Management and Resistance Monitoring of Avocado Thrips and Persea Mite

Joseph Morse
Department of Entomology, UC Riverside

Cooperators:
Technical Assistance: Alan Urena, Lindsay Robinson, and Pamela Watkins, UC Riverside;
Collaborative Research on Systemic Pesticides: Frank Byrne and Nick Toscano, UC Riverside;
Grower and Pest Control Advisor Collaborators

We cannot emphasize enough that it is likely that avocado thrips will develop resistance to abamectin (Agri-Mek and generic abamectins) if this material continues to be heavily relied on as the major means of controlling avocado thrips and especially if it is also used for control of persea mite (and possibly *Neohydatothrips burungae* if this species were to become problematic in commercial areas). 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 spinosyns (Success, Entrust, unregistered Delegate) and/or other materials. 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 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, any generic abamectin, Success, Entrust, or Delegate [when it is registered] per year in that grove). 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 <u>you</u> 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 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 spinosyns; (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 (unregistered 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)	Syngenta	6	Likely cross resistance to 5
generic abamectins	Several	6	
spinosad (Success, Entrust)	Dow	5	Likely cross resistance to 6
sabadilla (Veratran D)	Dunhill	close to 3	
Possible future products for avocado thrips - not registered at present			
spinetoram (Delegate)	Dow	5	Likely cross resistance to 6
fenpropathrin (Danitol)	Valent	3	Also effective against persea mite
spirotetramat (Movento)		Bayer 23	Efficacy not clear yet
NNI-0101	Nichino	unknown	
Possible future need for armored scale control - not registered at present			
dinotefuran (Venom)	Valent	4A	

We are quite concerned that one of the several species of armored scales present on Mexican avocados entering California (but not known to be present in CA) may eventually establish in California. If so, a systemic neonicotinoid such as dinotefuran may be one of the few practical means of treating hillside groves that are not easily treated with ground sprays to the degree necessary to achieve good control of an armored scale insect.

Spinetoram (Delegate) is in the same class of chemistry as spinosad (Success, Entrust) but from trials to date, it appears it may be more effective and more persistent against avocado thrips than is spinosad. Federal (EPA) registration was granted 10-2-07 and CA registration on avocados is likely quite soon.

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. Submission of the registration package to EPA is expected April – June 2008 with likely registration in CA in 2009.

Spirotetramat (Movento) is a new class of chemistry (but the same as spirodiclofen for persea mite below) that shows promise against a number of pests. Registration on citrus for citrus thrips control is expected early 2008. In efficacy trials to date with avocado thrips we have not seen the excellent activity seen with citrus thrips and we are presently trying to see if we improve efficacy by improving leaf penetration (the material is systemic and surface residues provide little control). So far, it appears that moving adequate levels of spirotetramat into avocado leaves is challenging.

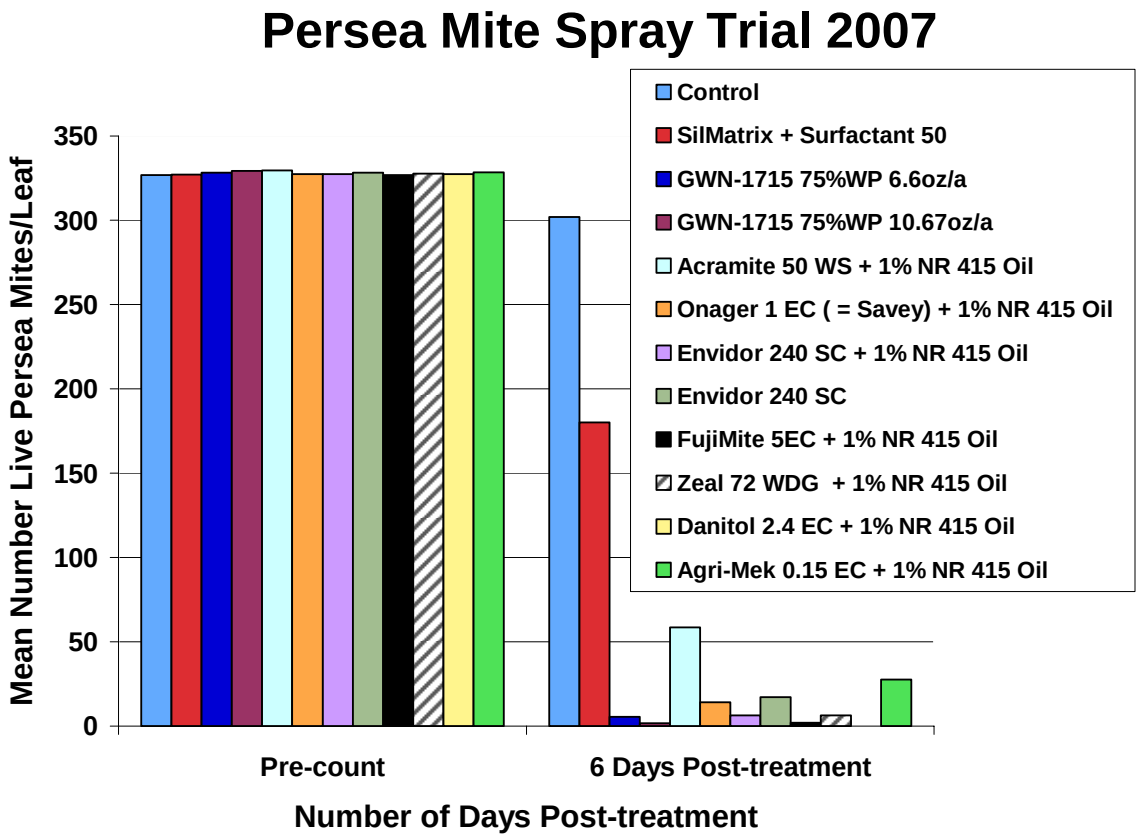
NNI-0101 is a new chemistry from Nichino, is a feeding inhibitor/ behavior modifier, and appears effective against avocado thrips. Although we first tested it several years ago, it has been held up by EPA preliminary review which was finally completed September 2007. Nichino now plans to move ahead with development and registration might be contemplated ca. 2012 or 2013.

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 4 field trials (2 were ruined by last year's freeze) with a fifth one in progress. With the current trial, we have taken only the 1-week post-treatment count (the 4-week count is planned for the week of Oct. 22) and early results are shown in Figure 1 below.

Pesticide	**Company**	**IRAC Class**	**Notes**
Persea Mite – Presently available products			
abamectin (Agri-Mek)	Syngenta	6	
generic abamectins	Several	6	
Narrow range oils	Several	-	Resistance thought to be unlikely
Future products for persea mite – not registered at present			
fenpropathrin (Danitol)	Valent	3	See above registration notes
etoxazole (Zeal)	Valent	10B	
spirodiclofen (Envidor)	Bayer	23	
fenpyroximate(FujiMite)	Nichino	21	
hexythiazox (Onager)	Gowan	10A	Cross resistance potential to etoxazole

Figure 1. Early results of a persea mite pesticide trial in Goleta



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. With the support of Valent, CAC pushed for and was able to include etoxazole residue work in the 2006 IR-4 program and this field work is now complete with analysis of data in progress. 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 the recent 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.

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 control failures

We recently investigated two reports of abamectin – avocado thrips control failures in San Diego Co. but resistance evaluations confirmed that the suspected lack of field control was not due to resistance. Investigation of a reported abamectin – persea mite field failure in Ventura Co. will be done over the next several weeks.

RECENT PUBLICATIONS AND REFERENCES CITED

Byrne, F. J., N. C. Toscano, A. A. Urena, and J. G. Morse. 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, F. J., N. C. Toscano, A. A. Urena, L. J. Robinson, and J. G. Morse. 2007. Neonicotinoid Toxicity to Avocado Thrips, *Scirtothrips perseae* Nakahara (Thysanoptera: Thripidae). Pest Management Science 63: 210-216.

Dreistadt, S., B. Ohlendorf, M. L. Flint, P. A. Phillips, B. A. Faber, J. G. Morse, and M. S. Hoddle. 2007. UC IPM Pest Management Guidelines: Avocado: Insects and Mites. UC ANR Publication 3436. UC IPM Program, Davis, CA.
Available at http://www.ipm.ucdavis.edu/PMG/selectnewpest.avocado.html

Humeres, E. C. and J. G. Morse. 2005. Baseline Susceptibility of Persea Mite (Acari: Tetranychidae) to Abamectin and Milbemectin in Avocado Groves in Southern California. Experimental & Applied Acarology 36: 51-59.

Humeres, E. C. and J. G. Morse. 2006. Resistance of Avocado Thrips (Thysanoptera: Thripidae) to Sabadilla, a Botanically Derived Bait. Pest Management Science 62: 886-889.

Jetter, K. M. and J. G. Morse. 2004. Agri-Mek Section 18 Approved for the 2004 Field Season. AvoResearch 3(1): 1-2, 4-6. California Avocado Commission, Irvine, CA.

Morse, J. G. 2004. Avocado Thrips Resistance: A Real Concern for the Future. Update, Mission Avocados, Oxnard, CA. December 2004, p. 3.

Morse, J. G. and M. S. Hoddle. 2006. Invasion Biology of Thrips. Annual Review of Entomology 51: 67-89.

Morse, J. G. and G. W. Witney. 2005. Avocado Thrips – Resistance to Pesticides. AvoResearch, Spring 2005, California Avocado Commission, Irvine, CA. 2 pp.

Morse, J. G., F. J. Byrne, N. C. Toscano, A. A. Urena, E. C. Humeres, and L. Robinson. 2005. Evaluation of Systemic Chemicals for Avocado Thrips and Avocado Lace Bug Management. pp. 24-33, *In*: Proceedings, California Avocado Commission Research Symposium, October 29, 2005, California Avocado Commission, Irvine, CA. 133 pp.

Morse, J. G., E. C. Humeres, A. A. Urena, P. J. Watkins, A. P. Flores, and D. R. Anderson. 2004. Biology and Chemical Control of Avocado Thrips; Pesticide Resistance Monitoring with Avocado Thrips and Persea Mite. Pp. 43-53, *In*: Proceedings, California Avocado Commission Research Symposium, October 30, 2004, California Avocado Commission, Irvine, CA. 125 pp.

Morse, J. G., A. A. Urena, E. C. Humeres, L. J. Robinson, A. P. Flores, and P. J. Watkins. 2005. Biology, Management, and Resistance Monitoring of Avocado Thrips and Persea Mite. Pp. 14-23, *In*: Proceedings, California Avocado Commission Research Symposium, October 29, 2005, California Avocado Commission, Irvine, CA. 133 pp.

Morse, J., A. Urena, and L. Robinson. 2006. Biology, Management and Resistance Monitoring of Avocado Thrips and Persea Mite. Pp. 16-24, *In*: *Proceedings*, California Avocado Research Symposium, November 4, 2006, California Avocado Commission, Santa Ana, CA. 155 pp.

Phillips, P. A., B. A. Faber, J. G. Morse, and M. S. Hoddle. 2007. Invertebrates. Pp. 10-50, In: UC IPM Pest Management Guidelines: Avocado. UC ANR Publication No. 3436. UC IPM Program, Davis, CA. 85 pp.

Tollerup, K. E. and J. G. Morse. 2006. The Effect of Horticultural Spray Oil and Surfactants on the Residual Efficacy of Spinosad against Avocado Thrips, *Scirtothrips perseae* (Thysanoptera: Thripidae). Journal of Agricultural and Urban Entomology 22: 127-131.

Triapitsyn, S. V. and J. G. Morse. 2005. A Review of the Species of *Ceranisus* Walker (Hymenoptera: Eulophidae) in the New World. Transactions of the American Entomological Society 131: 69-86.

Witney, G. 2004. The Long Road to Section 18 Registration. AvoResearch 3(1): 3-4. California Avocado Commission, Irvine, CA.