Enhanced Modelling of Swede Midge Population Dynamics in North America

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Swede midge has been an economically significant pest of Brassica crops in ON, QB, NS, and PEI since 2000. An insect with swede midge like appearance has also been observed in SK and MB since 2007 and 2008. This pest could become an emerging issue for major canola production regions in western Canada. Since the development of the initial "MidgEmerge" model in 2009, new knowledge has been gained on factors that affect swede midge population dynamics. An updated model with new parameters can allow more accurate predictions for different regional conditions and populations of swede midge, and this will enable better informed decisions on pest management timing and crop rotations. A three-year study conducted by the University of Guelph and AAFC researchers revised the existing model "MidgEmerge" and developed a more accurate prediction model "MidgEmergeII". Research data indicated that when a high number of adults coincided with days of high temperatures, egg laying would increase and result in higher damage levels in the current year and outbreak-level populations of adults in the subsequent year.

Key words: revision, modelling, swede midge, population dynamics, North America

Swede midge (*Contarinia nasturtii*) has been an economically significant pest of Brassica crops in Ontario, Quebec, Nova Scotia, and Prince Edward Island since 2000. An insect with swede midge like appearance has also been observed in Saskatchewan and Manitoba since 2007 and 2008; this pest, has since been identified as a separate species known as the Canola Flower Midge, could become an emerging issue for major canola production regions in western Canada. The initial "MidgEmerge" model was developed in 2009 to predict swede midge emergence peaks based on 2008 and 2009 field data in Ontario and Quebec. Since this time, new knowledge has been gained on factors that affect swede midge population dynamics including oviposition rates on canola, day-length associated diapause entry rates and termination, overwintering survival, multi-year diapause, temperature-based mortality rates, predator and parasitism rates, and insecticide-based mortality rates. By accounting for these parameters, the updated model is now more accurate for different regional conditions and populations of swede midge, and this will allow better informed decisions on pest management timing and crop rotations.

This three-year study was initiated by the University of Guelph and Agriculture and Agri-Food Canada researchers to: (1) generate temperature-dependent development and mortality data for Ontario populations of swede midge, (2) revise an existing swede midge life cycle model "MidgEmerge" with information gained from temperature-dependent development and mortality, and (3) utilize the new model "MidgEmergeII" to determine climatic contributors to swede midge outbreaks in its invaded range.
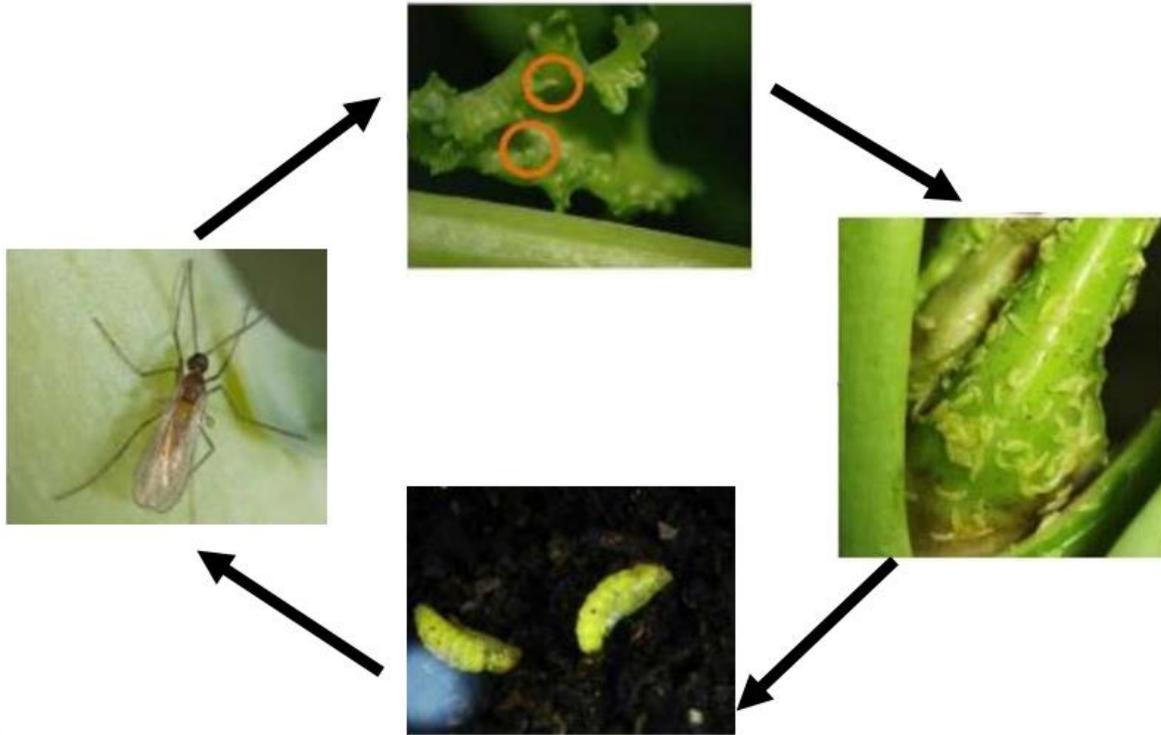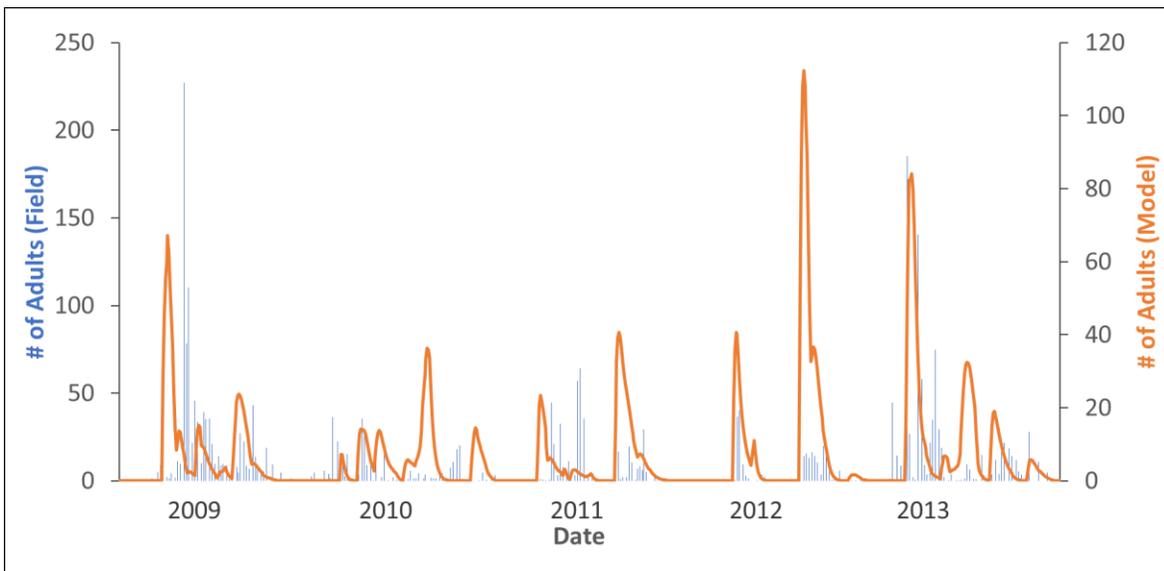
Swede midge development

Temperature-dependent development and mortality rates were determined for all swede midge life stages. This information, and robust adult count field data, were used to re-parameterize MidgEmerge in order to develop MidgEmergeII. Egg and larval development times were found to differ between Ontario and UK populations. The re-developed MidgEmergeII model more accurately predicted swede midge population dynamics in various southern Ontario locations. Results indicate that there are three swede midge emergence phenotypes and two to three generations per year in Ontario, in contrast to the previous model. MidgEmergeII was then run with weather data from Ontario sites that experienced swede midge outbreaks and compared with those that did not. It was found that when a high number of adults coincided with days of high temperatures, egg laying would increase and result in higher damage levels in the current year and outbreak-level populations of adults in the subsequent year. These findings have implications for swede midge management in its invasive range.
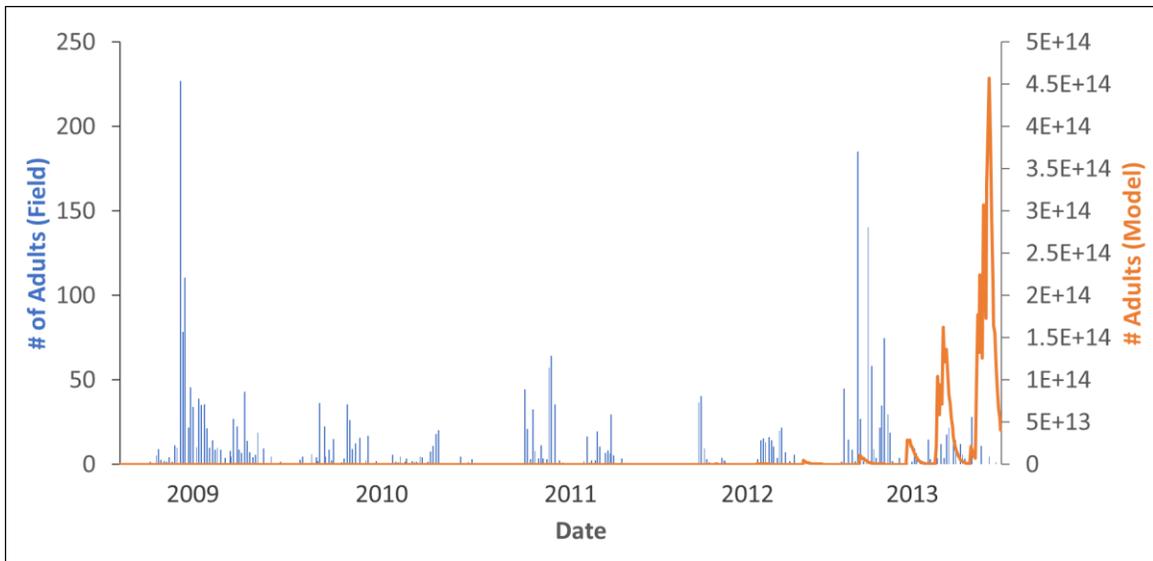
Number of adults predicted by the original MidgEmerge model (orange) compared to adult numbers from field traps (blue).

Number of adults predicted by an updated MidgEmergeII model (orange) compared to adult numbers from field traps (blue).

Overall, this research made significant revisions to the pre-existing swede midge model "MidgEmerge" and developed the updated model "MidgEmergeII" for more accurately predicting swede midge populations dynamics as influenced by environmental and mortality parameters.

Note:
A follow up study "Assessing the Impact of *Contarinia sp.* on Canola Production Across the Prairies" was initiated in 2017 by researchers at Agriculture and Agri-Food Canada. According to this research, the insect species observed in Saskatchewan and Manitoba since 2007 and 2008 was mis-identified as swede midge; actually, it is a new species of midge, *Contarinia brassicola* Sinclair, now commonly named the Canola Flower Midge. This research also confirmed that there are presently no established populations of swede midge on Canadian prairies, but is example of our proactive approach towards a new potential threat. If swede midge areas were to expand into the prairies, we have significant expertise and background knowledge available to assist us with management.

Two follow up studies on canola flower midge were co-funded by SaskCanola and Alberta Canola in 2017. Results of these studies can be found on SaskCanola's website:

[Canola Flower Midge - Assessing Impact on Canola Production](#)

[Canola Flower Midge - Pheromone Monitoring System](#)