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Bayfield Codling Moth Mating Disruption Trial - Year 2

Lake Superior Eco-Apple Network

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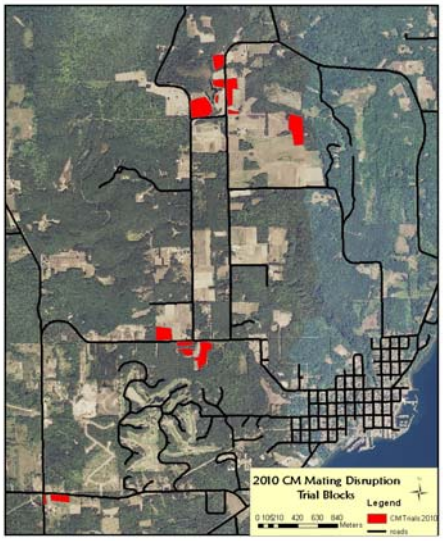
Introduction

Codling moth is one of three major insect pests of apples in the Bayfield fruit growing region. The female adult moths (Photo 2) lay their eggs on or near developing apples and the larvae tunnel into the flesh and become the classic worm in the apple. Apples attacked by codling moth are unfit for sale (Photos 3, 4). There are two generations per year in WI with a peak flight in late-June and again in mid-August in the Bayfield area. Producing #1 apples requires managing codling moth, usually with a conventional or organic chemical spray program.

Using Mating Disruption to Control Codling Moth

Mating disruption can be an effective method for controlling codling moths and is used extensively in other apple producing regions. Mating disruption is an IPM technique which targets the breeding cycle. To lay eggs, female moths must first mate with male moths. To find each other, the female moths emit a pheromone plume that the male moths follow to the female. With mating disruption, pheromone emitters (Photos 5, 6) are placed throughout the orchards, saturating the orchard with pheromone. Due to this blanket effect, the males can't find the females, no mating occurs, and no eggs are laid. To confirm the emitters are disrupting the normal mating, pheromone traps are hung in the orchard (Photo 7). If the traps catch moths, that means the males are able to follow a pheromone plume and are likely mating with females.



▲ **Photo 1.** An aerial view of Bayfield orchards participating in the program. The Atkins orchard is not shown.

The primary roadblock to using mating disruption in the Bayfield orchards is the likelihood of codling moths mating in adjacent abandoned orchards or wild trees and the mated females flying into the managed orchards and laying eggs. To mitigate that risk, an abandoned apple orchard removal program from 2008-2009 removed the most problematic blocks. A successful mating disruption trial was conducted in three orchards in 2009, and the trial was expanded to include 5 orchards and 48.5 acres of trees for 2010.

For the 2010 Bayfield trial, the emitters were placed in the orchards just prior to bloom, at a rate of 400 emitters per acre. The number of emitters per tree was determined by the density of the orchard, with high-density orchards receiving the fewest emitters per tree. Trees occupying edge rows are considered more at risk for codling moth damage, and were hung with double the emitter rate used in the rest of the orchard. Two types of emitters were hung: thin tubes that can be wrapped around branches or twisted into a loop and hung on branches, and pre-formed spirals which hold their shape once placed around a branch. The spirals are easiest to apply, especially when the buds are still small and the leaves haven't emerged.

◄ **Photo 2.** The codling moth female lays the eggs and the larvae tunnel into the apples.

◄ **Photo 3.** The larvae tunnel through the apple making it unfit for fresh eating.

◄ **Photo 4.** Often the only sign an apple is infested with codling moth larvae is a small hole with frass, usually at the calyx end.

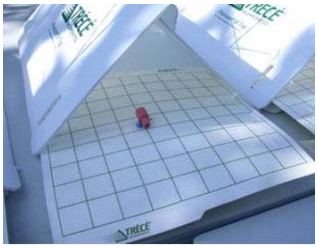
Because most codling moth mating activity occurs in the top third of the tree, emitters were placed as high up in the canopy as possible. This was done using a hooked staff that could bend supple branches to a reachable height or loop an emitter over a high branch.

Prior to harvest, each orchard was assessed for codling moth damage. To determine a percent damage to the crop, individual apple clusters from a random sampling of trees in each orchard were visually assessed for signs of codling moth damage.

Table 1 shows the labor and material costs of deploying the pheromone emitters at the five orchards, the average total trap catch, and the pre-harvest damage assessment. In orchard 1 and a portion of orchard 3, the pheromone emitters did not shut down trap catches and it can be assumed the codling moths were mating, although likely at lower rates. In orchard 1, a single application of Cyd-X was made during the second flight and likely contributed to minimal codling moth damage. Interestingly, in orchard 3, there was more codling moth damage in the block with no codling moth catches compared to the block without catches. In both blocks, Assail was applied 4 times during the season for plum curculio and apple maggot control. An aggressive insecticide program was followed in orchard 2, likely contributing to both no moth catches and minimal damage. Orchard 5 was not trapped or treated with any insecticide, and despite the pheromone disruption, experienced significant codling moth damage.

◄ **Photo 5.** For this trial, NoMate CM pheromone emitters were hung at a density of 400/ac. This emitter is a pre-formed spiral which holds its shape once placed around a tree branch.

◄ **Photo 6.** Another type of emitter used is Isomate C -Plus, which is a single tube that is wrapped around or twisted into a loop and hung on branches.



◄ **Photo 7.** One measure of whether the mating disruption is working is to trap the male moths using baited sticky traps. If the traps catch moths, the mating disruption is not working and some other sort of moth control is needed.

Conclusions

As in 2009, the results of the trial indicate that mating disruption can be an effective means to eliminate or greatly reduce codling moth trap catches. Most likely, this translates into fewer matings, less egg laying, and less codling moth pressure. The fact that some moths are being caught in the traps, indicates that mating disruption in the relatively small Bayfield blocks is not entirely effective at confusing the male moths and, thus, some sort of supplemental codling moth control is justified. The results from orchard 1 and 3 suggest that only minimal insecticide applications are necessary and the cross-over effects from treatments for plum curculio and apple maggot may be sufficient to provide the supplemental codling moth control. The pheromone disruption is cost-competitive with reduced-risk pesticide applications and should be considered an effective tool for codling moth control in Bayfield orchards.

Table 1. Codling moth mating disruption costs and results from nine orchard blocks.

						Ave Total	%
Orchard	**Acres**	**Hrs/ac**	**lures/tree**	**Cost/ac***	**# Traps**	**Trap Catch**	**Damage**
1-High Density	2	2	0.67	$ 135	3	3.3	< 1
1-Moderate Density	4	2	2.5	$ 135	2	4	< 1
1-Stdrs-Low Density	14	2	6	$ 135	6	3.6	< 1
1-Stdrs	11	2.3	4.5	$ 140	3	4.6	< 1
2-Mixed	6	2.5	4.5	$ 143	4	0	< 1
3-High Density	3.5	2	0.5	$ 135	3	5	1.8
3-Stdrs	0.5	2.3	4.5	$ 140	1	0	7.8
4-Stdrs	6	2.5	4.5	$ 143	4	Spring Frost-No Apples	
5-Mixed	1.5	2.5	4.5	$ 143	1	ND	26.5
6-Stdrs**	7	N/A			N/A		46.6

*$15/hr for labor, $105/400 emitters; Stdrs=standard sized trees

**Abandoned and unmanaged

Photo Credits: 2-www.ukmoths.org; 3,4-Dan Mahr, 5,6,7 Jason Fischbach

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