



**FINAL PROJECT REPORT**  
**Canola Agronomic Research Program (CARP)**

The Final Report should fully describe the work completed for the year and note the personnel involved. It should also note any deviations from the original plan and next and/or corrective steps as may be required if deviations are noted. The report should also provide an update on the status of the Project including forecasted date of completion. A complete statement of expenses should be included. In the event major changes are anticipated within the budget supporting notes along with a proposed budget should also be included. The report should also capture a complete summary of activity for the year.

Project Title: Enhanced modelling of swede midge population dynamics in North America.

**Research Team Information**

<b>Lead Researchers:</b>		
<i>Name</i>	<i>Institution</i>	<i>Project Role</i>
Dr. Rebecca Hallett	University of Guelph	PI, Overseeing research, defining objectives and making guiding decisions on research focus
Jenny Liu	University of Guelph	MSc Student undertaking project
<b>Research Team Members (add rows as required)</b>		
<i>Name</i>	<i>Institution</i>	<i>Project Role</i>
Dr. Boyd Mori	Agriculture and Agri-Food Canada	Verifying swede midge rearing and experimental methods, statistical analysis, providing access to advanced lab equipment, editing research papers
Dr. Owen Olfert	Agriculture and Agri-Food Canada	Providing expertise in spatial insect population modelling, with specific experience modelling swede midge, editing research papers
Dr. Jonathan Newman	University of Guelph	Providing expertise in insect life cycle modelling, including statistical analysis and validation methods, editing research papers

Project Start Date: September 1, 2016 Project Completion Date: August 31, 2019

Reporting Period: January 1, 2019 to August 31, 2019

CARP Project Number: 2016-18

**Instructions:** This Final Project Report shall be completed and submitted on or about March 31<sup>st</sup> of the fiscal year that the agreement is in effect (upon completion of the project). The Lead Researcher of the project in question shall complete and submit the report on behalf of his/her complete research team.

This Report is a means by which to provide a detailed account upon completion of the project.. Final project financial reporting should be provided at this time.

The following template is provided to assist you in completing this task. Please forward the completed document electronically to the CCC contact listed below.

**In addition** to the Final Project Report, a one page Research Abstract including rationale, objective, methodology, summary and conclusions (with a summary graph/table or supporting image for the project), acknowledgement and references is due upon completion. The Research Abstract is intended for use in publications such as the *Canola Digest* and the CCC Research Hub and is intended to support messaging to all audiences.

Please include the funding acknowledgements outlined in your research agreement in all deliverables (publications, presentations, etc.) from this project.

**1. Date of Completion:**

August 31, 2019

**2. Status of Activity: (please check one)**

Ahead of Schedule  On Schedule  Behind Schedule  Completed

Comment:

All deliverables have been completed and will be published in 3 scientific research papers. One paper has been published, and the remaining two will be completed and submitted to scientific journals by the end of September.

**3. Completed actions, deliverables and results; any major issues or variance between planned and actual activities.**

*N.B. Numbering of activities corresponds with numbering used in full proposal, and modifications made in 1<sup>st</sup> Annual Report.*

Completed activities

1. Recruit graduate student. Summer 2016.
  - a. Completed. Jenny Liu, MSc student commenced program in Sep 2016.
2. Conducted experiments determining temperature-dependent rates of development for eggs, larvae, and adults.
3. Collect weather data for all sites and years for which we have pheromone trapping data.
  - a. Completed. Southern Ontario canola grower sites, 2013–2016 and Elora Research Station, 2003–2016.
  - b. Completed. Northern Ontario sites, 2012–2015.
  - c. Completed. Saskatchewan sites, 2007–2016.
4. Training of graduate student on Dymex v4 software package. Fall 2016.
  - a. Completed. Jenny Liu attended Dymex training (delivered by R. Weiss), AAFC

Saskatoon Research Centre. 24–28 October 2016.

- b. Rebecca Hallett also visited the research centre 25–26 October for meetings with collaborators.

5. Graduate student coursework, thesis proposal, literature review. Fall 2016–Winter 2017.
  - a. Literature review completed December 2016.
  - b. Coursework completed April 2017.
6. Assessed accuracy of MidgEmerge model in predicting adult population peaks. Winter 2017.
  - a. Ran original MidgEmerge model for all parameterization sites and years.
  - b. Examined model performance with respect to prediction of spring emergence of overwintered generation first.
  - c. Model altered and identified necessary improvements.
7. Developed new population dynamics model with additional life history & mortality parameters.
  - a. Incorporated revised life history parameters related to diapause entry and termination (from published studies), temperature-dependent development and mortality rates (from lab and field studies), and mortality factors (from literature and/or data collected by others in Hallett lab). Fall 2018.
8. Establish field cage studies to validate lab-derived development and mortality rates. This activity, planned for 2017, was removed as lab-derived data is more useful for model than field cage studies in determining effects of environmental parameters on insect development.
9. Presented at each of the following conferences in Summer–Fall 2017: International Pest Risk Research Group Annual Meeting (Best Student Presentation); the Annual Meeting of the Entomological Society of Canada in Winnipeg, Manitoba (Best Poster Award); and the Ontario Pest Management Conference.
10. Validated new model using population data from validation sites and years.
  - a. Assessed performance of model in matching observed population dynamics in long-standing areas of infestation (e.g., Elora, southern Ontario).
  - b. Assessed performance of model in matching observed population dynamics in northern Ontario (Timiskaming, ON).
11. Elucidate life history differences in swede midge populations in different regions of invasion (i.e., populations in Eastern vs Western Canada).
  - The midge that is widespread in Western Canada has been identified as a new *Contarinia* sp., rather than the swede midge, and therefore this activity is no longer relevant and has been removed.
12. Potential continuation of Ontario field cage studies to investigate life history parameters, if needed. Summer 2018. Activity discontinued as per #8.
13. Presented at each of the following conferences in Fall 2018: Annual Meeting of the Entomological Society of Ontario, Ontario Pest Management Conference, Joint Annual Meeting of the Entomological Societies of America and Canada (won President's Prize for Best Oral Presentation).
14. Elucidate environmental conditions under which swede midge can reach economically damaging populations and become an economic pest in a new area of invasion.
  - The updated MidgEmerge model was used to compare data from a region with very high

populations (i.e., outbreak conditions, Timiskaming, ON) with that of lower populations (i.e., non-outbreak conditions, southern Ontario), for climatic similarities and differences that may help to identify factors contributing to high population growth and severe economic impacts.

- Other factors (e.g. crop rotation) contributing to outbreaks have been identified.

#### 16. Thesis writing, manuscript writing, and thesis defense.

- Thesis writing and thesis defense was completed in April 2019.
- One manuscript has been published in the Journal of Economic Entomology, and 2 more are in preparation.

#### Major issues

Activity removed action due to insufficient data and/or time constraints:

15. Additional activities to enhance utility of model for integrated pest management purposes may be added, depending upon progress with previous activities and time remaining in program.

Potential additional activities include:

- Run multi-year scenarios to examine impact of different proportions of canola in the landscape on swede midge populations. This information could be used to predict optimum rotation to maintain swede midge populations below manageable levels in northern Ontario.
- Incorporation of mortality by parasitoids into model to assess the required parasitoid population densities and parasitism rates of parasitoids.
- Possible investigation of the cumulative average growth index (obtained from Dymex model) from first record to economic damage in initial area of invasion and comparison with cumulative average growth indices in areas of subsequent economic damage (e.g., northern Ontario, Quebec, Vermont) and in new areas of invasion (Saskatchewan, Manitoba, Alberta).

#### **4. Significant Accomplishments**

- Made significant revisions to and completed the MidgEmerge II model
- Completed and submitted MSc thesis and successfully defended
- Published 1<sup>st</sup> research paper on swede midge temperature-dependent development in Ontario in Journal of Economic Entomology
- 2<sup>nd</sup> research paper on MidgEmergell model is completed and in final editing stages. It will be submitted to the Bulletin of Entomological Research
- Completed the introduction, methods, and results for 3<sup>rd</sup> research paper on swede midge outbreak in new areas of introduction; completed assessment of model performance for northern Ontario midge populations and elucidated environmental conditions under which swede midge will reach economically damaging populations

#### **5. Research and Action Plans**

- 3<sup>rd</sup> research paper on swede midge outbreak is in the final stages of completion and will be completed by the end of the first week of September
- Paper editing and submission of 2<sup>nd</sup> and 3<sup>rd</sup> research papers to follow in the next month

#### **6. Final Project Budget and Financial Reporting**

Please note that official final financial reporting can only be generated by UofG Research Financial Services, and is typically done at least a month after the project end date. Thus, the budget reported here is an unofficial budget summary and is subject to change.

<u>Budget Category</u>	<u>Total Expenses</u>
Personnel	\$ 60,000
Travel	\$ 3,800
Operating	\$ 700
Indirect costs	\$ 1,500
TOTAL	\$ 66,000

**Please forward an electronic copy of this completed document to:**

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