

Section 7

Clean-up Programs

Apple Pest Management Transition Project

Tree Fruit Research & Extension Center

Codling moth clean-up in an organic orchard



In 2002, a 270-acre certified organic demonstration orchard was established in the Royal Slope area of WA. During the first year of the project, 2,836 codling moth adults were captured in pheromone-baited traps. This included an average of 67 moths/trap over a three-week period of the second generation (Fig. 1). Pheromone mating disruption was used in 2002, while the spray program relied primarily on frequent oil applications as ovicide. Total insecticide cost was \$407/acre. The grower was forced to hand remove 158 bins of damaged apples (1000 man-hours). Still, 5% damage was noted at harvest and the grower packed only 16 of 25 boxes/bin (64% pack-out).

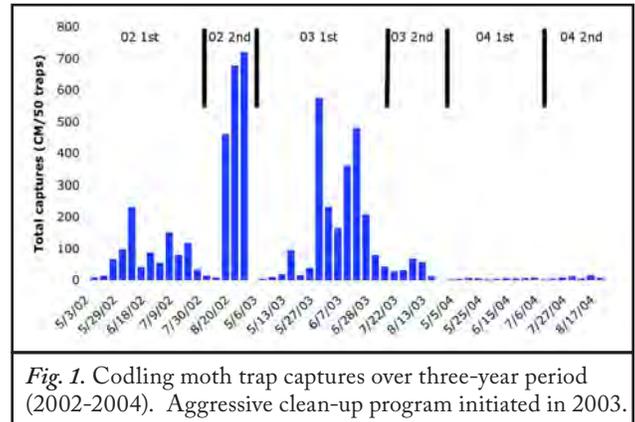


Fig. 1. Codling moth trap captures over three-year period (2002-2004). Aggressive clean-up program initiated in 2003.

In 2003, a high carryover population resulted in an average capture of 46 moths/trap during the first generation (2,261 moths). After using a management program that continued to have mating disruption as the foundation and employing two newly registered organic products, Entrust and Cyd-X granulosis virus (neither available in 2002), codling moth captures were reduced to an average of 3.6 moths/trap during the second generation (227 moths).

Less than 1% damage was noted at harvest and no hand removal of CM injured fruit was needed in 2003. The grower packed 21 of 25 boxes/bin (85% pack-out). The total insecticide cost was \$80/acre more (20% increase) in 2003 but this was more than offset by the reduction in lost fruit and higher pack-out (Table 1). The new organic management program returned an additional \$1,772/acre in 2003 despite the increased cost of insecticides.

In 2004, 78 moths were captured over the entire season. The reduction in codling moth pressure following the 2003 cleanup efforts allowed for reduced insecticide inputs while maintaining a high level of fruit protection. The savings in insecticide costs returned an additional \$130/acre to the grower.

Table 1: Summary of organic codling moth clean-up program, 2002-2004.			
	2002	2003	2004
Trap captures (total moths)			
First generation	587	2,261	35
Second generation	2,249	227	43
Fruit damage	5%	<1%	<1%
Hand removal of damage:			
\$/acre ¹	\$37	0	0
Crop Removal (bins/a)	0.6	0	0
Harvest (Bins/acre) ²	39	40	40
Pack-out	64%	85%	85%
Crop value (\$/bin) ³	200	200	200
Insecticide cost (\$/acre)	407	480	350
Value (bins/acre x \$/bin)	\$7,800	\$8,000	\$8,000
Less crop loss (pack-outs)	\$4,992	\$6,800	\$6,800
Less thinning + Insecticides	444	480	350
Net⁴	\$4,548	\$6,320	\$6,450

1. Assumption: 1000 hours x \$10/hour / 270 acres.
 2. Assumption: Average harvest of 40 bins/acre with no hand removal of fruit.
 3. Assumption: Organic Delicious apple returns to grower of \$200/bin.
 4. Net value of crop based on cost of codling moth management program and pack-outs. This value does not represent actual net profit to grower, as other management costs outside of codling moth control were not included.

Insecticide treatments for immediate results:

- Hand-applied pheromone at 400 disp/acre.
- Oil applied at 375DD (200 DD) as an ovicide.
- Entrust and oil at 525DD (350DD), repeated every 10-12 days (3 applications).
- Virus alternated with Entrust during the 1st generation.
- Spot treatments of virus and Entrust during 2nd generation.

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Codling moth clean-up in a conventional orchard



Over the course of a two-year research project in an apple orchard managed with conventional insecticides, a very high codling moth infestation was transformed into a manageable population. The situation was typical of orchards that have undergone ownership restructuring. The result is often at least a partial neglect in horticulture and pest management allowing codling moth pressure to increase dramatically.

Despite an intensive spray program and half-rates of mating disruption, the study area suffered over 25% codling moth damage in 2005 (Table 2). Most damage was noted high in the tree canopy. We felt inadequate pruning was likely to blame for poor spray coverage, allowing the population to build in the top of the trees.

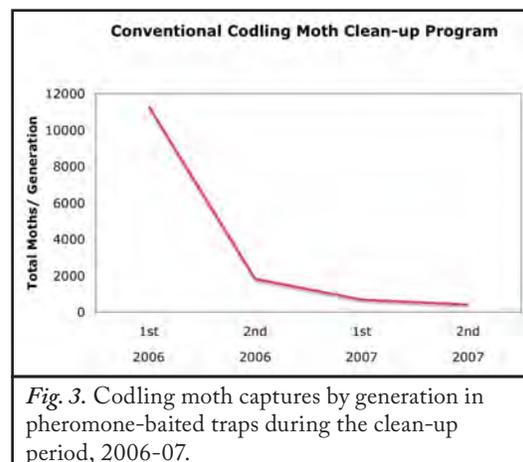


Fig. 3. Codling moth captures by generation in pheromone-baited traps during the clean-up period, 2006-07.

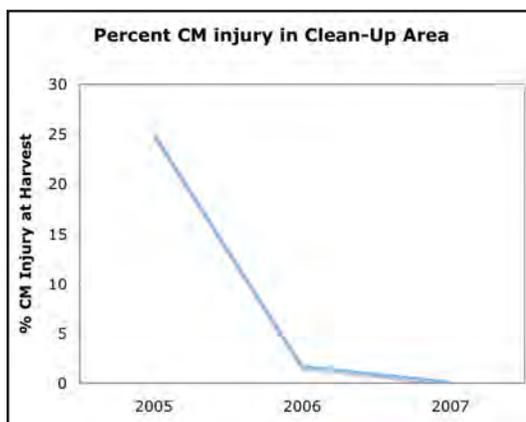


Figure 4. Codling moth damage at the harvest evaluation prior to (2005), and during the clean-up period, 2006-07.

In early 2006, major saw cuts replaced detailed pruning to improve spray penetration. Mating disruption rates were increased to 400 dispensers/acre, and a heavy spray program continued. Total trap catch in the 160-acre study area was 11,282 moths during the first generation of 2006, but declined to 1,824 during the second generation (Fig. 3). Nine specific codling moth sprays were applied over the entire season.

In 2007, total trap captures were 681 moths and 406 moths during the first and second generations, respectively. Just three codling moth sprays were applied over the whole season, which included an insect growth regulator applied as an ovicide at 200 degree-days. Damage across the entire project was reduced to just 0.10% (Fig.4).

The expense of this cleanup effort was considerable. Heavy pruning resulted in a significant decrease in yield, but increased pack-outs made up for the loss in production. Within two years, the management program with mating disruption at its foundation was biologically stable and economically viable, returning approximately \$2,850 more per acre than prior to the codling moth cleanup program (Table 2).

	2005	2006	2007
Trap captures (total moths)			
First Generation	8,316	11,282	681
Second Generation	15,656	1,824	406
Fruit damage	25%	1.7%	0.1%
Harvest (Bins/acre)	73	56	66
Pack-out ¹	60%	83%	85%
Crop value (\$/bin) ²	150	150	150
Insecticide cost (\$/acre)	\$400	\$420	\$220
Value (bin/acre x \$/bin)	\$10,950	\$8,400	\$9900
Less crop loss (pack-outs)	\$4,380	\$1,428	\$1485
Less Insecticides	\$370	\$420	\$220
Net³	\$6,200	\$6,552	\$8,195

1. Assumption: Average return to grower of \$150/bin.
 2. Assumption: Average return to grower for conventional Granny Smith apples of \$150/bin.
 3. Net value of crop based on cost of codling moth management program and pack-outs. This value does not represent actual net profit to grower, as other management costs outside of codling moth control were not included.

Stabilized Codling moth management following clean-up:

- Hand-applied mating disruption at 400 disp./acre.
- Ovicide applied at 375 DD (200 DD).
- Most effective larvicide available applied at 525 DD (350 DD), with repeat in 17 days.
- Spot treatments of non-disruptive larvicides during 2nd generation.