OREGON STATE UNIVERSITY

Southern Oregon Experiment Station

ANNUAL REPORT IN ENTOMOLOGY 1990

Prepared by

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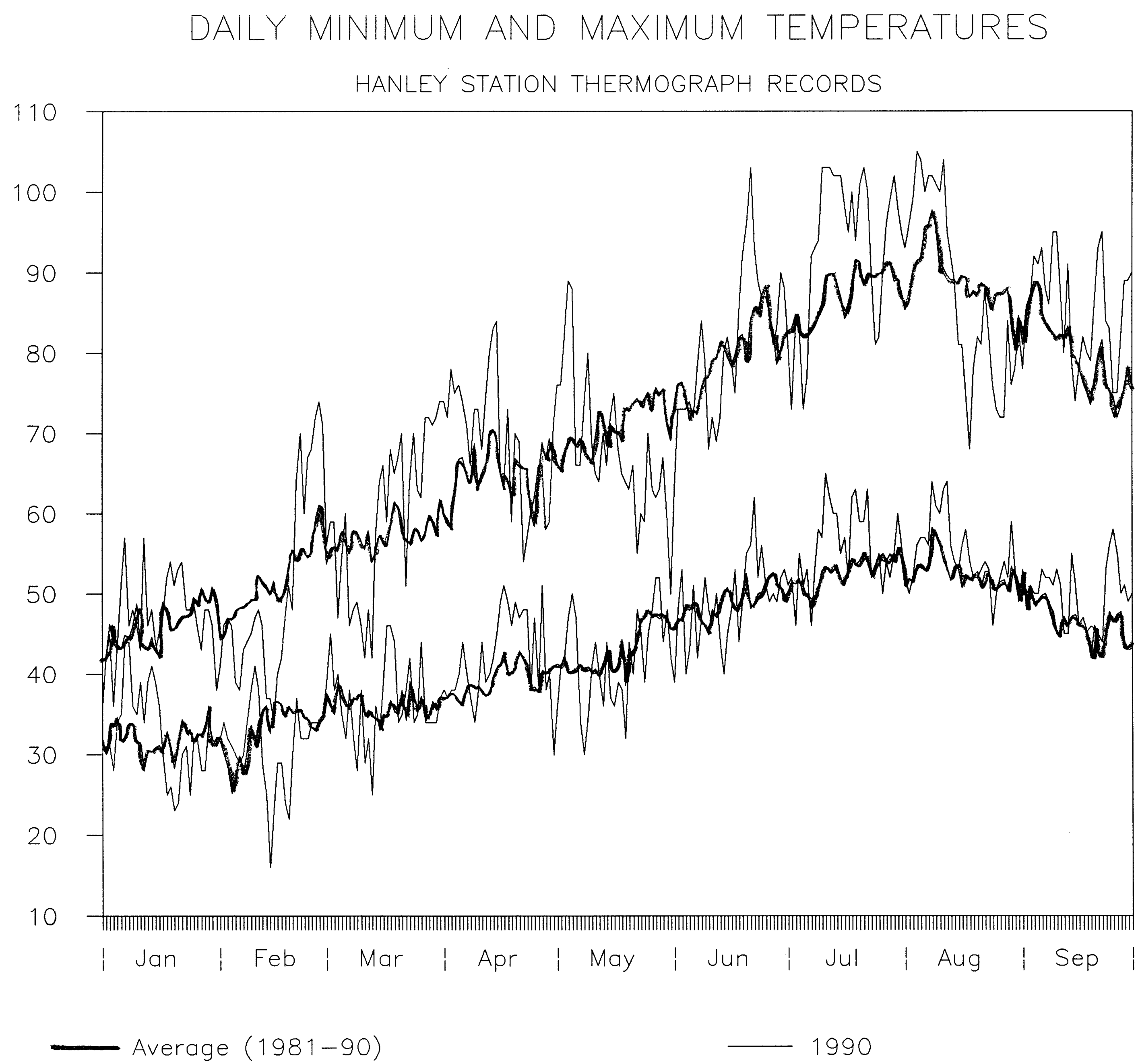
R. J. Hilton, P. Gonzalves

CONTENTS

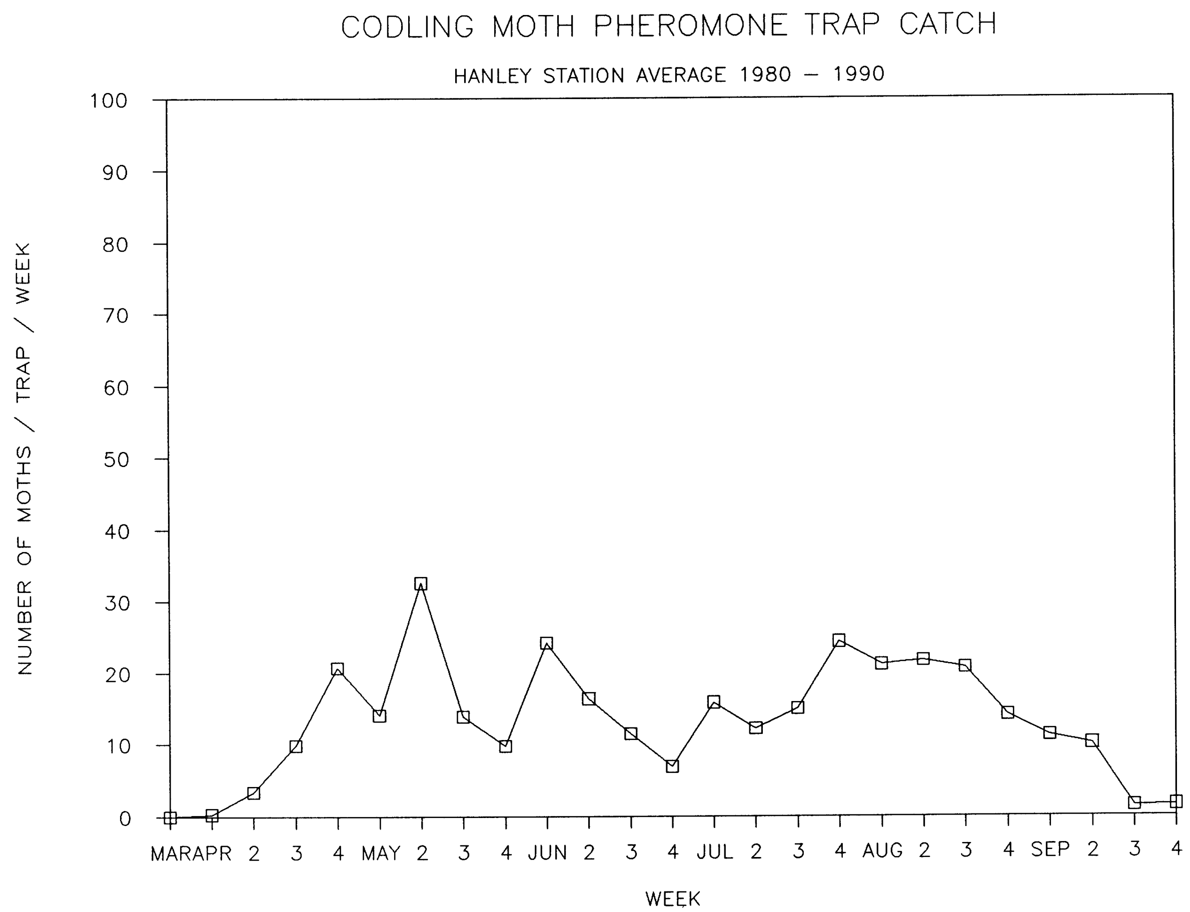

DAILY MINIMUM AND MAXIMUM TEMPERATURES
HANLEY STATION THERMOGRAPH RECORDS
110
100
90
80
70
60
50
40
30
20
10
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Average (1981–90)
1990

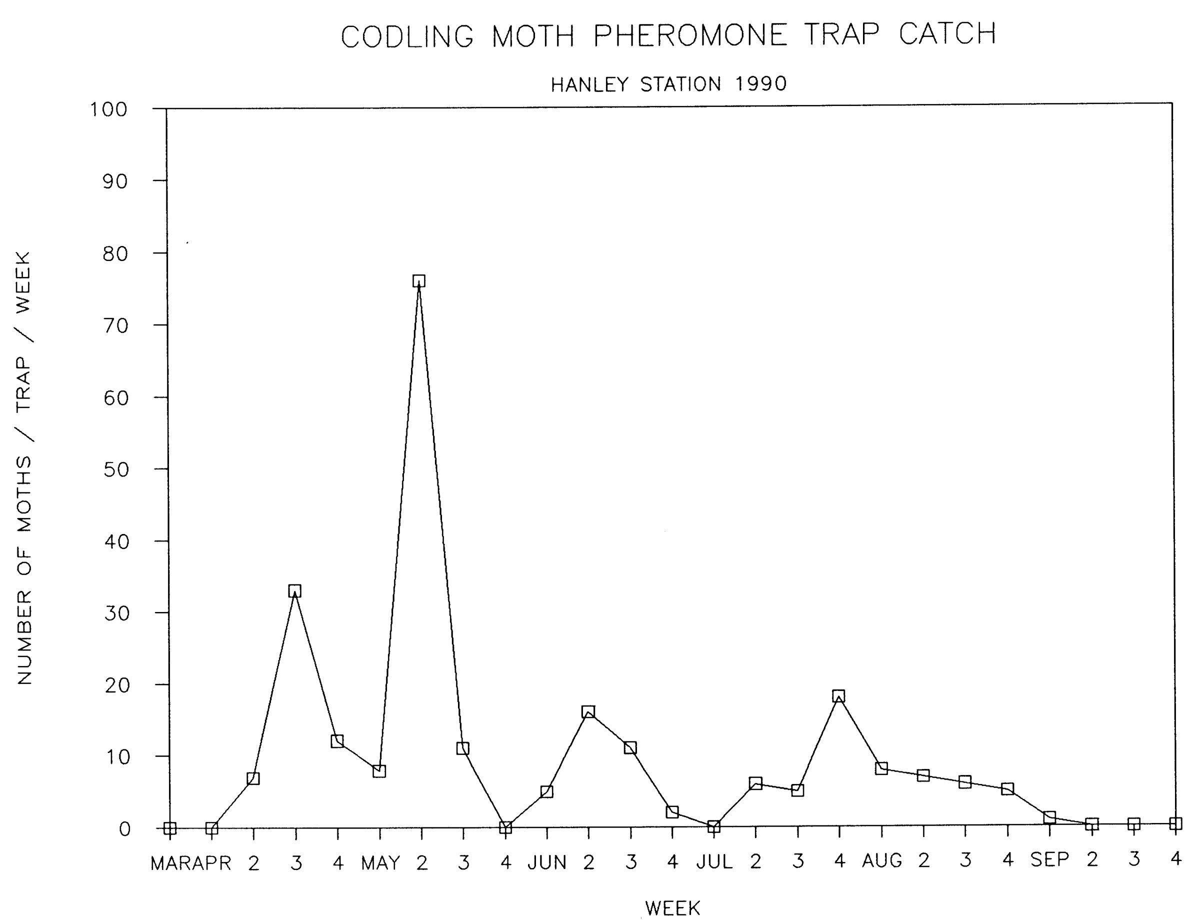
ROGUE VALLEY TEMPERATURES AND PRECIPITAION 1990

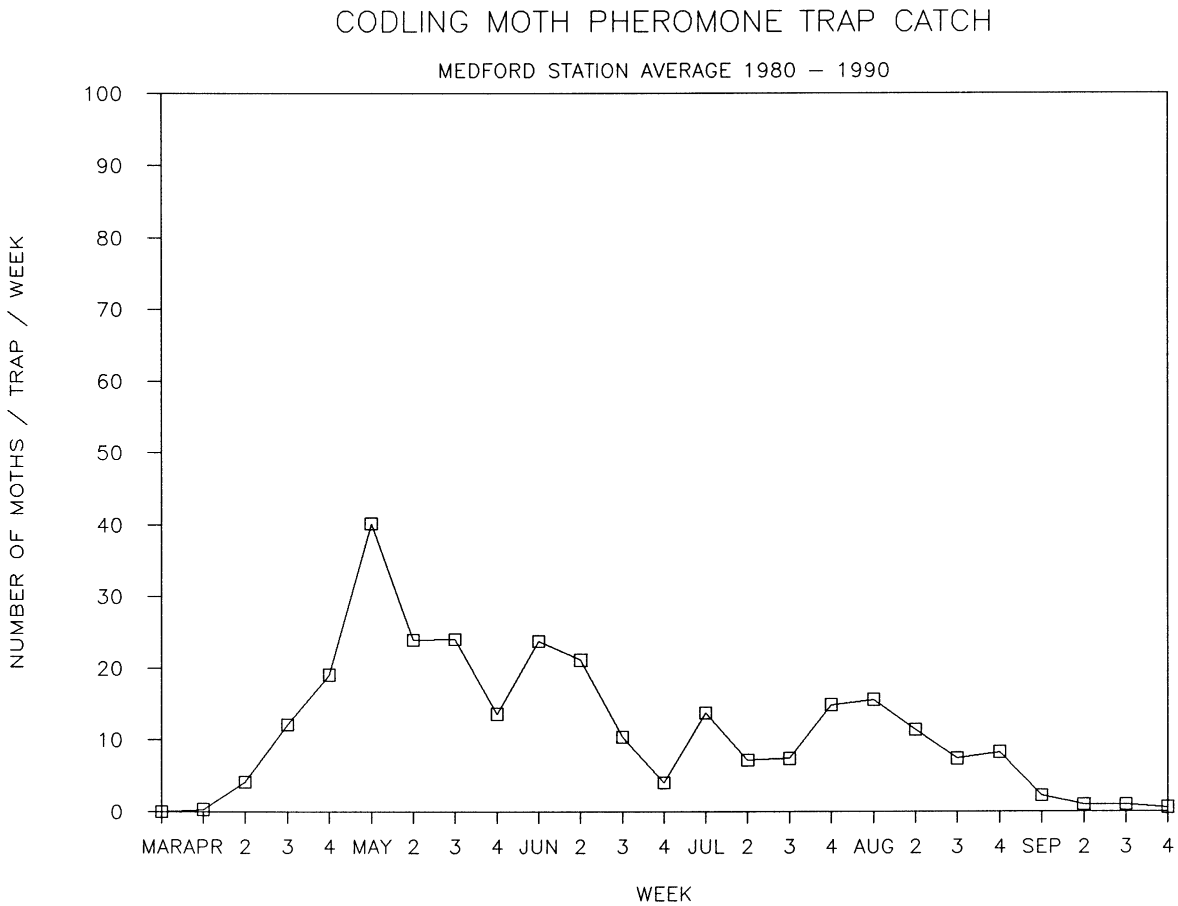
Daily minimum and maximum temperatures from Hanley Station records
Precipitation data from Medford Station records

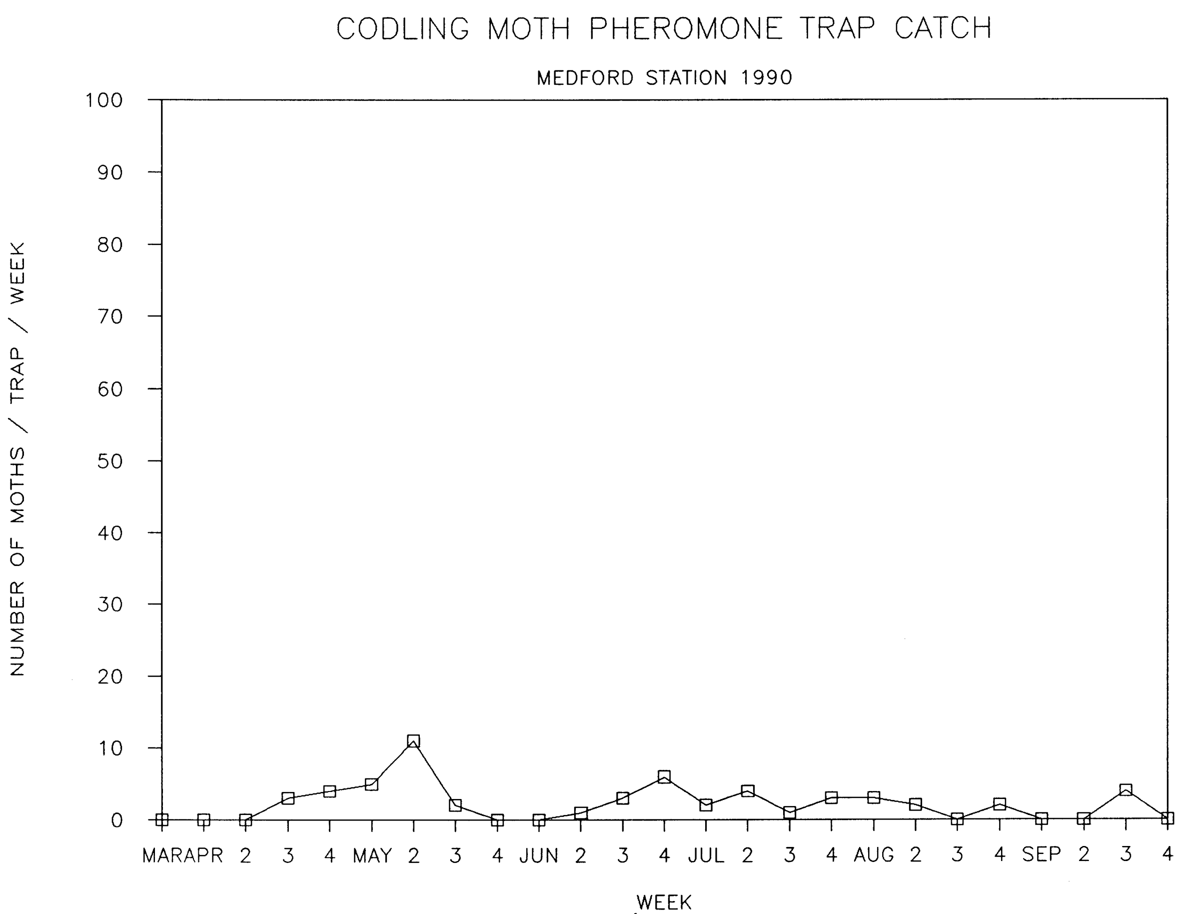
DATE	JANUARY MIN	JANUARY MAX	JANUARY PRECIP	FEBRUARY MIN	FEBRUARY MAX	FEBRUARY PRECIP	MARCH MIN	MARCH MAX	MARCH PRECIP	APRIL MIN	APRIL MAX	APRIL PRECIP	MAY MIN	MAY MAX	MAY PRECIP
1	32	36	0.05	32	41	0.17	39	56		38	74		36	76	
2	30	42	0.17	34	46	0.07	45	59	0.25	37	72		41	76	
3	31	45	T	32	47	T	38	59		38	78		42	82	
4	28	36		31	46	0.07	40	47		38	75		47	89	
5	34	43	0.02	30	39		35	54	0.74	40	76		50	88	
6	35	51	0.01	29	38	0.03	32	60	0.01	44	74		47	66	
7	44	57	0.71	30	43	0.03	38	46		40	71		34	66	
8	44	46	1.47	34	44	0.04	32	48	0.60	37	66		30	73	
9	36	48	0.11	38	45	0.03	28	49	T	34	73		35	80	
10	35	46	0.02	41	47	0.03	38	46	0.09	38	73		41	69	
11	39	43	T	38	48		29	42	0.06	44	68		44	65	
12	34	57	T	29	46		32	48	0.17	39	74		40	64	
13	39	46	T	25	37	0.05	25	42	0.16	40	80		36	70	
14	41	48	0.07	16	37		36	57	0.05	42	83		44	66	
15	39	44	0.06	23	34		33	64		45	84		37	72	
16	36	42	0.14	29	40	0.4	39	66		49	65		36	75	
17	30	47	T	29	42	0.01	46	59	T	51	63	0.27	39	68	
18	25	52		24	47	0.01	46	68		49	73	0.02	38	65	
19	26	54		22	51		44	65		46	59		32	64	
20	23	51		30	48	T	34	67		49	70	0.05	44	63	0.10
21	24	53		37	64		35	70		47	69		40	66	0.01
22	30	54	T	32	70		38	51		48	54	0.02	48	55	0.41
23	31	48		32	60		42	64	0.25	48	57	0.48	45	60	0.69
24	25	48		32	67		34	70	T	38	60	0.06	39	59	0.05
25	32	49		34	68		35	63		47	62	T	45	70	0.01
26	32	46	0.02	34	72		44	62	0.14	38	66	0.02	48	63	0.15
27	28	43	T	34	74		34	72		51	66		52	62	0.01
28	28	48		35	71		34	72		38	58		52	63	0.49
29	34	48	0.17				34	71		40	59	0.04	44	67	0.03
30	32	46	0.16				34	72		30	71	T	48	59	0.27
31	31	38	0.11				37	74					42	50	0.08
Total			3.29			0.94			2.52			0.96			2.30
Average	33	47		31	50		36	59		42	69		42	68	

DATE	JUNE MIN	JUNE MAX	JUNE PRECIP	JULY MIN	JULY MAX	JULY PRECIP	AUGUST MIN	AUGUST MAX	AUGUST PRECIP	SEPTEMBER MIN	SEPTEMBER MAX	SEPTEMBER PRECIP
1	39	63	0.08	51	81		52	93		53	78	
2	48	73	0.01	52	73	0.13	50	96		48	85	
3	53	73	0.13	46	84	0.04	52	99		51	87	
4	40	73	0.01	55	83		56	105		50	92	
5	43	74		51	73		57	104		50	91	
6	51	72		53	77		57	100		53	93	
7	42	78	T	46	92		56	102		52	88	
8	47	84		53	93		64	102		52	86	
9	52	79		58	94		61	101		51	95	
10	48	68		57	103		60	100		53	95	
11	46	72		65	103		63	104	0.19	51	88	
12	50	69		62	103		64	95		45	80	
13	44	72	T	60	102		56	92		45	91	
14	40	80		60	102		54	89		55	79	
15	45	82		55	102		53	81		51	74	
16	48	79	0.05	57	98		56	81		46	78	
17	53	75		52	95		58	75	0.27	46	82	
18	44	85		62	100		54	68	0.1	45	80	
19	49	92		63	94	0.09	52	78	0.04	42	79	
20	55	96		59	101		52	82	T	46	86	
21	56	103		59	103		53	81	0.15	45	93	
22	62	93		63	100		54	88		44	95	
23	52	89		52	90		53	82		53	84	
24	56	87		53	81		46	76		56	83	
25	51	87		55	82		50	73		58	75	0.06
26	49	85		50	90		52	72	0.14	55	75	0.09
27	50	81		54	96		54	72	0.1	50	82	0.01
28	49	83		52	99		52	84	T	51	89	
29	52	90		55	102		59	76		49	89	
30	53	88		60	98		53	78	0.22	50	90	
31				56	95		49	83				
Total			0.28			0.26			1.21			0.16
Average	49	81		56	93		55	87		50	85	


CODLING MOTH PHEROMONE TRAP CATCH
HANLEY STATION AVERAGE 1980 – 1990
NUMBER OF MOTHS / TRAP / WEEK
WEEK
MAR APR 2 3 4 MAY 2 3 4 JUN 2 3 4 JUL 2 3 4 AUG 2 3 4 SEP 2 3 4


CODLING MOTH PHEROMONE TRAP CATCH
HANLEY STATION 1990
NUMBER OF MOTHS / TRAP / WEEK
WEEK
MAR APR 2 3 4 MAY 2 3 4 JUN 2 3 4 JUL 2 3 4 AUG 2 3 4 SEP 2 3 4


CODLING MOTH PHEROMONE TRAP CATCH
MEDFORD STATION AVERAGE 1980 – 1990
NUMBER OF MOTHS / TRAP / WEEK
100
90
80
70
60
50
40
30
20
10
0
MAR APR 2 3 4 MAY 2 3 4 JUN 2 3 4 JUL 2 3 4 AUG 2 3 4 SEP 2 3 4
WEEK


CODLING MOTH PHEROMONE TRAP CATCH
MEDFORD STATION 1990
NUMBER OF MOTHS / TRAP / WEEK
100
90
80
70
60
50
40
30
20
10
0
MAR APR 2 3 4 MAY 2 3 4 JUN 2 3 4 JUL 2 3 4 AUG 2 3 4 SEP 2 3 4
WEEK

Variation in Date of Biofix for Codling Moth

Year	Hanley Farm	Medford Farm
1980	4/20	4/16
1981	4/13	4/13
1982	4/22	4/22
1983	4/28**	5/3**
1984	4/28**	4/22
1985	4/8	4/9
1986	4/3*	4/6*
1987	4/13	4/13
1988	4/11	4/10
1989	4/16	4/17
1990	4/8	4/7

*earliest date
**latest date

MODIFICATION IN FIRST GENERATION CODLING MOTH CONTROL ON PEAR.

Pears, as opposed to apples, exhibit a moderate to high level of tolerance to fruit entry by codling moth larvae. This tolerance is most strongly exhibited in the early summer months (May-July) and appears to be related to the prevalence of "stone cells" found just below the fruits epidermal structure. As fruit begins to mature in August or September its tolerance to codling moth entry disappears. The period of fruit tolerance coincides with appearance of immatures of the first generation codling moth and a portion of the second generation.

Standard codling moth control programs utilizing organophosphate chemicals (Guthion or Imidan) are applied twice against first and once or twice, depending on pear variety, against the second generation. Timings of first generation sprays follows those directed by the codling moth phenology model (Brunner et al 1982) i.e. at ca. 250 °D following biofix (first flight) and again 21-28 days later.

In the present 1990 study we evaluated codling moth suppression using a single first generation application of Guthion applied at about 360 °D following biofix. It was hypothesized that this single treatment along with the added codling moth mortality due to host plant tolerance measured at this period could permit elimination of one spray while still providing acceptable commercial codling moth control.

The study area was composed of 2, 1 acre blocks of mature pears, cv.'Bartlett', located at the Hanley Farm of Southern Oregon Experiment Station near Medford. Each block was divided into 3 treatments with two replicates each. The treatment included a standard program with two Guthion treatments (250 °D following biofix and 28 days later) directed against first generation codling moth, a modified program using a single first generation spray (360 °D after biofix) and an unsprayed check. Both the standard and the modified program received a normal second generation spray on July 18 (1300 °D after biofix). Guthion applications were made at 1.0 lb ai per acre using an air-carrier sprayer set to deliver 250 gpa. 1990 pheromone trap records indicated that both test areas were subjected to moderate codling moth pressure. Evaluations of codling moth fruit damage was made at the end of overwintering adult emergence (82% predicted egg hatch) on June 21 and at harvest on July 30 (46% egg hatch 2nd generation).

The results (table 1) show low levels of codling moth infected fruit in the early evaluation (June 21) ranging from 0% to 0.3% in the treated plots. However by harvest on July 30 the degree of infestation had increased to between 7% and 10% in the modified program whereas the standard program sustained only from 0% to 0.5% damage in the two blocks.

Based on these results, using the 'Bartlett' variety under moderate codling moth pressure, it would appear that reduction in the number of sprays for suppression of first generation codling moth would be highly risky and may result in substantial fruit loss.

Table 1. Codling moth (CM) fruit infestation in plots receiving one or two chemical applications against the first generation. Guthion applied at 1.0 lb ai/acre.

	% CM infested fruit			
	Orchard 1		Orchard 2	
Program (Date applied)	June 21	Harvest July 30	June 21	Harvest July 30
Standard: 2, 1st gen. sprays (5/4, 6/2)	0	0.5	0.3	0
Modified: 1, 1st gen. spray (5/9)	0	10.5	0.3	7.0
untreated	4.6	14.5	0.7	15.5

USE OF THE INSECT GROWTH REGULATORS FENOXYCARB AND DIFLUEBENZURON WITH ORCHEX OIL IN A SEASONAL PROGRAM ON PEAR

P. H. Westigard, R. J. Hilton

Resistance by the codling moth to the organophosphate chemicals has been reported from 3 locations in the Pacific coast states of Washington, Oregon, and California. Field failure has been reported from areas in California where CM exhibited a 6-8 field resistance ratio to azinphosmethyl (Guthion) (Welter). In Oregon and Washington there have been no obvious field failures but a considerable number of growers here reported larval fruit damage following use pattern and rates of Guthion previously found highly effective. In addition, laboratory bioassays from Oregon and Washington indicate a 2-4 fold resistance level in codling moth (Westigard and Moffitt, Brunner).

Registered alternatives to the O-P pesticides are few in number but possibly include synthetic pyrethroids (e.g. fenvalerate) or the carbamate carbaryl (Sevin). The latter chemical has generally exhibited cross resistance to any resistance shown by the O-P compounds and both compounds are highly toxic to predaceous species, especially predatory mites.

Another alternative is use of insect growth regulators (IGR's) either chitinase inhibitors e.g. Dimilin or juvenoids e.g. Insegar. Dimilin (25W) currently is being used on about 500 acres of pear in southern Oregon under an experimental use permit (FIFRA section 24C). Typically Dimilin is combined with petroleum oil (1%) in the first two cover sprays and without oil in the final 1 (Bartlett) - 2 (winter pears) treatments. The addition of oil to this IGR has been found to greatly improve performance against pear psylla and is suppressant to spider mite populations. The deletion of oil from the late season treatments is due to concerns regarding lowering of fruit quality through lenticel darkening.

Fenoxycarb has been previously tested in southern Oregon against several pear pests but has not been evaluated on commercial type applications. Its use with oil has also not been evaluated for phytotoxicity potential on winter pear cultivars.

In this 1990 trial we compared fenoxycarb with and without Orchex 796 oil to the Dimilin-oil combination in a seasonal program of 4 sprays timed for codling moth suppression.

Materials and Methods

Studies were conducted in a 1.9 acre pear block containing 6 different cultivars. These varieties included Anjou, Bartlett, Red Sensation Bartlett, Seckel, Bosc and Comice. The block was divided into 16 subblocks representing 4 treatments with 4 replicates each. Each replicate contained 24 trees with 4 trees each of the various pear cultivars. Replicates were separated by a single buffer row of the Bosc variety. Four IGR treatments were made based on the codling moth temperature-phenology model (see table 1). Orchex 796 oil at 1% was combined with Dimilin and one fenoxycarb treatment in the first two cover sprays (4/19, 5/17), reduced to 0.25% in the third spray (7/5) and not included in the fourth (8/3) in order to avoid lenticel darkening on the clear-skinned pear cultivars (Anjou and Comice). Oil sprays were applied at 200 gpa using a commercial air-carrier sprayer.

Monitoring of pest densities was carried out at biweekly intervals from mid-April through late August. Numbers of pear psylla immatures and twospotted spider mites were estimated by collecting 20 leaves (10 new, 10 mature) per replicate, processed through a mite brushing machine and counted with the aid of a dissecting microscope. Leaf samples were only taken from the Anjou and Bosc cultivars.

Fruit damage caused by codling moth and pear psylla was evaluated at harvest (September 4-5) for the winter pear varieties Bosc and Anjou.

Results

Codling moth (CM). Damage at harvest due to this key pest ranged from 1.3% in the fenoxycarb plus oil plot to 9.5% in both the check and the Dimilin plots (table 2). Fenoxycarb used by itself resulted in 3.0% CM infested fruit. The lack of control with Dimilin may be related to the location of the test as tolerance to this compound was detected from nearby pear blocks at this site in 1984. If this explantation is correct it would appear then that there is probably no obvious cross resistance between the juvenoid fenoxycarb and the chitinase inhibitor Dimilin. the improved performance of fenoxycarb with Orchex can be attributed to several factors including increased egg penetration by fenoxycarb, direct egg mortality or to improved distribution of the IGR over the plant surface.

Pear Psylla (PP). Due to unexpectedly good prebloom control obtained with Thiodan plus Orchex oil, PP densities were relatively low through May and early June. In addition exceptionally hot temperatures (25 days exceeding 100 F) in July and August also appeared to suppress the development of PP densities normally expected. Downgrading of fruit at harvest due to PP induced fruit russet was 2.3% in the check plot and less than 0.5% in the treated plots (table 2). Non-downgrading psylla marking was 2.8% in the Dimilin plus oil treatment and 1.8% in the fenoxycarb used alone treatment. (table 3).

Twospotted spider mite (TSM). Neither IGR used in this study is known to possess acaricidal activity and TSM populations reached potentially damaging levels in late June and early July (table 4), and were treated with Apollo (3 ozs AI/acre) on July 5. No application was made to the check plot. Overall mite densities in plots receiving oil were about one-half of those recorded in the non-oil fenoxycarb treatment (table 4).

Other mites. A low number of pear rust mite and predaceous mite were recorded in July and August counts but their distribution and density did not appear to be related to any particular treatment program.

Phytotoxicity. Evaluations of fruit and foliage damage caused by the chemical treatment was made about 1 week following each application. All 6 varieties were evaluated at each time period. No phytotoxicity was recorded on any variety with the exception of that examination made following the first treatment on April 19. This damage found only in the oil treatments took the form of light bronzing on the underside of young shoot leaves but was restricted to just the Anjou and Bosc varieties. The injury was of a minor nature and should be of no concern to commercial growers. No direct fruit injury was noted. Further studies of potential phytotoxicity should be conducted at various pear growing localities using both concentrate and dilute applications.

Table 1. Treatment schedules for seasonal use of fenoxycarb and diflubenzuron with Orchex 796 oil. 4, 27-tree replicates. Application by air-carrier sprayer at 200 gpa.

Treatment & rate AI/acre	Timing from CM biofix and date of treatment: 1st (1st generation CM)	2nd (1st generation CM)	3rd (2nd generation CM)	4th (2nd generation CM)
fenoxycarb 42.6 g	75 °D 4/19	75 °D + 28 days 5/17	900 °D 7/5	900 °D + 28 days 8/03
fenoxycarb 42.6 g plus	timing as above	timing as above	timing as above	timing as above
Orchex oil	1%	1%	0.25%	no oil
diflubenzuron 85 g plus	timing as above	timing as above	timing as above	timing as above
Orchex oil	1%	1%	0.25%	no oil

Table 2. Direct codling moth fruit damage to winter pear cultivars at harvest following seasonal foliar applications of diflubenzuron and fenoxycarb with and without combination of Orchex 796 spray oil. Fruit harvested September 4-5, 1990.

Material and rate AI/acre	Codling moth % fruit with entries	Pear psylla honeydew injury: non-downgrading	downgraded
Fenoxycarb 42.6 g	3.0	1.8	0.25
Fenoxycarb 42.6 g plus Orchex 796 1%	1.3	0.3	0
Diflubenzuron plus Orchex 796 1%	9.5	2.8	0.5
Untreated	9.5	8.8	2.3

Table 3. Population densities of pear psylla in plots receiving seasonal IGR treatments with Orchex 796 oil. See table 1 for spray dates.

Material and rate AI/acre	No. immatures/leaf 4/10	4/30	5/14	5/29	6/11	6/26	7/9	7/24	8/7	8/23	$\bar{x}$ 4/30-8/23
fenoxycarb 42.6 g	0.6	0	0.2	0.1	0.2	0.4	0.3	0.2	0.3	0.6	0.26
fenoxycarb 42.6 g plus Orchex oil 1%	0.4	0.1	0.1	0.2	0.2	0.6	0.1	0.1	0.1	0.1	0.21
diflubenzuron 85 g plus Orchex oil 1%	0	0	0	0.1	0.5	0.4	0.2	0.1	0.4	0.9	0.29
Check	0	0.2	0.1	0.1	0.4	0.8	1.1	0.3	0.5	0.9	0.49

Table 4. Twospotted spider mite densities in plots treated with IGRs ± Orchex oil. See table 1 for spray dates.

Material and rate AI/acre	Average number mite/leaf 6/11	6/26	7/9	7+/24	8/7	8/23	$\bar{x}$ 6/11-8/24
Fenoxycarb 42.6 g	0.8	9.2	20.4	13.4	11.2	13.4	11.4
Fenoxycarb 42.6 g plus Orchex 796 oil	0	3.2	8.8	7.2	6.2	11.2	6.1
Diflubenzuron 85 g plus Orchex 796 oil	0.6	4.4	6.2	8.2	7.2	21.3	7.9
Check	0.6	4.2	14.0	41.6	85.0	89.8	39.2

THE USE OF PHEROMONE CONFUSION FOR THE CONTROL OF CODLING MOTH

P. H. Westigard, R. J. Hilton, Pete Gonzalves

The 1990 research on the use of pheromone confusion was expanded and various factors which could impact the utilization of this technology were investigated. In addition to Bartlett, plots of winter pears were established. One application of pheromone dispensers was compared to two applications on Bosc, Comice and, as in 1989, Bartlett. Biocontrol Ltd. provided a new type of dispenser shielded against UV degradation, which was compared against the regular dispenser. In the continuation of last years plot, conducted in Bartletts, pheromone applications were compared to a Dimilin based program, and a hybrid program consisting of two Dimilin and oil sprays timed for the first codling moth (CM) generation and a single pheromone application aimed at the second CM flight.

Unfortunately, due to unacceptible levels of CM infestation, all of the plots, which were located in commercial orchards were sprayed with organophosphorous (OP) insecticides prior to harvest.

Methods and Materials

Three separate commercial blocks were used for the various field tests in 1990. The 1989 field trial was repeated. Five plots were set up in the 15 ac. block of Bartletts just as they had been in 1989. The four treatments, located in four contiguous plots each 1.8 ac., were: 1)a single application of pheromone dispensers, 4/10; 2)two pheromone applications, 4/10 and 6/29; 3)two Dimilin sprays, 4/18 and 5/11 ,and a pheromone application on 6/29; and 4) three Dimilin sprays, 4/18, 5/11 and 6/28. A fifth, non-contiguous plot, was also treated solely with Dimilin as was the remainder of the block. CM traps were set in the middle of each plot and monitored weekly. Fruit samples were taken at the end of the first CM generation, as determined by phenology model, and then toward the end of July as problems became apparent, but prior to normal August harvest.

A 3 ac. Red Anjou block in an adjoining orchard was treated twice with pheromone dispensers, 4/10 and 6/29. Five pheromone traps were placed throughout the block and fruit samples were taken several times through the season. For comparison purposes nearby blocks of Dimilin treated Red Anjous and Guthion treated green Anjous were also monitored with pheromone traps and fruit samples.

On the opposite side of the valley an 11 ac. block of Comice and Bosc was used for field testing. Comparisons were made between one application and two applications of pheromone, and in a five acre section of Comice a further comparison between the regular Biocontrol dispenser and their newer shielded dispenser was conducted. Four CM pheromone traps were monitored throughout the season and fruit samples were examined at the end of the first CM generation, 6/29, and on 7/31. Again, nearby blocks of Dimilin treated and Imidan treated Bosc were monitored with both pheromone traps and fruit sampling.

Results

The results of the pheromone trap monitoring through the first CM generation and the fruit sample taken on 6/29 are shown on Table 1 for all the plots. On only one date, 5/23, and in only one trap, located in the single application plot in its second year, were any moths reported to be caught. In the two application Bartlett block only one infested fruit was found out of the 200 fruit checked. Overall, a total of 1300 fruit were examined from the pheromone treated blocks in the initial fruit sample.

In mid to late July it became apparent that control was being lost in the pheromone treated Bartlett plots. A fruit sample was taken on July 23 showing 3.5% infested fruit with 7% along the south border. The Red Anjou block was checked and no CM infested fruit were discovered. In a subsequent check of the Bosc and Comice block low levels of CM infestation were found. On July 31 a final fruit sample was taken from all of the pheromone treated blocks, see Table 2. It should be noted that despite this high level of fruit infestation the pheromone traps in the pheromone treated blocks were shut down for the remainder of the season.

A detailed look at the fruit infestation in the Bartlett block , which was in the second year of testing, showed that the CM infestation was much higher along the border of the pheromone plots than in the interior, Table 3.

Conclusions

1990 was a very difficult year for codling moth control. Unusually high levels of CM infestation were reported from both Dimilin and OP based programs, with problems developing later in the season. Following the first CM generation, the infestation was negligible or zero in the pheromone treated plots, and except for one anomalous trapping date early in the season all the traps were shut down. However, within three weeks of the initial fruit sample significant fruit damage was apparent in two out of the three blocks. Only the Red Anjous were free of a measurable infestation, but as Bartlett pollinizers in that block began to exhibit some CM entries, that plot was also sprayed out with OP's in early August. In virtually all of the comparisons no explainable trends were apparent. In some cases CM infestation was higher with one pheromone application than two applications, but in other instances the reverse was true. Shielded versus regular dispensers showed no important differences. In the Bartlett plot infestation levels were significantly higher on the border, whether the border was next to a fallow field or a Dimilin treated orchard. Since the blocks were sprayed out prior to harvest, seasonal levels of control are not available. However, there did not appear to be any appreciable difference in infestation level between the Bartlett block in the second year of pheromone confusion and the Comice and Bosc block in the first year.

The results from 1990 are largely inconclusive--whether the comparison is summer pear vs. winter, one application of pheromone vs. two, regular dispenser vs. shielded, or even first year vs. second. The only obvious findings were the presence of high border populations in the Bartlett block and the apparent tolerance of Red Anjou to CM entry later in the season. The observed edge effect in the Bartlett plot does not necessarily indicate that the CM infestation resulted from mated females flying in from adjacent blocks treated with Dimilin, which has no effect on adult moths. Since it is unclear where fly-ins to the northern border would have originated, the 19% infestation level seen there may have been partly due to prevailing northwest winds pushing the pheromone plumes off that border.

More information is needed in order to determine which factor, or combination of factors, resulted in the extremely poor second generation control seen in the pheromone treated plots. One could point to the widespread inefficacy of the second pheromone treatment and question the performance of those dispensers, but a large percentage were from the same batch as the first application. One positive result was the effectiveness of the hybrid program, utilizing Dimilin and oil sprays in the first CM generation and pheromone dispensers in the second generation. While the residual effect of Dimilin may have played some factor in that second generation CM control, there is an indication that the pheromone application was indeed beneficial. In fact, the success of that treatment implies that the breakdown of the pheromone confusion began in the first CM generation, perhaps as indicated by the early season trap catch. However, that conclusion is not supported by the results of the initial fruit sample taken at the end of the first CM generation when no CM eggs and only one infested fruit were found.

Table 1
1990 - 1st Codling Moth Generation 6/29

	Trap Catch	CM Eggs per 100 fruit	Fruit Damage
Bartletts (2nd year)			
1 application	2	0	0
2 applications	0	0	0.5%
Red Anjou			
	0	0	0
Comice and Bosc			
Regular Dispensers	0	0	0
Shielded Dispensers	0	0	0

Table 2
1990 - 2nd Codling Moth Generation 7/31

	Trap Catch	CM Eggs per 100 fruit	Fruit Damage
Bartletts (2nd year)			
1 application	0	0	2.5%
2 applications	0	0	4.5%
Red Anjou	0	0.5	0
Comice			
Regular Dispensers	0		
1 application		1.5	1.5%
2 applications		0	6.0%
Shielded Dispensers	0		
1 application		4.5	3.0%
2 applications		0	1.5%
Bosc	0		
1 application		2.0	11.0%
2 applications		2.0	4.0%

Table 3 Bartlett Plot Map - (2nd Year)

Location and Level of CM Infestation

Fallow Field

↑ N

Open Area	19.0% 2.5% 1 Pheromone Application	1.0% 0.5% 2 Dimilin Applications 1 Pheromone Application	Dimilin Treated Orchard 1.0%
	2 Pheromone Applications 4.5% 9.0%	3 Dimilin Applications 0.0% 1.0%	

Dimilin Treated Orchard

PEAR PSYLLA: TOLERANCE TO PREBLOOM PYRETHROIDS. 1990 BIOASSAYS.

Overwintering pear psylla adults in 6 southern Oregon orchards have been monitored for several years to detect possible changes in tolerance to the pyrethroid chemical fenvalerate. In 1990 treatments were applied to field collected adults on 25 January using the slide-dip technique. The bioassay results (table 1) indicate that psylla populations in southern Oregon have not as yet developed resistance to this compound. Also, generally good control was obtained in commercial orchards following delayed dormant pyrethroid application.

Table 1. Overwintering adult pear psylla mortality using fenvalerate in laboratory slide-dip bioassays. 1988-1990. Treated Feb. 23-March 1, 1988, Feb. 27, 1989, Jan. 25, 1990.

		% psylla mortality 48 hrs. after treatment Equivalent rate fenvalerate (lb ai/acre)		
Orchard	Year	0.1	0.2	Check
Bishop	1988	85.2	100	1.9
	1989	100	100	0
	1990	96.3	98.0	5.0
Hanley	1988	96.3	100	1.9
	1989	100	100	1.9
	1990	99.0	96.3	7.0
Medford	1988	94.4	100	1.9
	1989	98.1	100	0
	1990	95.3	92.4	0
Phipps	1988	92.6	100	1.9
	1989	97.2	100	1.6
	1990	100	100	7.4
Antelope	1988	99.1	99.1	0
	1989	92.6	99.1	1.6
	1990	95.3	96.3	0
Grants Pass	1988	98.1	99.1	0
	1989	95.4	100	1.6
	1990	100	99.0	0

FALL AND PRESPRAY-WINTER DENSITIES OF PEAR PSYLLA

Over wintering pear psylla adults normally reach peak densities in late October or early November. In 1989 the average adult fall densities were about 15/tray (range: 3.2-50.6) which was the higher number recorded since the fall of 1983 (table 1). most of the lower densities recorded were from orchards using a selective, Dimilin-oil based foliar program. Psylla adult levels found prior to 1990 chemical application in the dormant period average about 3/tray (range: 1.3-8.0). Despite these relatively high values the prebloom program (Oil dormant, Pyrethroid-oil delayed dormant) provided excellent control.

Table 1. Peak fall densities (FD) and peak winter densities (WD) of overwintering pear psylla adults in 12 southern Oregon pear orchards over an 8 year period.

Average No. Pear Psylla adults/tap

	Year															
	1982-83		1983-84		1984-85		1985-86		1986-87		1987-88		1988-89		1989-90	
Orchard	FD	WD	FD	WD	FD	WD	FD	WD	FD	WD	FD	WD	FD	WD	FD	WD
Bishop	11.6	2.5	42.4	2.7	14.1	0.4	1.0	2.3	0.3	0.7	1.1	0.7	6.8	3.0	10.8	4.1
Cate	48.6	4.6	30.3	2.7	4.5	1.2	0.7	1.4	0.1	1.3	0.5	0.5	3.1	1.8	10.3	2.1
Corliss	56.0	3.1	25.6	4.7	4.7	3.6	0.6	2.9	6.0	2.7	9.5	2.3	4.3	5.1	6.1	1.7
Cory	9.1	2.4	22.9	2.9	3.1	1.6	56.0	3.4	0.1	1.0	3.1	1.4	0	1.3	3.3	1.4
Hillcrest	10.2	2.3	23.7	4.5	28.2	0	1.7	5.5	4.6	2.9	7.3	0.9	19.7	3.7	11.0	1.5
Medford Pear	5.6	0.9	38.7	2.9	23.2	1.8	1.7	1.7	0.7	0.7	0.1	0.3	45.5	1.9	12.2	1.3
Minear	4.5	2.6	7.3	2.4	3.3	1.1	0.9	3.3	2.0	1.9	0.2	1.2	5.1	2.8	3.7	3.1
Moran	35.1	1.3	36.7	2.7	6.6	0.5	0.1	1.3	0.2	1.5	0.7	0.4	6.8	1.6	3.2	1.5
Naumes	20.4	3.5	21.3	3.2	3.7	0.9	1.1	2.1	1.0	0.9	0.2	0.3	1.1	2.4	7.6	1.7
Norcross	27.8	2.0	7.3	2.2	15.8	1.4	1.8	3.0	2.3	1.3	9.0	1.3	35.4	3.4	50.6	2.4
Phipps	10.4	3.0	36.6	2.9	14.9	1.8	98.0	8.3	14.3	2.1	17.4	4.0	1.5	1.7	22.9	8.0
Suncrest	9.3	2.6	32.7	4.5	18.5	2.5	1.1	3.4	0.5	0.9	0.5	0.4	12.1	3.5	33.3	5.8
X	20.8	2.4	27.1	3.2	11.7	1.4	13.7	3.2	2.7	1.5	4.1	1.1	11.8	2.8	14.6	2.9

MODIFICATION IN THE PREBLOOM PROGRAM FOR PEAR PSYLLA CONTROL. EFFECTS OF DELETION OF SYNTHETIC PYRETHROIDS ON TWO PEAR CULTIVARS.

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An area-wide prebloom program for suppression of overwintering pear psylla adults has been used by Pacific Northwest pear growers for about 25 years. The purpose of this prebloom program was to reduce adult levels in order to avoid early season direct fruit damage induced by nymphal secretions of honeydew. In addition, substantial reduction in the density of overwintering adults may result in reduced or delayed need for pesticide treatment in the late spring or summer months. Since 1975 the adulticides utilized in this program have been the synthetic pyrethroids, predominately fenvalerate (Pydrin). In 1987 field failure due to resistance to this compound was documented in Washington State and, based on past experience, will undoubtedly soon appear in other fruit growing districts. The only other registered alternative synthetic psylla adulticide is endosulfan (Thiodan) whose effectiveness or longevity is much in doubt.

Though the area-wide program has appeared to produce a general lowering in psylla densities its use has some disadvantages from a pest management standpoint. First, the use of the synthetic pyrethroids in the prebloom period may stimulate spider mite densities leading to increased acaricide use. Second, the prebloom use of pesticides in an area-wide pattern does not consider variations in damage potential that may be exhibited by inter-orchard differences in pear psylla adult densities or the difference between pear cultivars in their susceptibility to honeydew damage. Finally, the nearly simultaneous application of a single synthetic pesticide to an entire area for the suppression of the monophagus pear psylla may lead to a more rapid development of resistance as few non-selected refugia are present.

In this study we evaluated the effect of deletion of prebloom pyrethroid treatment on pear psylla control and damage measured on two pear cultivars.

Methods and Materials

The studies were conducted from 1988 through 1990 in a 1.2 acre block of 25 year old pears located at the Southern Oregon Experiment Station, Medford. The block was divided into two treatments with three randomized replicates each. Each replicate contained about 80 trees; 40 Bartlett and 40 Anjou. With the exception of the pyrethroid fenvalerate, which was deleted from one-half the block, the remainder of the prebloom program was uniform. This included spray oil at the dormant period and oil-plus-sulfur in the delayed dormant.

The foliar program, primarily directed at control of codling moth, included 3 sprays of the insect growth regulator diflubenzuron (Dimilin) in combination with oil. In previous studies the use of this IGR plus oil along with predator activity has provided economic suppression of summer populations of pear psylla. The selective acaricide Apollo was used in the foliar period if population densities of the twospotted spider mite exceeded 4-5 mites/leaf. All chemical treatments were applied using commercial, air-carrier spray equipment set to deliver 200 gpa.

Results

Pear psylla (PP). Population densities of overwintering PP adults varied dramatically from year to year when measured prior to the application of the delayed dormant treatment (table 2). The pretreatment adult densities recorded from Anjou were 0.5, 12.7, and 1.3 per tray for 1988, 1989, and 1990 respectively. The higher value for 1989 adult densities was apparently due to immigration into the study site from nearby orchards that supported extremely high fall psylla levels. Based on post treatment densities taken prior to the first foliar Dimilin-oil application the delayed dormant pyrethroid-oil-sulfur combination reduced adult levels by 80, 95, and 77% for the 3 years respectively. This compares to 80, 76, and 54% for the plot in which the pyrethroid was deleted. A similar level of control was measured in these treatments on the Bartlett cultivar (table 2).

Adult pear psylla densities on Anjou following the use of Dimilin-oil in the foliar period from April or May through the end of the evaluation period averaged 0.4, 2.6, and 0.3 in the pyrethroid treatment for 1988, 1989, and 1990 respectively. This compares to 0.3, 3.0, and 0.3 for these years in the program in which the pyrethroid was deleted. On the Bartlett variety these values were 0.2, 0.8, and 0.2 in the pyrethroid and 0.1, 2.2, and 0.2 in the non-pyrethroid programs respectively.

Densities of immature stages (eggs and nymphs) of pear psylla recorded following the delayed dormant programs but prior to the foliar Dimilin-oil treatment were substantially greater in the non-pyrethroid program compared to the pyrethroid treatment. For the former program the average immature levels per leaf on Anjou recorded in the late March or early April were 1.9, 6.2, and 2.8 for 1988, 1989, and 1990 respectively and for the pyrethroid program 0, 1.6 and 0.

These same values on the Bartlett variety were 0.3, 4.6, and 2.0 in the oil-sulfur and 0, 0.9, and 0 following pyrethroid use.

Subsequent densities of immatures found in the foliar period following Dimilin-oil treatments on Anjou were 0.3, 1.2, and 0.3 respectively in the pyrethroid and 0.2, 1.0, and 0.3 in the non-pyrethroid programs for the three years respectively. On Bartletts for the same three years the values were 0.1, 0.7, and 0.6 in the non-pyrethroid program versus 0.2, 0.8, and 0.1 following the use of pyrethroids.

Overall the deletion of the pyrethroid from the delayed dormant spray resulted in higher psylla densities only from the time of this treatment until the application of the Dimilin-oil program which is begun shortly after petal fall. There was no substantial difference in average psylla densities recorded in the post-Dimilin evaluations between the two prebloom programs.

Early season pear psylla induced damage found on Bartlett and Anjou fruit at harvest for the 3-year period is presented in table 3. The data show no significant downgrading to the Bartlett cultivar in any of the 3 years with the maximum damage being 0.7% downgrading in 1989. In that year peak densities of the immature forms averaged 4.6 per leaf in the April counts. On the Anjou variety again no significant fruit loss was measured in 1988 or 1990 with a maximum loss of 1% recorded in the latter year. However, this variety in 1989 suffered substantial damage on both the prebloom pyrethroid treatment (5.1%) and in the non-pyrethroid program (18.8%).

The subsequent fruit injury of 1989 may be due to the relatively high densities of psylla immatures found on Anjou during April of that year (table 2) as the injury recorded appeared typical for early season honeydew damage rather than that caused in the foliar, i.e. post petal fall, period.

Twospotted spider mite (TSM). Initial population densities of the TSM recorded in late April of 1988 were about 13/leaf on the Anjou and ranged from 6 to 9/leaf on the Bartlett varieties (table 5). These densities exceeded the accepted treatment thresholds of about 5 mite/leaf and the entire block was treated with chlorfentizine (Apollo) at 4 ozs/acre put in combination with the Dimilin-oil spray for codling moth. Following this treatment TSM populations decreased to below 1/leaf in May and June. In late June and July resurgence in TSM levels was noted but was significantly greater in the plot which received prebloom application of the of the pyrethroid fenvalerate (Pydrin). By early August TSM densities were 47/leaf compared to 12/leaf in the pyrethroid, non-pyrethroid programs respectively.

In 1989 initial TSM densities again exceeded treatment thresholds but only in the pyrethroid treated areas. Chlorfentizine was again applied to these plots. In plots not receiving the prebloom pyrethroid, no acaricide was required at this time and none was used for the entire season. In this treatment mite densities did not exceed 2.5/leaf on any sample date through early September.

Summary

1. Pear psylla control following two prebloom programs, one with pyrethroid, oil, sulfur, the other with the pyrethroid deleted were compared over a 3-year period (1988-1990) on the Anjou and Bartlett pear cultivars in southern Oregon.

2. Reductions of psylla adults following delayed dormant treatment averaged 84% in the pyrethroid and 70% in the non-pyrethroid programs.

3. No differences in psylla densities were recorded between the two prebloom treatments during the foliar period which followed use of Dimilin-oil applications for codling moth control.

4. Pear psylla induced fruit damage varied from year to year depending upon psylla densities and the pear variety. a) No significant damage was recorded to the Bartlett cultivar in any of the 3 study years regardless of the prebloom program or dramatic differences in psylla density recorded from year to year. b) On Anjou in 2 years of low overwintering adult densities, likewise no meaningful fruit damage was recorded following either the pyrethroid or the non-pyrethroid prebloom program. c) Under conditions of high overwintering adult densities the prebloom pyrethroid program reduced subsequent fruit damage to about 5% compared to 19% in the non-pyrethroid program.

5. The application of the pyrethroid fenvalerate in the prebloom program for psylla suppression resulted in elevated densities of the twospotted spider mite causing increased use of acaricides.

Table 1. **Treatment schedule of chemicals used in a modified pest control program on Anjou and Bartlett pears in southern Oregon. 1988-1990. The letters ST. preceeding particular chemicals indicates it was only used in the Standard Program.**

Prebloom Program		Foliar Program		
Dormant (date)	Delayed Dormant (date)	1st cover (date)	2nd cover (date)	3rd cover (date)
1988				
oil 4 gal (2/10)	oil 4 gal plus orthrorix 2.5 gal plus ST. fenvalerate 0.3 lb (3/9)	Dimilin 0.75.lb plus oil 2 gal plus Apollo 4 ozs. (4/25)	Dimilin 0.75 lb plus oil 2 gal (5/24)	Dimilin 0.75 lb (7/18)
1989				
oil 4 gal (2/23)	oil 4 gal plus orthrorix 2.5 gal plus ST. fenvalerate 0.3 lb (3/15)	Dimilin 0.75.lb plus oil 2 gal plus ST. Apollo 6 ozs. (5/2)	Dimilin 0.75 lb plus oil 2 gal (5/31)	Dimilin 0.75 lb (7/5)
1990				
oil 4 gal (2/15)	oil 4 gal plus orthrorix 2.5 gal plus ST. fenvalerate 0.3 lb (3/8)	Dimilin 0.75.lb plus oil 2 gal plus	Dimilin 0.75 lb plus oil 2 gal (5/18) (4/18)	------

Table 2. Monthly average densities of pear psylla adults in two prebloom programs. 1988-1990. Medford, OR.

Program	Average number pear psylla adults/tray																	
	1988							1989						1990				
	p.t. March	March	May	June	July	Aug	Sept	p.t. March	March	May	June	July	Aug	p.t. March	March	April	May	June
Anjou																		
Standard Prebloom	0.5	0.1	0.0	0.8	0.5	0.8	0.0	15.1	0.7	4.8	2.5	1.6	1.3	1.3	0.3	0.2	0.2	0.5
Modified Prebloom	0.5	0.1	0.2	0.1	0.1	0.8	0.1	15.1	3.6	6.6	3.2	1.6	0.7	1.3	0.6	0.0	0.3	0.5
Bartlett																		
Standard Prebloom	0.5	0.3	0.2	0.1	0.2	0.2	0.1	12.5	0.7	1.2	1.0	0.4	0.7	1.3	0.0	0.2	0.2	0.4
Modified Prebloom	0.3	0.2	0.0	0.2	0.1	0.1	0.1	13.1	3.6	6.4	1.1	0.3	1.1	1.3	3.8	0.4	0.1	0.0

(p.t. signifies pre-treatment count)

Table 3. Monthly average densities of pear psylla immature stages following two prebloom programs. 1988-1990. Medford, OR.

	Average number pear psylla immatures/leaf														
	1988					1989						1990			
Program	April	May	June	July	Aug	April	May	June	July	Aug	Sept	March	April	May	June
Anjou															
Standard Prebloom	0.0	0.2	0.4	0.2	0.0	1.6	2.8	2.1	0.4	0.6	0.2	0.0	0.6	0.1	0.2
Modified Prebloom	1.9	0.3	0.2	0.1	0.1	6.2	2.9	1.2	0.5	0.5	0.1	2.8	0.7	0.3	0.1
Bartlett															
Standard Prebloom	0.0	0.1	0.5	0.1	0.0	0.9	2.2	0.8	0.1	0.1	0.0	0.0	0.2	0.1	0.1
Modified Prebloom	0.3	0.3	0.1	0.1	0.0	4.6	1.9	0.9	0.1	0.4	0.1	2.0	1.6	0.1	0.1

Table 4. Early season pear psylla damage to Bartlett and Anjou pears at harvest in a pyrethroid vs a non-pyrethroid prebloom program. 1988-1990.

	% downgraded fruit					
	Bartlett (harvest date)			Anjou (harvest date)		
	Year					
Delayed Dormant Program	1988 (Aug.16)	1989 (Aug. 4)	1990 (Aug. 14)	1988 (Sept. 13)	1989 (Aug. 24)	1990 (Sept. 18)
fenvalerate oil sulfur	0.0	0.0	0.0	0.0	5.1	0.0
oil sulfur	0.0	0.7	0.0	0.0	18.8	1.0

Table 5. Monthly average mean density of the twospotted spider mite following application of two prebloom programs for pear psylla control. 1988-1989. Medford, OR.

	Average number twospotted spider mite/leaf										
	1988					1989					
Program	p.t. April	May	June	July	Aug	p.t. April	May	June	July	Aug	Sept
						Anjou					
Standard Prebloom	12.5	0.5	0.5	16.3	47.1	7.7	0.0	0.0	0.9	2.4	3.1
Modified Prebloom	13.1	0.8	0.2	2.0	12.3	2.0	0.4	0.6	1.2	2.3	1.9
						Bartlett					
Standard Program	6.8	0.7	0.3	3.6	11.7	7.2	0.2	0.1	0.4	0.6	1.3
Modified Prebloom	9.1	0.4	0.0	1.2	5.7	4.2	0.2	1.0	0.9	2.5	1.4

DELAYED DORMANT AND PINK BUD TIMINGS FOR CONTROL OF PEAR PSYLLA

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The standard prebloom program for prebloom suppression of pear psylla includes a dormant application of oil for delaying egg laying by overwintering adults followed by a delayed dormant treatment of pyrethroid plus oil. Several southern Oregon pear growers have expressed interest in deleting the dormant treatment due to difficulties encountered in logistics and weather patterns normally expected at that time. In addition the dormant treatment is a separate spray for only one target species as opposed to delayed dormant or pink timing which are directed at several arthropod and disease pests. In this test we evaluated 3 pyrethroid insecticides used in the delayed dormant and/or in the pink bud stage. No dormant oil treatment was applied.

The pyrethroid chemicals tested were Danitol, Baytheroid, and Asana. The first 2 were applied at the pink stage (3/2g) while Asana was used at the delayed dormant only or this timing followed by Morestan in the pink. Applications were made by conventional high pressure handgun equipment to 2, 6-tree replicates.

The results from this trial are presented in table 1. These show a relatively high number of psylla eggs (range: 13-30/spur) in all plots prior to the delayed dormant spray. Prior to the pink bud spray on March 29, the 8 plots which received the delayed dormant treatment averaged 23.0 immature psylla per fruit cluster compared to 82.3 in plots not sprayed at this timing. In the final evaluation on March 5, following the pink bud treatment, the 4 plots which received both applications averaged 2.7 immatures/leaf. This compared to 4.8/leaf following delayed dormant treatment only and 6.5/leaf in the pink bud only plots. Of the materials and timing evaluated, Baytheroid used at both timings and the Asana followed by Morestan provide the best overall psylla control. The two applications of Danitol, both at 0.1 lb./100, provided the best control achieved with this product.

Table 1. Pear psylla control with pyrethroids applied in the delayed dormant and/or the pink bud stages of Bartlett pears. Medford. 1990. Two-six tree replicates.

	Application Timing and rate/100 (date)		Average no. pear psylla Adults (A)/tray or immatures (Eggs, Nymphs)/Cluster (C) or Leaf (L) Date					
Material	Del.Dor. (3/9)	Pink (3/29)	A/T 3/6	E/S 3/7	A/T 3/21	E+N/S 3/26	A/T 4/2	E+N/L 4/5
Danitol	0.05 lb. + oil 1 gal.		4.8	23.5	0.6	19.8	0.8	12.5
Danitol		0.05 lb.	4.4	19.8	5.6	79.4	0.1	5.2
Danitol	0.05 lb. + oil 1 gal.	0.05 lb.	4.7	28.1	1.2	42.6	0.0	6.2
Danitol	0.10 lb. + oil 1 gal.		5.0	30.6	1.6	27.8	0.8	4.3
Danitol		0.10 lb.	4.6	27.2	4.4	65.7	0.2	10.2
Danitol	0.10 lb. + oil 1 gal.	0.10 lb.	4.2	26.2	0.6	37.2	0.2	3.6
Baythroid	0.013 lb. + oil 1 gal.		6.5	25.3	0.7	17.4	1.4	4.8
Baytheroid		0.013 lb.	4.8	24.8	5.7	99.3	0.2	4.2
Baytheroid	0.013 lb. + oil 1 gal.	0.013 lb.	5.0	12.6	0.7	11.7	0.0	0.4
Asana	0.1 lb. + oil 1 gal.		4.2	23.2	0.3	12.2	0.4	1.8
Asana D.D. (Morestan P)	0.1 LB. + oil 1 gal.	Morestan 1.0 lb.	4.5	28.0	0.1	16.4	0.1	0.6
check			3.5	27.9	4.9	84.7	1.7	18.0

ACARICIDE RESISTANCE DEVELOPMENT FOLLOWING VARYING USE PATTERNS OF HEXYTHIOZOX (SAVEY) AND FENBUTATIN OXIDE (VENDEX) ON PEARS

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Reports form several tree fruit areas have indicated that hexythiozox (Savey) and a similar ovicide clofentezine (Apollo) have rapidly developed high levels of resistance following 10-20 or fewer consecutive selections with these compounds. It has also been shown that the development of resistance to one of these compounds results in resistance to both, this phenomenon is termed cross-resistance. Theoretically, resistance development may be slowed by several operational (management) factors including chemical rotation or alternation or through the use of chemical combinations. To be successful both of these approaches require the use of a second non-related chemical which possesses a different mode of toxic action from the first material.

In 1987, studies were begun to evaluate the rapidity and intensity of resistance development to two acaricides by the twospotted spider mite <u>Tetranychus urticae</u> following various use patterns on pear in southern Oregon. The chemicals selected were the ovicide Savey and an organotin (OT) (cyhexatin in 1987, fenbutatin in 1988 - 1990) acaricide. These compounds were chosen as it was thought that they had dissimilar modes of action from one another.

In addition, populations of TSSM in southern Oregon that are resistant to OT acaricides have been shown to revert to susceptible levels in the absence of continual OT selection. Thus, judicious use patterns of both Savey and Vendex could result in preservation of both acaricides.

Materials and Methods

<u>Field tests</u>. A 1.9 acre block of mature 60-year-old Bartlett trees was divided into 5 treatments with 3 replicates. The replicates were composed of 9 trees (3x3) or about 0.13 acres each. Acaricide treatments were applied twice per season during the foliar period using high pressure conventional handgun equipment. Trees were sprayed to runoff or about 400 gpa. The twice yearly treatments applied included:

1. hexythiozox (2 oz. ai/acre) in consecutive pattern. 1987, 1988, 1989, 1990.

2. hexythiozox (2 ozs. ai/acre) 1987, 1989 in an annual rotation between years with fenbutatin oxide (0.75 lb. ai/acre) 1988, 1990.

3 hexythiozox and fenbutatin oxide (above rates) in a within season rotation with Savey used early season and Vendex later. 1987, 1988, 1989, 1990.

4. hexythiozox (1 oz. ai/acre) plus fenbutatin oxide 0.375 lb. ai/acre) combined each year. 1987, 1988, 1989, 1990.

5. fenbutatin oxide (0.75 lb. ai/acre) in consecutive pattern. 1987, 1988, 1989, 1990.

To evaluate the degree of field control obtained by the various programs, leaf samples (25/rep) were taken prior to treatment and at biweekly intervals through the season. Mature leaves were selected from the center tree and from the inside canopy limbs of the border trees of each replicate.

Laboratory bioassays. In 1987 and 1988 pretreatment and post-treatment bioassays were conducted prior to and following each treatment. In 1989 and 1990 a single laboratory bioassay was evaluated after the first acaricide application when mite densities in the field had recovered to moderate densities. Mites were collected from all plots (replicates pooled) and returned to the laboratory where they were reared on lima beans until colonies were large enough to bioassay. Mortality of the adults from each colony was estimated with a contact residue leaf disk bioassay using fenbutatin oxide in a serial dilution of five concentrations plus a water control. Mortality of eggs was estimated with a contact residue leaf disk bioassay using hexythiozox in a serial solution of six concentrations plus a water control. LC_{50} values, which show the level of resistance in a population, were obtained from a probit analysis program after correction for control mortality by Abbot's formula.

Results for 1990

Field control. (Fig. 1) With the exception of Vendex used in a consecutive pattern all treatments continued to provide satisfactory spider mite suppression. In the Vendex plot, twospotted mite densities continued to rise after the 1st 1990 treatment on May 10 reaching injury levels of over 10 mites/leaf in mid-June. Essentially, field effectiveness of Vendex was completely lost at this time. This represented the 7th consecutive application since the study began in 1987. It is interesting to note that the control achieved with Vendex in combination with Savey, both at 1/2 rates, continued to provide excellent control though this also represented the 7th and 8th treatment with Vendex.

Bioassays. Vendex. Results from 1987 - 1990 bioassays with Vendex applied to the mites taken from the five field plots are presented in figure 2. The 1990 data show a similar pattern to that measured the previous year with mites having been exposed to consecutive Vendex use having the highest LC_{50} values. The 1990 LC_{50} for mites taken from other treatments are clustered together below 0.1% ai and exhibiting little change from 1988 bioassay levels. These laboratory results along with field evaluations are very encouraging as far as resistance management of Vendex is concerned. They indicate that the useful life of this acaricide may be lengthened by rotations or combinations as opposed to sequential use of the same compound. This is most notably illustrated by the bioassay data from the Savey-Vendex combination which show no increase in Vendex tolerance over those found in the initial pretreatment level of 1987.

Savey. The results from the Savey bioassays are presented in figure 3. While these results are less straight forward than those obtained in the Vendex bioassay there are several trends that appear to be developing. First there appears to be a one-way cross tolerance between Vendex and Savey, i.e. Vendex resistance development in the consecutive Vendex plot appears to convey high levels of tolerance to Savey in this same population. This is unlike normal cross resistance since the increased resistance to Savey seen in the consecutive Savey plots does not occur in conjunction with increased resistance to Vendex. This relationship was first indicated in the 1989 bioassay but became more pronounced in the 1990 test. This finding is most surprising and troubling as the mode of action of Savey is primarily ovicidal while Vendex is considered as an adulticide.

A second feature of the 1990 data shows that the alternate year and within season rotation treatments have maintained the twospotted mite at relatively low levels of susceptibility. However at this time it is premature to judge acaricide rotation as a preferred tactic in resistance management as these have received only about 1/2 of the Savey treatments that were applied to the plot receiving Savey sequentially. In addition, no field failures with this acaricide, in any of the use patterns, have been recorded in the field plots.

Figure 1

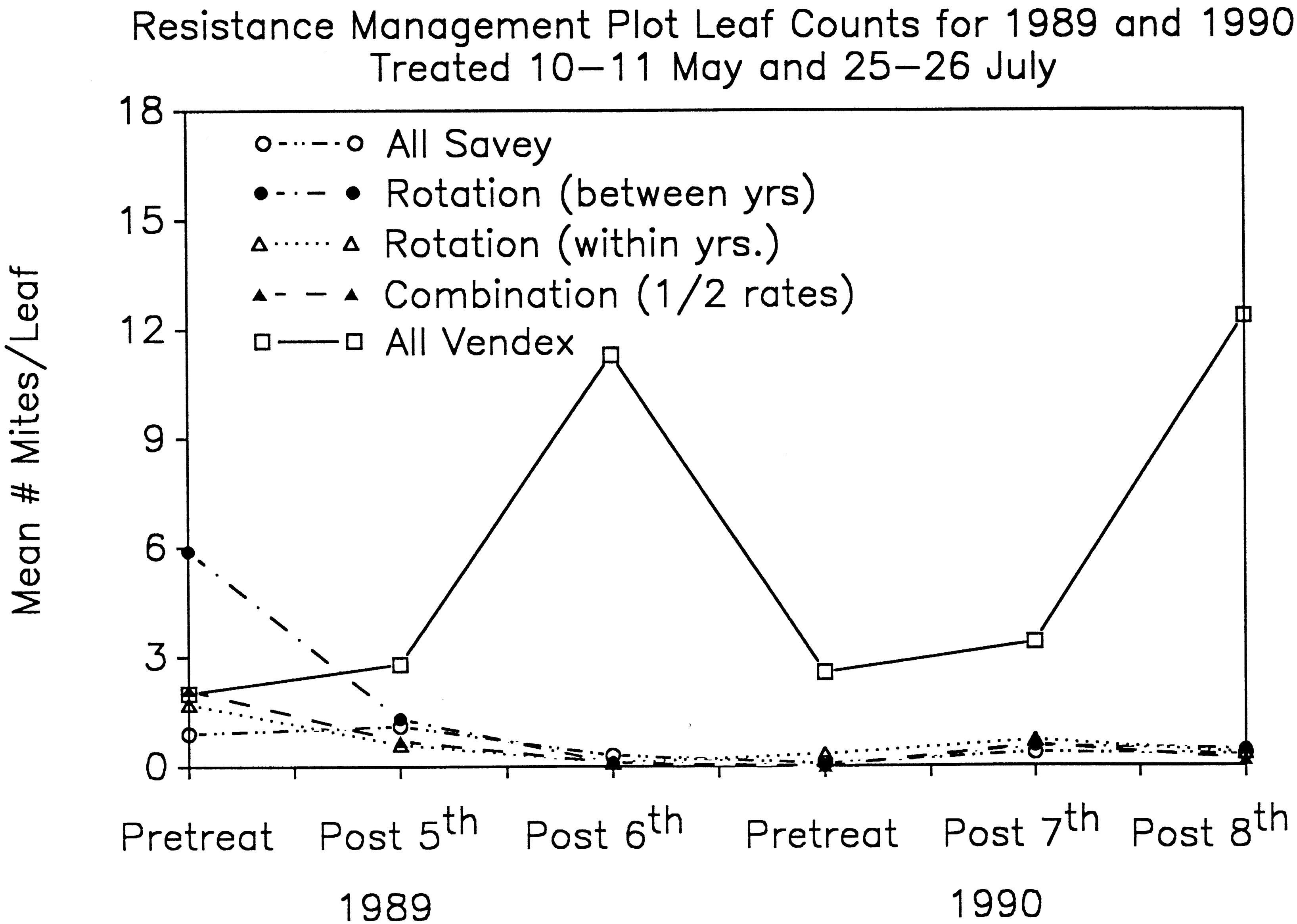
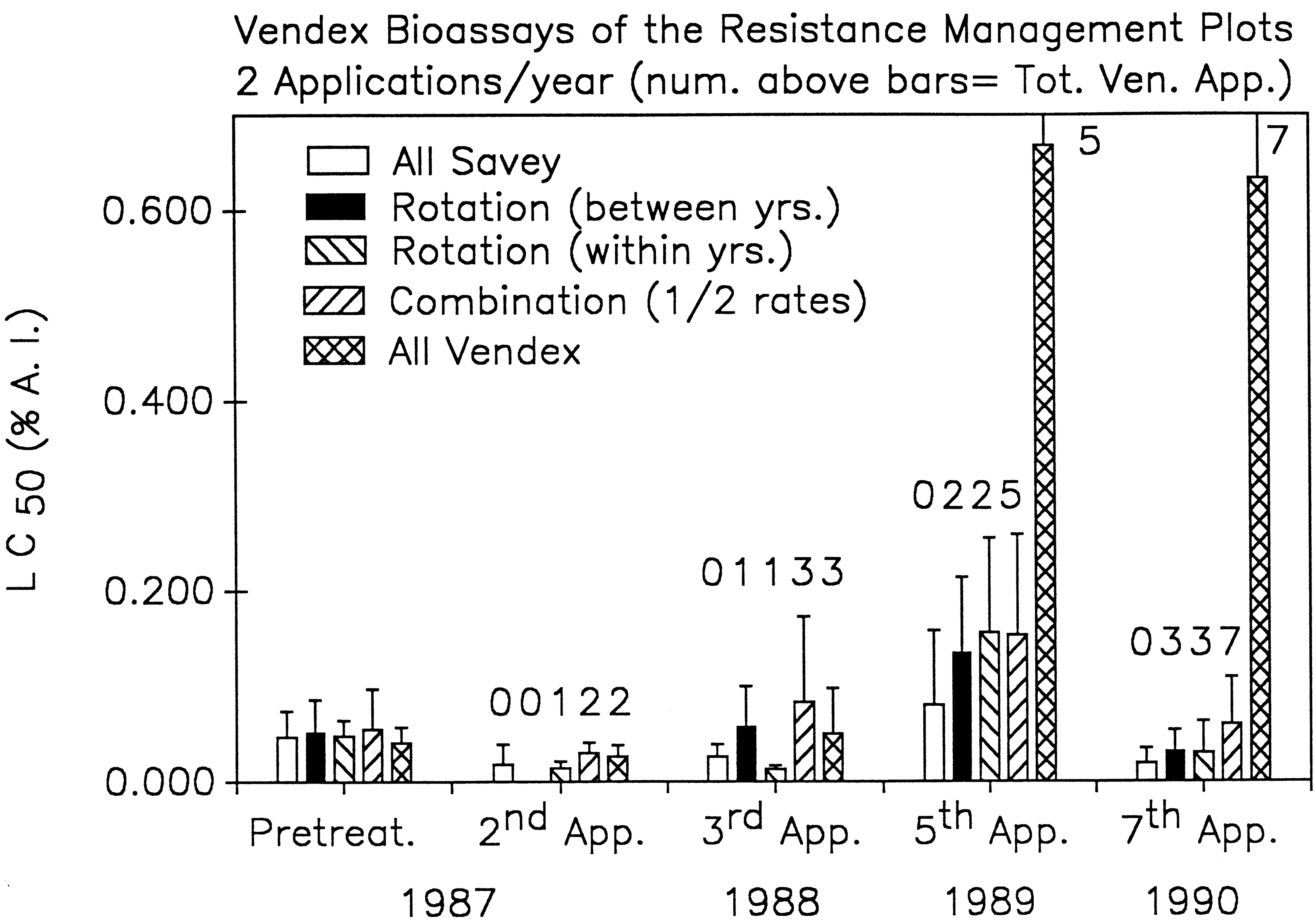

Resistance Management Plot Leaf Counts for 1989 and 1990
Treated 10–11 May and 25–26 July
Mean # Mites/Leaf
18
15
12
9
6
3
0
All Savey
Rotation (between yrs)
Rotation (within yrs.)
Combination (1/2 rates)
All Vendex
Pretreat
Post 5th
Post 6th
Pretreat
Post 7th
Post 8th
1989
1990

Figure 2

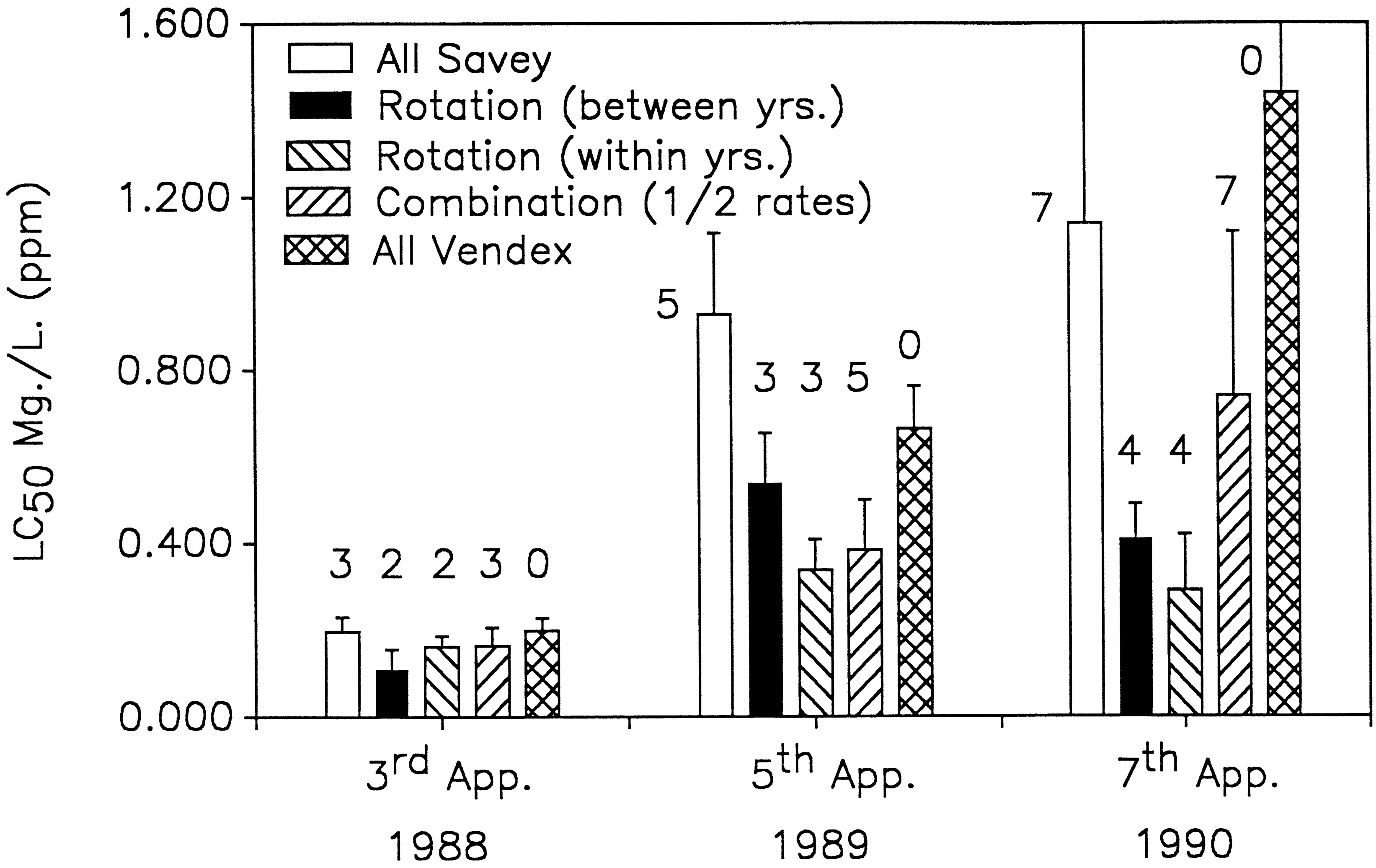


Vendex Bioassays of the Resistance Management Plots
2 Applications/year (num. above bars= Tot. Ven. App.)
All Savey
Rotation (between yrs.)
Rotation (within yrs.)
Combination (1/2 rates)
All Vendex
L C 50 (% A. I.)
0.600
0.400
0.200
0.000
00122
01133
0225
5
0337
7
Pretreat.
2nd App.
3rd App.
5th App.
7th App.
1987
1988
1989
1990

Figure 3

Savey Bioassays of the Resistance Management Plots

2 Applications/year (num. above bars= Tot. Sav. App.)



PETAL FALL TIMING OF AGRIMEK AND APOLLO FOR CONTROL OF THE TWOSPOTTED SPIDER MITE (TSM) ON PEAR.

P. H. Westigard, R. J. Hilton

Both Agrimek and Apollo acaricides are normally used by southern Oregon pear growers in the early foliar period. Applications of Apollo are scheduled at the 1st cover timings and Agrimek generally at the 2nd cover period. Previous studies with Agrimek have indicated that the earlier the applications the better the TSM control achieved. In this test we evaluated the two acaricides at the petal fall period as to the longevity of residual control of the TSM.

Each acaricide was applied on April 10 to 2, 4 X 8 tree replicates of the Seckel pear variety using a commercial air-carrier sprayer set to deliver 200 gpa. Pre-and post-treatment mite densities were estimated by selecting 20 mature/leaves/replicate, removing mites with a brushing machine and counting eggs and post-embyrionic stages with the aid of a dissecting microscope.

The results from this trial are given in table 1 and show relatively high pretreatment TSM densities of over 20/leaf. At this time (April 9) approximately 95% of the TSM were in the egg stage. The Agrimek plus oil treatment resulted in excellent, nearly season-long suppression of the TSM with the pretreatment densities of post-embryonic stages not being reached until the end of July. By harvest of this variety in mid-August only limited leaf injury was noted in this treatment. TSM population in the Apollo-oil treatment provided good control for about six weeks when post-embryonic stages were measured at about 5/leaf. This plot was retreated on June 15 with Agrimek-oil but this combination used at this period only provided about 3-4 weeks control. Severe defoliation was present in this program by late August,.

Table 1. **Control of the twospotted spider mite (TSM) with Abamectin and Apollo. 1st treated April 11, 1990. Seckel variety.**

Treatment (spray date)	TSM stages	No. TSM/leaf [Eggs (E), Post-embryonic stages (PE)] Date 4/9	4.27	5/7	5/21	6/5	6/20	7/5	7/18	7/21
Agrimek 16 ozs. plus	E+PE	42.2	4.3	0.2	0.2	0.0	0.4	1.1	0.6	5.6
oil 0.25% (4/11)	PE	2.6	3.7	0.1	0.1	0.0	0.1	0.2	0.2	2.2
Apollo 6 ozs. plus oil 1% (4/11)										
Agrimek 16 ozs. plus	E+PE	20.0	8.4	7.2	7.2	16.7	24.1	14.2	20.6	49.8
oil 0.25% (6/13-6/18)	PE	1.2	0.8	1.0	2.3	5.4	6.7	1.4	11.0	14.2

CONTROL OF THE TWOSPOTTED SPIDER MITE WITH THE NEWER ACARICIDES ANDALIN, APOLLO, AND AGRIMEK.

In this test we compared control of the twospotted spider mite (TSM) with various acaricides and acaricide tank mix combinations applied at the first cover spray period. Materials were applied on May 18 to 3, single-tree replicates of the Bosc variety using conventional high pressure handgun equipment. Pretreatment densities of TSM on May 16 were predominately in the embryonic stage (60%). Mean post-treatment densities of all TSM stages recorded about 1 month after treatment showed: Andalin at both rates plus 1% oil, Apollo plus oil, and Agrimek plus oil plus Apollo to have provided the best control. However, for the two month test period the Agrimek-oil-Apollo combination produced the greatest overall residual reduction in TSM densities (table 1). In an evaluation of mite damage taken on July 30 the degree of leaf burn was judged lowest in the Agrimek-oil and the Apollo-Agrimek-oil treatments. Severe defoliation was present on trees left unsprayed and in the plots receiving the low rates of Andalin.

Table 1. **Control of the twospotted spider mite with experimental acaricides. Treated May 18, 1990. Three single-tree replicates of the Bosc pear variety.**

Material and Rate form/100	TSM stages	No. TSM/leaf, Date: May 16	May 29	June 11	June 25	July 3	July 18	$\overline{X}$ post-treatment densities 5/29-7/18
Andalin 4 ozs.	E+PE	7.2	7.3	15.5	9.4	37.0	60.9	26.0
	PE	2.4	1.9	1.7	4.8	10.6	24.1	
Andalin 4 ozs. + oil 1 gal.	E+PE	5.5	6.4	3.5	2.3	8.6	18.9	7.9
	PE	1.2	0.4	0.2	0.9	1.8	5.4	
Andalin 6 ozs. + oil 1 gal.	E+PE	5.8	10.6	2.8	4.6	12.4	37.0	13.5
	PE	2.4	2.4	0.6	2.2	3.4	12.2	
Andalin 6 ozs. + oil 1 gal.	E+PE	3.3	2.9	1.9	2.9	14.0	19.4	8.2
	PE	0.6	0.3	0.2	0.8	2.1	5.4	
Agrimek 4 ozs. + oil 1 qt.	E+PE	10.3	8.5	1.0	1.6	3.3	6.7	4.2
	PE	2.5	1.8	0.2	0.5	1.7	2.1	
Apollo 2 ozs. + oil 1 gal.	E+PE	2.4	2.6	2.0	0.8	6.0	20.6	6.4
	PE	0.5	0.4	0.0	0.1	0.8	7.1	
Agrimek 2 ozs. + Apollo 1 ozs. + oil 1 qt.	E+PE	9.1	7.7	1.8	0.3	1.6	2.9	2.9
	PE	1.9	1.0	0.0	0.0	0.4	0.9	
Check	E+PE	9.7	22.3	40.7	44.7	82.8	83.8	95.0
	PE	3.9	7.2	9.9	23.5	30.4	39.4	

CONTROL OF THE TWOSPOTTED SPIDER MITE WITH KELTHANE

In this trial we evaluated two formulations of Kelthane, a 50 w and a 35 w, for suppression of the TSM. This acaricide had not been used in the study pear block for over 20 years. Treatments were applied to 2, 20-tree replicates on June 27 using a commercial air-carrier sprayer set to deliver 200 gpa. The first Kelthane application of either formulation produced about 3-4 weeks suppression and the second about 2 weeks control. Control achieved with a single Agrimek-oil spray gave about 6 weeks control. There was little indication from this test that the TSM had lost a significant degree of its Kelthane resistance despite its non-use for many years.

Table 1. Control of the twospotted spider mite (TSM) with Kelthane and Agrimek. Treated June 27, 1990. Bartlett variety.

Material and rate/acre	Average no. TSM/leaf					
	6/18	7/5	7/16	7/26	8/6	8/13
Kelthane 50 wp 5 lbs.	4.4	1.5	3.6	39.6*	1.25	9.9
Kelthane 35 wp 7.14 lbs.	7.0	1.2	5.7	19.9*	4.75	18.2
Agrimek 10 ozs. plus oil 0.25%	5.4	1.6	0.7	2.3	1.7	12.25
check	10.0	6.6	8.0	49.0	101.0	158.2

*retreated 7/30

USE OF APOLLO MITICIDE ON COMMERCIAL PEAR ORCHARDS IN SOUTHERN OREGON, 1990

Pete Gonzalves and Peter Westigard

1990 was the second year of full registration for use of Apollo Miticide on pear in southern Oregon. Applications were made to blocks exhibiting high carryover populations of twospotted spider mite (TSSM) at the first cover spray timing. Applications of this ovicidal material were at the rate of 6 oz. formulated per acre and included 1% spray oil in the tank mix. One Red Bartlett block in the monitoring program was treated with 4 oz. per acre plus 1% oil. Materials were mixed in 250 gallons of water per acre and applied by conventional air blast orchard sprayers.

About 40% of the Apollo plus oil treated pear blocks (including the 4 oz. per acre treatment) experienced seasonal control of TSSM. These tended to be younger trees which typically support smaller initial mite populations and recieve better spray coverage. All blocks showed declining levels of post-embryonic mites by the second cover spray sample time, however some populations remained above treatment thresholds and the decision was made to apply another miticide. Of the blocks left untreated for TSSM at second cover, approximately half required additional miticide treatment later in the season. These treatments with older materials such as Vendex, Kelthane, or Carzol proved to be marginally successful.

Table 1. Pear orchard spider mite densities and control using Apollo (6 oz. per acre plus 1% oil) at the first cover spray timing, southern Oregon, 1990.

COMICE

Age	Date	Control	Pre treatment population % infested clusters	No. mites per leaf eggs	motiles
Mature	4/19	4 weeks	100%	-	-
Young	4/18	4 weeks	88%	-	-
Young	4/17	Season	63%	-	-
Young	4/21	13 weeks	-	8.5	0.7
Young	4/18	Season	-	6.6	0.3

BARTLETT

Age	Date	Control	Pre treatment population % infested clusters	No. mites per leaf eggs	motiles
Mature	5/4	4 weeks	-	20.7	13.2
Young*	4/19	Season	-	1.6	0.3
Young	4/14	Season	60%	-	-

BOSC

Age	Date	Control	Pre treatment population % infested clusters	No. mites per leaf eggs	motiles
Mature	5/4	Suppression	-	20.7	14.7
Mature	4/16	Season	35%	-	-
Young	4/20	Season	-	3.0	0.2

SECKEL

Age	Date	Control	Pre treatment population % infested clusters	No. mites per leaf eggs	motiles
Mature	4/21	8 weeks	-	22.9	1.2
Mature	4/21	11 weeks	68%	-	-
Young	4/21	12 weeks	-	1.4	0.0

D'ANJOU

Age	Date	Control	Pre treatment population % infested clusters	No. mites per leaf eggs	motiles
Mature	5/4	Suppression	-	42.1	28.4

* Red Bartlett block treated with 4 oz. Apollo per acre.

USE OF AGRIMEK MITICIDE/INSECTICIDE ON COMMERCIAL PEAR ORCHARDS IN SOUTHERN OREGON, 1990

Pete Gonzalves and Peter Westigard

1990 was the third season of Agrimek application to southern Oregon commercial pear orchards for the control of spider mites and pear psylla. The material was made available under an emergency exemption from full registration by the Environmental Protection Agency and the Oregon Department of Agriculture.

Twospotted spider mite (TSSM) and pear psylla pest populations were distinctly influenced by weather patterns in 1990. Cooler than normal afternoon high temperatures during early to mid-summer were followed by prolonged hot weather including a record 23 straight days of temperatures exceeding 100^{O}F. This weather pattern moderated spider mite populations early but encouraged explosive population growth after mid-season. The opposite effect was observed with pear psylla where persistant early populations were drastically reduced by the July and August heat to rebound only late in the harvest period.

Of the acreage we monitored, Agrimek was applied to about 50 and 90 percent of selective and standard program blocks respectively. Several applications were made at the first cover spray timing while most were applied at second cover. Blocks under the selective pest management program received second cover sprays in May while second cover was applied to standard blocks in June.

Spider Mite Control

Control of twospotted spider mite was excellent at both first and second cover timings yielding seasonal control in nearly all treated blocks (Tables 1 and 2). Treatment decisions were based on the results of TSSM population monitoring, tree growth stages, varietal sensitivity to the pest, history of TSSM damage in the block, and cost of materials. Most applications involved 16 oz. of Agrimek per acre plus 1/4% spray oil in the tank mix. A rate of 10 oz. per acre (plus oil) was used on blocks which showed low potential for fruit injury due to pear psylla. Blocks in which mite populations remained below injury thresholds until late July are rated as having experienced seasonal control because tree sensitivity declines as harvest approaches.

One Bosc block experienced about seven weeks of control before re-treatment was deemed necessary. This rising TSSM population may have been influenced by pest levels residing in the weed groundcover. D'Anjou is one of the most mite-sensitive pear cultivars and most of these plantings did not exprience seasonal control. Some of these trees were re-treated while, for others, some leaf damage was tolerated in preference to additional miticide applications. In contrast, two Red D'Anjou blocks did experience seasonal control with Agrimek.

Several blocks began the season with either very high or very low TSSM populations. Some of the high populations were treated with an ovicidal miticide during first cover and, along with the very low populations, remained below treatment thresholds through the second cover timing. With the onset of hot weather later in the season, many of these populations increased dramatically and proved to be difficult to control with alternative miticides resulting in significant leaf burn in some blocks. Agrimek has been shown to be an unreliable miticide for late season use.

Very few yellow mites and pear rust mites were recorded from the acreage monitored in 1990. Mite densities recorded in Tables 1 and 2 are TSSM eggs plus post-embryonic stages per leaf. The "End" count represents results of the last sample prior to harvest or, in the case of non-seasonal control, prior to re-treatment.

Pear Psylla

Suppression of pear psylla following first cover 16 oz. Agrimek applications averaged about 5 weeks (Table 3) and was followed by additional psyllicide treatments. Second cover applications provided similar suppression although additional psyllicides were rarely warranted due to late season, population-limiting high temperatures. This resulted in apparent seasonal control. Pest densities recorded in Table 3 and 4 are psylla eggs plus nymphs per leaf or, where indicated, adults per limb tap. The "End" count represents results of the last sample prior to harvest or, in the case of non-seasonal control, prior to re-treatment.

Fruit Quality

Over 7000 fruit from 23 blocks were examined at harvest for phytotoxic markings. None of the damage recorded resembled that previously associated with applications of Agrimek plus spray oil.

Table 1. Pear orchard spider mite densities and control using Agrimek at the first cover spray timing, southern Oregon, 1990.

Cultivar	Rate/Acre	Date	Control	Prespray	End
D'Anjou	10 oz.	4/25	seasonal	15.7	0
D'Anjou	10	4/25	12 weeks	15.7	2.9
Bartlett	16	5/10	seasonal	17.7	0.3
Red Bartlett	16	5/10	seasonal	5.7	2.2
Bosc	16	5/11	seasonal	7.7	0.6
Bosc	16	5/11	seasonal	19.1	4.1

Table 2. Pear orchard spider mite densities and control using Agrimek at the second cover spray timing, southern Oregon, 1990.

Cultivar	Rate/Acre	Date	Control	Prespray	End
Bartlett	10 oz.	5/17	seasonal	6.4	0.3
Bartlett	16	6/15	seasonal	11.4	0.3
Bartlett	16	6/16	seasonal	6.5	3.3
Bartlett	16	7/2	seasonal	32.1	0
Bosc	10	5/18	7 weeks	11.0	16.6
Bosc	16	5/17	seasonal	6.0	1.7
Bosc	16	5/18	seasonal	3.9	2.5
Bosc	16	6/13	seasonal	9.1	1.3
Bosc	16	6/14	seasonal	7.1	0.1
Bosc	16	6/15	seasonal	11.4	0.2
Comice	10	5/16	seasonal	8.9	2.2
Comice	10	5/29	seasonal	7.2	0
Comice	16	5/16	seasonal	6.1	0.3
Comice	16	6/16	seasonal	11.9	0.2
D'Anjou	16	6/13	seasonal	12.3	2.6
D'Anjou	16	7/2	3 weeks	41.8	4.6

Table 3. Pear orchard pear psylla densities and control using Agrimek at the first cover spray timing, southern Oregon, 1990. "Prespray" counts represent adult psylla per limb tap while "End" counts are eggs plus nymphs per leaf.

Cultivar	Rate/Acre	Date	Control	Prespray	End
D'Anjou	10 oz.	4/25	4 weeks	0.60	1.34
D'Anjou	10	4/25	7 weeks	0.10	1.32
Bartlett	16	5/10	5 weeks	0.60	0.27
Red Bartlett	16	5/10	3 weeks	0.43	1.33
Bosc	16	5/11	5 weeks	0.43	2.00
Bosc	16	5/11	seasonal	0.33	0.92

Table 4. Pear orchard pear psylla densities and control using Agrimek at the second cover spray timing, southern Oregon, 1990. Asterisk indicates adults per limb tap whereas all other counts represent eggs plus nymphs per leaf.

Cultivar	Rate/Acre	Date	Control	Prespray	End
Comice	16 oz.	5/16	3 weeks	0.10*	2.06
Comice	16	5/29	season	0.33*	0.24
Bartlett	20	6/13	season	0.76	0.17
Bartlett	16	6/16	season	0.20	0.08
Bosc	16	6/13	none	0.67	1.28
Bosc	16	6/15	season	0.96	0.40

USE OF CARZOL AND VENDEX MITICIDES IN SOUTHERN OREGON PEAR ORCHARDS, 1990

Pete Gonzalves and Peter Westigard

The majority of southern Oregon pear orchards were treated with Agrimek miticide at the second cover spray timing for the control of twospotted spider mite (TSSM) populations which annually threaten fruit production. The control provided was excellent, lasting throughout the season in nearly all treated blocks. Untreated blocks had either been treated earlier with the ovicidal miticide, Apollo, for high winter carryover populations or had begun the season with sub-economic TSSM levels. Of the blocks not treated with Agrimek, most required subsequent control measures later in the season as consistantly above normal temperatures forced rapid TSSM population growth and injury to pear foliage became apparent.

Available miticides for mid to late season application are materials for which spider mites have developed documented resistance following years of use. Carzol was applied alone or in combination with Vendex in an attempt to slow the progress of TSSM injury.

Spider mite control was realized only in younger pear blocks and only in those treated with the combination of miticides (Table 1). Only two of the Carzol alone treatments reduced TSSM counts but the mite levels in those blocks remained above treatment thresholds of ca. 2.00 mites per leaf. Any additional chemical control measures were deemed pointless although spider mite injury continued to progress.

Table 1. Twospotted spider mite (TSSM) densities in southern Oregon pear orchards before and after combined application of Carzol and Vendex miticides, 1990.

Cultivar	Age	Application Date	TSSM per leaf (all stages) Pre-treatment	Post-treatment	Date
Seckel	3yr	7/7	4.27	0.08	7/16
Bartlett	9	6/29	8.74	0.32	7/22
Bosc	9	6/29	8.63	2.84	7/19
Bosc	8	7/3	7.43	6.63	7/16
D'Anjou	60	7/23	2.93	4.47	8/2
D'Anjou	50	7/23	4.63	3.33	8/2

Table 2. Twospotted spider mite (TSSM) densities in southern Oregon pear orchards before and after application of Carzol miticide alone, 1990.

Cultivar	Age	Application Date	TSSM per leaf (all stages) Pre-treatment	Post-treatment	Date
Seckel	6yr	7/26	17.17	16.27	9/4
Seckel	50	7/26	27.00	29.76	9/4
Seckel	50	7/26	17.60	40.56	9/4
Bosc	35	7/25	4.68	2.53	8/1
Bosc	9	7/26	6.63	10.86	8/1
Bosc	20	7/28	3.76	4.04	8/1

PRELIMINARY STUDIES TO ESTABLISH A CULTIVAR SPECIFIC PEST MANAGEMENT PROGRAM FOR THE BOSC PEAR IN SOUTHERN OREGON

P. H. Westigard, R. J. Hilton

The Bosc variety bears a highly russeted fruit type which has previously been found to be moderately tolerant of early season pear psylla damage. This damage appears at harvest as a dark scaly russet usually restricted to the calyx area of the fruit. Current grade standards do not provide for downgrading of such damaged fruit. Also injury caused by the pear rust mite is generally masked by the naturally russeted surface of this variety. While the Bosc variety is susceptible to other pest species such as spider mites and codling moth, the above tolerances may still provide an opportunity to develop an integrated control program utilizing predaceous mites in a system normally devoid of these species. Based on previous studies, it was hypothesized that deletion of the pyrethroid chemicals for psylla control from the prebloom program would not result in substantial early season honeydew damage and that subsequent damage potential by this pest would be minimized by natural enemies normally found in a selective program using the insect growth regulator, Dimilin. In addition, prebloom pyrethroid use has been found to exaccerbate spider mite levels. The encouragement of pear rust mite by deletion of prebloom organo-phosphate or sulfur treatments was thought important as this species serves as an alternate host for predaceous mites when the spider mite host density is low, and its presence if not injurious may be beneficial in the management of the pear arthropod complex.

This test was designed as a preliminary trial to evaluate a reduced chemical program designed for the characteristics apparently exhibited by the Bosc variety.

Methods and Materials

A 1.5 acre block of mature Bosc pear trees was subdivided into two treatments, with two replicates each. One treatment considered here a standard received normal pyrethroid-oil-organophosphate application in the prebloom (delayed dormant) period followed by a standard 4 cover spray program for codling moth using azinphosmethyl (Guthion). This program also included one application of abamectin (Agrimek) combined with oil and Guthion at the second cover period (table 1). A modified program was used in comparison to the standard and included oil alone at the delayed dormant timing followed by 4 Dimilin treatments for codling moth. All Dimilin applications included oil at 1% except the final treatment on Aug. 1 in which the oil was deleted (table 1).

Evaluations of pest and beneficial species density were made biweekly from mid-March until September. At each sample date 40 leaves (20 young, 20 mature) were selected per replicate, arthropods removed by using a mite brushing machine and counted with the aid of a dissecting microscope. In addition pear psylla adults and larger more mobile predators were sampled by tapping limbs using a 20" x 20" catching frame. Ten limbs, 2 on each of 5 trees/rep, were tapped on each sample period. Damage caused by pear psylla and codling moth to 75 fruit/replicate was evaluated at harvest on August 24.

Results

Pear psylla (PP). Population densities of immature PP peaked in March at an average of 2.2/cluster compared to less than 0.1/cluster in the standard program (table 2). This difference in early season PP is attributed to the effect of the prebloom psylla adulticide Asana use in the standard program. However, late season PP were more abundant in the standard program with adult densities from about 200 fold those found in the modified program. PP honeydew-induced fruit damage at harvest (table 4) reflected this temporal variation in PP abundance with about 14% late season staining recorded from the standard and less than 1% from the modified program. Of the late season damage about 7% was judged to be of sufficient intensity to result in downgrading. None of the early season "frogging" damage (4% modified and 2% in the standard program) was severe enough to cause downgrading.

Spider Mites. (table 3) The mean number of twospotted spider mites/leaf from April - August averaged 3.8 and 5.4 in the modified and standard programs respectively despite the later treatment having received an Agrimek treatment on June 12. In addition some resurgence in spider mite density was indicated in the standard program in August leaf counts. While predaceous mites were found in both the programs during June and July their density was about 3 fold greater in the modified program and may have accounted for the late season depression in spider mite numbers.

Other pests. Damage by the codling moth was minimal in both treatments averaging 0 and 0.6% infested fruit in the standard and modified plots respectively (table 4). No pear rust mite were detected in any treatment until late July or August and then only in very low densities.

Conclusions. Results from this preliminary test indicate that the Bosc variety may be a suitable target for lowered pesticide input without risk of a resultant reduction of fruit quality. Indeed, these 1990 data show improved fruit quality, lowered use of synthetic chemicals and reduced fall carry-over of both pear psylla and the twospotted spider mite.

Table 1. Chemicals used in a modified and standard seasonal program on the Bosc pear cultivar. Medford. 1990.

Timing	Material and rate/acre	
	Modified Program	Standard Program
Dormant	oil 4 gal	oil 4 gal
Delayed Dormant	oil 4 gal (Mar. 9)	oil 4 gal + Asana 0.1 lb AI + Diazinon 4 lbs (Mar. 9)
1st cover	Dimilin 25w 0.75 lb + oil 1% (2 gal) (April 18)	Guthion 35w 2.5 lbs (May 4)
2nd cover	Dimilin 25w 0.75 lb + oil 1% (2 gal) (May 18)	Guthion 35w 2.5 lb + Agrimek 10 oz + oil .25% (2 qts) (June 12)
3rd cover	Dimilin 25w 0.75 lb + oil 1% (2 gal) (June 28)	Guthion 35w 2.5 lbs (July 18)
4th cover	Dimilin 25w 0.75 lb (Aug. 1)	Guthion 35w 2.5 lbs (Aug. 15)

Table 2. Population trends of pear psylla immatures and adults in a modified seasonal control program on the Bosc pear cultivar. Medford. 1990.

Program	March (S,C)	April (L)	May (L)	June (L)	July (L)	Aug. (L)	Sept. (L)
	Average # Psylla Immatures/Spur (S), Cluster (C) or Leaf (L)						
Modified	2.2	0.1	0.05	0.05	0.13	0.62	-
Standard	0.07	0	0.03	0.15	0.33	3.05	-
	Average number adults/tap						
Modified	1.5	0.1	-	0.20	0.13	0.52	4.9
Standard	2.05	0	-	0	0.75	6.20	215.0

Table 3. Population trends of the twospotted spider mite (TSM) and predaceous mites (PM) in a modified seasonal control program on the Bosc pear cultivar. Medford. 1990.

Program	April	May	June	July	Aug.
	Average number TSM/leaf				
Modified	2.1	5.4	8.8	2.1	0.5
Standard	1.5	5.5	13.2	1.5	5.3
	Average number PM/10 leaves				
Modified	0	0	1.0	1.8	0
Standard	0	0	0.25	0.8	0

Table 4. Direct fruit injury by pear psylla (PP) and codling moth (CM) in a modified seasonal control program on the Bosc pear cultivar. Medford, Oregon. 1990. Harvest August 24.

Program	PP damage (%) Early Season "frogging"	PP damage (%) Late Season staining	CM entries (%)
Modified	4.0%	0.6%	0.6%
Standard	2.0%	13.3%	0%

IMPLEMENTATION OF A SELECTIVE PROGRAM FOR THE MANAGEMENT OF ARTHROPOD PEAR PESTS IN SOUTHERN OREGON, 1990

Pete Gonzalves and Peter Westigard

1990 was the fifth pear growing season in which the insect growth regulator (IGR) Dimilin was applied for codling moth (CM) control in southern Oregon under an Experimental Use Permit (EUP). As opposed to broad-spectrum organophosphate insecticides used against CM in standard programs, Dimilin is a selective material which allows for the survival of beneficial arthropods to aid in the control of secondary pests such as spider mites and pear psylla. An intensive monitoring program is required to take full advantage of the opportunity to minimze pesticide applications directed at these secondary pests as well as maintain economic CM control. Management with the selective program has been associated with reduced overwintering populations of mites and psylla as indicated for 1990 in Tables 1 and 2. Aside from spray oil, fifteen percent of the 61 selective blocks monitored required no foliar pesticide applications for control of either spider mites or pear psylla.

CODLING MOTH

Above normal high temperatures during the later half of the 1990 growing season favored codling moth development which included a partial third generation of the pest. Several incidents of low level CM damage were reported from throughout the valley. Fruit damage exceeding 1.5% tolerance occurred in 2 of 17 selective pear blocks sampled at harvest. Half of the remaining 14 selective blocks which were closely inspected at harvest revealed no CM damage while the other half showed damage at 0.5% or less. Results of visual inspections just prior to harvest indicated little or no CM damage in 42 additional selective pear blocks. By comparison, samples from 6 of 17 blocks managed under the standard organophosphate CM program also revealed excessive CM damage. In the previous four years, pear blocks managed under the selective program have suffered no significant CM damage.

Season total trap catches in selective blocks ranged from 11 to 225 adult male moths. The highest catch was from a Bosc block which experienced less than 1% CM damaged fruit at harvest. However, the adjacent Bartlett block (a more CM susceptible cultivar) experienced about 7% cullage and produced a season total trap catch of 167 moths. A mid-season fruit sample in the Bartletts revealed three CM eggs found on 2 of 300 fruit examined.

The other damaged block was a Comice block with 6% cullage due to CM. Two traps in this block yielded season totals of 67 and 72 moths. Three CM eggs were found among 600 fruit during the mid-season sample. This block was treated with an organophosphate insecticide in mid-August to curtail further damage as were the Bosc blocks adjacent to the damaged Bartlett block. Both of the affected blocks have a history of significant CM populations.

SPIDER MITES

Cool weather extending into June suppressed the development of spider mite populations then above normal temperatures in July and August encouraged rapid population expansions. Nevertheless, 18% of the selective blocks required no specific miticide treatments throughout the growing season. Only one of these blocks (Bartlett) showed significant mite burn to the foliage at harvest time and this was considered to have minimal impact on fruit sizing and no impact on next year's fruit bud development. Spray oil is included in the first and second cover sprays as a selective pesticide especially for the suppression of spider mites. Among standard blocks, only 8% were able to endure the season without miticidal supplements to the oil treatments.

PEAR PSYLLA

The weather pattern in 1990 had an opposite effect on pear psylla populations causing early season encouragment followed by severe suppression with hot temperatures in July. Dimilin plus spray oil is moderately active against the early nymphal stages of psylla and nearly half of the selective blocks monitored required no additional foliar season psyllicidal treatment. Fruit from 4 of the 17 blocks sampled at harvest exhibited some downgrading psylla damage but none of this affected more than 2% of the fruit from any one block.

All of the standard program blocks received at least one specific psyllicide application during the foliar season. Downgradable psylla marking appeared in 7 Of the 17 standard blocks examined and ranged from less than 1% to 9% of the fruit from those blocks.

OTHER ARTHROPOD PESTS

Because Dimilin is a selective insecticide, injury might be expected from lessor pests which are typically controlled by the broad-spectrum organophosphate CM materials. Two such pests, fruitmorms and stinkbugs, were observed in 1990.

Fruitworm surface-feeding damage was noted in four of the selective blocks on 0.3 to 1.3% of fruit. Fruitworm injury was also noted in one standard block. Stinkbugs are difficult to monitor and their damage is often undetectable without cutting into the fruit. Early season feeding leaves depressions on the fruit but this can be difficult to distinguish from other types of deformities. Late feeding causes degradation of fruit flesh but leaves no external signs except for occasional frass. Only one block suffered cullage (less than 1%) attributed to stinkbug while signs or actual bugs were noted in 6 additional blocks at harvest. Presense of stinkbug was also recorded from two standard blocks.

San Jose scale (SJS) pheromone trapping records in 1990 indicated large flights of this pest for which Diazinon was applied to several blocks. The management of SJS is related more to tree age and structure than the use of selective materials. Very few yellow mites or pear rust mites were recorded from the acreage monitored in 1990.

Pest management summaries from four commercial selective pear blocks and one standard block are presented in Tables 3-8. These summaries describe the range of foliar season insecticide and miticide inputs as well as pest damage results experienced with the selective program in 1990. An example of a more typical standard foliar season spray program for pears is presented in Table 9 for comparative purposes.

Table 1. Overwintering populations of twospotted spider mite (TSSM) in selective and standard pest management pear blocks in southern Oregon, 1990. Blocks compared on the same line are of similar age.

Cultivar	Percent of Fruit clusters with TSSM Selective	Standard
Red Bartlett	10.0%	40.0%
Red Bartlett	0	20.0
Bartlett	0	80.0
Bartlett	60.0	80.0
Average Bartlett	17.5	55.0
Bosc	4.0	90.0
Bosc	0	33.3
Average Bosc	2.0	61.7
Comice	12.0	10.0
Comice	40.0	40.0
Comice	36.0	75.0
Average Comice	29.3	41.7
Average All Cultivars	18.0%	52.0%

Table 2. Population densities of overwintering pear psylla in selective and standard pest management pear blocks in southern Oregon, Fall, 1989.

Orchard	Average No. pear psylla adults per tap, overwintering forms, November 1 and 2, 1989 Selective	Standard
1	1.4	9.3
2	2.0	22.3
3	5.5	11.0
Average	3.0	14.2

Table 3. Coker Butte Orchard, Red Bartlett Block
18 acres of 9 year old Sensation grafts
Overtree sprinkler irrigation
First year of selective program

Date	Material	Rate per Acre
4/19	Dimilin	1 lb.
	Oil	2.5 gal.
5/15	Dimilin	1 lb.
	Oil	2.5 gal.
7/3	Dimilin	1 lb.

Damage at harvest:		
	codling moth	0
	psylla	0
	mite burn	0

Season total codling moth catch: 33

Chemical cost per acre: $103.50

Spider mite levels remained very low until July and never exceeded treatment thresholds on this moderately mite-tolerant cultivar. Dimilin plus oil provided sufficient suppression of pear psylla to avoid any damage at harvest.

Table 4. Highland Orchard, Casey Block
24 acres of ca. 20 year old Bosc
Undertree sprinkler irrigation
Second year of selective program

Date	Material	Rate per Acre
4/18	Dimilin	3/4 lb.
	Oil	2.5 gal.
5/15	Dimilin	3/4 lb.
	Oil	2.5 gal.
6/29	Dimilin	3/4 lb.
7/28	Dimilin	3/4 lb.
	Carzol	2.5 lb.

Damage at harvest:	codling moth	0
	psylla	0
	mite burn	0

Season total codling moth catch: 52

Chemical cost per acre: $159.77

Spider mite levels remained very low until the hot weather in July when a miticide was applied to this mite-sensitive cultivar. Psylla approached treatment thresholds at mid-season but Dimilin plus oil and the late season high temperatures provided sufficient suppression to avoid damage at harvest.

Table 5. Minear Orchard, Block F
3 acres of ca. 20 year old Bartlett
Overtree sprinkler irrigation
Fourth year of selective program

Date	Material	Rate per Acre
4/14	Dimilin	1 lb.
	Oil	2.5 gal.
	Apollo	6 oz.
5/21	Dimilin	1 lb.
	Oil	80 oz.
6/22	Diazinon	4 lb.
6/30	Dimilin	1 lb.
	Mitac	3 lb.

Damage at harvest:	codling moth	0
	psylla	0
	mite burn	0

Season total codling moth catch: 64

Chemical cost per acre: $255.80

First cover Apollo plus oil was directed at a moderately high carryover population of spider mites which remained low for the remainder of the season. Pear psylla were held below damage thresholds by the application of Mitac. Diazinon was included to control San Jose scale.

Table 6. Corey Orchard, Young Corey Block
7 acres of 9 year old Red and Green Comice
Overtree sprinkler irrigation
Fourth year of selective program

Date	Material	Rate per Acre
4/19	Dimilin	3/4 lb.
	Oil	2.5 gal.
5/29	Dimilin	3/4 lb.
	Agrimek	16 oz.
	Oil	2.5 gal.
6/28	Dimilin	3/4 lb.
7/28	Dimilin	3/4 lb.

Damage at harvest:	codling moth	0
	psylla	0
	mite burn	0

Season total codling moth catch: 55

Chemical cost per acre: $183.50

A small psylla population and about 4 mites per leaf were controlled for the remainder of the season by the single Agrimek application at second cover. The mites caused no leaf burn on these tolerant cultivars.

Table 7. Talent Orchard, Bartlett Block
9 acres of mature Bartlett
Undertree sprinkler irrigation
Fourth year of selective program

Date	Material	Rate per Acre
4/18	Dimilin	3/4 lb.
	Oil	2.5 gal.
	Apollo	6 oz.
5/18	Dimilin	3/4 lb.
	Oil	2.5 gal.
7/3	Dimilin	1 lb.

Damage at harvest:	codling moth	6.4%
	psylla	0.3%
	mite burn	0
	fruitworm	1.3%

Season total codling moth catch: 167

Chemical cost per acre: $178.50

In 1989, this block was treated with an organophosphate insecticide due the discovery of a low level codling moth (CM) infestation during the mid-season fruit sample. Although CM eggs were seen during the same sample in 1990, the decision was made to continue the Dimilin program without modification. Reduced rates of Dimilin application and the CM susceptibility of this cultivar contributed to the 6.4% damage recorded at harvest. Spider mite levels remained low following the first cover applicaton of Apollo. Psylla levels of about 1.1 immature stages per leaf in mid-July resulted in the downgradable marking of 0.3% of the fruit.

Table 8. Budge Orchard, Bartlett North Block
12 acres of mature Bartlett
Overtree sprinkler irrigation
Standard pest management program

Date	Material	Rate per Acre
5/10	Azinphos	2 lb.
	Agrimek	16 oz.
	Oil	80 oz.
6/15	Imidan	4 lb.
	Mitac	3 lb.
7/16	Guthion	2.5 lb.

Damage at harvest:	codling moth	8.2%
	psylla	0
	mite burn	1

Season total codling moth catch: 142

Chemical cost per acre: $177.30

High spider mite and pear psylla populations were largely controlled for the remainder of the season by the Agrimek and Mitac applications respectively. Mite levels increased late in the season resulting in some interior canopy leaf burn as indicated by the mite burn rating of 1. Cullage due to codling moth damage was associated with mid-season strikes while additional, non-downgrading light stings were noted at harvest.

Table 9. An example of a typical standard pest management foliar chemical progam for pears in southern Oregon, 1990.

Date	Material	Rate per Acre
5/4	Azinphos	2.6 lb.
	Oil	2.5 gal.
	Vendex	1.5 pt.
6/15	Imidan	5 lb.
	Agrimek	10 oz.
	Oil	80 oz.
6/22	Diazinon	5 lb.
	Mitac	3 lb.
7/14	Imidan	5 lb.
	Mitac	3 lb.
	Vendex	1.5 pt.
	Carzol	1.25lb.

Chemical cost per acre: $330.27

PEAR PSYLLA CONTROL ON PEAR: POST-HARVEST EVALUATION OF SAFER INSECTICIDE

In August of 1989 a test conducted to evaluate the effectiveness of Safer Insecticide Concentrate (SIC) applied post-harvest on pear psylla indicated that a concentration of 2% SIC when used alone and applied by handgun was the weakest of the treatments tested. That study also reported SIC to be very effective on early nymphal stages of pear psylla, but not very effective on adults (see 1989 report).

In October of that same year the test was repeated, with minor changes, to determine if the findings of the original test were accurate, i.e. SIC used alone has little or no effect on adult pear psylla.

Methods

Research plots were established at the Southern Oregon Experiment Station where three different treatments were compared: 1) 2% SIC in 200 gallons of water per acre; 2) 2% SIC in 50 gallons of water per acre; 3) 8% SIC applied in 50 gallons of water per acre; and 4) a check with no sprays applied.

Treatments were applied to 40 year old Bartlett and D'Anjou pears, with plots measuring .46 acres in size, and replicated two times in a randomized block design. Application of chemicals was made using conventional air-carrier equipment.

Samples were taken pretreatment and every three days posttreatment by tapping three limbs per tree, five trees per plot, and counting the adult pear psylla that dropped onto an 18 inch square collecting frame.

Results

All three treatments of SIC tested failed to control adult pear psylla when applied as a late post-harvest spray, supporting the results of the previous study. Three days following application there was a slight reduction in populations that was seen in all treatments indicating a natural shift in life stages (Table 1). Within six days adult populations were as high or higher than the pre-treatment counts.

Table 1. Post-harvest Application of Safer Insecticide Concentrate 1989 (Treated 10/6/89).

Treatment	Average Number of Pear Psylla Adults Per Tap			
	pretreatment 10/5	10/9	10/12	10/17
2%Soap 200 gal./AC.	27.0	23.3	27.8	33.7
2% Soap 50 gal./AC.	39.1	28.4	43.8	42.1
8% Soap 50 gal./AC.	31.1	27.0	35.1	38.5
check	44.2	36.8	47.3	48.0

TWO-SPOTTED SPIDER MITE AND PEAR PSYLLA CONTROL ON PEAR: 1990 SAFER INSECTICIDE EVALUATION TRIALS

During field testing of Safer Insecticide Concentrate (SIC) at the OSU Southern Oregon Experiment Station in 1989, it was determined that 2% SIC plus 2% Ultra Fine Spray Oil applied two times during the summer season on Bartlett pear, could reduce psylla populations enough to eliminate pear psylla damage to the fruit. While the SIC and oil combination controlled psylla populations, it caused severe phytotoxicity to the pear fruit. The fruit damage was such that it would not have an effect on fruit going to the cannery, but could have a major effect on commercial fresh market fruit. The conclusion that was reached during that study was that if SIC was to be used in commercial orchards on fresh market fruit the phytotoxicity problem would have to be overcome. It was suggested that a more concentrate spray using less oil and applied by an air blast sprayer rather than handgun sprayer might reduce phytotoxicity without reducing the effectiveness of the materials.

Based on the information collected in 1989, field testing of Safer Insecticide Concentrate (SIC) and Ultra Fine Spray Oil (UFSO) continued during the foliar season of 1990 with two objectives in mind: 1) to determine the effectiveness of SIC and Ultra Fine Spray Oil on two-spotted Spider Mite (*Tetranychus urticae*) and Pear Psylla (*Psylla pyricola*) populations when applied at Petal Fall and midsummer; and 2) to evaluate 7 pear varieties for phytotoxicity when SIC is applied by air blast sprayer at petal fall and midsummer.

Methods

Research plots were established at the OSU Southern Oregon Experiment Station where five different treatments were compared: 1) 1% Ultra Fine Spray Oil (UFSO); 2) 2% Safer Insecticide Concentrate (SIC); 3) 2% SIC plus 1% UFSO; 4) Agrimek (20 ounces per acre rate) plus 0.25% UFSO; and 5) a check with no sprays applied.

All treatments were applied at 2 different timings during the growing season: 1st cover (5/14/90) and midsummer (6/18/90) with the exception of the Agrimek plots which only received the first application. Due to the slow development of the mite and/or psylla populations, the 1st cover spray replaced the proposed petal fall application. All applications were made at the rate of 200 gallons per acre using conventional air-carrier equipment.

Pest control treatments were applied to 20 year old Bosc trees with plots about 0.6 acres in size, replicated two times in a randomized block design. Phytotoxicity plots were unreplicated and 0.6 acres in size for Seckel, Comice, Bosc and Green Bartlett, and were 0.2 acres in size for Red Comice, Red Bartlett, and Cascade. Trees ranged in age from 12 to 20 years old.

Pear psylla eggs and nymphs and two-spotted spider mite eggs and post-eggs were sampled by randomly selecting 4 leaves per tree, 5 trees per plot and processed through a leaf brushing machine. All counts were then made with the aid of a dissecting microscope. Psylla adults were sampled throughout the season by tapping five trees per plot, and counting the adults that dropped onto an 18 X 18" square collecting frame. A pretreatment sample was made, and posttreatment samples were taken approximately every 7 days.

Two-Spotted Spider Mite Control

The 1st cover application resulted in a significant reduction (between 35% and 96%) of two-spotted spider mite in all treatments relative to the check plot (Table 1). However, only two of the treatments, 2% SIC plus 1% UFSO and Agrimek plus .25% UFSO reduced populations below the injury threshold of 2-2.5 mites per leaf. By the 14th day, all treatments exceeded the retreatment threshold of 1 mite per leaf. The fact that there was an increase in the number of mites in the Agrimek plots from 5/21 to 5/29 may be explained by cooler temperatures and rain during that period which reduces the activity of the miticide and the feeding activity of the mites. With the return of warmer temperatures between 5/29 and 6/4 we see an increase in the effectiveness of the Agrimek plus oil treatment which lasted six weeks post-treatment before the retreatmeant threshold was again reached.

The results of the midsummer treatments were almost identical to the 1st cover results with only two exceptions (Table 1). Again there was a significant reduction of two-spotted spider mites in all treatments relative to the check at 7 days post-treatment, with the exception of the Agrimek plus oil treatment which was now at 6 weeks post-treatment. Even though populations were reduced in the UFSO alone, SIC alone and the SIC plus UFSO combination treatments, populations were not reduced below the retreatment thresholds.

Mite Burn Evaluation

Injury to the pear crop caused by the two-spotted spider mite is indirectly induced through leaf damage. The most noticeable sign of mite damage is the blackening of the leaves or transpiration burn caused by rapid water loss through the leaf cuticle. This type of damage is more commonly called mite burn. If not controlled early or by midsummer it may reduce fruit size that season and reduce fruit set the following season.

On June 29, 1990, three days before the last sampling date all trees within each plot were evaluated to determine the extent of mite burn by treatment and by pear variety.

The results of the evaluation by treatment, showed that Agrimek plus oil sustained the least amount of mite burn and the SIC plus oil sustained the second lowest amount of damage (Table 2). Based on the amount of control that each treatment provided during the season there were no surprises in the results.

The extent of leaf injury produced by two-spotted spider mite is also related to susceptibility of the pear variety as well as to the density of the mite population (See 1989 OSU Southern Oregon Experiment Station Entomology Annual Report). Tables 3-7 show the incidence of mite burn by variety and treatment. The ranking of the varieties evaluated, in the order of most susceptible to least susceptible: Bosc, Comice, Bartlett, Seckel, and then the three red varieties: Red Comice, Red Bartlett, and Cascade. When comparing green varieties to red, red varieties as a whole are less sensitive to mite burn and will withstand larger mite populations.

Pear Psylla Control

Due to higher than normal temperatures during the 1990 foliar season and materials used during the delayed dormant spray, pear psylla populations failed to develop in the test plots. Therefore, data to determine the effectiveness of SIC and/or UFSO at 1st cover was inconclusive (Tables 8 and 9). However, data collected following the midsummer application suggest that all treatments suppressed psylla populations below the retreatment level of .5 immature pear psylla/leaf for over 14 days.

Phytotoxicity Evaluation

The evaluation of phytotoxicity on Bartlett fruit following both the 1st cover and midsummer applications showed that the percentage of fruit suffering moderate to heavy damage, increased over last year in the SIC alone treatment. The SIC alone treatment increased from 0% in 1989 to 36% in 1990 at 1st cover and from 1.7% to 32% when applied at midsummer (Table 14). Phytotoxicity in the remaining Bartlett treatments remained the same or were reduced.

The reduced rate of UFSO (from 2% to 1%) in the combined SIC and UFSO treatment did reduce the percentage of phytotoxicity over last year. The phytotoxicity was reduced from 80% in the moderate to heavy range in 1989 to 60% in 1990 at 1st cover. Following the midsummer application the reduction in the amount of phytotoxicity was more dramatic, from 40% moderate to heavy damage in 1989 to 4% in 1990.

The reason for such a high percentage of Bartlett fruit phytotoxicity at 1st cover in the SIC alone and the combined SIC and UFSO treatment may be due to the advanced development of the fruit over last year. The fruit in 1989 were pointed upward where in 1990 the majority of the fruit were partly turned downward and laying on their side where most of the damage occurred. Damage at midsummer was the same as 1989, restricted just to the calyx end of the fruit.

When comparing phytotoxicity of fruit across all varieties following 1st cover and midsummer, fruit in the SIC alone treatment had the highest percentage of phytotoxicity. When the SIC was added to the UFSO phytotoxicity also increased. An attempt to rank varieties by degree of susceptibility to phytotoxicity at 1st cover and/or midsummer was inconclusive (Tables 8 & 9).

Foliage phytotoxicity in 1990 was much less than in 1989. The damage was restricted to marginal leaf or tip burn at both 1st cover and midsummer applications.

Conclusion

While the use of SIC to control pear psylla was inconclusive when applied by air carrier, it was determined that SIC and SIC plus UFSO were weak controls for two-spotted spider mite at the rates tested. The ability of SIC to reduce mite populations below retreatment thresholds required the addition of UFSO and low mite populations and still was only effective for a little over 7 days.

Phytotoxicity on Bartlett pear in the SIC alone treatment increased in 1990 when compared to the handgun trials of 1989. The reduction of UFSO from 2% to 1%, in the SIC and UFSO combination treatment reduce the amount of phytotoxicity, but also may have reduced its effectiveness.

Table 1. Control of Two-Spotted Spider Mite 1st Cover and Midsummer (Treated 5/14/90 and 6/18/90).

Treatment	Mites per Leaf (All life stages)						
	Pre-treatment 5/10	5/21	5/29	6/4	6/11	6/25	7/2
% Ultra Fine Spray Oil	6.0	3.6	25.1	21.3	15.3	11.3	12.9
2% Safer Insecticide Concentrate	7.2	4.7	1.1	2.5	18.8	12.4	10.8
2% Safer Insecticide Concentrate + Ultra Fine Spray Oil	4.5	0.2	12.5	16.6	9.4	5.2	10.0
Agrimek (20 oz/ac rate) + .25% Ultra Fine Spray Oil	1.6	0.4	5.3	0.7	0.4	1.0	0.4
Control	6.0	10.3	8.1	36.6	19.2	28.5	20.75

Table 2. Evaluation Of Mite Burn After Two Miticide Treatments: Average of All Pear Varieties Treated (6/29/90).

Treatment	% Leaf Burn Average of 7 varieties tested				
	None	0-20	20-40	40-60	60-80
1% Ultra Fine Spray Oil	57.0	29.0	14.0	0	0
2% Safer Insecticide Concentrate	43.0	29.5	28.5	0	0
2% Safer Insecticide Concentrate + Ultra Fine Spray Oil	71.0	29.0	0	0	0
Agrimek (20 oz/ac rate) + .25% Ultra Fine Spray Oil	100.0	0	0	0	0
Control	57.0	14.3	14.3	14.3	0

Table 3. Evaluation Of Mite Burn After Two Miticide Treatments: On Seckel Pear (6/29/90).

Treatment	% Leaf Burn				
	None	0-20	20-40	40-60	60-8
1% Ultra Fine Spray Oil	X				
2% Safer Insecticide Concentrate		X			
2% Safer Insecticide Concentrate + Ultra Fine Spray Oil	X				
Agrimek (20 oz/ac rate) + + .25% Ultra Fine Spray Oil	X				
Control	X				

Table 4. Evaluation Of Mite Burn After Two Miticide Treatments: On Comice Pear (6/29/90).

Treatment	None	% Leaf Burn 0-20	20-40	40-60	60-8
1% Ultra Fine Spray Oil		X			
2% Safer Insecticide Concentrate			X		
2% Safer Insecticide Concentrate + Ultra Fine Spray Oil		X			
Agrimek (20 oz/ac rate) + + .25% Ultra Fine Spray Oil	X				
Control				X	

Table 5. Evaluation Of Mite Burn After Two Miticide Treatments: On Bosc Pear (6/29/90).

Treatment	None	% Leaf Burn 0-20	20-40	40-60	60-8
1% Ultra Fine Spray Oil			X		
2% Safer Insecticide Concentrate			X		
2% Safer Insecticide Concentrate + Ultra Fine Spray Oil		X			
Agrimek (20 oz/ac rate) + + .25% Ultra Fine Spray Oil	X				
Control			X		

Table 6. Evaluation Of Mite Burn After Two Miticide Treatments: On Green Bartlett Pear (6/29/90).

Treatment	None	% Leaf Burn 0-20	20-40	40-60	60-8
1% Ultra Fine Spray Oil		X			
2% Safer Insecticide Concentrate		X			
2% Safer Insecticide Concentrate + Ultra Fine Spray Oil	X				
Agrimek (20 oz/ac rate) + + .25% Ultra Fine Spray Oil	X				
Control		X			

Table 7. Evaluation Of Mite Burn After Two Miticide Treatments: On Red Comice, Red Bartlett, and Cascade Pear (6/29/90).

Treatment	None	% Leaf Burn 0-20	20-40	40-60	60-8
1% Ultra Fine Spray Oil	X				
2% Safer Insecticide Concentrate	X				
2% Safer Insecticide Concentrate + Ultra Fine Spray Oil	X				
Agrimek (20 oz/ac rate) + + .25% Ultra Fine Spray Oil	X				
Control	X				

Table 8. Control Of Pear Psylla On Pear: 1ST Cover (Treated 5/14/90).

Treatment	Average Number Pear Psylla Adults/Tap or Immatures/Leaf									
	Pre-treatment 5/10		5/21		5/29		6/4		6/11	
	(A)	(I)	(A)	(I)	(A)	(I)	(A)	(I)	(A)	(I)
1% Ultra Fine Spray Oil	0.1	0	0	0	0	0	0	0.5	0.1	0.4
2% Safer Insecticide Concentrate	0.3	0	0	0	0.2	0	0.1	0	0.1	0.1
2% Safer Insecticide Concentrate + Ultra Fine Spray Oil	0.1	0	0	0	0	0	0	0	0	0.5
Agrimek (20 oz/ac rate) + .25% Ultra Fine Spray Oil	0.2	0	0	0	0	0	0.1	0	0.2	0.1
Control	0.1	0	0.2	0	0	0	0.1	0.2	0.2	0.2

PEAR PSYLLA CONTROL ON PEAR: DELAYED DORMANT EVALUATION OF SAFER INSECTICIDE.

Past research conducted on the pear psylla has shown that there are two distinct adult forms, the overwintering form and the summer form. Therefore, a test was conducted to determine effectiveness of Safer Insecticide Concentrate (SIC) on the overwintering adult form of pear psylla migrating back to the orchards in the early spring.

Methods

Research plots were established at the OSU Southern Oregon Experiment Station where three different treatments were compared: 1) 2% Safer Insecticide Concentrate; 2) 2% Safer Insecticide Concentrate plus 2% Ultra Fine Spray Oil; 3) 2% Ultra Fine Spray Oil; and 4) a check with no sprays applied.

All treatments were applied at delayed dormant (March 9, 1990). Applications were made to groups of single 20-year-old Bartlett pear trees, 11-15 trees per plot, and replicated two times in a randomized block design. Application of chemicals was made using a handgun sprayer at 250 psi and trees sprayed to runoff.

A pretreatment sample was made, with posttreatment samples taken approximately every 7 days following application. Pear psylla nymphs and eggs were sampled by randomly selecting 10 flower clusters per plot and the eggs and nymphs were then counted. Cluster samples were only taken pretreatment and three weeks posttreatment due to a limited number of flower buds available. Psylla adults were sampled by tapping three limbs per tree, five trees per plot and counting the adults that dropped onto an 18 inch square collecting frame.

Results

The three primary results of the study were: 1) that SIC alone was effective in suppressing adult pear psylla in the delayed dormant; 2) that Ultra Fine Spray Oil alone had little or no effect against adult pear psylla populations; and 3) that the SIC and spray oil combination provided a quicker knock down and also provided a residual effect equal to or slightly better than that of the SIC alone (Table 1).

Adult counts in the SIC treatment alone dropped 37% the first week (3/16). At the same time the adults in the control plot increased by 111%, definitely indicating SIC's effectiveness against overwintering adults. Adult counts continued to drop in the SIC plots by an additional 47% over the next 7 days (3/22), but counts in the control also dropped 37% during that same time frame. By the third week adult counts in the SIC treatment begin moving upward as counts increased by 113%.

In the Ultra Fine Spray Oil alone and SIC plus UFSO treatments, we also see a suppression of adults (compared to the check) which lasted over 21 days following application. The reason for the 21 day suppression in these plots was most likely due to the masking affect of the oil.

Conclusion

SIC was shown to be effective against the overwintering adult form of the pear psylla in the delayed dormant. Also, it was shown again that the addition of 2% Ultra Fine Spray Oil to SIC enhanced pear psylla control.

Table 1. Delayed Dormant Application Of Safer Insecticide Concentrate 1990 (Treated 3/9/90).

	Average Number of pear Psylla Adults (A)/Tap or Eggs and/or nymphs (E+N)/Fruit Spur					
	pretreatment 3/8		3/16	3/22	3/29	
Treatment	(E)	(A)	(A)	(A)	(E+N)	(A)
2% Safer Soap	10.5	2.4	1.5	0.8	34.7	1.7
2% Safer Soap + 2% Ultra Fine Spray Oil	20.4	3.1	2.3	1.4	33.4	0.8
2% Ultra Fine Spray Oil	20.4	2.3	2.3	1.2	51.0	0.8
Control	27.9	3.7	7.8	4.9	42.4	4.9

Table 9. Control Of Pear Psylla On Pear: Midsummer (Treated 6/18/90).

Treatment	Average Number Pear Psylla Adults/Tap or Immatures/Leaf							
	Pre-treatment 6/11		6/25		7/2		Post-Treatment Average	
	(A)	(I)	(A)	(I)	(A)	(I)	(A)	(I)
1% Ultra Fine Spray Oil	0.1	0.4	0.0	0.0	0.0	0.1	0.0	0.0
Safer Insecticide Concentrate	0.1	0.1	0.0	0.0	0.1	0.0	0.1	0.0
2% Safer Insecticide Concentrate + Ultra Fine Spray Oil	0.0	0.5	0.1	0.0	0.0	0.0	0.1	0.0
Agrimek (20 oz/ac rate) + .25% Ultra Fine Spray Oil	0.2	0.1	0.1	0.0	0.2	0.0	0.2	0.0
Control	0.2	0.2	0.2	0.4	1.0	0.0	2.6	0.2

Table 10. Phytotoxicity Evaluation: Average Of All Varieties.

Treatment	% Fruit Marking Following Application							
	1st Cover Evaluated 5/29/90				Midsummer Evaluated 8/2/90			
	None	Slight	Moderate	Heavy	None	Slight	Moderate	Heavy
1% Ultra Fine Spray Oil	74.4	21.4	3.6	0.6	97.7	2.3	0.0	0.0
2% Safer Insecticide Concentrate	56.5	27.4	14.9	1.1	26.9	43.4	20.1	0.6
2% Safer Insecticide Concentrate + Ultra Fine Spray Oil	66.9	20.6	10.9	1.6	33.7	54.9	11.4	0.0
Agrimek (20 oz/ac rate) + .25% Ultra Fine Spray Oil	70.8	21.7	6.9	0.6	98.9	1.1	0.0	0.0
Control	100.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0

Table 11. Phytotoxicity Evaluation: Seckel Pear.

Treatment	% Fruit Marking Following Application							
	1st Cover Evaluated 5/29/90				Midsummer Evaluated 8/2/90			
	None	Slight	Moderate	Heavy	None	Slight	Moderate	Heavy
1% Ultra Fine Spray Oil	44.0	52.0	4.0	0.0	96.0	4.0	0.0	0.0
2% Safer Insecticide Concentrate	16.0	72.0	12.0	0.0	40.0	28.0	32.0	0.0
2% Safer Insecticide Concentrate + Ultra Fine Spray Oil	36.0	48.0	16.0	0.0	28.0	72.0	0.0	0.0
Agrimek (20 oz/ac rate) + .25% Ultra Fine Spray Oil	20.0	72.0	8.0	0.0	92.0	8.0	0.0	0.0
Control	100.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0

Table 12. Phytotoxicity Evaluation: Comice Pear.

Treatment	% Fruit Marking Following Application							
	1st Cover Evaluated 5/29/90				Midsummer Evaluated 8/2/90			
	None	Slight	Moderate	Heavy	None	Slight	Moderate	Heavy
1% Ultra Fine Spray Oil	100.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0
2% Safer Insecticide Concentrate	88.0	12.0	0.0	0.0	16.0	44.0	36.0	4.0
2% Safer Insecticide Concentrate + Ultra Fine Spray Oil	76.0	20.0	4.0	0.0	4.0	96.0	0.0	0.0
Agrimek (20 oz/ac rate) + .25% Ultra Fine Spray Oil	88.0	12.0	0.0	0.0	100.0	0.0	0.0	0.0
Control	100.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0

Table 13. Phytotoxicity Evaluation: Bosc Pear.

Treatment	% Fruit Marking Following Application							
	1st Cover Evaluated 5/29/90				Midsummer Evaluated 8/2/90			
	None	Slight	Moderate	Heavy	None	Slight	Moderate	Heavy
1% Ultra Fine Spray Oil	20.0	68.0	8.0	4.0	100.0	0.0	0.0	0.0
2% Safer Insecticide Concentrate	0.0	48.0	44.0	8.0	8.0	56.0	36.0	0.0
2% Safer Insecticide Concentrate + Ultra Fine Spray Oil	8.0	32.0	48.0	12.0	20.0	76.0	4.0	0.0
Agrimek (20 oz/ac rate) + .25% Ultra Fine Spray Oil	8.0	48.0	40.0	4.0	100.0	0.0	0.0	0.0
Control	100.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0

Table 14. Phytotoxicity Evaluation: Green Bartlett Pear.

Treatment	% Fruit Marking Following Application							
	1st Cover Evaluated 5/29/90				Midsummer Evaluated 8/2/90			
	None	Slight	Moderate	Heavy	None	Slight	Moderate	Heavy
1% Ultra Fine Spray Oil	88.0	12.0	0.0	0.0	88.0	12.0	0.0	0.0
2% Safer Insecticide Concentrate	32.0	32.0	36.0	0.0	0.0	68.0	32.0	0.0
2% Safer Insecticide Concentrate + Ultra Fine Spray Oil	8.0	32.0	48.0	12.0	20.0	76.0	4.0	0.0
Agrimek (20 oz/ac rate) +								
.25% Ultra Fine Spray Oil	96.0	4.0	0.0	0.0	100.0	0.0	0.0	0.0
Control	100.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0

Table 15. Phytotoxicity Evaluation: Red Comice Pear.

Treatment	% Fruit Marking Following Application							
	1st Cover Evaluated 5/29/90				Midsummer Evaluated 8/2/90			
	None	Slight	Moderate	Heavy	None	Slight	Moderate	Heavy
1% Ultra Fine Spray Oil	81.0	6.0	13.0	0.0	100.0	0.0	0.0	0.0
2% Safer Insecticide Concentrate	100.0	0.0	0.0	0.0	16.0	20.0	64.0	0.0
2% Safer Insecticide Concentrate + Ultra Fine Spray Oil	92.0	8.0	0.0	0.0	44.0	36.0	20.0	0.0
Agrimek (20 oz/ac rate) +								
.25% Ultra Fine Spray Oil	88.0	12.0	0.0	0.0	100.0	0.0	0.0	0.0
Control	100.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0

Table 16. Phytotoxicity Evaluation: Red Bartlett Pear.

Treatment	% Fruit Marking Following Application							
	1st Cover Evaluated 5/29/90				Midsummer Evaluated 8/2/90			
	None	Slight	Moderate	Heavy	None	Slight	Moderate	Heavy
1% Ultra Fine Spray Oil	88.0	12.0	0.0	0.0	100.0	0.0	0.0	0.0
2% Safer Insecticide Concentrate	96.0	4.0	0.0	0.0	96.0	20.0	4.0	0.0
2% Safer Insecticide Concentrate + Ultra Fine Spray Oil	88.0	12.0	0.0	0.0	92.0	36.0	8.0	0.0
Agrimek (20 oz/ac rate) +								
.25% Ultra Fine Spray Oil	96.0	4.0	0.0	0.0	100.0	0.0	0.0	0.0
Control	100.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0

Table 17. Phytotoxicity Evaluation: Cascade Pear.

Treatment	% Fruit Marking Following Application							
	1st Cover Evaluated 5/29/90				Midsummer Evaluated 8/2/90			
	None	Slight	Moderate	Heavy	None	Slight	Moderate	Heavy
1% Ultra Fine Spray Oil	100.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0
2% Safer Insecticide Concentrate	64.0	24.0	12.0	0.0	28.0	20.0	52.0	0.0
2% Safer Insecticide Concentrate + Ultra Fine Spray Oil	100.0	0.0	0.0	0.0	12.0	84.0	4.0	0.0
Agrimek (20 oz/ac rate) +								
.25% Ultra Fine Spray Oil	100.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0
Control	100.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0