

# Control of Codling Moth in Backyard Orchards with Last Call CM (Permethrin and pheromone in a paste formulation)

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## INTRODUCTION

Codling moth, the “worm” in the apple, is a serious pest of apples, pears and walnuts. It overwinters as a mature larva inside a cocoon in rough bark, debris, and the soil. In the spring it pupates and emerges as an adult, a dull colored moth about 7/16” long that flies around, mates, and lays eggs on fruit and leaves. The eggs hatch into pink larvae that enter the fruit, ultimately consuming the seeds. The feeding damage includes the dispersal of excrement and the introduction of microorganisms that cause the fruit to drop and rot. This whole sequence can occur 3-4 times during the growing season causing up to 100% damaged fruit (Vossen et al 1994).

Codling moth control methods are expensive, complicated and very time consuming, but justifiable in a commercial venture. Due to the lack of an economic incentive, however, wormy fruit has been a persistent problem for backyard fruit tree growers. There is a lack of knowledge of when to spray based on climate - degree day models or trap catches. There are always questions too of what materials are effective, easy to use, do not have an offensive odor, are safe to use around residences and hopefully could be classified as “organic.”



Most home garden sprayers also don't cover the leaf and fruit surfaces very well, because of low pressure and the small volume of water used. Individual backyard apple, pear, and walnut trees or small-scale orchards with a few trees on a couple of acres have not been effectively protected from codling moth damage with the pheromone dispensers and mating disruption technique. This is primarily due to the inability to saturate enough of an area around the orchard to prevent the males from finding the females, mating to occur, and the females returning to the trees to lay eggs (Brown 1996).

Conventional growers of commercial-sized orchards use pheromone baited monitoring traps to time insecticide sprays that kill the adults and young larva. Pheromone technology has been an effective method for monitoring male codling moth numbers for over twenty-five years. The synthetic female pheromone is commonly placed in a dispenser surrounded by a cardboard trap covered with a sticky material to capture any male moths attracted to the pheromone. Many males are captured, but mass trapping has never been shown to be effective even when placing one trap per tree. Enough males always seem to survive and mate with the females.

Organic growers primarily use pheromone mating disruption combined with sanitation and beneficial insect releases. In the last ten years, synthetic female codling moth pheromone formulations were incorporated into various types of dispensers in order to saturate the air surrounding orchard trees with enough pheromone that mating was disrupted; the males could not locate the pheromone scent of the real females. This method has been demonstrated to be effective under conditions where the concentration of the pheromone could be maintained around the trees in large enough blocks, usually deemed to be about five acres, to reduce the number of border trees with inadequate pheromone air saturation (Swezey et. al 2000)(Caprile 1995). IPM Technologies Inc. developed a sticky paste material incorporating the pheromone to attract the male moths and an insecticide (permethrin 6%) to kill the moth when it contacted the material. Its trade name is Last Call.

This study was designed to determine the effectiveness of Last Call on the control of codling moth in small-scale orchard situations and backyard fruit tree gardens. The amount of toxicant (insecticide) used and its placement make this treatment method very environmentally friendly, leaving no residue on the fruit and has no known negative effects on beneficials. Its relative safety and ease of application by backyard gardeners has the potential to make this a very widely used product.

## MATERIALS AND METHODS

Seven replications were used of the Last Call treatment. Each group of treated trees was accompanied by at least one untreated control tree nearby. The treated trees and untreated (control) trees experienced very similar insect pressure and climatic conditions. Three treatments were applied at five week intervals: May 21, June 27 and August 4 of 2003. Last Call was applied at the rate of 50 drops for a large tree, 30 for a medium tree and 18 for a small tree. Two-thirds of the product was applied in the upper one-third of the tree, according to label instructions, and most of the material was placed on the inside of the tree, so that it would be shaded. Last Call was applied with the normal applicator and a long-handled applicator provided by IPM Tech. The paste material with pheromone and insecticide is deposited by squeezing the plunger to leave measured droplets.



Fruit was evaluated for damage at harvest. At each site, early ripening treated trees were compared to early ripening control trees and late ripening treated varieties were compared to late ripening controls. In some cases, all of the fruit from each tree was checked, including fallen fruit. In other cases, a minimum of 100 fruit were evaluated including the cutting of 10% to identify the percentage with hidden damage.



A standard codling moth trap was placed in or near each backyard orchard in most cases and monitored weekly for trap catch numbers. Treatment means for the apples were analyzed with a Multiple Paired Comparison T-Test. We used paired comparisons from seven sites to determine the treatment means. There were nine sites originally, but one was inadvertently sprayed and the other had no damage on the treatment or control trees. The data on pears was not analyzed statistically, because there were insufficient untreated control pear trees. The pear data is presented as an interesting observation only.

### **Backyard orchard sites**

**Site 1:** Four apple trees, including one Golden Delicious, and three pear trees in a semi-rural neighborhood on 2 acres surrounded by large open fields. There was a very light crop on both the apple and pear trees. A large untreated Golden Delicious control tree was located next door. This site has a warm coastal climate with some marine influence.

**Site 2:** Five apple trees (Gala, Golden Delicious, Fuji, Lady, and an unknown variety) and two pears (Seckel and Bartlett) integrated into the landscape in a suburban tract bordering open space. The control trees were located next door where the neighbor has both apples (Gala) and pears (Bartlett). This site had a cool climate with a significant marine influence.

**Site 3:** Two apple trees (Gravenstein and Jonathan) and two pear trees (Bartlett and Hosui) located on one acre in a semi-rural neighborhood with an old apple orchard located nearby. The control apple trees (Gravenstein and Golden Delicious) were located on a neighboring property. This site has a moderate coastal climate.

**Site 4:** Various unknown early and late ripening varieties of apples and pears located in a suburban area. The trees were planted in a small orchard configuration. The control trees were in an organic community garden containing several early and late ripening apple trees (unknown varieties) located 500 feet down the road from the treated site. This site has a warm coastal climate.

**Site 5:** Three apple trees (one Gravenstein and two Golden Delicious) and one Bartlett pear located on a residential street with one acre lots. This is a semi-rural garden surrounded by wine grapes, forest, and pasture. The control trees (Golden Delicious) were located on a neighboring property. This site has a moderate coastal climate.

**Site 6:** Four apple trees (Gravenstein, Golden Delicious, Granny Smith and Fuji) plus three pears (Bartlett, Comice and D’Anjou) on a small lot in a suburban residence backyard. The control was an untreated Red Delicious tree in the neighborhood. This site has a moderate coastal climate.

**Site 7:** Three apple trees (Jonathon, Golden Delicious and Fuji) and one Bartlett pear located in a suburban neighborhood. The control was a neighbor’s untreated Red Delicious tree. This site has a moderate coastal climate.

## RESULTS

Sites 1, 3, and 5, had damage levels on the Last Call treated trees that were very similar to the untreated control trees. The apple trees at these three sites were quite large and application of the product was difficult because of the dense growth.

Sites 2 and 4 showed large differences between the Last Call treated apple and pear trees and the controls; the treated trees had one-third to one-fourth the amount of damage as the untreated trees. These sites had very different climates (site 2 was our coolest; site 4 was one of the hottest), but all had trees of moderate or small size. Application of the product was very easy on these compared to larger trees.

Site 7 showed 23% and 30.6% less worm damage in the Last Call treated apple and pear trees respectively. These were also smaller sized semi-dwarf trees. Site 6, however, with its large dense trees had greater damage on the Last Call treated apple trees by 15.5%. The Last Call treated pears at site 6 had close to the same damage level as the untreated control apple trees.

<b>Table 1. PERCENT CODLING MOTH DAMAGE TO ‘LAST CALL’ TREATED AND TO UNTREATED ‘CONTROL’ TREES</b>				
Backyard Locations	Last Call Treated Apple Trees	Untreated Control Apple Trees	Last Call Treated Pear Trees	Total Trap Catches
<i>Site 1</i>	45.5%	50.0%	3.3%	-
<i>Site 2</i>	14.8%	43.0%	17.0%	7
<i>Site 3</i>	28.5%	30.4%	0%	9
<i>Site 4</i>	16.1%	60.1%	20.2%	-
<i>Site 5</i>	36.2%	40.8%	22.6%	24
<i>Site 6</i>	68.8%	53.3%	54.0%	24
<i>Site 7</i>	30.5%	53.3%	22.7%	-
Mean	34.3%	47.3%	17.7%	12.8

The average codling moth damage level in the Last Call treated apple trees was 34.3% and the untreated apple trees had 47.3% damage. There is no significant difference between these two damage levels. The coefficient of variation was 34.4, indicating that there was considerable variability in the levels of damage between the Last Call treated and untreated control trees at each site (See table 1). The total number of male moths caught was low, especially compared to the amount of fruit damage observed. For most of the pears, the damage level for Last Call treated trees was less than in the treated apples, but two of the pear treatment sites had codling moth damage levels slightly higher than in the apples. There is no significant difference between the treatments means at the 5% level.

## DISCUSSION

The paste dispenser was not as easy to use as it originally appeared, especially when it was attached to the pole extension for reaching into tall trees. Problems were evident right from the beginning. The applicators leaked, came apart, and often did not dispense a droplet of paste when operated. By wrapping wire around

the dispenser to hold it more securely to the pole and plunger device, we were able to make it work, but it was always messy and difficult to use. It sometimes took several pumps of the dispenser in order to get a droplet of paste to come out. The instructions regarding frequency of application could also be improved to better indicate what factors determine tree size, the proper number of paste droplets to apply, and the frequency of treatment. It is possible with more frequent treatment, knowing that the insect pressure was high, that control might have been better. This was close to a worst case scenario with heavy damage levels on mostly late maturing varieties.

The efficacy of this product was extremely variable; it seemed to work at some sites but not at others. More detailed comparisons of its performance under well-controlled circumstances would be very useful. A second year of replicated trials in the field seems necessary, perhaps to compare efficacy of the product based on tree size. On the other hand, some of the same factors involved in codling moth control with the mating disruption technique in small plots or individual back yard trees are applicable with Last Call. The same problem exists, in that only those moths in the immediate vicinity of the tree and the applied droplets of paste are killed. Males that are a short distance away and unaffected by the pheromone in the Last Call paste can still mate with females. Controlling the females would be much more efficient.

Based on the results of this trial, the use of a paste formulation of Permethrin and codling moth pheromone is not effective enough to justify the cost or difficulty in application. The homeowners (Master Gardener Volunteers) had high hopes of much less damage to their fruit on treated trees. They noted that even though the application of Last Call paste was easier than spraying trees, it did not meet their expectations and they were disappointed by the control level.

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