syngenta Several	6	Possible cross resistance to 5
spinetoram (Delegate)	Dow	5	Possible cross resistance to 6
spinosad (Success, Entrust)	Dow	5	Possible cross resistance to 6
sabadilla (Veratran D)	Dunhill	close to 3	Resistance documented at 2 sites but resistance reverted after disuse
Possible future products for avocado thrips - not registered at present			
fenpropathrin (Danitol)	Valent	3	Also effective against persea mite
NNI-0101	Nichino	unknown	Additional trials needed to evaluate
spirotetramat (Movento)	Bayer	23	Avocado leaf uptake appears problematic – more research is needed

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Delegate Now Registered:

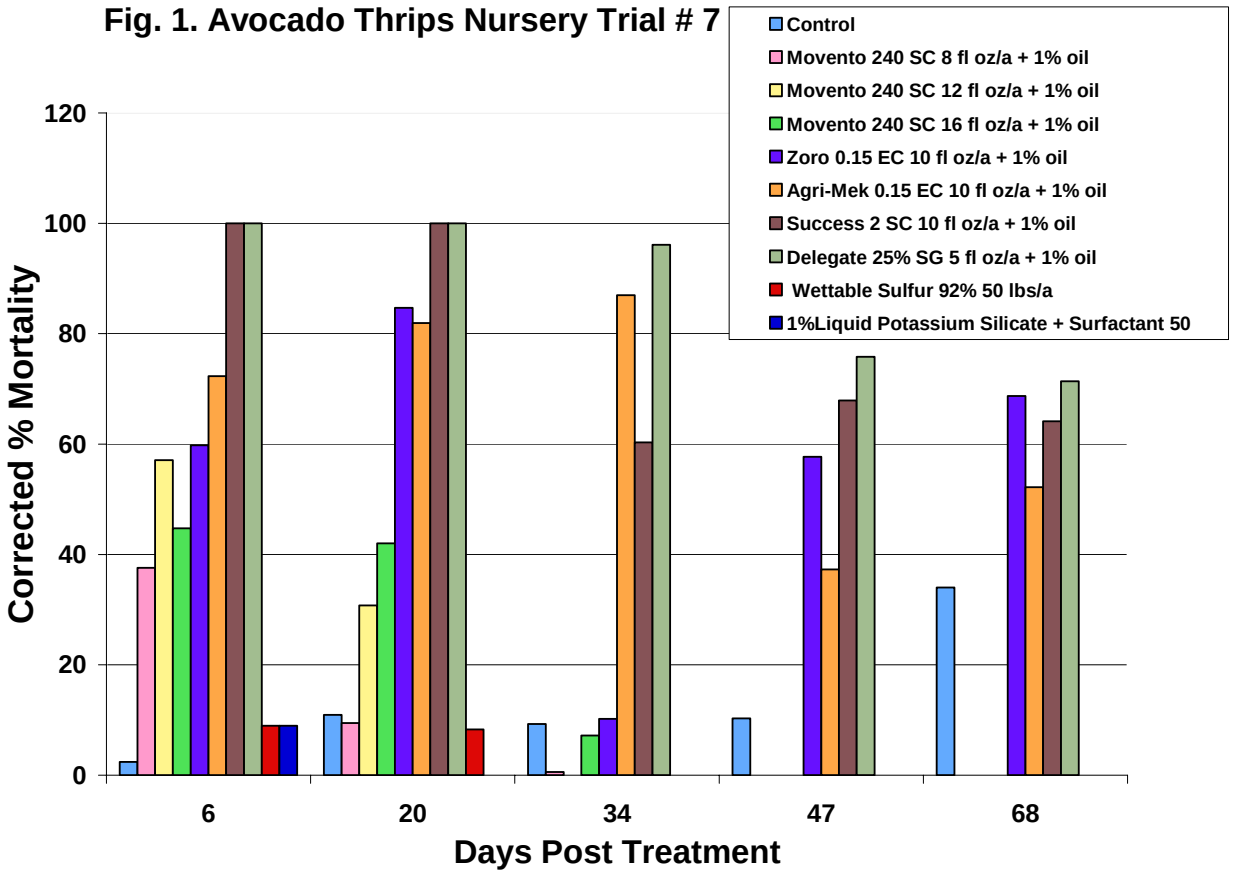
Spinetoram (Delegate) is in the same class of chemistry as spinosad (Success, Entrust) but from trials to date, it appears it to be more effective and more persistent against avocado thrips than is spinosad (see data from Fig. 1 below in which its efficacy appeared slightly better than Agri-Mek at 47 and 68 days after treatment). This material was recently registered for use on avocados and is a material that might be tried in rotation with abamectin to slow resistance evolution. Recall that there is the potential for cross-resistance between abamectin and the spinosyns (Delegate, Entrust, and Success). Ideally, we would like to rotate between completely different classes of chemistry but until these are available, we consider an Agri-Mek – Delegate rotation to be better than using either product twice in a row.

Research on Unregistered Products:

Fenpropathrin (Danitol) has the advantage of being effective against both avocado thrips and persea mite but this class of chemistry (the synthetic pyrethroids) is notorious for pest resistance evolution. We are hoping for registration on California avocados within the next year or two.

Spirotetramat (Movento) is a new class of chemistry (but the same as spirodiclofen that will be registered in the future for persea mite mite control – see below) that shows promise against a number of pests. This material was recently registered for use against citrus thrips on citrus in California and it has looked very strong in recent trials. We have not seen as good results against avocado thrips (see Fig. 1 below) and we suspect the problem may be more difficult leaf uptake (the material is systemic). Future trials will evaluate whether we can improve leaf uptake via addition of urea, boron, Nutraphyte, or surfactants.

NNI-0101 is a new chemistry from Nichino, is a feeding inhibitor/ behavior modifier, and appears effective against avocado thrips. Although we first tested it several years ago, it has been held up by EPA preliminary review, which was finally completed last year. Nichino now plans to move ahead with development and registration might be contemplated ca. 2012 or 2013.



Results from Avocado Thrips Nursery Trial #7:

For trials evaluating non-systemic chemicals, potted avocado plants are sprayed to runoff with candidate pesticides, pesticides are allowed to weather in the field, leaves tagged prior to the spray (identifying them as being fully expanded but tender at the time of pesticide application) are picked on various dates post treatment, second instar avocado thrips collected from the field are placed on the leaves inside Munger cells in the laboratory (5-8 Munger cells per treatment, 10-15 thrips per cell), and thrips mortality is evaluated after 48 hours.

Control second instar avocado thrips mortality was low until day 68 post treatment (34%) when leaves tagged at the beginning of the trial started to harden off. By day 96, leaves were quite tough resulting in 80% control thrips mortality and the trial was discontinued.

During the first several bioassays, Success and Delegate provided the most effective control of avocado thrips. On days 47 and 68, the most effective treatments were Zoro, Agri-Mek, Success, and Delegate, in no order. We have no good explanation for the low mortality observed with Zoro on day 34 – mortality of thrips both before and after this bioassay was relatively high and similar to that observed with Agri-Mek. Wettable sulfur and liquid potassium silicate did not appear to provide good residual control. Note that this test does not evaluate the contact activity of treatments because the first bioassay was done 6 days after treatment by placing second instar thrips on treated leaves in the laboratory.

2. Screening for Persea Mite Control Materials

We have also developed a fairly good means of screening new products for efficacy against persea mite and to date, we have run 5 field trials (2 were ruined by the 2006 freeze) with a sixth one in progress. The results of our most recent trial are shown in Fig. 2 below.

Pesticide	Company	IRAC Class	Notes
Persea Mite – Presently available products			
abamectin (Agri-Mek)	Syngenta	6	
generic abamectins	Several		
Narrow range oils	Several	-	Resistance thought to be unlikely
Future products for persea mite – not registered at present			
fenpropathrin (Danitol)	Valent	3	Also effective against avocado thrips; see above registration notes
etoxazole (Zeal)	Valent	10B	
spirodiclofen (Envidor)	Bayer	23	Same class as spirotetramat (Movento)
fenpyroximate (FujiMite)	Nichino	21	

Comments:

Etoxazole (Zeal) appears to be quite effective against persea mite and would be a new class of chemistry to take some of the pressure off products such as abamectin and fenpropathrin. Once we have several of these miticides registered for use on avocados, a grower would be wise to use abamectin and fenpropathrin (when registered) only for avocado thrips control. The etoxazole registration package is scheduled for submission to EPA in 2009. If we were able to obtain concurrent review by DPR, this material might be available to growers by 2010.

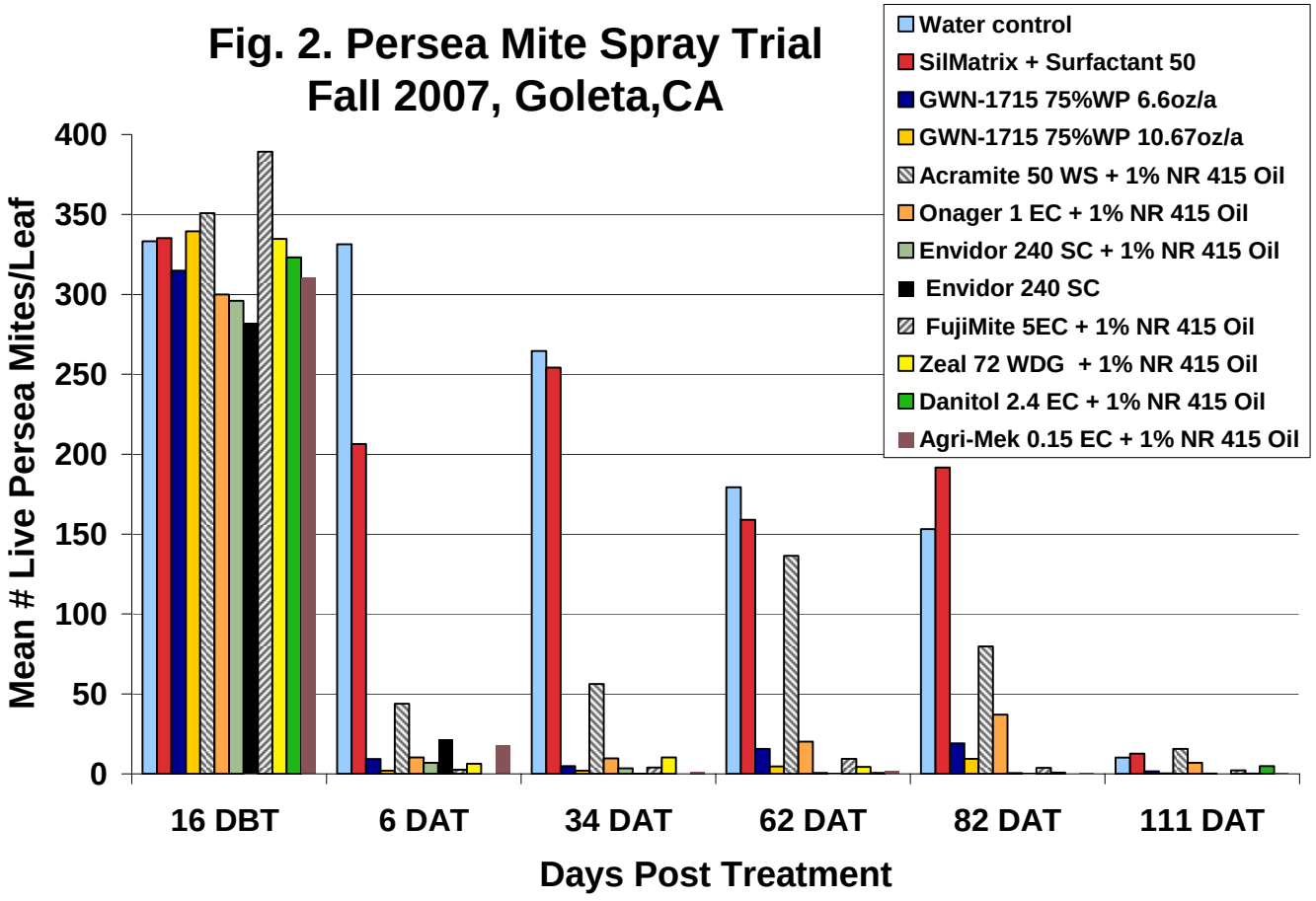
Spirodiclofen (Envidor) residue work is being done by Bayer and EPA submission is planned for late 2008 or early 2009 with likely registration by 2010.

Guy Witney attended an IR-4 meeting and was able to push for inclusion of fenpyroximate (Portal or FujiMite) in IR-4's planned residue program for 2008. Competition for projects is difficult within IR-4 so

Guy's efforts on this were important. Down the road, we look forward to having 3 effective persea mite materials (etoxazole, spirodiclofen, and fenpyroximate), all with different chemistries, that could be rotated to avoid the evolution of resistance, leaving other chemistries for use against avocado thrips.

Results with our September 2007 persea mite screening trial in Goleta:

A 2-year old (planted 8-06) Hass avocado grove on Dusa rootstock in Goleta, CA was used to evaluate the impact of 12 treatments on avocado persea mite. At the time of treatment, trees were 4-5 feet tall. Five mature leaves were randomly selected per tree and were returned to the laboratory where the total number of motile persea mites (larvae, protonymphs, deutonymps, and adults combined; i.e. all except eggs) on the bottom surface of the leaf were counted unless it was visually estimated that there were more than 50 motiles per leaf. In this case, the second half vein method of Machlitt (1998) was used - i.e. all motile mites were counted within one viewing field of the miscroscope as one proceeded down the second half vein of the leaf. Total persea mites per leaf are estimated as = 11.35 multiplied by the number seen around the second half vein (Machiltt 1998).



Pre-count leaves were collected from 138 trees (5 leaves/tree) on 9/10/07. The pre-count was taken by randomly selecting 5 leaves per tree. There were 12 experimental treatments so the 12 trees with the high pre-count level of mites were assigned to block 1, the next 12 to block 2, etc., until 8 blocks were assigned (i.e. 8 single tree replicates were used per treatment). One tree in each block was then randomly assigned to each treatment.

Treatments were applied on 9/26/07 and 9/27/07 using a Stihl SR 400 backpack mistblower using setting #3 (of 5 on the sprayer). A total of ca. 3 gallons of spray was used for the 8 trees in each of the

twelve treatments. Sprays were applied starting early in the morning and continuing as long as conditions were calm (i.e. sprays were discontinued if sufficient wind was present to reduce spray coverage on the trees). Post counts were taken in the same way as pre-counts and data are expressed as the mean number of motile mites per leaf.

Mean mite levels pre-treatment did not differ significantly between the 8 trees assigned to each of the various treatments. All treatments except Silmatrix were fairly effective in reducing mite levels up to 34 days post-treatment but based on mite levels (not consistently supported by statistical separation), Acramite and to a lesser extent, Onager (and perhaps the low rate of GWN-1715), appeared somewhat less effective later in the trial. Zeal, Agri-Mek, Envidor, the high rate of GWN-1715, FujiMite, and Danitol all appeared quite effective out to 111 days post-treatment (1/15/08) although mite levels on control trees had declined substantially by that date.

3. Developing Baseline Resistance Data

It is important to develop baseline data documenting the inherent susceptibility of avocado thrips, persea mite, and other pests to various pesticides so that later, after the material begins to be used, we can determine whether a reported field failure is actually due to resistance or might be due to the presence of a high population at the time of treatment, favorable weather conditions that promoted rapid population growth, was the result of poor spray coverage or less than optimal treatment timing, etc. Such work has now been completed with persea mite and abamectin (Humeres & Morse 2005), avocado thrips and sabadilla (Humeres & Morse 2006), and avocado thrips and both abamectin and spinosad (unpublished data). Such work will be important in the future with avocado thrips and both spinetoram and fenpropathrin.

4. Field Monitoring of Reported Control Failures

This last year was the first in the last several years when we did not have reports of possible control failures to investigate. This is good news and we hope that abamectin susceptibility can be maintained until new products such as fenpropathrin (Danitol), etoxazole (Zeal), spirodiclofen (Envidor), and fenpyroximate (FujiMite) are registered for use on California avocados. The recent avocado registration of spinetoram (Delegate) is a welcome start of what we hope will be several new registrations.

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