

Pome Fruits—Implementation

Leafrollers in Apple

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**Pandemis Leafroller**

**Study site description.** MD as a control for pandemis leafroller (PLR) was evaluated at a single study site in 1992. Six apple blocks (23.6 acres) were treated with Hamaki-con (Biocontrol, Ltd.) dispensers. These dispensers contain ca. 150 mg of Z11-14OAc, which is the main component of the PLR pheromone. Application rates of 250 d/a, 400 d/a, and two treatments of 400 d/a were evaluated. In addition, combination treatments of pheromone and *Bt* were tested.

**Trap catch and larval density.** Trap catch through the season and changes in larval densities from one generation to the next were used to evaluate the effectiveness of MD. Three Pherocon 1C traps baited with 1 mg of PLR pheromone (96%: Z11-14Ac, 4%: Z9-14Ac) in red septa were placed in each orchard in late May. Larval sampling was conducted toward the end of each generation. The overwintering generation was sampled post petal fall when the population was comprised of late instar larvae feeding in spur shoot leaves. Densities of the summer generation were estimated in mid-summer when most individuals were late instar larvae feeding in shoot tips. All growing points on each of 36-48 trees per block were examined during each generation.

The first application of pheromone was targeted at adults of the overwintering generation which were active from May to July. Good control was achieved where initial population densities were low (Table 1). Treatment of blocks I and J with 400 d/a resulted in a 98% reduction in trap catch of the OW generation moths relative to trap catch in a non-pheromone treated control. Moreover, larval densities at the end of the summer generation were significantly lower than those at the end of the overwintering generation. In contrast, 400 d/a provided less suppression in two blocks with high PLR pressure (Table 1, blocks C and D). In both blocks only an 88% reduction in trap catch was recorded and larval densities of the summer generation were 5-fold greater than the overwintering generation. A similar degree of population increase was found in two blocks with low PLR pressure (Table 1, blocks E and F) that were treated with 250 d/a.

The effectiveness of these treatments against the summer generation will not be determined until the spring of 1993 when larval densities resulting from mating in late summer of 1992 will be taken. However, levels of trap shutdown during the flight of the summer generation in four of the six MD blocks were below 93% (Table 1), suggesting an inadequate degree of disruption.

### **Obliquebanded Leafroller**

**Study site description.** In 1992 we also initiated tests to evaluate MD as a control for obliquebanded leafroller (OBLR). Five apple blocks (17.2 acres) at one site and two apple blocks at a second site (10 acres) were treated with Hamaki-con dispensers at various rates. The Z11-14OAc released from these dispensers comprises the main component of the OBLR pheromone.

**Trap catch and larval density.** Trap catch through the season and changes in larval densities from one generation to the next were used to evaluate the effectiveness of MD. Three Pherocon 1C traps baited with 1 mg of OBLR pheromone in red septa were placed in each orchard in late May. Larval sampling of the overwintering and summer generation was conducted as described for PLR. Ten or 20 growing points on each of 36-48 trees per block were examined during each generation.

Good suppression of the overwintering generation of OBLR by a single application of 400 d/a was recorded in five of the seven blocks (Table 2). Each had a low starting population. The other two blocks were under higher pressure and were treated with a reduced rate of pheromone (250 d/a). Larval densities at the end of the summer generation in both were significantly higher than the pre-treatment counts recorded at the end of the overwintering generation. However, this relatively poor level of control may have been associated with a late application date (ca 25% of emergence had already occurred), rather than a failure of the pheromone. This explanation is supported by the high level of trap shutdown recorded in both blocks following the application of pheromone (Table 2).

### **PLR and OBLR Small Plot Trials**

**Comparison of pheromone blends.** Some research in MD suggests that the best results will occur if the complete pheromone blend of the target species is used in a dispenser. Shin-Etsu provided dispensers loaded with the reported blends of PLR, a 96:4 mixture of Z11-14OAc and Z9-14OAc and OBLR, a 90:5:5 mixture of Z11-14OAc, E11-14OAc and Z11-14OH. The Hamaki-con dispenser used in mating disruption trials contains 100% Z11-14OAc. In addition, Scentry Inc. provided "spiral type" dispensers loaded with either 100 mg of Z11-14OAc (100%) or a 95:5 mixture of Z11-14OAc and Z11-14Ald. To evaluate the effectiveness of single and multiple component dispensers for MD of leafrollers small plot trials were conducted during the flight of the second generation in 1992. Tests were conducted in orchards at three sites (W6, W9 and MF1). Two or more pheromone blends and a non-pheromone treated control were tested at each site. Treatments were applied to three 0.3 acre blocks and were evaluated by comparing trap catch. A single Pherocon 1C trap baited with either 1 mg of PLR pheromone (W6 and W9) or 1 mg of OBLR pheromone (MF1) was placed in each block.

Capture of either OBLR or PLR males was lower in all of the pheromone treatments than in the untreated controls (Table 3). Dispensers releasing the single component were as effective as those releasing a blend. Trap catch in blocks treated with the spiral dispenser was not significantly different than in those treated with the twist-tie dispenser. However, a consistent pattern of higher numbers of moths caught in blocks treated with the spiral dispenser was noted.

**Pheromone dosage in traps.** In light of our work with CM, we examined the potential

for increasing trap sensitivity in leafroller MD orchards by loading septa with 10 mg (10 times the normal load) of pheromone. The relative attractancy of septa loaded with 1 mg or 10 mg of pheromone was determined in paired comparisons in all pheromone treated blocks at site W6 (PLR) and sites MF1 and MF2 (OBLR). To minimize position effects, paired traps were rotated twice a week. Septa were changed at three-week intervals and trap bottoms were replaced every six weeks, more often if dirty.

Capture of PLR males in traps baited with 10 mg was significantly ( $p < 0.05$ ) greater than in traps baited with 1 mg. Overall, there was about a 5- to 6-fold increase in sensitivity. Traps baited with 10 mg of pheromone may provide a means of following the seasonal development of PLR and predicting when population levels are too high to control with MD alone.

Capture of OBLR males in traps baited with 10 mg was not significantly ( $p < 0.05$ ) different than in traps baited with 1 mg. Treatment of orchards with Z11-14OAC greatly inhibits OBLR trap catch and a higher dosage, in the range of 25 mg, may be required to increase the attractancy of traps.

**Table 1.** PLR trap catch and larval density in pheromone and non-pheromone treated blocks at study site 6 (W6) in 1992.

Block	Treatment	Mean trap catch (moths/trap)		% reduction in trap catch		Mean larval density <sup>2</sup> (larvae/tree)	
		OW <sup>1</sup>	SU	OW	SU	OW	SU
H	<i>Bt</i> x 2 Pheromone	80.3	642.2			1.21	2.45
I	400	1.7	11.0	98	98	1.56*	0.48*
J	400 + <i>Bt</i>	1.3	20.3	98	97	0.97*	0.28*
A	(Oil & Lorsban) + <i>Bt</i> Pheromone	170.0	412.0			0.34	0.52
F	250	3.7	34.0	98	92	0.19*	1.58*
E	250 + <i>Bt</i>	3.0	39.7	98	90	0.23*	0.80*
D	400 + ( <i>Bt</i> x 2)	21.0	64.0	88	84	0.81*	4.85*
C	(400 x 2) + ( <i>Bt</i> x 2)	20.0	71.7	88	83	0.94*	5.00*

<sup>1</sup>OW=overwintering generation, SU=summer generation.

<sup>2</sup>Mean pairs followed by \* are significantly different (paired *t*-test,  $p < 0.05$ ).

**Table 2.** OBLR trap catch and larval density in pheromone and non-pheromone treated orchards at Milton-Freewater study sites 1 (MF1) and 2 (MF2) and Vantage study site 1 (V1) in 1992.

Block	Treatment	Mean trap catch (moths/trap)		% reduction (moths/trap)		Mean larval density <sup>2</sup> (larvae/tree)	
		OW <sup>1</sup>	SU	OW	SU	OW	SU
MF1	Organophosphates		82.0				
	Organophosphates	29.5	115.0			0.47	0.70
	Pheromone						
	Parathion & (0 + 400)	33.0	12.5		89	0.20	0.40
	250 + 400	0.7	7.3	98	94	1.48	2.25
	250 + 800	0.3	2.0	99	98	1.35*	3.98*
MF2	Organophosphates	35.0	141.3			0.22*	0.03*
	Pheromone						
	400 + ( <i>Bt</i> x 4)	0.7	35.7	98	75	0.33*	0.07*
	400 + Parathion	1.0	5.8	97	96	0.18	0.18
V1	<i>Bt</i> x 2	25.5					0.20
	Pheromone						
	400	0.3	0.3	99			0.00
	400 + ( <i>Bt</i> x 2)	0.3	0.7	99			0.00

<sup>1</sup>OW=overwintering generation, SU=summer generation.

<sup>2</sup>Mean pairs followed by \* are significantly different (paired *t*-test, *p*<0.05).

**Table 3.** Comparative capture of obliquebanded leafroller (OBLR) and pandemis leafroller (PLR) moths in blocks treated with single component pheromone dispensers, multiple component dispensers or no pheromone.

Dispenser	Treatment	Mean OBLR/trap <sup>1</sup>	Mean PLR/trap <sup>1</sup>	
		Site MF1	Site W9	Site W6
Twist-tie	Z11-14OAc:Z9-14OAc (96:4)			33.0ab
Twist-tie	Z11-14OAc:E11-14OAc:Z11-14OH (95:5:5)	0.7a		
Twist-tie	Z11-14OAc (100)	0.7a	47.7a	7.7a
Spiral	Z11-14OAc (100)	6.0a	155.7a	
Spiral	Z11-14OAc:Z11-14Ald (95:5)	2.0a	110.3a	
	No pheromone	66.0a	649.3b	148.3b

<sup>1</sup>Mean pairs followed by the same letter are significantly different (ANOVA, Student-Newman-Keuls at *P*=0.05). Log<sub>10</sub> (*x*+1) applied to catches before analysis; actual means are given.