

<i>DESCRIPTION:</i>	Areawide Implementation of Mating Disruption in Pears Using Puffers
<i>PROJECT LEADER:</i>	Rachel Elkins, UCCE Lake County
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Contract Title: *Areawide Implementation of Mating
Disruption in Pears Using Puffers*

Principal Investigator:

Rachel Elkins, Pomology Farm Advisor
University of California Cooperative Extension
883 Lakeport Blvd.
Lakeport, CA 95453
Phone: (707) 263-6838
FAX: (707) 263-3963
Email: rbelkins@ucdavis.edu

Contractor Organization: Regents of the University of California

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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 2001, 1300 acres of pears farmed by 15 growers in Kelseyville, Lake County, were treated with the relatively 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, CM traps were hung in all participating orchards. Approximately 50% of the traps were monitored by UCCE staff and 50% by participating pest control advisers. Each set of UCCE traps consisted of a 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 several standard treated blocks and two untreated sites. Harvest data showed a total of less than 0.1% damage in the puffer treated blocks, with the majority of damage in first and second-year upwind orchards, those transitioning to organic, and those adjacent to under-farmed orchards and piles of cut trees. Damage was 0.3% in the grower controls and 61% in the untreated controls. OBLR damage at harvest was 0.5%, reflecting the effectiveness of chlorpyrifos (i.e. Lorsban[®]) applied at pre-bloom and tebufenozide (Confirm[®]) for the first summer generation hatch. True bug damage (i.e. boxelder and stink bug) increased greatly in 2001 throughout the project area. Due to the success of the program, acreage under the puffer program will likely increase in 2001.

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 over 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 (although some newer products claim a longer field life).

The demonstration project underway is utilizing 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. of Bakersfield, a large almond and pistachio operation. It is manufactured in Canada and sold directly by Paramount Ag Technologies. The codling moth product is registered as the Paramount Aerosol Pheromone Dispenser®. Rather than hanging many dispensers which 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. Prior to initiating this project, this dispenser was the focus of three years of pear industry-funded UC research on 160 acres farmed by 5 growers in Lake County, which in 1999 expanded to 500 acres and 10 growers under a USDA Areawide Codling Moth Project (CAMP) grant. Based on the success in 1999, the Lake County project was expanded to 820 acres and 11 growers in 2000 and 1300 acres and 15 growers in 2001 under the CalDPR IPM Demonstration Grant. This is about 65% of the total acreage in the Kelseyville growing district and about 40% of the total Lake County acreage. Three upwind 10-20 acre blocks of standard-treated Bartletts and two untreated sites were utilized as grower and untreated controls, respectively.

Materials and Methods

The recommended labeled commercial application rate using the Paramount puffer is two units per 40-acres, placed around the perimeter of the block. In the project year 2001, approximately 1.1 units per acre were hung in late March around the perimeters of each orchard block. Spacing was 50-65 feet upwind and 100-130 feet downwind. Each unit was programmed to emit 7.5 mg. of codlemone every 15 minutes from 3:00 p.m. to 3:00 a.m., for a total of 79.2 gms. of codlemone per acre over the season. Emission ceased whenever the ambient temperature dropped to 50° F. Units were hung in the upper one-third of trees using a hooked, telescoping swimming pool pole. If orchards shared borders, only one side was treated, thus the reason for the reduced rate. Monitoring traps were hung in all blocks. UCCE-monitored trap sets consisted of a 1 mg. low, 1 mg. high, and 10 mg. high codling moth (CM) and an oblique-banded leafroller (OBLR) trap. OBLR is the major secondary pest associated with reduced OP programs.

UCCE monitored traps in 31 puffer-treated orchards, as well as in grower and untreated controls; pest control advisers (PCA's) monitored in the remainder. This contrasts with 1996-2000 in which UCCE monitored all project blocks. Trapping rate in 2001 was one set per five acres in the original five orchards (160 acres) and one set per 10-20 acres in other blocks. Rate was purposely reduced in 2001 to learn if fewer traps per acre could be used due to the great expense involved in monitoring mating disruption orchards. All traps were monitored weekly (Figure 1).

CM and OBLR infestation was evaluated at specific intervals through the growing season. Egg searches using two sample types were performed in the spring prior to first cover and periodically through late July prior to the stop-drop spray; this allowed for treatment decisions to be made in case significant numbers of eggs were found. The first method was a visual evaluation of fruit in the tops and bottoms of trees. The second method was developed by a local PCA and consisted of observing fruit from which a quarter-size area of the peel was cut away. This created a wound, which would ostensibly catalyze release of volatiles and in turn attract CM females. First generation larval damage was evaluated via tree counts in late June and ground fruit counts in early July, again prior to a key treatment opportunity. 1B and second generation larval damage and worms were evaluated via late July tree and harvest bin counts. To evaluate overwintering potential, a post-harvest sample of fruit remaining on trees was done. Each sample consisted of from 300 to 2,000 fruit per block, depending on block size and sample type.

For trapping and damage evaluations, puffer-treated blocks were compared to several 10-20 acre standard-treated orchards, and two completely untreated sites upwind of the puffer project.

Results of UCCE and PCA field activity were reported weekly to participating growers, PCA's, the CalDPR Project Manager, and other interested parties via fax (19 issues to date). Breakfast meeting with PCA's were held monthly. In addition, mid-summer field days in both English and Spanish were held in July to present results to date. A cost study for the program was prepared for the 1999 season and is being updated for the 2000 and 2001 seasons. A summary of comparative pesticide use for standard versus puffer mating disruption programs is also being completed (Appendix III and IV).

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 less than 0.1% overall across 58 blocks versus 0.3% in the standard control blocks and 61% in the untreated controls. Damage occurred primarily in orchards with overwintering CM pressure from 2000, those transitioning to organic, and those with large edge effects i.e. where the orchard bordered less effective mating disruption, or large open areas, or in proximity to piles of removed or under-farmed trees. Versus 2000 when damage was mainly in first year blocks, most damage in 2001 was in second year blocks which were the same ones with problems in 2000. Most first year blocks avoided damage due to 1-3 supplemental treatments of azinphosmethyl or tebufenozide (Confirm®). Damage averaged 0.09% in first year blocks (located on the south and west upwind borders) 0.34% in second year blocks, 0.04% in third year, 0.0% in fourth, and 0.02% in the original blocks treated since 1996. The puffer units lasted the entire season, showing only one hanging per season is required, although there was concern about battery life late in the season (Tables 2, 4, 6, 8).
- b) **Objective 2:** *Verify the minimum level of monitoring needed to commercially use this method.* Of 32 moths caught in UCCE 1 mg. low traps 28 were in grower and untreated controls and three of the remaining in orchards that had pressure in 2000. There were several orchards with damage but no catch in 1XL traps and two orchards with 1XL catch but no damage. 1 mg. high traps caught 91 moths, 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 (136). Correlation between trap catch and damage was much lower than in 2000. The best correlation with damage in 2001 was with 10 mg. high traps, which correctly predicted damage in 58% of the blocks where it occurred, and likewise correctly predicted no damage would occur in 58% of damage-free blocks. 1xH traps correctly predicted damage would occur only 36% of the time it occurred but was 58% correct in predicting no damage. UCCE-monitored OBLR traps caught many moths, but as has been the case previously, numbers showed little correlation to severity of damage (Figures 2-5, Tables 1 and 2).
- c) **Objective 3:** *Produce commercial yields of U.S. #1 Bartlett and Bosc pears using greatly reduced amounts of organophosphate insecticides.* No OP or other CM-target insecticide was applied to most multiple year blocks during the 2001 season, versus the standard block that received at least two sprays. First year blocks with moderate pressure received one to three OP or tebufenozide (Confirm®) treatments depending on trap catches and egg sampling. Organic transition blocks received several applications of oil at egg laying. Exact amounts of insecticides 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 generally controlled by one pre-bloom chlorpyrifos (i.e. Lorsban®) and one or more tebufenozide sprays for the first summer hatch. OBLR damage averaged only 0.5% at harvest and ranged from 0.0-2.4%. Damage was worst where no pre-bloom Lorsban® was applied, and near riparian corridors. OBLR trap counts again appear to be uncorrelated with damage. One in-season spray was applied for pear psylla and mite control in most puffer-treated orchards, although some orchards received no treatments for these pests except dormant oil. Post-harvest treatments were unnecessary in most puffer-treated blocks except for sulfur applied for pear rust mite. (Data on secondary pest treatment will be compiled from monthly use reports). Boxelder and stink bug damage was much higher this year and has become the newest secondary pest issue in the program. No San Jose scale was found. (Tables 3, 5, 7, 8).

Discussion

Data at harvest indicated several points:

- 1) Mating disruption, specifically puffers, 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. The newly registered insect growth regulator tebufenozide (Confirm®) was used in many orchards this year rather than azinphosmethyl and appears to have given acceptable control where CM pressure was low to moderate.
- 2) Orchards that begin the season with high pressure will require greater supplementation by insecticides and more years to achieve adequate control. In 2001, the most problematic orchards were those with pressure from the 2000 season, transitioning to organic, or bordering underfarmed orchards or piles of cut trees. Two CM flights occurred during harvest in 2001, a period where flight is often poorly monitored and infestation cannot be controlled. This will further exacerbate pressure next spring (Figure 2).
- 3) Current poor economic conditions in the pear industry have caused a large number of removed and underfarmed orchards. Situations include: 1) some piles of felled trees last year which remained in place through the season; adult CM then emerged and flew to nearby orchards. 2) orchards that were removed but single rows of trees left uncared for around the perimeters, and 3) severely underfarmed orchards which increased pressure on neighboring blocks. These circumstances, combined with favorable conditions for CM development, greatly challenged mating disruption in 2001, and will likely continue to do so in 2002.
- 4) Leafrollers, specifically oblique-banded leafroller (OBLR), were controlled well with pre-bloom Lorsban® and/or Confirm®. Confirm® often replaced azinphosmethyl for CM control and in many cases there was enough overlap in spray timing to reduce the severity of both CM and OBLR damage. Confirm® also replaced BT as the primary in-season OBLR treatment.
- 5) The major secondary pests in 2001 were true bugs, particularly boxelder and stink bugs, but also possibly other types. Many field-run cannery loads exceeded 5% total defects due to true bug damage. It remains to be seen whether these will be a chronic problem or were simply more abundant due to the dry winter, but will be the focus of applied research in 2002.
- 6) 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). Experience in 2001 brought out several economic and logistical issues:
 - a. In 2001 growers were responsible for deploying, checking and taking down their own units. It was emphasized by UCCE through the season that 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 2001, batteries appeared to last through the season, although the reading on some units went to zero. Some of the newly-designed closed battery cases were also subject to cracking. 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.

- b. The accompanying programming unit currently costs \$350.00 and must be purchased separately by the user(s). In 2001, users largely did their own programming and became 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 (though growers have thus far been undeterred). 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 the number of acres in puffers has increased, the number of units per acre has decreased, 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. 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. Care must be taken, however, to deploy an adequate number of units to be effective. Failing to do so will result in more in-season insecticide treatments and/or damage at harvest.

In 2001, the 1,300 acre project in Kelseyville remained at 1.13 units per acre; the rate was the same as 2000 because of the large number of orchard removals surrounding the project area, as well as the location of new orchards on the southern upwind side. Given the increased CM pressure in 2001 due to late season flights and continued economic hardship, puffers were added to some orchards during the growing season and others in retrospect probably should have utilized an increased number of units per acre.

- 7) There appears to have been less correlation between trap catches and damage in 2001 than in previous years. One factor may have been the reduced rate of trapping (1 set per 10-20 acres versus the previous 1 set per 5 acres). Damage data from non-UCCE monitored orchards has yet to be compared with PCA trapping rates, trap type and seasonal catches. Once this is complete, it will be easier to determine the effect of reduced trapping density. The efficacy of the cut fruit egg sample also remains to be analyzed.

Summary and Conclusions

The UC Shorey “puffer”, now sold as the Paramount Aerosol Pheromone Dispenser[®], was utilized to control codling moth (CM) 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 in their sixth year. An additional 337 acres were added in 1999, which expanded to 820 acres in 2000 and to 1300 acres in 2001.

Acreage added in 2001 was almost all to the south (upwind) and east (downwind). It was expected the southern blocks would require supplemental organophosphate (OP) treatments to reduce the incoming population and mitigate certain “edge effects”.

Puffers were hung at an average rate of 1.13 per acre (the same rate as in 2000), 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 on the North Coast continued to increase in 2001, with higher overall trap catches and damage in all growing areas. Despite this, damage in the 58 puffer-treated project blocks was only 0.09%.
- 2) Virtually all damage occurred in upwind blocks, those transitioning to organic, and those bordered by either a) large open space or vineyard, b) less effective mating disruption programs, or c) in close proximity to under-farmed orchards or piles of felled trees. Damage also occurred in proximity to one of the untreated controls with a high population.
- 3) Damage was reduced to nearly zero in third year orchards and was zero in fifth and sixth year orchards, despite a complete lack of OP sprays for several years.
- 4) OBLR damage decreased greatly in 2001 due to widespread adoption of a pre-bloom chlorpyrifos application. Tebufenozide (Confirm[®]) applied for CM also provided enough overlap to control the first summer generation hatch.
- 5) The main secondary pests were true bugs, mainly boxelder and stink bug. 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. Pear rust mite required treatment in some blocks after harvest due to greatly reduced avermectin (i.e. Agrimek[®]) sprays during the growing season.
- 6) Trap catch data was less successful in predicting damage in 2001. 1XL catches were minimal except in the untreated controls and two high pressure puffer blocks and failed to predict damage outcome correctly in several cases. A reduced trapping rate may have contributed to the poorer results.

Despite challenges, results after 2001 continue 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. Orchards transitioning to organic will also likely have problems due to lack of adequate supplemental materials. 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. Accurate and cost-effective monitoring also continues to challenge the long-term feasibility of MD. Development and implementation of effective and cost-effective monitoring methods is critical to future success.

Figure 1

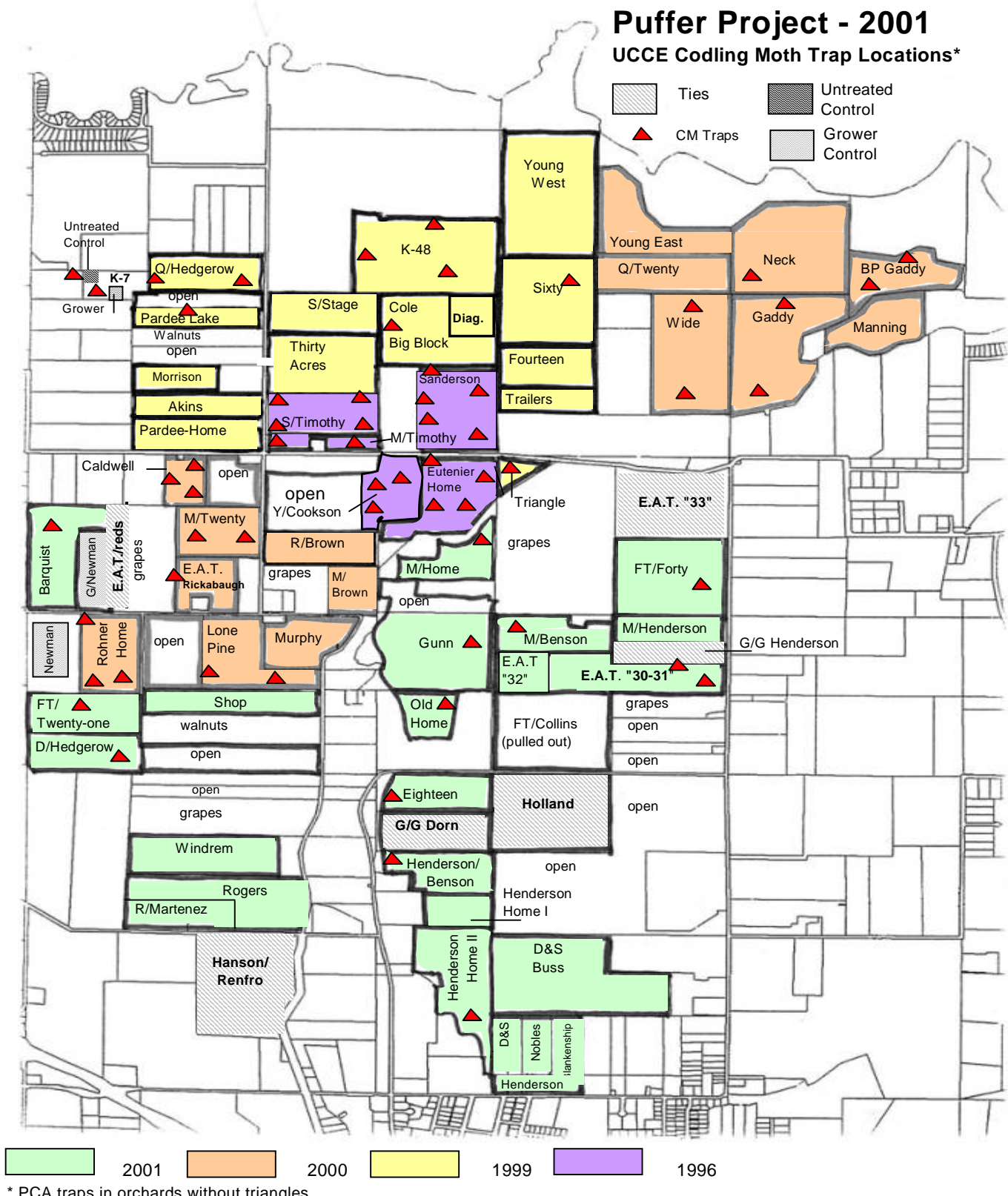


Figure 2
Total CM Trap Catches in Puffer Plots
 Kelseyville, Lake County
 April - September 2001

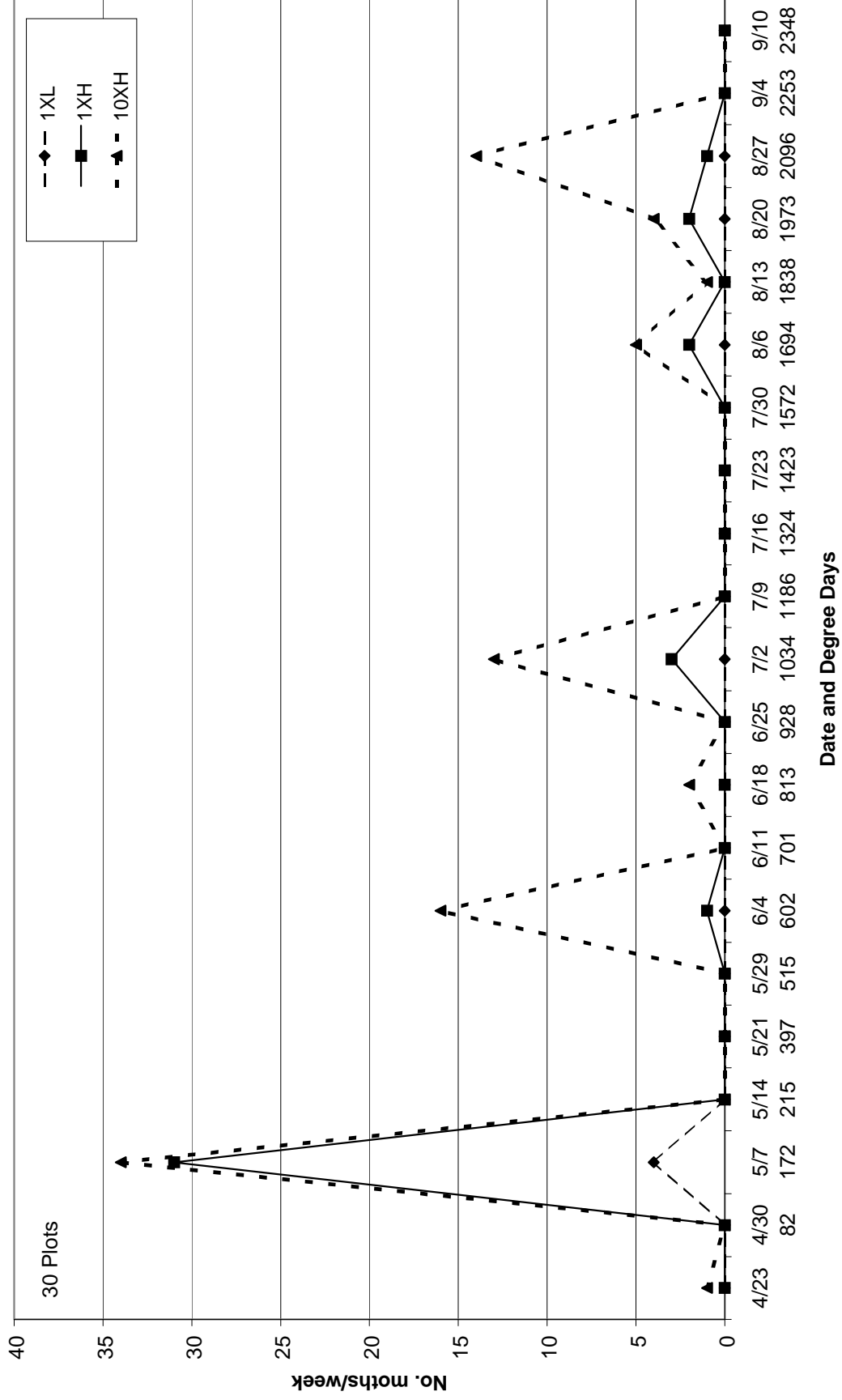


Figure 3
Total OBLR Trap Catches in Puffer Plots
 Kelseyville, Lake County
 April - September 2001

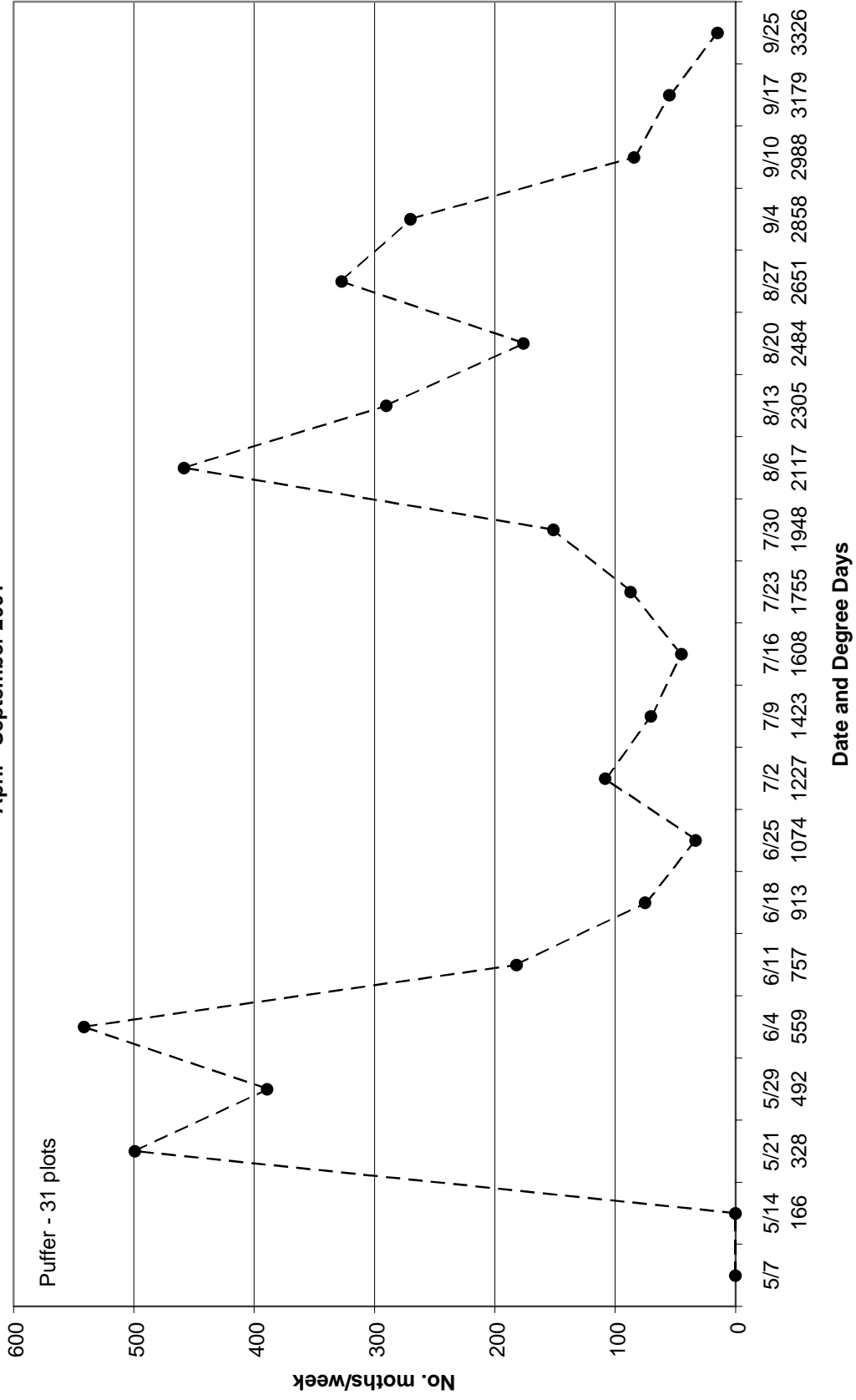


Figure 4 Total CM and OBLR Trap Catches in Grower Control Plots
 Kelseyville, Lake County
 April - September 2001

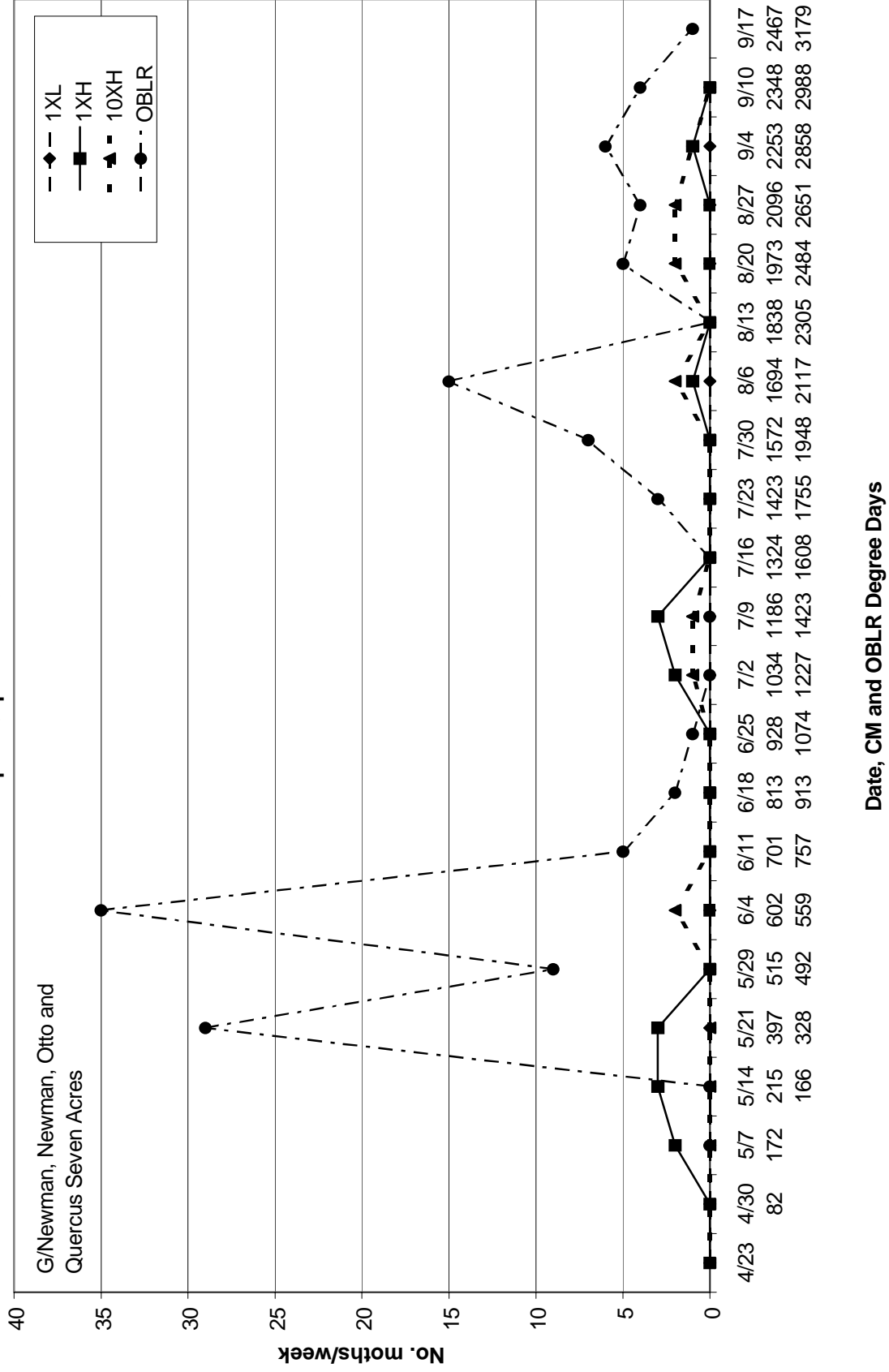


Table 1

2001 LAKE COUNTY PUFFER PROJECT			
CM/OBLR UCCE Trap Catches			
Total Catch Thru September 25, 2001			
TRAP TYPE	TREATMENT		
	Puffer (31 plots)	Grower (2 plots)	Control (2 plots)
CM 1 X LOW	4	6	22
CM 1 X HIGH	38	15	29
CM 10 X HIGH	89	11	25 (1 plot)
OBLR W/HIGH	3855	126	100 (1 plot)

Puffers hung by growers first week of April
CM biofix April 23, 2001, **OBLR** biofix May 7

2000 LAKE COUNTY PUFFER PROJECT			
CM/OBLR Trap Catches			
Total catch thru August 29, 2000			
TRAP TYPE	TREATMENT		
	Puffer (37 plots)	Grower (2 plots)	Control (2 plots)
CM 1 X LOW	1	0	44
CM 1 X HIGH	40	0	50
CM 10 X HIGH	74	1	0
OBLR W/HIGH	3845	57	0 (1 plot)

Puffers hung by UCCE staff March 22, 2000
CM biofix April 3, 2000, **OBLR** biofix May 21, 2000

Table 2

2001 LAKE COUNTY PUFFER PROJECT
Codling Moth Trap Catches* and Fruit Damage
April - September 2001
Ground Fruit Samples - %/500, Pre-harvest Tree Fruit Samples - %/2000
Bin Fruit Samples - %/1000 and Post-harvest Samples - %/300

TREATMENT/ PROJECT YEAR/BLOCK	1XL	1XH	10XH	% 1ST GEN GRND DAMAGE	% PRE-HARV DAMAGE	% BIN DAMAGE	% POST-HARV DAMAGE	1XL	1XH	10XH	% 1ST GEN GRND DAMAGE	% PRE-HARV DAMAGE	% BIN DAMAGE	% POST-HARV DAMAGE
PUFFERS														
First Year Orchards														
D&S Buss	**	**	**	0.0	0.0	0.1	0.0	**	**	**	0.0	0.05	0.1	0.0
D/Hedgerow	0	0	6	0.0	0.05	0.8	0.3	0	0	1	0.0	0.0	0.0	0.0
E.A.T. "30-31"	0	0	0	0.0	0.1	0.0	0.0	**	**	**	1	1	0.0	0.0
E.A.T. "32"	**	**	**	0.6	0.05	1	0.0	0	0	0	0.0	0.0	0.0	0.0
Eighteen	0	0	0	0.0	0.0	0.1	0.0	**	**	**	0.2	0.0	0.0	0.0
Forty	0	0	0	0.0	0.0	0.0	0.0	**	**	**	0.4	0.4	0.0	0.0
G/G Dorn	**	**	**	0.0	0.0	0.1	0.0	0	0	2	0.2	0.05	0.0	0.0
G/G Henderson	**	**	**	0.0	0.0	0.0	0.0	**	**	**	0.0	0.0	0.0	0.0
Gunn	0	0	2	0.0	0.0	0.1	0.0	0	1	1	1	0.0	0.1	2.0
H/Benson	0	0	1	0.0	0.05	0.0	0.0	0	0	0	0.0	0.0	0.1	0.0
Henderson Home I	**	**	**	1	1	1	0.0	**	**	**	0.0	0.0	0.0	0.0
Henderson Home II	0	0	0	0.0	0.0	0.0	0.0	0	0	0	0.0	0.0	0.0	0.0
M/Benson	1	0	0	0.0	0.0	0.1	0.0	**	**	**	0.0	0.0	0.0	0.0
M/Henderson	**	**	**	0.0	0.0	1	0.0	**	**	**	0.0	0.0	0.0	0.0
M/Home	0	0	0	0.0	0.0	0.1	0.0	**	**	**	0.0	0.0	0.0	0.0
Old Home	0	0	2	0.0	0.0	0.0	0.0	**	**	**	0.0	0.0	0.0	0.0
R/Martinez	**	**	**	0.0	0.0	0.0	0.0	**	**	**	0.0	0.0	0.0	0.0
Rogers	**	**	**	0.0	0.0	0.2	0.0	**	**	**	0.0	0.0	0.0	0.0
Rohrer Shop	**	**	**	0.6	0.0	0.0	0.0	**	**	**	0.0	0.0	0.0	0.0
Twenty-one	0	0	1	0.8	0.0	0.0	0.0	**	**	**	0.0	0.0	0.0	0.0
Windrem	**	**	**	0.2	0.0	0.0	0.0	**	**	**	0.0	0.0	0.0	0.0
Average First Year	0.09	0.0	1.09	0.2	0.06	0.09	0.02	0.09	0.0	0.2	0.06	0.04	0.02	0.1
Second Year														
BP Gaddy	0	0	1	0.0	0.0	0.0	0.0	0	1	2	0.0	0.3	0.0	0.0
Caldwell	1	11	17	1	0.6	1.8	0.0	0	0	0	0.0	0.0	0.1	0.0
E.A.T. Rickabaugh	0	0	1	0.0	0.2	0.05	0.0	0	0	1	0.6	0.1	0.0	0.0
Gaddy	0	0	0	0.0	0.0	0.0	0.0	0	0	1	0.0	0.1	0.0	0.0
Lone Pine (neck)	0	2	4	1	0.0	0.0	0.0	0	0	0	0.2	0.0	0.0	0.0
Lone Pine (west)	0	1	11	1	1	0.2	0.3	0	0	0	0.2	0.1	0.02	0.0
M/Brown	**	**	**	13.8	0.9	0.4	0.3	**	**	**	0.6	0.1	0.1	0.1
M/Twenty	2	20	23	1	0.0	0.8	6.7	0	1	2	0.0	0.3	0.0	0.0
Manning	**	**	**	0.0	0.0	0.0	0.0	0	0	0	0.0	0.0	0.0	0.0
Murphy	**	**	**	20.0	0.8	1.5	0.0	0	3	9	16.5	0.4	0.4	4.3
Q/Neck	0	0	0	0.0	0.3	0.0	0.0	**	**	**	2.2	0.0	0.2	0.0
Q/Twenty	**	**	**	0.0	0.1	0.1	0.0	**	**	**	1.8	0.5	0.4	0.0
R/Brown	**	**	**	0.0	0.2	0.2	0.0	3.0	7.5	5.5	6.8	0.2	0.3	1.1
Rohrer Home	0	0	6	0.0	0.0	0.1	0.0	0	12	2	0.0	0.0	0.0	0.0
Wide	0	2	5	0.2	0.0	0.0	0.0	6	3	9	16.5	0.4	0.4	4.3
Young East	**	**	**	0.2	0.0	0.0	0.0	**	**	**	49.5	4.1	32.1	3.0
Average Second Year	0.3	3.6	6.8	2.9	0.2	0.4	0.5	11.0	14.5	25.0	49.5	33.8	61.2	41.5
UNTREATED CONTROLS														
Gold Dust 1	18	21	-	1	63.5	90.3	80.0	18	21	-	1	63.5	90.3	80.0
Quercus Seven Acres	4	8	25	49.5	4.1	32.1	3.0	4	8	25	49.5	4.1	32.1	3.0
Average Untreated Controls	11.0	14.5	25.0	49.5	33.8	61.2	41.5	11.0	14.5	25.0	49.5	33.8	61.2	41.5

* Orchards with UCCE traps
** Orchards with traps monitored by PCAs
¹ Orchard not sampled

Table 3

**2001 LAKE COUNTY PUFFER PROJECT
1st Generation CM and OBLR Damage
Kelseyville, Lake County
Tree Fruit Samples - %/1000, Ground Fruit Samples - %/500**

TREATMENT	Tree June 19 - July 12, 2001			Ground July 18 - 27, 2001		
	CM 829-1238 °D		OBLR 936-1495 °D	CM 1339-1514 °D		OBLR 1637-1871 °D
	Eggs	Damage	Damage	Eggs	Damage	Damage
Average Puffer¹ Grower Control	0.01	0.04	0.04	0.02	0.8	0.2
G/Newman	0.0	0.0	0.0	0.0	1.8	0.0
Newman	0.0	0.0	0.0	0.0	2.2	0.0
Quercus Seven Acres (500 fruit)	0.0	0.2	0.2	0.0	16.5	0.0
Otto	0.0	0.0	0.0	0.0	*	*
Average Grower Controls	0.0	0.05	0.05	0.0	6.8	0.0
Untreated Controls						
Quercus Seven Acres	1.4	0.5	0.6	30.3 ³	49.5 ³	0.0 ³
Gold Dust ²	4.6	16.2	0.2	**	**	**
Average Untreated Control	3.0	8.4	0.4	30.3	49.5	0.0

¹ 59 site samplings

² 500 fruit sampled

³ 99 fruit sampled

** no ground fruit

Table 4a

2001 LAKE COUNTY PUFFER PROJECT
Late 1st and 2nd Generation Codling Moth Damage
July 30 - August 3, 2001 (1572-1644 °D)
Pre-harvest Tree Fruit Sample - %/2000

TREATMENT/BLOCK	Top	Bottom	Total
PUFFERS			
With UCCE Traps			
BP Gaddy	0.0	0.0	0.0
Caldwell	0.7	0.4	0.6
Cole	0.0	0.0	0.0
D/Hedgerow	0.0	0.1	0.1
E.A.T. "30-31"	0.0	0.2	0.1
E.A.T. Rickabaugh	0.0	0.3	0.2
Eighteen	0.0	0.0	0.0
Eutenier (west)	0.0	0.5	0.3
Forty	0.0	0.0	0.0
Gaddy	0.0	0.0	0.0
Gunn	0.0	0.0	0.0
H/Benson	0.0	0.1	0.05
Henderson Home II	0.0	0.0	0.0
K-48	0.0	0.0	0.0
Lone Pine (neck)	0.0	0.0	0.0
M/Benson	0.0	0.0	0.0
M/Home	0.0	0.0	0.0
M/Timothy	0.0	0.0	0.0
M/Twenty	0.0	0.0	0.0
Old Home	0.0	0.0	0.0
Pardee Lake (east)	0.0	0.1	0.05
Q/Hedgerow	0.0	0.0	0.0
Q/Neck	0.2	0.4	0.3
Q/Triangle	0.0	0.0	0.0
Rohner Home	0.0	0.0	0.0
S/Timothy	0.2	0.0	0.1
Sanderson	0.1	0.1	0.1
Sixty	0.0	0.0	0.0
Twenty-one	0.0	0.0	0.0
Wide	0.0	0.0	0.0
Young Cookson	0.0	0.0	0.0
Average UCCE Traps	0.04	0.07	0.05
Without UCCE Traps			
Akins	0.0	0.1	0.05
Blankenship	0.0	0.0	0.0
D&S Buss	0.0	0.0	0.0
E.A.T. "32"	0.0	0.1	0.05
G/G Dom	0.0	0.0	0.0
G/G Henderson	0.0	0.0	0.0
M/Henderson	0.0	0.0	0.0
M/Brown	0.9	0.8	0.9
Manning	0.0	0.0	0.0
Morrison	0.0	0.0	0.0
Murphy	1.2	0.3	0.8
Nobles	0.0	0.0	0.0
Pardee Home	0.2	0.5	0.4
Q/Fourteen	0.0	0.0	0.0
Q/Twenty	0.1	0.1	0.1
R/Brown	0.2	0.1	0.2
R/Martinez	0.0	0.0	0.0
Rogers	0.0	0.0	0.0
Rohner Shop	0.0	0.0	0.0
S/Stage	0.0	0.0	0.0
Thirty Acres	0.0	0.0	0.0
Trailers	0.0	0.0	0.0
Windrem	0.0	0.0	0.0
Young East	0.0	0.0	0.0
Young West	0.0	0.0	0.0
Average Without UCCE Traps	0.1	0.08	0.09
AVERAGE PUFFERS	0.07	0.08	0.07
Grower Controls			
Otto	0.0	0.0	0.0
Quercus Seven Acres	0.4	0.4	0.4
Newman	0.0	0.0	0.0
G/Newman	0.7	0.3	0.5
AVERAGE GROWER CONTROLS	0.3	0.2	0.2
Untreated Controls			
Gold Dust (381 fruit)	-	-	63.5
Quercus Seven Acres	3.2	5.0	4.1
AVERAGE UNTREATED CONTROLS	3.2	5.0	33.8

Table 5a

2001 LAKE COUNTY PUFFER PROJECT
Oblique-banded Leafroller Damage
July 30 - August 3, 2001 (1948-2047 °D)
Pre-harvest Tree Fruit Sample - %/2000

TREATMENT/BLOCK	Top	Bottom	Total
PUFFERS			
With UCCE Traps			
BP Gaddy	0.1	0.4	0.3
Caldwell	0.2	0.3	0.3
Cole	0.0	0.0	0.0
D/Hedgerow	0.2	0.1	0.2
E.A.T. "30-31"	0.0	0.0	0.0
E.A.T. Rickabaugh	0.0	0.0	0.0
Eighteen	0.0	0.7	0.4
Eutenier (west)	0.2	0.2	0.2
Forty	0.2	0.7	0.5
Gaddy	0.0	0.0	0.0
Gunn	0.1	0.1	0.1
H/Benson)	0.0	0.8	0.4
Henderson Home II	0.0	0.2	0.1
K-48	0.0	0.0	0.0
Lone Pine (neck)	0.0	0.0	0.0
M/Benson	0.0	0.2	0.1
M/Home	0.2	0.0	0.1
M/Timothy	0.0	0.0	0.0
M/Twenty	0.1	0.0	0.05
Old Home	0.0	0.0	0.0
Pardee-Lake (east)	0.0	0.0	0.0
Q/Hedgerow	0.0	0.1	0.05
Q/Neck	0.0	1.0	0.5
Q/Triangle	0.0	0.0	0.0
Rohner Home	0.0	0.0	0.0
S/Timothy	0.0	0.8	0.4
Sanderson	0.0	0.0	0.0
Sixty	0.0	0.0	0.0
Twenty-one	0.0	0.0	0.0
Wide	0.2	0.0	0.1
Young Cookson	0.0	0.0	0.0
Average UCCE Traps	0.05	0.2	0.1
Without UCCE Traps			
Akins	0.0	0.0	0.0
Blankenship	0.0	0.1	0.03
D&S Buss	0.0	0.0	0.0
E.A.T. "32"	0.1	0.0	0.05
G/G Dorn	0.0	0.0	0.0
G/G Henderson	0.0	0.0	0.0
M/Henderson	0.0	0.0	0.0
M/Brown	0.0	0.0	0.0
Manning	0.1	0.1	0.1
Morrison	0.0	0.0	0.0
Murphy	0.0	0.0	0.0
Nobles	0.0	0.0	0.0
Pardee Home	0.0	0.1	0.03
Q/Fourteen	0.0	0.0	0.0
Q/Twenty	0.3	0.2	0.3
R/Brown	0.0	0.0	0.0
R/Martinez	0.0	0.0	0.0
Rogers	0.1	0.0	0.05
Rohner Shop	0.0	0.0	0.0
S/Stage	0.0	0.0	0.0
Thirty Acres	0.0	0.1	0.03
Trailers	0.0	0.0	0.0
Windrem	0.0	0.0	0.0
Young East	0.2	0.1	0.1
Young West	0.0	0.0	0.0
Average Without UCCE Traps	0.03	0.02	0.03
AVERAGE PUFFERS	0.04	0.1	0.07
Grower Controls			
Otto	0.0	0.0	0.0
Quercus Seven Acres	0.0	0.0	0.0
Newman	0.0	0.0	0.0
G/Newman	0.0	0.0	0.0
AVERAGE GROWER CONTROLS	0.0	0.0	0.0
Untreated Controls			
Gold Dust (381 fruit)	0.0	0.0	0.0
Quercus Seven Acres	0.0	0.0	0.0
AVERAGE UNTREATED CONTROLS	0.0	0.0	0.0

Table 5b

2001 LAKE COUNTY PUFFER PROJECT
Oblique-banded Leafroller Damage
July 30 - August 3, 2001 (1948-2047 °D)
Pre-harvest Tree Fruit Sample - %/2000

TREATMENT/BLOCK	Top	Bottom	Total
First Year Orchards			
D&S Buss	0.2	0.1	0.2
D/Hedgerow	0.0	0.0	0.0
E.A.T. "30-31"	0.0	0.7	0.4
E.A.T. "32"	0.2	0.7	0.5
Eighteen	0.1	0.1	0.1
Forty	0.0	0.8	0.4
G/G Dorn	0.0	0.2	0.1
G/G Henderson	0.0	0.2	0.1
Gunn	0.2	0.0	0.1
H/Benson	0.0	0.0	0.0
Henderson Home II	0.0	0.0	0.0
M/Benson	0.0	0.0	0.0
M/Henderson	0.1	0.0	0.05
M/Home	0.0	0.0	0.0
Old Home	0.0	0.0	0.0
R/Martinez	0.0	0.0	0.0
Rogers	0.0	0.0	0.0
Rohner Shop	0.1	0.0	0.05
Twenty-one	0.0	0.0	0.0
Windrem	0.0	0.0	0.0
Average First Year	0.05	0.1	0.09
Second Year Orchards			
BP Gaddy	0.1	0.4	0.3
Caldwell	0.2	0.3	0.3
E.A.T. Rickabaugh	0.0	0.0	0.0
Gaddy	0.0	0.0	0.0
Lone Pine (neck)	0.0	0.0	0.0
M/Brown	0.1	0.0	0.05
M/Twenty	0.0	1.0	0.5
Manning	0.0	0.0	0.0
Murphy	0.2	0.0	0.1
Q/Neck	0.0	0.0	0.0
Q/Twenty	0.1	0.1	0.1
R/Brown	0.0	0.0	0.0
Rohner Home	0.3	0.2	0.3
Wide	0.0	0.0	0.0
Young East	0.2	0.1	0.1
Average Second Year	0.08	0.1	0.1
Third Year Orchards			
Akins	0.0	0.0	0.0
Cole	0.0	0.0	0.0
K-48	0.0	0.0	0.0
Morrison	0.0	0.0	0.0
Pardee Home	0.0	0.1	0.03
Pardee Lake (east)	0.0	0.0	0.0
Q/Fourteen	0.0	0.0	0.0
Q/Hedgerow	0.0	0.1	0.05
Q/Triangle	0.0	0.0	0.0
S/Stage	0.0	0.0	0.0
Sixty	0.0	0.0	0.0
Thirty Acres	0.0	0.1	0.03
Trailers	0.0	0.0	0.0
Young West	0.0	0.0	0.0
Average Third Year	0.0	0.01	0.01
Fourth Year Orchards			
Blankenship	0.0	0.1	0.03
Nobles	0.0	0.0	0.0
Average Fourth Year	0.0	0.03	0.01
Sixth Year Orchards			
Eutenier (west)	0.2	0.2	0.2
M/Timothy	0.0	0.0	0.0
S/Timothy	0.0	0.8	0.4
Sanderson	0.0	0.0	0.0
Young Cookson	0.0	0.0	0.0
Average Sixth Year	0.04	0.2	0.1

2001 LAKE COUNTY PUFFER PROJECT
Codling Moth Damage
August 6-28, 2001 (1694-2116 °D)
Bin Fruit Samples - %/1000

Table 6

TREATMENT/PROJECT YEAR/BLOCK	1st pick	2nd pick	Total
PUFFER ORCHARDS			
First Year			
D/Hedgerow (east)	0.7	-	0.7
D/S Buss (west)	0.1	-	0.1
E.A.T. "30-31"	0.1	-	0.1
E.A.T. "32"	0.0	-	0.0
Eighteen	*	*	*
Forty	0.1	-	0.1
G/G Dorn	0.0	0.0	0.0
G/G Henderson	0.1	-	0.1
Gunn	0.0	-	0.0
H/Benson	0.1	-	0.1
Henderson Home I	*	*	*
Henderson Home II	0.0	-	0.0
M/Benson	0.1	-	0.1
M/Henderson	*	*	*
M/Home	0.1	-	0.1
Old Home	0.1	-	0.1
R/Martinez	0.0	-	0.0
Rogers	0.0	-	0.0
Rohner Shop	0.2	-	0.2
Twenty-one	0.0	-	0.0
Windrem	0.0	-	0.0
Average First Year	0.08	0.0	0.08
Second Year			
BP Gaddy	0.0	-	0.0
Caldwell	1.8	-	1.8
E.A.T. Rickabaugh	0.1	0.0	0.05
Gaddy	0.0	-	0.0
Lone Pine (neck)	0.9	-	0.9
Lone Pine (west)	0.2	-	0.2
M/Brown	0.4	-	0.4
M/Twenty	0.8	-	0.8
Manning	0.0	-	0.0
Murphy	1.5	-	1.5
Q/Neck	0.0	-	0.0
Q/Twenty	0.1	-	0.1
R/Brown	0.2	-	0.2
Rohner Home	0.0	0.2	0.1
Wide	0.0	-	0.0
Young East	0.0	-	0.0
Average Second Year	0.4	0.1	0.4
TREATMENT/PROJECT YEAR/BLOCK			
PUFFER ORCHARDS			
Third Year			
Akins	0.1	-	0.1
Cole-Big Block	0.0	-	0.0
Cole-Diagonal	0.0	-	0.0
K-48	0.0	-	0.0
Morrison	0.0	-	0.0
Pardee Home	0.0	-	0.0
Pardee-Lake (east)	0.0	-	0.0
Q/Fourteen	0.0	-	0.0
Q/Hedgerow	0.1	-	0.1
Q/Triangle	0.1	-	0.1
S/Stage	0.0	-	0.0
Sixty	0.0	-	0.0
Thirty Acres	0.0	-	0.0
Trailers	0.0	-	0.0
Young West	0.0	-	0.0
Average Third Year	0.02	-	0.02
Fourth Year			
Blankenship	0.0	-	0.0
D&S	0.0	-	0.0
Nobles	0.0	-	0.0
Average Fourth Year	0.0	-	0.0
Sixth Year			
Eutenier Home	0.0	0.0	0.0
M/Timothy	0.1	-	0.1
S/Timothy	0.0	0.0	0.0
Sanderson	0.0	-	0.0
Young Cookson	0.0	-	0.0
Average Sixth Year	0.02	0.0	0.02
AVERAGE PUFFERS	0.1	0.03	0.1
Grower Controls			
Otto	0.3	-	0.3
Quercus Seven Acres	0.4	-	0.4
Newman	0.2	-	0.2
G/Newman	0.4	-	0.4
AVERAGE GROWER CONTROLS	0.3	-	0.3
Untreated Controls			
Gold Dust ¹	90.3	-	90.3
Quercus Seven Acres	32.1	-	32.1
AVERAGE UNTREATED CONTROLS	61.2	-	61.2

¹ Not a bin count

* Orchard not sampled

2001 LAKE COUNTY PUFFER PROJECT
OBLR Damage
August 6-28, 2001 (2117-2677 °D)
Bin Fruit Samples - %/1000

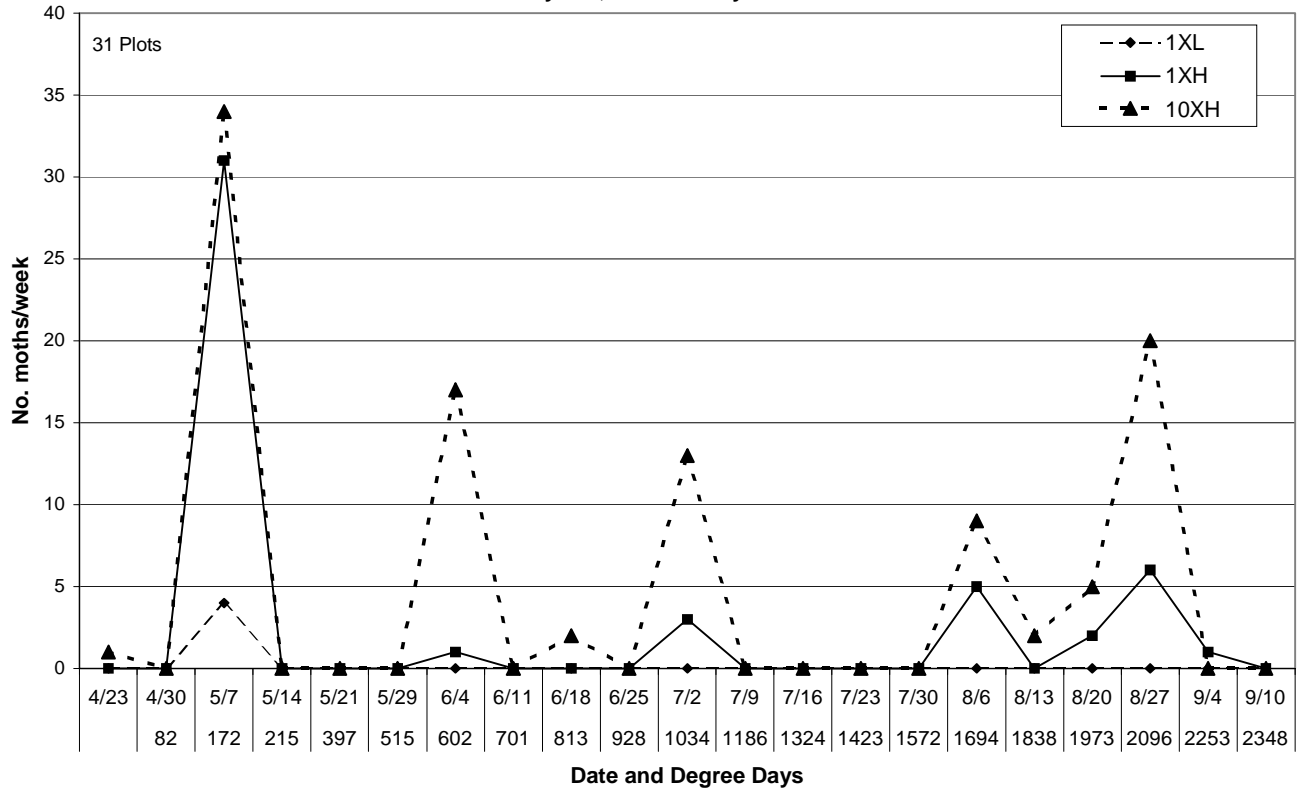
Table 7

TREATMENT/PROJECT YEAR/BLOCK	1st pick	2nd pick	TOTAL
PUFFER ORCHARDS			
First Year			
D/Hedgerow (east)	0.0	-	0.0
D/Hedgerow (west)	0.1	-	0.1
D&S Buss	0.0	-	0.0
E.A.T. "30-31"	0.0	-	0.0
E.A.T. "32"	*	-	*
Eighteen	0.0	-	0.0
Forty	0.3	0.1	0.15
G/G Dorn	0.1	-	0.1
G/G Henderson	0.1	-	0.1
Gunn	0.3	-	0.3
H/Benson	0.4	-	0.4
Henderson Home I	*	-	*
Henderson Home II	0.1	-	0.1
M/Benson	0.3	-	0.3
M/Henderson	*	-	*
M/Home	0.1	-	0.1
Old Home	0.0	-	0.0
R/Martinez	0.0	-	0.0
Rogers	0.0	-	0.0
Rohner Shop	0.0	-	0.0
Twenty-one	0.1	-	0.1
Windrem	0.0	-	0.0
Average First Year	0.1	0.1	0.1
Second Year			
BP Gaddy	0.9	-	0.9
Caldwell	2.5	-	2.5
E.A.T. Rickabaugh	0.5	0.0	0.3
Gaddy	2.3	-	2.3
Lone Pine (neck)	1.0	-	1.0
Lone Pine (west)	0.4	-	0.4
M/Brown	1.4	-	1.4
M/Twenty	0.0	-	0.0
Manning	0.4	-	0.4
Murphy	1.1	-	1.1
Q/Neck	1.1	-	1.1
Q/Twenty	1.6	-	1.6
R/Brown	0.7	-	0.7
Rohner Home	0.1	0.2	0.2
Wide	1.1	-	1.1
Young East	2.4	-	2.4
Average Second Year	1.1	0.1	1.1
TREATMENT/PROJECT YEAR/BLOCK			
PUFFER ORCHARDS			
Third Year			
Akins	0.0	-	0.0
Cole-Big Block	0.0	-	0.0
Cole-Diagonal	0.3	-	0.3
K-48	0.1	-	0.1
Morrison	0.5	-	0.5
Pardee Home	0.2	-	0.2
Pardee-Lake (east)	0.4	-	0.4
Q/Fourteen	0.1	-	0.1
Q/Hedgerow	1.8	-	1.8
Q/Triangle	0.2	-	0.2
S/Stage	1.0	-	1.0
Sixty	0.6	-	0.6
Thirty Acres	0.1	-	0.1
Trailers	0.3	-	0.3
Young West	0.6	-	0.6
Average Third Year	0.4	-	0.4
Fourth Year			
Blankenship	0.2	-	0.2
D&S	0.2	-	0.2
Nobles	0.2	-	0.2
Average Fourth Year	0.2	-	0.2
Sixth Year			
Eutenier Home	1.4	0.4	0.9
M/Timothy	0.5	-	0.5
S/Timothy	1.5	0.3	0.9
Sanderson	0.5	-	0.5
Young Cookson	0.2	-	0.2
Average Sixth Year	0.8	0.4	0.6
AVERAGE PUFFERS	0.5	0.2	0.5
GROWER CONTROLS			
Otto	0.0	-	0.0
Quercus/Seven Acres	0.8	-	0.8
Newman	0.5	-	0.5
G/Newman	0.8	-	0.8
AVERAGE GROWER CONTROLS	0.5	-	0.5
UNTREATED CONTROLS			
Gold Dust ¹	0.2	-	0.2
Quercus Seven Acres	1.6	-	1.6
AVERAGE UNTREATED CONTROLS	0.9	-	0.9

¹ Not a bin count

* Orchard not sampled
 .. %/2000 Fruit

**Total CM Trap Catches in Puffer Plots
Kelseyville, Lake County - 2001**



2001 LAKE COUNTY PUFFER PROJECT CM/OBLR UCCE TRAP CATCHES Total catch thru September 10, 2001			
TRAP TYPE	BLOCK		
	Puffer (31 plots)	Grower (2 plots)	Control (2 plots)
CM 1 X LOW	4	6	22
CM 1 X HIGH	47	15	29
CM 10 X HIGH	100	11	25 (1 plot)
OBLR W/HIGH	3785	125	99 (1 plot)

Puffer Project - 2001

OBLR Catch Locations 9/10/01

