Evaluation of Synthetic Plant Semiochemicals for Colorado Potato Beetle (*Leptinotarsa decemlineata*) Management

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Introduction

The **Colorado potato beetle** (CPB), *Leptinotarsa decemlineata* (Say) (Coleoptera: Chrysomelidae), is a major insect pest of solanaceous crops, with a preference for potato. Increasing **insecticide resistance** and deregistration of insecticides has **reduced available management options**.

CPB are known to respond to **potato plant volatiles**, with **greater attraction to damaged plants**. Foundational research of CPB antennal responses was conducted from the 1970s-1990s.

Building on previous research, this study uses gas chromatographic–electroantennographic detection (GC-EAD) and gas chromatography–mass spectrometry (GC-MS) to **identify potato volatiles detected by CPB antennae**. Identified compounds will be used to develop a synthetic volatile lure for potential CPB management.



Objectives

1. **COLLECT**
   Collect volatiles from undamaged potato plants and from plants during and after feeding by CPB.
2. **IDENTIFY**
   Identify antennally-active volatiles using GC-EAD and GC-MS.
3. **TEST**
   Test synthetic volatile blends at naturally occurring ratios for CPB attraction using four-arm olfactometry.

Methods

1. **PLANT MATERIAL**
   Headspace volatiles were collected from undamaged potato plants, and from plants actively fed on by either CPB larvae or adults. Feeding was standardized to achieve approximately 20% plant damage.
2. **VOLATILE COLLECTION**
   Airborne volatiles were collected during active feeding (0–24 h) and post-feeding (24–48 h) on Porapak-Q (50-80) cartridges. Incoming air was purified through activated charcoal filters. Collections were repeated twice.
3. **COMPOUND IDENTIFICATION**
   Extracted volatiles were analyzed using GC-EAD to identify compounds eliciting antennal responses in CPB, and antennally-active compounds were identified using GC-MS.
4. **BEHAVIOURAL TESTING**
   Synthetic blends of antennally-active volatiles were prepared at their naturally occurring ratios and evaluated for adult CPB attraction in four-arm olfactometer bioassays.

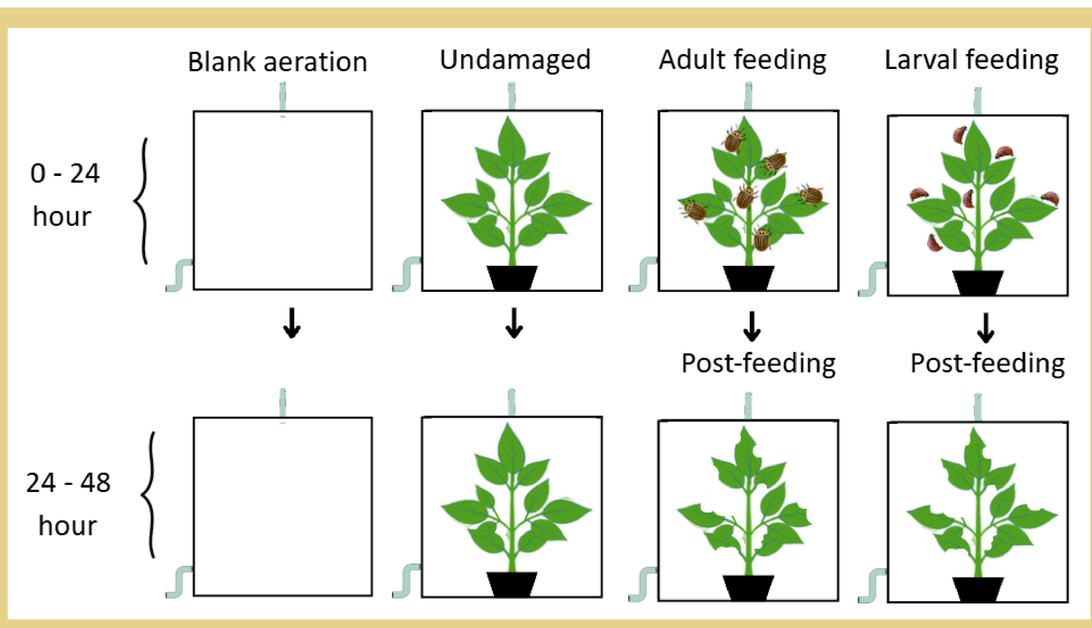


Figure 1. Potato plant headspace volatile collection experimental design showing blank aerations (0–24 h and 24–48 h), undamaged potato plants (0–24 h and 24–48 h), and plants exposed to active feeding by five female + five male CPB adults or by 6 CPB larvae (0–24 h), followed by post-feeding collections (24–48 h) after insect removal.

Results

17 of the **potato plant volatiles** collected from the active-feeding and post-feeding treatments **elicited antennal responses** in male and/or female CPB (Figure 2, Table 1). Seven of these compounds were found in the headspace of both undamaged plants and plants damaged by CPB feeding.

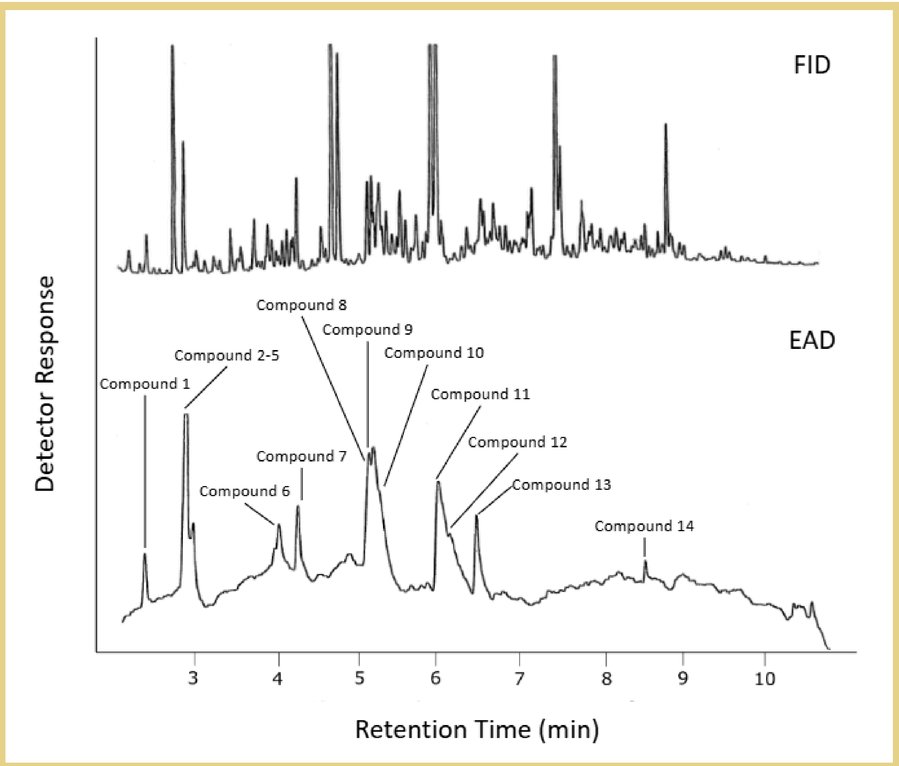


Figure 2. Representative GC-EAD/FID chromatogram of adult CPB antennal responses to potato plant volatiles collected 24 h post-feeding, following removal of adult CPB. Numbered peaks correspond to detected compounds; compound identities withheld.

Table 1. Antennally-active potato plant volatiles detected in undamaged and CPB-damaged plants following active-feeding and post-feeding treatments with larval or adult CPB. Compound numbers correspond to Figure 2.

Group	Compound	Undamaged	CPB-damaged
Green Leaf Volatiles	1	-	x
	2	-	x
	3	-	x
	4	-	x
	5	-	x
	7	-	x
Aromatics	10	x	x
	11	x	x
	15	x	x
	16	-	x
Aliphatics	6	-	x
	9	x	x
	12	x	x
	13	x	x
	14	-	x
Terpenoids	8	-	x
	17	x	x

Conclusion

Potato plants that have been fed on by CPB **release more antennally-active compounds** than undamaged potato plants.

Synthetic blends of the 17 compounds are currently being evaluated using four-arm olfactometer bioassays to determine which blends elicit behavioural attraction in CPB.

The most promising blend will be further evaluated for its potential to be used for **mass-trapping of adult CPB in agricultural fields to reduce crop damage.**

References

Bolter et al., 1997, *Journal of Chemical Ecology*; Dickens, 1999, *Agricultural and Forest Entomology*; Dickens, 2000, *Agricultural and Forest Entomology*; Dickens, 2002, *Agricultural and Forest Entomology*; Dickens et al., 2002, *Journal of Experimental Biology*; Dickens, 2006, *Journal of Applied Entomology*; Landolt & Phillips, 1997, *Annual Review of Entomology*; Landolt et al., 1999, *Environmental Entomology*; Martel et al., 2005a, *Agricultural and Forest Entomology*; Martel et al., 2005b, *Agricultural and Forest Entomology*; Ontario Ministry of Agriculture, Food and Rural Affairs, 2024, *Ministry of Agriculture, Food and Rural Affairs*; Schütz et al., 1997, *Naturwissenschaften*; Visser, 1979, *Entomologia Experimentalis et Applicata*; Visser & Avé, 1978, *Entomologia Experimentalis et Applicata*; Visser & Nielsen, 1977, *Entomologia Experimentalis et Applicata*; Weissbecker et al., 1999, *Journal of Chemical Ecology*; Weissbecker et al., 1997, *Talanta*.

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