FINAL REPORT

Project Title: Codling moth control using CpGV—with and without mating disruption.
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Significant findings:

- Under conditions of high codling moth pressure—

1) *Cydia pomonella* granulosis virus (CpGV) applied regularly (10-14 day interval) gave 70% to 85% control of codling moth relative to an untreated check in replicated trials.
2) Mating disruption alone (200 Isomate TT dispensers/ac.) gave 15% to 50% control of codling moth when compared to untreated blocks.
3) Combining CpGV with mating disruption gave 86% to 90% control of codling moth over two years of trials, therefore the bulk of the control in the combination was provided by the applications of CpGV.

- There was no significant difference in successful codling moth entries between CpGV applied on a frequent basis (10-14 day interval) and conventional codling moth treatments (Imidan, Guthion, or Calypso) applied every three weeks, although stings (i.e. unsuccessful entries) were higher when CpGV was applied.

- The addition of encapsulated pear ester to the CpGV did not significantly improve the level of codling moth control.

Results and Discussion:

Tests conducted in 2003 demonstrated that applications of CpGV applied on a 10 day interval gave 80-90% control of codling moth entries in a location with high pest pressure (Table 1). Tests conducted in a grower block where mating disruption was being used and pest pressure was very low indicated that CpGV could be substituted for standard conventional codling moth control materials and still provide a high level of control (Table 2).

Replicated trials were carried out with CpGV in 2004 in two blocks, one without mating disruption (Table 3) and one with mating disruption (Table 4). Again, pest pressure was high and the addition of CpGV provided significant control of codling moth. As the CpGV particles require ingestion, the level of stings was higher where CpGV was used but the level of successful entries by codling moth was not significantly different than standard materials applied on a three week schedule. As these studies were conducted in separate blocks, direct statistical comparisons between blocks could not be made but a general comparison is shown in Table 5 which indicates that the most of the control was the result of the CpGV applications. One difficulty in this comparison is that different cultivars were being compared, Packham's and Bartletts. Both Packham's and Bartlett have an open calyx and are subject to considerable early attack by codling moth but there are also major differences between the two cultivars that may make a direct comparison somewhat questionable.

Trials conducted in 2005 to repeat the 2004 studies were performed in blocks where Bartlett was present so that more direct comparisons could be made. The block with mating disruption was the same as in 2004 and contained both Bartlett and Anjou. The comparison block also had Bartletts and Anjou in every replicate. Plot sizes were also increased in 2005. An additional replicated study was carried out on single Bartlett trees to examine the effect of combining microencapsulated pear ester with CpGV. In all the 2005 studies, CpGV was applied on a two week interval. As in 2004, the use of CpGV resulted in a significant decrease in the percent successful entries along with a rise in stings. A comparison between the two blocks (Table 6 and Figure 1) gave results similar to those seen in 2004 with Bartletts. Mating disruption by itself reduced entries by about 50% while control with CpGV alone was better than 80%. The combination of CpGV and mating disruption resulted in an 89% reduction in entries. In Anjous, the effect of either tactic by itself was much less than observed for Bartletts but the combination of CpGV and mating disruption gave a 90% reduction in entries. Thus, it seems that with Bartletts the effect of combining the two methods was only additive, whereas with Anjous there was some synergistic effect from combining the two methods. The additional study showed no significant effect from adding the microencapsulated pear ester to applications of CpGV despite the fact that applying the pear ester by itself did reduce early codling moth entries.

It is not unexpected that mating disruption has limited effectiveness under conditions of high codling moth pressure, however, the effectiveness of CpGV, even when stretched to a two week spray interval, is notable. The fact that the bulk of the control when the two tactics were combined could be attributed to the CpGV implies that under conditions of initial high pressure, a program consisting of frequent CpGV applications would most likely be more cost effective than a combined program, particularly if the addition of mating disruption meant a reduction in the number of CpGV applications. An example of this can be seen in a pear orchard transitioning to organic production from 2002-2005 (Table 7). Various control programs were employed over the last four years. In 2002, mating disruption was used in most of the orchard with one block left untreated as a comparison. Codling moth damage was about twice as high in the block without mating disruption. In 2003 the control program was minimal with just two or three oil sprays being applied and, as a result, the Bartlett crop was a total loss due to codling moth injury. With the registration and use of CpGV materials in 2004, codling moth damage was reduced by 75% from the 2003 levels. In 2005 CpGV was again used throughout the orchard with half the orchard being treated with mating disruption. While stings and total damage were lower in the mating disruption treated area, successful entries were not reduced. In this case, the addition of mating disruption did not appear to provide any improvement over the CpGV used by itself.

The results of the replicated tests and the organic orchard demonstration plots show that the use of CpGV can provide a high level of codling moth control. When codling moth pressure is high, the use of CpGV does result in an increased level of stings relative to standard control measures, but many of these stings are superficial and are generally located in the calyx and do not represent economic injury. The use of mating disruption is probably not warranted when codling moth levels are extreme, however when codling moth levels are low then the use of mating disruption may be called for as a way to maintain codling moth at low levels, using additional treatments as necessary.

Table 1. Field trial comparing CpGV products in small blocks with high codling moth pressure (cv. Bartlett).

Treatment	Rate (form./ac)	CM injury	
		% stings	% entries
Check	-----	20.75	51.5
Carpovirusine	400 ml	65.75	9.25
Cyd-X **Nu-Film 17**	3.0 fl oz 16 fl oz	69.25	6.5

Table 2. Comparison of CpGV products in an on-farm trial using mating disruption under conditions of low codling moth pressure (cv. Comice and Bosc)

Treatment	Rate (form./ac)	% CM injury	Mean seasonal trap catch	
			Pheromone trap	DA trap
<u>Standard program</u> **Intrepid** **Assail**	 16 fl oz 3 oz	0.03	8.25	9.0
Carpovirusine	400 ml	0	4	4
Cyd-X **Nu-Film 17**	3.0 fl oz 16 fl oz	0	0	2

Table 3. Replicated comparison of CpGV with standard control measures without mating disruption (cv. Packham's).

Material	Rate and Frequency	CM injury		
		% Stings	% Larvae	% Exits
Calypso	4 oz—21 days	18.50 a	7.25 a	3.75 a
Calypso	6 oz—21 days	14.50 a	6.00 a	2.00 a
Calypso	8 oz—21 days	15.50 a	4.25 a	1.75 a
Cyd-X	3 oz—10/11 days	68.00 b	6.75 a	3.00 a
Imidan	5 lb—21 days	12.00 a	5.50 a	1.50 a
Check	-----	21.25 a	32.50 b	31.00 b

Table 4. Replicated trial evaluating CpGV applied at two time intervals (21 days and 10.5 days) in combination with mating disruption.

cv. Bartlett

Material	Rate and Frequency	CM injury		
		% Stings	% Larvae	% Exits
MD alone	-----	40.67 a	31.00 b	12.67 b
Cyd-X	3 oz—10/11 days	67.75 b	7.50 a	1.00 a
Cyd-X	3 oz—21 days	69.25 b	10.50 a	1.00 a

cv. Anjou

Material	Rate and Frequency	CM injury		
		% Stings	% Larvae	% Exits
MD alone	-----	18.00 a	35.00 b	9.67 b
Cyd-X	3 oz—10/11 days	30.25 b	7.69 a	0.25 a
Cyd-X	3 oz—21 days	41.13 c	12.5 a	1.25 a

Table 5. Combined results of trials conducted in 2004 showing the effect of CpGV applications on the level of codling moth injury in blocks with and without mating disruption (cv. Bartlett and Packham's).

Type of CM injury	% CM injury			
	Check plots		Cyd-X every 10/11 days	
	w/o MD	with MD	w/o MD	with MD
Stings	21.25	40.67	68.00	67.75
Larvae	32.50	31.00	6.75	7.50
Exits	31.00	12.67	3.00	1.00

Table 6. Combined results of trials conducted in 2005 showing the effect of CpGV applications on the level of codling moth injury in blocks with and without mating disruption.

cv. Bartlett

Type of CM injury	% CM injury			
	Check plots		Cyd-X every 14 days	
	w/o MD	with MD	w/o MD	with MD
Stings	27.75	40.00	41.75	56.00
Larvae	33.00	13.25	7.25	4.75
Exits	11.75	9.5	0.25	0.0

cv. Anjou

Type of CM injury	% CM injury			
	Check plots		Cyd-X every 14 days	
	w/o MD	with MD	w/o MD	with MD
Stings	15.5	12.0	41.5	35.5
Larvae	37.25	30.5	11.5	4.25
Exits	6.25	6.0	1.25	0.25

Table 7. Injury due to codling moth in a transitional organic pear orchard under various control programs (cv. Bartlett).

Year and CM control program	% CM injury		
	Shallow stings	Entries (exits +larvae)	Total damage (entries + deep stings)
2002 2-3 oil sprays	1.6	19.0	21.8
2002 2-3 oil sprays + MD	1.1	10.6	11.6
2003 2-3 oil sprays	-----	—Total Crop Failure— -----	61.8
2004 4 Cyd-X sprays	47.3	6.5	15.7
2005 4 Cyd-X sprays	40.0	5.0	27.0
2005 4 Cyd-X sprays + MD	24.0	7.0	17.0

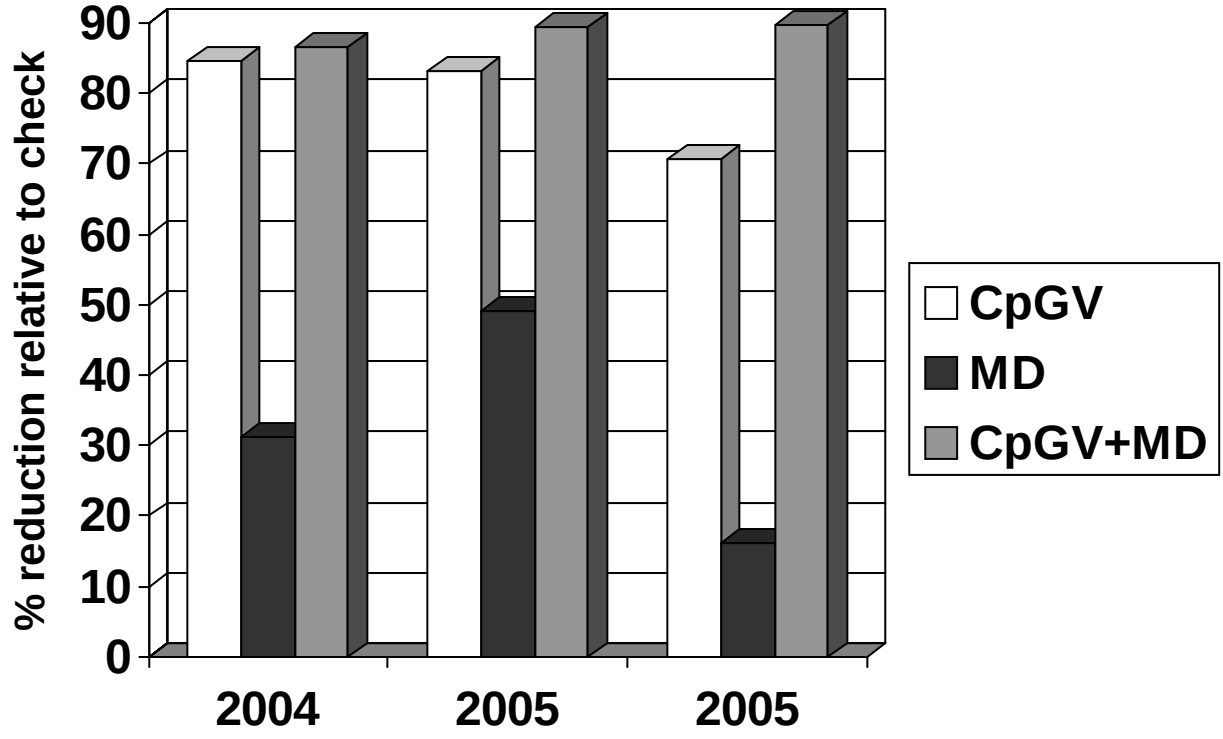

Figure 1. Level of codling moth control (% reduction in entries relative to the untreated check) with CpGV applications, mating disruption (MD), and a combination of CpGV and MD.

Budget:

Project Title: Codling moth control using CpGV—with and without mating disruption.
PI: Richard Hilton
Project duration: 2004-2005
Project total (2 years): $15,000
Current year request: n/a

Item	Year 1 (2004)	Year 2 (2005)
Wages	$7,500	$7,500
Total	$7,500	$7,500