

Codling Moth Control at Hoch Orchard

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CM control on Hoch Orchard takes a truly integrated approach. There is no single silver bullet that can take care of the problem. We use a combination of chemical, biological, and environmental techniques to enhance the pest/predator balance on the farm. Our goal is to allow natural CM predators to keep CM populations at low natural levels. These levels drop and spike naturally but the spikes will not be as high as they would be in an intensive pesticide program. A sound understanding of basic entomology and CM phenology is also an important tool. We try to keep a balanced low pest level and then use soft targeted controls to nudge down the natural population spikes that are caused by weather and breeding cycles.

Environmental

Enhancing the environment is the most important part of the integrated approach to CM control. Beneficial insects that feed on, compete with, or parasitize all phases of the CM life cycle are key to the success of this system. Birds, bats, toads, and frogs all feed on the adult CM. This same group of vertebrate predators will also feed on the larval stage. Invertebrate predators will feed on the egg stage. Bacterial, fungal, and viral pathogens can attack CM in all developmental stages. A strong biologically active soil will host many natural CM pathogens and an array of insects that will feed on the stationary pupae or larvae in diapause. Soil that has been degraded by herbicides, insecticides, and synthetic fertilizers will host far fewer beneficial organisms. A diversity of plants on the orchard floor creates an exponentially greater diversity of soil organisms that have symbiotic relationships with specific groups of plants.

At Hoch Orchard we use a system of timed alternate row mowing. Regular country club style mowing makes an environment that enhances grasses and makes a diversity of broadleaf plants less competitive. We mow every other row in the orchard. Then we wait until the mowed row starts to show some flowers in the ground cover. These flowers provide a food source for many of the beneficial insects that will parasitize apple pests. Many of the beneficial insects require pollen or nectar for feed. If these beneficials do not have anything to eat they will not stick around to mate and parasitize the apple pests. Timed mowing keeps an array of continuously flowering plants on the orchard floor. Some apple growers use a minimal mowing system where they let orchard floor grow until harvest and then mow everything. This method does not keep the constant flowering that timed mowing does. In fact, the unmowed orchard floor often becomes dominated by vigorous growing spring flowering plants. This gives a flush of flowers early, then the seed production sets in by early summer, and by late summer the orchard floor is brown with drying wild grasses and grains. At our location, timed mowing enhances a diverse multistoried group of grasses and broadleaves. As I mentioned earlier, a diversity of plants enhances the soil biology. Many different species of bacteria, fungi, beneficial nematodes and bugs will all inhabit the soil and compete with (or feed on) the overwintering pupae or resting larvae of the CM.

Chemistry

We use both chemistry and biology when controlling CM. The most important chemistry that we depend on is synthetic pheromones. While these are not produced naturally they are considered an accepted synthetic under the national organic standards. We do not spray the synthetic pheromone, we use it to attract the male adult moths into traps with a tanglefoot board. This allows us to monitor the population levels and identify action thresholds.

Monitoring

We monitor CM population levels with Delta traps baited with a long life pheromone lure. We count and clean the traps once per week. We start monitoring CM levels shortly after bloom. We use an action threshold of seven moths caught in a one week period. We use multiple zone monitoring in order to identify which blocks to treat when they go over threshold. Our blocks range from 1.5 to about 5 acres in size. The larger blocks or longer narrower blocks will have two pheromone traps. Each zone/block is monitored and treated independently. Monitoring starts after bloom and continues through August.

The pheromone traps catch male moths. Males and females emerge at the same time so this gives us a representation of the population level over a specific time period. We also use a weather data logger to record temperature twice per hour. CM is a cold blooded animal so its rate of development is dependant on the temperature in the orchard. The warmer it is the faster they develop. The traps tell us when the adult moths are flying and breeding. Knowing this date and the rate of development allows us to predict when the CM eggs will be laid and when they will hatch. We use Spectrum Technologies data loggers and computer model to predict the most efficient time to apply our CM controls.

2010 Trap Counts

BLOCK	5-24	5-27	6-2	6-9	6-16	6-23	6-30	7-7	7-14	7-21	7-28	8-4	8-12	8-18	8-25	9-2
6		16	2	0	1	0	0	1	0	1	0	0	0	0	0	0
1	3	3	1	0	4	2	2	0	1	3	2	5	1	1	0	3
7	13	4	8	0	1	0	0	1	1	0	0	3	0	0	0	2
8	SET	4	9	0	4	0	1	0	1	2	0	0	0	0	0	0
18W	SET	0	1	3	0	0	0	0	0	2	0	1	4	0	1	0
18E	9	4	8	3	2	0	0	0	0	3	2	1	0	3	0	0
14	SET	2	2	3	0	0	0	0	0	0	1	0	2	0	0	0
9	17	12	14	1	4	3	0	0	0	0	3	1	2	0	0	0
11	8	2	6	0	0	0	1	0	0	0	1	2	1	0	1	0
4	5	4	7	0	1	1	2	2	0	0	3	1	2	1	0	0
5		0	1	0	1	0	0	0	0	0	/	1	0	1	0	0
F2W	10	6	14	3	4	17	3	3	1	3	3	2	1	3	2	2
F2E	SET	14	17	7	3	3	4	0	1	2	8	9	6	1	0	2

2009 Trap Counts

Block	5-30	6-4	6-10	6-17	6-29	7-1	7-8	7-15	7-22	7-29	8-5	8-13	8-20	8-27	9-2	9-9
1	2	1	0	5	4	2	2	0	0	1	1	6	5	2	0	1
7	3	5	1	4	6	2	2	1	0	0	4	8	3	6	0	0
8	1	4	2	1	2	0	1	2	0	0	3	6	2	0	1	0
18North	0	0	0	4	0	0	0	0	0	0	0	0	1	0	0	0
18West	3	3	1	4	2	0	1	0	0	4	23	16	7	4	2	0
14	1	0	0	1	0	0	1	1	0	0	2	0	1	0	0	0
9	New	1	0	4	4	0	1	0	0	0	2	1	2	0	0	0
11	4	4	0	1	3	4	5	0	0	0	5	1	7	0	0	0
4	4	3	0	3	3	1	1	2	1	1	10	6	6	0	0	0
F2W	1	1	0	3	2	1	1	4	0	1	4	2	14	4	1	1
F2E	0	4	2	1	2	2	2	2	3	1	4	4	5	0	0	1

Treatment

Biological

Our primary treatment for CM is the granulosis virus. CydX is the commercial formulation that we use. If the CM flight is short we use one application between 180 and 200 degree days (base 50) after the recorded action threshold was reached. If the flight is long (over threshold for two or more consecutive weeks) we will apply CydX two times. The second application is around seven days after the first.

Repellant

We usually apply Surround to repel Plum Curculio around the time first generation CM begins to fly. While the Surround is not applied specifically for the CM, it will have some effect on the adult moths. Surround is not a stand alone control for CM, but it will irritate the moths. This may shorten their life by making them more agitated and forcing them to use more of their limited body fat before they lay all of their eggs or get a chance to breed. Surround will also repel some of the adult moths. It may also affect the larvae as they search for an apple to enter. The clay particles may make it harder for a larva to identify an apple, and it will most likely slow down the movement of this tiny newly hatched worm. The longer it searches for an apple the longer it is exposed to the elements, predators, and pathogens. We also apply Surround in the summer to repel Apple Maggot Flies. This application often overlaps second generation CM and helps reduce damage.

Chemical

In addition to CydX and Surround, we will add Entrust to the mix if the trap catch is very high. If we catch 7-13 moths per week we use only CydX. If we exceed 13 moths per week or have a sustained catch in double digits we add Entrust.

Level of Control

This approach to CM control is doing a good job on our orchard. While we can occasionally find infested apples in the field, the larvae are usually discolored and/or listless. Sub lethal infection of the virus will cause some damaged fruit. This fruit usually aborts prior to harvest. It is rare that

we find CM damage in the packing house. We intend to increase our action threshold from 7 to 10 moths per week in 2011. Since we rarely find damage on harvested fruit, we can assume there is the ability to reduce our use of pesticides. If you look at the trap counts in 2010 there were several incidents with catches above six and below ten. With a slightly higher threshold, several sprays would have been saved.

I believe our approach is working very well on our farm, but I do not know if it will work on all farms in all locations. The multi faceted approach utilizing a balanced environment with high levels of beneficial insects and limited amount of chemicals may be what makes the whole system work. A cleanly mowed orchard, a history of heavy chemical use, or exceptionally high trap catches may cause this approach to fail. Multiple zone monitoring with targeted pesticide applications may allow beneficial insects to thrive in unsprayed blocks and recover quickly in sprayed blocks. Eliminating the multiple zone monitoring on a small or large orchard may be enough to cause this system to fail.

I encourage the reader to use the information I am sharing here, but cannot recommend this control strategy be implemented on all orchards. I suggest trying parts of my strategy, or better yet test the strategy on block or one section of your farm. See how it works, then adapt it to your situation.

Cost of Control

Organic pest control can be exceptionally expensive. The cost of the higher priced pesticides can be limited with high levels of pest monitoring. The current price from our local supplier for CydX is \$311.25 per quart, Entrust is \$530.00 per pound, and Surround is \$1.30 per pound. We apply these products using a 300 gallon airblast sprayer. We use 75 gallons of water per acre. This gives very good coverage with little loss to drift or drip. Thorough coverage is important when using biologicals and repellants. These products are not like the old conventional pesticides that will redistribute around the apples with light rain and dew. The organic products have to be carefully sprayed and coverage of all apple and leave tissue is necessary. These products will fail if incomplete coverage is caused by inconsistent volumes carelessly sprayed from a hand gun or sections of the tree missed because a backpack sprayer could not reach all parts of the tree.

Poorly pruned trees, or trees that are very large, will require the highest rates of organic products. Even then they may not give the same level of control that we are getting on our open pruned trees and dwarf orchards. Good quality equipment, well pruned trees, and the labor needed for weekly monitoring are some of the costs associated with organic CM control that are significant but difficult to put an exact number on. We will have at least one scout on our farm average about one day of labor per week from mid May to the end of August. This includes maintaining and monitoring traps, and scouting for several pests on 30 acres of apples.

Hoch Orchard Sprays by block

Date	Product	Rate per acre	Amount per tank	Total sprayed	Blocks Treated
5-24	Surround	25lbs	100lbs	400lbs	1,4,5,6,7,8,9,11,12,14
5-31	Cydx	3 oz	12 oz	36	4,5,6,7,8,9,11
	Surround	25lbs	100lbs	300	
5-31	Cydx	3 oz	12 oz	12	F2
	Entrust	2 oz	8 oz	8	
6-1	Cydx	3 oz	12 oz	12	1,4,18
	Surround	25lbs	100lbs	100	
6-7	Cydx	2 oz	8 oz	32	4,5,6,7,8,9,11,18
	Surround	25lbs	100lbs	400	
6-7	Cydx	2 oz	8 oz	8	F2
	Entrust	2 oz	8 oz	8	
6-14	Cydx	3 oz	12 oz	24	4,7,F2
6-15	Cydx	3 oz	12 oz	6	9
7-5	Cydx	2 oz	8 oz	8	5,F2
	Entrust	2 oz	8 oz	8	
7-12	Cydx	1.5 oz	6 oz	6	5,F2
	Entrust	2 oz	8 oz	8	
7-18	Surround	25lbs	100lbs	200	1,5,11 boarder,F2
	Surround	40lbs	150lbs	150	8
7-22	Surround	25lbs	100lbs	100	F2
8-9	Cydx	3 oz	12 oz	12	F2
8-23	Cydx	3 oz	12 oz	12	F2

Total Surround used - 1650 lbs Cost \$2145

Total CydX - 168 oz Cost \$1634

Total Entrust- 32 oz Cost \$1060

Total cost to control CM Organically on 30 acres in 2010 was \$4839 or \$161.30 per acre. The actual cost for CM alone should be lower considering the Surround was sprayed as the primary control for Plum curculio in the early season and Apple maggot in the summer.

Multiple zone monitoring is a critical part of this IPM system. Without multiple traps and zones I would have either spent considerably more money or missed some areas of high pest pressure and had more damaged fruit. If I had treated all 30 acres instead of targeting the applications to the ones over threshold, the cost of controlling CM with this strategy would have been almost four times higher.

Full treatment scenario

The current price of CydX is \$311.25 per quart (\$9.73 per oz), Entrust is \$530.00 per pound (\$33.13 per oz), and Surround is \$1.30 per pound

- Surround 25lb per acre x \$1.30 = \$32.50 x 30 acres = \$975 per orchard application x six apps = \$5850
- Entrust 2oz per acre x \$33.13 = \$66.26 x 30 acres = \$1987 per orchard application x 4 apps = \$7951.20
- CydX 2.5 oz per acre x \$9.73 = \$24.32 x 30 acres = \$729.60 per orchard app x 7 apps = \$5107.2

I would have spent a total of \$18908.40 had I sprayed the entire orchard every time one block went over threshold.