

Management and Resistance Monitoring of Avocado Thrips and Persea Mite

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Project Overview

Next year, we anticipate two and perhaps three new pesticides will be available to assist in control of avocado thrips and persea mite, Danitol for avocado thrips and Envidor for persea mite management (with Zeal also possibly available for persea mite control). 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 mites being moved somewhat 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 if the material is overused is specifically because of its long persistence 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.

The present focus of our research is 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 abamectin and the spinosyns; (2) Monitor for possible resistance of avocado thrips and persea mite to current products such as abamectin (Agri-Mek and generics), spinosad (Entrust), spinetoram (Delegate), and newer materials once they are introduced; and (3) other research as needed to optimally manage these and other pests of avocado.

Brief Summary of Research Results

Objective 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. Table 1 summarizes products that are (1) already available and (2) likely future products (i.e. unregistered at present) that have been identified and when we anticipate they will 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.

Table 1. Status of pesticides registered or being developed for avocado thrips control

| Pesticide | Company | IRAC Class | Notes |
|---|---------------------|-------------------|--|
| <u>Avocado Thrips - Presently available products</u> | | | |
| 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 |
| <u>Possible future products for avocado thrips - not registered at present</u> | | | |
| fenpropathrin (Danitol) | Valent | 3 | Federal registration obtained; expect CA registration ca. Dec. 2009 |
| spirotetramat (Movento) | Bayer | 23 | Breakthrough may have been made to solve leaf uptake problems on avocado |

Experimental Studies

Movento is a new class of chemistry (but the same as Envidor that will soon be for persea 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 has looked very strong in recent trials against a variety of pests including thrips, armored scale insects, psyllids, and mites. We had not seen as good results against avocado thrips and suspect the problem may be more difficult leaf uptake on avocado (the material is systemic). We are very encouraged by recent trial data from a study conducted by David Machlitt (Consulting Entomological Services, Moorpark) in which several surfactants added to Movento appeared to result in good control. We will soon be running studies to evaluate this result.

We ran another screening trial in August (thanks to the Maddock Ranch Nursery, Fallbrook for cooperation) in which we evaluated 10 experimental treatments for efficacy against avocado thrips over a 41-day period. Several weak materials were eliminated from consideration and several stronger materials will continue to be evaluated in future studies.

Danitol Moving Towards Registration for Spring 2010 Use:

Danitol is a pyrethroid insecticide that was registered recently at the federal level for use on avocados. California registration was posted in April 2009 and registration typically follows 6-8 months later so we expect CA registration any time now. The proposed CA label will allow aircraft application and will limit treatments to a single application per year. Given how quickly pyrethroid resistance developed in citrus thrips populations on citrus, we suggested the one application per year limit and were very pleased that Valent agreed to this restriction. In addition to strong activity on avocado thrips, Danitol is also quite active against perseas mite. However, with the several new materials soon to be available for perseas mite control (see below), we suggest growers restrict Danitol applications to control of avocado thrips and be extremely careful to rotate treatments between this chemistry and Agri-Mek or Delegate. Ideally, we suggest Danitol be used at a specific location only once every third year.

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

Because Danitol is nearing registration and Delegate was registered for use on avocados recently, we were interested in evaluating these two products as large-plot commercial treatments in comparison with Agri-Mek. All of our recent studies with Danitol have been small-scale trials. Even though Danitol is not registered for use on California avocados yet, a federal tolerance has been established. Thus, we were able to study its performance in large-scale commercial field trials without crop destruction under a Research Authorization filed by Valent. These trials were set up at 6 different field sites, 3 in the north (PCAs David Holden, Dave Machlitt, and Tom Roberts) and 3 in the south (PCAs Joe Barcinas, Jim Davis, and Matt Hand). At each study site, each of the 3 chemicals was applied to two plots (each of 2-5 acres in size), avocado thrips larval counts were taken weekly post-treatment in all 6 plots (3 chemicals x 2 plots per chemical; some sites also had untreated control plots), and we will evaluate levels of avocado thrips fruit scarring (this has been done at 3 field sites so far). We greatly appreciate the assistance of the 6 PCAs, the growers they worked with, and Dow AgroSciences, Syngenta Crop Protection, and Valent USA regarding cooperation on these studies.

In these field trials, we wanted to look at the performance of these 3 materials against avocado thrips in a diversity of situations. Two of the trials went on pre-bloom and 4 post-bloom. Applications were made by ground in 3 situations and by helicopter in 3 cases. Treatment rates were 20 fl oz per acre Agri-Mek 0.15EC, 7 oz per acre Delegate WG, and 21.33 fl oz per acre Danitol 2.4EC. With all 3 chemicals, oil was added to the spray. Spray gallonage varied between 50 and 100 gpa by site but was uniform for each treatment at each site.

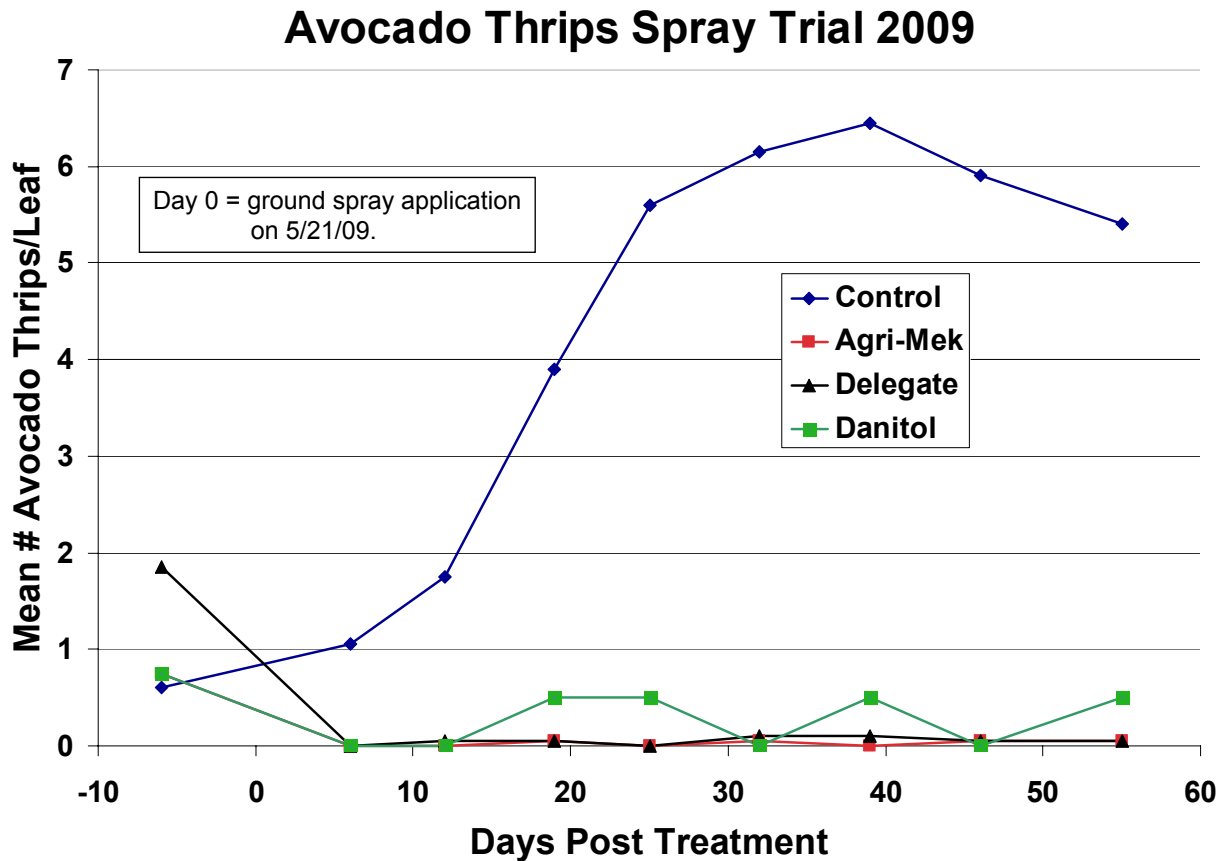
Some PCAs took thrips infestation counts on leaves and some on fruit. As an example, Fig. 2 shows weekly thrips infestation counts at the Holden site in Somis. Table 2 summarizes fruit scarring evaluations we took at 3 of the study sites so far (the other 3 will be assessed shortly before harvest next year). At all 3 of these sites, the performance of Agri-Mek, Danitol, and Delegate was similar (i.e. all appear to be effective materials against avocado thrips). None of these 3 field sites, however, had high levels of avocado thrips in 2009 (this happens sometimes – we have often joked that a good way to make sure thrips levels are going to be low in a particular year is for us to run a large set of field trials).

Table 2. Fruit Scarring Data from 3 of the PCA Cooperator Avocado Thrips Field Studies ¹

| Goleta, Santa Barbara Co. PCA Dave Machlitt | Agri-Mek South | Agri-Mek North | Danitol South | Danitol North | Delegate South | Delegate North | | |
|--|-------------------|-------------------|------------------|------------------|-------------------|-------------------|------------------|------------------|
| Fruit with 0-5% scarring | 2.6% | 0.0% | 0.2% | 0.2% | 0.6% | 0.2% | | |
| Mean | | 1.3% | | 0.2% | | 0.4% | | |
| Fruit with 6-10% scarring | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | | |
| Mean | | 0.0% | | 0.0% | | 0.0% | | |
| Total Economic Scarring (> 10% of surface) | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | | |
| Mean | | 0.0% | | 0.0% | | 0.0% | | |
| Somis, Ventura Co. PCA Tom Roberts | Agri-Mek East | Agri-Mek West | Danitol East | Danitol West | Delegate East | Delegate West | | |
| Fruit with 0-5% scarring | 8.8% | 23.4% | 0.0% | 2.6% | 16.2% | 10.2% | | |
| Mean | | 16.1% | | 1.3% | | 13.2% | | |
| Fruit with 6-10% scarring | | | | | | | | |
| Mean | 0.0% | 0.4% | 0.0% | 0.0% | 1.2% | 0.2% | | |
| | | 0.2% | | 0.0% | | 0.7% | | |
| Total Economic Scarring (> 10% of surface) | 0.0% | 0.0% | 0.0% | 0.0% | 0.2% | 0.0% | | |
| Mean | | 0.0% | | 0.0% | | 0.1% | | |
| Somis, Ventura Co. PCA David Holden | Agri-Mek South | Agri-Mek North | Danitol South | Danitol North | Delegate South | Delegate North | Control South | Control North |
| Fruit with 0-5% scarring | 17.6% | 10.4% | 0.4% | 0.0% | 11.4% | 9.4% | 24.6% | 14.8% |
| Mean | | 14.0% | | 0.2% | | 10.4% | | 19.7% |
| Fruit with 6-10% scarring | 6.2% | 1.6% | 0.0% | 0.2% | 4.8% | 4.2% | 9.6% | 4.0% |
| Mean | | 3.9% | | 0.1% | | 4.5% | | 6.8% |
| Total Economic Scarring (> 10% of surface) | 2.2% | 1.2% | 0.0% | 0.0% | 2.8% | 2.2% | 5.8% | 2.6% |
| Mean | | 1.7% | | 0.0% | | 2.5% | | 4.2% |

¹ 500 fruit per plot (1,000 per treatment) were assessed for the percent of fruit surface area scarred by avocado thrips.

Fig. 1. Weekly counts of the mean # of immature thrips per leaf at the Holden study site in Somis



Objective 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, have run 6 field trials. As a result, 3 new and effective materials are moving towards registration on avocado (Envidor [2010], Zeal [late 2010], and FujiMite [ca. 2011]). These 3 materials all are different chemistries and each chemistry is different from Agri-Mek, making the likelihood of cross-resistance developing low.

Envidor Moving Towards Registration for 2010 Use:

Envidor 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 Agri-Mek and Danitol (when registered). Once we have one or more of these miticides registered for use on avocados, a grower would be wise to use Agri-Mek and Danitol only for avocado thrips control. We don't yet have a precise data when CA Envidor registration is expected but will have an expected registration data to announce at the spring CAC – Cooperative Extension – Grower meetings.

Zeal Registration Likely late 2010

The Zeal registration package was submitted to US EPA in August 2009. At this point, it is unclear whether it will be available for use in time for the 2010 persea mite field season. Each of Envidor, Zeal, and FujiMite have appeared to be of similar efficacy as Agri-Mek against persea mite in small field trials but the real test of these materials will have to await large-scale field trials.

Table 1. Status of pesticides registered or being developed for avocado thrips control

| Pesticide | Company | IRAC Class | Notes |
|---|----------------|-------------------|---------------------------------------|
| <u>Persea Mite – Presently available products</u> | | | |
| abamectin (Agri-Mek) | Syngenta | 6 | |
| generic abamectins | several | | |
| Narrow range oils | several | - | Resistance thought to be unlikely |
| <u>Future products for persea mite – not registered at present</u> | | | |
| spirodiclofen (Envidor) | Bayer | 23 | Same class as spirotetramat (Movento) |
| etoxazole (Zeal) | Valent | 10B | |
| fenpyroximate (FujiMite) | Nichino | 21 | |

FujiMite Registration Expected in 2011

FujiMite US EPA registration is expected ca. Feb. 2011 and CA registration ca. June 2011.

Objective 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 Agri-Mek (Humeres & Morse 2005), avocado thrips and Veratran D (Humeres & Morse 2006), and avocado thrips and both Agri-Mek and Success (unpublished data). Such work will be important in the future with avocado thrips and both Delegate and Danitol.

Objective 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 Agri-Mek susceptibility can be maintained until new products such as Danitol, Envidor, Zeal, and FujiMite are registered for use on California avocados. The recent avocado registration of Delegate is a welcome start of what we anticipate will be several new registrations.

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