

Status of the codling moth and the Oriental fruit moth populations in apple orchards of Quebec, Canada

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Introduction

A steady increase of the amount of trapped codling moths, *Cydia pomonella* (L.) (Lepidoptera: Tortricidae) and of damages at harvest were observed in the last decade. Furthermore, a second species of internal feeding Lepidoptera, the oriental fruit moth, *Grapholitha molesta* (Busck), has been observed for the first time in 2002 in south-western Quebec. A survey conducted from 2003 to 2005 indicated that the distribution area of *G. molesta* was gradually expanding in Quebec (Bellerose et al. 2007). Beside insect resistance and climate changes, we hypothesized that the distribution expansion of these two species could originate from (1) an increase in the numbers of weakly managed apple orchards including abandoned orchards, and (2) an increase in the amount of imported apples.

Moth traps were checked weekly for two years from the beginning of adult flight in early May to harvest in the three most important apple growing areas of Quebec, Canada, to determine which of these two potential infestation sources could be involved.

Materials and Methods

Apple Orchard Characteristics (Table 1)

- Integrated fruit production: Apple orchard under a IFP program
- Conventional: Apple orchard under a regular insecticide spray program
- Organic: Apple orchard under an organic management program
- Abandoned: apple orchard not managed for several years
- Bin storage site: outdoor site with thousands of bins

Table 1. Number of apple orchards under different management practices sampled during the two years

Sampled sites	2010	2011
Integrated fruit production	11	11
Conventional	10	10
Organic	4	2
Abandoned	4	4
Bin storage site	2	2

Codling Moth

- Monitoring: 2 Multiplier® I traps + CM Standard™ lures (Trécé Inc.) per site
- Sampling periods: 3 May - 20 September 2010
2 May - 19 September 2011
- Moth identification: hand lens during trap monitoring

Oriental Fruit Moth

- Monitoring: 2 Multiplier® III + OFM Standard™ lures (Trécé Inc.) per site
- Sampling periods: 12 April - 20 September 2010
12 April - 19 September 2011
- Moth identification: under binocular using taxonomic criteria (Heinrich, 1926; Chapman et Lienk, 1971; Chambon, 1999)

Dependent Variables and Statistical Analysis

- Codling moth and oriental fruit moth captures
- Kruskal-Wallis followed by multiple comparison tests

References

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Results

- Codling moth captures were similar between sites in 2010 ($X^2 = 0.1831$, $df = 4$) but statistically different in 2011 ($X^2 = 0.0493$, $df = 4$) (Table 2).
- In 2011, abandoned apple orchards and bin storage sites had the lowest number of codling moth captures (Table 2).
- Oriental fruit moth captures were similar between sites in 2010 ($X^2 = 0.2393$, $df = 4$) and in 2011 ($X^2 = 0.8149$, $df = 4$) (Table 3).
- There is no clear pattern of codling moth captures between geographical region for the same year and between years for the same region (Fig. 1).

Table 2. Cumulative (\pm SEM) number of codling moth adults caught in apple orchards under different management practices

Sampled sites	2010	2011
Integrated fruit production	343.8a (70.9)	263.7a (40.9)
Conventional	317.4a (55.4)	238.9a (40.5)
Organic	479.0a (91.4)	419.5a (35.5)
Abandoned	302.0a (167.3)	183.5b (76.1)
Bin storage site	64.5a (43.5)	30.0b (8.0)

Means in the same column followed by the same letter are not significantly different from each other (Kruskal-Wallis, $\alpha = 0.05$)

Table 3. Cumulative (\pm SEM) number of oriental fruit moth adults caught in apple orchards under different management practices

Sampled sites	2010	2011
Integrated fruit production	45.0a (16.5)	57.6a (29.3)
Conventional	51.1a (18.2)	49.3a (15.0)
Organic	201a (147.4)	3.0a (1.0)
Abandoned	84.3a (71.3)	47.5a (42.5)
Bin storage site	60.5a (43.5)	7.5a (6.5)

Means in the same column followed by the same letter are not significantly different from each other (Kruskal-Wallis, $\alpha = 0.05$)

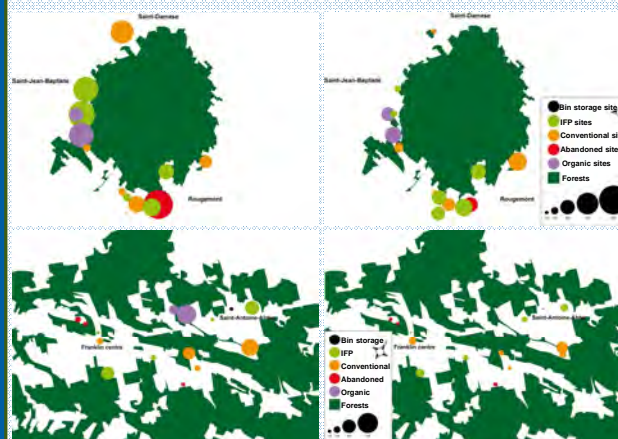


Figure 1. Geographical distribution of the codling moth captures of the eastern (a, b) and western (c, d) sites of the sampled area in Québec, Canada during 2010 (a, c) and 2011 (b, d).

Conclusion

- Our two hypotheses are rejected because the abandoned apple orchards and the bin storage sites had the lowest number of codling moth catches, thus they cannot be considered primary infestation sites.
- However, imported bins from areas harbouring resistant populations of codling moth may be the source of new resistant codling moth populations in a recipient region, regardless of the population density.
- The low number of codling moth caught in abandoned apple orchards may be related to the decreased number of apples that can support a codling moth population in orchards not managed for a long period of time.
- High number of trapped oriental fruit moth suggests that this pest is established in Quebec.