

Pest Management Grants Final Report
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Disruption in Pears Using Puffers*

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ABSTRACT

Codling moth (*Cydia pomonella*) (CM) is the primary pest of pears in California. The economic threshold for cannery damage is 5% (including all other defects). FQPA and CalDPR use restrictions on azinphosmethyl and encapsulated methyl parathion have hastened the adoption of alternative CM control programs, mainly using mating disruption (MD). In 2000, 820 acres of pears in Kelseyville, Lake County were treated with the new Paramount Aerosol Pheromone Dispenser[®], a method which entails hanging relatively few (1-2 per acre) widely-spaced units around the orchard perimeter, each emitting a large amount of pheromone for a finite period each day, and above a certain ambient temperature threshold. To monitor CM activity, one set of four traps was hung per five acres: 1 mg. low, 1 mg. high, 10 mg. high and oblique-banded leafroller (OBLR) (the major secondary pest of CM MD programs). Egg-laying and larval infestation was evaluated for each CM and OBLR generation using tree, ground, and bin samples. Puffer-treated orchards were compared to an upwind 20-acre standard treated block and two upwind untreated sites. Harvest data showed a total of less than 0.2% damage in the puffer treated blocks, with the majority of damage in first-year upwind and border blocks adjacent to less-effective MD methods and large open spaces. Slight damage also occurred adjacent to a riparian corridor. Damage in the grower control was 0.0% and 48% in the untreated controls. OBLR damage averaged 1.0% and was present in almost all blocks at harvest but least where chlorpyrifos (e.g. Lorsban[®]) was applied pre-bloom, followed by a BT treatment for the first summer generation hatch. Due to the success of the program, acreage in the Kelseyville puffer project has increased to 1360 acres in 2001 and the total Lake County acreage treated with puffers is nearly 2000. The project also received CalDPR's 2000 IPM Innovator Award, one of eight awards statewide.

EXECUTIVE SUMMARY

Codling moth (*Cydia pomonella*) (CM) is the primary insect pest of pears in California. The maximum threshold for cannery damage is 5% (including all other defects). Food Quality Protection Act (FQPA) and CalDPR use restrictions on azinphosmethyl (e.g. Guthion[®]) and encapsulated methyl parathion (i.e. Penncap[®]) have necessitated the rapid transition to alternative CM control programs, mainly using mating disruption (MD). Resistance of CM to azinphosmethyl is another factor stimulating decreased dependence on that material.

CM MD has been studied in California since 1986. The main commercial strategy employed in California has been to hang 160-400 individual codlemone dispensers per acre twice during the growing season. This is a labor-intensive process during an era of tightening labor availability, increasing costs, and relatively decreasing returns. In addition, users in some locations have also experienced variable pheromone emission during very cool or hot weather, which has led to diminished disruption in some cases. The late Dr. Harry Shorey of UC Riverside developed a new emission strategy to resolve the above issues. His dispenser was designed to emit a very large, uniform amount of pheromone at preset intervals, thus eliminating emission variability. Only one hanging of one or two units per acre was necessary, greatly reducing labor cost. Dr. Shorey named the unit the "puffer", and upon his death in 1998, it was developed commercially by Paramount Farming Co. of Bakersfield, California, and was named the Paramount Aerosol Pheromone Dispenser[®] in 2000.

MD research using puffers on the North Coast began in 1996 in cooperation with Dr. Shorey. Initial trials, sponsored by the Pear Pest Management Research Fund, took place on 160 acres of Bartlett pears in Kelseyville, Lake County. In 1999, acreage expanded to 500 with funding from the USDA, and to 820 in 2000 under a CalDPR Demonstration Grant and the Pear Pest Management Alliance. (360 acres of pears in Potter Valley, Mendocino County, virtually the entire acreage in the valley, were also treated in 1999, the first year of CalDPR Demonstration Grant funding). Participants in 2000 included ten growers and five licensed pest control advisers (PCAs). Standard treated orchards in the area had historically high CM pressure, requiring from three to four organophosphate treatments most years. Dispensers were hung at a rate of 1.13 per acre, down from 1.3 in 1999 and 1.6 in 1996-1998. 42 mg. of codlemone was emitted every 15 minutes from 3:00 p.m. to 3:00 a.m. from April 1 through early October.

CM adult activity was monitored using four traps per five acres: 1 mg. low, 1 mg. high, 10 mg. high, and oblique-banded leafroller (OBLR) (the major secondary pest of CM MD programs). Egg laying and larval infestation was evaluated for each CM and OBLR generation using tree, ground, and bin samples during both the growing season and after harvest. Puffer-treated orchards were compared to three upwind sites: a 20-acre standard-treated block, and two sets of untreated trees. Although supplemental treatment decisions were made by growers and the PCA, all first year growers and those with CM damage in 1999 were advised to apply an initial OP and/or border sprays as needed.

Samples taken prior to, during, and after harvest showed virtually no CM damage in most puffer blocks, despite the fact that no OP's were applied during the growing season to orchards that had been in the program more than two years. Damage in the 37 puffer blocks was 0.15% at harvest and was restricted to first-year upwind blocks and border blocks adjacent to less effective MD methods and large open spaces. Slight damage also occurred adjacent to a riparian corridor. Damage in the standard grower control was 0.0%. Damage in untreated controls was nearly 48%, almost double that of 1999. OBLR damage averaged 1% and was present in nearly all

blocks at harvest, but was most severe in those blocks lacking pre-bloom chlorpyrifos (Lorsban®) applications. BT applications successfully reduced the amount of damage by the summer brood, indicating potential for this tactic. A mixed CM/OBLR puffer unit was evaluated during the 2000 season in two of the project blocks; while trap catches were reduced 90%, damage was not significantly reduced.

Total material and monitoring costs using puffers was tabulated in 1999. For an individual orchard of 40 acres or less, material costs using two dispensers per acre are \$240/acre initially, plus \$350 for a programming unit and negligible labor costs. This decreases to \$160/acre thereafter. The number of units per acre decreases as treated acreage increases, offering substantial savings when applied on an areawide basis. CM MD is currently more expensive to monitor than a standard organophosphate program. Much of the additional monitoring costs have been underwritten by various grant funds, but must be eventually be borne by growers. A less intensive trapping rate is being utilized in 2001 as confidence in the MD technique has increased. Monthly pesticide use report data is also being collated to show that reduced pear psylla and spider mite treatments offset many of the added costs after the first year. This is corroborated by the fact that the only blocks which required a post-harvest mite and/or psylla treatment in 2000 were those which received in-season OP sprays. Fifth year puffer orchards received one or no in-season mite or psylla sprays.

Progress and results of the 2000 Kelseyville project season were presented in both English and Spanish at summer field days in Lake and Mendocino Counties and at several winter grower meetings in Lake, Sacramento, and El Dorado Counties. Despite very poor returns for pears in 1999 and 2000, nine new growers committed to purchase the puffers for the 2001 project season. Results from the USDA/CalDPR project have led to increased puffer use in other areas of Lake County and in Mendocino County, as well as renewed interest in the technique in walnuts and pears in other areas of California. Total puffer treated acreage is now about 2500 on the North Coast, or about 30% of the acreage. If results continue to be positive in 2001, it is likely that more North Coast pear growers will seriously consider purchasing puffers for future use.

INTRODUCTION

Codling moth (*Cydia pomonella*) is the key pest of pears in California. The economic threshold for damage in cannery loads is 5% (including all other defects). Damage in untreated controls ranges from 10 to 50%, signifying great need for effective control. State and federal actions in 1998 and 1999 have resulted in the restriction or loss of the two key organophosphate insecticides used to control codling moth, azinphosmethyl (e.g. Guthion[®]) and encapsulated methyl parathion (e.g. Penncap[®]). These restrictions have necessitated rapid transition of the pear industry into alternative pest management programs. The most proven and available current alternative is mating disruption, which has been researched in pears since 1987. Mating disruption has been demonstrated to be most effective when utilized on an areawide basis in orchards under low to moderate codling moth pressure. The most widely used strategy is hanging 150-400 pheromone dispensers per acre throughout a treated block. Each dispenser emits a small amount of pheromone over the life of the unit, about 60-120 days.

The 2000 demonstration project utilized an alternative, reasonably priced dispenser, the “puffer”, developed by the late Dr. Harry Shorey of UC Riverside. The puffer has been further developed and registered by Paramount Farming Co., a large almond and pistachio operation in Bakersfield. It is manufactured in Canada and sold directly by the new subsidiary Paramount Ag Technologies, Inc. The codling moth product is now registered as the Paramount Aerosol Codling Moth Pheromone Dispenser[®]. Rather than hanging many dispensers that each emit small amounts of pheromone, this method involves hanging two or fewer dispensers per acre, each emitting a large amount of pheromone at preset intervals and above a minimum ambient temperature threshold for 200 days. This dispenser was the focus of three years of pear industry-funded UC research on 160 acres in Lake County, which expanded to 500 acres in 1999 under a USDA Areawide Codling Moth Project (CAMP) grant then 820 in 2000 under the current sponsorship of California Dept. of Pesticide Regulation through the Pest Management Demonstration Grant and Pear Pest Management Alliance programs.

The success of the Lake County project led to an additional areawide puffer project in 1999 to control codling moth on 360 acres of Bartlett and Bosc pears in Potter Valley, Mendocino County. This was nearly the total acreage in the valley and included 75 acres of certified organic fruit. Only one 22-acre block of Bartletts and one 2-acre block of organic pears remained untreated which were used as “grower controls”. One set of untreated apple trees upwind of the project area served as a completely untreated control. Results were excellent in non-organic blocks, which received no OP treatments for the entire season. The organic blocks remained problematic due to extreme initial pressure and inability to adequately supplement MD. Due to very poor market conditions, however, the Potter Valley project was disbanded in 2000 as the growers could not commit to purchasing puffer units.

The expanded Lake County project, however, continued to demonstrate the four primary objectives in 2000:

- 1) Demonstrate a cost-effective, labor saving, efficient, commercially available method of delivering pheromone in a mating disruption program.
- 2) Verify the minimum level of monitoring needed to commercially use this method.
- 3) Produce commercial yields of U.S. #1 Bartlett and Bosc pears using greatly reduced amounts of organophosphate insecticides.
- 4) Control secondary pests as needed.

RESULTS

- a) **Objective 1:** *Demonstrate a cost-effective, labor saving, efficient, commercially-available method of delivering pheromone in a mating disruption program.* CM damage to puffer-treated blocks at harvest was 0.15% overall across 37 blocks versus 0.0% in the one standard control block and nearly 48% in the untreated controls in 2000. Damage occurred only in first-year upwind blocks with large edge effects i.e. where the orchard bordered less effective mating disruption, or large open areas, or in proximity to apple trees. More telling, damage averaged 0.32% in first year blocks, located on the south and west upwind borders, but only 0.03% in second year blocks and 0.0% in the five original project blocks treated since 1996. Post-harvest damage, which indicates potential overwintering flight and damage potential the following season was 0.4% and only occurred where bin damage was found (a first cover OP will be recommended in these blocks in 2001). Like CM, OBLR damage was most severe in first year blocks, but present throughout all puffer-treated blocks, while the OP-treated grower control was free of damage. The puffer units lasted the entire season, showing only one hanging per season is required, although there was one (unexpected) battery change (Tables 1 to 6).
- b) **Objective 2:** *Verify the minimum level of monitoring needed to commercially use this method.* Only one moth was caught in 1 mg. low traps in puffer blocks through the entire season, versus almost 50 in the much smaller untreated controls. 1 mg. high traps caught 40 moths (0.05 per acre), but also caught moths in some blocks that had no 1 mg. low catches. 10 mg. high traps caught the most moths in the puffer blocks. The best correlation with damage in 2000 was with 1 mg. high traps, which correctly predicted damage in 71% of the blocks where it occurred, and likewise correctly predicted no damage would occur in 86% of damage-free blocks. 10x high traps correctly predicted damage 50% of the time it occurred but were 83% correct in predicting no damage. OBLR traps caught many moths, but numbers showed no statistical correlation to severity of damage. The 5-acre trapping unit, though intensive, resulted in being able to pinpoint potential "hotspots". In 2001, the number of trap sets monitored by UCCE staff will be reduced to verify if fewer traps can be used to predict damage. A cut fruit sampling technique developed by Dr. Broc Zoller to monitor egg laying will also be tested (Table 7).
- c) **Objective 3:** *Produce commercial yields of U.S. #1 Bartlett and Bosc pears using greatly reduced amounts of organophosphate insecticides.* No OP was applied to multiple year blocks during the 2000 season, versus the standard block that received at least two sprays. First year blocks received one to three OP treatments depending on trap catches and egg sampling. Exact amounts applied are currently being compiled from monthly use reports.
- d) **Objective 4:** *Control secondary pests as needed.* No attempt was made to dictate secondary pest control. Leafrollers were controlled by one pre-bloom chlorpyrifos (e.g. Lorsban®) and perhaps one or two BT sprays for the first summer hatch. OBLR damage averaged 1.0% at harvest and ranged from 0.0-9.2%. Damage was worst where no pre-bloom Lorsban® was applied, and near riparian corridors. Only one in-season pear psylla and mite treatment was applied in most puffer-treated orchards, using much lower rates than needed in OP-treated blocks. Post-harvest treatments were also unnecessary in puffer-treated orchards. In fact, fifth year orchards required no in-season or postharvest mite or psylla treatments. Data on secondary pest treatment is still being compiled from monthly use reports. Very little stink bug damage was noted at harvest (0.013%) and no San Jose scale was found.

DISCUSSION

Data at harvest indicated several points:

- 1) Mating disruption, specifically the Paramount Aerosol Codling Moth Pheromone Dispenser®, controls codling moth well even in a first year program *if* orchards start the season with relatively low pressure, and particularly when supplemented by at least one well-timed, effective cover spray.
- 2) Orchards that begin the season with high pressure will require greater supplementation by insecticides and more years to achieve adequate control. In 2000, the most problematic orchards were those on upwind edges bordered by less effective pheromone programs or large areas of open space or vineyard. Damage was also found close to backyard apple trees and in one orchard that had previously contained an untreated control in one corner. Insecticide applications, however, may only be necessary on borders as transectional sampling indicated damage, declined from 5-10 rows into the block in several instances.
- 3) Leafrollers, specifically oblique-banded leafroller (OBLR), will need to be controlled with chemicals under CM mating disruption because OBLR pheromone is still inadequate. Orchards lacking pre-bloom Lorsban® had the most OBLR damage. BT applied for the first generation hatch was quite effective in reducing the severity of OBLR damage, and could be useful in mating disruption programs provided weather conditions are conducive to excellent timing and coverage. Other secondary pests, such as stink bugs and San Jose scale, may also eventually be problematic but only early-season damage from Western flower thrips was noticeable in 2000.

As a mating disruption tool, puffers are good dispensers in that distribution pattern, emission rates and timing are controllable and flexible, and they are only slightly affected by changes in ambient temperature (due to vapor pressure shifts). However, experience in 2000 brought out several economic and logistical issues:

- a. Units must be periodically taken down and checked to make sure they are emitting correctly. They are susceptible to being knocked down by heavy wind and human activity, such as spraying and harvesting. In 2000, batteries unexpectedly needed to be changed about two-thirds through the season. Checking each unit takes about one minute per unit and can be done at the same time traps are checked. Another two or three minutes is required if reprogramming is required. UCCE staff recommended that 20% of the units be taken down and checked every two weeks in 2001.
- b. The accompanying programming unit currently costs \$350.00 and must be purchased separately by the user(s). It is very important that users are well trained in its function to avoid possible misprogramming.
- c. The current initial cost to enter the puffer program is theoretically an impediment to adoption, especially in poor market years such as 2000 (though few growers have thus far been deterred). For example, at the maximum two per acre for one 40-acre block, the cost would be \$40.00 per unit x 2 = \$80.00 plus \$80.00 per filled cannister x 2 = \$160.00, for a total cost of \$240.00 per acre. Cost to hang, check and remove adds about \$3.00 per acre. This is compared to \$220.00 for two hangings of 400 Pacific BioControl dispensers plus about \$25.00 per acre per hanging for application, or about \$270.00 per acre per season. Once the puffer and programming units are purchased, they are guaranteed for at least five

years, so annual cost for a 40-acre or less block is reduced to \$160.00 per year plus hanging, checking and removing. As acreage increases, the number of units per acre decreases, making the system most cost effective for areawide programs where growers share up front and ongoing program expenses and benefit from reduced per acre costs. In 2000, the 820 acre project in Kelseyville used 1.13 units per acre. Also, as the total number of units purchased increases, the manufacturer will theoretically be able to purchase pheromone at a cheaper price, thus reducing the cost of a filled cannister.

SUMMARY AND CONCLUSIONS

The UC Shorey “puffer”, now sold as the Paramount Aerosol Pheromone Dispenser[®], was utilized to control codling moth in an areawide demonstration project in Kelseyville, Lake County. The project was an expansion of an industry-funded one initiated by Dr. Harry Shorey and the current Principal Investigator in 1996. The original 163 acres are now entering their sixth year. An additional 337 acres were added in 1999, which expanded to 820 acres in 2000.

Acreage added in 2000 was almost all on the upwind south and west edges, and along a bordering riparian corridor. It was expected these blocks would require supplemental OP treatments to reduce the incoming population and mitigate certain “edge effects”.

Puffers were hung at an average rate of 1.13 per acre (0.2 per acre fewer than in 1999), mainly around the perimeter of each block. Both codling moth and leafroller populations and damage were monitored throughout the growing season. Trap catch, egg-laying, and damage data showed that:

- 1) Codling moth pressure was much higher in 2000 than in 1998 or 1999, with higher overall trap catches and damage in all growing areas. Despite this, damage in the 37 puffer-treated project blocks was only 0.15%.
- 2) Virtually all damage occurred in first year, upwind blocks and mainly in rows bordered by either a) large open space or vineyard, b) less effective mating disruption programs, or c) in close proximity to backyard apple trees. Damage also occurred in proximity to a previously untreated control that had built up a high population, and along bordering riparian corridors.
- 3) Damage was reduced ten-fold in second year orchards and was zero in fifth year orchards, despite a complete lack of OP sprays for several years.
- 4) OBLR damage continues to be a noticeable secondary pest. Damage was worst, however, in first year orchards and those lacking a pre-bloom chlorpyrifos application. BT applied for the first summer generation hatch reduced final damage.
- 5) Other secondary pests such as stink bugs and San Jose scale were unproblematic and have failed to thus far increase appreciably. Early-season thrips damage was noticeable, though not economic. Pear psylla and spider mite damage was minimal in puffer-treated blocks despite the omission of the pre-harvest treatment required to control mites in standard-treated orchards.
- 6) Trap catch data indicated that 1XH catch gave the best correlation with the presence or absence of damage. 1XL catches were minimal except in the untreated controls and one high-pressure puffer block. Presence of 10XH catches predicted damage in only half of the blocks where damage occurred, versus 70% for the 1XH traps. This contrasts with 1999 data in Potter Valley, Mendocino County, where damage was most closely correlated to 1XL catches.

Results after 2000 continued to be encouraging. As previous research and other demonstration projects have shown, however, mating disruption of any type is a multiple-year, multi-tactic strategy. In the Lake County project, one orchard required three years to reduce damage to zero and it is likely those with damage this year will need to receive at least one OP for the next one or two years. Growers must thus make a long-term commitment to the program, which often includes high initial costs required to reduce flight and subsequent damage. A plan to eliminate pressure from unfarmed apple and pear trees, especially upwind is becoming increasingly critical as mated females can fly 100 or more yards from an infested tree.

APPENDIX I

List of Figures and Tables

FIGURE 1: Kelseyville Puffer Locations - 2000

FIGURE 2: Kelseyville Trap Locations -- 2000

TABLE 1: Codling Moth Trap Catches and Fruit Damage – Summary Table

TABLE 2: 1st Generation CM and OBLR Damage

TABLE 3a: Kelseyville CM Damage – Pre-harvest

TABLE 3b: Kelseyville CM Damage – Pre-harvest; comparison of 1st, 2nd and 5th year orchards

TABLE 4a: Kelseyville OBLR Damage – Pre-harvest

TABLE 4b: Kelseyville OBLR Damage – Pre-harvest; comparison of 1st, 2nd and 5th year orchards

TABLE 5a: Late 1st and 2nd Generation CM Damage – Harvest

TABLE 5b: Kelseyville CM Damage – Harvest; comparison of 1st, 2nd and 5th year orchards

TABLE 6a: OBLR Damage – Harvest

TABLE 6b: Kelseyville CM Damage – Harvest; comparison of 1st, 2nd and 5th year orchards

TABLE 7a-d: 2000 Kelseyville “Puffer” Trial – Weekly CM and OBLR Trap Catches

Figure 1

2000 Puffer Location Map

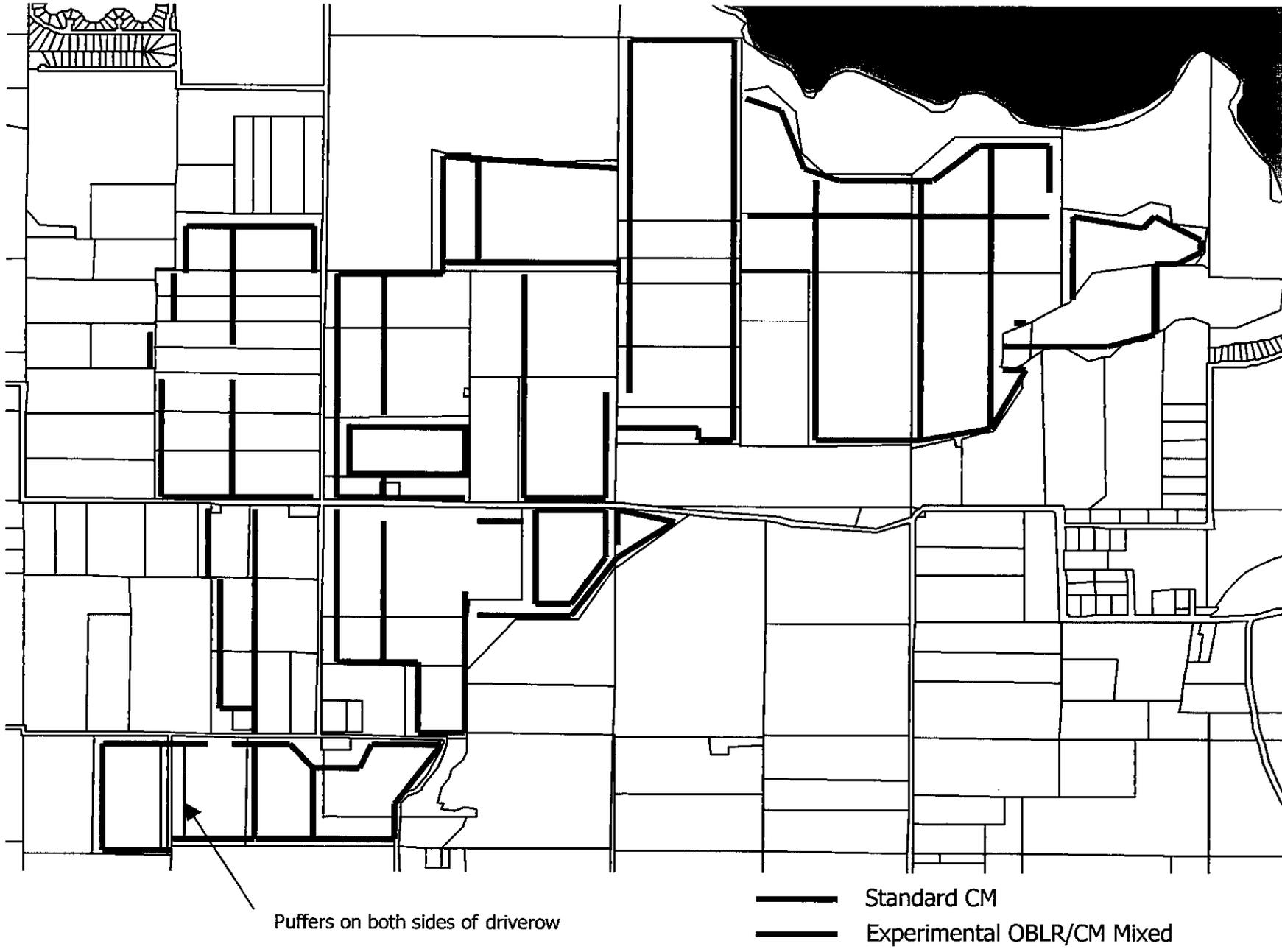
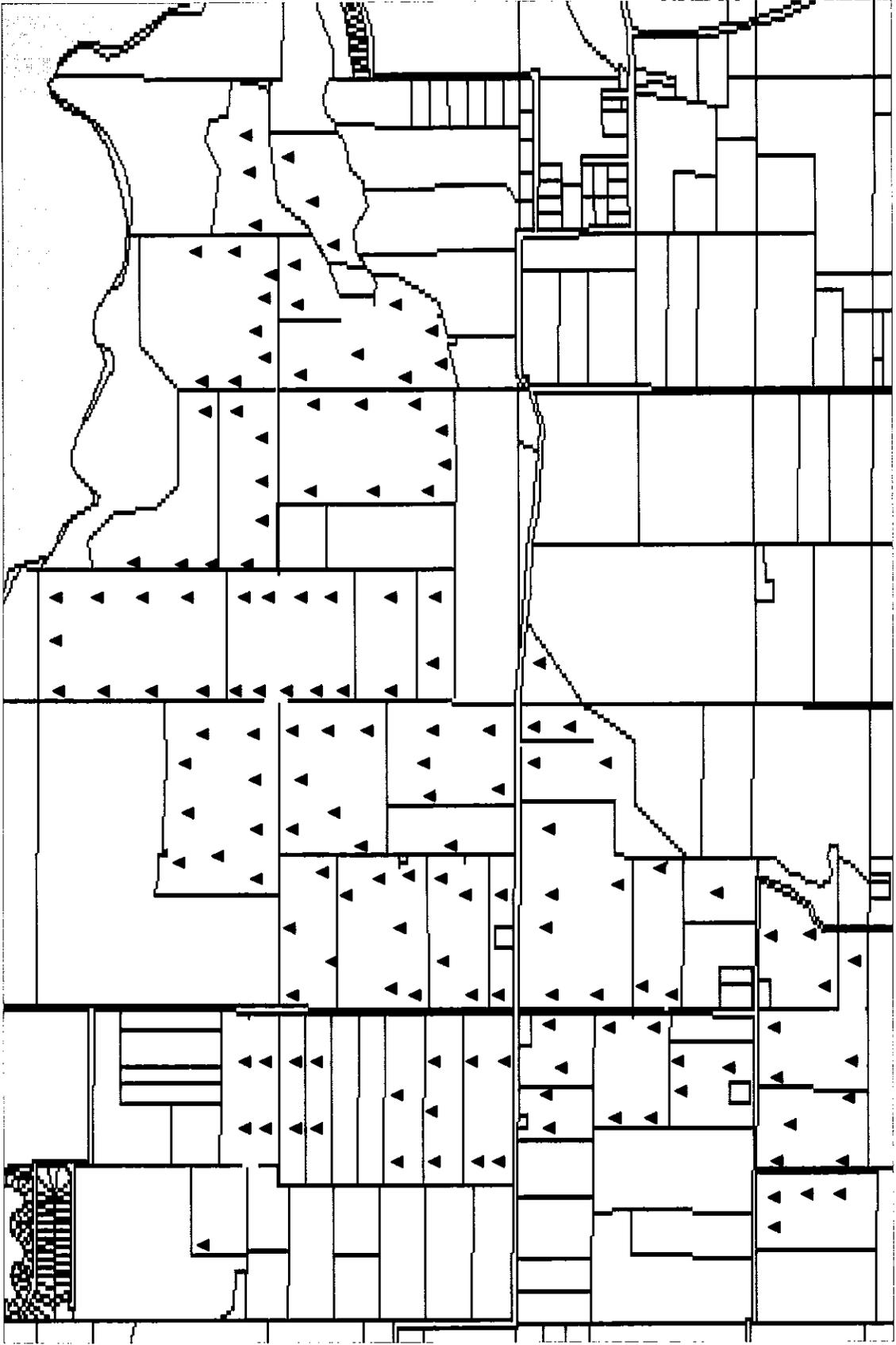


Figure 2

Trap set locations



Appendix III

2000 LAKE COUNTY PUFFER PROJECT Codling Moth Trap Catches and Fruit Damage - Summary Table April - September 2000 Ground Fruit Samples - %/500, Pre-harvest Tree Fruit Samples - %/2000 Bin Fruit Samples - %/1000 and Post-harvest Samples - %/300

Table 1.

TREATMENT/BLOCK	Trap Totals			% 1ST GEN GRND DAMAGE	% PRE-HARV DAMAGE	% BIN DAMAGE	% POST-HARV DAMAGE
	1XL	1XH	10XH				
PUFFER							
North-west Area							
Hedgerow	0	0	0	0.0	0.0	0.0	0.0
Renfro	0	0	4	***	0.0	0.1	0.3
Pardee-Lake	0	0	4	0.2	0.0	0.2	0.0
Morrison	0	0	2	***	0.0	0.0	0.0
Akins	0	0	1	0.0	0.05	0.0	0.0
Pardee-home	0	2	7	0.7	0.15	0.1	0.0
South-west Area							
Colwell	0	7	5	17.0	1.6	1.2	1.0
Y/Stage	1	6	8	0.6	0.6	**	1.0
M/Twenty	0	6	7	0.0	2.7	0.3	5.0
E.A.T. Rickabaugh	0	1	2	0.4	0.0	0.0	***
Rohner Home	0	2	3	0.7	0.0	0.1	0.0
Old Rickabaugh	0	1	6	0.0	0.0	0.2	0.0
Lone Pine - 2 sections	0	1	0	0.0	0.0	0.0	3.0
East Neck	-	-	-	-	-	1.3	-
Main block	-	-	-	-	-	0.4	-
M/Brown	0	0	0	***	2.9	0.7	0.3
Murphy	0	11	12	17.3	3.3	0.9	2.0
Mid Area							
S/Stage	0	0	0	***	0.0	0.0	0.0
30 Acres	0	0	1	***	0.0	0.0	0.0
S/Timothy (sprayed)	0	0	2	***	0.0	0.0	0.0
S/Timothy (unsprayed)	-	-	-	***	0.05	0.0	***
M/Timothy	0	0	2	***	0.05	0.0	0.3
K-48	0	0	0	***	0.0	0.0	0.0
Cole	0	1	0	0.0	0.0	0.0	0.0
Sanderson	0	0	0	***	0.0	0.0	0.0
Cookson	0	1	4	***	0.0	0.0	0.0
Eutenier (sprayed)	0	0	0	***	0.0	0.0	0.0
Eutenier (unsprayed)	-	-	-	***	0.1	0.0	***
R/Brown	0	0	0	***	0.0	0.1	0.0
East Area Downwind							
Young West	0	0	0	0.0	0.0	0.0	0.0
Sixty	0	0	0	***	0.0	0.0	0.0
Fourteen	0	0	0	***	0.0	0.0	0.0
Trailers	0	0	0	***	0.0	0.0	0.0
Triangle	0	0	1	0.0	0.0	0.0	0.0
Young East	0	0	0	0.0	***	0.0	0.0
Quercus 20	0	0	0	***	0.0	0.0	0.0
Wide	0	0	0	***	0.0	0.0	0.0
Neck	0	0	0	0.0	0.0	0.0	0.0
Gaddy	0	0	1	0.0	0.0	0.0	0.0
BP Gaddy	0	1	0	0.0	0.0	0.0	0.0
Manning	0	0	2	0.0	0.0	0.0	0.7
AVERAGE PUFFER	-	-	-	1.8	0.3	0.15	0.4
GROWER CONTROL							
Springer	0	0	1	0.0	0.0	0.0	0.0
Quercus/Seven Acres ²	-	-	-	-	-	0.2	-
AVERAGE GROWER CONTROL	-	-	-	0.0	0.0	0.1	0.0
UNTREATED CONTROL							
Quercus/Seven Acres	2	11	0	50.4	21.4	24.7	6.0 ***
Gold Dust	42	39	0	***	63.2	71.0 ¹	86.0
AVERAGE UNTREATED	-	-	-	50.4	42.3	47.9	46.0

¹ not a bin count

² this area sampled only for bin damage.

** bin sample not reliable (pears were presorted before project team could sample).

*** most infested fruit had fallen already.

2000 LAKE COUNTY PUFFER PROJECT
1st Generation CM and OBLR Damage
Tree Fruit Samples - %/1000, Ground Fruit Samples - %/500

TREATMENT	Tree June 27-28, 2000			Ground July 18-25, 2000		
	CM 998 °D		OBLR 897 °D	CM 1314 - 1443 °D		OBLR 1335 - 1511 °D
	Eggs	Damage	Damage	Eggs	Damage	Damage
Average Puffer¹	0.06	0.04	0.26	0.1³	1.8³	1.6³
Grower Control²	0.0	0.0	0.0	0.0	0.0	0.0
Untreated Controls						
Quercus Seven Acres	3.3	3.8	1.0	8.4	50.4	0.8
Gold Dust (500 fruit)	0.6	27.8	1.6	**	**	**
Average Untreated Control	2.0	27.8	1.3	8.4	50.4	0.8

¹ 37 orchards

² 1 plot

³ 21 orchards

** no ground fruit

2000 LAKE COUNTY PUFFER PROJECT
Late 1st and 2nd Generation Codling Moth Damage

August 2 - 8, 2000, 1607 – 1722 °D

Table 3a:

Pre-harvest Tree Fruit Sample - %/2000

TREATMENT/BLOCK	TOP	BOTTOM	TOTAL
PUFFER			
North-west Area			
Hedgerow	0.0	0.0	0.0
Renfro	0.0	0.0	0.0
Pardee-Lake	0.0	0.0	0.0
Morrison	0.0	0.0	0.0
Akins	0.1	0.0	0.05
Pardee-home	0.2	0.1	0.15
South-west Area			
Colwell	1.9	1.2	1.55
Y/Stage	1.1	0.1	0.6
M/Twenty	1.9	3.5	2.7
E.A.T.	0.0	0.0	0.0
Rohner Home	0.0	0.0	0.0
Old Rickabaugh	0.0	0.0	0.0
Lone Pine	0.0	0.0	0.0
M/Brown	3.3	2.4	2.85
Murphy	3.6	2.9	3.25
Mid Area			
S/Stage	0.0	0.0	0.0
30 Acres	0.0	0.0	0.0
S/Timothy	0.0	0.0	0.0
M/Timothy	0.1	0.0	0.05
K-48	0.0	0.0	0.0
Cole	0.0	0.0	0.0
Sanderson	0.0	0.0	0.0
Cookson	0.0	0.0	0.0
Eutenier (%/1000)	0.0	0.0	0.0
R/Brown	0.0	0.0	0.0
East Area Downwind			
Young West	0.0	0.0	0.0
Sixty	0.0	0.0	0.0
Fourteen	0.0	0.0	0.0
Trailers	0.0	0.0	0.0
Triangle (%/1000)	0.0	0.0	0.0
Young East	**	**	**
Quercus 20	0.0	0.0	0.0
Wide	0.0	0.0	0.0
Neck	0.0	0.0	0.0
Gaddy	0.0	0.0	0.0
BP Gaddy	0.0	0.0	0.0
Manning	0.0	0.0	0.0
AVERAGE PUFFER	0.3	0.3	0.3
GROWER CONTROL			
Springer	0.0	0.0	0.0
UNTREATED CONTROL			
Quercus/Seven Acres (%/1000)	33.6	9.2	21.4
Gold Dust (%/1000)	-	-	63.2
AVERAGE UNTREATED	33.6	9.2	42.3

** no sample

2000 LAKE COUNTY PUFFER PROJECT
Late 1st and 2nd Generation Codling Moth Damage

August 2 - 8, 2000, 1607 - 1722 °D

Table 3b: **Pre-harvest Tree Fruit Sample - %/2000**

PROJECT YEAR/BLOCK	TOP	BOTTOM	TOTAL
FIRST YEAR ORCHARDS			
Colwell	1.9	1.2	1.55
Y/Stage	1.1	0.1	0.6
M/Twenty	1.9	3.5	2.7
E.A.T.	0.0	0.0	0.0
Rohner Home	0.0	0.0	0.0
Old Rickabaugh	0.0	0.0	0.0
Lone Pine	0.0	0.0	0.0
M/Brown	3.3	2.4	2.85
Murphy	3.6	2.9	3.25
Young East	**	**	**
Quercus 20	0.0	0.0	0.0
Wide	0.0	0.0	0.0
Neck	0.0	0.0	0.0
Gaddy	0.0	0.0	0.0
BP Gaddy	0.0	0.0	0.0
Manning	0.0	0.0	0.0
AVERAGE FIRST YEAR	0.79	0.67	0.73
SECOND YEAR ORCHARDS			
Hedgerow	0.0	0.0	0.0
Renfro	0.0	0.0	0.0
Pardee-Lake	0.0	0.0	0.0
Morrison	0.0	0.0	0.0
Akins	0.1	0.0	0.05
Pardee-home	0.2	0.1	0.15
S/Stage	0.0	0.0	0.0
30 Acres	0.0	0.0	0.0
K-48	0.0	0.0	0.0
Cole	0.0	0.0	0.0
R/Brown	0.0	0.0	0.0
Young West	0.0	0.0	0.0
Sixty	0.0	0.0	0.0
Fourteen	0.0	0.0	0.0
Trailers	0.0	0.0	0.0
Triangle (%/1000)	0.0	0.0	0.0
AVERAGE SECOND YEAR	0.019	0.006	0.013
FIFTH YEAR ORCHARDS			
S/Timothy	0.0	0.0	0.0
M/Timothy	0.1	0.0	0.05
Sanderson	0.0	0.0	0.0
Cookson	0.0	0.0	0.0
Eutenier (%/1000)	0.0	0.0	0.0
AVERAGE FIFTH YEAR	0.020	0.000	0.010

** no sample

Oblique-Banded Leafroller Damage

August 2-8, 2000, 1727 - 1881 °D

Table 4a: Pre-harvest Tree Fruit Sample - %/2000

TREATMENT/BLOCK	TOP	BOTTOM	TOTAL
PUFFER			
North-west Area			
Hedgerow	0.0	0.2	0.1
Renfro	0.3	0.9	0.6
Pardee-Lake	0.0	0.0	0.0
Morrison	1.0	0.5	0.8
Akins	1.1	0.2	0.70
Pardee-home	0.6	0.0	0.3
South-west Area			
Colwell	0.2	0.0	0.1
Y/Stage	0.0	0.0	0.0
M/Twenty	0.7	1.0	0.85
E.A.T.	0.0	0.2	0.1
Rohner Home	0.0	0.0	0.0
Old Rickabaugh	0.0	0.0	0.0
Lone Pine	0.0	0.0	0.0
M/Brown	0.5	0.0	0.25
Murphy	0.3	0.6	0.5
Mid Area			
S/Stage	0.2	0.1	0.15
30 Acres	0.2	0.0	0.1
S/Timothy	0.0	0.0	0.0
M/Timothy	0.3	0.4	0.35
K-48	0.0	0.0	0.0
Cole	0.0	0.0	0.0
Sanderson	0.0	0.0	0.0
Cookson	0.2	0.1	0.15
Eutenier (%/1000)	0.6	0.4	0.5
R/Brown	0.2	0.6	0.4
East Area Downwind			
Young West	0.2	0.6	0.4
Sixty	0.0	0.0	0.0
Fourteen	0.0	0.0	0.0
Trailers	0.0	0.0	0.0
Triangle (%/1000)	0.0	0.0	0.0
Young East	**	**	**
Quercus 20	0.0	0.0	0.0
Wide	0.0	0.0	0.0
Neck	0.0	0.1	0.05
Gaddy	0.0	0.0	0.0
BP Gaddy	0.0	0.0	0.0
Manning	0.0	0.0	0.0
AVERAGE PUFFER	0.2	0.2	0.2
GROWER CONTROL			
Springer	0.0	0.0	0.0
UNTREATED CONTROL			
Quercus/Seven Acres (%/1000)	0.0	0.8	0.4
Gold Dust (%/1000)	-	-	1.4
AVERAGE UNTREATED	0.0	0.8	0.9

** no sample

2000 LAKE COUNTY PUFFER PROJECT
Oblique-banded Leafroller Damage
August 2-8, 2000, 1727 – 1881 °D
Pre-harvest Tree Fruit Sample - %/2000

Table 4b:

PROJECT YEAR/BLOCK	TOP	BOTTOM	TOTAL
FIRST YEAR ORCHARDS			
Colwell	0.2	0.0	0.1
Y/Stage	0.0	0.0	0.0
M/Twenty	0.7	1.0	0.85
E.A.T.	0.0	0.2	0.1
Rohner Home	0.0	0.0	0.0
Old Rickabaugh	0.0	0.0	0.0
Lone Pine	0.0	0.0	0.0
M/Brown	0.5	0.0	0.25
Murphy	0.3	0.6	0.5
Young East	**	**	**
Quercus 20	0.0	0.0	0.0
Wide	0.0	0.0	0.0
Neck	0.0	0.1	0.05
Gaddy	0.0	0.0	0.0
BP Gaddy	0.0	0.0	0.0
Manning	0.0	0.0	0.0
AVERAGE FIRST YEAR	0.11	0.13	0.12
SECOND YEAR ORCHARDS			
Hedgerow	0.0	0.2	0.1
Renfro	0.3	0.9	0.6
Pardee-Lake	0.0	0.0	0.0
Morrison	1.0	0.5	0.8
Akins	1.1	0.2	0.7
Pardee-home	0.6	0.0	0.3
S/Stage	0.2	0.1	0.15
30 Acres	0.2	0.0	0.1
K-48	0.0	0.0	0.0
Cole	0.0	0.0	0.0
R/Brown	0.2	0.6	0.4
Young West	0.2	0.6	0.4
Sixty	0.0	0.0	0.0
Fourteen	0.0	0.0	0.0
Trailers	0.0	0.0	0.0
Triangle (%/1000)	0.0	0.0	0.0
AVERAGE SECOND YEAR	0.24	0.19	0.22
FIFTH YEAR ORCHARDS			
S/Timothy	0.0	0.0	0.0
M/Timothy	0.3	0.4	0.35
Sanderson	0.0	0.0	0.0
Cookson	0.2	0.1	0.15
Eutenier (%/1000)	0.6	0.4	0.5
AVERAGE FIFTH YEAR	0.22	0.18	0.20

2000 LAKE COUNTY PUFFER PROJECT
Codling Moth Damage
August 7 - September 1, 2000, 1703 - 2110 °D
Bin Fruit Samples - %/1000

Table 5a:

TREATMENT/BLOCK	1st pick	2nd pick	TOTAL
PUFFER			
North-west Area			
Hedgerow	0.0	-	0.0
Renfro	0.1	-	0.1
Pardee-Lake	0.2	-	0.2
Morrison	0.0	-	0.0
Akins	0.0	-	0.0
Pardee-home	0.1	-	0.1
South-west Area			
Colwell	1.2	-	1.2
Y/Stage	**	-	**
M/Twenty (%/1200)	0.3	-	0.3
E.A.T.	0.0	-	0.0
Rohner Home	0.1	-	0.1
Old Rickabaugh	0.2	-	0.2
Lone Pine - 2 sections			
East Neck	1.3	-	1.3
Main block	0.4	-	0.4
M/Brown	0.7	-	0.7
Murphy (%/2000)	0.9	-	0.9
Mid Area			
S/Stage (%/2000)	0.0	-	0.0
30 Acres	0.0	-	0.0
S/Timothy (%/1200)	0.0	-	0.0
M/Timothy (%/1200)	0.0	-	0.0
K-48	0.0	-	0.0
Cole	0.0	-	0.0
Sanderson	0.0	-	0.0
Cookson	0.0	-	0.0
Eutenier (%/1200)	0.0	-	0.0
R/Brown	0.1	-	0.1
East Area Downwind			
Young West	0.0	-	0.0
Sixty	0.0	-	0.0
Fourteen	0.0	-	0.0
Trailers	0.0	-	0.0
Triangle	0.0	-	0.0
Young East	0.0	-	0.0
Quercus 20	0.0	-	0.0
Wide (%/2000)	0.0	0.0	0.0
Neck (%/2000)	0.0	0.0	0.0
Gaddy	0.0	-	0.0
BP Gaddy	0.0	-	0.0
Manning	0.0	-	0.0
AVERAGE PUFFER	0.15	0.0	0.15
GROWER CONTROL			
Springer (%/1200)	0.0	-	0.0
Quercus/Seven Acres	0.2	-	0.2
AVERAGE GROWER CONTROL	0.1		0.1
UNTREATED CONTROL			
Quercus/Seven Acres	24.7	-	24.7
Gold Dust1 (%/400)	71.0	-	71.0
AVERAGE UNTREATED	47.9		47.9

2000 LAKE COUNTY PUFFER PROJECT

Codling Moth Damage

August 7 -September 1, 2000, 1703 - 2111 °D

Table 5b:

Bin Fruit Samples - %/1000

PROJECT YEAR/BLOCK	1st pick	2nd pick	TOTAL
FIRST YEAR ORCHARDS			
Colwell	1.2	-	1.2
Y/Stage	**	-	**
M/Twenty (%/1200)	0.3	-	0.3
E.A.T.	0.0	-	0.0
Rohner Home	0.1	-	0.1
Old Rickabaugh	0.2	-	0.2
Lone Pine - 2 sections			
East neck	1.3	-	1.3
Main block	0.4	-	0.4
M/Brown	0.7	-	0.7
Murphy (%/2000)	0.9	-	0.9
Young East	0.0	-	0.0
Quercus 20	0.0	-	0.0
Wide (%/2000)	0.0	0.0	0.0
Neck (%/2000)	0.0	0.0	0.0
Gaddy	0.0	-	0.0
BP Gaddy	0.0	-	0.0
Manning	0.0	-	0.0
AVERAGE FIRST YEAR	0.32	0.0	0.32
SECOND YEAR ORCHARDS			
Hedgerow	0.0	-	0.0
Renfro	0.1	-	0.1
Pardee-Lake	0.2	-	0.2
Morrison	0.0	-	0.0
Akins	0.0	-	0.0
Pardee-home	0.1	-	0.1
S/Stage (%/2000)	0.0	-	0.0
30 Acres	0.0	-	0.0
K-48	0.0	-	0.0
Cole	0.0	-	0.0
R/Brown	0.1	-	0.1
Young West	0.0	-	0.0
Sixty	0.0	-	0.0
Fourteen	0.0	-	0.0
Trailers	0.0	-	0.0
Triangle	0.0	-	0.0
AVERAGE SECOND YEAR	0.03	-	0.03
FIFTH YEAR ORCHARDS			
S/Timothy (%/1200)	0.0	-	0.0
M/Timothy (%/1200)	0.0	-	0.0
Sanderson	0.0	-	0.0
Cookson	0.0	-	0.0
Eutenier (%/1200)	0.0	-	0.0
AVERAGE FIFTH YEAR	0.0	-	0.0

** bin sample not reliable (pears were presorted before project team could sample)

2000 LAKE COUNTY PUFFER PROJECT
Oblique-Banded Leafroller Damage
August 7 - September 1, 2000, 1855 - 2421 °D
Bin Fruit Samples - %/1000

Table 6a:

TREATMENT/BLOCK	1st pick	2nd pick	TOTAL
PUFFER			
North-west Area			
Hedgerow	0.2	-	0.2
Renfro	0.4	-	0.4
Pardee-Lake	0.9	-	0.9
Morrison	0.4	-	0.4
Akins	6.0	-	6.0
Pardee-home	0.5	-	0.5
South-west Area			
Colwell	1.3	-	1.3
Y/Stage	**	-	**
M/Twenty (%/1200)	0.3	-	0.3
E.A.T.	0.3	-	0.3
Rohner Home	0.2	-	0.2
Old Rickabaugh	0.0	-	0.0
Lone Pine - 2 sections			
East Neck	0.8	-	0.8
Main block	2.4	-	2.4
M/Brown	1.1	-	1.1
Murphy (%/2000)	1.5	-	1.5
Mid Area			
S/Stage (%/2000)	0.2	-	0.2
30 Acres	0.4	-	0.4
S/Timothy (%/1200)	0.8	-	0.8
M/Timothy (%/1200)	0.3	-	0.3
K-48	0.0	-	0.0
Cole	0.1	-	0.1
Sanderson	0.4	-	0.4
Cookson	0.1	-	0.1
Eutenier (%/1200)	2.9	-	2.9
R/Brown	0.3	-	0.3
East Area Downwind			
Young West	0.3	-	0.3
Sixty	0.1	-	0.1
Fourteen	0.3	-	0.3
Trailers	0.0	-	0.0
Triangle	0.8	-	0.8
Young East	0.3	-	0.3
Quercus 20	1.4	-	1.4
Wide (%/2000)	0.2	0.0	0.1
Neck (%/2000)	0.4	0.6	0.5
Gaddy	1.1	-	1.1
BP Gaddy	1.4	-	1.4
Manning	9.2	-	9.2
AVERAGE PUFFER	1.0	0.3	1.00
GROWER CONTROL			
Springer (%/1200)	0.3	-	0.3
Quercus/Seven Acres	0.0	-	0.0
AVERAGE GROWER CONTROL	0.2	-	0.2
UNTREATED CONTROL			
Quercus/Seven Acres	7.3	-	7.3
Gold Dust1 (%/400)	2.4	-	2.4
AVERAGE UNTREATED	4.9	-	4.9

2000 LAKE COUNTY PUFFER PROJECT

Table 6b: **Oblique-Banded Leafroller Damage**
August 7 -September 1, 2000, 1855 - 2421 °D

Bin Fruit Samples - %/1000			
PROJECT YEAR/BLOCK	1st pick	2nd pick	TOTAL
FIRST YEAR ORCHARDS			
Colwell	1.3	-	1.3
Y/Stage	**	-	**
M/Twenty (%/1200)	0.3	-	0.3
E.A.T.	0.3	-	0.3
Rohner Home	0.2	-	0.2
Old Rickabaugh	0.0	-	0.0
Lone Pine - 2 sections			
East neck	0.8	-	0.8
Main block	2.4	-	2.4
M/Brown	1.1	-	1.1
Murphy (%/2000)	1.5	-	1.5
Young East	0.3	-	0.3
Quercus 20	1.4	-	1.4
Wide (%/2000)	0.2	0.0	0.1
Neck (%/2000)	0.4	0.6	0.5
Gaddy	1.1	-	1.1
BP Gaddy	1.4	-	1.4
Manning	9.2	-	9.2
AVERAGE FIRST YEAR	1.4	0.3	1.4
SECOND YEAR ORCHARDS			
Hedgerow	0.2	-	0.2
Renfro	0.4	-	0.4
Pardee-Lake	0.9	-	0.9
Morrison	0.4	-	0.4
Akins	6.0	-	6.0
Pardee-home	0.5	-	0.5
S/Stage (%/2000)	0.2	-	0.2
30 Acres	0.4	-	0.4
K-48	0.0	-	0.0
Cole	0.1	-	0.1
R/Brown	0.3	-	0.3
Young West	0.3	-	0.3
Sixty	0.1	-	0.1
Fourteen	0.3	-	0.3
Trailers	0.0	-	0.0
Triangle	0.8	-	0.8
AVERAGE SECOND YEAR	0.7	-	0.7
FIFTH YEAR ORCHARDS			
S/Timothy (%/1200)	0.8	-	0.8
M/Timothy (%/1200)	0.3	-	0.3
Sanderson	0.4	-	0.4
Cookson	0.1	-	0.1
Eutenier (%/1200)	2.9	-	2.9
AVERAGE FIFTH YEAR	0.9	-	0.9

** bin sample not reliable (pears were presorted before project team could sample)

Table 7a: 2000 LAKE COUNTY PUFFER PROJECT - Weekly 1XL Trap Catch Summary

(Blank areas indicate zeros)

	Orchard Name				
Date	Gold Dust	Hanson	K-7	Y/Stage	Grand Total
4/4/00	0	1	0		1
4/6/00	0	0	0		0
4/11/00	1	0	0	0	1
4/18/00	1	0	1	0	2
4/25/00	0	0	0	0	0
5/2/00	3	0	0	0	3
5/9/00	4	0	0	1	5
5/16/00	0	0	0	0	0
5/23/00	12	0	0	0	12
5/30/00	0	0	0	0	0
6/6/00	1	0	0	0	1
6/13/00	0		0	0	0
6/20/00	4		0	0	4
6/27/00	0		0	0	0
7/4/00	1		0	0	1
7/11/00	2		0	0	2
7/18/00	0		0	0	0
7/25/00	0		0	0	0
8/1/00	1		0	0	1
8/8/00	3		0	0	3
8/15/00	0		0	0	0
8/22/00	7		1	0	8
8/29/00	1		0	0	1
9/5/00	1		0	0	1
9/12/00	0		0	0	0
Grand Total	42	1	2	1	46

Table 7b: LAKE COUNTY PUFFER PROJECT – Weekly 1XH Trap Catch Summary

Orchard Name	Date																Grand Total							
	4/11	4/18	4/25	5/2	5/9	5/16	5/23	5/30	6/6	6/13	6/20	6/27	7/4	7/11	7/18	7/25		8/1	8/8	8/15	8/22	8/29	9/5	9/12
30 Acres	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Akins	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BP Gaddy	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Cole	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
Colwell	0	0	2	0	4	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7
Cookson	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
E.A.T. Rickabaugh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1
Eutenier Home	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Fourteen	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gaddy	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gold Dust	2	3	1	3	10	1	4	0	0	4	3	1	0	0	0	0	1	0	0	0	1	3	1	39
Hanson	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hedgerow	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
K48	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
K-7	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	8	0	0	11
Lone Pine	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
M/Brown	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
M/Timothy	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
M/Twenty	0	0	1	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	6
Manning	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Morrison	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Murphy	0	1	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	8	0	0	11
Neck	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Old Rickabaugh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pardee-Home	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1
Pardee-Lake	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Q/Twenty	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
R/Brown	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Renfro	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rohner Home	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	2
S/Stage	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
S/Timothy	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sanderson	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sixty	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Springer	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Trailers	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Triangle	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Walnuts	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Wide	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Y/Stage	0	0	0	0	3	0	0	0	1	0	0	0	0	2	0	0	0	0	0	0	0	0	0	6
Young East	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Young West	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Grand Total	2	4	4	3	24	1	4	1	0	8	3	1	0	8	1	0	1	0	0	19	4	1	1	90

TABLE 7c: 2000 LAKE COUNTY PUFFER PROJECT - Weekly 10XH Trap Catch Summary

Orchard Name	Sum Of 10x Catches										Date										Grand Total		
	4/11	4/18	4/25	5/2	5/9	5/16	5/23	5/30	6/6	6/13	6/20	6/27	7/4	7/11	7/18	7/25	8/1	8/8	8/15	8/22		8/29	9/5
30 Acres	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1
Akins	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
BP Gaddy	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cole	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Colwell	0	0	0	2	0	0	0	0	0	2	1	0	0	0	0	0	0	0	0	0	0	0	5
Cookson	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	1	0	0	4
EAT Rickabaugh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	2
Eutenier Home	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Fourteen	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gaddy	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1
Gold Dust	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hanson	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hedgerow	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
K48	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
K-7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lone Pine	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
M/Brown	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
M/Timothy	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	2
M/Twenty	0	0	0	0	0	0	0	0	0	7	0	0	0	0	0	0	0	0	0	0	0	0	7
Manning	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	2
Morrison	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	2
Murphy	0	0	0	0	0	0	0	0	0	1	3	0	0	0	3	0	0	0	0	5	0	0	12
Neck	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Old Rickabaugh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	4	0	0	6
Pardee-Home	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	1	0	0	0	4	0	0	7
Pardee-Lake	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	2	0	0	0	4
Q/Twenty	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
R/Brown	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Renfro	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	3	0	0	4
Rohner Home	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	1	0	0	3
S/Stage	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
S/Timothy	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	2
Sanderson	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sixty	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Springer	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Trailers	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Triangle	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Walnuts	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Wide	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Y/Stage	0	0	0	1	1	0	0	0	0	3	0	0	0	0	2	0	0	0	0	1	0	0	8
Young East	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Young West	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Grand Total	1	0	0	2	5	0	0	0	0	13	7	3	0	1	13	4	1	1	0	24	1	0	75

Table 7d: 2000 LAKE COUNTY PUFFER PROJECT - Weekly OBLR Trap Catches

Orchard Name	5/16	5/23	5/30	6/6	6/13	6/20	6/27	7/4	7/11	7/18	7/25	8/1	8/8	8/15	8/22	8/29	9/5	9/12	Grand Total
30 Acres	0	3	21	5	4	2	1	0	1	0	0	3	1	0	1	0	2	3	47
Akins	0	11	20	16	13	12	6	0	0	0	0	0	2	3	8	0	0	0	91
BP Gaddy	0	7	24	12	18	60	51	8	1	4	7	22	10	3	6	4	0	0	237
Cole	0	2	24	4	13	3	3	2	0	0	1	1	2	1	5	1	2	0	64
Colwell	0	11	15	5	15	0	0	0	0	0	0	0	0	4	0	2	0	1	53
Cookson	0	4	29	22	8	19	25	10	0	1	3	1	5	11	16	1	2	2	159
E.A.T. Rickabaugh	0	0	8	7	7	6	3	1	0	0	0	1	1	0	3	2	1	0	40
Eutenier Home	0	2	19	6	0	6	2	3	0	0	0	0	0	0	0	1	0	0	39
Fourteen	0	0	2	4	0	0	3	0	0	0	0	3	1	0	4	2	0	0	19
Gaddy	0	24	35	43	45	100	79	17	7	9	5	11	16	1	43	11	1	7	454
Hedgerow	0	5	16	22	18	21	10	4	1	1	1	8	9	5	24	6	0	0	151
K48	0	0	5	8	7	0	0	0	0	2	0	4	9	12	12	4	5	1	69
K-7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lone Pine	0	8	22	4	13	13	2	4	1	1	0	3	1	7	3	1	0	0	83
M/Brown	0	3	8	0	0	0	6	2	1	0	0	0	0	2	1	0	0	0	23
M/Timothy	0	14	11	7	0	6	7	0	0	1	0	0	4	0	6	0	0	0	56
M/Twenty	0	20	31	2	20	11	1	4	2	0	1	6	3	2	14	6	4	7	134
Manning	0	7	17	15	18	42	23	21	1	1	2	1	11	2	13	6	0	8	188
Morrison	0	3	12	7	9	9	0	0	0	1	0	2	0	4	3	0	1	0	51
Murphy	0	12	58	48	36	62	58	23	4	2	3	3	7	2	1	1	5	1	326
Neck	0	36	91	25	87	76	41	6	4	3	2	13	23	8	10	5	2	2	434
Old Rickabaugh	0	5	6	4	7	5	3	2	0	1	1	1	3	5	2	6	0	3	54
Pardee-Home	0	19	24	38	18	5	4	2	0	1	0	1	0	2	1	0	2	2	119
Pardee-Lake	0	6	14	1	3	3	1	2	0	1	1	2	0	1	0	4	3	0	42
Q/Twenty	0	3	15	9	7	7	13	0	0	0	1	5	11	8	10	0	0	1	90
R/Brown	0	3	20	18	17	23	12	9	1	0	0	0	5	4	0	1	1	2	116
Renfro	0	4	6	6	5	5	2	0	0	1	0	1	4	2	2	0	0	0	38
Rohner Home	0	8	26	10	3	22	23	8	1	0	1	0	10	11	7	6	0	0	136
S/Stage	0	0	11	5	3	0	0	2	0	0	0	0	4	0	4	1	4	2	36
S/Timothy	0	0	4	0	0	2	0	0	0	0	0	0	0	0	3	2	0	0	11
Sanderson	0	0	2	2	4	4	5	0	3	0	0	1	3	0	3	0	0	0	27
Sixty	0	0	21	6	5	1	4	1	1	0	0	2	7	10	28	0	0	1	87
Springer	0	0	7	4	2	8	1	4	1	0	0	15	8	7	0	0	0	6	63
Trailers	0	0	8	4	1	1	1	0	0	2	1	2	8	5	9	2	0	0	44
Triangle	0	0	1	0	0	0	2	0	0	0	0	0	0	0	1	0	1	0	5
Walnuts	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Wide	0	9	22	31	24	35	17	11	3	5	6	12	13	9	23	8	3	3	234
Y/Stage	0	5	13	12	14	11	3	2	0	0	0	0	3	5	4	4	2	3	81
Young East	0	0	1	6	2	1	4	0	1	0	1	6	7	0	3	0	1	4	37
Young West	0	0	11	2	2	5	7	0	0	0	1	9	9	2	10	7	0	1	66
Grand Total	0	234	680	420	448	586	423	148	34	37	38	139	200	138	283	94	42	60	4004

Appendix IV

University of California Cooperative Extension
Lake County
883 Lakeport Blvd., Lakeport, Ca. 95453
Tel: 707.263.6838
Fax: 707.263.3963

FACSIMILE COVER PAGE

To: Mark Lockhart	From: Lake County
Fax #: 263-1052	Fax #: 707-263-3963
Company: Ag Commissioner	Tel #: 707-263-6838
Subject: 2000 CM/OBLR PUFFER PROJECT	
Sent: 8/25/00 at 5:54:00 PM	Pages: 7 (including cover)

MESSAGE:

THIS FAX INCLUDES TRAP CATCHES FOR THE WEEK OF 8/22/00. THERE ARE 6 PAGES ARE NUMBERED 2 -7

FAX UPDATE #18

August 25, 2000

Issued weekly to participating growers, PCA's, and project sponsors.

CAL DPR PUFFER PROJECT

Codling Moth

8/22-24 trap catch since biofix (using April 3). (Moth locations on attached maps)

ALL ZEROS EXCEPT:

	<u>1XL</u>	<u>1XH</u>	<u>10XH</u>	<u>Total</u>
Y/Stage	1		1	2
M/Twenty		1		1
Murphy		8	5	13
H/Rickabaugh		1	4	5
Cookson			1	1
¹ E.A.T. Rickabaugh			1	1
Morrison			2	2
Pardee Home			4	4
Pardee Lake			2	2
Renfro			3	3
Rohner Home			1	1
	<u>1</u>	<u>10</u>	<u>24</u>	<u>35</u>

¹ not yet picked

This is the largest catch this year and "echoes" the 1B flight that peaked June 13. This flight "snuck up" on me (with a vengeance). I am calling this the '2B' flight and still expect a true 3rd flight to occur around September 1. Catches correlate well with damage and were confined to the west and south blocks. Worms were already gone from many of the damaged fruit found in bins which corroborates this since normally newly-hatched larvae are found. **THIS FLIGHT IS VERY CRITICAL; MOTHS ARE NOW LAYING EGGS ON REMAINING FRUIT. THESE WILL LIKELY DEVELOP AND OVERWINTER, EMERGING AS 1B MOTHS NEXT YEAR.**

There are now five cohorts to be concerned about: 1A, 1B, 2A, 2B, and 3. Effects of the upcoming third flight will be less next year as the chances of larvae surviving in the fruit will decrease due to later emergence in this cool year.

IF YOU PLAN TO APPLY LORSBAN 4E, it should be applied ASAP for hatching larvae. This may be the final opportunity this season to counteract any existing resistance pressure since the true third flight continues to be delayed due to cool weather. If you do not apply Lorsban please survey your orchards after harvest and strip out noticeable clusters of fruit remaining in trees. Numerous small patches where fruit was left have been observed. As was seen in some (non-puffer) orchards this year, seemingly low populations have the potential to explode next year unless all precautions are taken.

Degree-day Accumulation

As of August 24 there were 1979 °D, at the KV PestCast station. The true third flight is now predicted to occur about August 31. Again, please make sure orchards are cleaned of as much remaining fruit as possible by this date (see above).

Damage and larval sampling

Bin counts are nearly complete. Out of 34 puffer blocks sampled so far, damage is averaging 0.2% and was found in 13 blocks (range 0.1 – 1.3%). All were either west of Soda Bay Road or south of Finley Road.

An adjacent non-puffer but pheromone-treated block to the south, which had noticeable damage, probably affected the south-edge blocks. This was corroborated by the gradient of decreasing damage from the south to Finley Road. Control on the west edge was likely hindered by 1) a large open area of grapes to the west creating more air flow. 2) the apple tree at the house on Soda Bay Road. 3) the old untreated check in the Stage orchard. There will be no bin counts listed for the Y/Stage as there was intensive sorting by pickers and bin sorters, making the "official" count unreliable (it was 0% and we know there were worms, probably 1.0 - 1.5%).

Several wormy fruit were found along the driverow between the Eutenier and Old Cookson orchards. There was some flight in the Cookson this year, and this find (the first since pre-1996) indicates the great CM pressure this year.

South and west "edge" orchards will all require first cover next spring using 3 lbs. of azinphosmethyl. The 1B flight may also need a second full 3 lbs. The big concern, of course, is the level of resistance going into 2001.

Given the amount of pressure this year, however, the program did exceedingly well, especially in blocks using puffers for several years and east of Park Drive. The final post-harvest sample will be completed by the end of September.

Orchard observations

Puffer orchards will likely need little or no post-harvest treatments for non-CM pests.

A couple of pears with damage resembling that of leaf-miners were found in the Eutenier Home orchard at harvest. Otherwise fruit was clean and the trees are in beautiful shape.

MIXED CM/OBLR PUFFER TRIAL

As of August 24, 2192 CM °D had been accumulated at the PV Adcon Station. The third flight is underway.

8/20 and 8/25 PV Codling Moth trap catches

ALL ZEROS EXCEPT:

<u>Orchard</u>	<u>Set</u>	<u>8/20</u>	<u>8/25</u>
Sides (CM/OBLR puffer)	1	10XH - 1	ALL ZEROS
Boynton (CM only puffer)	3	10XH - 3	
Untreated apples		1XL - 4 1XH - 6	

This is the main part of the true third flight that started the previous week. It appears the flight has ended.

Damage and larval sampling

The grower control was sampled August 22 and had no damage. A post-harvest sample will be done in mid to late September. Dan has done such an excellent job stripping the trees obtaining an adequate sample size may be difficult.

OBLR

8/22 -24 KV trap catches and OBLR °D accumulation (attached table and map):

Flight increased significantly this week. The highest catches were in the Gaddy, Hedgerow, Sixty, and Y/Stage.

As of August 24 there were 2238 OBLR °D at the KV PestCast station (based on 43 °F minimum and 85 °F maximum). According to the WSU model the second flight should be about 84% completed with 65% hatch. It is more likely about 67% complete with about 23% hatch.

In the two blocks with mixed CM/OBLR puffers catches were:

		8/16/99
Eutenier	0	0
S/Timothy	3	3

PV OBLR trap catches and degree day accumulation

As of 8/24 there were 2347 °D at the PV Adcon station.

8/20 AND 8/25 trap catches

Orchard	8/20		8/25	
	Set#	No.	Set#	No.
Boynton	5	1	5	2
(CM puffer only)	6	3	6	1

OBLR damage and larval sampling

KV bin samples thus far reveal 1.2% total OBLR damage with damage found in 34 out of the 35 blocks sampled so far. The only blocks without damage were the H/Rickabaugh and the K-48. There was a little brand new feeding indicating hatch of the second summer generation began but no new worms were found. Damage was 0.3% in the Springer grower control. Final tallies will be in next week's fax.

No OBLR damage was found in the PV grower control sampled August 22.

PUFFER UNIT UPDATE

The machines should be left in the orchard through September. Plan to remove them the first week of October. Take them down, stack them in a holding container of some sort (bins perhaps), cover the container and put them away until next spring. Punch a hole in the empty canisters and dispose of them as you would any empty household cleaner can. Plan to begin next year with NEW BATTERIES.

The units appear to have survived harvest fine. Several along Kelsey Creek were shot with a pellet gun prior to harvest and one was also broken by a thrown rock. The new units are more brittle than last year's units, which had thicker and more supple plastic.

Growing degree-days

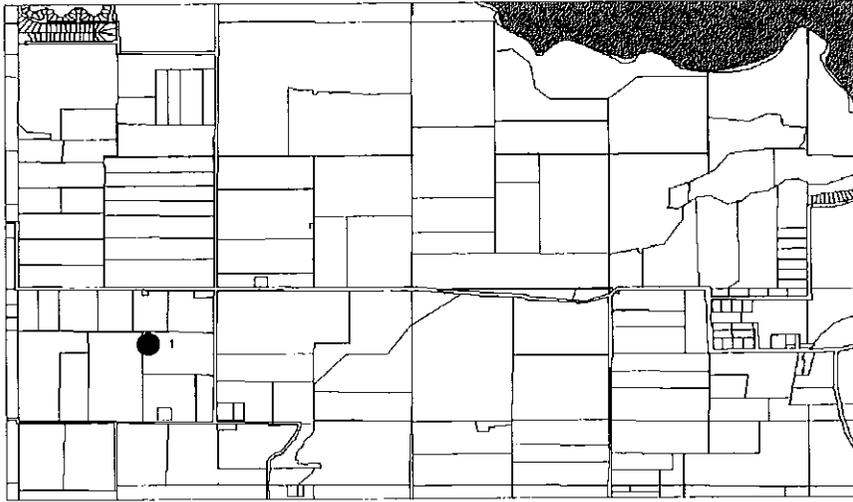
This will be in next week's fax.

NOTE: I will be gone to the International Symposium on Pear Growing in Bologna, Italy from September 1-15. I am presenting two papers: the Bosc training and rootstock trial at Ken Barr's in Finley and the iron chlorosis trial at Don Eutenier's in Kelseyville; these will also be presented at the winter meetings. You will receive a fax next week with trap catches, degree-days, final bin counts, and growing degree-days, but without the commentary. Please discuss your situation with your PCA. The next fax after that will be sent on OCTOBER 6, and will summarize the entire season. I would like to call a meeting with the puffer group when I return to begin discussions about the 2001 season.

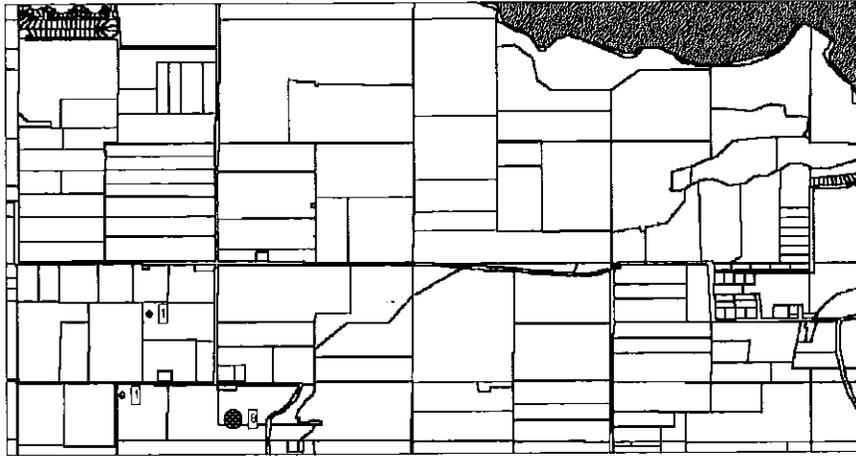
I hope you all get a little chance to rest; for those with grapes, happy harvest (again!)

Questions, comments, suggestions? Contact us! Until next week...

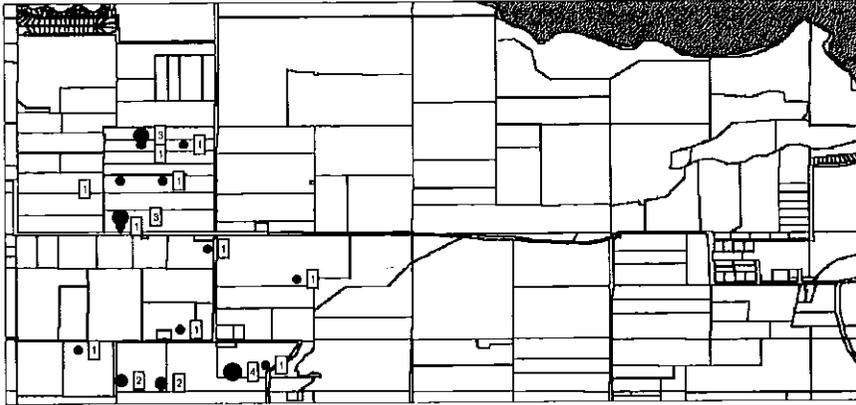
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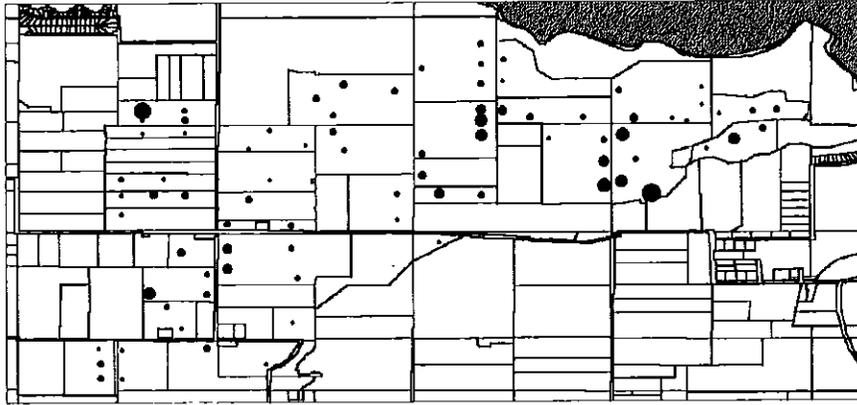
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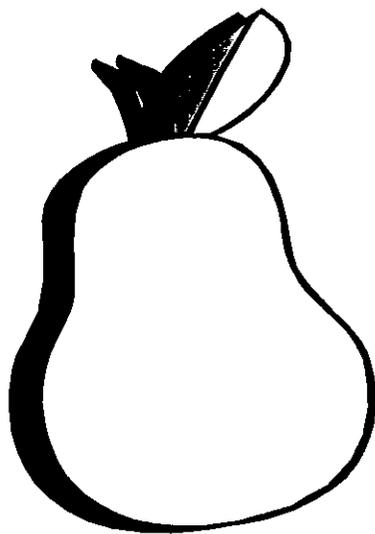


OBLR



OBLR																
Orchard Name	5/16/00	5/23/00	5/30/00	6/6/00	6/13/00	6/20/00	6/27/00	7/4/00	7/11/00	7/18/00	7/25/00	8/1/00	8/8/00	8/15/00	8/22/00	Grand Total
30 Acres	0	3	21	5	4	2	1	0	1	0	0	3	1	0	1	42
Alkins	0	11	20	16	13	12	6	0	0	0	0	0	2	3	8	91
BP Gaddy	0	7	24	12	18	60	51	8	1	4	7	22	10	3	6	233
Cole	0	2	24	4	13	3	3	2	0	0	1	1	2	1	5	61
Colwell	0	11	15	5	15	0	0	0	0	0	0	0	0	4	0	50
Cookson	0	4	29	22	8	19	25	10	0	1	3	1	5	11	16	154
E.A.T. Rickabaugh	0	0	8	7	7	6	3	1	0	0	0	1	1	0	3	37
Eutenier Home	0	2	19	6	0	6	2	3	0	0	0	0	0	0	0	38
Fourteen	0	0	2	4	0	0	3	0	0	0	0	3	1	0	4	17
Gaddy	0	24	35	43	45	100	79	17	7	9	5	11	16	1	43	435
Gold Dust	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hanson	0	0	0	0												0
Hedgerow	0	5	16	22	18	21	10	4	1	1	1	8	9	5	24	145
Johnson																0
K48	0	0	5	8	7	0	0	0	0	2	0	4	9	12	12	59
K-7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lone Pine	0	8	22	4	13	13	2	4	1	1	0	3	1	7	3	82
M/Brown	0	3	8	0	0	0	6	2	1	0	0	0	0	2	1	23
M/Timothy	0	14	11	7	0	6	7	0	0	1	0	0	4	0	6	56
M/Twenty	0	20	31	2	20	11	1	4	2	0	1	6	3	2	14	117
Manning	0	7	17	15	18	42	23	21	1	1	2	1	11	2	13	174
Morrison	0	3	12	7	9	9	0	0	0	1	0	2	0	4	3	50
Murphy	0	12	58	48	36	62	58	23	4	2	3	3	7	2	1	319
Neck	0	36	91	25	87	76	41	6	4	3	2	13	23	8	10	425
Old Rickabaugh	0	5	6	4	7	5	3	2	0	1	1	1	3	5	2	45
Pardee-Home	0	19	24	38	18	5	4	2	0	1	0	1	0	2	1	115
Pardee-Lake	0	6	14	1	3	3	1	2	0	1	1	2	0	1	0	35
Q/Twenty	0	3	15	9	7	7	13	0	0	0	1	5	11	8	10	89
R/Brown	0	3	20	18	17	23	12	9	1	0	0	0	5	4	0	112
Renfro	0	4	6	6	5	5	2	0	0	1	0	1	4	2	2	38
Rohner Home	0	8	26	10	3	22	23	8	1	0	1	0	10	11	7	130
S/Stage	0	0	11	5	3	0	0	2	0	0	0	0	4	0	4	29
S/Timothy	0	0	4	0	0	2	0	0	0	0	0	0	0	0	3	9
Sanderson	0	0	2	2	4	4	5	0	3	0	0	1	3	0	3	27
Sixty	0	0	21	6	5	1	4	1	1	0	0	2	7	10	28	86
Springer	0	0	7	4	2	8	1	4	1	0	0	15	8	7	0	57
Trailers	0	0	8	4	1	1	1	0	0	2	1	2	8	5	9	42
Triangle	0	0	1	0	0	0	2	0	0	0	0	0	0	0	1	4
Walnuts	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Wide	0	9	22	31	24	35	17	11	3	5	6	12	13	9	23	220
Y/Stage	0	5	13	12	14	11	3	2	0	0	0	0	3	5	4	72
Young East	0	0	1	6	2	1	4	0	1	0	1	6	7	0	3	32
Young West	0	0	11	2	2	5	7	0	0	0	1	9	9	2	10	58
Grand Total	0	234	680	420	448	586	423	148	34	37	38	139	200	138	283	3808

NORTH COAST PEAR FIELD DAYS 2000



July 13 & 14, 2000

Sponsored by:

University of California Cooperative Extension
California Department of Pesticide Regulation
California Pear Advisory Board
Pear Pest Management Research Fund
Ukiah Valley IPM Pear Growers, Inc.

2000 UC LAKE COUNTY PEAR FIELD DAY
Thursday, July 13, 2000

SPONSORS:

U.C. Cooperative Extension
California Department of Pesticide Regulation
California Pear Advisory Board (CPAB)
Pear Pest Management Research Fund

3 units PCA Continuing Education Credit applied for

For both sessions, meet at Quercus Ranch, 4150 Soda Bay Road, Kelseyville. Follow parking signs to labor camp. The meeting will then progress to local orchards on Soda Bay Road.

SPANISH SESSION: 12:30 - 3:00 p.m. (Registration at 12:30 p.m., program begins at 1:00)

Translation by Lucia Varela (*Please encourage employees to attend at least one of the Spanish sessions in Lake or Mendocino County – for your benefit as well as theirs!!*) **A HAND LENS WILL BE GIVEN TO EACH ATTENDEE.**

ENGLISH SESSION: 3:30 – 6:00 p.m. (Registration at 3:30, program begins at 4:00)

PROGRAM

(same for English and Spanish sessions)

- **Registration, refreshments, welcome**
Rachel Elkins, U.C. Cooperative Extension, Lake and Mendocino Counties
- **Oak root fungus management and using the pressure bomb to measure tree stress**
HANDS-ON PRACTICE USING THE NOW-COMMERCIAL “SHACKEL” PRESSURE BOMB MADE BY PMS INSTRUMENTS
Rachel Elkins and field staff
Dave Rizzo, Dept. of Plant Pathology, UC Davis
Ken Shackel, Dept. of Pomology, UC Davis
Jeff Hamel, PMS Instrument Co., Corvallis, OR
- **Pear Pest Management Alliance late-season pheromone hanging (final update)**
Rachel Elkins
Participating growers and PCA's
- **CalDPR/PMA areawide codling moth “puffer” project**
DISCUSSION AND HANDS-ON PRACTICE WITH DISPENSERS AND PROGRAMMER
Rachel Elkins and field staff, UCCE
Bob Elliott, CalDPR Project Manager
Roland Gerber, Paramount Farming Co., Bakersfield
Bob McClain, CPAB
Participating Growers and PCA's
- **European pear variety trial – 2000 observations and fruit viewing**
Rachel Elkins
- **ADJOURN**

Those who wish to view and discuss the 8th leaf Golden Russet Bosc training and rootstock trial in Finley are welcome to join us after the English meeting ends at 6:00. Training systems are central leader, 3-leader, 'parallel hedgerow', perpendicular fan and Tatura trellis. Rootstocks are OHxF 40, 69, 87, 97, 217, 333, and 513, Quince BA29C and *P. betulaefolia*.

UPDATE ON THE LAKE COUNTY AREAWIDE CODLING MOTH 'PUFFER' PROJECT
(for Gerber Integrated Pest Management Newsletter) (in progress)

By Rachel Elkins

Ten growers farming a total of 820 acres in Kelseyville, Lake County, California utilized the "puffer" pheromone dispensing system to control codling moth in 2000. The dispenser was developed the late UC entomologist Dr. Harry Shorey and is now known as the Paramount Aerosol Pheromone Dispenser (Paramount Agricultural Technologies, Bakersfield, California). It emits a preset amount of pheromone at present times and intervals. It is widely spaced (65 feet apart), mainly around the perimeter of the orchard at about one to two per acre. The rate used in Lake County in 2000 was 1.1, or a half unit per acre fewer than when the project began on 163 acres in 1996.

Codling moth damage averaged 0.15% in 2000, with almost all damage in first year and/or upwind blocks. Orchards that had been in the program for two or more years had virtually no damage. This was in contrast to an average of 48% damage in untreated controls.

Another important benefit in multiple year orchards was the reduced level of pesticide use for pear psylla and spider mites. Orchards treated one or more times with organophosphates (especially 2-3 times) suffered pear psylla and, more significantly, mite damage late in the season which required extra treatments. Savings, however, were offset by the need to apply a pre-bloom application of chlorpyrifos (i.e. Lorsban®) and one or two follow up BT sprays to control oblique-banded leafrollers, which have become the main secondary pest in codling moth mating disruption programs.

The continuing success of the Lake County project has attracted new participants and next year the project will encompass approximately 1460 acres farmed by 19 growers. Research is continuing to control OBLR without the use of OP's, although chlorpyrifos will continue to be an important tool until adequate alternatives are found. Costs and benefits of initiating and remaining in a puffer MD program are also being documented in collaboration with the Department of Agricultural Economics at UC Davis.

The project was recently recognized as one of eight statewide recipients of the IPM Innovator Award sponsored by the California Department of Pesticide Regulation. The growers, pest control advisers, and project sponsors (including Gerber), can be proud of their commitment and achievement.



Making Our Best...Better

Integrated Pest Management Newsletter

Year 5, Issue 10

Spring 2000

Editorial by Todd DeKryger



“From Sea to Shining Sea”

As we move into the summer season and head towards Independence Day on the Fourth of July, we celebrate all that is good in America and we reflect on how we got here as a nation. As we look around this nation, there are many examples of the innovation of the American farmer and how they have worked with the land, not against it, to produce a bountiful harvest of a variety of crops.

This edition of “Making Our Best...Better” is designed to highlight some of the agricultural research projects going on throughout the country that Gerber Products Company is involved with. The projects range from apple growers getting together in the Carolinas to address production problems facing their industry to pear growers tackling codling moth using novel control strategies in Northern California. All across our nation, growers are facing challenges with innovation and determination just like they always have. Gerber Products Company has been a part of that process since our beginning.

Gerber Products Company started in Michigan in 1901 as the Fremont Canning Company processing a number of different canned fruits, vegetables and meats. Today, our domestic market covers all 50 states and we source fruits and vegetables from 21 of those 50 states. As an important part of the Novartis Consumer Health family, Gerber Products Company has been a global leader in infant nutrition and healthcare products for many years.

As a researcher for a global company, I have the privilege and responsibility to go to many fruit and vegetable growing areas around this country. Part of my job is to learn as much about each growing area as possible so that the dollars Gerber provides for agricultural research each year effectively addresses the production concerns that our growers face each day.

While change is never easy, there are numerous examples of growers across the nation who are addressing the challenges faced by their industry and are equipped to compete on a global market. These innovative growers are competing in a highly competitive world market and succeeding. Gerber Products Company is proud to be associated with many of these growers.

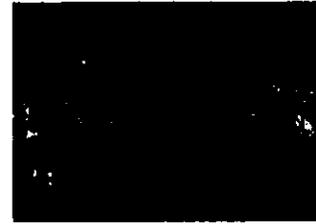
The words of “America, the Beautiful” ring as true today as they did when they were written. “O beautiful for spacious skies, for amber waves of grain...” Katharine Lee Bates had it right when she penned those words in 1895. One of the stories about Ms. Bates suggests that she was inspired to write the poem after visiting Pikes Peak in the Colorado Rocky Mountains. I must confess that the innovation of the American fruit and vegetable grower inspired me to write this newsletter. While I am sure that this edition of “Making Our Best...Better” won't become as famous as “America, the Beautiful,” I hope that it will effectively highlight a few of the many innovative programs in progress throughout this beautiful country.



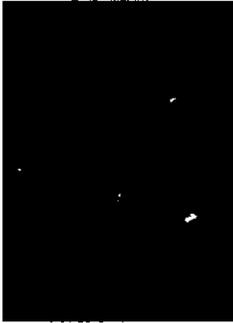
Todd DeKryger

Above the Fruited Plain (cont'd)

One of the most important factors in the success of this program will be the communication between the peach growers and their pest control advisors (PCAs). This communication will be important for improving the timing of the biological insecticides and the effectiveness of the applications. To facilitate the communication, Janine Hasey, a Farm Advisor in Sutter and Yuba Counties north of Sacramento, will hold grower meetings during the season as well as provide individual contact with the participating growers. Gerber Products Company provided a grant to the program to cover the cost of the IPM scouting for the growers.



Janine Hasey holding a peach grower meeting.



A grower checks the Oriental fruit moth monitoring trap in the peach tree.

Leaf and flower spur samples were taken from the dormant trees in January to determine the baseline populations of pests such as the San Jose scale and the European red mite. The levels of parasitism from predator insects in the scale and mite populations were also determined at that time. Based on this information from the PCA's, applications of dormant oil were applied to the orchards when needed.

In February and March, the program's IPM scout monitored the orchards for the peach twig borer emergence and all blocks will be treated with *Bacillus thuringiensis* at 20 - 40 % egg hatch. A second treatment will be applied at 80 - 100 % egg hatch. *Bacillus thuringiensis* is a bacterium that produces a toxin that is a stomach poison for certain species of insects. This naturally occurring insecticide is considered harmless to humans. The toxin is very short-lived and needs multiple applications to maintain effective control.

The mating disruption pheromone dispensers were put in the orchard in March to target the 1st generation of Oriental fruit moth. Orchard blocks will be monitored for shoot strikes from May until harvest and fruit strikes as the fruit ripens. Secondary insect pests, such as two-spotted mites, will also be monitored on a regular basis. If a particular orchard block develops pest populations exceeding the threshold for potential damage during the growing season, a Gerber field representative and the PCA will be contacted before the decision is made to apply an insecticide application. The fruit will be assessed for insect damage at harvest.

Codling Moth Mating Disruption in California Pear Orchards Using an Aerosol Pheromone Dispenser

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email: rbelkins@ucdavis.edu*

Mating disruption has become a major control strategy used in integrated pest management (IPM) programs in California tree fruit orchards. It involves inundating one or a group of orchards with large amounts of the chemical females emit to attract potential mates. These chemicals as a group are called pheromones, and in the case of codling moth (CM), the major pest of pome fruit, the pheromone is called "codlemone."

Knowledge of how pheromones work and how to synthesize them led to the development of the monitoring traps that are now standard orchard IPM tools. Under normal circumstances, female CM emit a trail of a very small quantity of codlemone as they fly. Males can detect this trail from a long distance and use it to seek out a mate. Trapping works because the male detects the pheromone and follows it to the source, which is an

artificial lure in a trap rather than a virgin female moth.

Entomologists have long been interested in using pheromones as a control method as well as simply a monitoring tool. Mass trapping is one well-known strategy and involves hanging numerous pheromone traps that literally "trap out" all the moths in an orchard. This method has been utilized most successfully in small orchards and by organic growers with limited control options. Modern mating disruption (MD) programs now represent the most commonly practiced control strategy using pheromones.

The commercial MD strategies used in orchards today were implemented in the early 1980's following research done in the 1960's - 1970's. Several companies introduced various types of dispensers to disrupt mating of pests such as cotton bollworm, artichoke plume moth, and oriental fruit moth. Pacific BioControl successfully tested a product for use in pear orchards against CM in the Sacramento Valley of California in 1987. Their Isomate C® product was first sold in 1991.



The aerosol pheromone dispenser hanging in a pear tree.

There are now several CM pheromone dispensers being sold, most of which utilize multiple "point sources." This strategy employs many dispensers (200-400 per acre) each of

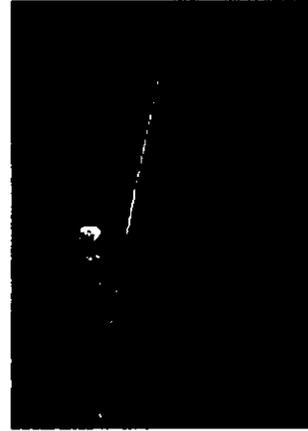
which emits a small amount of pheromone through a porous membrane. Users hang, twist or clip them into the upper parts of trees according to a pattern determined by tree spacing.

Several problems associated with early dispensers slowed widespread adoption until recently. Two of the main ones were poor control when insect populations were high and erratic release rates, mainly due to ambient temperature changes. Another major drawback was total program cost. Besides product cost of about \$200 per acre, labor costs to apply up to 400 units per acre, often twice per season, ranged from \$15-30 per acre per application. Most orchards also required one or more supplemental insecticide sprays that further increased costs.

In response to some of the above issues, the late Dr. Harry Shorey of UC Riverside developed a dispenser that emitted a large amount of pheromone and was spaced widely apart. Dr. Shorey was a pioneer in the field of pheromone-based control technology. He theorized that the number of "point sources" was less important than

having an adequate, **consistent** pheromone dose permeate the orchard. Dispersal studies showed him that a given amount of pheromone moved with air currents laterally and outwardly far beyond the initial emission point. **As long as emission rates remained constant**, pheromone from a relatively small number of dispensers moved and mixed throughout the treated area.

Dr. Shorey utilized the aerosol dispensers commonly found in lavatories and kitchens. These battery-powered units emit a pre-programmed amount of room freshener at set intervals 24 hours per day. Dr. Shorey loaded the pressurized canisters with pheromone instead of perfume. He then modified the programming to emit based on when the target insect flew and mated, rather than 24 hours a day; this extended the field life of the dispenser. The unit was also unaffected by temperature or particulate matter so emission rate was stable from the start to the end of the season. The most attractive benefit for growers, however, was the labor savings. Shorey's goal was to limit application rates to a maximum of two units per acre, hung from the ground around the field perimeter. This would eliminate most of the application costs. Each year, a new canister would be placed in the plastic outer unit and re-hung, so after initial purchase, material cost would also go down.



The dispensers are placed in the upper branches of the pear tree.

Dr. Shorey called his dispenser the "puffer." The first tests of his "puffer" in California pear orchards were conducted in 1996. A major project was funded by the Pear Pest Management Research Fund, a joint grower-processor group dedicated to furthering new pest management strategies (Gerber belongs to the PPMRF). 160 acres in Lake County on the North Coast were initially treated with one dispenser per 1.3 acres. Traps, egg samples, and damage counts were used to evaluate codling moth control. The end results will be briefly summarized below (complete details may be obtained from the author).

In 1996, total damage in areas where CM was controlled only with puffers was less than 1% and was

(Codling Moth Mating Disruption in California Pear Orchards Using an Aerosol Pheromone Dispenser continues on page 8)

Codling Moth Mating Disruption in California Pear Orchards Using an Aerosol Pheromone Dispenser (cont'd)

limited to upwind blocks. The same 160 acres was retreated in 1997 and 1998, with increasingly promising results. Tragically, Dr. Shorey died in a car accident in late summer 1998, so his inspiration and ideas were suddenly lost. Participating growers, however, decided to carry on with the project, and in 1999 it was expanded to 500 acres with funding from the USDA Codling Moth Area-wide Project (CAMP). The California Department of Pesticide Regulation provided funds to treat an additional 360 acres in Potter Valley, Mendocino County.

After Dr. Shorey's death, development of his "puffer" was taken over by Paramount Farming Co., a large almond and pistachio grower/processor in the southern San Joaquin Valley. The company wanted to use it on its ranches against peach twig borer and Oriental fruit moth. The codling moth unit was registered as the "Paramount Aerosol Pheromone Dispenser" in late 1999 and made commercially available to other growers in 2000.

1999 results continued to be excellent. There was virtually no CM trap catch or damage in the Lake County treated acreage. Damage in Potter Valley occurred only in organic blocks, along borders of standard blocks adjacent to the organic ones, and along one riparian corridor harboring feral apple seedlings. These results were achieved despite the fact that in Lake County only about 35% of the acreage received an organophosphate (OP) spray and 100% of the Potter Valley acreage received no OP treatments at all.

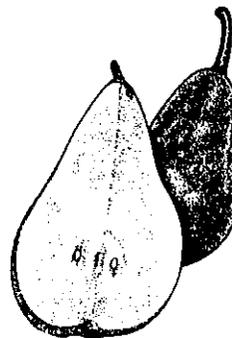
After the 1999 season, participating Lake County growers chose to again expand the project to its current 820 acres using a rate of 1.1 units per acre, and it is still the primary control method for 75 acres of organic pears in Potter Valley. There have been very few moths caught to date in 2000 and no CM eggs found except in standard insecticide and untreated controls. Damage after the first and second generation will again be evaluated to determine efficacy. If the Lake County acreage expands in 2001, the application rate should fall below one per acre, generating further cost savings.

After almost five years, researchers and users have learned much about the strategy. The dispenser is a

mechanical device programmed by a computer. Batteries must be replaced annually and units checked periodically. The programming unit must be set correctly to ensure the proper emission rate, interval and times. Units must be left hanging undisturbed by field workers and harvest crews. They must be taken down at season's end, cleaned, and stored until the next season. **If properly cared for, they should last five years.**

Like other mating disruption programs, the Lake and Mendocino projects have had problems of secondary pest outbreak and need for supplemental chemical control in high-pressure orchards. The most severe secondary pest problem is oblique-banded leafroller (OBLR). A mixed CM/OBLR dispenser is being tested this season in two orchards in Lake and one in Mendocino County. If it is successful, the mixed canister should be commercially available within a couple of years. Pre-bloom applications of the OP Lorsban® and/or in-season applications of BT (e.g. Dipel®) and the insect growth regulator tebufenozide (Confirm®) are presently being used to control OBLR. True bugs have also been a sporadic problem and damage is expected to increase as OP use declines.

In summary, the "Shorey puffer," now known as the "Paramount Aerosol Pheromone Dispenser," like other types of dispensers used in mating disruption programs, appears to be a promising tool if managed wisely.



Sample Costs

*To produce Bartlett pears
In Lake County, California*

Using

PUFFERS

*An amendment to the 1997
Lake County cost study*

Rachel Elkins
Karen Klonsky
Dustin Blakey

Abstract

Sample costs to produce Bartlett pears in Lake County have been compiled most recently in 1997 using standard production practices of the time. Growers at that time were assumed to make three cover spray applications with organophosphate materials to control codling moth. The advent and recent use of aerosol-released pheromone mating disruption ("puffers") created a need for a cost comparison of the two production systems. Man-hours were recorded for all operations that were considered to be part of a diligent, puffer-based codling moth control program. A model spray program was created that was representative of the sprays applied to puffer acreage according to submitted monthly pesticide use reports. The cultural expenses of the 1997 cost study were amended by adding any additional costs incurred from using puffers and by subtracting any savings. For a 40-acre block, it is recommended to use 2 puffers per acre. As contiguous acreage increases, this rate can be reduced. In this study a rate of 1.3 puffers per acre is used in a 500-acre contiguous block of orchards. One trap set (4 traps) is used every 5 acres to monitor insect development. All other 1997 costs, fees, and interest rates were used when possible so that there could be a valid basis for comparison. To produce pears using standard practices cost \$1,847 per acre; using a puffer program cost \$2,042 per acre (1997 dollars). A net additional expense of \$194 was incurred by using puffers. Use of an improved design puffer cabinet (available in 2000), a reduced number of traps per acre, and elimination of the remaining cover spray would lower costs of production using puffers by reducing material and labor expenses. In subsequent years, the cost of the reusable puffer cabinet would be eliminated.

Table 1. Labor used for operations related to using puffers to produce pears. Amounts given are in man-hours per acre (6 min = 0.1 hours).

Operation	MAR	APR	MAY	JUN	JUL	AUG	SEP
Hang Puffers	0.08	-	-	-	-	-	-
Hang CM Traps	0.07	-	-	-	-	-	-
Change Lures (caps)	-	0.125	0.125	0.125	0.125	0.125	-
Check Traps	-	0.144	0.37	0.4	0.28	0.29	0.11
Hang OBLR Traps	-	-	-	0.1	-	-	-
Egg Counts	-	-	0.046	0.046	0.046	-	-
Check Ground Fruit	-	-	-	-	0.064	-	-
Check Tree Fruit	-	-	-	0.172	0.172	-	0.086
Inspect Puffers	0.02	0.02	0.02	0.02	0.02	0.02	-
Compile Weekly Results	-	0.03	0.03	0.03	0.03	0.03	0.03
Bin Counts	-	-	-	-	-	0.24	-
Take Down Traps	-	-	-	-	-	-	0.112
Reprogram Puffers*	-	-	-	-	0.09	-	-

*Not included in cost study.

Table 2. Material costs for puffers and traps. 1999 Prices shown (\$US).

Material	Cost	Rate/Acre
Puffer Cabinet	\$40.00	1.3
Puffer Canister	\$80.00	1.3
Traps*	\$32.96**	0.8

* Includes all lures and replacement liners. Average cost of CM and OBLR types.

** Assumes 4% bulk discount over retail, single case price. Discount will vary with quantity purchased.

Cost of traps.

As the cost of one trap used through a season may seem high, the method by which it was calculated is shown in Table 3. These prices reflect full retail prices quoted by Trece in late 1999 less a 4% discount for buying a reasonable quantity. For a quantity of traps to cover 700 acres, the researchers obtained a more sizable discount. A set of traps consists of four traps: 1xCM high, 1xCM low, 10xCM high, and OBLR-W high.

Table 3. Itemized list of costs used to calculate average cost of one trap.

Item	Qty	Price	Price/100	Needed	Cost of 100
1x CM Lures	25	\$43.17	\$172.68	10	\$1,726.80
OBLR-W Lures	25	\$43.17	\$172.68	5	\$863.40
10x CM Lures	25	\$27.38	\$109.52	3	\$328.56
Liners	100	\$94.29	\$94.29	3	\$282.87
Traps	100	\$231.34	\$231.34	1	\$231.34
				Total	\$3,432.97
				Less 4% discount	\$3,295.65
				Cost per trap	\$32.96

Sample Spray Program.

This is the spray program used in conjunction with puffers for pear pests in our cost study. This is a transition orchard and will receive one cover spray with Guthion. This does not include dormant oil, herbicide, or disease sprays. *This is only an example and may not reflect the actual program in every orchard.*

MARCH

Lorsban, 3 lb / ac
Asana XL 7.25 oz / ac

APRIL

Asana XL 7.25 oz / ac

MAY

Guthion 2 lb / ac
Agri-mek 15 oz / ac (with oil)

JUNE

Dipel 2 lb / ac

JULY

Dipel 2 lb / ac

Table 4. Cultural costs to produce pears using standard practices. Unchanged 1997 cost study amounts.

Beginning JAN 97 Ending DEC 97	JAN 97	FEB 97	MAR 97	APR 97	MAY 97	JUN 97	JUL 97	AUG 97	SEP 97	OCT 97	NOV 97	DEC 97	TOTAL
Cultural:													
Pest Control - Dormant		55											55
Weed Control - Strip Spray 3X		31		10			9						50
Pest Control - Gophers 3X			7										7
Pest Control - Budbreak			16										16
Weed Control - Mow Middles 7X			8	8	8	14	14						50
Pest Control - Scab			35	5									40
Frost Protection				24	24								48
Pest Control - Fungicide Spray				11	59								71
Pest Control - Blight				65	65								131
Pest Control - Blight & Scab				22									22
Prune & Train Trees					792								792
Pest Control - Blight & Cover					38								38
Pest Control - Cover Spray						44	22						66
Irrigate						29	29						58
Fertilize - Nitrogen						34							34
Pest Control - Psylla & Mites						17	155						172
Apply Hormone								28					28
PCA Fees		4	4	4	4	4	4	4	4				33
Leaf Analysis					19								19
Pickup Truck Use	5	5	5	5	5	5	5	5	5	5	5	5	62
ATV Use	5	5	5	5	5	5	5	5	5	5	5	5	57
TOTAL CULTURAL COSTS	10	100	79	159	1019	152	242	42	14	10	10	10	1847

Table 5. Cultural costs to produce pears using puffers. Labor and chemical costs are from 1997. Traps and puffers are 1999 prices. Changes to 1997 study are indicated in *italic* type.

Beginning JAN 99 Ending DEC 99	JAN 99	FEB 99	MAR 99	APR 99	MAY 99	JUN 99	JUL 99	AUG 99	SEP 99	OCT 99	NOV 99	DEC 99	TOTAL
Cultural:													
Pest Control - Dormant		55											55
Weed Control - Strip Spray 3X		31		10			9						50
Pest Control - Gophers 3X			7										7
Pest Control - Budbreak			16										16
Weed Control - Mow Middles 7X		8	8	8	8	14	14						52
Pest Control - Scab			35	5									40
Frost Protection				24	24								48
Pest Control - Fungicide Spray				11	59								70
Pest Control - Blight				65	65								130
Pest Control - Blight & Scab				22									22
Prune & Train Trees					792								792
Pest Control - Blight & Cover					38								38
<i>Pest Control - Cover Spray</i>													0
Irrigate						29	29						58
Fertilize - Nitrogen						34							34
<i>Pest Control - Psylla & Mites</i>			13	13	102								128
<i>Change Caps</i>				1	1	1	1	1	1				6
<i>Check Traps</i>				2	2	2	2	2	2				12
<i>Egg Counts</i>					0.5	0.4	0.5						1.4
<i>Check Tree + Ground Fruit & Bins</i>						0.75	0.75	0.75	0.75				3
<i>Compile Weekly Results</i>				1									1
<i>Hang Puffers</i>			157										157
<i>Hang OBLR Traps</i>						7							7
<i>Inspect Puffers</i>				1									1
<i>Hang CM Traps</i>				20									20
<i>Pest Control - OBLR</i>				36		29	29						94
<i>Take Down Traps</i>									1				1
Apply Hormone								28					28
PCA Fees		4	4	4	4	4	4	4	4				32
Leaf Analysis					19								19
Pickup Truck Use	5	5	5	5	5	5	5	5	5	5	5	5	60
ATV Use	5	5	5	5	5	5	5	5	5	5	5	5	60
TOTAL CULTURAL COSTS	10	100	307	176	1125	132	100	45	18	10	10	10	2042

Table 6. Cost comparison of standard and puffer blocks.

Production Type	Cultural Cost
Standard	\$1,847
Puffer	\$2,041

Table 7. Comparisons of various hypothetical production regimes using puffers at full- and half-rate trap coverage (1 trap per 1.25 acres vs. 1 trap per 2.5 acres) based on 1997 cost study.

Program	One-half trap rate	Full trap rate
Year 1 program	\$2,019	\$2,042
In year 2 with one cover spray	\$1,967	\$1,990
Same but with no cover sprays	\$1,945	\$1,968
Year 2 using mixed OBLR-CM canister, 1 Lorsban application & 1 CM cover	\$1,909	\$1,932
Year 2 mixed OBLR-CM, no CM spray, 1 Lorsban	\$1,887	\$1,910
Standard production (1997 Study)	\$1,848	\$1,848