

Canadian Agri-Science Cluster for Horticulture 3



Update to Industry

Semi-Annual – Fall 2021

Activity title: Integrated management of the pepper weevil, an invasive pest of greenhouse pepper crops in Canada

Name of Lead Researcher: Roselyne Labbe, PhD

Names of Collaborators and Institutions:

Félix Longpré, Insect rearing biologist, London Research and Development Centre, Agriculture and Agri-Food Canada

Cara McCreary, Greenhouse Vegetable Integrated Pest Management Specialist, Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA)

Miyuki Santiago, Business Development, Koppert Biological Systems

Niki Bennett, Science Coordinator, Ontario Greenhouse Vegetable Growers

Dr. Cynthia Scott-Dupree, Bayer Chair in Sustainable Pest Management School of Environmental Sciences University of Guelph.

Bruce Power and Nordion, producers of Cobalt-60 isotopes required for weevil irradiation.

Tim McDowell, Chemist, , London Research and Development Centre, Agriculture and Agri-Food Canada

Activity Objectives (as per approved workplan):

- 1) Develop improved rearing methods for the pepper weevil.
- 2) Evaluate reduced-risk conventional and biopesticides for the management of the pepper weevil.
- 3) Evaluate non-target impacts of management products on beneficial insects used in greenhouse pepper biological control.
- 4) Establish the efficacy of parasitoid *Jaliscoa hunteri* for the management of the pepper weevil. Establish and compare the efficacy of rearing methods for *J. hunteri* production. Explore alternate crop delivery methods for *J. hunteri*.
- 5) Conduct laboratory and greenhouse trials investigating the potential of the Sterile Insect Technique (SIT) for managing the pepper weevil.

Research Progress to Date (use plain language, not to exceed 500 words):

1. Improve pepper weevil rearing methods

In 2021, Félix Longpré conducted trials which examined the impact of pruning pepper plants on host fruit production and how fruit placement in rearing cages affects pest productivity. Work was also initiated to investigate the role of artificial diets for pepper weevil mass-rearing in to support SIT strategies with minimal manipulation. Félix has also developed a new apparatus to simplify rearing of laboratory colonies of *Jaliscoa hunteri*. With this novel method, the need for manual aspiration of insects is eliminated as they are instead collected automatically by a system containers, mesh and funnels which will be minimize manipulation while maximizing natural enemy production.

2. Evaluate pepper weevil control agents

Having completed and published work associated with this objective in 2020, we now continue to work with OMAFRA to seek new label expansions and registrations in Canada for pepper weevil control products. These include potential label expansions and registrations for kaolin clay, *Beauveria bassiana* strain ANT-03, mineral oil and Spinetoram.

3. Non-target testing / cold tolerance of pepper weevil

Having completed a metadata analysis for non-target effects of products on biocontrol organisms in summer 2020, have proceeded to evaluation of the overwintering potential or cold tolerance of pepper weevil in Canada. Through a series of laboratory, greenhouse and field studies, the rate of winter survival among various populations of this pest was investigated. Among findings were that low temperature exposures caused pepper weevil mortality even before freezing occurred, which inherently suggest that the establishment of this insect species is restricted outdoors under winter conditions typical of temperate regions of the globe. However, protected environments, particularly greenhouses continue to serve as shelter for this pest species, as winter temperatures do not typically reach sub-zero values in such environments.

4. Parasitism of the pepper weevil

Research on the parasitoid, *Jaliscoa hunteri* were substantially advanced by completing Y-tube wasp attraction trials which showed a strong attraction of adult females to infested peppers, especially when these contained 3rd instar pepper weevil. Along with plant headspace volatile captures trials (Tim McDowell AAFC London), this groundwork will better elucidate the chemical cues mitigating parasitoid attraction to pepper weevil and help to develop novel sensor technologies for detecting this pest in greenhouse crops.

5. Evaluate Sterile Insect Technique (SIT) for pepper weevil management

Pepper weevil pupae irradiation and dosimetry protocols were successfully developed in collaboration with Nordion Inc. and six irradiations of 853 insects across five doses completed. The fecundity and fertility of irradiated weevils were measured to determine their sterility. Male and female weevils irradiated at 110Gy showed a dose response curve approaching 100% sterility (the highest dose assessed). Irradiated weevils' quality suffered, as their longevity was greatly decreased, surviving for approximately two weeks at 110Gy. Flight activity was also negatively impacted with increased dose. Continued study of irradiated pepper weevil quality, namely sperm production and transfer during mating, and mating competitiveness is ongoing.

Extension Activities (presentations to growers, articles, poster presentations, etc.):

1. Basso, J., Labbé, R. and Scott-Dupree, C. 2021. Potential new tool for pepper weevil management in Ontario greenhouses: Sterile Insect Technique. Entomology 2021 Annual meeting of the Entomological Society of America. (Virtual Presentation) Award winning presentation.
2. Leo, S., Scott-Dupree, C. and Labbé, R. 2021. Parasitoid wasp *Jaliscoa hunteri* Crawford (Hymenoptera: Pteromalidae) can effectively suppress pepper weevil (*Anthonomus eugenii* Cano) at both first and third larval instars. Entomology 2021 Annual meeting of the Entomological Society of America. (Virtual Presentation) Award winning presentation (honourable mention)
3. Basso, J., Labbé, R. and Scott-Dupree, C. 2021. Potential new tool for pepper weevil management in Ontario greenhouses: Sterile Insect Technique. Ontario Pest Management Conference. (Virtual Presentation)
4. Award winning presentation (honourable mention)
5. Leo, S., Scott-Dupree, C. and Labbé, R. 2021. Evaluating the parasitoid *Jaliscoa hunteri* as a biological control agent for the pepper weevil *Anthonomus eugenii* on Canadian greenhouse pepper crops. Ontario Pest Management Conference (Virtual Presentation)
6. Basso, J., Labbé, R. and Scott-Dupree, C. 2021. Potential new tool for pepper weevil management in Ontario greenhouses: Sterile Insect Technique. Entomological Society of Canada Joint Annual Meeting. November 17, 2021. (Virtual Presentation)
7. Leo, S., Scott-Dupree, C., Fernandez, C., Gagnier, D., Rizzato, R. and Labbé, R. 2021. Evaluating the parasitoid *Jaliscoa hunteri* as a biological control agent for the pepper weevil (*Anthonomus eugenii*) on greenhouse pepper crops. Entomological Society of Canada Joint Annual Meeting. November 17, 2021. (Virtual Presentation)
8. Leo, S., Scott-Dupree, C., Fernandez, C., Gagnier, D., Rizzato, R. and Labbé, R. 2021. The pepper weevil parasitoid *Jaliscoa hunteri* is attracted to volatiles released by host weevil pests. Canadian Greenhouse Conference. (Virtual Poster Presentation)

9. Basso, J., Labbé, R. and Scott-Dupree, C. 2021. Potential new tool for pepper weevil management in Ontario greenhouses: Sterile Insect Technique. Canadian Greenhouse Conference. (Virtual Poster Presentation)
10. Leo, S., Scott-Dupree, C. and Labbé, R. 2021. Evaluating the parasitoid *Jaliscoa hunteri* as a biological control agent for the pepper weevil (*Anthonomus eugenii*) on greenhouse pepper crops. School of Environmental Sciences Graduate Student Virtual Conference – University of Guelph. Aug 26, 2021 (Virtual Presentation) Award winning presentation.
11. Basso, J., Labbé, R. and Scott-Dupree, C. 2021. The sterile insect technique as a novel tool for control of pepper weevil (*Anthonomus eugenii* Cano) in greenhouse and field pepper crops. Graduate Students Association Virtual Conference – University of Guelph. Aug 26, 2021
12. Fernandez, D. C., VanLaerhoven, S., Sinclair, B. and Labbé, R. 2021. Cold tolerance of the pepper weevil (*Anthonomus eugenii*). Ontario Fruit and Vegetable Convention. (Virtual Poster Presentation)
13. Leo, S., Labbé, R. and Scott-Dupree, C., 2021. Biological control of the pepper weevil using the parasitoid wasp, *Jaliscoa hunteri*. University of Guelph School of Environmental Sciences Graduate Student Virtual Conference. May 27, 2021
14. Leo, S., Scott-Dupree, C., Fernandez, C., Gagnier, D., Rizzato, R. and Labbé, R. 2021. Biological control potential of *Jaliscoa hunteri* for suppression of the pepper weevil. Ontario Fruit and Vegetable Convention. (Virtual Poster Presentation)
15. Basso, J., Labbé, R. and Scott-Dupree, C. 2021. Potential new tool for pepper weevil management in Ontario greenhouses: Sterile Insect Technique. Ontario Fruit and Vegetable Convention. (Virtual Poster Presentation)
16. Fernandez, D. C., VanLaerhoven, S., Sinclair, B. and Labbé, R. 2021. Cold tolerance of the pepper weevil (*Anthonomus eugenii*). Ontario Fruit and Vegetable Convention. (Virtual Poster Presentation)
16. Fernandez, D., VanLaerhoven, S. and Labbé, R. 2021. Host utilization by the pepper weevil (*Anthonomus eugenii*): suitability, preference and offspring performance. Pest Management Science. 77:10: 4719-4729.

COVID-19 Related Challenges:

Work associated with non-target product testing (**objective 3**) was affected by continued limitations in access to research facilities in 2021 and was therefore adjusted to conducting a metadata analysis for non-target effects of products, as well as a study on the overwintering potential of pepper weevil.

Key Message(s):

While COVID-19 has affected our progress on non-target, we were able to progress on a study of the overwintering potential of pepper weevil, as well as work associated with the parasitism of this pest, which will lay the groundwork for better understanding the factors that mitigate parasitoid attraction to pepper weevil. Finally, ongoing work on the SIT for pepper weevil control are generating valuable knowledge in this novel field of research.

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