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Granulovirus for Management of Codling Moth, *Cydia pomonella* L. (Tortricidae)

Charles Vincent[1], Lerry Lacey[2], Joan Cossentine[3]

1 Agriculture and Agri-Food Canada, Horticulture Research and Development Centre, Saint-Jean-sur-Richelieu, QC Canada J3B 3E6 * Correspondence: vincentch@agr.gc.ca
2 USDA-ARS, Yakima Agricultural Research Laboratory, Wapato, WA 98951, USA
3 Agriculture and Agri-Food Canada, Pacific Agri-Food Research Centre, Summerland, B.C. Canada V0H 1Z0

Introduction

The codling moth, *Cydia pomonella* L. (Tortricidae), is the most significant and widespread insect pest of apples worldwide. While chemical control remains the mainstay for most conventional growers, concerns over environmental impact, insecticide resistance and anticipated loss of registered compounds such as Guthion (azinphos methyl) in the USA has focused efforts to find alternative approaches. Among the biological control options available (Cossentine and Vincent 2002), the granulovirus of *C. pomonella* (CpGV) (family Baculoviridae) (Fig. 1) has offered potential for selective control of this key pest (Lacey et al. 2002; Jaques, 1990). Although CpGV has received considerable attention as a microbial insecticide, problems including a perceived lack of persistence and speed of kill in the orchard agroecosystem and previous quality control issues have to date limited its widespread commercial development and adoption by orchardists (Cross et al. 1999).

Virosoft CP4, (a codling moth granulovirus-based insecticide registered in the USA and Canada by Biotepp), Carpovirusine (Sumitomo) and CydX (Certis) were assessed in apple orchards of British Columbia and Quebec (Canada) and Washington State (USA).


1- *Cydia pomonella* granulosis virus in phase contrast


2- *Cydia pomonella* damage


3- Leaf discs assay


4- Apple assay


5- Applying CpGV to experimental plots at Moxee, WA (2003)

Objectives

To determine:

Exp. 1: the effect of Virosoft CP4 sprayed alone or mixed with Surround (Engelhard Corporation, Iselin, N.J.) on fruit damage at mid season and harvest (Quebec)

Exp. 2: the residual activity of Virosoft CP4 and Carpovirusine sprayed on fruit and foliage (British Columbia)

Exp. 3: the relative residual activity of Virosoft CP4, CydX and Carpovirusine (Washington State)

Materials & Methods

Experiment 1 – Quebec

- Organic orchard (MacIntosh, Cortland, Lobo) at Saint Hilaire (Qc), a site that suffered high codling moth pressure (ca. 57% Cm damage (Fig. 2) on fruit at harvest in 2002)
- Completely randomized block design (5 treatments x 4 replicates) 6 trees /experimental unit

-Treatments: Starting 16 June 2003 (determined by biofix) 4 treatments with CP4 (every second week), 7 treatments with CP4 (every week), 4 treatments with CP4 +0.25 Surround, 7 treatments with CP4 +0.25 Surround, Control (water)

- Virosoft CP4 dosage: 250 mL/ha i.e. 10^{13} Obs/ha; Surround: ¼ of recommended dose (i.e. 6 kg/100L)

-Evaluation of damage at mid season (28 July 2003) and harvest (3 September 2003) by examining 200 apples per experimental unit

Experiment 2 – British Columbia

- Five rows of MacIntosh, high density apples sprayed per treatment in experimental orchard, AAC Summerland
- Virosoft CP4 dosage: 239 mL/ha i.e. 10^{13} Obs/ha
- Carpovirusine dosage: 1 L/ha (original prep. 10^{13} Obs/ha
- Control was untreated
- Two replicates: 12 June and 3 July 2003

-Apples (Fig. 4) and discs (Fig. 3) cut from leaves collected immediately and after 1, 4, 6, 8 and 12 days were challenged with 5 codling moth neonates. Larvae on leaf discs were transferred to a meridic diet after 60 min. Mortality was read after 7 days.

Experiment 3 – Washington State

-Trial done at the USDA experimental farm at Moxee (WA)

-10 trees sprayed at random per treatment on 2 June and 14 July 2003

- 2doses (27 and 54 ml/ha) (Fig. 5)
- Apples collected immediately and after 1, 3, 7, 10 and 14 days and challenged with 5 codling moth neonate larvae

Results

Experiment 1- (Qc) (Fig. 6):

Results of Codling moth damage assessments on 28 July and 3 September 2003 (n=200 fruit/experimental unit)

A) Evaluation of CM damage on fruit, 28 July 2003 (1W-ANOVA, P= 0.034) (6 tr.)					
	Control (water)	CP(4)	CP(7)	CP(4)+S	CP(7)+S
Mean	34.375	15.375	12.25	13.5	13.625
Tukey-Kramer	a	ab	b	ab	ab
B) Evaluation of CM damage on fruit, 3 September 2003 (1W-ANOVA, P= 0.0078) (7 tr.)					
Mean	19.8	10.3	9.6	14.8	11.6
Tukey-Kramer	a	b	b	a	b

Experiment 2- (BC) (Figs. 7 A and B):

Residual activity of Virosoft CP4 and Carpovirusine

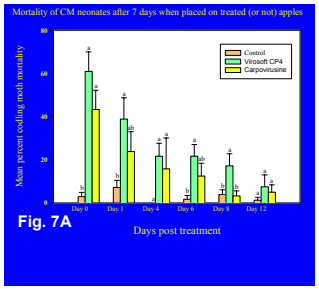


Fig. 7A

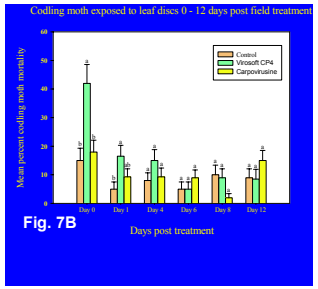
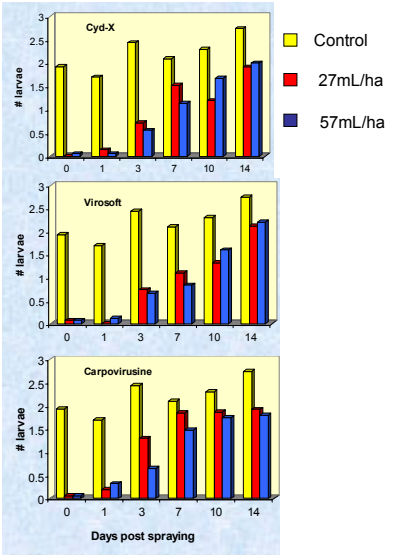


Fig. 7B

Experiment 3- (WA) (Fig. 8):

Live codling moth larvae recovered from apples previously treated with commercial CpGV products. Fruit was challenged with 5-neonate larvae at various intervals after spraying



Discussion

Exp. 1: At mid-season, the CP4(7) treatment was significantly lower than the control and, at harvest, treatments CP4(4), CP4(7) and CP4(7)+S resulted in significantly less damage than the control and the CP4(4)+S treatment (Fig. 6). **Exp. 2:** Although virulence decreased quickly with only 39% larval mortality recorded on fruit collected one day post-treatment (Fig. 7A), Virosoft CP4 caused significant larval mortality up to 8 days post-treatment. Mortality was generally lower after codling moth were exposed to the virus on foliage (Fig. 7B). **Exp. 3:** For the June application residual activity of all products (label rates) remained highly effective (>80% larval mortality relative to controls) for 24 hours following application and moderately effective (>70%) after 72 hours (Fig. 8). Significant activity in all treatments remained after 14 days, suggesting prolonged survival of the virus in UV-protected locations, such as the calyx of fruit. Fruit damage was also reduced; while overall >97% control larvae formed deep entries, <35% of CpGV-killed larvae's stings were >3mm. The second application showed similar results (data not shown).

Our results show that repeated applications of commercial CpGV formulations provide a valuable alternative for management of codling moth in multiple localities and agronomic situations.

References

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We thank Biotepp (www.biotepp.com) for supplying Virosoft CP4, Certis for supplying CydX, Sumitomo for supplying Carpovirusine, and Engelhard Corporation for supplying Surround.

Many thanks to: M. Trudeau, P. Lemoyne, S. Cloutier, J. Valéro, L. Samson, H. Rasamimanana, S. P. Arthurs, H. Headrick, R. Fritts, D. Thomson, L. Jensen, D. Sekutowski.

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