

USING A COMBINED CM/OBLR "PUFFER" DISPENSER FOR OBLIQUE-BANDED LEAFROLLER MATING DISRUPTION

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ABSTRACT

A trial was established in Lake and Mendocino County pear orchards to determine whether an improved pheromone formulation could successfully reduce damage from oblique-banded leafrollers (OBLR) when applied in a mating disruption program. Another lesser goal was to learn if codling moth (CM) control could be achieved using a reduced rate of pheromone emitted from aerosol dispensers. Two Paramount Aerosol Pheromone Dispensers[®] ("puffers") per acre of mixed CM/OBLR pheromone were applied downwind of units emitting only CM pheromone. Comparative treatments were CM/OBLR pheromone-only, CM/OBLR pheromone + chemical (i.e. pre-bloom Lorsban[®], BT and oil depending on the orchard), CM pheromone only + chemical, non-pheromone OP standard, and untreated control. Data included CM and OBLR trap catch, OBLR larval presence, and CM and OBLR damage. The CM/OBLR pheromone reduced OBLR trap catch significantly from 1999 levels 97%, versus only a 37% decrease in the CM pheromone only treatment. OBLR damage was higher, though not significantly, where CM/OBLR pheromone was not supplemented with either pre-bloom Lorsban[®] or in-season BT applications. Data on OBLR damage corroborates previous results that showed greatly reduced trap catch but unacceptable damage levels. It will be necessary to determine the source of moths in surrounding habitat and learn how far mated female moths will fly in order to explain why trap shut down fails to translate into reduced damage. CM trap catches were lower compared to 1999 in all orchards. CM damage occurred only in the organic orchard and was no greater than in the CM pheromone only block that received twice the amount of pheromone per acre. It may be possible, therefore, to reduce the amount of pheromone emitted (and hence program cost), especially in low-pressure orchards; however, this will require much more study.

INTRODUCTION

Oblique-banded leafroller (OBLR) has thus far been the main secondary pest problem related to codling moth mating disruption programs (CM MD) on the North Coast. Chemical control has been only partially successful for several reasons: 1) OBLR is difficult to monitor, thus impeding correct spray timing decisions; 2) an accurate phenology model for California is still being developed; and 3) the few registered chemicals are mainly organophosphates and pyrethroids, which are under scrutiny by regulatory agencies. BT, though effective when timed correctly, must be applied during ideal weather conditions, which often fail to occur on the North Coast in the spring. The field efficacy of new insect growth regulators (IGRs), e.g. Confirm[®] and the as yet unregistered Success[®], is limited due to need for excellent coverage and their use adds considerable expense to a MD program.

OBLR MD has been researched intermittently over the past several years. Dr. Harry Shorey tested several formulations of OBLR pheromone for trap shutdown ability (Shorey 1995). Dr. Alan Knight of USDA-ARS has also had some success using OBLR MD. However, previously

used pheromone formulations have failed to provide commercially acceptable control. Large scale use in 1997 in the Lake County areawide CM MD project resulted in a 97% trap shut down but failed to reduce OBLR damage to acceptable levels (Shorey and Elkins 1997). Based on experience in British Columbia and other places, Paramount Farming Company (dba Paramount Agricultural Technologies, Inc.) obtained reformulated OBLR pheromone, for testing in 2000. A successful trial of OBLR MD would greatly alleviate the (thus far) major problem associated with CM MD. It would also increase the efficiency of the puffer system by allowing dispensing of dual pheromones. The objective of the 2000 season was thus to test a combined CM/OBLR Paramount aerosol pheromone dispenser ("puffer") in areas already under puffer CM MD, and which had documented OBLR damage to see if an improved formulation would result in reduced damage as well as trap shut down.

PROCEDURES

Three comparison sites were established in April 2000. Two blocks were in Kelseyville, Lake County within the 820-acre areawide CM MD puffer project (Figure 1). The third comparison was in organic orchards in Potter Valley, Mendocino County, also under CM MD using puffers. The Lake County sites were divided into two 20-acre sections and the Potter Valley site into 10 and 15-acre sections. It was originally planned to utilize 40-acre section comparisons, however, the decision was subsequently made to utilize blocks with a history of OBLR data and research and these were 10-20 acres in size. The downwind section of each site was treated with two CM/OBLR pheromone puffer dispensers per acre and the upwind section with only the CM pheromone dispenser. The mixed units contained 36 grams each of CM and OBLR pheromone, versus the CM only units of 72 grams each. Since the two Lake County orchards were in the CM MD project, CM dispensers had already been hung in late March 2000. The second set of dispensers were hung in late April, resulting in CM being double treated with a total of 72 plus 36 grams. The Potter Valley site utilized the mixed unit as its CM as well as OBLR control so these were hung in March in order to provide CM control prior to OBLR biofix. CM control was thus achieved at this site with only 36 grams of CM pheromone per unit rather than the full 72 grams. A one-acre area was delineated in the center of each CM/OBLR section in which no supplemental CM or OBLR treatments were applied. This interior one acre was inadvertently omitted from the upwind CM-only blocks, thus data in the CM-only blocks includes any treatments applied in those sections. This was limited to only one pre-bloom application of Lorsban® but no in-season treatments for OBLR or CM in the two Lake County trials. The CM-only section in Potter Valley received the same OBLR and CM treatments (i.e. BT and oil) as the CM/OBLR section. Treatment materials and application dates for both OBLR and CM are shown in Figures 3 to 5.

Upwind standard (OP-treated) orchards and small, untreated controls were also monitored.

Treatments may be summarized as:

- 1) CM/OBLR puffer only (1 acre)
- 2) CM/OBLR puffer plus supplemental insecticides (pre-bloom Lorsban[®], BT, oil) at grower and PCA discretion (10-20 acres)
- 3) CM only puffer + supplemental insecticides (pre-bloom Lorsban, BT, oil) at grower and PCA discretion (10-20 acres)
- 4) Grower standard (OP-treated only)
- 5) Untreated controls

Thirteen OBLRW traps were hung in each block in addition to standard CM 1XL, 1XH and 10XH traps. OBLR larval presence was evaluated via three eye-level cluster samples in June and July. CM and OBLR damage was evaluated at the end of the first generation (tree fruit and ground samples), just prior to harvest (tree fruit sample), during harvest (bin sample), and post-harvest (tree fruit sample).

RESULTS AND DISCUSSION

Trap catches – 91% fewer OBLR moths were caught in the CM/OBLR pheromone treated blocks in 2000 versus in the pre-treatment year of 1999. This is compared to only 37% fewer caught in the CM only pheromone treated blocks, and was a significant difference (Table 1, Figure 2-2a). These results were similar to those obtained previously (Shorey and Elkins 1997). CM trap catches were very low in both Lake County blocks, regardless of treatment, but did show an increase in the CM/OBLR pheromone treated organic block in Potter Valley, which may be taken to indicate reduced confusion at the lower CM rate of 36 grams. This, however, contradicts damage data and would need to be confirmed in expanded trials. It is more likely that the increased trap catch in the organic blocks was due to other factors such as overwintering pressure from 1999 and the overall higher CM populations in 2000 which is also reflected in the untreated control levels (Table 2). The pattern of 1999 versus 2000 CM trap catches in the Potter Valley organic orchard is shown in Figures 6-6a.

OBLR larval presence – Damage was seen in the June cluster sample prior to observing larval presence. It is likely more worms would have been observed if samples had been taken from the top one-third of the trees. This shows the difficulty in locating larvae early in the season unless populations are quite high, as in the organic Potter Valley orchards. Worms were found in early July in all orchards, though in much less numbers than damaged fruit. By the end of July, damage had increased in all blocks and was greatest in the CM/OBLR puffer only blocks, though actual worms were still elusive and there was no significant difference among treatments (Table 3).

OBLR damage – Differences in damage severity among treatments was non-significant and quite variable among the sites. Results of the 300 cluster samples did corroborate the pre-harvest tree and bin samples. OBLR damage was higher in the CM/OBLR pheromone only blocks and least where supplemental insecticides (i.e. pre-bloom Lorsban[®] alone or followed by BT and/or oil) had been applied. OBLR damage in the organic Potter Valley CM only + BT/oil treated block was higher than in the CM/OBLR + BT/oil block in both the first generation and pre-harvest tree fruit samples. This may indicate an additive effect of the OBLR pheromone and supplemental BT treatments. Bin damage, however, was higher in the CM/OBLR treated block (Tables 5 and 6).

Codling moth damage – Damage was highest in the untreated controls. It was next highest in the CM/OBLR only blocks but equal in the CM/OBLR plus insecticide and CM only plus insecticide blocks. This contradicts trap catch data and suggests the lower pheromone rate in the CM/OBLR block had no negative effect on CM control and that supplemental oil provided CM control (Tables 4 and 5). There was no damage in the OP treated standard orchards.

The post-harvest sample gave no useful information on OBLR damage as most affected fruit had fallen or was damaged unrecognizable. This is in contrast to CM for which the post-harvest sample is quite useful and again showed no difference between the CM/OBLR and CM only treated blocks (Table 5).

CONCLUSIONS

The mixed CM/OBLR puffer significantly reduced trap catches in 2000 compared to CM only treated blocks when comparing 1999 versus 2000 catch. This corroborates previous large-scale experience with OBLR pheromone. There were, however, no significant differences in OBLR damage among treatments. OBLR damage appeared highest when the mixed unit was un-supplemented by insecticides, but may have an additive affect when applied in conjunction with insecticides (based only on results from one sampling time at one site). CM damage appeared unaffected by the reduced pheromone rate in the mixed puffer unit, but this conclusion is based only on one site and must also be confirmed in future trials.

Mating disruption of OBLR appears able to reduce trap catch. The key question is whether trap shut down on a large scale will result in reduced damage. It is likely that MD may eventually be one tool in integrated program combined with judicious use of insecticides such as BT and IGRs. It will, however, be necessary to determine the source of moths in surrounding habitat and learn how far mated female moths will fly to reach host trees. This may explain why trap shut down fails to translate into reduced damage and determine how large treated areas must be to achieve control.

ACKNOWLEDGEMENTS

Much thanks goes to growers Lars Crail, Don Eutenier and Syd Stokes of Lake County and Dan and Alice Todd of Mendocino County. Thanks also to Paramount Agricultural Technologies, Inc., particularly Pheromone Specialist Roland Gerber, for technical support and for preparation and the use of the mixed CM/OBLR pheromone dispenser units.

REFERENCES

- Shorey, H.H. and R. Elkins. 1997. Disruption of pheromone communication for control of codling moth and leafrollers in pears. 1997 California Pear Research Reports. p. 25-37.
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**Total OBLR Trap Catch
Kelseyville, Lake County and Potter Valley, Mendocino County**

May - September 1999 vs. 2000

Table 1

Orchard	1999	2000	% CHANGE
CM/OBLR Puffer ± Chem			
Eutenier	259	39	(85)
S/Timothy	118	11	(91)
Todd Sides	106	4	(96)
Average	161	18	(91) a
CM only Puffer + chem			
Cookson (pre-bloom Lorsban only)	187	159	(15)
S/Stage (pre-bloom Lorsban only)	48	36	(25)
Todd Boynton (Bt + oil)	546	154	(72)
Average	260	116	(37) b
OP Grower Control			
Springer	55	63	15
Gary Todd	71	na	na
Average	63	63	-
			*

* Mean separation between treatments significant at P<0.05.

**Total Codling Moth Trap Catch
Kelseyville, Lake County and Potter Valley, Mendocino County
April - September 1999 vs. 2000**

Table 2

Orchard	1999	2000	% Change
CM/OBLR Puffer ± Chem			
Eutenier	0	0	0
S/Timothy	0	2	200
Todd Sides	13	33	153
Average	4.3	11.7	117.7
CM Only Puffer + Chem			
Cookson (pre-bloom Lorsban only)	0	5	500
S/Stage (pre-bloom Lorsban only)	0	0	0
Todd Boynton (Bt + oil)	80	28	(64)
Average	27	11	188.0
OP Grower Control			
Springer	10	1	(82)
Gary Todd	12	0	(92)
Average	11	0.5	(87.0)
Untreated Control			
Quercus Seven Acres	25	13	(46)
Gold Dust	84	83	(1)
Harvey apples	37	72	92
Average	48.7	56.0	46.3
			NS

Data transformed using (x+1) to accommodate zero catches.

Mean separation between treatments not significant at P>0.1.

OBLR Damage And Larvae
Kelseyville, Lake County and Potter Valley, Mendocino County
% / 300 Clusters

Table 3

Treatment	June 20-21 669°D (KV)		July 5 1088°D (KV)		July 25 1511 °D (KV)	
	Damage	Worms	Damage	Worms	Damage	Worms
CM/OBLR Puffer Only						
Eutenier Home	0.0	0.0	0.0	0.0	10.0	0.0
S/Timothy	0.3	0.0	0.3	0.0	2.3	0.0
Todd Sides*	1.3	0.0	17.3	1.3	23.7	-
Average	0.5	0.0	5.9	0.4	12.0	0.0
CM/OBLR Puffer + Chem						
Eutenier Home (pre-bloom Lorsban, BT)	0.0	0.0	0.0	0.0	2.0	0.0
S/Timothy (pre-bloom Lorsban only)	0.0	0.0	1.3	0.7	1.3	0.0
Todd Sides* (Bt + oil)	2.0	0.0	13.3	0.7	13.7	-
Average	0.7	0.0	4.9	0.5	5.7	0.0
CM Only Puffer + Chem						
Cookson (pre-bloom Lorsban only)	0.3	0.0	0.0	0.0	0.3	0.0
S/Stage (pre-bloom Lorsban only)	0.0	0.0	0.3	0.3	0.7	0.0
Todd Boynton* (Bt+oil)	5.3	0.0	17.3	0.7	9.7	-
Average	1.9	0.0	5.9	0.3	3.6	0.0
OP Grower Control						
Gary Todd	-	-	-	-	0.0	0.0
	NS		NS	NS	NS	-

* Potter Valley: 738 °D (6-21), 1101°D (7-5), 1614 °D (7-26)

NS=means not significant at P>0.1.

1st Generation CM And OBLR Damage
Kelseyville, Lake County and Potter Valley, Mendocino County
Tree Fruit Samples - %/1000 June 27-28, 2000
Ground Fruit Samples - %/500 July 18, 2000

Table 4

Treatment	CM			OBLR
	Eggs	Damage	Ground	Damage
	998°D (KV)		1335°D (KV)	897°D (KV)
CM/OBLR Puffer Only				
Eutenier Home	0.0	0.0	0.0	1.9
S/Timothy	0.0	0.0	++	0.0
Todd Sides*	9.7	5.3	74.8	7.9
Average	3.2	1.8 a	37.4	3.3
CM/OBLR Puffer + Chem				
Eutenier Home (pre-bloom Lorsban, BT)	0.0	0.0	0.0	0.7
S/Timothy (pre-bloom Lorsban only)	0.0	0.0	++	0.0
Todd Sides* (Bt + oil)	11.5	2.0	54.4	1.6
Average	3.8	0.7 a	27.2	0.8
CM Only Puffer + Chem				
Cookson (pre-bloom Lorsban only)	0.0	0.0	++	0.0
S/Stage (pre-bloom Lorsban only)	0.0	0.0	++	0.1
Todd Boynton* (Bt + oil)	1.3	2.5	78.6	5.2
Average	0.4	0.8 a	78.6	1.8
Grower OP Control				
Springer Mauldin	0.0	0.0	++	0.0
Gary Todd *	0.0	0.0	0.0	0.1
Average	0.0	0.0	0.0	0.05
Untreated Control				
Quercus Seven Acres	3.3	3.8	50.4	1.0
Gold Dust (500 fruit)	0.6	27.8	++	1.6
Harvey apples*	0.0	16.3	++	++
Average	1.3	16.0 b	50.4	1.3
	NS	*	-	NS

* Potter Valley: 1160 CM °D, 974 OBLR °D, 1471 Ground °D

* means separation between treatments significant at P<0.05. NS=means not significant at P>0.1.

++ No sample due to an inadequate amount of remaining fruit.

**Late 1st, 2nd And 3rd Generation CM And OBLR Damage
Kelseyville, Lake County and Potter Valley, Mendocino County
April - September 2000**

Table 5

Treatment	CM DAMAGE			OBLR DAMAGE		
	Pre-harvest Tree	Bin	Post- harvest	Pre-harvest Tree	Bin	Post- harvest
CM/OBLR Puffer Only						
Eutenier Home	0.1	0.0	++	3.2	5.8	0.0
S/Timothy	0.05	0.0	++	0.5	1.3	0.0
Todd Sides	23.7	31.1	0.0	4.9	9.0	0.0
Average	11.9	15.6	0.0	2.9	5.4	0.0
CM/OBLR Puffer + Chem						
Eutenier Home (pre-bloom Lorsban, BT)	0.0	0.0	0.0	0.5	2.9	0.0
S/Timothy (pre-bloom Lorsban only)	0.0	0.0	0.0	0.0	0.8	0.0
Todd Sides (Bt + oil)	24.2	24.6	36.0	1.3	5.2	0.0
Average	8.1	8.2	12.0	0.6	3.0	0.0
CM Only Puffer + Chem						
Cookson (pre-bloom Lorsban only)	0.0	0.0	0.0	0.15	0.1	0.0
S/Stage (pre-bloom Lorsban only)	0.0	0.0	0.0	0.15	0.2	0.0
Todd Boynton (Bt + oil)	21.7	23.8	38.0	3.6	3.7	0.0
Average	7.2	7.9	12.7	1.3	1.3	0.0
Grower OP Control						
Springer Mauldin	0.0	0.0	0.0	0.0	0.3	0.0
Gary Todd	0.0	0.0	0.0	0.0	0.0	0.0
Average	0.0	0.0	0.0	0.0	0.2	0.0
Untreated Control						
Quercus Seven Acres	21.4	24.7	6.0	0.4	7.3	0.0
Gold Dust (500 fruit)	63.2	71.0	86.0	1.4	2.4	0.0
Harvey apples	27.5	++	++	++	++	++
Average	37.4	47.9	46.0	0.9	4.9	0.0
	NS	NS	NS	NS	NS	NS

** No sample due to an inadequate amount of remaining fruit.

NS = means not significant at P>0.1.

Figure 1

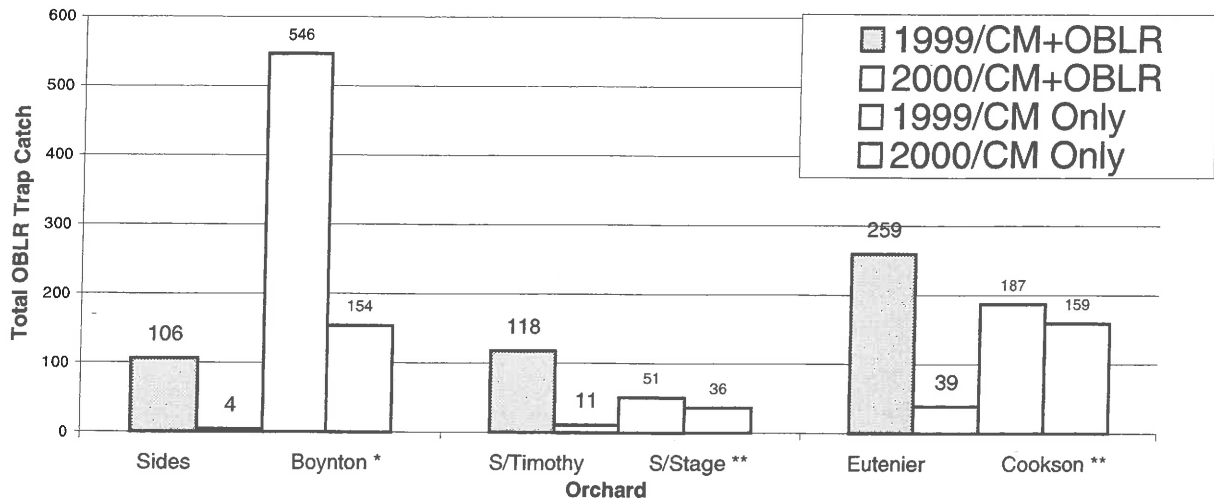
Prevailing wind W,NW

Total OBLR Catches for the Entire Season
Kelseyville, Lake County - 2000



TOTAL OBLR TRAP CATCH - CM/OBLR vs. CM-ONLY PUFFERS
 Kelseyville, Lake County and
 Potter Valley, Mendocino County
 1999 vs. 2000

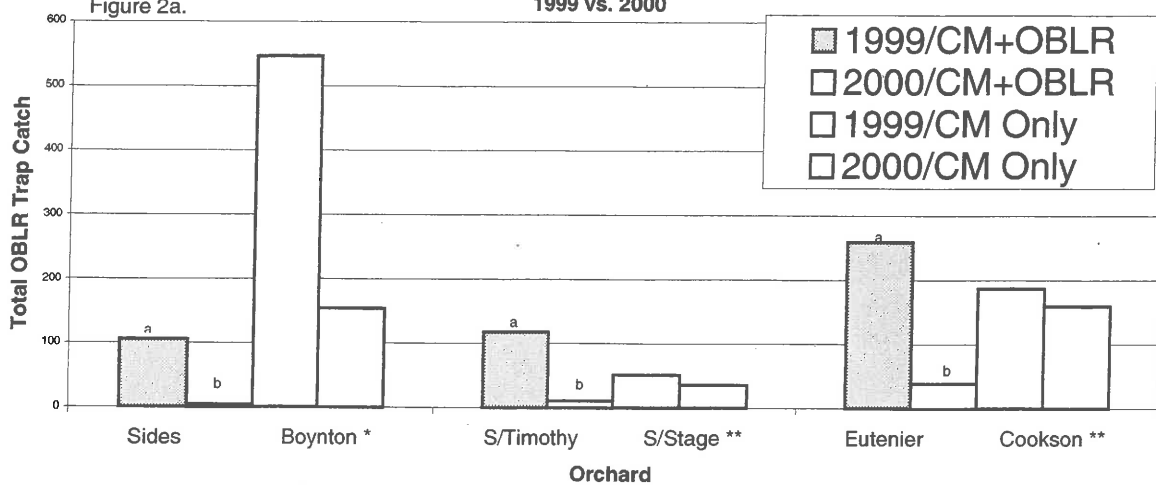
Figure 2



Mean separation among orchards by Tukey-Kramer multiple range test, $P < 0.05$
 * Means significant at $P < 0.1$, ** Means not significant at $P > 0.1$

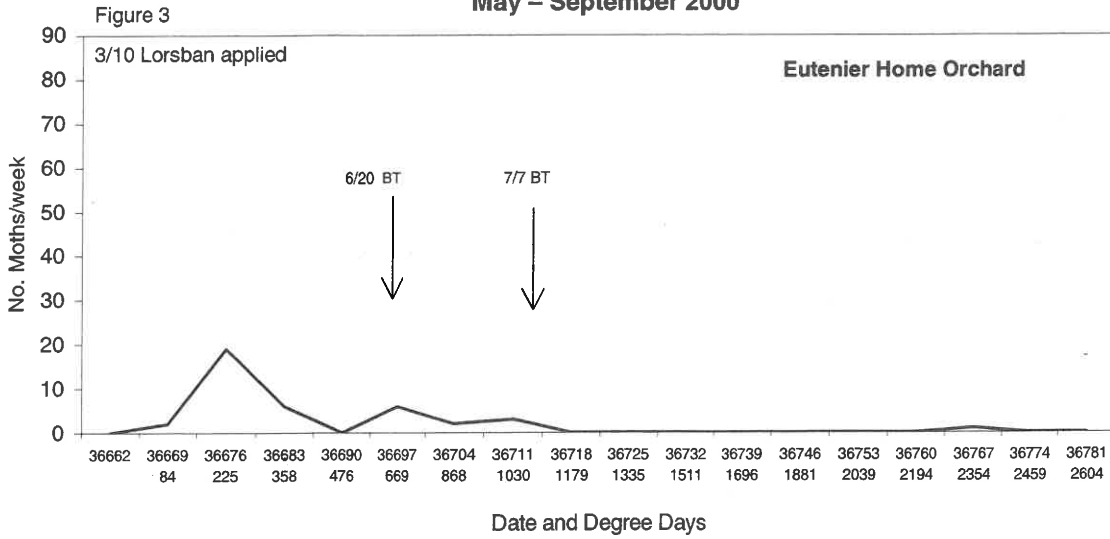
COMPARISON OF CHANGE IN OBLR TRAP CATCH
CM/OBLR vs. CM-ONLY PUFFERS
 Kelseyville, Lake County and
 Potter Valley, Mendocino County
 1999 vs. 2000

Figure 2a.

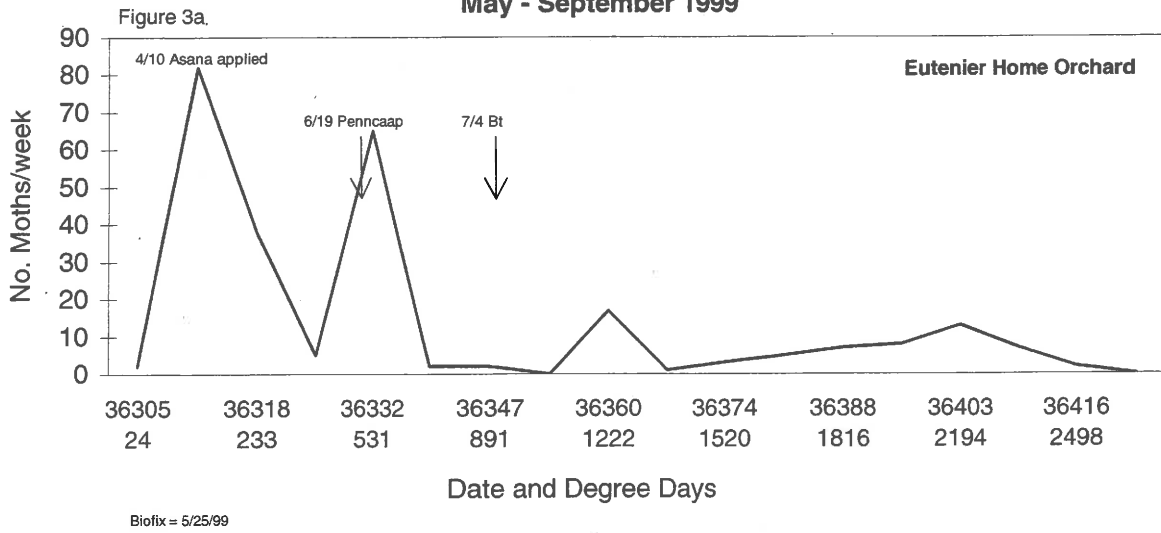


Mean separation among orchards by Tukey-Kramer multiple range test, $P < 0.05$.
 * Means significant at $P < 0.1$, ** Means not significant at $P > 0.1$.

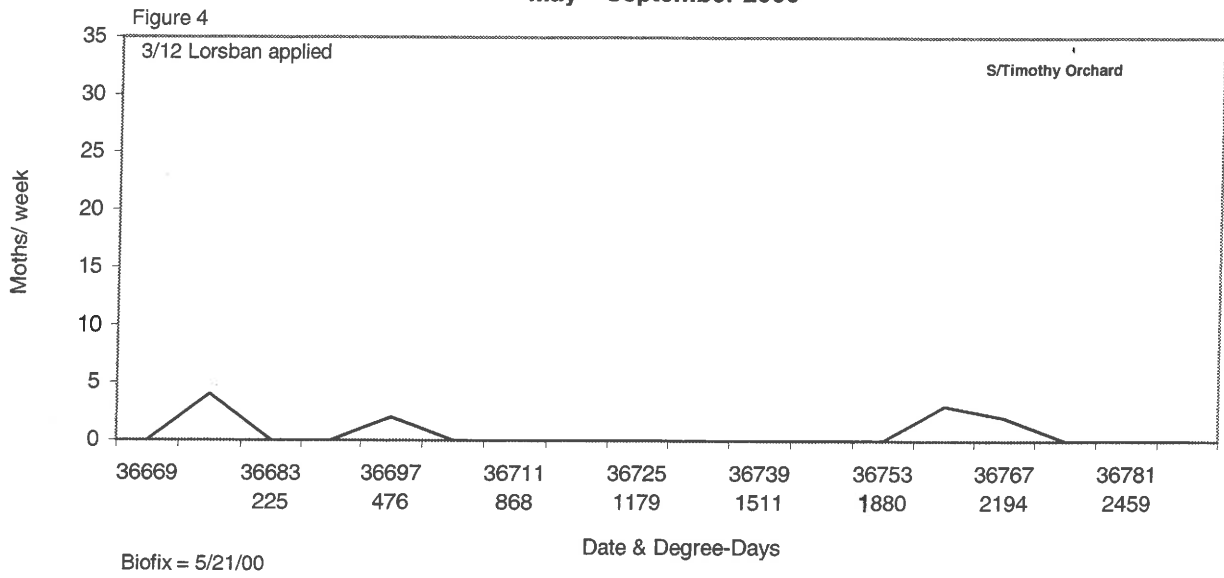
**OBLR Trap Catches
Keiseyville, Lake County
May - September 2000**



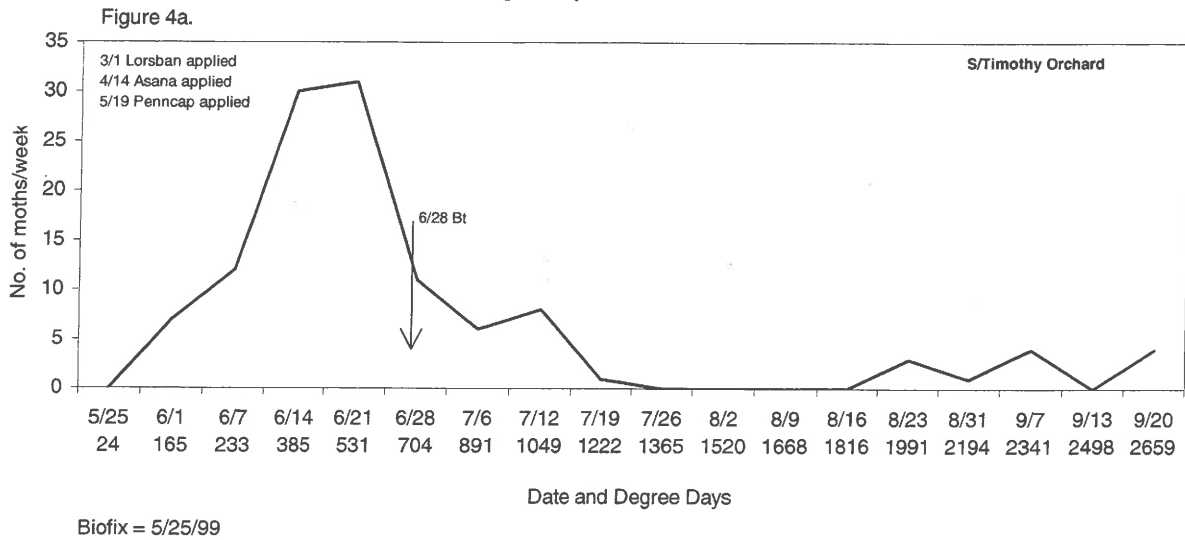
**OBLR Trap Catches
Keiseyville, Lake County
May - September 1999**



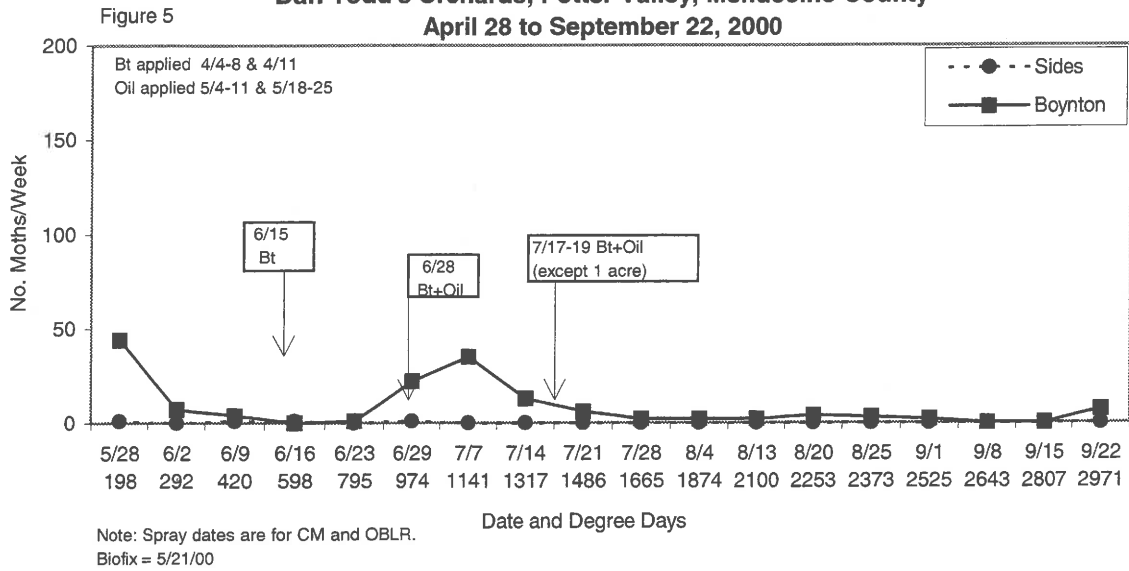
**OBLR Trap Catches
Kelsayville, Lake County
May – September 2000**



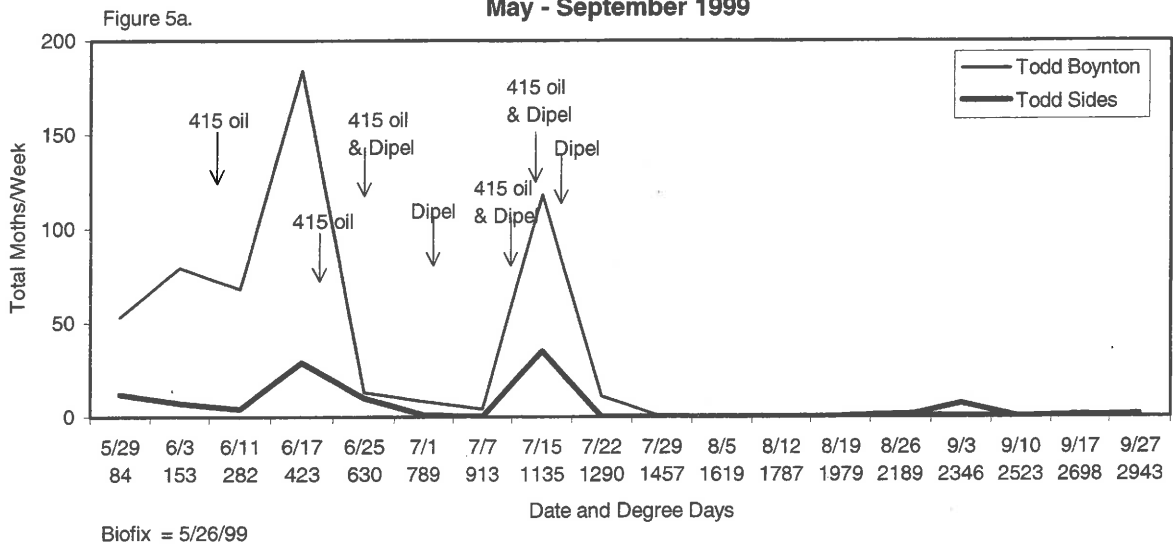
**OBLR Trap Catches
Kelsayville, Lake County
May – September 1999**



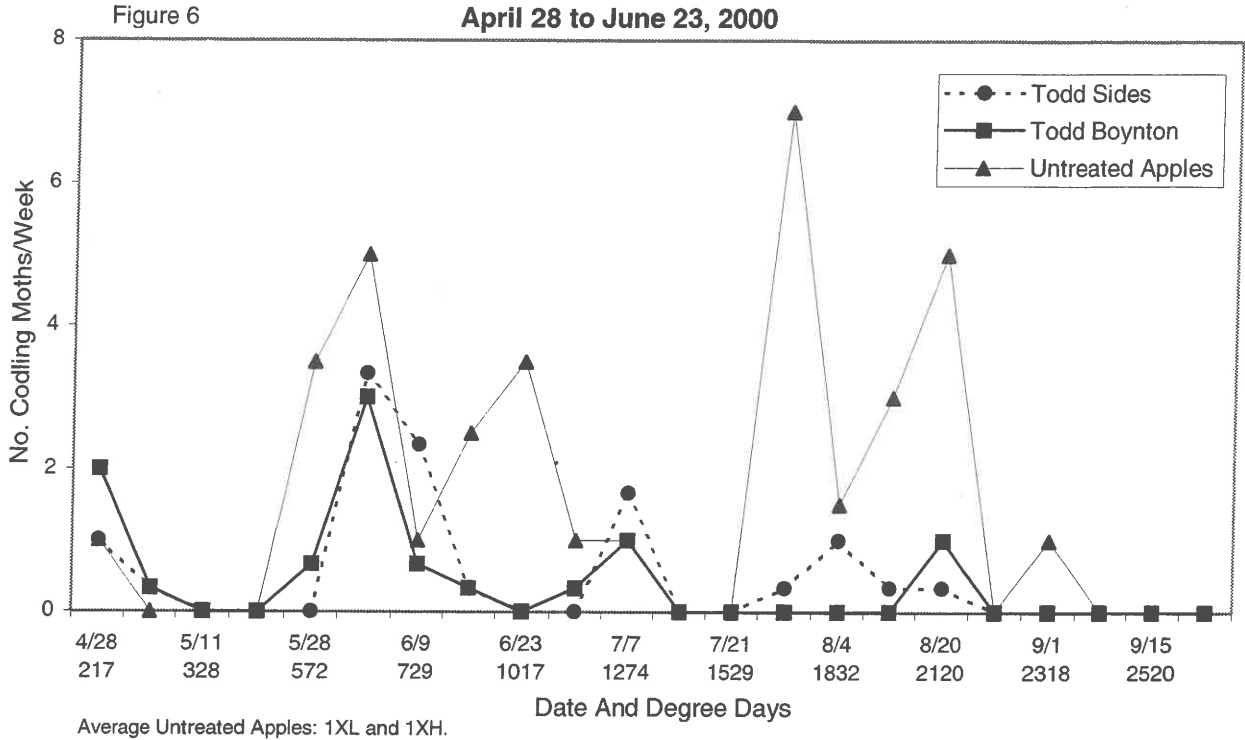
OBLR TRAP CATCHES
Dan Todd's Orchards, Potter Valley, Mendocino County
April 28 to September 22, 2000



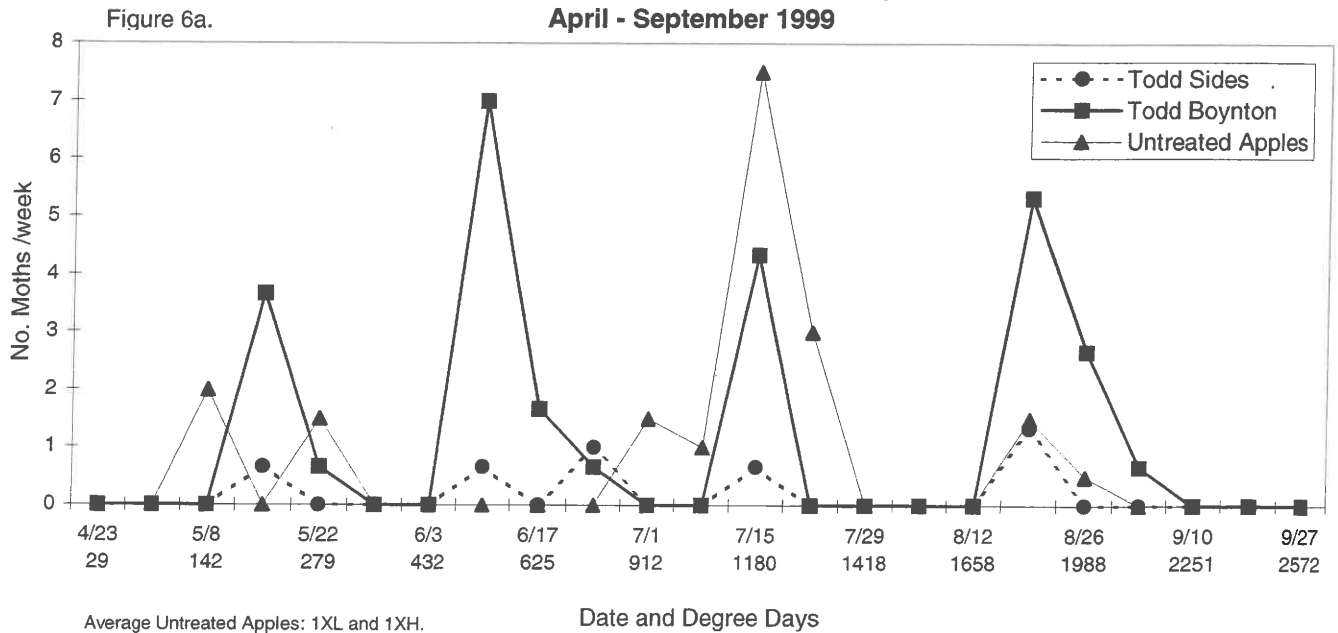
1999 POTTER VALLEY PUFFER PROJECT
Total OBLR Trap Catches
May - September 1999



Codling Moth Trap Catches
Average of 1XL, 1XH, and 10XH
Potter Valley, Mendocino County
April 28 to June 23, 2000



Codling Moth Trap Catches
Average of 1XL, 1XH, and 10XH
Potter Valley, Mendocino County
April - September 1999



Biofix = 4/21/99

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