Field Research on Avocado Thrips in Ventura County in 2003

New Project: Year 1

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Since the introduction of the avocado thrips (*Scirtothrips perseae* Nakahara) in California in 1996, this species has developed into a serious pest costing the industry about $8 million annually (Hoddle *et al*, 2003). Although *S. perseae* preferentially feed on flushing leaves, feeding on small fruit during early development causes severe fruit surface scarring (Yee *et al*., 2001). To decrease thrips populations during early fruit set, selective chemical sprays are currently used in most conventional groves (Yee *et al*., 1999; Oevering *et al*., 2002). Alternative means of *S. perseae* control are not yet economically viable. In order to facilitate *S. perseae* monitoring and pesticide applications, a growing number of orchards are being pruned annually. The UCCE research in Ventura County in 2002-2003 focused on cultural management (pruning) and chemical management (spot application, experimental threshold determination and an Entrust pilot study) as part of the development of an Integrated Pest Management Program. In addition a survey of natural enemies in the region was undertaken to identify possible alternatives to chemical and cultural pest control. The results are discussed below.

Cultural Management - Pruning

The objective for this research was to determine the effect of pruning time on occurrence of growth flush as a preferred food substrate for avocado thrips. Pruning as a cultural practice to control tree size, to increase canopy light penetration, to regulate crop production and to facilitate pest control activities, has been increasingly applied in 'Hass' avocado since the mid 1990s (Brainstorming 1999). Pruning activities observed in Southern California vary from light pruning to stumping, and most often take place during January through March (Faber & Bender, 2003). Pruning is known to stimulate growth and development of dormant buds (Stassen *et al.*, 1999). An increase in growth flush or new foliage would serve as an increased food substrate for *S. perseae*. It is hypothesized that pruning during certain months (pruning time) may increase the availability of flush growth during the critical early fruit development stage, providing a preferred food source for *S. perseae* and therewith possibly limiting fruit feeding damage.

In this study, pruning time was related to yield and substrate availability for avocado thrips, in order to determine a preferred time to prune "Hass" avocado in Southern California so as to minimize avocado thrips damage to fruit.

Materials and methods
'Hass' trees grafted on 'Duke 7' rootstock growing in a two year old commercial orchard in Santa Paula, Ventura County, were used in this study. Trees were planted in 1999 at 20 × 20 ft spacing on a sandy loam soil (pH = 7.2). The plot was regularly irrigated to supplement the annual rainfall. In June and September nine gal/acre CAN-17 (Calcium Ammonium Nitrate 17-0-0, Unocal, Chevron Corp., Richmond, CA) were applied through the irrigation system.

Applications of abamectin (12oz Agrimek in 80gal/acre) with 0.25% NR415 oil were made for *S. perseae* control on April 24 and July 10, 2002 and April 9, 2003. Additionally, one application of spinosad (6oz Success in 80gal/acre with 1% NR415 oil) was made for *S. perseae* control on March 10, 2003. For control of persea mite (*Oligonychus perseae* Tuttle, Baker & Abbatiello) (Acari:

Tetranychidae) 60,000 and 100,000 *Amblyseius* (= *Neoseiulus*) *californicus* McGregor (Acari: Phytoseiidae) were released per acre on September 20 and December 5, 2002 respectively.

In a random design, 20 trees were assigned to each of 12 monthly pruning treatments and 1 control (not pruned). For a period of one year, a different set of 20 trees was lightly pruned in the first week of each month. The developmental stages (bud, flower, fruit set, fruit size) of the trees were recorded with every observation. A phenological score (to represent the presence and quantity of growth flush) was determined for each tree by observing five terminals in each quadrant and allocating one point to each flushing terminal. As a result a score of 20 indicated a tree in full flush, a score of 0 a tree without flush. Once a month the numbers of immature *S. perseae* were counted on ten flush leaves per tree and a phenological score for the tree was recorded. In March 2003, the total number of fruit per tree was counted on the trees a week before harvest of the 2002 crop. The 2003 fruit set was recorded on the trees in August 2003.

Results

Trees in the control treatment (no pruning) were flowering when the trial started in January 2002 and continued to do so through June. Fruit set began to occur from April through to June, with fruit developing between June and August at which point they were over 2 inches (5 cm) in length. In August, September and October no flowers were present. Following the early rains in October, bloom commenced once more in November and continued for the remainder of the observed time period (Fig. 1). Fluctuations in the phenological scores followed the same overall pattern during the year (Fig. 1).

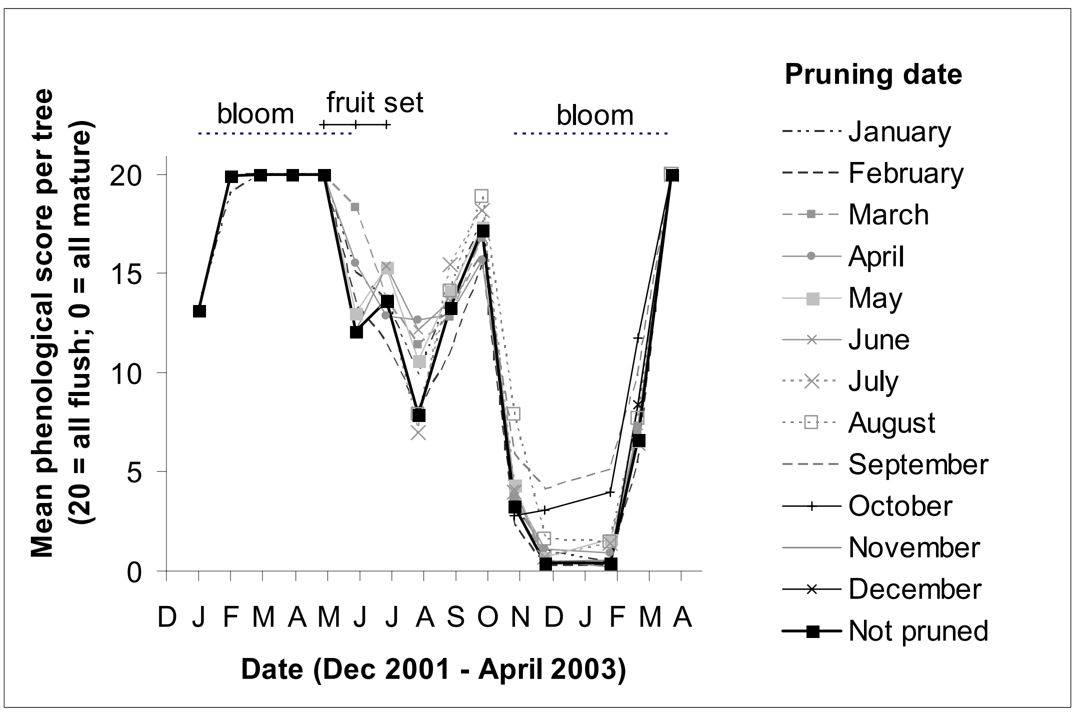

Fig. 1. Mean phenological scores per tree per prune date from January 2002 to April 2003

Mean phenological scores for all treatments were compared to unpruned trees over the same time period until the end of the trial (from one month after pruning until April 2003). When considering the presence of flush during the months of fruit set and early fruit development (June, July, August), pruning between January and May increased the presence of flush in June and August, but not in July (Table 1).

Because of the chemical controls applied for avocado thrips, absolute effects of pruning on population development were not determined. However, differences in numbers of avocado thrips on pruned and control trees were significant following pruning in April, and a trend (t-test, $P < 0.1$) of higher numbers recorded on pruned trees following pruning in May, June, August and September (Table 2).

The number of fruit harvested in 2002 from trees pruned in January or December did not differ from the unpruned trees and when pruned in February and March yields were significantly lower than any of the other pruning times (Table 3). For 2003, January was the only prune date that did not negatively affect the number of fruit set. All other dates, especially pruning in October and December, significantly reduced the number of fruit set in 2003 (Table 3).

Table 1. Mean phenological score per tree per prune date for June, July and August 2002

Month	Prune Date[1]	Mean phenological score ± se[2]	t value	*P* value	S[3]
June	No Prune	12.05 ± 0.344			
	January	15.0 ± 0.223	-3.371	0.002	S
	February	15.76 ± 0.252	-3.973	< 0.001	S
	March	18.3 ± 0.286	-6.544	< 0.001	S
	April	15.5 ± 0.213	-3.992	< 0.001	S
	May	13.0 ± 0.235	1.067	0.293	
July	No Prune	13.6 ± 0.246			
	January	13.65 ± 0.207	-0.073	0.942	
	February	13.59 ± 0.302	0.014	0.989	
	March	13.7 ± 0.315	-0.117	0.907	
	April	12.85 ± 0.187	1.370	0.263	
	May	15.2 ± 0.275	-2.152	0.038	S
	June	15.3 ± 0.277	-2.369	0.023	S
August	No Prune	7.9 ± 0.206			
	January	9.9 ± 0.215	-3.146	0.003	S
	February	9.47 ± 0.182	-2.638	0.012	S
	March	11.35 ± 0.323	-4.217	< 0.001	S
	April	12.65 ± 0.149	-8.736	< 0.001	S
	May	10.6 ± 0.202	-4.377	< 0.001	S
	June	1.71 ± 0.288	-4.983	< 0.001	S
	July	7.89 ± 0.227	-0.008	0.994	

[1]Trees were pruned during the first week of the month (2002)

[2]20 trees per prune date and 20 trees per control, phenological score of 20 = all flush

[3]S = Phenological score is significantly ($P<0.05$) higher than in unpruned control trees

Discussion

The primary objective of this research was to investigate whether pruning affects the amount of flush present before fruit set and during fruit development when fruit is prone to scarring. Since pruning promotes growth and development of dormant buds (Stassen *et al.*, 1999), it is no surprise that most early pruning dates increase the overall phenological score during the critical fruit development stage (Table 1). In July, when this relationship was not apparent, control trees were also fully in bloom and producing flush, which may have masked any flush inducing effect in pruned trees. During the cooler months (November and December) the trees scored low (small amounts of flush present) on phenology in general, and pruning activities in that time period did not accelerate bud development enough to differ significantly from controls.

Flush normally hardens off during fruit development, forcing thrips to find other food sources such as young tender fruit. Therefore, the presence of flush during fruit set and development may maintain thrips on leaves during the scarring-sensitive period of fruit development. Our observations indicate that in order to continue flush production, pruning during spring is required. Leaf hardening occurred during July in control trees causing a significant decrease in availability of flush growth. At the same time, trees pruned between January and May responded more vigorously to a June fertilizer application than control trees, producing a flush of growth during August. Since the fruit is of critical size between July and August, an earlier (late may, early June) application of fertilizer may encourage this flush presence better.

Table 2. Mean number of immature *S. perseae* thrips per observation of 10 leaves from prune date until April 2003

Prune Date[1]	Mean number of immatures ± se[2]		t-test		
	Pruned trees	Control trees	t value	*P* value	S[3]
January	32.97 ± 0.482	30.54 ± 0.411	-0.488	0.626	
February	29.44 ± 0.457	33.25 ± 0.461	0.782	0.435	
March	44.24 ± 0.677	36.48 ± 0.522	-1.266	0.206	
April	55.99 ± 0.844	39.74 ± 0.600	-2.308	0.022	S
May	57.39 ± 0.927	44.68 ± 0.693	-1.715	0.087	T
June	63.55 ± 1.184	48.68 ± 0.831	-1.719	0.087	T
July	54.44 ± 1.042	56.32 ± 0.983	0.237	0.813	
August	82.00 ± 1.637	64.18 ± 1.234	-1.725	0.086	T
September	84.23 ± 2.077	61.75 ± 1.638	-1.891	0.060	T
October	74.57 ± 2.908	69.27 ± 2.320	-0.368	0.714	
November	30.93 ± 2.450	34.40 ± 2.555	0.314	0.754	
December	0.70 ± 0.127	2.25 ± 0.387	1.781	0.083	

[1]Trees were pruned during the first week of the month (2002)
[2]20 trees per prune date and 20 trees per control, one observation of 10 leaves per tree per month
[3]S Number of immature thrips is (S) significantly ($P<0.05$) higher, or shows a (T) trend (P<0.10) to be higher than in unpruned control trees

All treatments received a total of two abamectin applications for control of avocado thrips, which suppresses populations for at least 60 days and one spinosad application (effective for at least 3 weeks) (Oevering *et al*., 2001). Additionally predatory mites, which prey on first instar avocado thrips (Oevering, personal observation), were released twice. In spite of these measures for thrips control, late spring and summer-pruned trees still showed a trend of higher *S. perseae* numbers compared to control trees (Table 2), which may not be desired.

Table 3. Mean number of fruit per tree per prune date in 2002 and 2003

Prune Date[1]	Mean number of fruit per tree ± se[2,]	
	2002 fruit set[3]	2003 fruit set[3]
January	14.4 ± 1.90 bc	44.8 ± 10.57 d
February	7.1 ± 1.59 a	22.4 ± 4.08 bc
March	6.1 ± 1.97 a	17.3 ± 4.19 ab
April	14.0 ± 2.15 b	17.7 ± 3.43 ab
May	13.1 ± 2.22 b	20.8 ± 3.19 ab
June	3.9 ± 2.21 b	14.4 ± 4.22 ab
July	13.3 ± 2.27 b	14.5 ± 3.14 ab
August	13.5 ± 1.83 b	18.1 ± 3.02 ab
September	13.3 ± 2.05 b	13.3 ± 2.24 ab
October	13.7 ± 2.14 b	7.2 ± 1.08 a
November	13.7 ± 2.37 b	12.3 ± 2.41 ab
December	14.4 ± 1.64 bc	7.3 ± 1.36 a
Unpruned Control	20.1 ± 2.19 c	36.8 ± 11.67 cd

[1]Trees were pruned during the first week of the month (2002)
[2]20 trees per prune date and 20 trees per control, 2002 crop observed March 2003; 2003 crop observed August 2003
[3]Different letters indicate significantly different number of fruit set (ANOVA (2002): 12df, F = 2.62, $P = 0.02596$, LSD $P<0.05$; ANOVA (2003), 12df, F = 4.24; $P = 0.00001$, LSD $P<0.05$)

Even with fruit present on the tree, light pruning in January is preferred over any other month because it has the least effect on the next year's crop and in this study actually increased the number of fruit per tree slightly (Table 3).

Similar yield (Table 3) increased flush presence during fruit set (Table 1) and thrips populations that do not exceed those found in unpruned trees using the current chemical control (Table 2) indicate that pruning in January may be most suitable for the industry. The timing of fertilizer applications will be crucial in ensuring the continuing presence of flush leaves. Pruning in January established a leaf flush on which thrips persist during fruit set. Based on IPM guidelines this leaf flush can then be used to predict chemical applications. Before pruning can be used in an IPM program as a means of cultural control, future trials omitting any chemical control for avocado thrips and including different fertilizer application times around June are required to evaluate whether higher numbers of thrips on flush affect fruit scarring in the presence of flush.

Until then, in combination with current control methods, this study showed that the practice of pruning young trees lightly during January rather than February or March as appears to be the current practice, will not greatly affect yields, or increase thrips numbers, and will provide benefits associated with pruning practices.

Chemical Management as part of IPM – (a) Abamectin spot application

The objective for this research was to compare the effect of abamectin as a ground-applied pre-bloom spot spray with aerial application on the suppression of avocado thrips. By precision targeting the areas in the tree where *S. perseae* is present less chemicals may be required to achieve the same suppression. In 2002 this trial failed because of very low thrips pressure in the Santa Paula area. This year a field in Oxnard was used.

Materials and methods
'Hass' trees grafted on 'Duke 7' and 'Toro Canyon' rootstock growing in a 30 acre commercial orchard in Oxnard, Ventura County, were used in this study. Trees were planted in 1997 at 20 × 20 ft spacing on a sandy loam soil (pH = 7.8). The plot was regularly irrigated to supplement the annual rainfall and received applications of 50/50 mix of N-phuric 15/49 and phosphoric acid (0-52-0) in July (350 gallons), August (600 gallons) and September (475 gallons).

In a randomized block design, 12 blocks of 81 trees (9 rows of 9 trees) were allocated to one of 4 treatments in 3 replicates following a pre-treatment count of immature thrips numbers:

(1) abamectin 20 oz/acre with 2% NR 415 oil (100 gallons/acre) applied by helicopter (Aspen),
(2) abamectin 12 oz/acre with 2% NR 415 oil (60 gallons/acre) spot application to flushing parts of the tree only, by ground using an ATV and two handguns on hoses,
(3) spinosad 10 oz/acre with 2% NR 415 oil (100 gallon/acre) ground application
(4) no treatment.

All treatments were applied April 16 and 17, 2003. Every two weeks, five trees in the center of each block were observed and the number of immature thrips was counted on ten fully expanded flush leaves for each tree. Fruit scarring observations are planned for winter 2003/4.

Results

The mean number of immature thrips per leaf was significantly reduced in all three treatments following application (Fig. 2). For a period of 97 days, no difference in the reduction of immature thrips numbers per leaf was observed between the helicopter application and the ground spot spray of abamectin. Both treatments were effective for 83 days. The ground application of spinosad also suppressed immature thrips numbers for 83 days but was significantly weaker than either of the abamectin treatments. After 97 days, differences between treatments and control blocks were no longer observed (Table 4). Analyses of the effect treatments had on fruit scarring will be undertaken in winter 2003/4.

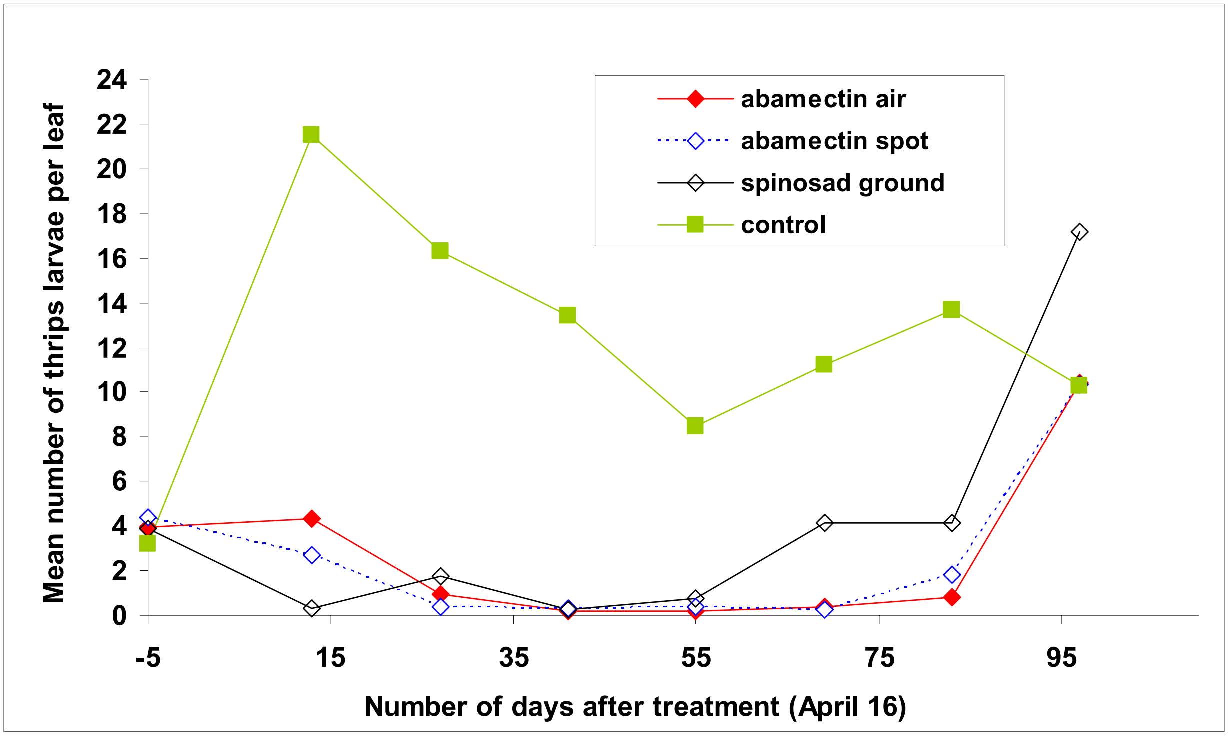

Fig. 2. Mean number of immature avocado thrips per leaf in an abamectin spot spray trial

Table 4. Mean number of immature thrips per leaf ± se following applications of abamectin and spinosad

DAT[1]	Abamectin helicopter[2]	Abamectin spot spray[3]	Spinosad ground[4]	Control	F ratio[5]	P value[5]
-5	7.9 ± 1.30 a	8.8 ± 0.60 a	7.7 ± 2.05 a	6.3 ± 2.54 a	0.33	0.8017
13	4.3 ± 0.19 a	2.7 ± 0.56 a	0.3 ± 0.03 a	18.2 ± 3.30 b	24.91	0.0004
27	0.9 ± 0.51 a	0.4 ± 0.20 a	1.7 ± 0.81 a	16.3 ± 6.20 b	6.92	0.0168
41	0.2 ± 0.06 a	0.3 ± 0.14 a	0.2 ± 0.09 a	13.4 ± 1.53 b	66.26	0.00001
55	0.2 ± 0.12 a	0.4 ± 0.08 a	0.7 ± 0.34 a	8.5 ± 1.44 b	31.37	0.0002
69	0.4 ± 0.16 a	0.3 ± 0.23 a	4.1 ± 1.06 b	11.2 ± 1.97 c	19.63	0.0009
83	0.8 ± 0.28 a	1.8 ± 0.37 a	4.1 ± 2.03 a	13.7 ± 3.50 b	7.44	0.014
97	10.4 ± 3.62 a	10.4 ± 2.61 a	17.1 ± 3.59 a	10.2 ± 3.44 a	1.06	0.4246

[1]Days after treatment, treatments applied April 16, 2003
[2]Agrimek 20 oz/acre + 2% NR 415 oil (100 gallons/acre) air application
[3]Agrimek 12 oz/acre + 2% NR 415 oil (60 gallons/acre) spot application
[4]Success 10 oz/acre + 2% NR 415 oil (100 gallon/acre) ground application
[5]ANOVA, LSD<0.05, different letters in same row indicate significant differences

Discussion
The primary objective of this trial was to compare the effectiveness of a spot spray application to both an aerial and a complete ground application. In order for the spot application to be considered for commercial use it had to be more effective than a spinosad application and at least as effective as a helicopter applied abamectin treatment. Our results indicate this to be the case, and although only 12oz of abamectin were used in the spot application the suppression of immature thrips was equal. This

indicates that when directed at the flushing leaves, which are the sole source of avocado thrips early in the season, a smaller amount of abamectin can be used.

The fruit scar analyses planned for winter 2003/4 will indicate if the spot application had any effect on fruit scarring.

Chemical Management as part of IPM – (b) Threshold levels

The objective for this trial was to experimentally relate thrips levels to fruit scarring by maintaining thrips levels at pre-established thresholds. The relationship between thrips densities and fruit scarring is not known, but it is essential information needed to prevent unnecessary applications. In 2002, this trial failed because of very low thrips pressure in the Santa Paula area. This year a field in Oxnard was used.

Materials and methods
An orchard with 10 ft tall Hass trees was used. In ten rows, five trees were assigned one of 5 maximal immature thrips levels. Twice weekly, 10 leaves of each tree were observed and the numbers of immature thrips per fully expanded flush leaf were counted. When numbers exceeded the threshold allocated to that tree, an application of sabadilla was scheduled for the same day or the next morning. From May 9 onwards throughout the main fruit set and development (until August 5) the five treatments were: not exceeding 2, 3, 4, 6 or 9 immatures per leaf.

Fruit scarring observations at harvest 2004 will determine which of these thrips densities caused economic damage.

Chemical Management as part of IPM – (c) Entrust pilot study

Entrust (Dow Agrosciences LLC, Indianapolis, IN), a spinosad formulation, was approved for use against avocado thrips in organic avocado groves in 2003. To initially determine the effectiveness in thrips suppression of this chemical, a pilot study was designed and undertaken in the coastal region Also included in this pilot study was the recently approved GC-Mite (JH Biotech Inc, Ventura, CA), a cotton seed/clove oil with garlic extracts for use against mites and thrips in organic avocado groves. In the GC-Mite application, Natural Wet (JH Biotech Inc, Ventura, CA), an organically approved wetting agent (WA) was used.

Materials and Methods
In Santa Paula, two-year-old 'Hass' avocado trees were used. In 5 single tree replications, four treatments were compared: (1) Entrust 3 fl oz/acre in 50 gallon/acre with 2% NR 415 oil, (2) Success 10 fl oz/acre in 50 gallon/acre with 2% NR 415 oil, (3) GC-Mite 1,5 oz/gallon and 0.16 oz WA/gallon in 50 gallon/acre and (4) water (pH 7.6) 50 gallon/acre,. In twice weekly observations, numbers of immature thrips, adult persea mites and predatory thrips and mites on ten fully expanded flush leaves per tree were counted.

Results

No differences were observed in suppression of immature avocado thrips numbers between Entrust and Success. The suppression of persea mites was also the same and there was no effect of either chemical on the occurrence of predator species (Table 5). GC-mite reduced the number of thrips for one week and the number of persea mites for 29 days, without an effect on the occurrence of natural predators (Table 5).

Table 5. Mean number of insects and mites per ten leaves (± se) following applications of Entrust, Spinosad, GC mite and water (control), pilot study 2003

DAT[1]	Entrust[2]	Spinosad[3]	GC mite[4]	Water[5]	F ratio[6]	P value[6]
			Immature avocado thrips per ten leaves			
-1	49.4 ± 9.32 a	43.8 ± 11.17 a	53.0 ± 9.13 a	52.8 ± 4.07 a	0.23	0.8773
3	0.0 ± 0.00 a	0.2 ± 0.20 a	19.0 ± 8.08 b	54.2 ± 9.21 c	16.54	0.001
7	2.4 ± 0.68 a	4.2 ± 2.11 a	66.0 ± 12.67 b	93.0 ± 14.95 b	24.03	0.00001
13	3.0 ± 1.67 a	0.4 ± 0.40 a	79.8 ± 21.42 b	65.8 ± 21.73 b	6.91	0.0038
16	0.2 ± 0.20 a	0.4 ± 0.40 a	54.0 ± 14.09 b	58.6 ± 7.41 b	15.69	0.0001
21	0.0 ± 0.00 a	0.0 ± 0.00 a	45.8 ± 12.40 b	38.4 ± 10.09 b	12.22	0.0003
24	0.0 ± 0.24 a	0.6 ± 0.40 a	24.4 ± 7.03 b	34.4 ± 10.56 b	7.81	0.0023
29	0.2 ± 0.20 ab	0.6 ± 0.40 a	3.4 ± 1.12 b	6.2 ± 1.24 c	9.88	0.0008
38	7.6 ± 2.44 a	5.0 ± 2.30 a	7.4 ± 2.38 a	9.6 ± 2.91 a	0.58	0.6393
42	0.2 ± 0.20 a	0.0 ± 0.00 a	0.0 ± 0.00 a	0.8 ± 0.49 a	1.92	0.1698
45	0.4 ± 0.24 a	0.0 ± 0.00 a	0.0± 0.00 a	0.6 ± 0.40 a	1.62	0.2274
55	0.0 ± 0.00 a	0.0 ± 0.00 a	0.0 ± 0.00 a	0.0 ± 0.00 a	error	
			Adult persea mites per ten leaves			
-1	0.0 ± 0.00 a	0.0 ± 0.00 a	0.0 ± 0.00 a	0.0 ± 0.00 a	error	
3	3.2 ± 0.22 ab	0.0 ± 0.00 a	0.0 ± 0.00 b	0.8 ± 0.04 c	16.54	0.0001
13	4.2 ± 0.40 a	0.4 ± 0.24 a	0.8 ± 0.49 b	4.0 ± 0.17 b	6.91	0.0038
21	5.4 ± 0.47 a	0.8 ± 0.49 a	7.8 ± 3.75 b	22.6 ± 1.68 b	12.22	0.0003
24	9.6 ± 0.82 a	0.8 ± 0.58 a	5.2 ± 1.28 b	19.8 ± 1.66 b	7.81	0.0023
29	17.4 ± 1.52 ab	3.0 ± 0.55 a	7.0 ± 3.90 b	37.4 ± 1.41 c	9.88	0.0008
38	10.0 ± 0.64 a	18.6 ± 9.00 a	43.6 ± 11.00 a	45.6 ± 2.82 a	0.58	0.6393
42	8.8 ± 0.60 a	9.4 ± 3.72 a	33.2 ± 8.00 a	43.4 ± 1.74 a	1.92	0.1698
45	2.8 ± 0.18 a	1.2 ± 0.73 a	11.6 ± 7.22 a	6.4 ± 0.13 a	1.62	0.2274
55	1.8 ± 0.16 a	2.6 ± 1.54 a	4.8 ± 3.84 a	5.2 ± 0.17 a	0.57	0.6415
			Natural enemies per ten leaves			
-1	0.0 ±0.00 a	0.0 ± 0.00 a	0.0 ± 0.00 a	0.0 ± 0.0 a	error	
3	0.0 ±0.00 a	0.0 ± 0.00 a	1.0 ± 0.20 a	2.0 ± 0.24 a	2	0.1573
7	0.0 ±0.00 a	0.0 ± 0.00 a	1.0 ± 0.20 a	3.0 ± 0.4 a	1.59	0.2336
13	1.0 ±0.20 a	0.0 ± 0.00 a	1.0 ± 0.20 a	2.0 ± 0.4 a	0.56	0.6499
16	2.0 ±0.24 a	1.0 ± 0.20 a	1.0 ± 0.20 a	3.0 ± 0.4 a	0.47	0.7141
21	2.0 ±0.24 a	1.0 ± 0.20 a	2.0 ± 0.24 a	2.0 ± 0.24 a	0.32	0.8138
24	3.0 ±0.24 a	2.0 ± 0.24 a	2.0 ± 0.24 a	3.0 ± 0.24 a	0.21	0.886
29	2.0 ±0.24 a	0.0 ± 0.00 a	2.0 ± 0.24 a	2.0 ± 0.24 a	0.86	0.4845
38	0.0 ±0.00 a	0.0 ± 0.00 a	1.0 ± 0.20 a	2.0 ± 0.40 a	0.89	0.4702
42	2.0 ±0.24 a	1.0 ± 0.20 a	4.0 ± 0.37 a	2.0 ± 0.24 a	0.85	0.4889
45	0.0 ±0.00 a	0.0 ± 0.00 a	0.0 ± 0.00 a	1.0 ± 0.2 a	0.94	0.447
55	0.0 ±0.00	0.0 ± 0.00	0.0 ± 0.00	1.0 ± 0.2	0.57	0.6415

[1] Days after treatment, treatments applied June 17, 2003
[2] Entrust 3 fl oz/acre in 50 gallon/acre
[3] Success 10 fl oz/acre in gallon/acre + 2% NR415 oil
[4] CG Mite 16oz WA+1.5 fl oz /100 gallon /acre
[5] Water 50 gallon/acre, pH 6
[6] ANOVA, LSD < 0.05, different letters in the same row indicate significant differences between treatments, error indicates invalid ANOVA when all data points equal 0.

Discussion

This pilot study showed promising results for Entrust. Control of avocado thrips was similar to Success and it may be the first successful chemical approved for use in organic groves. Further research using Entrust is warranted. We suggest including Entrust with 2% oil (organically approved rather than NR 415) in a field study in 2004, comparing it in ground and helicopter applications with the materials available to the conventional or non-organic industry. The usefulness of GC-mite for thrips control was minimal and did not last longer than 7 days, compared to a water application. GC-mite for persea mite control needs further study, comparing it to NR 415 oil.

The organic avocado industry has not had effective chemical means for control of thrips or persea mite in the past, and studies on use of these newly approved chemicals are warranted.

Ventura County-Specific Avocado Thrips Natural Enemy Population Dynamics

The objective for this trial was to determine the identity and population dynamics of generalist predators and parasitoids associated with avocado thrips in organic groves and in groves with a history of chemical control in Ventura County and determine any spatial and temporal differences that might exist.

Materials and methods

In January 2002, a total of 15 plots (7 treated with abamectin and 8 not treated during 2003) were selected for use in a twice a month observation schedule. Each plot consisted of two stations of 5 trees each that were located at least 1 acre (70 meters) apart, were selected and observed a total of 13 times between April and September. With each observation, trees were scored for their phenological status and ten leaves per tree were observed for numbers of pest and natural enemy species. Additionally, each quadrant of the 5 trees was beat-sampled for natural enemies and at each station three sticky cards were changed and brought to the laboratory to be counted.

Results

We have not had the time to analyze all the data collected in the fields. We started with the count of enemies on the sticky cards, but most will be observed this winter. As soon as that data becomes available, the analyses will be completed (early 2004).