North San Joaquin Valley Almond Day
Modesto, CA, January 22, 2009

Integrated Management of Mites in Orchard Systems

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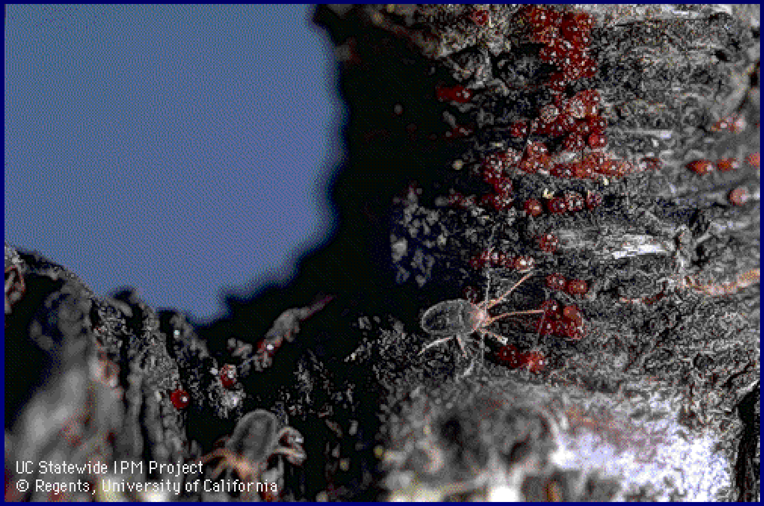
Spider Mites

Twospotted
Spider Mite

Pacific Spider Mite

Brown Almond Mite



European Red Mite

Spider Mites

European Red Mite

Panonychus ulmi

- No webbing
- Found on nut, pome and stone fruit trees
- Usually thought of as an early season species
- Overwinters in egg stage

Eggs - red with a stipe

Adults - dark red with long, curved hairs from white spots

Can have 5 to 10 generations a year

Spider Mites

European Red Mite

Panonychus ulmi

- Feeding causes stippling and rarely leaf drop
- Yellowed leaves from spring feeding may 'green up'
- Possible yield loss with chronic infestations

Spider Mites

Brown Almond Mite

Bryobia rubrioculus

- No webbing
- Found on nut, pome and stone fruit trees
- Overwinters in egg stage

Eggs - red with no stipe; laid in masses
Adults - reddish-brown, 1st pair of legs are long
Juveniles - newly hatch young are bright red

- Feeding causes whitish gray spots to appear on leaves
- Mites move off of foliage during the day
- Defoliation observed at densities of 50 per leaf

Spider Mites- Dormant Spur Sampling

European Red Mite and Brown mite

Controlled with the oil in a (delayed) dormant spray

- Sample between mid-November and late January
- Randomly clip 2 to 3 spurs from the inside of each tree's canopy for a total of 100 spurs
- Clip the spur off at the base, making sure to include some old spur wood
- Examine the spurs in groups of 20 under magnification for mite eggs, and record the number of spurs where they are present or not (presence/absence sample)
- Treat with oil if over 20% have mite eggs present

Spider Mites

Pacific Spider Mite

Tetranychus pacificus

A webspinning spider mite

- Broad host range
- Usually thought of as the greater problem in warm growing areas

Eggs - spherical and may be laid in webbing

Adults vary in color from slightly amber to greenish or reddish; usually 2 larger spots forward, 2 rear

Spider Mites

Twospotted Spider Mite

Tetranychus urticae

A webspinning spider mite

- Broad host range
- Usually thought of as the greater problem in cooler growing areas

Eggs - spherical and may be laid in webbing

Adults vary in color from whitish or greenish to amber; usually 2 large spots forward that may merge

Spider Mites - Damage

Tetranychus spp.

Suck cell contents; stippling, yellowing and leaf drop

Spider Mites

Tetranychus spp.

Overwinter as diapausing mated females
Move up the tree as weather warms
Early season distribution on foliage
in lower and central part of tree

Spider Mites - sampling

Webspinning mites can be sampled by counting number of mites per leaf or by a presence/absence sample

If counting - select 10 leaves from five trees and determine number per leaf; sample leaves randomly from all 4 compass points and the tree interior

Calculate average number of mites per leaf

Rule of thumb treatment threshold is 4 mites

Mite brushing machine
(I know these aren't almond leaves!)

Spider Mites - sampling

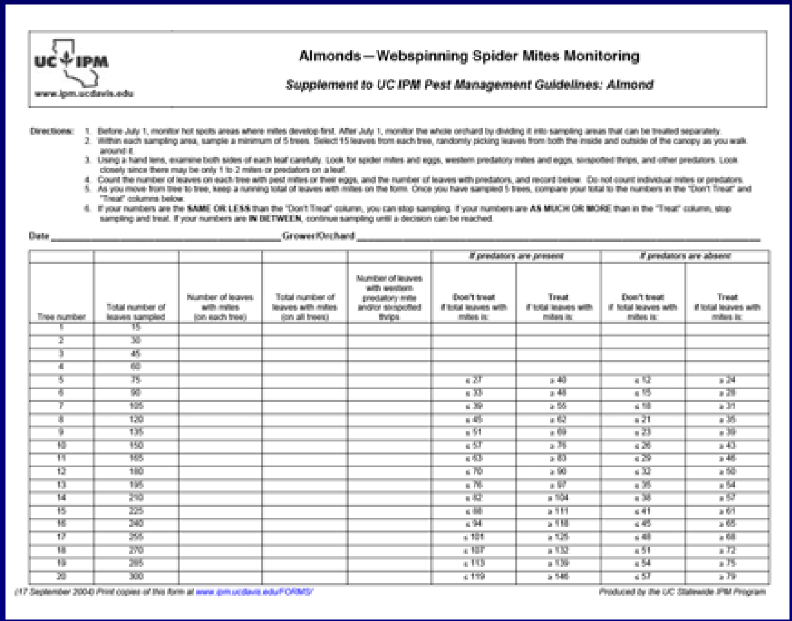
Webspinning mites can be sampled by counting number of mites per leaf or by a presence/absence sample

If using presence/absence - select 15 leaves from five trees and determine number per leaf; sample leaves randomly from all 4 compass points and the tree interior

Record number of leaves with mites (not number of mites per leaf)

Continue sampling until a decision is made

Rule of thumb treatment threshold is 40% infested leaves



UC IPM
www.ipm.ucdavis.edu

Almonds—Webspinning Spider Mites Monitoring

Supplement to UC IPM Pest Management Guidelines: Almond

Directions:
1. Before July 1, monitor hot spots areas where mites develop first. After July 1, monitor the whole orchard by dividing it into sampling areas that can be treated separately.
2. Within each sampling area, sample a minimum of 5 trees. Select 15 leaves from each tree, randomly picking leaves from both the inside and outside of the canopy as you walk around it.
3. Using a hand lens, examine both sides of each leaf carefully. Look for spider mites and eggs, western predatory mites and eggs, sixspotted thrips, and other predators. Look closely since there may be only 1 to 2 mites or predators on a leaf.
4. Count the number of leaves on each tree with pest mites or their eggs, and the number of leaves with predators, and record below. Do not count individual mites or predators.
5. As you move from tree to tree, keep a running total of leaves with mites on the form. Once you have sampled 5 trees, compare your total to the numbers in the "Don't Treat" and "Treat" columns below.
6. If your numbers are the **SAME OR LESS** than the "Don't Treat" column, you can stop sampling. If your numbers are **AS MUCH OR MORE** than in the "Treat" column, stop sampling and treat. If your numbers are **IN BETWEEN**, continue sampling until a decision can be reached.

Date ____________________ Grower/Orchard ____________________

					If predators are present		*If predators are absent*	
Tree number	Total number of leaves sampled	Number of leaves with mites (on each tree)	Total number of leaves with mites (on all trees)	Number of leaves with western predatory mite and/or sixspotted thrips	Don't treat if total leaves with mites is:	Treat if total leaves with mites is:	Don't treat if total leaves with mites is:	Treat if total leaves with mites is:
1	15							
2	30							
3	45							
4	60							
5	75				≤ 27	≥ 40	≤ 12	≥ 24
6	90				≤ 33	≥ 48	≤ 15	≥ 28
7	105				≤ 39	≥ 55	≤ 18	≥ 31
8	120				≤ 45	≥ 62	≤ 21	≥ 35
9	135				≤ 51	≥ 69	≤ 23	≥ 39
10	150				≤ 57	≥ 76	≤ 26	≥ 43
11	165				≤ 63	≥ 83	≤ 29	≥ 46
12	180				≤ 70	≥ 90	≤ 32	≥ 50
13	195				≤ 76	≥ 97	≤ 35	≥ 54
14	210				≤ 82	≥ 104	≤ 38	≥ 57
15	225				≤ 88	≥ 111	≤ 41	≥ 61
16	240				≤ 94	≥ 118	≤ 45	≥ 65
17	255				≤ 101	≥ 125	≤ 48	≥ 68
18	270				≤ 107	≥ 132	≤ 51	≥ 72
19	285				≤ 113	≥ 139	≤ 54	≥ 75
20	300				≤ 119	≥ 146	≤ 57	≥ 79

(17 September 2004) Print copies of this form at www.ipm.ucdavis.edu/FORMS/

Produced by the UC Statewide IPM Program

Why do spider mites become problems?

Usually there is some kind of disruption

- Hot, dry conditions
- irrigation practices that promote water stress
- pesticide use - secondary (induced) pests
- changes in insecticide and fungicide use patterns
- *What about newer products?*

Do they affect six-spotted thrips, lacewings, hemipterans, predaceous beetles, or predator mites?

What about their effects on spider mite development?

Spider Mites - Natural enemies


Lacewings

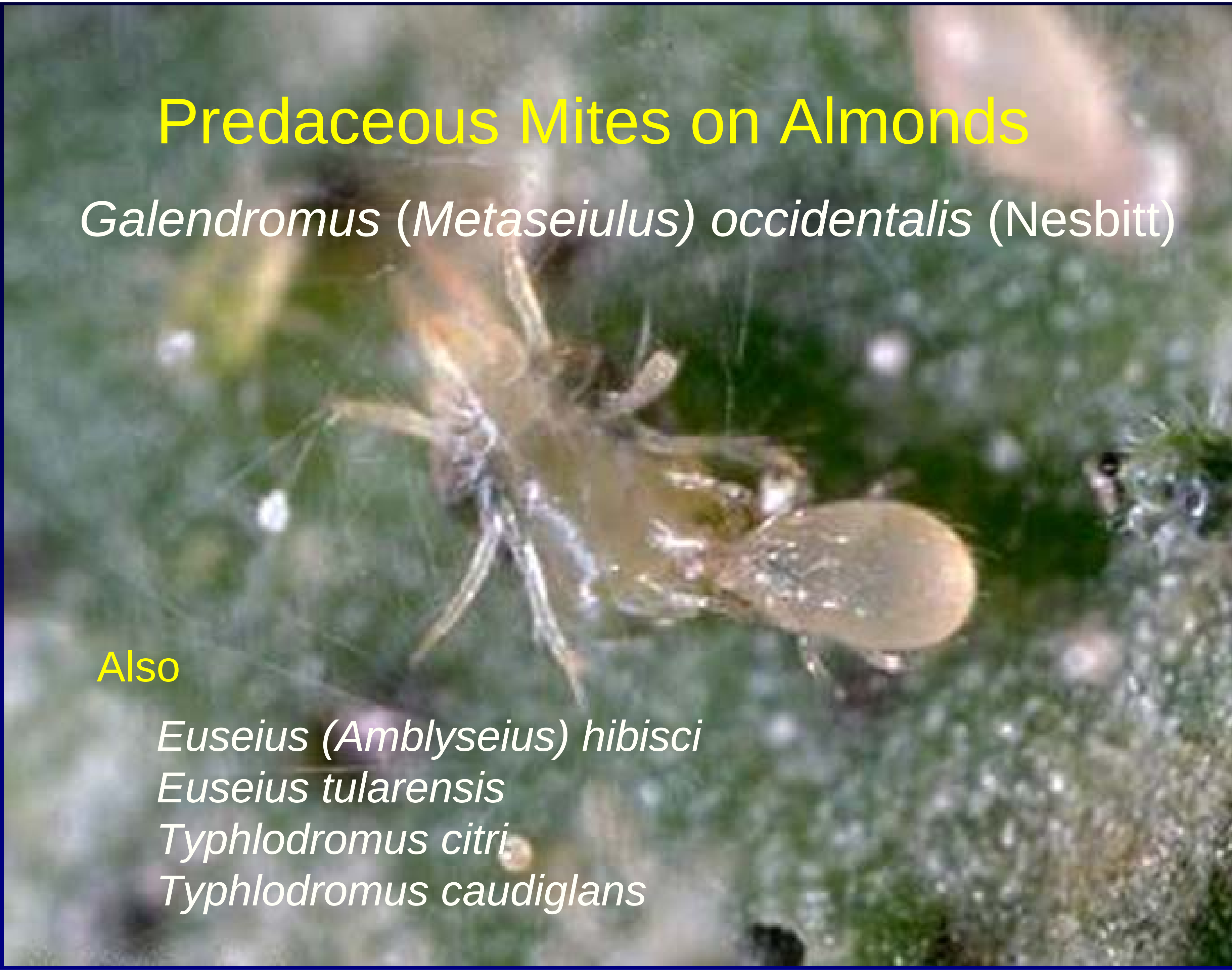
Spider mite destroyer

Predatory mites

Six-spotted thrips

Spider Mites - Chemicals

- Pesticide use has a major impact on spider mites - use selective products
- Consider possibility of unintended impacts on spider mites whenever introducing a new chemical into an orchard
- General predators like six-spotted thrips, lacewings, hemipterans and predaceous beetles can be affected, not just predator mites
- Older products such as carbaryl were known to increase spider mite reproduction in addition to killing mite predators



Predaceous Mites on Almonds

Galendromus (*Metaseiulus*) *occidentalis* (Nesbitt)

Also

Euseius (Amblyseius) hibisci
Euseius tularensis
Typhlodromus citri
Typhlodromus caudiglans

Predaceous mites on almonds

- Adult females are typically narrowly oval
- Most are shiny white to slightly yellow or reddish
- Tend to move much more quickly than do spider mites
- Eggs are elliptical and perhaps 3 to 4 times larger than the spherical eggs of spider mites
- Overwinter primarily as mated, adult females on bark

Sampling and decision rules in -
"Integrated Pest Management for Almonds, 2nd Edition"

Predaceous mites - monitoring

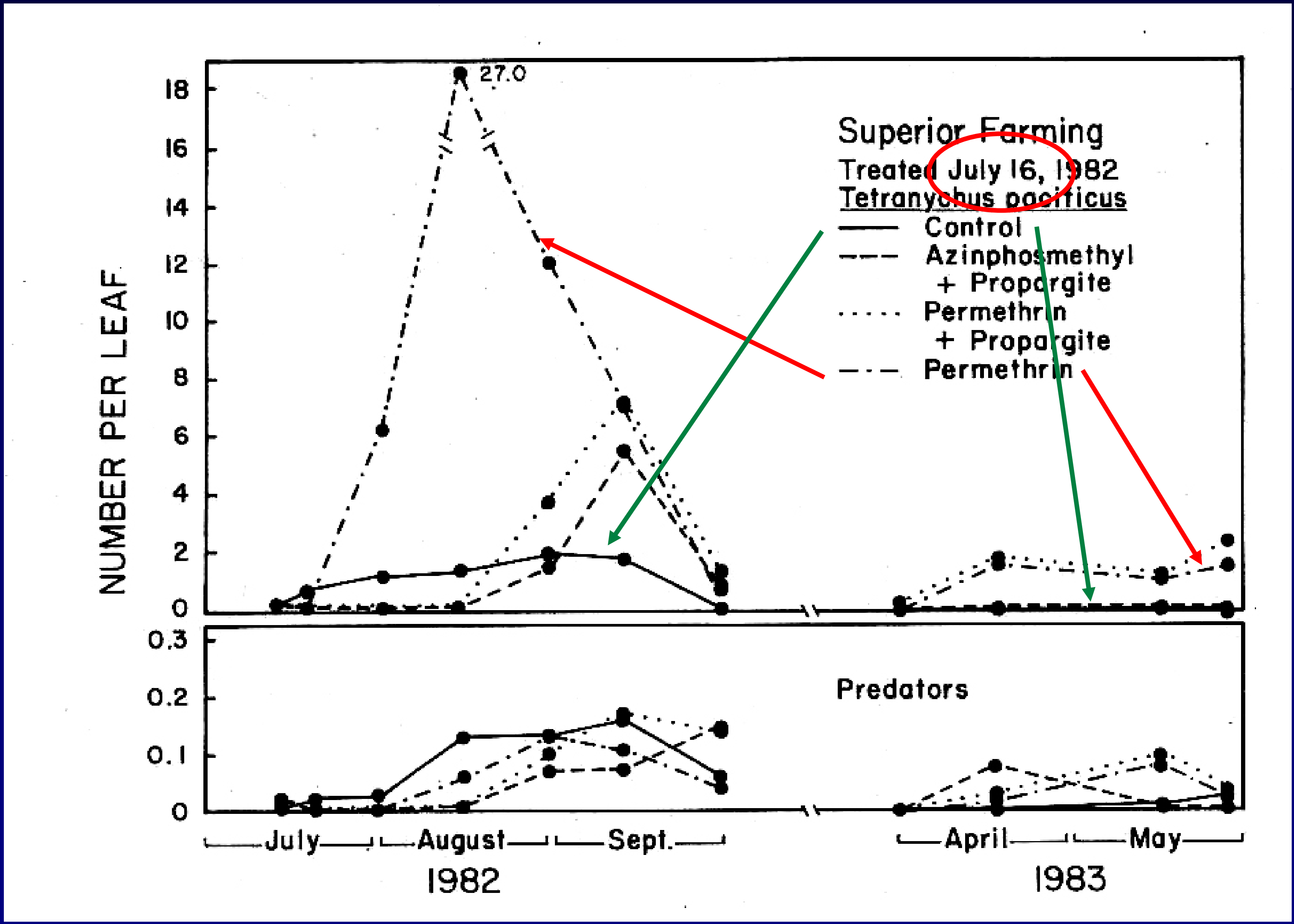
- Monitor using presence/absence sample for both spider mites and predators
- Predator will maintain good control unless the proportion of leaves with spider mites is higher than the proportion with predatory mites (actual number of each is not critical)
- A good rule of thumb is that predator mites will control spider mites if presence/absence sampling indicates a 1:1 of leaves with a predatory mite to leaves with a webspinning mite
- When predators are present but are not controlling the spider mites, a lower-than-label rate of a selective miticide may be applied to create a more balanced ratio

Field observations of effect of registered insecticides on spider mite and *G. occidentalis* populations

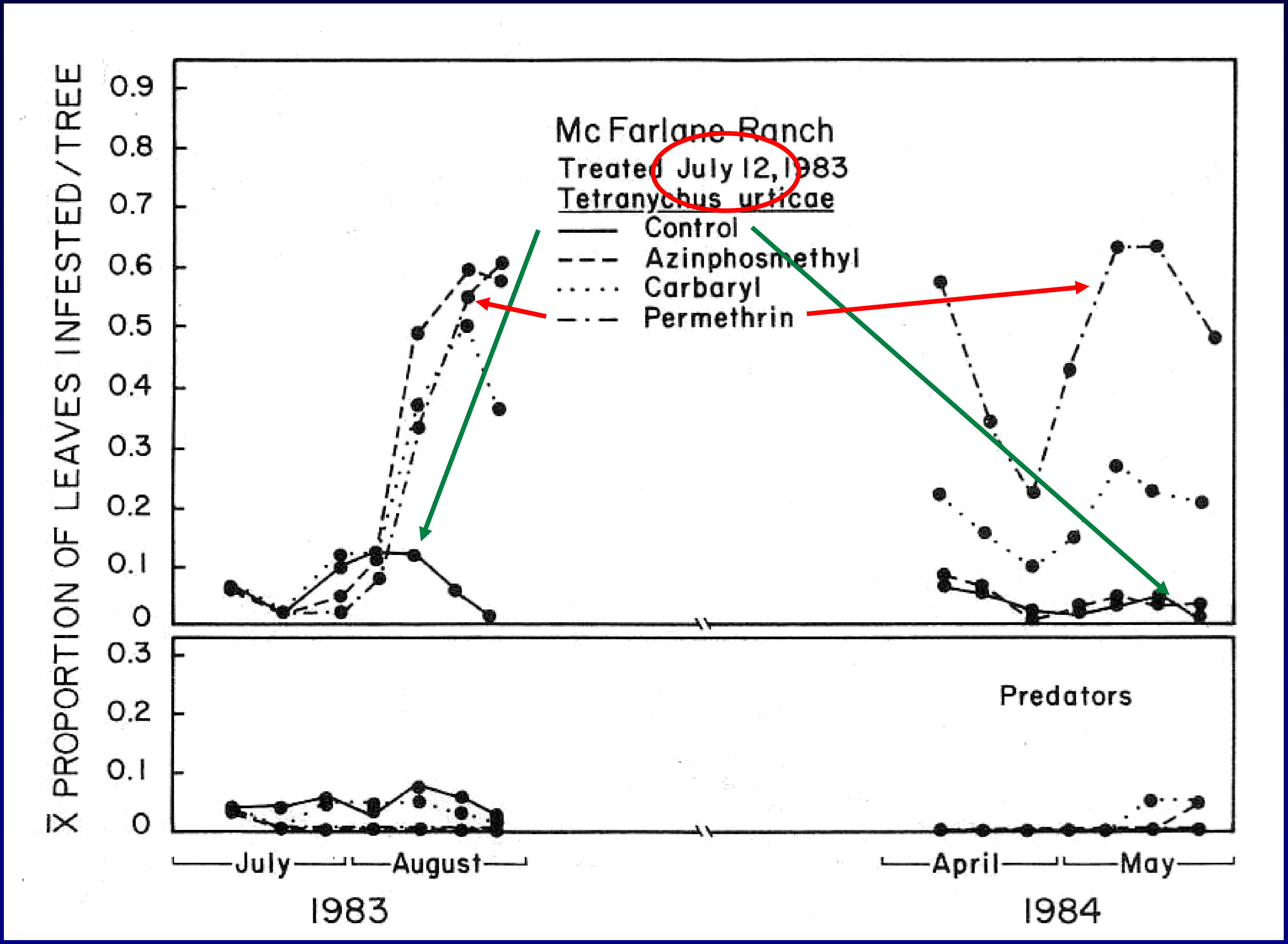
3 sites - Kern Co., Fresno Co., Butte Co.
3 insecticides - azinphosmethyl, carbaryl, permethrin
Weekly sampling for proportion of leaves infested

Bentley, W., F.G. Zalom, W.W. Barnett, and J.P. Sanderson. 1987. Population densities of *Tetranychus* spp. (Acari: Tetranychidae) after treatment with insecticides for *Amyelois transitella* (Lepidoptera: Pyralidae). J. Econ. Entomol. 80: 193-200.

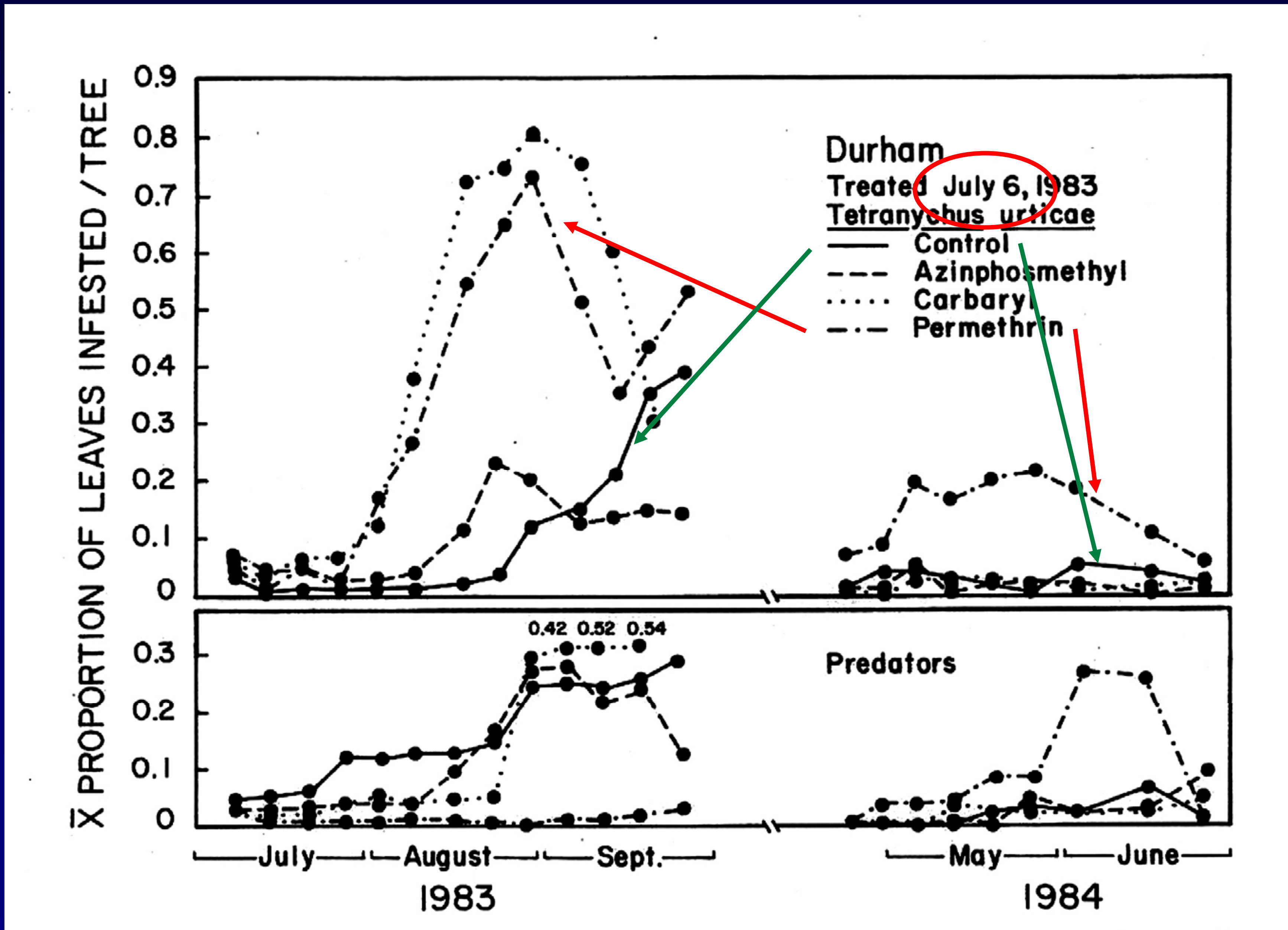
Mean number of *T.pacificus* and its predators per almond leaf



Mean number of *T.urticae* and its predators per almond leaf



Mean number of *T.urticae* and its predators per almond leaf



Zalom, F. G., M. W. Stimmann, T. S. Arndt, D. B. Walsh, C. Pickel, and W. H. Krueger. 2001. Analysis of permethrin (*cis*- and *trans*- isomers) and esfenvalerate on almond twigs and effects of residues on the predator mite *Galendromus occidentalis* (Acari: Phytoseiidae). Environ. Entomol. 30: 70-75.

Pyrethroid bark residues - Methods

- Orchard was never previously treated
- Eight single tree replicates applied by handgun sprayer; randomized complete block design
- Untreated buffer trees between each treatment replicate
- Rates: esfenvalerate - 0.1 lbs ai per acre
  permethrin - 0.4 lbs ai per acre

Pyrethroid bark residues - Methods

Treatments

1. Esfenvalerate dormant spray only
2. Permethrin dormant spray only
3. Esfenvalerate dormant spray and hull-split spray
4. Permethrin dormant spray and hull-split spray
5. Esfenvalerate hull-split spray only
6. Permethrin hull-split spray only
7. Untreated

Dormant spray - February 3, 1995
Hull split spray - July 21, 1995

Esfenvalerate residues on field treated almond twigs on sampling dates after dormant and hull-split applications

Esfenvalerate application	ng/mm^2 esfenvalerate
Dormant only	
2/3/95	0.84 ± 0.12
7/21/95	0.28 ± 0.08
8/24/95	0.12 ± 0.04
Dormant + hullsplit	
7/21/95	0.35 ± 0.09
8/24/95	0.29 ± 0.08
Hullsplit only	
8/24/95	0.26 ± 0.11

Application date 2/3/1995

Mean SD; each value = 4 samples run in duplicate

Permethrin residues on field treated almond twigs on sampling dates after dormant and hull-split applications

Permethrin application	cis-permethrin	trans-permethrin
Dormant only		
2/3/95	0.77 ± 0.23	0.95 ± 0.26
7/21/95	0.16 ± 0.11	0.24 ± 0.16
8/24/95	0.10 ± 0.07	0.16 ± 0.11
Dormant + hullsplit		
7/21/95	0.50 ± 0.21	0.65 ± 0.28
8/24/95	0.25 ± 0.18	0.36 ± 0.26
Hullsplit only		
8/24/95	0.34 ± 0.28	0.50 ± 0.41

Application date 2/3/1995

values expressed as mean ng/mm^2 SD;

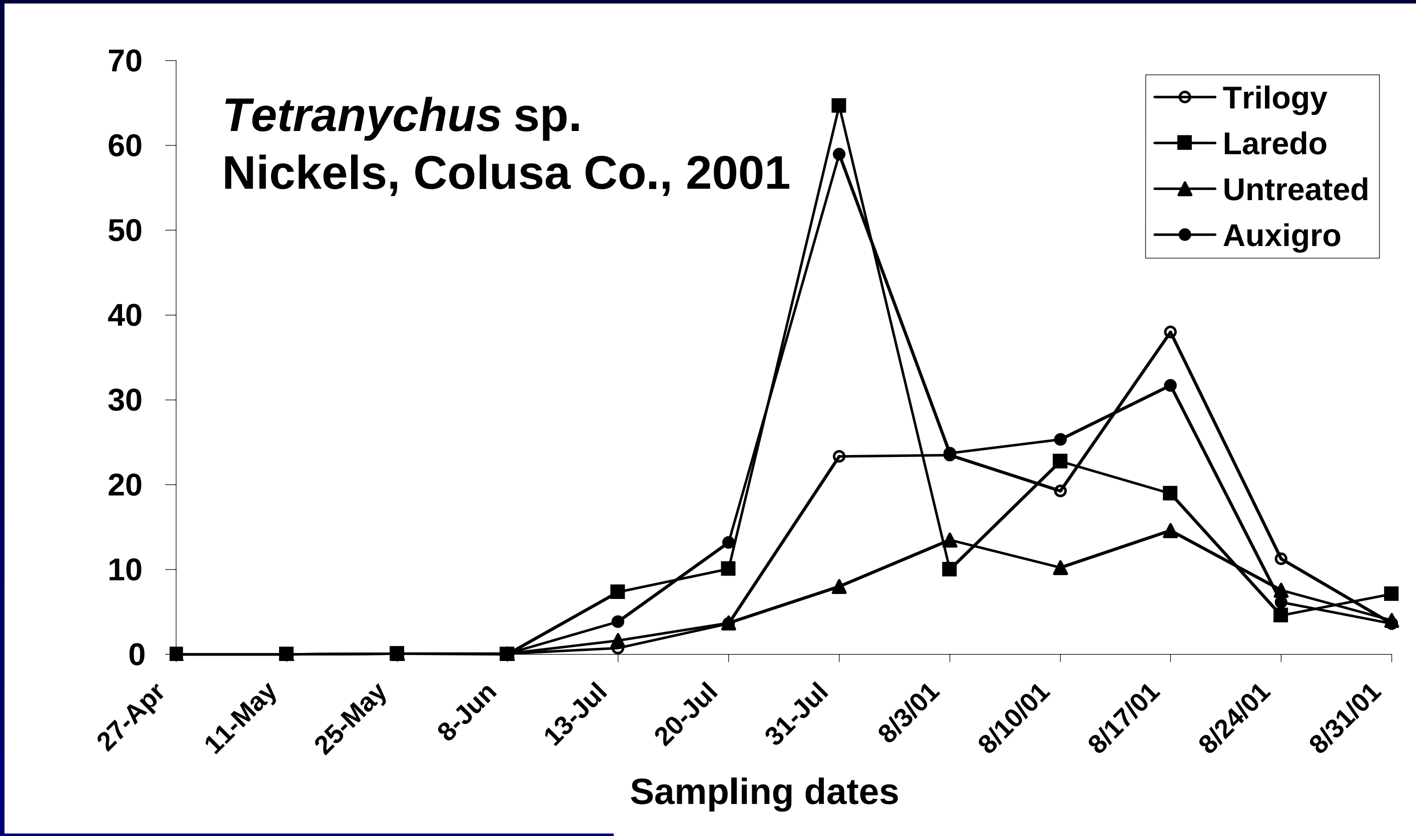
each value = 4 samples run in duplicate

Percent survival of the predator mite *Galendromus occidentalis* on pyrethroid treated almond twigs ~7 months after dormant application

Pesticide and timing	Percent survival corrected for control mortality 24 hrs[a/]	48 hrs[b/]
Untreated	100.0 d	100.0 d
Esfenvalerate dormant	19.6 a	8.4 ab
Permethrin dormant	53.6 c	48.1 c

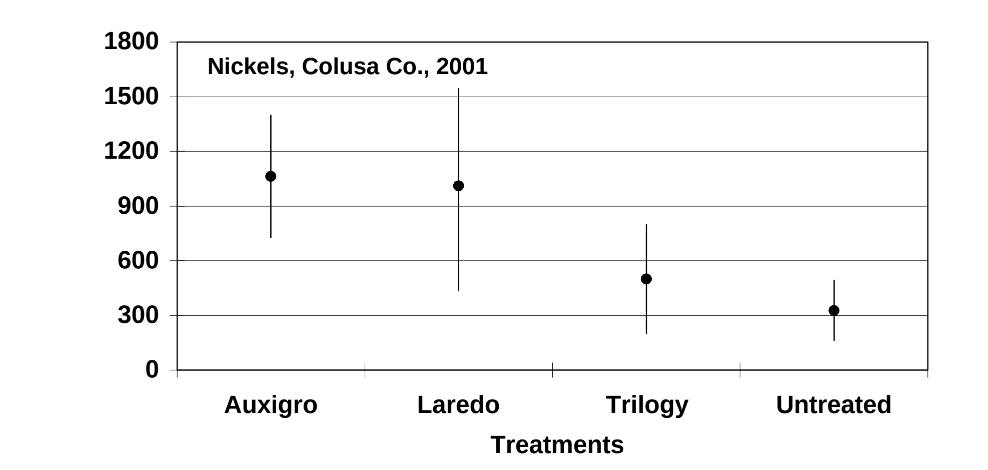
Treatments applied 2/3/95
Bark samples collected 8/24/95
Treatment means followed by the same letter do not differ significantly ($p<0.05$) when compared by Fishers protected LSD.
[a] $F = 8.85$, $df = 8$, $p<0.0001$
[b] $F = 8.355$, $df = 8$, $p<0.0001$

Spider mites collected from experimental fungicide plots



Season total mite-days

ANOVA statistics -
F=3.875; df= 3,12; *P*=0.0378



Almond Acaricide IRAC* Classification

Product	Active ingredient	Primary target site of action	IRAC #
Agri-Mek	Abamectin	Chloride channel activators	6
Apollo	Clorfentezine	Mite growth inhibitor	10A
Onager	Hexythiazox	Mite growth inhibitor	10A
Zeal	Etoxazole	Mite growth inhibitor	10B
Vendex	Fenbutatin oxide	Inhibitor of mitochondrial ATP synthase	12B
Omite	Propargite	Inhibitor of mitochondrial ATP synthase	12C
Kanemite	Acequinocyl	Mitochondrial complex III electron transport inhibitor	20B
Fujimite	Fenpyroximate	Mitochondrial complex I electron transport inhibitor	21
Nexter	Pyridaben	Mitochondrial complex I electron transport inhibitor	21
Desperado	Sulfur + Pyridaben	Unclassified + Mitochondrial complex I electron transport inhibitor	UNC + 21
Envidor	Spirodiclofen	Inhibitor of lipid synthesis	23
Acramite	Bifenazate	Unknown mode of action	UN
Various	Botanical oils	Unclassified	UNC
Various	Narrow range oil	Unclassified	UNC

* Insecticide resistance action committee

Acaricide efficacy

Mean (SD) motile two spotted spider mites per leaf, Arbuckle, 2005

		Mean ± SD 2-spot motiles/leaf					
Treatments	Rate	Pretreat 8/15/2005	8/23/05	8/30/05	9/6/05	9/14/05	9/21/05
Untreated	NA	0.13 ± 0.19	0.13 ± 0.10	1.43 ± 0.93	1.35 ± 0.89	5.13 ± 5.18	4.38 ± 5.94
Summer oil	1%	0.68 ± 0.79	0.45 ± 0.70	1.58 ± 2.18	1.68 ± 1.73	14.15 ± 21.05	10.49 ± 8.67*
Ecotrol EC	4 pts	0.23 ± 0.45	0.38 ± 0.45	1.53 ± 2.18	0.93 ± 0.83	5.03 ± 9.05	3.73 ± 4.75
Kanemite	21 oz	0.13 ± 0.25	0.08 ± 0.10	0.03 ± 0.05	0.43 ± 0.46*	2.25 ± 3.07	2.08 ± 2.55
Kanemite	26 oz	0.05 ± 0.06	0.03 ± 0.05	0.00 ± 0.00	0.13 ± 0.10*	0.55 ± 0.62	1.40 ± 1.26
Kanemite	31 oz	2.48 ± 2.55*	0.00 ± 0.00	0.48 ± 0.56	0.20 ± 0.11*	0.90 ± 0.47	1.15 ± 1.27
Acramite	1 lb	0.00 ± 0.00	0.03 ± 0.05	0.08 ± 0.10	0.10 ± 0.00*	0.23 ± 0.22	0.83 ± 1.05
Onager	20 oz	0.03 ± 0.05	0.00 ± 0.00	0.03 ± 0.05	0.33 ± 0.17*	0.38 ± 0.22	0.65 ± 0.59
Agri-Mek + Oil	15.6 oz + 0.25%	0.00 ± 0.00	0.15 ± 0.19	0.15 ± 0.13	0.38 ± 0.22*	0.42 ± 0.72	0.31 ± 0.10

Treatment date - August 16, 2005

* Means significantly different from untreated control at *P*<0.05 by Student's t-test

10 leaves per replicate sampled

n = 4 reps

Acaricide efficacy

Mean (SD) motile European red mites per leaf, Arbuckle, 2005

Treatment	Rate (Form)	Pretreatment 8/15/2005	8/23/05	8/30/05	9/6/05	9/14/05
		Mean ± SD European red mites/leaf				
Untreated	NA	7.65 ± 4.17	17.55 ± 18.42	7.40 ± 6.84	4.68 ± 3.69	1.60 ± 0.91
Summer Oil	1%	10.45 ± 7.98	7.65 ± 6.32	2.95 ± 1.68	6.13 ± 5.25	7.08 ± 8.77
Ecotrol EC	4 pts	15.55 ± 12.48	15.68 ± 10.42	26.80 ± 19.00*	9.25 ± 4.09*	5.68 ± 5.22
Kanemite	21 oz	9.88 ± 8.45	2.70 ± 3.46	0.63 ± 0.51*	1.70 ± 2.60*	3.04 ± 2.90
Kanemite	26 oz	9.35 ± 9.89	7.73 ± 11.07	0.88 ± 0.62*	0.45 ± 0.37*	1.28 ± 1.19
Kanemite	31 oz	9.03 ± 11.27	0.53 ± 0.79	0.53 ± 0.73*	1.25 ± 1.45*	0.80 ± 0.56
Acramite	1 lb	15.35 ± 12.72	15.58 ± 9.28	4.28 ± 5.29	1.03 ± 0.71*	2.05 ± 2.30
Onager	20 oz	10.25 ± 5.21	5.45 ± 9.57	1.40 ± 1.19*	2.64 ± 3.47	1.58 ± 2.18
Agri-Mek + Oil	15.6 oz + 0.25%	13.65 ± 6.34	11.70 ± 6.73	11.95 ± 8.00	6.50 ± 3.39	2.13 ± 2.10

Treatment date - August 16, 2005
* Means significantly different from untreated control at *P*<0.05 by Student's t-test
10 leaves per replicate sampled
n = 4 reps

Acaricide efficacy

Mean (SD) motile Pacific spider mites per leaf, Arbuckle, 2006

		Mean ± SD Pacific mites per leaf				
Treatments	Rate/ac	7/26/06	8/2/06	8/9/06	9/6/06	9/13//06
Untreated	NA	3.00 ± 2.16	3.40 ± 3.86	3.80 ± 3.67	65.00 ± 51.95	49.40 ± 46.14
Envidor	18.0 oz	0.00 ± 0.00*	0.80 ± 0.35	1.13 ± 1.27	32.40 ± 43.98	12.53 ± 10.94
Envidor + oil	18.0 oz + 1% v/v	0.00 ± 0.00*	0.73 ± 0.81	4.30 ± 4.23	22.03 ± 20.53	15.73 ± 12.93
Ecotrol **	2.0 pts	0.60 ± 0.60*	1.80 ± 2.62	7.00 ± 5.10	61.73 ± 49.14	10.37 ± 15.97
Ecotrol **	4.0 pts	0.60 ± 0.60*	3.40 ± 3.30	3.47 ± 3.82	45.00 ± 60.85	40.30 ± 68.51
Kanemite	25.0 oz	0.00 ± 0.00*	2.20 ± 3.30	2.87 ± 4.29	38.80 ± 45.95	22.60 ± 27.21
Kanemite	31.0 oz	0.03 ± 0.06*	0.20 ± 0.35	1.40 ± 1.25	37.40 ± 19.41	30.40 ± 12.73
Fujimite **	1 pt	0.07 ± 0.06*	0.43 ± 0.67	1.10 ± 1.21	32.93 ± 44.69	34.80 ± 40.07
Fujimite **	2 pts	0.13 ± 0.23*	0.20 ± 0.20	3.63 ± 5.00	40.90 ± 37.77	24.87 ± 27.15
Agri-Mek **	15.6 oz	0.40 ± 0.69*	0.00 ± 0.00	2.00 ± 3.46	6.07 ± 9.82	3.17 ± 5.05
Omni Oil	1% v/v	0.60 ± 0.60*	1.20 ± 0.00	3.40 ± 1.83	68.00 ± 40.27	35.10 ± 35.71
Omni Oil	4% v/v	0.00 ± 0.00*	0.40 ± 0.35	1.87 ± 1.10	45.20 ± 33.70	11.07 ± 11.93
Acramite	1 lb	0.20 ± 0.35*	0.20 ± 0.35	0.57 ± 0.60	20.93 ± 24.58	6.97 ± 7.78
Onager	20 oz	0.40 ± 0.69*	0.00 ± 0.00	0.80 ± 0.92	5.80 ± 5.50	8.10 ± 8.65
Zeal	3 oz	0.00 ± 0.00*	0.00 ± 0.00	0.13 ± 0.23	2.60 ± 2.59	1.57 ± 1.34

Treatment date - July 19, 2006

* Means significantly different from untreated control at P<0.05 by Student's t-test

10 leaves per replicate sampled

n = 4 reps

** plus an adjuvant; Ecotrol + Natural Wet @ 0.13% v/v, Fujimite and Agri-Mek + LI7000 @ 0.25% v/v

Acaricide efficacy

Mean (SD) motile twospotted mites per leaf, almonds, 2007

Treatment	Rate (Form/ac)	Mean ± SD twospotted mites per leaf: August 14 Pretreat	August 21	August 28	Sept. 4	Sept. 11
Untreated	NA	6.8 ± 2.6	5.3 ± 2.1	4.8 ± 2.1	4.5 ± 1.7	3.5 ± 1.3
Envidor	18 oz	5.3 ± 2.1	0.0 ± 0.0*	0.3 ± 0.5*	1.0 ± 1.4*	1.0 ± 0.8*
Envidor **	18 oz	7.8 ± 2.1	0.0 ± 0.0*	0.0 ± 0.0*	0.5 ± 0.6*	0.8 ± 1.0*
Acramite	1 lb	5.8 ± 2.2	0.5 ± 0.6*	0.8 ± 1.0*	0.8 ± 1.0*	1.5 ± 1.3*
Fujimite + oil	32 oz + 1%	6.5 ± 3.1	0.3 ± 0.5*	0.5 ± 1.0*	0.8 ± 1.0*	1.0 ± 0.8*
Kanemite	31 oz	5.8 ± 2.9	0.0 ± 0.0*	0.5 ± 1.0*	0.8 ± 0.5*	1.3 ± 1.3*
Agri-mek + oil	15.6 oz + 1%	3.8 ± 1.0	1.0 ± 0.8*	0.8 ± 0.5*	1.3 ± 1.5*	1.8 ± 1.3
Orchex	1% v/v	7.3 ± 4.3	3.0 ± 0.8*	3.3 ± 1.0*	5.0 ± 2.2	3.3 ± 1.3
Orchex	4% v/v	8.5 ± 2.9	0.8 ± 1.0*	1.3 ± 1.0*	2.5 ± 1.3*	2.3 ± 1.9

Treatment date - August 14, 2007

* Means significantly different from untreated control at *P*<0.05 by Student's t-test

10 leaves per replicate sampled

n = 4 reps

** plus an adjuvant; Envidor + LI7000 @ 0.25% v/v

Acaricide side effects

Predator mite bioassays

Direct effects - acute toxicity to adult females
Indirect effects - sublethal effects

Examples of indirect effects -

- Reduced fecundity (fewer eggs per female)
- Reduced fertility (lower egg hatch)
- Development time
- Immature mortality
- Behavioral changes

Acaricide side effects

Predator mite bioassays

Total effects of pesticides - *E*

E (%) = 100% - (100% - M) x R

Where

M = Abbotts corrected mortality (Abbott, 1925)

R = reproduction per treated female (eggs/female x % fertility) / reproduction per untreated female

Acaricide side effects

Predator mite bioassays - direct contact

G. occidentalis survival, fecundity and fertility after treatment of adult females with label rates of five different acaricides.

	Contact spray			
Active ingredient	% Survival	Total eggs/ female	Fertility (% hatch)	*E*
Control	100 0a	12.4 0.8a	100 0a	-
Acequinocyl	100 0a	9.2 0.6b	96.0 4.9a	28.5
Bifenazate	100 0a	9.4 0.5b	92.3 3.4a	30.2
Etoxazole	98.3 2.2a	9.4 0.7b	0 0b	100
Spiromesifen	98.3 2.2a	8.6 0.5b	96.1 4.0a	34.0
Fenpyroximate	0 0b	0 0c	0 0b	100

Means followed by the same letter are significantly different at $p<0.05$ by LSD.

Acaricide side effects

Predator mite bioassays - residues

G. occidentalis survival, fecundity and fertility after treatment of leaves with label rates of five different acaricides.

Active ingredient	Surface residue			
	% Survival	Eggs laid	Fertility	*E*
Control	98.3 2.2a	11.2 1.0a	100 0a	-
Acequinocyl	93.4 3.0a	9.6 0.5a	92.2 4.9a	25.1
Bifenazate	95.1 2.7a	9.6 0.9a	96.0 4.0a	20.1
Etoxazole	93.4 3.0a	9.0 0.5a	0 0b	100
Spiromesifen	91.7 3.2a	5.0 0.7b	92.6 4.3a	61.7
Fenpyroximate	0 0b	0 0c	0 0b	100

Means followed by the same letter are significantly different at $p<0.05$ by LSD.

IOBC Classifications -

Leaf surface residues

Acequinocyl
Bifenazate → Harmless (class 1)

Spiromesifen → Slightly harmful (class 2)

Etoxazole
Fenpyroximate → Harmful (class 4)

Direct contact spray

Acequinocyl
Bifenazate
Spiromesifen → Harmless (class 1)

Etoxazole
Fenpyroximate → Harmful (class 4)

North San Joaquin Valley Almond Day
Modesto, CA, January 22, 2009

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