Chemical Control/New Products

Spider mite control in apple and tart cherry—2002

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Abstract: The efficacy of a new registered acaricide, Acramite 50W (bifenazate), was compared to standard acaricides (Agri-Mek, Pyramite, and Vendex), horticultural oils (JMS Stylet and Supreme oils) and an untreated for control of spider mites in apple and tart cherry. Phytophagous mite (twospotted spider mite, European red mite, and brown mite) densities were low in the apple trial and did not differ among treatments. In tart cherry, both rates of Acramite (0.75 and 1.0 lb/acre) and Vendex (2 lb/acre + 0.25% oil) significantly lowered phytophagous mite densities for two weeks post-treatment. The oil-alone treatments (1.5% JMS Stylet oil and 1.5% Supreme oil) were not effective in lowering phytophagous mite densities below untreated levels. All acaricides tested lowered predaceous mite (*Galendromus occidentalis* and *Zetzellia mali*) densities for up to six weeks after treatment.

Materials and Methods

Both trials were conducted at the Utah State University research farm in Kaysville, UT, during July and August 2002. All treatments were applied on July 17. A second application of the two oil-alone treatments, JMS Stylet oil and Supreme oil, was applied 6 days later on July 23. Materials were applied as dilute sprays to drip with a multi-tank sprayer and handgun at 80 psi and at a rate of 400 gpa.

Apples. Single-tree plots were placed in a mixed cultivar (‘Red Delicious’, ‘Gala’, ‘Jonathan’, ‘Idared’, ‘Prime Gold’ and ‘Mutzu’) orchard. The experimental design was a randomized complete block with seven treatments and four replications (28 plots). Tree spacing was 12 ft x 20 ft. The entire orchard was sprayed with oil and Lorsban on April 9 for control of early-season aphids and Campylomma, and with fungicides (Rally, Flint or Bayleton) for control of powdery mildew on April 23, May 6 and 20, June 4 and 18, and July 19.

Treatments.

1. Untreated.
2. Acramite 50W @ 0.75 lb/acre + Silwett L-77 @ 1.2 ml/gal.
3. Acramite 50W @ 1.0 lb/acre + Silwett L-77 @ 1.2 ml/gal.
4. Agri-Mek 0.15EC @ 16 oz/acre + 0.25% Supreme oil.
5. Pyramite 60W @ 10 oz/acre.
6. JMS Stylet oil @ 1.5% (applied twice).
7. Supreme oil @ 1.5% (applied twice).

Tart Cherries. Single-tree plots were placed in 5 rows of a 'Montmorency' tart cherry rootstock trial orchard. The experimental design was a randomized complete block with seven treatments and four replications (28 plots).

Treatments.

1. Untreated.
2. Acramite 50W @ 0.75 lb/acre + Silwett L-77 @ 1.2 ml/gal.
3. Acramite 50W @ 0.75 lb/acre.
4. Acramite 50W @ 1.0 lb/acre + Silwett L-77 @ 1.2 ml/gal.
5. Vendex 50W @ 2.0 lb/acre + 0.25% Supreme oil.
6. JMS Stylet oil @ 1.5% (applied twice).
7. Supreme oil @ 1.5% (applied twice).

At pre-treatment, 6, 14, 21 (cherry) or 23 (apple), 29, and 41 days after treatment (DAT), 10 leaves were randomly selected from each tree, placed in paper bags and transported to the lab in a cooler with blue ice. The number of all life stages of *Tetranychus urticae* (twospotted spider mite), *Panonychus ulmi* (European red mite), *Bryobia rubrioculus* (brown mite), *Aculus schlechtendali* (apple rust mite), *Galendromus occidentalis* (western predatory mite), and *Zetzellia mali* (Stigmaeid predatory mite) was counted and recorded per 10 leaves. The proportion of leaves per sample with spider mites (*T. urticae*, *P. ulmi*, and *B. rubrioculus*) and predatory mites (*G. occidentalis* and *Z. mali*) was also determined. Data are presented as number of mites per leaf. The mean density of mites per leaf and cumulative mite days were compared among treatments with analysis of variance (Proc GLM, SAS). All data were square root transformed before analysis. Proportion data were arcsine-square root transformed before analysis. When significantly different, treatment means were separated using Waller-Duncan *k*-ratio *t*-test ($P \leq 0.05$).

Results and Discussion

Twospotted spider mite (*Tetranychus urticae*) was the predominant phytophagous mite species present in both trials. Brown mite (*Bryobia rubrioculus*) and European red mite (*Panonychus ulmi*) were present in low to moderate numbers in both trials. Apple rust mite (*Aculus schlechtendali*) was present in very low numbers early in the apple trial, but rust mites were not detected in the mid and later sampling dates. The only predaceous mites found were the Phytoseiid, *Galendromus occidentalis*, and the Stigmaeid, *Zetzellia mali*. *Z. mali* specializes in preying on European red mite and rust mites while *G. occidentalis* is more of a generalist that prefers twospotted spider mite over European red mite. The incidence of thrips and other predators such as ladybeetle, lacewing and syrphid larvae was low. No phytotoxicity to treated trees from any treatment was observed.

Apples. Spider mite densities throughout the trial were well below an economic threshold of 10 motile stages per leaf (Fig. 1). Densities were highest at pre-treatment and then declined in all treatments, including the untreated, to very low levels by 6 DAT (Fig. 1 and Table 1). No acaricides or insecticides other than those in the trial were applied to the trees. Insecticides applied to neighboring orchards should not have drifted to the mite control plots, and the type of materials and timing of those applications do not correspond to the timing of the decline in mite densities. There were no significant differences among treatments in the mean number of spider mite motile or egg stages or the proportion of leaves infested with spider mites throughout the trial (Table 1). Cumulative mite days for the trial period, July 17 through August 27, were low (2.9-23.7) and not different among treatments (Table 2).

All acaricide treatments caused a decline in predaceous mite densities as compared to untreated plots (Fig. 2 and Table 3). Predaceous mite densities and the proportion of leaves with predaceous mites were significantly greater in the untreated than most other treatments on 14, 23, 29 and 41 DAT. Of the acaricide treatments, Acramite at the 1.0 lb per acre rate had the least negative effect on predatory mite numbers, although it was not different from other acaricides on most dates (Table 3). Predatory mite numbers increased in untreated trees from pre-treatment to a peak of 4.5 per leaf on 29 DAT (Fig. 2) and likely caused low phytophagous mite numbers in untreated trees later in the trial (Fig. 1). Unfortunately, what appears to be successful biological control occurring in untreated plots prevented the ability to distinguish differences in phytophagous mite numbers between untreated and treated plots post-treatment (Fig. 1). In addition to direct toxicity of acaricides to predaceous mites, the very low density of phytophagous mites in acaricide-treated plots may have contributed to low predatory mite densities. Apple rust mite, which can be an alternative prey for both predaceous mite species, was present in very low numbers at pre-treatment and on 6 DAT but not later in the trial and not in any greater numbers in the untreated than other treatments.

Cherries. Spider mite densities were higher in tart cherry than apple plots, ranging from 5-27 per leaf at pre-treatment (Fig. 3). Spider mite counts in Acramite and Vendex treatments declined to below 2 per leaf by 6 DAT and were significantly less than densities in untreated and the two oil treatments (JMS Stylet and Supreme each at 1/5%) on 6 and 14 DAT (Fig. 3 and Table 4). Densities in untreated and oil treatments were above an economic threshold of 10 per leaf on 6 and 14 DAT, but then declined on 21 DAT. Spider mite densities in all treatments remained low from 21-41 DAT. Cumulative mite days were much higher than in the apple trial, and were significantly greater in the untreated, Supreme oil and JMS Stylet oil treatments (3019-4493 mite days) than in Acramite and Vendex treatments (413-850 mite days) (Table 5). There were no differences in efficacy of Acramite rates (0.75 vs. 1.0 lb per acre), by the addition of Silwett L-77 adjuvant to Acramite, or of Acramite as compared to Vendex.

Densities of predaceous mites were lower in the tart cherry than apple trial (Fig. 4). Densities fluctuated over the trial with a peak of 2 per leaf in untreated trees on 6 DAT (Fig. 4 and Table 6). Predaceous mite counts were lowest in Acramite and Vendex treatments, but not significantly (Table 6). Low numbers of predaceous mites in Acramite and Vendex plots may be attributed to toxicity of materials to the predators and/or a lack of phytophagous mite prey in these plots which stimulated their dispersal to other trees. However, densities were low in all treatments later in the trial (21-41 DAT) indicating a general decline in mite densities by 29 DAT (mid-August).

Conclusions

Unfortunately, spider mite densities were low in the apple trial and not different among treatments. The building population of predaceous mites in untreated apple plots during the trial may have resulted in excellent biological control of spider mites and thus no differences in densities between treated and untreated plots. In the tart cherry trial, both rates of Acramite (0.75 and 1.0 lb per acre) and Vendex (2 lb per acre + 0.25% oil) significantly lowered spider mite densities post-treatment. The oil alone treatments (1.5% JMS Stylet oil and 1.5% Supreme oil) were not effective in lowering spider mite densities below untreated levels 6-14 DAT. Spider mite counts dropped in all plots by 21 DAT and remained low through 41 DAT.

All acaricides tested did appear to lower predaceous mite densities. In apple, the higher rate of Acramite did not lower predatory mite numbers as much as the other treatments. In tart cherry, the two oil-alone treatments appeared to have less effect on predaceous mites. Lower predaceous mite densities in acaricide treatments were likely a result of two factors, direct toxicity and reduced phytophagous mite prey. It is difficult to separate out the relative impact of these two effects.

Apple Trial

Table 1. Mean number of **twospotted spider mites, European red mites and brown mites** per leaf (motile and egg life stages) and proportion of leaves (out of 10) infested with spider mites at pre-treatment and 6, 14, 23, 29 and 41 days after treatment (DAT) in the **apple** mite control trial at Kaysville, UT, 2002

Treatment	Pre-treatment			6 DAT			14 DAT			23 DAT			29 DAT			41 DAT		
	Motile	Egg	Pr Lv	Motile	Egg	Pr Lv	Motile	Egg	Pr Lv	Motile	Egg	Pr Lv	Motile	Egg	Pr Lv	Motile	Egg	Pr Lv
Untreated	0.4	0.6	0.30	0.7	0.8	0.28	0.1	0.1	0.01	0	0.6	0.01	0	0.1	0.01	0.2	0.1	0.01
Acramite 0.75 lb + Silwett	7.4	14.6	0.65	0.03	0.03	0.15	0.2	0.7	0.01	0	0.3	0.01	0	0.02	0.01	0	0	0
Acramite 1.0 lb + Silwett	2.6	2.9	0.60	0.2	0.5	0.08	0.1	0.5	0.01	0	0.03	0.01	0.03	0.03	0.01	0	0.03	0.01
Agri-Mek + Oil	1.1	1.0	0.35	0.3	0.1	0.15	0.2	0.3	0.08	0.1	0	0.01	0.1	0.2	0.01	0.2	0.3	0.01
Pyramite	3.2	3.6	0.50	0.2	0.3	0.10	0.03	0.2	0.03	0.1	0.6	0.01	0.03	0.1	0.01	0	0.1	0.01
JMS Stylet Oil	0.5	1.2	0.28	0.2	0.1	0.15	0	0.2	0.01	0	0.4	0.01	0	0.1	0.01	0	0.03	0.01
Supreme Oil	4.6	7.4	0.43	0.5	0.2	0.25	0	0	0	0.03	0	0.01	0	0	0	0.03	0	0.01
P>F	0.1787	0.2078	0.4887	0.1459	0.1061	0.7614	0.8000	0.7807	0.6693	0.0842	0.1794	0.6998	0.3245	0.8507	0.4552	0.0961	0.0926	0.1794

Pr Lv=proportion of leaves (out of 10) with spider mite life stages present.
Data (square root transformed) were compared with Proc GLM (SAS) and means separated using Waller-Duncan *k*-ratio *t*-test ($P \leq 0.05$).

Table 2. Mean number of **cumulative mite days** for twospotted spider mite, European red mite, and brown mite during the experiment period (July 17 – August 27, 2002) in the **apple** mite control trial at Kaysville, UT, 2002

Treatment	Cum. Mite Days
Untreated	7.4
Acramite 0.75 lb + Silwett	23.7
Acramite 1.0 lb + Silwett	9.9
Agri-Mek + Oil	8.8
Pyramite	11.4
JMS Stylet Oil	2.9
Supreme Oil	17.5
P>F	0.1453

Data (square root transformed) were compared with Proc GLM (SAS) and means separated using Waller-Duncan *k*-ratio *t*-test ($P \leq 0.05$).

Apple Trial

Table 3. Mean number of ***Galendromus* and *Zetzellia* predaceous mites** per leaf (motile and egg life stages) and proportion of leaves (out of 10) with predaceous mites at pre-treatment and 6, 14, 23, 29, and 41 days after treatment (DAT) in the **apple** mite control trial at Kaysville, UT, 2002

Treatment	Pre-treatment			6 DAT			14 DAT			23 DAT			29 DAT			41 DAT		
	Motile	Egg	Pr Lv	Motile	Egg	Pr Lv	Motile	Egg	Pr Lv	Motile	Egg	Pr Lv	Motile	Egg	Pr Lv	Motile	Egg	Pr Lv
Untreated	1.3	0.9	0.50	2.2	0.2	0.58	2.4 a	1.1 a	0.83 a	4.4 a	1.1 a	0.85 a	4.5 a	1.1	0.75 a	3.9 a	0.1	0.75 a
Acramite 0.75 lb + Silwett	0.8	0.4	0.38	0.3	0.2	0.10	0.5 bc	0.1 b	0.33 b	0.4 bc	0.1 b	0.25 bc	0.7 b	0.5	0.50 abc	0.8 b	0	0.48 ab
Acramite 1.0 lb + Silwett	1.1	0.2	0.50	0.5	0	0.28	1.4 ab	0 b	0.45 b	1.0 b	0.4 ab	0.43 b	1.3 ab	0.3	0.63 ab	0.9 b	0.03	0.33 bc
Agri-Mek + Oil	0.6	0.2	0.40	0.2	0	0.10	0.3 c	0.3 b	0.15 b	0.3 bc	0.03 b	0.28 bc	0.5 b	0.1	0.35 abc	0.3 b	0.03	0.25 bc
Pyramite	1.4	0.6	0.70	0.1	0	0.05	0.4 c	0.3 b	0.20 b	0.2 c	0.2 b	0.13 c	0.3 b	0	0.20 bc	0.3 b	0.2	0.18 bc
JMS Stylet Oil	0.9	0.5	0.23	0.8	0.2	0.18	0.2 c	0.1 b	0.13 b	0.7 bc	0.3 b	0.43 b	0.1 b	0	0.05 c	0.1 b	0	0.10 c
Supreme Oil	1.4	0.1	0.43	1.1	0.2	0.38	0.2 c	0 b	0.13 b	0.3 bc	0 b	0.23 bc	0.2 b	0.1	0.13 c	0.4 b	0.03	0.20 bc
P>F	0.7968	0.2035	0.2383	0.0982	0.5048	0.2083	0.0025	0.0143	0.0078	0.0001	0.0380	0.0002	0.0209	0.2587	0.0244	0.0001	0.4467	0.0025

Pr Lv=proportion of leaves (out of 10) with predaceous mite life stages present.
Data (square root transformed) were compared with Proc GLM (SAS) and means separated using Waller-Duncan *k*-ratio *t*-test ($P \leq 0.05$). Means followed by the same letter within a column are not significantly different.

Tart Cherry Trial

Table 4. Mean number of **twospotted spider mites, European red mites and brown mites** per leaf (motile and egg life stages) and proportion of leaves (out of 10) infested with spider mites at pre-treatment and 6, 14, 21, 29 and 41 days after treatment (DAT) in the **tart cherry** mite control trial at Kaysville, UT, 2002

Treatment	Pre-treatment			6 DAT			14 DAT			21 DAT			29 DAT			41 DAT		
	Motile	Egg	Pr Lv	Motile	Egg	Pr Lv	Motile	Egg	Pr Lv	Motile	Egg	Pr Lv	Motile	Egg	Pr Lv	Motile	Egg	Pr Lv
Untreated	5.3	40.9	1.00	20.8 a	39.3 a	1.00 a	22.2 a	22.7 ab	1.00 a	3.0	2.2	0.35	0	0.6	0.01	0.1	0.1	0.05
Acramite 0.75 lb + Silwett	10.0	21.1	0.98	1.2 b	1.9 b	0.43 b	1.5 c	2.1 d	0.50 b	0.4	1.3	0.13	0.1	0.7	0.03	0.1	0.1	0.01
Acramite 0.75 lb	10.1	36.8	0.83	0.9 b	1.5 b	0.33 b	0.4 c	4.6 cd	0.53 b	0.2	0.3	0.08	0.03	0.1	0.01	0.03	0.1	0.01
Acramite 1.0 lb + Silwett	21.6	50.4	1.00	1.5 b	3.6 b	0.48 b	1.1 c	5.4 cd	0.87 a	0.2	0.1	0.05	0	0	0	0.03	0.03	0.01
Vendex + Oil	11.9	25.2	0.98	1.5 b	6.5 b	0.43 b	1.1 c	5.4 cd	0.48 b	0.1	0.2	0.08	0.03	0.2	0.01	0	0	0
JMS Stylet Oil	16.5	34.0	0.95	24.6 a	35.4 a	0.95 a	9.2 b	18.2 bc	1.00 a	1.4	1.4	0.33	0.1	0	0.01	0	0.1	0.01
Supreme Oil	27.3	46.6	1.00	32.6 a	41.7 a	0.85 a	12.6 b	52.6 a	0.98 a	5.9	7.0	0.28	0.1	0.1	0.03	0	0.2	0.01
P>F	0.3385	0.8742	0.3693	0.0049	0.0003	0.0001	0.0001	0.0013	0.0001	0.2051	0.1112	0.3365	0.6217	0.5402	0.4552	0.1403	0.5882	0.4552

Pr Lv=proportion of leaves (out of 10) with spider mite life stages present.
Data (square root transformed) were compared with Proc GLM (SAS) and means separated using Waller-Duncan *k*-ratio *t*-test ($P \leq 0.05$). Means followed by the same letter within a column are not significantly different.

Table 5. Mean number of **cumulative mite days** for twospotted spider mite, European red mite, and brown mite during the experiment period (July 17 – August 27, 2002) in the **tart cherry** mite control trial at Kaysville, UT, 2002

Treatment	Cum. Mite Days
Untreated	3515.1 a
Acramite 0.75 lb + Silwett	527.3 b
Acramite 0.75 lb	413.1 b
Acramite 1.0 lb + Silwett	850.0 b
Vendex + Oil	545.5 b
JMS Stylet Oil	3019.0 a
Supreme Oil	4493.3 a
P>F	0.0006

Data (square root transformed) were compared with Proc GLM (SAS) and means separated using Waller-Duncan *k*-ratio *t*-test ($P \leq 0.05$). Means followed by the same letter within a column are not significantly different.

Tart Cherry Trial

Table 6. Mean number of ***Galendromus* and *Zetzellia* predaceous mites** per leaf (motile and egg life stages) and proportion of leaves (out of 10) with predaceous mites at pre-treatment and 6, 14, 21, 29, and 41 days after treatment (DAT) in the **tart cherry** mite control trial at Kaysville, UT, 2002

Treatment	Pre-treatment			6 DAT			14 DAT			21 DAT			29 DAT			41 DAT		
	Motile	Egg	Pr Lv	Motile	Egg	Pr Lv	Motile	Egg	Pr Lv	Motile	Egg	Pr Lv	Motile	Egg	Pr Lv	Motile	Egg	Pr Lv
Untreated	0.03	0.3	0.03	2.0	0.3	0.43	0.2	0.1	0.10	0.8	0	0.18	0	0	0	0.1 a	0	0.05
Acramite 0.75 lb + Silwett	0.2	0	0.10	0.1	0.1	0.08	0.2	0.03	0.10	0.03	0.1	0.03	0.03	0	0.03	0.03 b	0	0.03
Acramite 0.75 lb	0	0	0	0	0.03	0.01	0.2	0.1	0.18	0	0	0	0.1	0	0.08	0 b	0	0
Acramite 1.0 lb + Silwett	0	0	0	0.1	0.1	0.08	0	0	0	0	0	0	0	0.03	0.03	0.03 b	0	0.03
Vendex + Oil	0.5	0	0.15	0.2	0.2	0.18	0.3	0.2	0.25	0.2	0.3	0.13	0.03	0	0.03	0 b	0	0
JMS Stylet Oil	0.3	0.03	0.10	1.0	0.03	0.23	0.7	0	0.18	0.1	0.1	0.08	0	0	0	0 b	0	0
Supreme Oil	0.1	0.03	0.05	0.5	0	0.10	0.8	0.03	0.08	0.03	0.1	0.05	0.03	0.1	0.05	0.1 a	0	0.05
P>F	0.4264	0.5324	0.5420	0.1493	0.7659	0.2756	0.7868	0.5355	0.5590	0.1509	0.6069	0.4484	0.2846	0.5701	0.4153	0.0399	--	0.3572

Pr Lv=proportion of leaves (out of 10) with predaceous mite life stages present.
Data (square root transformed) were compared with Proc GLM (SAS) and means separated using Waller-Duncan *k*-ratio *t*-test ($P \leq 0.05$). Means followed by the same letter within a column are not significantly different.

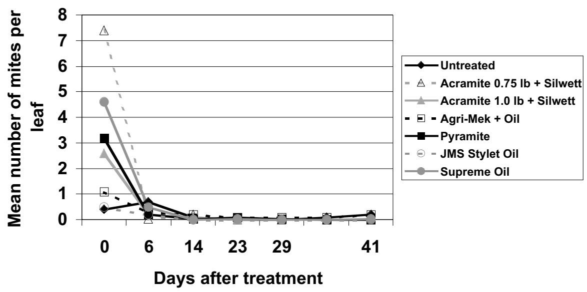

Figure 1. Mean number of motile **phytophagous mites** (Twospotted spider mite + European red mite + Brown mite) per leaf at pre-treatment, 6, 14, 23, 29 and 41 days after treatment in the Kaysville **apple** mite control trial, 2002.

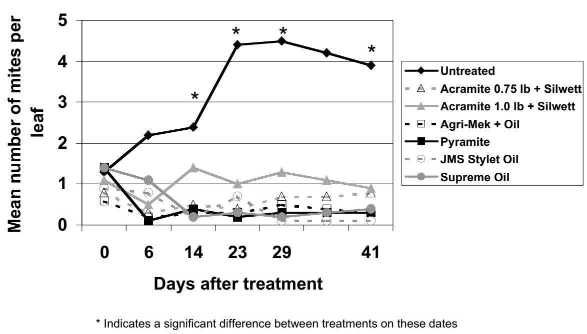

Figure 2. Mean number of motile **predaceous mites** *(Galendromus + Zetzellia)* per leaf at pre-treatment, 6, 14, 23, 29 and 41 days after treatment in the Kaysville **apple** mite control trial, 2002.

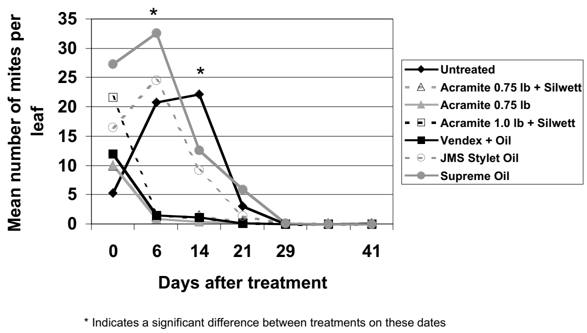

Figure 3. Mean number of motile **phytophagous mites** (Twospotted spider mite + European red mite + Brown mite) per leaf at pre-treatment, 6, 14, 21, 29 and 41 days after treatment in the Kaysville **tart cherry** mite control trial, 2002.

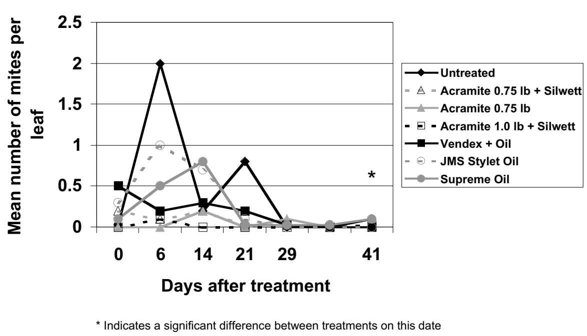

Figure 4. Mean number of motile **predaceous mites** *(Galedromus + Zetzellia)* per leaf at pre-treatment, 6, 14, 21, 29 and 41 days after treatment in the Kaysville **tart cherry** mite control trial, 2002.