

## **FINAL REPORT**

**Project Title:** Killing stations for Leafrollers on apple and pear.

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**Organization:** USDA, ARS, Yakima Agricultural Research Laboratory, Wapato

**Cooperator(s):** Jay Brunner, WSU, Wenatchee

### **Objectives:**

1. Quantify mortality rates of leafroller moths attracted to pheromone lures.
2. Determine repellency or deterrence of PLR to permethrin/teflon grease formulation.
3. In small plots, determine effects of killing stations on captures of PLR in monitoring traps.
4. Determine response of OBLR to feeding attractant. This objective was added when high populations of OBLR were found locally.

### **Significant Findings:**

1. Rate of contact and mortality of leafrollers was very high in laboratory tests that exposed moths to killing stations baited with pheromone lures.
2. Numbers of moths in pheromone monitoring traps was reduced significantly in plots with 50 killing stations per acre, indicating a knockdown of the population of moths in the orchard.
3. A commercially prepared killing station was very effective in killing contacting leafroller moths and holds promise for use in future experiments.
4. Oblique banded leafroller moths are attracted to controlled release dispensers that emit acetic acid, with an optimum release rate that is higher than that for either codling moth or Pandemis leafroller.

### **Methods**

Objectives 1 & 2. Mortality of leafrollers contacting killing stations/repellency of stations.

Two assay designs were used to evaluate Pandemis leafroller response to killing stations. Moths were tested in a flight tunnel to determine rates of attraction and mortality of tested moths. A touch test was also used to evaluate the toxicity of killing stations, including field exposed or aged killing stations. This test involved handling moths with forceps and touching an antenna, leg, or wing tip to the killing station surface and then holding the moth in a vial for observations. Moth mortality was assessed at intervals up to 24 hours.

Badminton shuttlecock killing stations were tested after exposure in apple orchards, and the Suterra killing station also was tested after 2 weeks exposure in the field.

Objective 3. Knockdown of PLR in treated plots

Six apple orchard plots that were each one acre in area were each monitored with a blacklight trap, a pheromone trap and a feeding attractant trap. Three of these plots were treated with 50 killing stations with pheromone, and three received no killing stations (negative control). Killing stations were badminton shuttlecocks coated with a formulation of permethrin, and with pheromone lures (septa) pinned inside the rubber bulb of the shuttlecock. Effectiveness of killing stations was evaluated by comparing numbers of leafroller moths captured in monitoring traps after killing stations were deployed, in treated versus control plots. This experiment was repeated during the second flight of Pandemis leafroller.

Objective 4. Leafroller response to feeding attractant.

To document a response by OBLR to acetic acid and to determine the optimum release rate of acetic acid for trapping OBLR, a test of varied amounts of acetic acid was conducted. Two tests were conducted; one comparing vial holes of 0.5 to 6 mm in diameter, and the other comparing vial holes of 3 to 25 mm in diameter. Traps were placed in apple trees in commercial orchards, using a randomized complete block experimental design. Three different apple orchards were used for these experiments.

A comparison was also made of acetic acid and molasses to determine if all attractiveness of molasses to PLR could be explained by PLR attraction to acetic acid. Acetic acid was dispensed from polypropylene vials with 3 mm holes. 200 ml of 10% molasses in water was used as the molasses bait. Agrisense dome traps were used because they can hold the molasses bait in the bottom reservoir of the trap. The test was conducted in an apple orchard during the second moth flight.

### **Results and Discussion:**

Objectives 1 & 2. Mortality of leafrollers contacting killing stations/repellency of stations.

All PLR moths responding to pheromone lures in a flight tunnel contacted the killing station (shuttlecock) and either died or became paralyzed. All PLR moths placed in contact with killing stations subsequently died (24 hour test), compared to none of the controls, and retained its effectiveness in killing PLR. Because assays of attraction, contact, and mortality were so successful, it was not necessary to set up additional experiments to test for repellency.

Both the badminton birdie killing stations and the Suterra killing stations remained lethal to contacting leafrollers after 7 days and 14 days in the field respectively. For both designs, mortality of PLR placed in contact with killing stations was close to 100% following field exposure.

Objective 3. Knockdown of PLR in treated plots.

Numbers of PLR in pheromone traps used to monitor moth activity in plots were greatly reduced in treated plots compared to control plots following the placement of fifty killing stations per one acre plot (Figure 1). These results were quite similar in all plots in both flights (June and August). A reduction in PLR in treated plots was not seen in blacklight trap catches however. These results are preliminary, but support the hypothesis that PLR numbers can be greatly reduced by killing stations. In similar tests conducted with killing stations against *Lacanobia* and against alfalfa looper, one acre plots were insufficient to overcome problems of immigration from outside plots, while 5 acre plots appeared to suffice. These encouraging results with the reduction in leafroller moths in pheromone traps with treated plots are however preliminary in that we do not know if this is a result of the death of a high percentage of males, or mating disruption because of 50 pheromone lures placed per acre in the plots. This is quite dramatically fewer than the 1000+ units per acre used in field trials of codling moth lure and kill formulations. This question of the mechanism (mortality or disruption) should be sorted out in subsequent testing in larger plots, as it was in the 5 acre *Lacanobia* killing station plots.

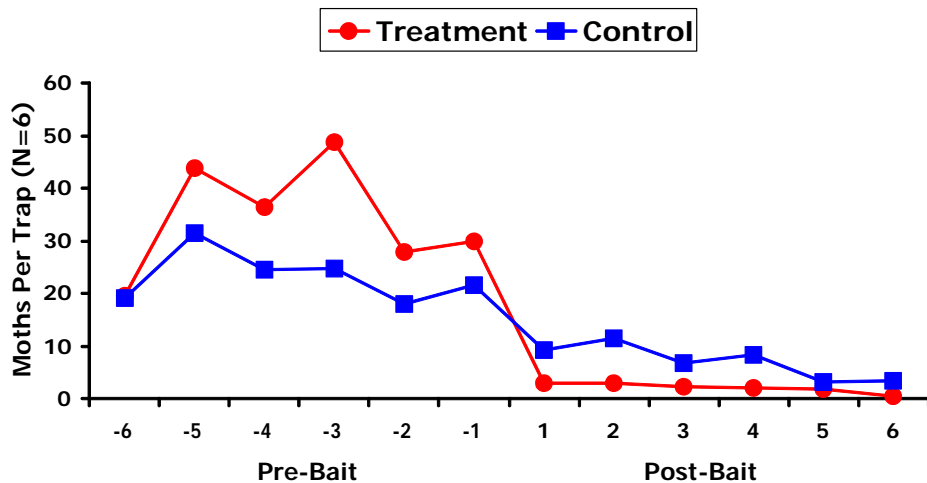


Figure 1. Mean numbers of *Pandemis* leafroller moths in pheromone traps used to monitor apple orchard plots in which killing stations were deployed.

#### Objective 4. Leafroller response to feeding attractant.

Greatest numbers of male and female OBLR were captured in AgriSense dome traps baited with polypropylene vials containing acetic acid released through 6 mm diameter holes (Figure 2). These vials release 2 milligrams of acetic acid per hour under laboratory conditions. This compares to an optimum of 1 milligram per hour for *Pandemis* leafrollers captured in traps, and 0.5 milligrams per hour for codling moth captured in traps. Both males and females of OBLR were captured in traps baited with acetic acid at a ratio of about one to one.

More *Pandemis* leafroller moths were captured in the Agrisense dome traps baited with vials releasing acetic acid than with 10% fermented aqueous solutions of molasses. These results indicate that all of the attractiveness of molasses to PLR could be due solely to the release of acetic acid from microbial fermenting of sugars in the molasses solution, and that further efforts to find co-attractants for PLR in fermented molasses are unlikely to be fruitful.

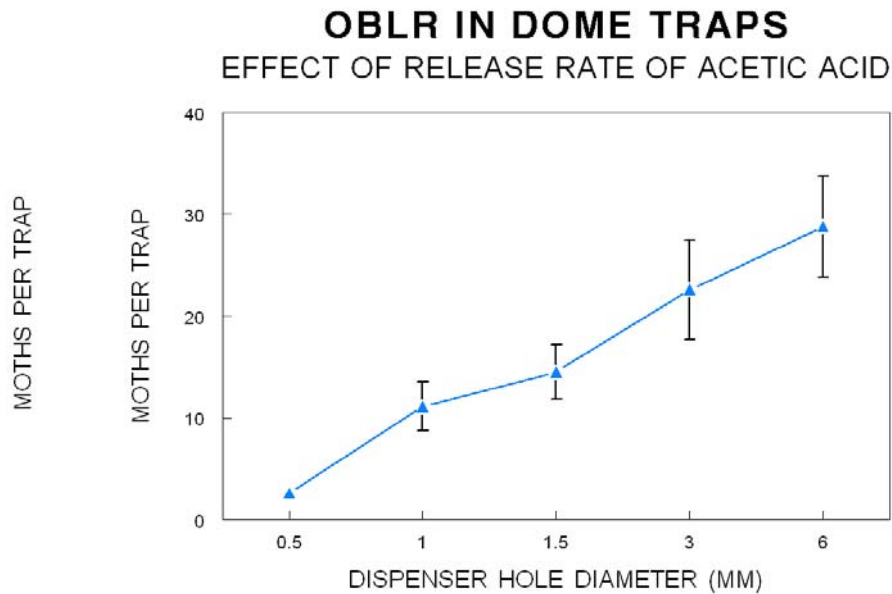


Figure 2. Mean numbers of OBLR moths captured in Agrisense dome traps baited with vials releasing acetic acid through holes in the vial lid, of varied diameters.

Budget:

**Project Title:** Killing Stations for Leafrollers on Apple and Pear.  
**PI:** Peter J. Landolt  
**Project Duration:** 2003.  
**Current Year:** 2003.  
**Project Total:** \$10,000

Year	Year 1
Salaries	\$8,000
Supplies	\$2,000
Travel	
Total	\$10,000