OREGON STATE UNIVERSITY
Southern Oregon Experiment Station

ANNUAL REPORT IN ENTOMOLOGY 1991

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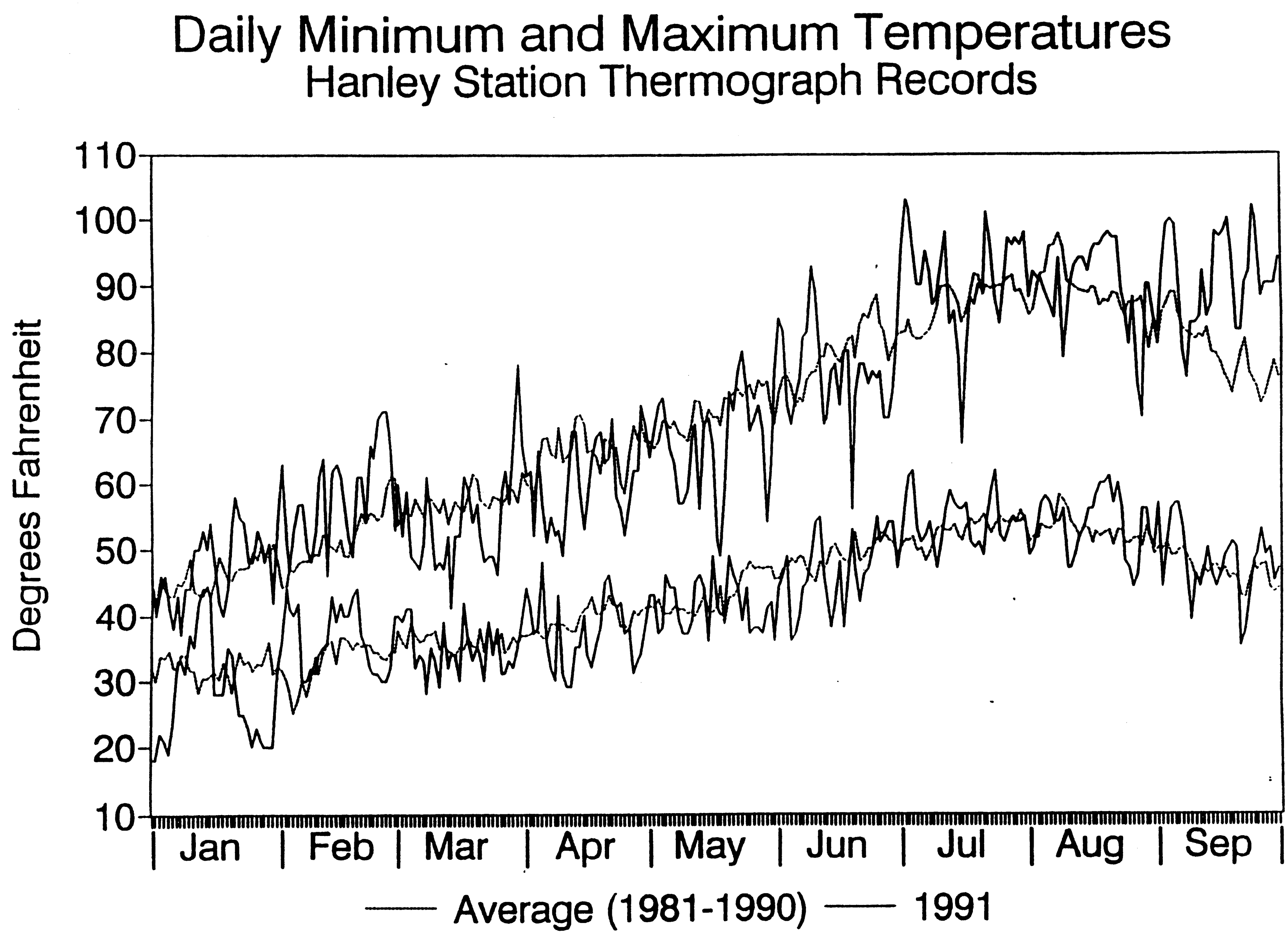
ROGUE VALLEY TEMPERATURES AND PRECIPITAION 1991

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

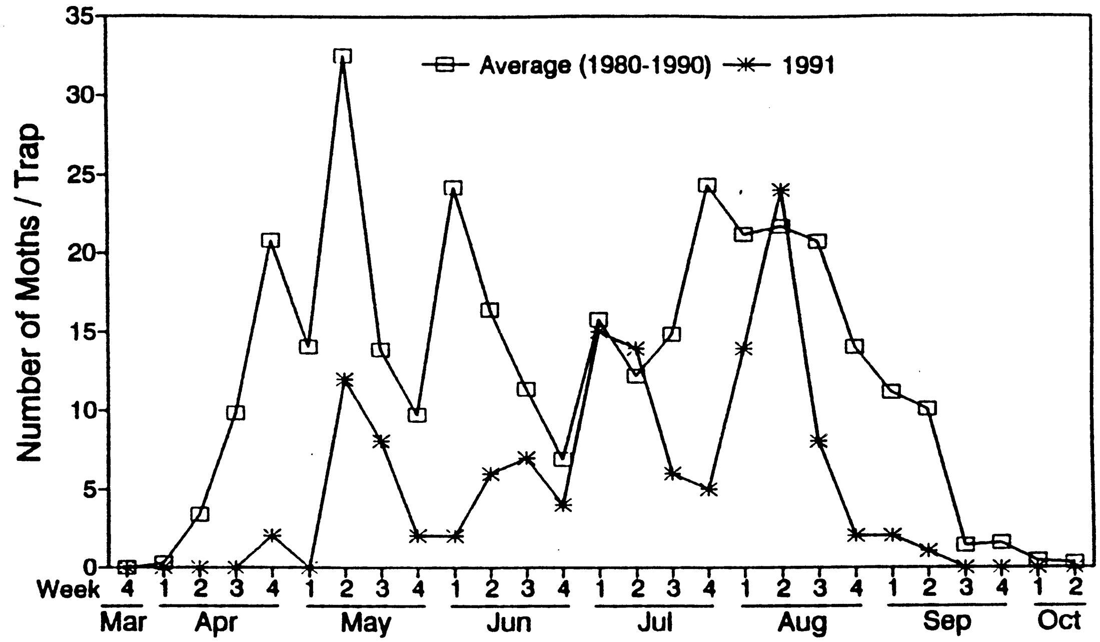
DATE	JANUARY MIN	JANUARY MAX	JANUARY PRECIP	FEBRUARY MIN	FEBRUARY MAX	FEBRUARY PRECIP	MARCH MIN	MARCH MAX	MARCH PRECIP
1	18	44		36	63		40	60	0.12
2	18	40		44	51	0.41	39	52	0.01
3	22	44		41	47	0.22	41	59	1.42
4	21	46		40	53	0.07	41	49	0.15
5	19	41		42	57	0.48	32	48	0.72
6	24	38		30	57	0.02	34	47	0.01
7	33	43	0.26	30	50	0.01	33	51	0.10
8	33	37	0.07	32	48	0.01	28	61	
9	31	44	T	31	53	0.01	35	55	
10	37	44	NA	34	61	T	33	47	0.22
11	35	50	NA	35	64		29	48	0.02
12	42	50	0.44	36	46		39	47	0.01
13	44	53	0.33	43	62	0.27	32	52	0.07
14	44	50	0.04	39	63	0.01	34	41	T
15	43	54	0.02	42	61	T	34	52	0.15
16	28	48		40	57	0.44	30	52	T
17	28	42		40	52	T	42	61	
18	28	40		43	49	0.05	36	59	
19	35	44	0.20	44	61	0.04	33	54	T
20	34	54	T	37	61		35	57	
21	30	58		35	54		34	52	0.01
22	25	55		32	66		30	48	0.07
23	25	54		31	64		39	49	0.12
24	23	48		31	70		34	49	0.04
25	20	48		30	71		38	46	0.03
26	23	53		30	71		31	59	0.12
27	21	51		32	65		31	62	T
28	20	48		40	53		33	57	
29	20	51					32	67	
30	20	42					35	78	
31	32	55					39	66	
Total			1.36			2.04			3.39
Average	28	47		36	58		35	54	

DATE	APRIL MIN	APRIL MAX	APRIL PRECIP	MAY MIN	MAY MAX	MAY PRECIP	JUNE MIN	JUNE MAX	JUNE PRECIP
1	44	61		43	64	0.12	44	85	
2	41	62		43	68	T	46	83	
3	37	52		37	72		49	72	
4	38	65	0.01	38	73		36	69	
5	48	57		46	70		37	73	
6	36	51	0.33	44	65		40	76	
7	32	55	0.03	44	63	0.03	44	82	
8	30	52		39	57	0.07	45	83	
9	43	53	0.19	37	57	0.13	49	93	
10	31	49	0.10	37	59	0.01	54	89	
11	29	58	0.02	39	67		55	79	
12	29	68		45	69		46	69	
13	35	68		46	56	0.40	43	70	
14	35	59		44	69	0.19	38	77	
15	40	53	0.27	36	70	T	42	78	
16	34	57	0.07	49	66	0.24	48	72	
17	32	64	T	41	51	1.34	38	80	
18	35	67		40	49	0.16	46	80	
19	38	68		40	58	0.01	53	56	0.23
20	45	63		49	74	T	47	73	0.34
21	46	64	0.52	46	71		42	78	T
22	43	70	0.01	44	77		46	78	NA
23	41	58	0.12	39	80		47	75	
24	42	56	0.18	44	74		50	77	
25	37	52	0.07	37	68		55	76	
26	38	57	0.10	38	70		51	77	
27	31	62	0.05	38	72		52	70	0.01
28	33	62	T	37	68		54	70	0.07
29	34	72		41	54		54	74	0.03
30	38	69		42	63	0.14	47	83	NA
31				36	77	T			
Total			2.07			2.84			0.68
Average	37	60		41	66		47	77	

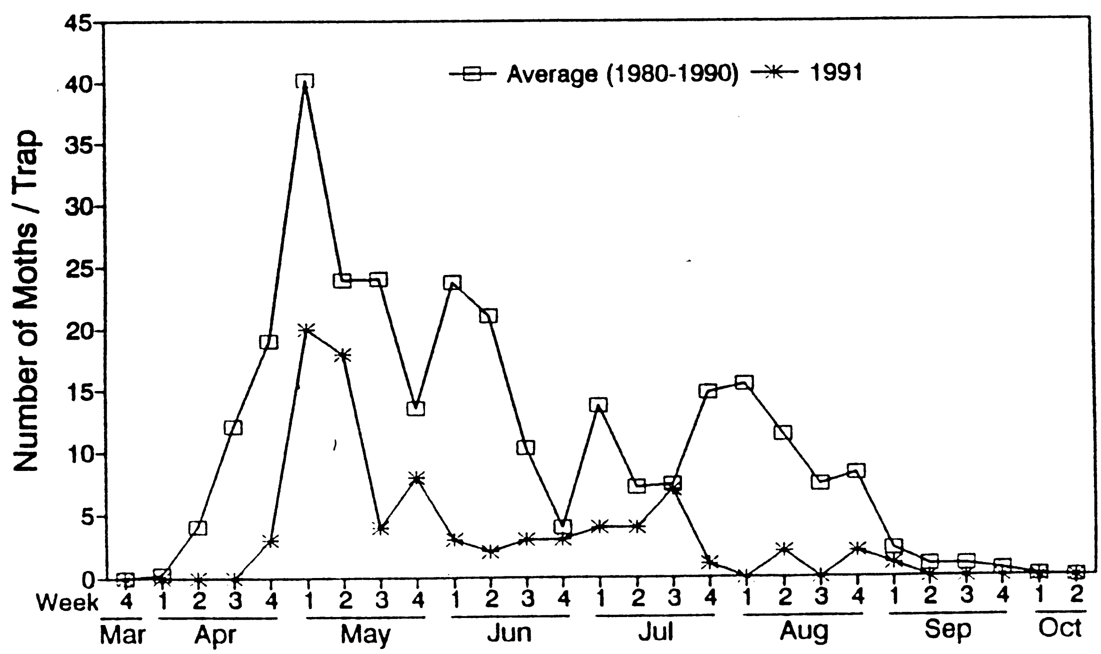
DATE	JULY MIN	JULY MAX	JULY PRECIP	AUGUST MIN	AUGUST MAX	AUGUST PRECIP	SEPTEMBER MIN	SEPTEMBER MAX	SEPTEMBER PRECIP
1	51	95		49	88		57	83	
2	58	103		50	92		44	92	
3	61	102		54	91		51	99	
4	62	96		57	91		56	100	
5	53	90		58	89		57	99	
6	51	90		57	87	T	57	93	
7	52	95		54	85		53	80	
8	54	92		54	94		46	76	
9	51	87		56	79		39	84	
10	47	88		47	86		46	84	
11	51	93		47	90		44	85	
12	56	98		49	93		46	92	
13	59	84		52	94		50	85	
14	57	86	0.05	53	94		46	87	
15	56	79		56	92		44	98	
16	56	66	0.83	56	95		46	97	
17	57	79	0.32	58	96		49	98	
18	51	88		60	96		50	100	
19	50	87		60	97		51	95	
20	51	90		61	98		50	83	
21	49	89		57	97	0.27	35	83	
22	54	101		60	97		37	90	
23	59	96	0.25	56	89		43	92	
24	62	88	0.01	48	87		48	102	
25	52	84		47	81		49	100	
26	51	90		44	88		53	88	
27	53	97		46	75		49	90	
28	55	96		56	70	0.01	50	90	
29	54	97		56	90		45	90	
30	54	96		52	90		47	94	
31	55	98		50	85				
Total			1.46			0.28			0.00
Average	54	91		54	90		48	91	


Daily Minimum and Maximum Temperatures
Hanley Station Thermograph Records
Degrees Fahrenheit
110
100
90
80
70
60
50
40
30
20
10
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Average (1981-1990)
1991

Codling Moth Pheromone Trap Catch
Hanley Station



Codling Moth Pheromone Trap Catch
Medford Station



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
1991	4/21	4/19

*earliest date
**latest date

Codling Moth. Resistance Monitoring (Table 1).

Limited testing for codling moth tolerance to azinphosmethyl (Guthion) and to esfenvalerate (Asana) was conducted in two southern Oregon pear orchards during 1991. Both sites (Medford-Budge and Hanley) had previously been surveyed for codling moth tolerance to Guthion in 1987 with LC_{50}s at that time being 0.076 micrograms/microliter/moth using the within pheromone trap method described by Riedl.

Levels of Guthion tolerance found at both sites in 1991 were about 300ppm or an increase of about 4-fold from the 1987 values. Slopes of the OP dosage-mortality line, however, remained constant at about 2.4 indicating little change in homogeneity of the population. The LD_{50} of Asana recorded at the Hanley site in 1991 was 12.6ppm with a slope of 5.6. At the Medford-Budge site a diagnostic dosage of 10ppm resulted in 51% mortality indicating similar levels of Asana tolerance at both locations. Field failure of both Guthion and Asana has been observed over the past 2 years at the Medford-Budge site but may, in part, be due to high moth pressure and/or poor spray timing and coverage.

Table 1. Laboratory bioasssays of codling moth adults from two southern Oregon pear orchards using Guthion and Asana.

Year	Chemical	Orchard Site	Bioassay Type	LD_{50} or % mortality using diagnostic dose
1987	Guthion	Medford-Budge	LD_{50}	76 ppm
		Hanley	LD_{50}	76 ppm
1991	Guthion	Medford-Budge	LD_{50}	320 ppm
		Hanley	diagnostic dose	51% at 300 ppm
1991	Asana	Medford-Budge	diagnostic dose	51% at 10 ppm
		Hanley	LD_{50}	12.6 ppm

Pheromone Confusion Study -- 1991 Annual Report
Southern Oregon Experiment Station, Medford Ore.

This was the third consecutive year that Biocontrol Ltd. pheromone dispensers were used in a codling moth (CM) control study in the Rogue Valley. Due to failure of the dispensers to adequately control CM damage in 1990, a new site was found for the 1991 study. Dispensers were applied at the standard rate of 400 per acre and also at a 2x rate of 800 dispensers per acre.

Methods

Plot Layout -- The orchard where the study was conducted is a 28 ac. mixed block of Red Anjou and Red Bartlett pears. The block was in 5th leaf, 212 trees/ac. and had no history of CM infestation. The study area consisted of 40 rows running north to south. The two varieties alternate every four rows. The block is divided into six equal sections (4.5 ac. each) by tractor drives running east-west (see figure 1). A large block of Granny Smith apples is located approximately 150 yds. to the west and some unsprayed apple trees are located to the northeast of the study block. Two of the six sections were treated with the Biocontrol Ltd. dispensers. Section 3 received the 400 dispenser rate while section 5 had the 800 dispenser rate. The other four sections were treated with the grower's standard organophosphate CM control program.

Pheromone Traps -- In each section pheromone traps with both 1 mg. and 10 mg. dosed lures were hung. The differentially dosed lures were obtained from Dr. Welter at U.C. Berkeley. In the pheromone treated sections two 1 mg. and two 10 mg. traps were placed ten rows apart through the middle of the section. One each of the 1 mg. and 10 mg. traps were placed in each of the standard treated sections. Those traps were also placed ten rows apart in the middle of the section. The traps within each section were rotated every other week and the lures were replaced every four weeks. Four other pheromone traps baited with standard Trece lures were placed along the edge of the study area. Three traps were set in a young Bosc pear block located directly west of the study area, opposite a large block of Granny Smith apples. Another trap was placed in the NE corner of the plot. These traps were placed to measure potential CM immigration from probable source areas.

Dimilin Treatment -- After two moths were caught in a pheromone treated area during mid-summer, a treatment of Dimilin was applied at third cover timing to the eastern half (2.25 ac.) of each pheromone plot. The Dimilin was applied by a commercial air-blast sprayed at a rate of 1 lb. per acre.

Fruit Evaluation -- At harvest, both Red Bartlett and Red Anjou fruit were randomly selected and examined for CM eggs, stings, and entries. Separate harvest samples were taken from the Dimilin and non-Dimilin treated portions of the pheromone blocks. In the case of the Red Bartletts, the calyx end of the fruit was removed to facilitate examination of the calyx interior. In addition to the harvest sample numerous walk-throughs were conducted during the season looking for CM entries while the fruit was on the tree.

Results

Pheromone Traps -- With the exception of the border traps, trap catches were very low (table 1). In the standard organophosphate treated blocks the four 10 mg. dosed traps caught only 9 moths compared to 6 moths in the 1 mg. dosed traps. In the pheromone treated blocks, no moths were caught in the 800 dispenser per acre plot while all 3 of the moths caught in the 400 dispenser per acre plot were in 10 mg. dosed traps.

Fruit Evaluation -- No CM activity was seen in any of the plots. Neither in the walk-throughs nor the harvest samples were any CM eggs, stings, or entries observed.

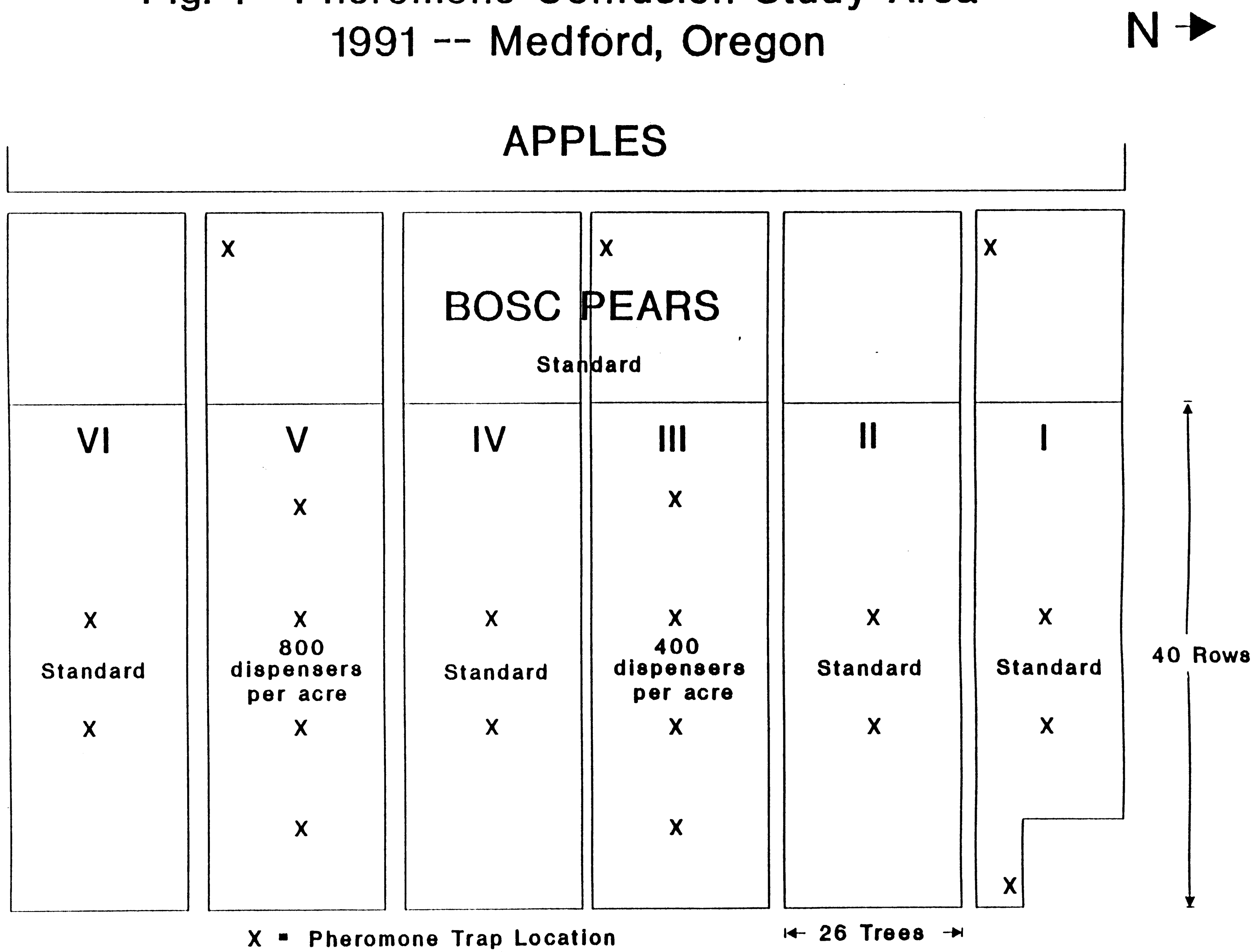
Conclusion

As this study was conducted in a young orchard with relatively low crop load and no history of CM infestation, CM pressure was expected to be minimal. This was confirmed by the low trap catch and absence of any observed CM activity in the orchard. CM flight activity was primarily restricted to the plot borders where approximately 20 moths per trap were caught over the season. The trap catch information indicates that baiting pheromone traps with 10 mg. lures increases trap sensitivity in a pheromone treated area. However, it should be noted that no moths were caught in the area treated with 800 dispensers per acre regardless of lure dosage.

Table 1. Pheromone Trap Summary

Treatment and Trap Location	Lure Type	# Traps	Seasonal CM Catch
<u>Standard Program</u>			
(Sections I, II, IV and VI combined)	1 mg.	4	6
	10 mg.	4	9
Plot Border	Trece	4	81
<u>Pheromone Treated</u>			
800 dispensers per acre (Section V)	1 mg.	2	0
	10 mg.	2	0
400 dispensers per acre (Section III)	1 mg.	2	0
	10 mg.	2	3

Fig. 1 Pheromone Confusion Study Area
1991 -- Medford, Oregon



Codling Moth: Pear Cultivar Tolerance to Larval Entry

Previous studies with a limited number of pear varieties have shown that some pear cultivars exhibit a tolerance to entry by the 1st codling moth larval instar. This tolerance varies from one variety to another and with the growth stage of the fruit. The purpose of this study was to evaluate some of the newer pear varieties for their susceptibility to codling moth as measured in laboratory tests.

The pear fruits selected for this study were as follows:

A. *Pyrus pyrifolia* (Asian Pears) selections.
   1) Twentieth Century (Nijissiki)

B. *Pyrus communis* (European Pears) selections.
   1) Red Bartlett (a sport of green Bartlett)
   2) Cascade (a cross between Comice and Bartlett)
   3) Red Clapps (Starkrimson, a sport of Clapps Favorite)
   4) Red Anjou (Gebhart sport of Green Anjou)
   5) Worden Seckel (a seedling of Seckel)
   6) Rogue Red (a cross between Seckel and Comice)

Fruit of the above cultivars were collected from a *Pyrus* species and variety collection located at the Hanley Farm of Southern Oregon Experiment Station. The block was left untreated for codling moth during the test period. On June 6 and July 8 fruit were selected from each of the above varieties, washed in tap water and examined for presence of codling moth. Any fruit found with codling moth eggs or larval entries was discarded. A total of 24 fruit/variety was used at each time period. Fruit was placed in egg cartons and a single mature codling moth egg affixed to each fruit. Cartons were placed in temperature cabinets set at 70^{o}F for 48 hrs., then examined for number and location of larval entry or surface scaring.

The preliminary results are presented in Table 1. Based upon past experimental trials the degree of susceptibility can be based on ability of larvae to enter through the side of the fruit (high susceptibility), through the calyx or stem (moderate susceptibility), restricted to surface fruit feeding (low susceptibility) or no damage (tolerant). Ranked on this basis (Table 2) the most tolerant varieties tested were Worden Seckel, Rogue Red and Red Clapps in test 1 and in test 2, Cascade, Seckel and Rogue Red. The most susceptible cultivar appeared to be the Asian pear Twentieth Century. It was also apparent that there was a major shift toward higher resistance to larval entry between the first and second tests as overall average side entries were 24.1% in test 1 compared to only 4.4% in test 2. These latter results are similar to those obtained previously with the green Anjou, Comice, and green Bartlett obtained over similar time intervals.

These results would indicate that chemicals programs now used for the codling moth can be modified based on susceptibility of individual pear cultivars at various time intervals.

Table 1. Codling moth infestation on 7 pear varieties under laboratory conditions. Medford OR. 1991.

Pear Variety	Date	% entries Side	Stemor Calyx	Total	% Surface feeding stings	% Clean
			June 8			
Nijissiki		37.5	54.2	91.7	0.0	8.3
Red Bartlett		34.8	34.8	69.6	4.3	26.1
Cascade		41.7	41.7	83.4	0.0	16.6
Red Clapps		12.5	25.0	37.5	4.2	58.3
Worden Seckel		4.5	68.2	72.7	9.1	18.2
Red Anjou		29.2	41.7	70.9	4.2	25.0
Rogue Red		8.3	50.0	58.3	33.3	8.3
Average		24.1	44.7	68.7	7.9	23.0
			July 10			
Nijissiki		9.1	90.0	100.0	0.0	0.0
Red Bartlett		8.7	34.8	43.5	8.7	47.8
Cascade		0.0	58.3	58.3	8.3	33.3
Red Clapps		8.3	41.7	50.0	37.5	12.5
Worden Seckel		0.0	13.6	13.6	27.3	59.1
Red Anjou		4.5	40.9	45.4	40.9	13.6
Rogue Red		0.0	12.5	12.5	0.0	87.5
Average		4.4	41.8	46.2	17.5	36.3

Table 2. Relative susceptibility of 7 pear cultivars during 2 time periods. Laboratory studies, 1991. Larger numbers are ranked more susceptible.

Pear Variety	Relative susceptibility No. Fruit with Side entry x 5, Caylx x 3, Surface x 1	
	Test period 1 (June 8)	Test period 2 (July 10)
Nijissiki	84.0	76.4
Cascade	80.0	44.0
Red Bartlett	67.8	37.6
Red Anjou	66.0	53.4
Worden Seckel	56.7	20.7
Rogue Red	54.0	12.0
Red Clapp	34.0	45.0
Average	63.2	41.3

Codling Moth. Chemical Control. (Table 1)

Data obtained from codling moth bioassays have indicated an increased tolerance to some registered synthetic chemicals such as Guthion. In California, resistance to this compound has been linked to cross resistance of a broad nature involving many chemical groups. In 1991 we established a codling moth trial within an orchard site that, according to bioassays, contained codling moth exhibiting a 3-fold level of tolerance to Guthion. The purposes of this plot were to: (1) compare field effectiveness of various Organo-Phosphate chemicals and different rates of the pyrethroid Asana; (2) evaluate Asana-B.t.tank mixes for synergistic effect on CM, and (3) evaluate non-conventional programs including B.t. and horticultural spray oils in a 3 or 6 spray-timing schedule.

The trial was conducted in a 1.5 acre block of 30 year old Bartlett pear trees. Spray applications were made to 4 single tree replicates and treated to runoff with conventional high pressure handgun equipment. Timing of application for the 3 spray programs were as follows: 1st; biofix plus 250 degree days; 2nd, 28-30 days following the 1st, and 3rd about 250 degree days following biofix of 2nd generation. Chemical treatments applied 6 times used the above schedule plus an additional application approximately 100 degree days following each of the conventional timings. Evaluation of CM damage was made following predicted egg hatch of the first generation (July 22) and at harvest (August 26). At both times 50 fruit/replicate, 200/treatment, were examined for side or calyx larval entries. Population densities of the twospotted spider mite (TSM) and the pear psylla (PP) were evaluated on 2 occasions, July 11 for PP and August 12 for the TSM by selecting 20 leaves/rep from each treatment.

Results. 1. Conventional program comparison. The 3 OP chemicals tested, Guthion, Imidan and Lorsban, all provided about equivalent control of the CM as recorded at the end of 1st generation and at harvest (Table 1). The infestation recorded in these treatments ranged from 1.5-2.5% was somewhat higher than expected based on similar studies conducted in previous years. Control obtained with Asana was excellent using either the 0.01 or the 0.03 lb rates but decreased in effectiveness when used below label rates (0.0025 and 0.005 lbs ai). Both Guthion and Imidan appeared to stimulate populations of the twospotted spider mite while the higher dosages of Asana provided excellent control (Table 2). Similarly, the 3 higher Asana rates provided good pear psylla suppression (Table 2)

2. Asana-B.t. combinations. There was no significant

difference in CM infestation between treatments containing the low rates of Asana, 0.0025 and 0.005, used alone and these Asana rates used in combination with 0.75 lb formulated Javelin (Table 1). Thus we could not detect any synergistic effect of this combination as has been reported with some other lepidopterous pests.

3. Non-conventional programs. In this trial we evaluated Javelin B.t. and MVP B.t. in a 3 vs. 6 spray program for CM as well as the horticultural spray oil Orchex 796 in a 3 and 6 application schedule. Evaluation on July 22, after the 1st CM generation, indicated excellent control with both Javelin or Orchex 796 following either the 2 or 4 sprays that had been applied at that time. At harvest on August 26 codling moth infestation averaged over 20% in both Javelin treatments, and 8%, and 2% in the 3 and 6 oil treatments respectively. Basically no codling moth suppression was measured in plots receiving the MVP B.t. treatments (Table 1). Application of either 3 or 6 Orchex oil sprays also resulted in excellent control of the pear psylla and the twospotted spider mite (Table 2) and no phytotoxicity was observed in these multiple oil plots. Surprisingly, both Javelin and MVP used in the 6 spray program significantly lowered pear psylla densities as measured on July 11 after the first 4 applications (Table 2).

Table 1. Control of the codling moth with conventional and modified treatment programs. Bartlett variety.

Material and rate ai/100	No Applications [1/]	% Codling Moth 1st Generation 7/22	Infested Fruit Harvest 8/26
Imidan 50W 0.25 lb	3	0.0 a	2.5 abc
Guthion 50W 0.125 lb	3	0.0 a	2.5 ab
Lorsban 50W 0.375 lb	3	0.6 a	1.5 ab
Asana 0.66 EC 0.0025 lb	3	0.0 a	5.0 bc
Asana 0.66 EC 0.005 lb	3	0.0 a	1.5 ab
Asana 0.66 EC 0.01 lb	3	0.6 a	0.0 a
Asana 0.66 0.03 lb	3	0.0 a	0.0 a
Asana 0.66 EC 0.0025 lb plus Javelin B.t. 0.75 lb Form.	3	0.0 a	6.0 bc
Asana 0.66 EC 0.005 lb plus Javelin B.t. 0.75 lb Form.	3	0.0 a	2.3 abc
Javelin B.t. o.75 lb Form.	3	1.2 a	23.5 de
Javelin B.t. o.75 lb Form.	6	1.2 a	20.0 d
MVP B.t. 1 pt Form.	3	10.6 b	37.0 f
MVP B.t. 1 pt Form.	6	7.5 b	32.0 ef
Orchex 796 oil 1 gal	3	1.3 a	8.0 c
Orchex 796 oil 1 gal	6	0.0 a	2.0 ab
Untreated		6.3 b	47.0 f

[1/] 3 treatments 5/29, 6/26, 7/30
6 treatments 5/29, 6/10, 6/26, 7/3, 7/30, 8/5

Table 2. Pear psylla (PP) and twospotted spider mite (TSM) densities recorded in codling moth control programs.

Material and rate ai/100	No Applications	PP e+n/leaf 7/11	TSM/leaf 8/12
Imidan 50W 0.25 lb	3	5.4 cde	36.1 f
Guthion 50W 0.125 lb	3	4.9 cde	25.4 ef
Lorsban 50W 0.375 lb	3	9.2 e	7.9 bcd
Asana 0.66 EC 0.0025 lb	3	9.6 e	10.9 de
Asana 0.66 EC 0.005 lb	3	3.7 abcd	8.3 bcd
Asana 0.66 EC 0.01 lb	3	2.0 abc	1.5 abc
Asana 0.66 0.03 lb	3	1.1 a	0.5 a
Asana 0.66 EC 0.0025 lb plus Javelin B.t. 0.75 lb Form.	3	4.3 bcd	7.9 bcd
Asana 0.66 EC 0.005 lb plus Javelin B.t. 0.75 lb Form.	3	4.6 bcd	5.2 abcd
Javelin B.t. o.75 lb Form.	3	5.0 cde	9.1 bcd
Javelin B.t. o.75 lb Form.	6	2.7 abc	14.0 de
MVP B.t. 1 pt Form.	3	6.4 de	7.9 bcd
MVP B.t. 1 pt Form.	6	1.7 ab	9.9 de
Orchex 796 oil 1 gal	3	1.1 a	1.4 ab
Orchex 796 oil 1 gal	6	1.4 ab	0.4 a
Untreated		8.1 de	8.4 cd

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		1990	1991
Orchard	FD	WD	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	14.5	14.1
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	16.7	18.8
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	0.0	1.3	3.3	1.4	43.0	2.1
Hillcrest	10.2	2.3	23.7	4.5	28.2	0.0	1.7	5.5	4.6	2.9	7.3	0.9	19.7	3.7	11.0	1.5	20.3	4.9
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	7.5	1.7
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	25.1	12.9
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	3.9	13.5
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	3.6	3.1
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	5.7	3.1
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	283.0	3.9
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	64.9	8.3
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	40.9	7.9

PEAR PSYLLA: TOLERANCE TO PREBLOOM PYRETHROIDS 1991 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 1991 treatments were applied to field collected adults on 31 January using the slide-dip techniques. The bioassay results (Table 1) indicate that psylla populations in southern Oregon have not a yet developed resistance to this compound. Also, generally good control was obtained in commercial orchards following delayed dormant pyrethroid application.

Table 1. Adjusted mortality of winterform pear psylla adults following fenvalerate treatment in laboratory slide-dip bioassays. Mean 1988-1990 and 1991. Southern Oregon.

Orchard		Treatment period	Equivalent rate fenvalerate (lb. ai/acre) 0.1	0.2
Bishop	$\bar{X}$	1988-1990	94.5	99.0
		1991	100.0	97.2
Hanley	$\bar{X}$	1988-1990	98.0	99.0
		1991	99.0	100.0
Medford	$\bar{X}$	1988-1990	96.0	97.0
		1991	99.0	99.0
Phipps	$\bar{X}$	1988-1990	96.0	100.0
		1991	98.3	100.0
Antelope	$\bar{X}$	1988-1990	96.0	98.0
		1991	100.0	100.0
Grants Pass	$\bar{X}$	1988-1990	98.0	99.0
		1991	100.0	99.0

Pear Psylla: Effect of Deleting Pyrethroids from the Prebloom Program on Four Pear Cultivars.

The objective of this study was to evaluate the potential for deleting synthetic pyrethroids from the prebloom program on various pear cultivars while maintaining acceptable fruit quality. The pyrethroid pesticides are used to suppress adult densities of over-wintering pear psylla, the nymphs of which secrete a fruit-marking substance called honeydew. Past trials have indicated that the severity of early season psylla damage is dependent upon psylla density and pear variety. In this test we evaluated four pear cultivars for their sensitivity to honeydew damage following a non-pyrethroid prebloom program.

A 1.1 acre block of mixed pear varieties located at the Medford Field Station of Southern Oregon Experiment Station was used in this study. The study area was divided in half with one side treated and the other left unsprayed in the prebloom period. The spray program consisted of a dormant spray of horticultural spray oil and a delayed dormant application of oil in combination with sulfur. The pyrethroid chemical normally combined with the latter treatment was deleted. In each the treated and non-treated portions of the plot five single tree replicates of each of four pear varieties were selected for sampling. Cultivars selected were Anjou, Comice, Seckel and Bosc. Estimates of pear psylla densities were made at two time intervals, petal fall (May 6) and on May 6 prior to the first folial spray for codling moth. Sampling of psylla immatures was conducted by selecting 20 fruit cluster leaves/rep/variety and recording the number of nymphal stages. The entire plot was treated on May 15 with Mitac to eliminate pear psylla and additional sprays were applied when needed to minimize any further psylla damage. Evaluation of pear psylla induced fruit damage was made at harvest on August 13. At this time the fruit was graded as to percent of the surface injured by honeydew marking and placed into the standard catagories of number 1, number 2 (fancy) and culls.

The results from this trial are given in Table 1. Densities of pear psylla nymphs averaged 0.3 and 15.0/ leaf on April 16 in the treated and untreated sections of the plot respectively, or a 98% reduction in the treated portion. By May 16 nymphal densities had increased to an average of 5.4 in the treated and 38.8 in the untreated or about a 86% reduction resulting from the prebloom program. Density of nymphs was lowest on the Bosc and Comice cultivars on both dates probably reflecting their delayed bud development compared to that of the Anjou and Seckel varieties. Fruit damage at harvest in the portion of the plot receiving the prebloom program averaged 0.4% on the Anjou and Comice varieties and 0 on the Seckel and Bosc. In the untreated portion the % fruit downgrading averaged 5.2, 0.8, 11.2 and 1.6% on the Anjou, Bosc, Comice and Seckel cultivars respectively. It would appear that use of the dormant oil followed by the sulfur-oil delayed dormant program may provide sufficient protection from psylla injury to justify deletion of the prebloom pyrethroid especially on the more tolerant pear cultivars such as Bosc and Seckel.

Table 1. Deletion of prebloom pyrethroids for pear psylla suppression: Effects on quality of 4 pear cultivars.

Plot	Chemical Timing	Program Material	Pear Variety	# PearPsylla Nymphs/Cluster 4/16	5/6	% Fruit Downgraded 8/13
I*	Dormant	Spray oil 4 gal/A	Anjou	0.7	7.5	0.4
			Bosc	0.0	2.8	0.0
	Delayed Dormant	Spray oil 4/gal/A Orthorix 2.5 gal/A	Comice	0.2	3.8	0.4
			Seckel	0.3	7.3	0.0
			Average	0.3	5.4	
II	Dormant	No Spray	Anjou	20.5	38.6	5.2
	Delayed Dormant	No Spray	Bosc	8.0	32.6	0.8
			Comice	13.4	31.8	11.2
			Seckel	17.9	52.2	1.6
			Average	15.0	38.8	

* plots treated with Mitac on 5/15

Mortality of Winterform Pear Psylla Comparing Asana and Pydrin in Laboratory Slide-dip Tests.

Monitoring of winterform pear psylla adults to detect possible elevation in tolerance to pyrethroid chemicals has been conducted for several years using fenvalerate as the standard material. However, fenvalerate (Pydrin) has been discontinued for use in commercial orchards with esfenvalerate (Asana) substituted for adult suppression. In order to continue our monitoring program using Asana in place of Pydrin we compared the two materials in slide-dip bioassays. The LC_{50} values obtained were 0.018 and 0.0069 lb ai/100 gal for Pydrin and Asana respectively (Table 1) or about a 3 fold differential between the two compounds. Slope of the dosage-mortality lines were similar with both chemicals (Table 1).

Table 1. Bioassays of winterform pear psylla using esfenvalerate (Asana). Treated 3/7/91.

Material and equivalent rate ai/100 gal.		No.	No. dead	% mortality	LC_{50} (slope)
Pydrin	check	53	4	7.5	
	0.025	105	65	61.9	
	0.50	104	95	91.3	
	0.10	104	101	97.1	
	0.20	108	106	98.1	
					0.018 (2.4)
Asana	check	53	3	5.7	
	0.00625	106	52	49.1	
	0.0125	108	80	74.1	
	0.025	104	97	93.3	
	0.05	107	105	98.1	
					0.0069 (2.5)

Prebloom Control of Pear Psylla with Thiodan, Danitol and Asana

A comparison of chemicals used for prebloom suppression of winterform pear psylla was made using commercial, air-carrier equipment set to deliver 200 gpa. Treatments were made to 2, 1/3 acre replicates of mature pears, cv. Bosc, at the delayed dormant period (March 19). All plots except the check had previously been treated in the dormant period with 4 gal of horticultural spray oil to delay oviposition by the pear psylla. Evaluation of psylla densities were made using the limb-jarring technique for adults and cluster examination for immature stages.

Results (Table 1) show pretreatment densities of adults ranging from about 11/tap in the check to 3-6/tap in the remainder of the plot. The final evaluation of immature forms taken on May 2 showed a 100% reduction with Asana and the 2 rates of Danitol, and a 94% reduction using Thiodan. At this time the sulfur-oil treatment exhibited about an 80% reduction compared to psylla numbers recorded in the untreated check.

Table 1. Pear psylla suppression following various prebloom programs. Medford, Oregon 1991.

Program: Material, Rate/acre, Treatment date — Dormant	Delayed Dormant	No. pear psylla Adults/Tap, Eggs/Spur or Cluster, Nymphs/cluster — Date: A/T 3/11	E/S 3/26	E/CL 4/3	N/CL 4/3	A/T 4/18	N/CL 4/18	N/CL 5/2	A/T 6/3
oil 4 gal. 2/6	Thiodan 3.3 qts. + oil 4 gal. 3/19	6.0	3.2	0.4	0.0	0.1	0.0	0.8	0.5
oil 4 gal. 2/6	Asana 0.1 lb. AI + oil 4 gal. 3/19	5.1	0.4	0.4	0.0	0.2	0.0	0.0	0.2
oil 4 gal. 2/6	Danitol 0.4 lb. AI + oil 4 gal. 3/19	3.3	0.5	0.3	0.0	0.0	0.0	0.0	0.4
oil 4 gal. 2/6	Danitol 0.2 lb. AI + oil 4 gal. 3 3/19	3.6	0.1	0.1	0.0	0.1	0.1	0.0	0.6
oil 4 gal. 2/6	oil 4 gal. + Orthorix sulfur 2.5 gal. (4/7)	4.5	0.3	1.4	0.0.	0.4	0.2	2.3	—
unsprayed	unsprayed	10.7	25.6	10.2	4.3	0.9	11.6	14.6	15.3

Pear Psylla Control on Pear: 1991 Evaluation Using M-Pede Insecticide in Combination with Natural Pyrethrum

During trials conducted in 1989 and again in 1990, M-PEDE (previously called Safer Insecticide Concentrate) combined with oil showed promise in controlling pear psylla, Psylla pyricola on pear. However, there were problems with phytotoxicity on the pear fruit, where the spray combination was used. Therefore, it was decided that ways to reduce that phytotoxicity and/or increase efficiency of the product should be explored. One possibility was to eliminate the oil and combine the M-PEDE with natural Pyrethrum.

Methods

Research plots were established at the OSU Southern Oregon Experiment Station where five different treatments were compared: 1) 2% M-PEDE; 2) 1% M-PEDE plus 16 oz. pyrethrum; 3) 16 oz. pyrethrum; 4) 64 oz. pyrethrum; and 5) a check with no sprays applied. To insure that there would be a high population of pear psylla at petal fall no dormant or delayed dormant sprays were applied.

All treatments were applied at petal fall (May 6, 1991) to 12 year old; Green Bartlett, Red Bartlett, Seckel, Comice, Bosc, and D'Anjou pear, with plots measuring .04 acres and replicated 3 times. Application of chemicals was made at the rate of 80 gallons per acre using conventional air-carrier equipment.

Pear psylla eggs and nymphs were sampled by randomly selecting 5-6 leaves per tree from actively growing shoots, 3 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.

Results

The results of the petal fall test showed that M-PEDE by itself was as good as, or better than M-PEDE combined with pyrethrum or pyrethrum by itself (Tables 1 & 2). However, none of the treatments reduced populations below the retreatment threshold of .5 eggs and nymphs per leaf. Again, as in past tests, no detectable phytotoxicity on the fruit was observed at this spray timing in any of the treatments. The extremely high initial pear psylla population most likely contributed to the poor performance of the materials tested. Perhaps, if a higher per acre gallonage had been used, where better coverage of the trees had resulted, better control could have been achieved?

Table 1.

1991 M-PEDE Trial Results--First Test
Pear Psylla Eggs and Nymphs Per Leaf

Treatment	5/2 (pretreatment)	5/13	5/20
2% M-PEDE	6.2	2.2a	2.2a
1% M-PEDE plus 16oz. pyrethrum	7.3	3.7a	4.2ab
16oz. pyrethrum	3.1	3.1a	4.6b
64oz. pyrethrum	6.1	2.6a	3.5ab
Control	5.8	2.9a	3.6ab

Note: Means followed by the same letter in each column are not significantly different (P=0.05).

Table 2.

1991 M-PEDE Trial Results--First Test

Pear Psylla Adults Per Tray

Treatment	5/2 (pretreatment)	5/13	5/20
2% M-PEDE	1.3	1.0a	70.4a
2% M-PEDE plus 16oz. pyrethrum	2.8	1.3a	57.3a
16oz. pyrethrum	1.8	2.7ab	62.1a
64oz. pyrethrum	2.5	4.4b	50.0a
Control	2.3	2.4ab	62.1a

Note: Means followed by the same letter in each column are not significantly different (P=0.05).

Pear Psylla Control on Pear: 1991 Evaluation Using M-Pede Insecticide in Combination with Oil

Combining the insecticide M-PEDE with natural Pyrethrum to control pear psylla, Psylla pyricola at petal fall was a failure, possibly due to higher than expected populations. Therefore, the discussion to further study the effectiveness of M-PEDE combined with oil to control pear psylla during the mid-season was made with two objectives in mind: 1) to determine the effectiveness of M-PEDE in controlling pear psylla when combined with different rates of oil, and 2) to evaluate 6 pear varieties for phytotoxicity when treated with this combination.

Methods

Research plots were established at the OSU Southern Oregon Experiment Station where five different treatments were compared: 1) 2% M-PEDE; 2) 2% M-PEDE plus 0.5% Ultra Fine Spray Oil; 3) 2% M-PEDE plus 1% Ultra Fine Spray Oil; 4) 1% Ultra Fine Spray Oil; and 5) a check with no sprays applied.

All treatments were applied at mid-summer (June 17, 1991 and June 25, 1991) to 12 year old; Green Bartlett, Red Bartlett, Seckel, Comice, Bosc, and D'Anjou pear, with plots measuring .04 acres and replicated 3 times. Application of chemicals was made at the rate of 200 gallons per acre using conventional air-carrier equipment.

Pear psylla eggs and nymphs were sampled by randomly selecting 5-6 leaves per tree from actively growing shoots, 3 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.

Results

Following the first mid-summer application on June 17, none of the treatments reduced pear psylla eggs and nymphs below the retreatment threshold of .5 per leaf (Table 1). With the exception of the treatment 1% oil alone, all treatments reduced pear psylla adults when compared to the control (Table 2).

Because control of pear psylla eggs and nymphs had not been achieved with one application of the products being tested, it was decided to make a second application on June 25, 1991, 8 days after the first application. The results showed that the combination of 2% M-PEDE and 1% oil was statistically better than any of the other treatments with the exception of the combination of 2% M-PEDE and 0.5% oil. However, it should be noted that again as in the first application none of the treatments reduced the pear psylla eggs and nymphs below the retreatment threshold. Again, as in the results following the first application, all treatments with the exception of 1% Oil alone reduced pear psylla adults when compared to the control.

The M-PEDE Insecticide like the Safer Insecticidal Soap tested in past years, showed some adulticide activity and phytotoxicity to the fruit (Table 3 & 4). When combined with oil its control of psylla eggs and nymphs was improved and the phytotoxicity slightly reduced when compared to M-PEDE used alone. With the exception of Bosc pear, because of its russeted fruit finish which mask the damage caused by the M-PEDE or Safer Insecticidal Soap the combination should not be used on commercially marketed pears after petal fall or following fruit turn down. Later applications will result in a significant downgrading of fruit.

Any future testing of M-PEDE should be restricted to examining different per acre gallonages, used at mid-summer, to see if the problem of phytotoxicity can be over come. Then that gallonage should be tested for control of pear psylla. Also, the feasibility of restricting the use of M-PEDE on pear to the Bosc variety should be considered.

Table 1.

1991 M-PEDE Trial Results--Second Test

Pear Psylla Eggs and Nymphs Per Leaf

Treatment	6/13 (pretreatment)	6/20	7/1
2% M-PEDE	4.0a	4.8a	6.0bc
2% M-PEDE plus 1% Sunspray oil	4.5a	5.0a	1.6a
2% M-PEDE plus 0.5% Sunspray oil	6.2a	4.7a	4.4ab
1% Sunspray oil	6.5a	5.8a	6.8bc
Control	4.2a	2.7a	8.7c

Note: Means followed by the same letter in each column are not significantly different (P=0.05).

Table 2.

1991 M-PEDE Trial Results--Second Test

Pear Psylla Adults Per Tray

Treatment	6/13 (pretreatment)	6/20	7/1
2% M-PEDE	76.2a	36.7a	17.1a
2% M-PEDE plus 1% Sunspray oil	74.8a	36.0a	11.1a
2% M-PEDE plus 0.5% Sunspray oil	114.3a	38.3a	14.0a
1% Sunspray oil	105.8a	51.8ab	20.9ab
Control	98.4a	75.3b	33.9b

Note: Means followed by the same letter in each column are not significantly different ($P=0.05$).

Table 3.

1991 M-PEDE Trial Results--Phytotoxicity
Per Cent Fruit Damage by Variety

2% M-PEDE Treatment

Variety	None	Slight	Medium	Heavy
Green Bartlett	8	12	40	40
Red Bartlett	48	0	16	36
Seckel	80	16	4	0
Comice	44	4	32	20
Anjou	20	20	24	36
Bosc	100	0	0	0

2% M-PEDE plus 1% Sunspray oil Treatment

Variety	None	Slight	Medium	Heavy
Green Bartlett	28	12	36	24
Red Bartlett	60	0	24	16
Seckel	88	4	4	4
Comice	36	4	20	40
Anjou	40	0	36	44
Bosc	100	0	0	0

Table 4.

1991 M-PEDE Trial Results--Phytotoxicity
Per Cent Fruit Damage by Variety

2% M-PEDE plus 0.5% Sunspray oil Treatment

Variety	None	Slight	Medium	Heavy
Green Bartlett	20	8	28	44
Red Bartlett	92	0	4	4
Seckel	72	8	12	8
Comice	56	0	24	20
Anjou	32	12	20	36
Bosc	100	0	0	0

1% Sunspray oil Treatment

Variety	None	Slight	Medium	Heavy
Green Bartlett	100	0	0	0
Red Bartlett	100	0	0	0
Seckel	96	4	0	0
Comice	88	12	0	0
Anjou	100	0	0	0
Bosc	100	0	0	0

ACARICIDE RESISTANCE DEVELOPMENT FOLLOWING VARYING USE PATTERNS OF HEXYTHIOZOX (SAVEY) AND FENBUTATIN OXIDE (VENDEX) ON PEARS. 1987-1991.

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 Tetranychus urticae 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

Field tests. 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, 1991.

2. hexythiozox (2 ozs. ai/acre) 1987, 1989, 1991 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, 1991.

4. hexythiozox (1 oz. ai/acre) plus fenbutatin oxide 0.375 lb. ai/acre) combined each year. 1987, 1988, 1989, 1990, 1991.

5. fenbutatin oxide (0.75 lb. ai/acre) in consecutive pattern. 1987, 1988, 1989, 1990. This treatment was discontinued following the development of field failure and confirming laboratory bioassay data.

To evaluate the degree of field control obtained by the various programs, leaf samples (25-40/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 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. In 1991 a second bioassay was conducted using mites from the consecutive Savey plot. Spider mite densities in other treatments were too low to allow laboratory colony establishment.

Results 1987-1991

Plot history. The study area used in this research project had been used previously (1985-1986) in TSM resistance studies. Results from the earlier tests had shown initially high levels of OT resistance but with deletion of these acaricides over the 2-year period had reverted to a susceptible level. The ovicide Savey had not been used in the study site prior to the 1987 season.

Field control. Table 1. No difference in TSM densities occurred between treatments until 1989 following the 5th field application. At this time the O-T Vendex used in a consecutive program had significantly higher mite densities than those found in other treatments. Field effectiveness of the OT was essentially lost by the end of 1989 with severe leaf damage evident in this plot. TSM densities following subsequent OT application in 1990 confirmed field failure and the consecutive OT program was dropped from further evaluation. The remaining acaricide programs continued to provide good TSM suppression through 1990.

In the 5th year of testing, following the 10th consecutive application of Savey this program also appeared to weaken with significantly higher TSM densities being measured in the 3 post treatment evaluations (8/7-9/3). TSM levels in the other acaricide regimes remained well below 0.5 mites/leaf and gave no indication of a weakened field performance (Table 1).

Laboratory bioassays. (Tables 2 and 3) Bioassays of TSM using both Vendex and Savey appear to substantiate the development of resistance with these compounds used alone in a consecutive manner. Initial LC_{50} values of the OT taken prior to treatment in 1987 was about 400 mg/l and following the 5th field application in 1989 had risen to over 9500 mg/l or an increase in tolerance of about 23-fold (Table 2). In the case of Savey the initial 1987 LC_{50} was measured at 0.20 mg/l and in 1991 following the 10th consecutive treatment was about 14.5 mg/l a 70-fold increase in LC_{50} value. No cross resistance to the OT was noted following resistance development by Savey used consecutively but the development of OT resistance following consecutive use of Vendex was accompanied by increased Savey tolerance (Tables 2 and 3). Despite being applied 10 consecutive times between 1987 and 1991 the LC_{50} values of the OT-Savey combination at 1/2 rates remained below 0.5 mg/l for the ovicide and at about 500 mg/l for the OT bioassays.

Thus far in this study we have shown TSM resistance development following 5 and 10 consecutive uses of Vendex and Savey respectively. Based on field and laboratory results the annual rotation, within season rotation, and the combination at 1/2 rates are still providing excellent TSM suppression. The study will continue into 1992 at which time the total number of OT applications in the acaricide rotation plots will be equal to those used in the consecutive OT plot when field resistance was noted.

Table 1. Number of twospotted spidermites per leaf from Southern Oregon Resistance Management Plots (1987-1990).

	Hexythiazox Consecutive	Annual Rotation	Within year Alternation	Combination 1/2 Rates	OT Consecutive
Pretreatment 5/21/87	0.35a [1/]	0.21a	0.35a	1.17a	0.29a
Pretreatment 7/15/88	1.50a	3.00a	8.10a	7.70a	8.40a
Pretreatment 4/27/89	0.90a	5.90a	1.70a	2.10a	2.00a
$\bar{X}$ Post 5th Treatment	1.10a	1.30a	0.60a	0.70a	2.80b
$\bar{X}$ Post 6th Treatment	0.30a	0.10a	0.10a	0.10a	11.30b
7th Pretreatment 5/2/90	0.07a	0.00a	0.33a	0.00a	2.57b
$\bar{X}$ Post 7th Treatment	0.37a	0.54a	0.70a	0.58a	3.40b
$\bar{X}$ Post 8th Treatment	0.32a	0.45a	0.35a	0.17a	12.35b
Pretreatment 5/20/91	0.1a	0.4a	0.1a	0.0a	
$\bar{X}$ Post 9th (6/3-7/12)	0.1a	0.1a	0.05a	0.05a	
Pretreatment 7/22/91	0.9a	1.5a	0.7a	0.7a	
$\bar{X}$ Post 10th (8/7-9/3)	1.93b	0.3a	0.25a	0.05a	

1/ Means within the same row with same letter are not significantly different based of Fisher's Least Significant Difference Test. (P < 0.05).

Table 2. Organotin bioassay data for 5 field populations of the TSM subjected to various acaricide regimes. Medford, Oregon 1987-1990.

Subscript

Acaricide Bioassay No. and Year	Acaricide Program	Cumulative No. Applications Hexythiazox	OT	Adult n	Slope (±SE)	LC_{50} 95% CI, mg/l
pretreatment 1987	Hexythiazox Consecutive	0	0	259	1.33 (0.25)	470 (340-740) bc 1/
	Annual Rotation	0	0	227	1.37 (0.25)	520 (360-860) bc
	Within Season Alternation	0	0	236	2.24 (0.40)	490 (380-640) bc
	Combination @ 1/2 rates	0	0	202	1.29 (0.2[illegible])	550 (370-970) bcd
	OT Consecutive	0	0	284	1.49 (0.21)	410 (320-570) b
Post 2nd 1987	Hexythiazox Consecutive	2	0	83	0.91 (0.74)	180 (0-390) ab
	Annual Rotation	2	0	-	--	--
	Within Season Alternation	1	1	108	2.74 (0.77)	140 (2-210) a
	Combination @ 1/2 rates	2	2	83	2.11 (0.82)	300 (170-410) ab
	OT Consecutive	0	2	171	1.70 (0.37)	260 (160-380) ab
Post 3rd 1988	Hexythiazox Consecutive	3	0	214	1.05 (0.20)	260 (150-390) ab
	Annual Rotation	2	1	253	0.81 (0.17)	580 (360-1000) bcd
	Within Season Alternation	2	1	225	2.53 (0.40)	130 (100-170) ab
	Combination @ 1/2 rates	3	3	233	0.84 (0.18)	830 (50-1710) abc
	OT Consecutive	0	3	240	0.67 (0.17)	500 (260-980) bc
Post 5th 1989	Hexythiazox Consecutive	5	0	464	1.67 (0.18)	826 (350-1520) bcd
	Annual Rotation	3	2	523	1.86 (0.20)	1254 (618-2334) bcd
	Within Season Alternation	3	2	609	0.94 (0.19)	1633 (619-3576) cde
	Combination @ 1/2 rates	5	5	495	0.80 (0.17)	1822 (964-3749) de
	OT Consecutive	0	5	562	1.01 (0.20)	9517 (5316-28,282) f
Post 7th 1990	Hexythiazox Consecutive	7	0	300	1.22 (0.28)	190 (50-350) ab
	Annual Rotation	4	3	337	1.09 (0.23)	320 (120-540) ab
	Within Season Alternation	4	3	363	0.73 (0.23)	300 (20-630) abc
	Combination @ 1/2 rates	7	7	466	1.28 (0.18)	600 (180-1090) abc
	OT Consecutive	0	7	348	0.76 (0.24)	6330 (2350-8340) d
Post 9th 1991	Hexythiazox Consecutive	9	0	371	1.56 (0.19)	540 (232-1093) a
	Annual Rotation	5	4	288	1.41 (0.30)	2130 (1382-4323) b
	Within Season Alternation	5	4	315	1.64 (0.26)	1092 (794-1557) ab
	Combination @ 1/2 rates	9	9	303	1.40 (0.21)	572 (274-1032) a
Post 10th 2/ 1991	Hexythiazox Consecutive	10	0	249	1.52 0.200	690 (490-940)

1/ Within year values with the same letter indicate no significant difference based on overlap of the 95% CI.

2/ Except for the consecutive hexythiazox plot, TSM field populations were insufficient for starting laboratory colonies.

Table 3. Hexythiazox bioassay data for 5 field populations of the TSM subjected to various acaricide regimes. Medford, Oregon 1988-1990.

Acaricide Bioassay No. and Year	Acaricide Program	Cumulative No. Applications Hexythiozox	OT	Adult n	Slope (±SE)	LC_{50} 95% CI, mg/l
Post 3rd 1988	Hexythiazox Consecutive	3	0	783	2.04 (0.17)	0.20 (0.16-0.23) ab [1/]
	Annual Rotation	2	1	503	1.43 (0.18)	0.11 (0.007-0.16 a
	Within Season Alternation	2	1	1350	2.40 (0.19)	0.16 (0.14-0.19) ab
	Combination 1/2 Rates	3	3	542	1.59 (0.16)	0.16 (0.12-0.21) ab
	OT Consecutive	0	3	1368	2.24 (0.15)	0.20 (0.17-0.23) b
Post 5th 1989	Hexythiazox Consecutive	5	0	868	2.14 (0.50)	1.09 (0.86-1.81) de
	Annual Rotation	3	2	859	4.59 (0.75)	0.54 (0.46-0.61) cd
	Within Season Alternation	3	2	733	3.77 (0.54)	0.34 (0.23-0.43) bc
	Combination 1/2 Rates	5	5	365	5.36 (1.19)	0.40 (0.27-0.51) c
	OT Consecutive	0	5	1882	3.33 (0.45)	0.67 (0.52-1.11) d
Post 7th 1990	Hexythiazox Consecutive	7	0	1108	2.82 (0.78)	1.14 ( ) [2/]
	Annual Rotation	4	3	1064	5.11 (0.48)	0.41 (0.33-0.49) c
	Within Season Alternation	4	3	652	2.79 (0.34)	0.29 (0.13-0.42) abc
	Combination 1/2 Rates	7	7	2192	3.59 (0.51)	0.74 (0.61-1.12) d
	OT Consecutive	0	7	1661	4.63 (0.61)	1.44 (1.20-1.83) e
Post 9th 1991	Hexythiazox Consecutive	9	0	1339	2.13 (1.11)	1.84 ( ) [2/]
	Annual Rotation	5	4	1224	3.58 (0.27)	0.42 (0.35-0.48)
	Within Season Alternation	5	4	1977	3.27 (0.19)	0.25 (0.23-0.27)
	Combination @ 1/2 rates	9	9	3082	4.0 (0.24)	0.42 (0.28-0.53)
Post 10th[3/] 1991	Hexythiazox Consecutive	10	0	2080	1.40 (0.30)	14.56 ( )[2/]

1/ Within year values with the same letter indicate no significant difference based on overlap of the 95% CI.

2/ No limits assigned.

3/ Except for the consecutive hexythiazox plot, TSM field populations were insufficient for starting laboratory colonies.

Field Performance and Bioassay Evaluation of Kelthane Against the Twospotted Spider Mite (TSM) on Pear.

Both Agrimek-oil and Apollo acaricides are most effective when used in the early (petalfall-first cover) foliar period. In general these compounds do not provide seasonal TSM suppression on the late picked pear cultivars such as Bosc and Anjou and a late season miticide is usually required to prevent substantial premature defoliation on these varieties. The performance of acaricides, such as Carzol, Vendex and Kelthane applied in the July-August period have provided acceptable control at some sites but not at others. In 1991 we evaluated a rapid bioassay method for Kelthane to find if this technology could be used to predict the degree of control achieved in the field.

Field performance of Kelthane was evaluated in a 0.7 acre block of 25 year old pears, cv. Bartlett, with applications made using conventional air-carrier equipment set to deliver 200 gpa. The plot was divided into 3 treatments, replicated twice. Treatment 1 was Kelthane at 2.5 lb ai/acre applied on July 18 and repeated on August 10. Treatment 2 was Kelthane at the above rate applied on August 10 following an early (May) application of Agrimek-oil. The 3rd treatment was an unsprayed check. TSM densities were evaluated prior to treatment and at biweekly intervals by selecting and brushing 20 mature leaves/rep. Laboratory bioassays were conducted in treatment 1 on July 9 prior to the first Kelthane spray and on August 6 prior to the second treatment. Bioassay of TSM from treatment 2 was made on July 6, 4 days before this single Kelthane application. Bioassays were conducted in plastic petri dishes (5 cm diam. X.7cm depth) treated on the inside top and bottom with 320 ppm Kelthane. TSM mortality was evaluated at 24 h.

Results. The bioassay technique has several drawbacks including the following: Kelthane appeared to be highly repellent to TSM and resulted in many escapes before transfers were completed; almost immediately upon being transferred, mites began to spin webs which kept them from prolonged or continuous contact with the Kelthane treated surface, and static electricity was also a problem during loading. In treatment 1, prior to the first Kelthane application TSM mortality was recorded at about 83% (adjusted for check mortality) which, according to Rohm and Haas, represents a moderately resistant population. The TSM mortality prior to the second treatment was even lower at 66% (Table 1) indicating selection from the population of susceptible individuals. Field control in treatment 1 lasted about 3 weeks after the first application and about the same after the second (Table 2). TSM bioassay from treatment 2 on August 6 resulted in a 100% adjusted mortality with the results from the field indicating good TSM suppression for the 20 day duration of the evaluation. Based on these very preliminary results, it would appear that there is a fair correlation between laboratory bioassays and expected field results using Kelthane but a more extensive program will be needed to verify this technique.

Table 1. Mortality to the twospotted spider mite (TSM) using Kelthane in a rapid bioassay.

Kelthane Bioassay Timing	Two Field Applications of Kelthane (7/18, 8/10) % adjusted mortality
Prior to 1st field application (July 9)	82.7%
Prior to 2nd field application (Aug 6)	66.4%
	One Field Application of Kelthane (8/10)
Prior to 1st field application (Aug 6)	100.0%

Table 2. Field performance of Kethane used in a one or two spray program on Bartlett pears for control of the twospotted spider mite (TSM). 1991.

Material rate ai/acre	Treatment Dates (s)	No. TSM/leaf 7/15	7/25	8/01	8/08	8/15	8/22	8/29
Kelthane 2.5 lb.	7/18, 8/10	3.85	2.15	0.8	1.6	0.9	0.3	1.7
Kelthane 2.5 lb.	8/10	-	-	-	2.45	0.5	0.6	0.35
Check	----	3.20	16.2	2.3	6.0	4.1	10.0	4.7

LATE SEASON CONTROL OF THE TWOSPOTTED SPIDER MITE ON PEAR WITH BRIGADE AND KELTHANE

The two most effective acaricides, Apollo and Agrimek, on the twospotted spider mite (TSM) are limited temporarily in their suitability to the early foliar period, i.e. petal fall and/or first cover. Early season application of theses acaricides seldom provide seasonal control on the late picked pear varieties such as Anjou and Bosc. Previous trials using Carzol or Vendex did not provide levels of control sufficient to prevent significant premature defoliation. In 1991 we evaluated the acaricidal pyrethroid, Brigade, and Kelthane for possible mid- to late-season effectiveness.

Treatments were applied to 2, 1/4 acre replicates of mature Bartlett pears using commercial air carrier equipment delivering 200 gpa. Brigade was applied at 0.1 lb ai/acre and Kelthane at 2.5 lb ai/acre. Brigade was applied only once on July 18 while Kelthane twice, July 18 and August 10. TSM densities were estimated by selecting 20 mature leaves/replicate on a weekly or biweekly basis.

The results are presented in table 1 and show excellent TSM suppression with Brigade over the 6 week test period. Kelthane provided about 3 weeks control after each application.

Table 1. Control of Twospotted Spider Mite (TSM) with Brigade and Kelthane. Bartlett variety. 200 gpa.

Material and rate ai/acre	Treatment date(s)	No. TSM/leaf						
		7/15	7/25	8/01	8/08	8/15	8/22	8/29
Brigade 0.1 lb	7/18	2.45	0.1	0.0	0.0	0.05	0.05	0.10
Kelthane 2.5 lb	7/18 8/10	3.85	2.15	0.8	1.6	0.85	0.30	1.70
Check		3.2	16.2	2.3	6.0	4.1	10.0	4.7

Application Timing of Agrimek-Oil for Control of the Twospotted Spider Mite and the Pear Psylla on Two Pear Varieties in Southern Oregon

The insecticide-acaricide Agrimek has been used on pears under a Section 18 for 4 years. During the first 3 years of use the material was not fully approved or available until the second foliar cover spray (June) and field results obtained at this time were somewhat variable, especially as recorded for the pear psylla. In 1991 a test plot was established to evaluate the efficacy of the Agrimek-oil combination when applied at 3 different timings; petal fall, 1st cover and 2nd cover.

The study was conducted in a 1.2 acre block of pears with alternating 4 row sets of each the Bartlett and Anjou varieties. The block was divided into 4 treatments with 2 replicates each. Applications were made using a commercial air-carrier sprayer set to deliver 200 gpa. Agrimek was applied at each timing at the rate of 20 fl ozs formulated/acre (0.023 lb ai/acre) plus 0.25% (1 gal/acre) Orchex 796 horticultural spray oil. Densities of the twospotted spider mite (TSM) and the pear psylla (PP) were estimated by selecting 20 mature and 20 younger leaves from each variety of each replicate on a biweekly schedule and recording the stages and numbers of each species.

Results. Twospotted spider mite (Figure 1). Application of Agrimek-oil to the Anjou cultivar at the petal fall timing on May 2 resulted in approximately 80 days of TSM suppression. Initial reduction in TSM numbers was very slow taking about 2 weeks before effects of the application were apparent. This same pattern was observed following petal fall treatment to the Bartlett variety where residual control was measured at about 70 days. This length of TSM suppression achieved with this timing would not generally be sufficient to span the entire preharvest period and would most likely require an additional acaricide application to prevent significant leaf damage.

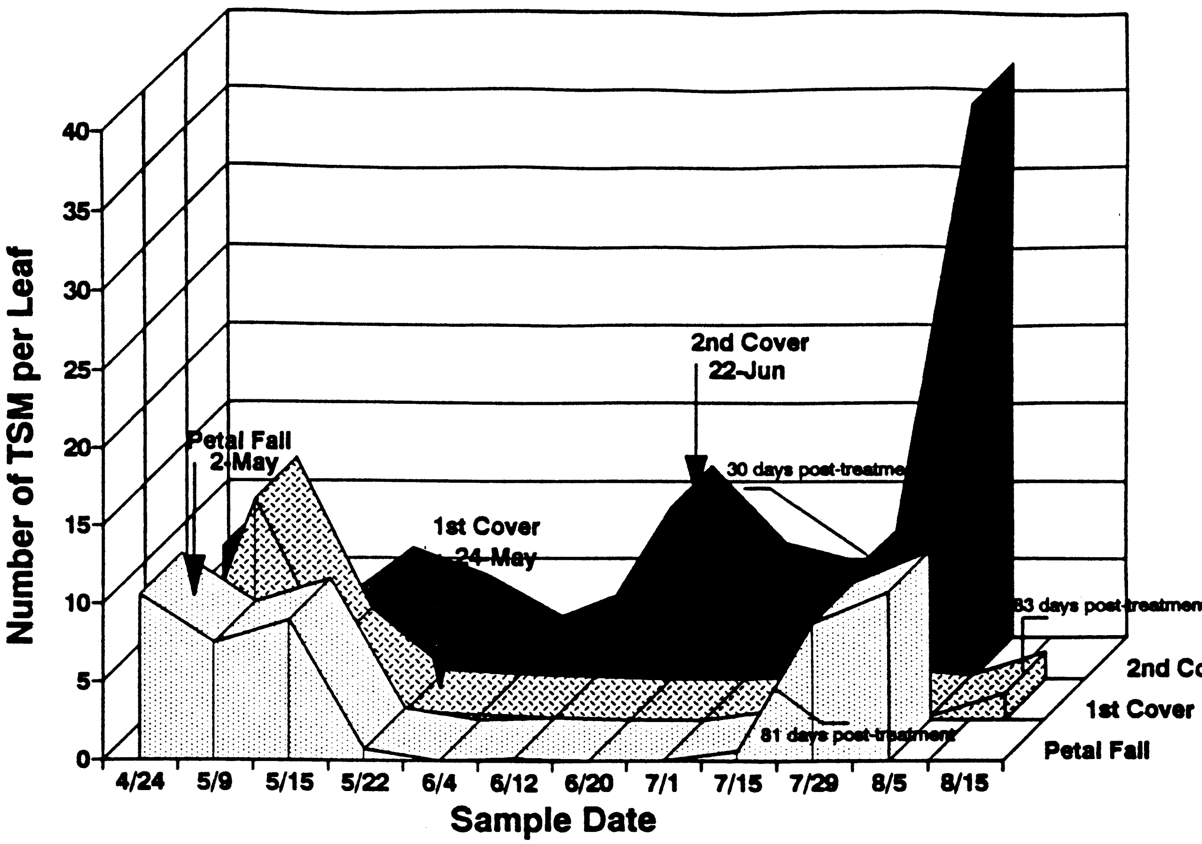
The 1st cover spray timing of Agrimek-oil (May 24) resulted in about the same length of residual control, i.e. 80 days) as found following the petal fall treatment. However, resurgence in TSM densities after this length of time was of little concern as harvest of the Bartlett fruit had commenced and that of Anjou was only 2 weeks away. Thus the 1st cover timing was considered to have provided seasonal TSM suppression.

Relatively poor TSM control was measured following the Agrimek-oil treatment at the 2nd cover timing (June 22) with residual suppression lasting perhaps 30-40 days depending on variety. The reason for this relatively poor performance compared to the earlier timings may be due to reduced leaf penetration by Agrimek. The correctness of this explanation could be easily tested by chemical residue analysis.

Pear Psylla (PP), Figures 2 and 3. The interpretation of Agrimek-oil timings and subsequent PP control was based on the % reduction in nymphal stages achieved by treatment compared to the untreated check. The results, then, show that PP densities following the petal fall treatment, as measured from May 9 through July 1, reduced nymphal densities by about 52%; for the 1st cover treatment (June 4-July 15) by 73%, and for 2nd cover (July 1-July 15) by only 3%. The span of time over which the Agrimek-oil showed some degree of PP suppression on Anjous was 60 days, 38 days and 9 days for the petal fall, 1st and 2nd cover treatments respectively.

While none of the Agrimek-oil timings resulted in outstanding PP control it would appear that the 1st cover treatment gave the most suitable suppression for control of this pest as well as for the TSM. However, it is possible that the most efficacious Agrimek-oil timing may vary from year to year depending upon the condition of pear leaves at various developmental stages.

Anjou Variety



Bartlett Variety

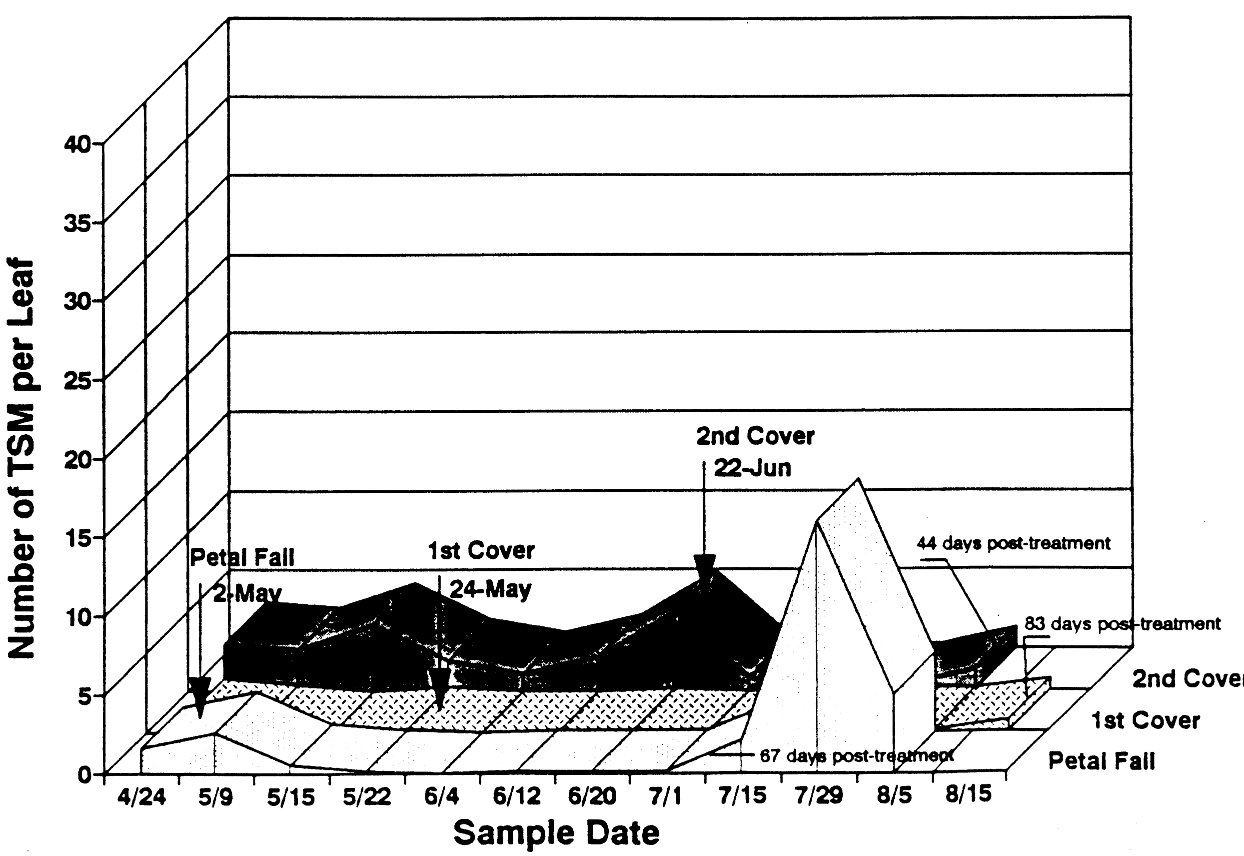
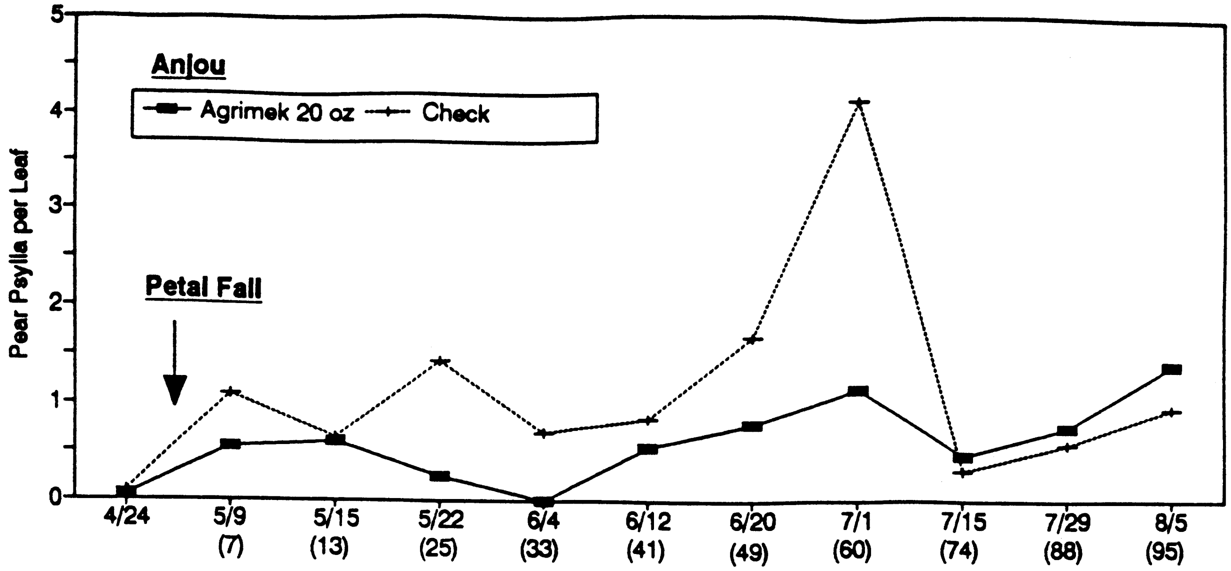
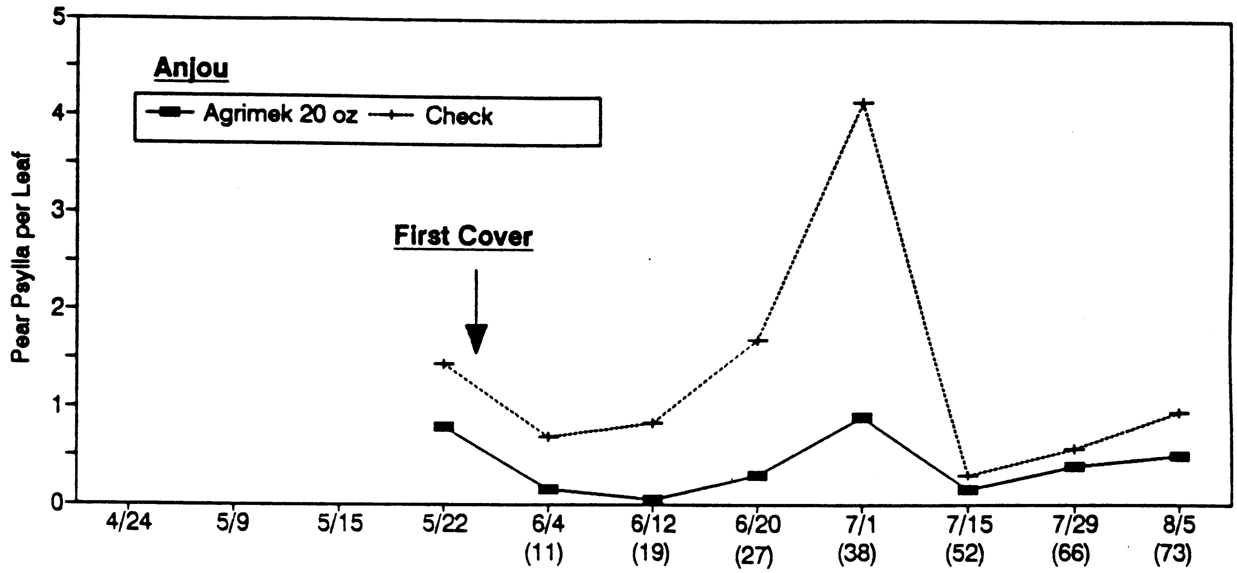


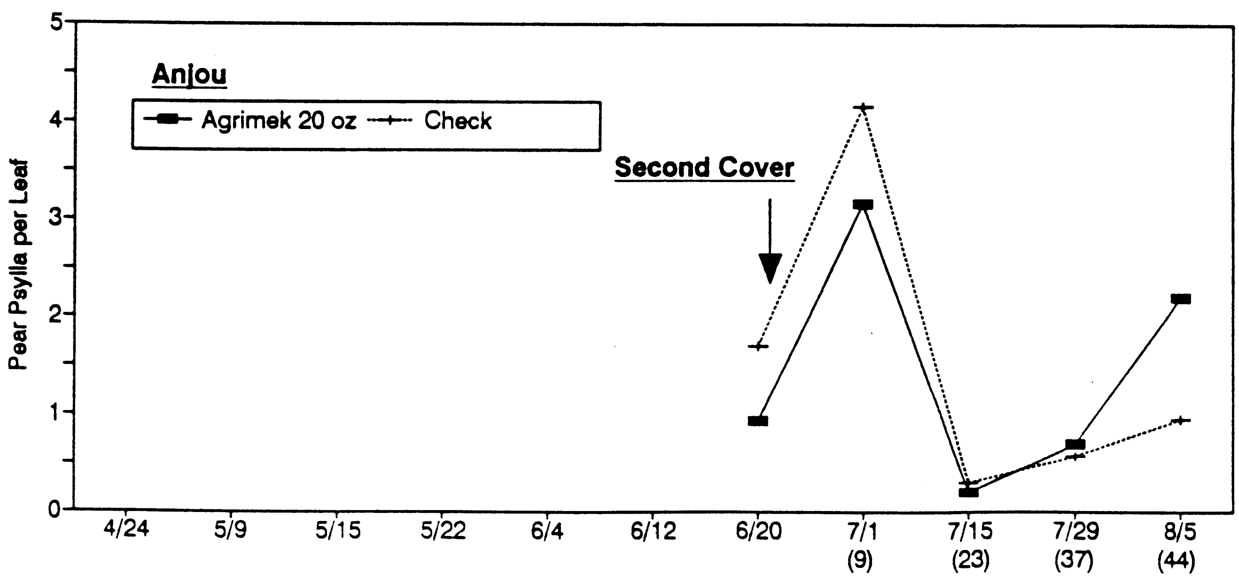
Table 1.



Anjou
Agrimek 20 oz
Check
Petal Fall
Pear Psylla per Leaf
0
1
2
3
4
5
4/24
5/9 (7)
5/15 (13)
5/22 (25)
6/4 (33)
6/12 (41)
6/20 (49)
7/1 (60)
7/15 (74)
7/29 (88)
8/5 (95)

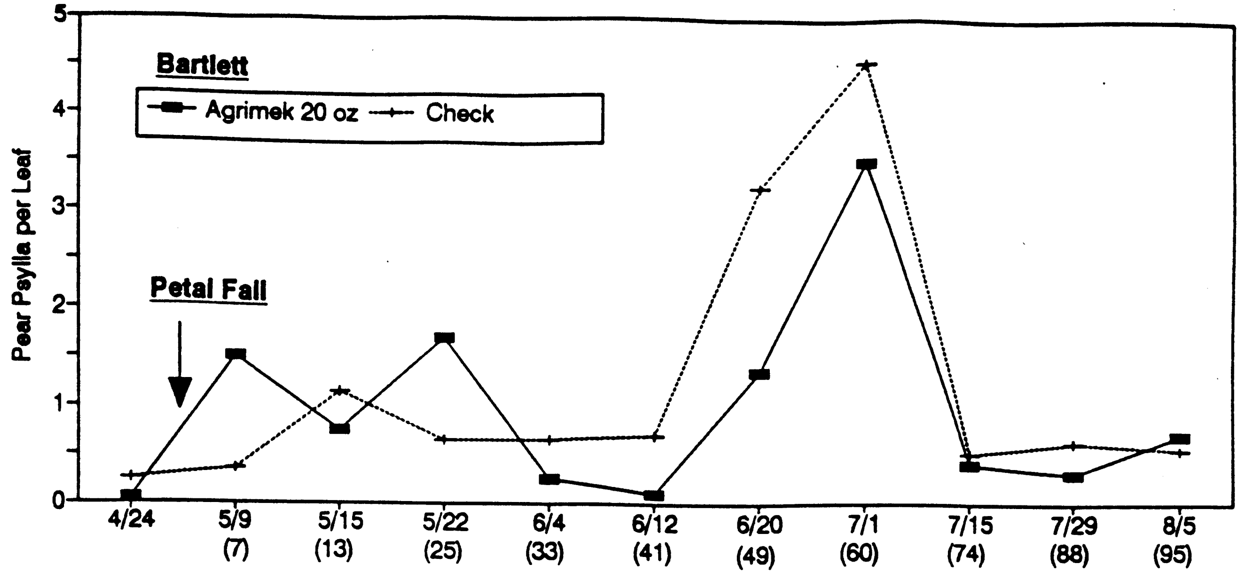


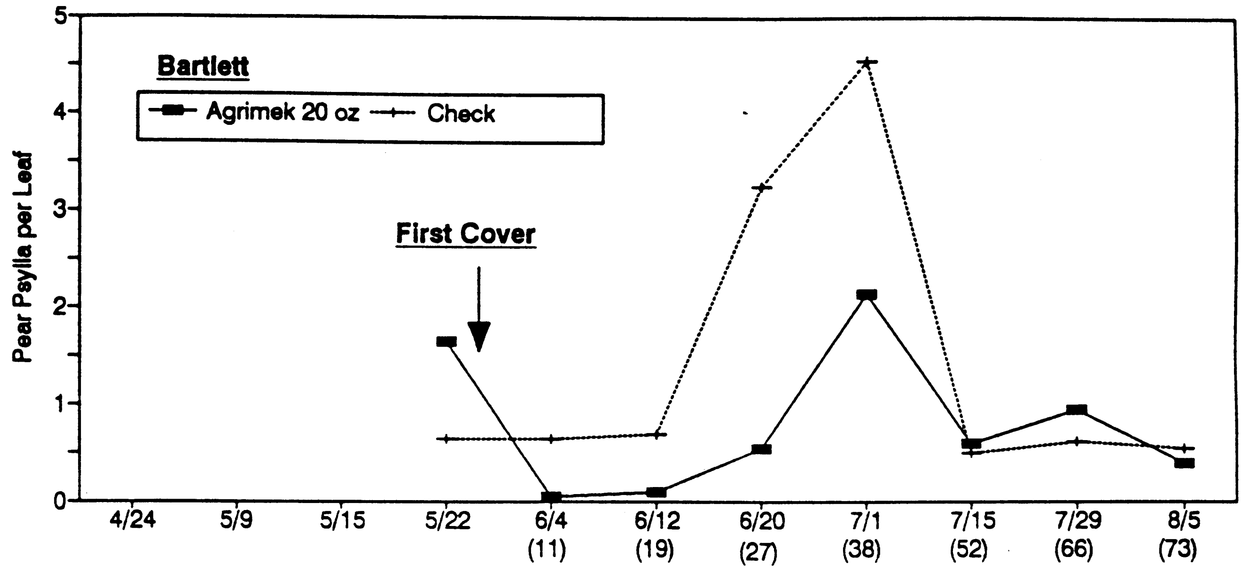
Anjou
Agrimek 20 oz
Check
First Cover
Pear Psylla per Leaf
0
1
2
3
4
5
4/24
5/9
5/15
5/22
6/4 (11)
6/12 (19)
6/20 (27)
7/1 (38)
7/15 (52)
7/29 (66)
8/5 (73)



Anjou
Agrimek 20 oz
Check
Second Cover
Pear Psylla per Leaf
0
1
2
3
4
5
4/24
5/9
5/15
5/22
6/4
6/12
6/20
7/1 (9)
7/15 (23)
7/29 (37)
8/5 (44)

Table 2.


Bartlett
Agrimek 20 oz
Check
Petal Fall
Pear Psylla per Leaf
0
1
2
3
4
5
4/24
5/9 (7)
5/15 (13)
5/22 (25)
6/4 (33)
6/12 (41)
6/20 (49)
7/1 (60)
7/15 (74)
7/29 (88)
8/5 (95)


Bartlett
Agrimek 20 oz
Check
First Cover
Pear Psylla per Leaf
0
1
2
3
4
5
4/24
5/9
5/15
5/22
6/4 (11)
6/12 (19)
6/20 (27)
7/1 (38)
7/15 (52)
7/29 (66)
8/5 (73)

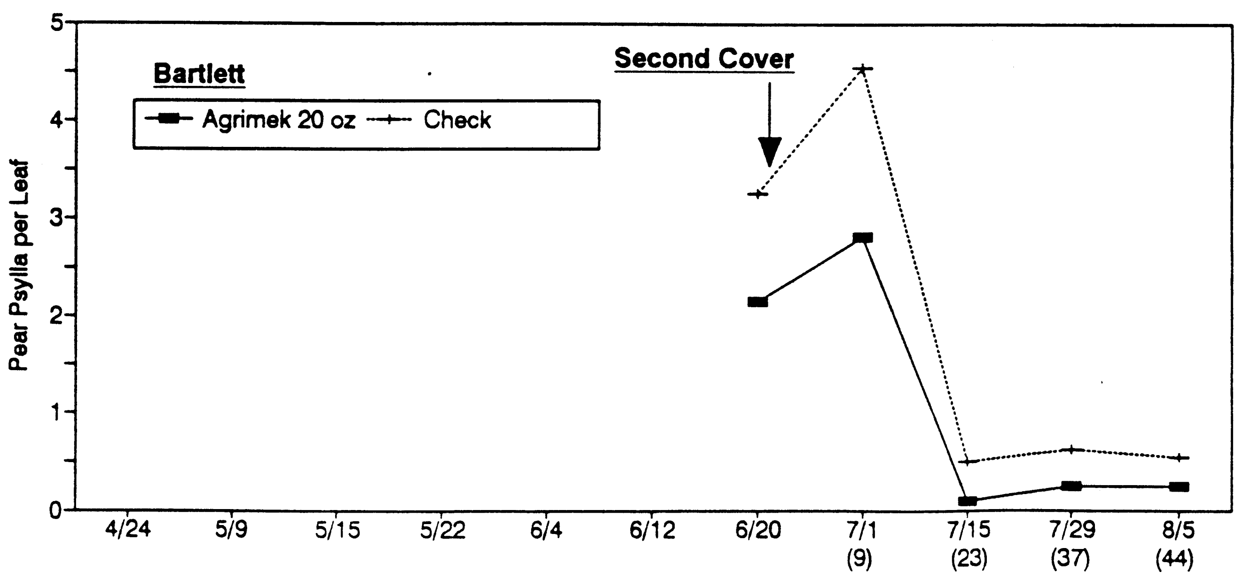

Bartlett
Second Cover
Agrimek 20 oz
Check
Pear Psylla per Leaf
0
1
2
3
4
5
4/24
5/9
5/15
5/22
6/4
6/12
6/20
7/1 (9)
7/15 (23)
7/29 (37)
8/5 (44)

Table 3.

A Selective Pest Management Program for the Bosc Pear Cultivar

The Bosc variety is a russeted-skinned winter pear which is increasingly popular in southern Oregon and now accounts for over 40% of the fresh marketed pears shipped from the area. The variety also possesses certain characteristics which, from an entomological standpoint, make it a likely candidate for a reduced chemical program for suppression of arthropod pests. These attributes include a relatively high tolerance to early season pear psylla honeydew induced fruit russeting as well as to russeting caused by feeding of the pear rust mite. In previous and current studies we have shown that the prebloom synthetic pesticides directed at pear psylla can be eliminated without concerns regarding loss of fruit quality, i.e. downgrading. The pyrethroid chemicals, which are currently used for prebloom psylla control, have been shown to exacerbate spider mite densities and deletion of these pesticides would most likely reduce overall mite levels and the need for multiple acaricide treatments. Additional modifications in the selective program include deletion of other disruptive chemicals including organophosphates (OPs), carbamates, and the psyllicide Mitac. A final modification on the Bosc variety involves the deletion of prebloom chemicals used for control of the pear rust mite. This species is a serious and persistent pest on "clear skinned" pear varieties but on Bosc the additional russet caused by this mite is not of serious concern. Also, the rust mite is an important alternative prey for predaceous mites and its conservation may aid in the implementation of an integrated program for spider mite control.

In 1990 a study was begun in southern Oregon to evaluate a control program designed for the Bosc cultivar which used the insect growth regulator Dimilin and the horticultural spray oil Orchex 796 as the only chemical agents used in the system for suppression of arthropod pests. The current report contains our results from the second year of testing.

Plot description. A 1.5 acre block of mature, 40 year old, Bosc pears was divided into two treatments each with two replicates. Treatment 1 was a conventional program using the pyrethroid Asana plus Lorsban and oil in the delayed dormant timing and Guthion in a normal 4 cover foliar program for codling moth control. In addition, oil was added to the Guthion at first cover, Mitac at second, and Agrimek-oil at the third. This program was compared to a modified program consisting of oil in the delayed dormant, and 4 Dimilin sprays for codling moth the first 3 tank mixed with 1% (2 gal/acre) Orchex oil Table 1). Evaluation of pest densities were measured biweekly from February through September. Densities of adult pear psylla and those of most predator species were made using the limb jarring technique while densities of other arthropods including immature pear psylla, spider mites, rust mite and predator mites estimated by leaf brushing. Direct fruit damage caused by codling moth or pear psylla was evaluated at harvest by examination of 500 fruit/treatment (250/rep).

1991 Results. Pear psylla (PP). Densities of PP prior to the delayed dormant sprays on March 15 averaged over 13/tap which, in southern Oregon is considered to be a relatively high carryover of winterform adults. Adult PP reduction in the conventionally treated plot, as measured 2 weeks post-spray averages about 96% while in the modified program with just oil was 66% (Table 4). Adult PP densities throughout the foliar period (April 18-September 26) averaged 2.8/tap and 1.4 in the conventional and modified programs respectively (Table 1). This same pattern of higher immature PP densities early season in the modified and later season in the conventional program was also evident in the 1991 studies (Table 3). Total pear psylla damage to fruit at harvest was similar in both treatments, averaging 1.2% and 1.4% in the conventional and modified programs respectively (Table 5). These results indicate that the conventional control program with the use of both Agrimek-oil and Mitac for PP suppression gave basically the same degree of economic control as that achieved with the oil-Dimilin program.

Spider mites (SM). Densities of the twospotted spider mite averaged 11.5 and 7.3/leaf over the entire season in the conventional and the modified programs respectively (Table 2). Severe preharvest leaf damage was noted in the conventional plot probably due to high mite levels in mid- to late July prior to the Agrimek-oil treatment. Mite densities measured in late September were over 63/leaf in the conventional program compared to about 29 in the oil-Dimilin plot which most likely will be reflected in higher mite/ densities encountered in the former plot in 1992.

Other pests. Damage caused by the codling moth was significantly higher than that recorded from this plot in 1990. Harvest records taken on September 16 showed 1.2 and 5.8% larval infestation in the conventional and modified programs respectively. High moth pressure in adjacent pear blocks and an extended first generation moth flight may account for the greater than expected infestation. Modest numbers of the pear rust mite were recorded in the modified plot in early July but no fruit damage was evident at harvest.

Conclusions. Results from this second year of testing indicates that the Bosc cultivar is a suitable target crop for lowering pesticide inputs without substantial risk of a resultant reduction in fruit quality. Data from the modified program over the two year two years show lowered pesticide costs, and generally lowered population densities of both pear psylla and the twospotted spider mite.

Table 1. Seasonal treatment programs used in conventional and modified programs on Bosc. 1991.

Timing	Material and Rate/acre (Date) Modified	Conventional
Dormant	horticultural oil 4 gal (2/7)	horticultural oil 4 gal (2/7)
Delayed Dormant	horticultural oil 4 gal (3/15)	horticultural oil 4 gal Asana 1 pt Lorsban 2 qts (3/15)
1st Cover	Dimilin 0.75 lb oil 1% (5/6)	Guthion 3.0 lb oil 1% (6/4)
2nd Cover	Dimilin 0.75 lb oil 1% (6/7)	Guthion 3.0 lb Mitac 3 lbs (6/21)
3rd Cover	Dimilin 0.75 lb oil 1% (7/15)	Guthion 3.5 lbs Agrimek 16 ozs oil 0.25%
4th Cover	Dimilin 0.75 lb (8/20)	Guthion 3.5 lb (8/30)
Total Material Cost/Acre	$144.60	$291.00

Table 2. Population densities of the twospotted spider mite (TSM) in conventional and modified seasonal control program on the Bosc pear variety. 1991.

Program (see table 1)	No. TSM/leaf 4/29	5/28	6/03	6/20	7/01	7/10	7/26	8/07	8/22	9/04	9/26	X̄
Conventional	0.0	0.0	0.0	0.0	0.6	8.3	21.2	3.6	17.1	13.0	63.1	11.5
Modified	0.0	0.1	0.0	0.0	0.0	2.5	0.5	7.5	22.3	19.3	28.6	7.3

Table 3. Population densities of immature pear psylla (PP) in a conventional and a modified program on the Bosc pear variety. 1991.

Program (see table 1)	No. pear psylla immatures/leaf 4/29	5/28	6/03	6/20	7/01	7/10	7/26	8/07	8/22	9/04	9/26	X̄
Conventional	0.4	0.9	1.4	2.8	1.3	0.4	0.2	0.2	0.1	0.2	0.9	0.8
Modified	1.6	0.6	0.4	0.9	3.2	1.6	0.5	0.2	0.2	0.2	0.1	0.9

Table 4. Population densities of adult pear psylla in a conventional and a modified control program on the Bosc variety. 1991

Program (see table 1)	No. pear psylla adults/tap 2/07	2/26	3/11	3/25	4/02	4/18	4/29	5/15	5/22	6/21	7/10	9/26	X̄
Conventional	2.9	14.0	5.2	0.2	0.2	0.6	0.8	0.5	0.2	9.9	0.6	7.2	3.5
Modified	3.2	13.2	6.8	2.3	1.4	1.4	1.1	0.4	0.2	4.1	2.4	0.5	3.1

Table 5. Direct fruit injury by pear psylla in a conventional and a modified program. 1991. Harvest Sept. 16.

Program (see table 1)	% psylla downgrading at harvest Early Season "frogging"	Late Season Staining
Conventional	1.2	0.0
Modified	0.6	0.8

1991 AGRIMEK/KINETIC SPRAY ADJUVANT TRIAL

Phil VanBuskirk and Rick Hilton

Agrimek abamectin, is an acaricide/psyllicide presently used on pears in southern Oregon. In order for Agrimek to be an effective control for pear psylla, (Psylla pyricola) and two-spotted spider mite (Tetranychus urticae), a summer spray oil must be combined with the chemical. Under certain conditions this combination can mark light skinned pear varieties such as D'Anjou, Comice and Green Bartlett which results in a down grading of that fruit.

During the foliar season of 1991 a trial evaluating the effectiveness of Agrimek in combination with Kinetic for control of pear psylla and the two spotted spider mite was conducted. It was thought that Kinetic, which is a wetter/spreader/penetrant adjuvant might reduce or eliminate the phytotoxicity occasionally seen when Agrimek is combined with oil. Two trials were conducted, one on OSU Southern Oregon Experiment Station property and the second in a commercial orchard.

Methods

Experiment Station-- Four different treatments were applied and compared: 1) Agrimek 10 oz./acre in combination with Summer spray oil 0.25%; 2) Agrimek 10 oz./acre in combination with Kinetic 16 oz. acre; 3) Agrimek 10 oz./acre in combination with Kinetic 16 oz./100 and 5) Mitac 50 WP 3 lb./acre (for psylla) with no miticide treatment. Each treatment was applied to small Bartlett pear trees 15-20 years old, at the rate of 100 gallons per acre by airblast sprayer on July 17, 1991.

Commercial Orchard-- Two different treatments were applied and compared: 1) Agrimek 16 oz./acre plus Kinetic 16 oz./acre and 2) Agrimek 16 oz./acre plus Regulaid 1 qt/acre. Both treatments were applied to large D'Anjou pear trees 50-60 years old, at a rate of 250 gallons per acre by airblast sprayer on July 24, 1991.

Pear psylla eggs and nymphs, and two-spotted spider mite eggs and post-eggs were sampled by randomly selecting 30-60 leaves per plot and processing the leaves through a leaf brushing machine. All counts were then made with the aid of a dissecting microscope. Psylla adults were sampled only in the Experiment station trial by tapping five trees per plot, and counting the adults that dropped onto an 18 X 18" square collecting frame. Pretreatment samples were taken with posttreatment samples taken every 7-10 days.

Results

Southern Oregon Experiment Station-- The results of the trial indicated that all treatments, with the exception of the lower rate of Kinetic, suppressed pear psylla populations below the retreatment threshold of 0.5 E+N/leaf for over 4 weeks (Table 1). This was extremely surprising due to the low rate of Agrimek used and the late season application. Control of two-spotted spider mite during the trial indicated that at 4 weeks post-treatment both rates of Kinetic combined with Agrimek outperformed the use of Agrimek plus oil (Table 2). Evaluation of the pear fruit for phytotoxicity following treatment revealed no problem with any of the treatments tested.

Commercial Orchard Data collected from the trial conducted on grower property showed that the treatment of Agrimek plus Kinetic was better at controlling pear psylla than controlling two-spotted spider mite when compared to the Agrimek plus Regulaid treatment (Tables 3 & 4). The difference between the results of this trial and the one above is most likely due to the variety of pear tested, size of the trees, spray coverage and the rate of Agrimek tested. Again, as in the trial above no problem with phytotoxicity to pear fruit was observed in any of the treatments.

It would appear, using Kinetic, inplace of spray oil, with Agrimek showed some promise for increasing control of pear psylla and two-spotted spider mite while reducing the potential for spray damage on pear fruit. However, it should be repeated again in 1992 at petal fall and/or first cover with two separate tests being set-up, one specifically for control of pear psylla and a second designed to measure two-spotted spider mite control.

Table. 1 Agrimek/Kinetic Evaluation for Control of Pear Psylla 1991
Southern Oregon Experiment Station (Treated 7/17/91).

Treatment	Average Number of Pear Psylla Adults (A)/Tap OR Eggs plus Nymphs (E+N)/Leaf									
	Pre-treatment 7/14		7/26		8/2		8/9		8/16	
	A	E+N	A	E+N	A	E+N	A	E+N	A	E+N
Agrimek (10 oz/ac) PLUS Kinetic (1/2 pt/ac)	14.6	3.4	4.6	0.4	2.4	0.3	0.8	0.1	—	0.7
Agrimek (10 oz/ac) PLUS Kinetic (1 pt/ac)	15.8	1.5	3.2	0.5	0.7	0.4	0.1	0.5	—	0.5
Agrimek (10 oz/ac) PLUS 0.25% summer spray oil	11.4	3.8	4.8	0.2	6.6	0.1	2.6	0.0	—	0.5
Standard Spray Mitac 50 WP 3 lb/ac	19.4	3.7	7.0	0.7	3.6	0.1	0.8	0.1	—	0.1

Table. 2 Agrimek/Kinetic Evaluation for Control of Spider Mites on
Pear: Southern Oregon Experiment Station (Treated 7/17/91).

Treatment	% Reduction of Eggs and Immatures When Compaired to the Control			
	7/26	8/2	8/9	8/16
Agrimek (10 oz/ac) PLUS Kinetic (1/2 pt/ac)	8%	-86%	84%	94%
Agrimek (10 oz/ac) PLUS Kinetic (1 pt/ac)	-285%	98%	98%	98%
Agrimek (10 oz/ac) PLUS 0.25% summer spray oil	54%	91%	84%	52%

Table. 3 Agrimek/Kinetic Evaluation for Control of Pear Psylla 1991 Earnest Orchards (Treated 7/24/91).

Treatment	Average Number of Pear Psylla Eggs plus Nymphs (E+N)/Leaf		
	Pre-treatment 7/23	8/5	8/15
Agrimek (16 oz/ac) <u>PLUS</u> Kinetic (1/2 pt/ac)	0.00	0.03	0.13
Agrimek (16 oz/ac) <u>PLUS</u> Regulaid (1 qt/100)	0.03	0.07	0.20

Table. 4 Agrimek/Kinetic Evaluation for Control of Spider Mites on Pear 1991: Earnest Orchards (Treated 7/24/91).

Treatment	Average Number of Spider Mite Eggs and Immatures/Leaf		
	Pre-treatment 7/23	8/5	8/15
Agrimek (16 oz/ac) <u>PLUS</u> Kinetic (1/2 pt/ac)	24.9	2.8	39.8
Agrimek (16 oz/ac) <u>PLUS</u> Regulaid (1 qt/100)	6.1	0.8	6.0

1991 USE OF AGRIMEK IN SOUTHERN OREGON COMMERCIAL PEAR ORCHARDS

1991 was the fourth season of Agrimek insecticide/miticide application to southern Oregon commercial pear orchards for the control of twospotted spider mite (TSM) and pear psylla. Due to lack of seasonal efficacy of available registered acaricides, Agrimek was again made available under an Emergency Exemption (Section 18) from the Environmental Protection Agency and the Oregon Department of Agriculture while full registration of the material is still pending.

Cool weather in spring and early summer resulted in low pest pressure from TSM and relatively high pressure from pear psylla. For this reason, Agrimek was generally applied at the higher rate of 16 oz/ac targeting psylla as well as mites. In standard program blocks, Agrimek was applied at the second cover timing from June 18 to 25. However, due to typically low mite and psylla populations under the selective program, reduced rates of Agrimek were not warranted until third cover (July 15-19) in over half of these blocks. Targeting only TSM, many of these applications were made at 12 oz. rather than 10 oz/ac in order to compensate for reduced absorption by older leaves.

Spider mite control. Seasonal control of TSM was achieved in the two blocks where Agrimek was applied at the first cover timing. The Comice block was treated with 10 oz/ac while the D'Anjou block received the 16 oz. rate.

Second cover Agrimek application to selective program blocks resulted in seasonal control in all cases at both the 10 oz and 16 oz/ac rates. Among standard program blocks, 88% experienced seasonal control while the remainder varied from 5 weeks of control to apparent failure. These results did not appear to relate to the rate of application.

All third cover applications, whether 10 oz. or 12 oz/ac were successful in preventing mite damage to the trees. In 85% of the cases, populations were drastically reduced while in the few other blocks, mite populations were maintained just below damaging levels.

Pear psylla control. Results with pear psylla contrasted sharply to the success in TSM control. Second cover timing of Agrimek at 16 oz/ac to 28 pear blocks provided psylla control in only one case, a Comice block under the selective program. Another four of the treated blocks experienced psylla declines but not to economic levels. The remaining 82% of blocks treated at second cover showed increasing pear psylla populations in samples collected at 2 to 4 weeks post-treatment.

Due to early season mite and psylla suppression by Dimilin plus spray oil, Agrimek applications were not made to most selective program blocks until the third coverspray. Despite potentially damaging psylla populations, only spider mites were targeted due to the recent experience at second cover. Application rates were 10 oz. and 12 oz/ac. Interestingly, psylla populations were significantly reduced in all blocks and 12 of the 16 blocks experienced complete control. One application at 18 oz/ac, specifically targeting psylla, also resulted in seasonal control. Although no full explanation of this unusual result is available, it may relate to lack of new growth (no untreated oviposition sites) late in the growing season.

IMPLEMENTATION OF A SELECTIVE PROGRAM FOR SOUTHERN OREGON PEAR, 1991

1991 was the sixth year in which the selective insect growth regulator (IGR), Dimilin, was available to commercial pear growers under an Experimental Use Permit (EUP) for control of codling moth and suppression of pear psylla. Through an intensive orchard monitoring program and pesticide management on a block by block basis, growers are able to reduce pesticide costs by approximately 50% on most cultivars by employing Dimilin and the selective pest management program. In 1992, this cost reduction was realized through reduced application rates of Agrimek and application of Mitac to fewer pear blocks.

Codling Moth. Cool weather throughout the spring of 1991 delayed codling moth (CM) development so that coversprays were applied nearly 30 days later than normal as based on a phenology model coupled with CM trap monitoring. Despite this delay, two full generations of codling moth succeeded in damaging low levels of fruit in both selective and standard pest management pear blocks throughout the valley.

Among 17 selective blocks closely evaluated at harvest, 8 revealed CM activity on the fruit but 7 of these were tolerable as light stings and downgrading at well under 1% of the sample. Sub-economic damage was recorded from an additional four of the remaining 53 blocks in the selective program.

Most of the damage occurred to the CM-sensitive 'Bartlett' cultivar which is at least partly explained by a reduced rate of application. Dimilin's EUP label allows a total of 3 lb/ac to be applied per season which, in the past, has been equally divided into three coversprays at 1 lb/ac each. Attempts to reduce the rate to 3/4 lb/ac per application (as is used on the more CM-tolerant winter pears) apparently allowed low levels of infestation.

The two blocks which suffered significant CM damage in 1990 under the selective program were returned to an organophosphate program for 1991. Fruit damage in these blocks declined somewhat despite higher season-total trap catches this year.

Spider mites. As in previous years, selective program blocks began the season with smaller overwintering twospotted spider mite populations than comparative standard organophosphate program pear blocks. One-third of the selective blocks required no specific miticide applications to supplement suppression provided by summer spray oil in the coversprays Spider mite populations developed with warmer temperatures around mid-season and those warranting treatment generally received the low 10 oz or 12 oz/ac rates of Agrimek at the third cover timing in mid-July. No selective blocks suffered damage from spider mites in 1991.

Pear psylla. Despite very high overwintering populations of pear psylla throughout the valley, Dimilin plus spray oil provided excellent psylla suppression. Over 40% of selective program blocks received no additional pesticide applications targeting this pest. Although fruit marking caused by psylla was observed in several blocks at harvest, it was rarely severe enough to cause downgrading which never exceeded 2% of the fruit sampled.