UNIVERSITY of GUELPH

ONTARIO AGRICULTURAL COLLEGE

SCHOOL OF ENVIRONMENTAL SCIENCES

SWEDE MIDGE RESEARCH 2019 PROGRAM UPDATE

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COMPLETED PROJECTS:

Pheromone-based technologies for management of the swede midge in Brassica crops

Funding: OMAFRA-UofG Program, 2016-2019.

Graduate Student: Matthew Muzzatti, MSc completed April 2019.

Major Findings:

- A pheromone-based action threshold for swede midge, *Contarinia nasturtii* (Kieffer), in canola, *Brassica napus* L., was developed through a series of laboratory experiments and action threshold field plot trials.
- In laboratory trials, evidence of compensation by canola in response to herbivory was discovered. Compensation occurred through increased production of 2° and 3° racemes and pods, and was maximized with exposure of 4.5 – 6.1 midge per plant. However, in the field, swede midge infestation leads to variability in maturation timing and complications at harvest.
- A pooled analysis of multiple field plot trials indicated that using an action threshold to time insecticide applications can be economical and effective, and that Matador® 120EC alone was more effective than Coragen® in alternation with Matador® 120EC. However, reliance on a single insecticide presents a significant risk for resistance development.
- The recommended pheromone-based action threshold protocol for swede midge in canola is now: an initial application of Coragen® after a cumulative trap capture of 20 midges across all traps, and then subsequent applications of Matador® 120EC whenever the threshold of ≥3 males/trap/day is reached, with a minimum 7-day interval between applications.

Enhanced modelling of swede midge population dynamics in North America

Funding: Canola Council of Canada, CARP Program, 2016-2019.

Graduate Student: Jenny Liu, MSc completed April 2019.

Major Findings:

- Temperature-dependent development and mortality rates were determined for all life stages of Ontario populations. Egg and larval development times were found to differ between Ontario and UK populations.

- MidgEmergeII: an improved population dynamics model for swede midge. A preliminary model of the swede midge life cycle, entitled MidgEmerge was created (Hallett et al. 2009a), but did not accurately predict population dynamics for fields that were not part of the study. New temperature-dependent development and mortality information, as well as diapause induction information, were incorporated into the model. The re-developed MidgEmergeII model accurately predicted *C. nasturtii* population dynamics in various southern Ontario locations. Results indicate that there are 3 *C. nasturtii* emergence phenotypes and 2-3 generations in Ontario, in contrast to the previous model (which estimated 4-5 generations). These findings have implications for *C. nasturtii* management in its invasive range.
- The outbreaks of swede midge in Timiskaming appear to be a result of high canola acreages rather than due to environmental conditions in the region.

Publications:

- Liu, J., Mori, B.A., Olfert, O., and R. H. Hallett. 2019. Determining temperature-dependent development and mortality parameters of the swede midge (*Contarinia nasturtii*) (Diptera: Cecidomyiidae). *Journal of Economic Entomology*, 112(4): 1665–1675, https://doi.org/10.1093/jee/toz095.
- Liu, J., Weiss, R., Mori, B.A., Olfert, O., and R. H. Hallett. Re-developing MidgEmerge, a population dynamics model for Canadian populations of the invasive swede midge (*Contarinia nasturtii*) (Diptera: Cecidomyiidae). In preparation.

ONGOING PROJECTS:

Improved management of swede midge with biological and chemical control tactics

Funding: OMAFRA-UofG Program, 2017-2020

OCGA, Bayer, Bunge

Collaborators: Meghan Moran - *Synopeas myles* survey.

Meghan Moran & Jason Deveau - Optimizing insecticide application protocols.

Graduate Students:

Charles-Etienne Ferland - *Synopeas myles* distribution and abundance; MSc in progress, anticipated completion Dec 2019.

Carol McLennan – Factors affecting *Synopeas myles* abundance, including insecticide susceptibility; MSc in progress, started January 2019.

Occurrence of swede midge and evaluation of potential control mechanisms in canola production in Ontario and Québec

Funding: Eastern Canada Oilseeds Development Alliance (ECODA), AAFC Canadian Agricultural Partnership, 2018-2023. (Leveraged contributing funds from OCGA, Bayer, Bunge).

Collaborators: Sebastien Boquel and Charles-Etienne Ferland (CEROM).

RECENT FINDINGS:

Charles-Etienne Ferland - *Synopeas myles* distribution and abundance

(Provincial survey, weekly field studies, and survival and fecundity studies)

- *S. myles* was found at 37 of the 60 sites sampled over the 3 years of the study (2016, 2017, 2018). *S. myles* was widespread across Ontario, from Shelburne (southernmost positive site) to Timmins (northernmost positive site), and from the Bruce Peninsula (westernmost positive site) to Arnprior (easternmost positive site).
- A total of 7,396 *S. myles* and 71,117 *C. nasturtii* were collected. The average parasitism rate was 6.36 ± 1.02% (based on parasitism rates of all sites and positive *S. myles* sampling events). The highest parasitism rates (up to 31%) were generally found in Dufferin, Temiskaming, Cochrane, West Nipissing, and Renfrew Counties.
- Adult *S. myles* were found emerging from *C. nasturtii* between June 23 and September 11 in provincial survey samples. In weekly sampling sites (near Shelburne), adult emergence of adult S. myles emergence occurred between July 20 and August 29. Based on approximate *S. myles* development times (19-30 days), the overwintering generation of *S. myles* likely emerges and begins parasitizing swede midge larvae in mid-June in central Ontario.
- Parasitoid survival is often enhanced by the presence of flowering plants that can provide a source of nectar to adult wasps. Lab studies examining the effect of the presence of sweet alyssum flowers and sugar solution on survival and fecundity were conducted in summer-fall 2019. Both male and female *S. myles* have a significantly higher probability of surviving longer if they have access to a sugar source. Maximum survival of females was 11-12 days in the presence of sweet alyssum flowers or a sugar solution compared to <6 days in the control.

Carol McLennan – Factors affecting *Synopeas myles* abundance, including insecticide susceptibility

(Insecticide susceptibility, Synopeas myles rearing, Sweet alyssum studies)

- Contact and 24 hr residual exposure experiments were conducted using field-collected *S. myles*. Coragen, Movento, and Matador were each evaluated at ½, full and 2x field rates (mL/ha). Distilled water was applied as a control treatment.
- Matador killed 100% of *S. myles* adults at half, full and double rates in both residual and contact experiments. Coragen and Movento caused <10% mortality at all rates in both the contact and residual experiments, except for the double rate of Movento which caused ~20% mortality in the contact experiment.
- In order to protect *S. myles*, use of Matador could be restricted to the early season before *S. myles* is present in mid-June.
- Future research could explore residual toxicity at longer time periods, and sublethal effects that commonly applied insecticides may have on *S. myles*. Further investigation of insecticide susceptibility will assist in developing insecticide programs that prevent harm to *S. myles*.