

## **Prairie Pest Monitoring Network Project Report, 2023-2024**

**Project Title:** Insect response to climate change and ag-inputs across the prairies

**ADF Project Number:** 20220112

**Project Leads:** Meghan Vankosky (AAFC-Saskatoon), Jennifer Otani (AAFC-Beaverlodge Research Farm), Boyd Mori (University of Alberta)

### **Executive Summary**

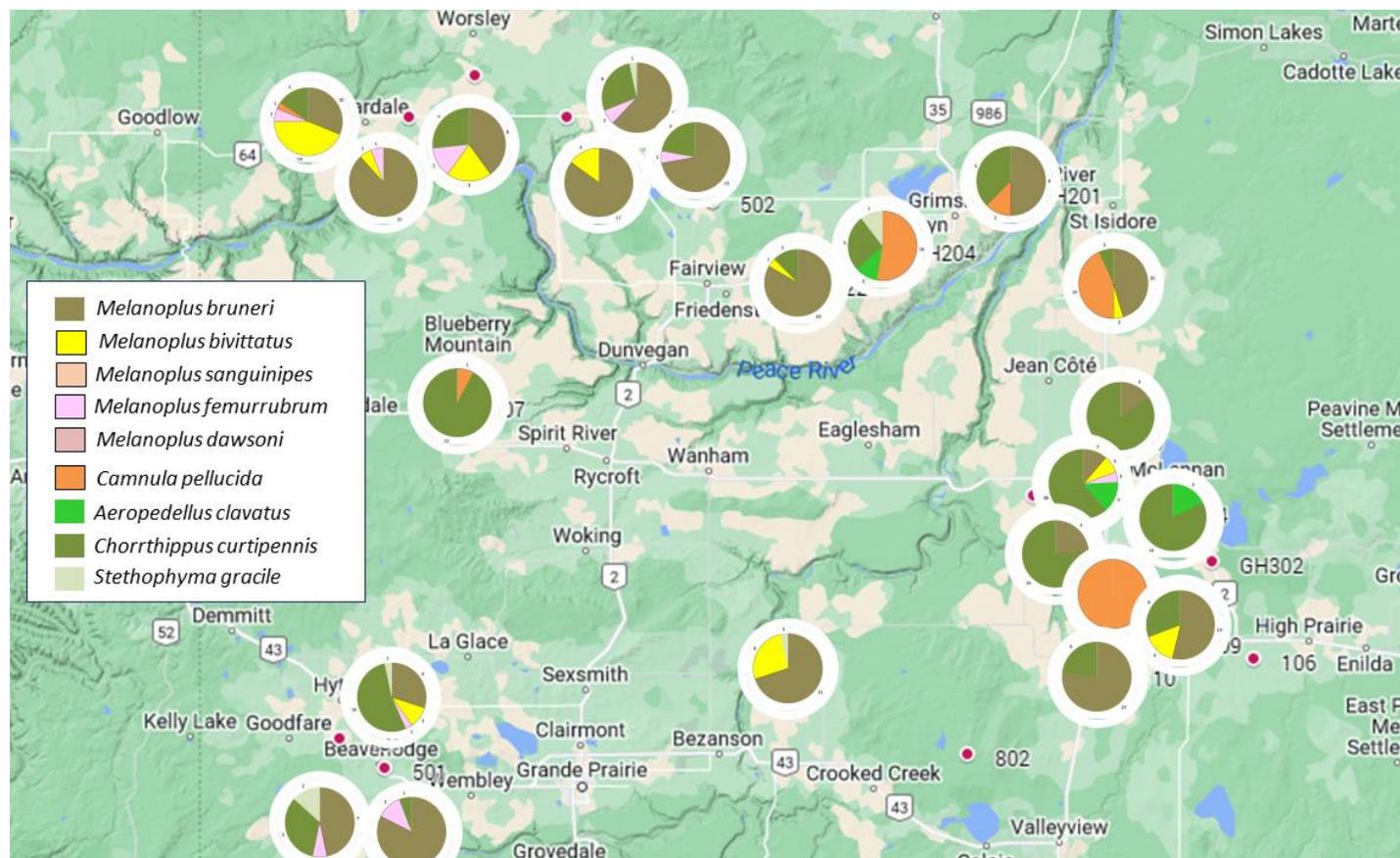
The Prairie Pest Monitoring Network conducts annual monitoring for insect pest populations and conducts research to understand the impact of climate and agricultural inputs on insect population dynamics and pest management. In the first year of the current project, “Insect response to climate change and ag-inputs across the prairies” (April 2023-March 2024), project collaborators from across western Canada contributed to annual monitoring of cabbage seedpod weevil, pea leaf weevil, diamondback moth, bertha armyworm, grasshoppers, wheat midge and wheat stem sawfly. We used models to predict in-season development of insect pest populations and mapped model and monitoring results, which are available online at <https://prairiepest.ca>. We also started work to meet two primary research objectives: 1) to study the impact of climate on insect pest biology and population dynamics, and 2) to evaluate the current status of insecticide resistance in populations of cabbage seedpod weevil, pea leaf weevil, and diamondback moth. Our focus in the first year of the project was to test the research methodology and begin collecting data to address these research objectives and these goals were met. Annual insect monitoring in 2023 revealed that insect pest species that thrive in drought conditions (warm, dry weather) continue to increase in density and could pose a serious risk to crop production in 2024, unless the weather patterns change. Other insect pest species have shifted their geographic distribution in response to growing season weather over the past 5-10 years and insects that thrive in wetter conditions currently persist in low population densities across western Canada.

### **Project Objectives**

1. Understand insect pest population dynamics and forecast pest populations
  - a. Conduct laboratory and field experiments to understand the impact of climate and biotic factors on insect population dynamics, for insects including pea leaf weevil, cabbage seedpod weevil, and Bruner’s grasshopper
  - b. Conduct annual monitoring for key insect pests of prairie field crops, using standardized protocols; use maps to visualize insect distribution and density across the prairie region
  - c. Develop and validate new models and refine existing predictive models.
2. Assess the current status of insecticide resistance in western Canada for insect pests including diamondback moth, pea leaf weevil, and cabbage seedpod weevil
  - a. Collect live specimens from the field and conduct laboratory bioassays to determine the current susceptibility of insect populations to registered insecticides
  - b. Evaluate the current risk of insecticide resistance development in populations of insect pests of prairie field crops
  - c. Incorporate insecticide resistance information into risk/forecast maps for insect pests on the prairies
3. Develop new insect information resources

**Results by Objective: Year 1**

**Objective 1a.** Laboratory research to study the impact of soil moisture on the population dynamics of cabbage seedpod weevil and pea leaf weevil are due to start in Year 2 of the project. Sampling was initiated in Year 1 to better understand grasshopper biology and species composition in the Peace River region, including of Bruner’s grasshopper. First, grasshopper development was monitored from May to August at sentinel sites; adult Bruner’s grasshopper were first observed on 8 June 2023. In August, sentinel sites with the highest grasshopper densities were revisited and sampled to collect adults for identification. These adults were used to determine the species composition of grasshoppers across the Peace River region (Figure 1). Bruner’s grasshopper was present at many sentinel sites, and was dominant at some. Other prominent grasshopper species included the two-striped grasshopper and the clear-winged grasshopper. In late fall, grasshopper eggs were sampled and will be used to estimate the stage of embryonic development of the eggs before winter.

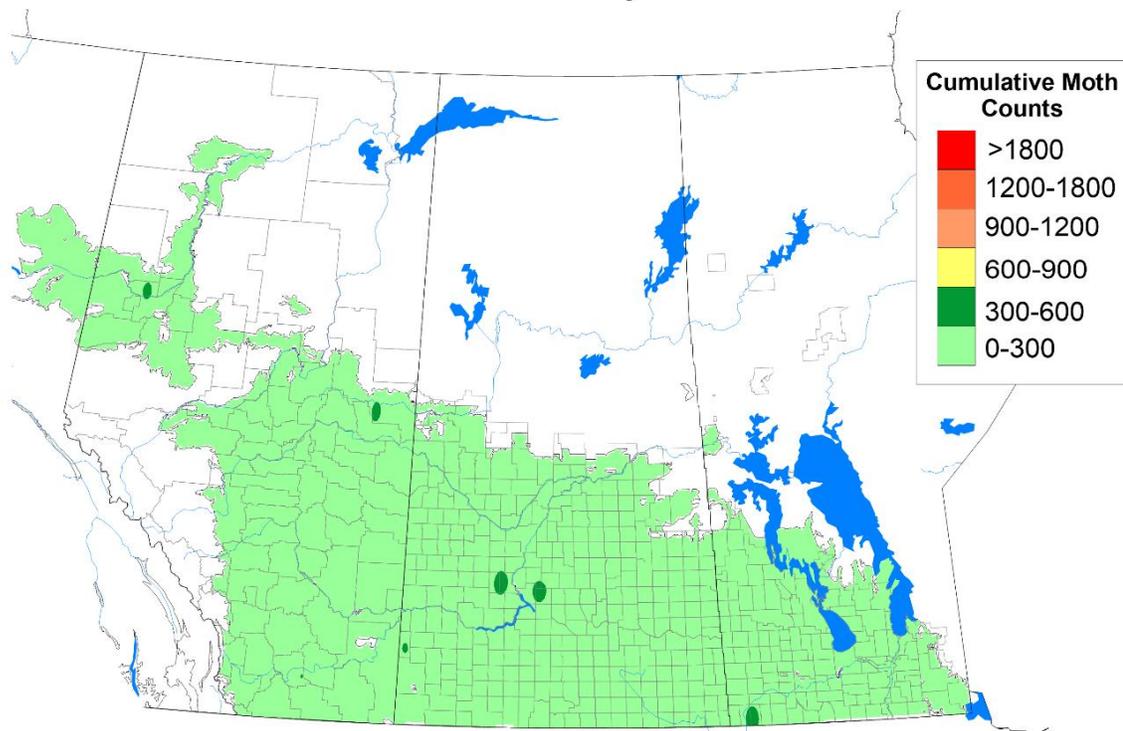


**Figure 1.** Relative proportion of grasshopper species in samples of adult grasshoppers collected in August 2023 at “high” population sites (i.e., >15 adults per metre<sup>2</sup> and >15 adults per 25 sweeps) across the Peace River region. Map developed by Jennifer Otani, AAFC-Beaverlodge.

**Objective 1b.** Annual monitoring and survey activities were conducted across the prairie region, following standardized protocols available from the Prairie Pest Monitoring Network (<https://prairiepest.ca>) in summer and fall 2023. Species surveyed included bertha armyworm (n=661

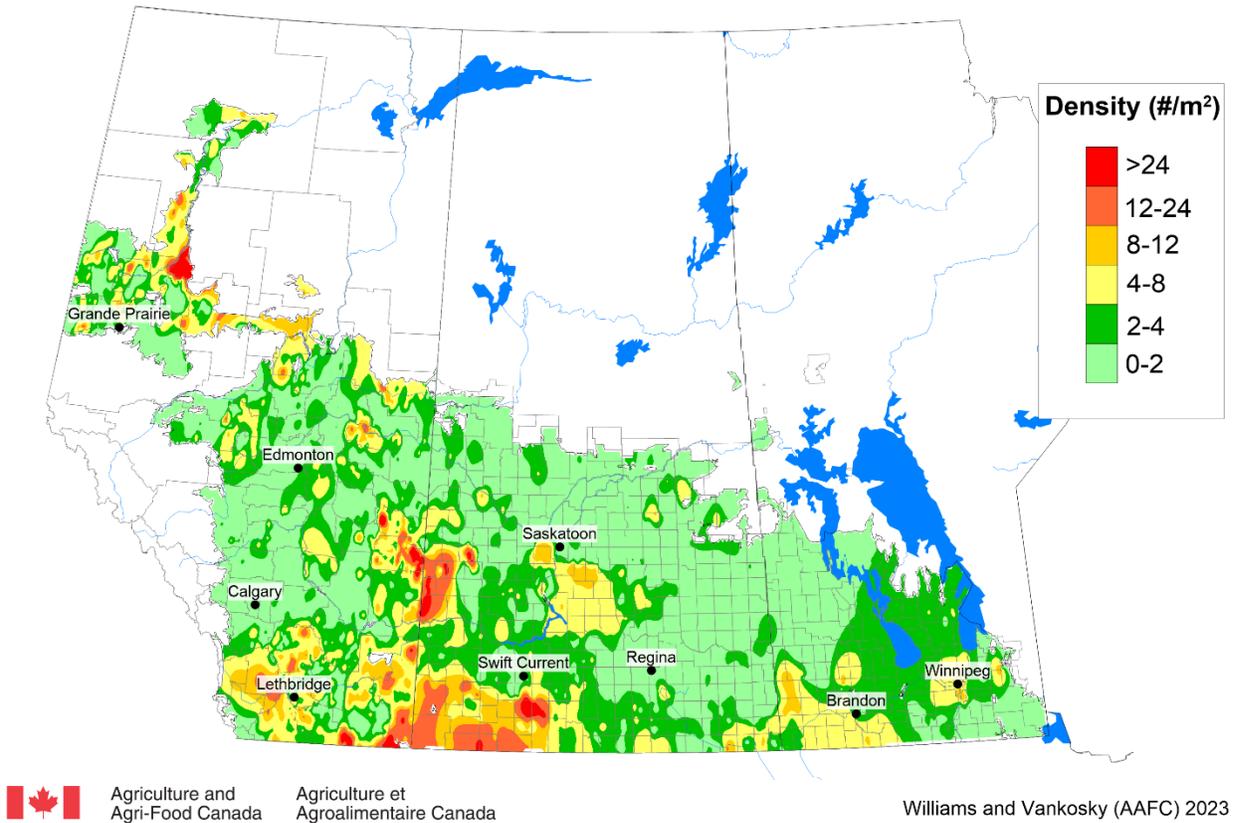
sample points), cabbage seedpod weevil (n=578), diamondback moth (n=181), pea leaf weevil (n=449), wheat midge (n=602), grasshoppers (n=3191) and wheat stem sawfly (n=87, AB sites only). Overall, the Prairie Pest Monitoring Network team members and volunteer collaborators collected insect monitoring data from 5,749 locations across the prairie region in 2023. All of the survey data was mapped for the insects that were monitored (Figures 2-7, below). A pheromone-trap survey for swede midge was also supported by the Prairie Pest Monitoring Network in 2023; no swede midge were detected in any of the traps deployed in 2023. All of the maps resulting from the 2023 field season are now available online from <https://prairiepest.ca>.

### Bertha armyworm 2023 Survey



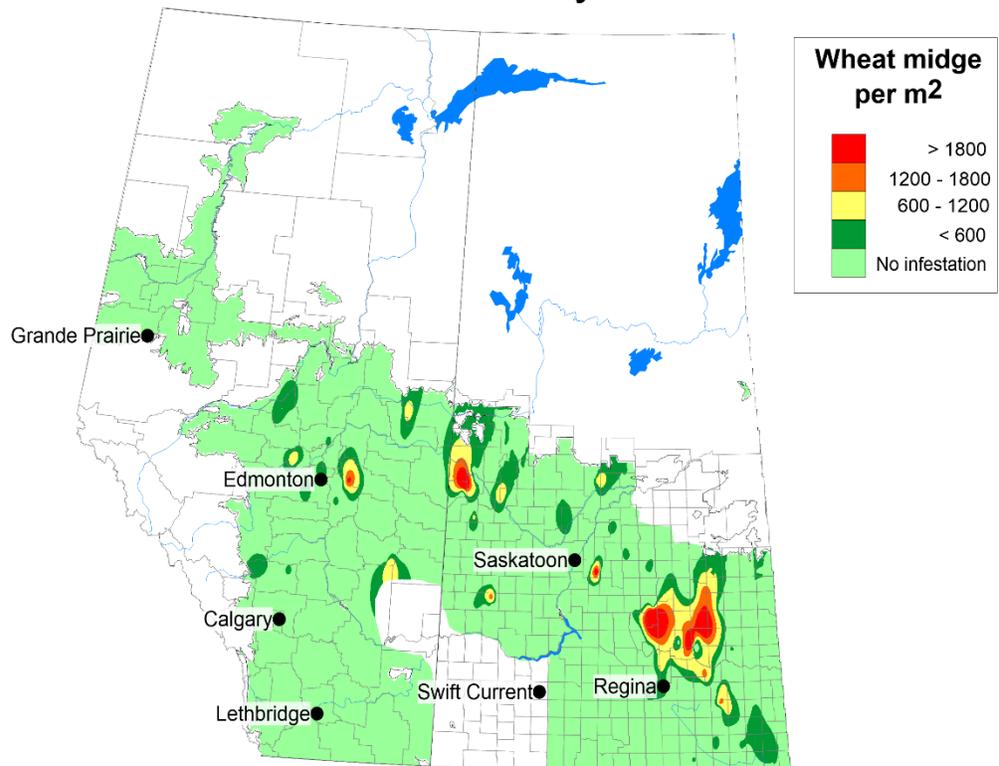
**Figure 2.** The cumulative trap catch of adult male bertha armyworm (*Mamestra configurata*) in pheromone-baited traps across the prairies in 2023 (map by Jon Williams, AAFC-Saskatoon).

### Grasshopper 2023 Survey



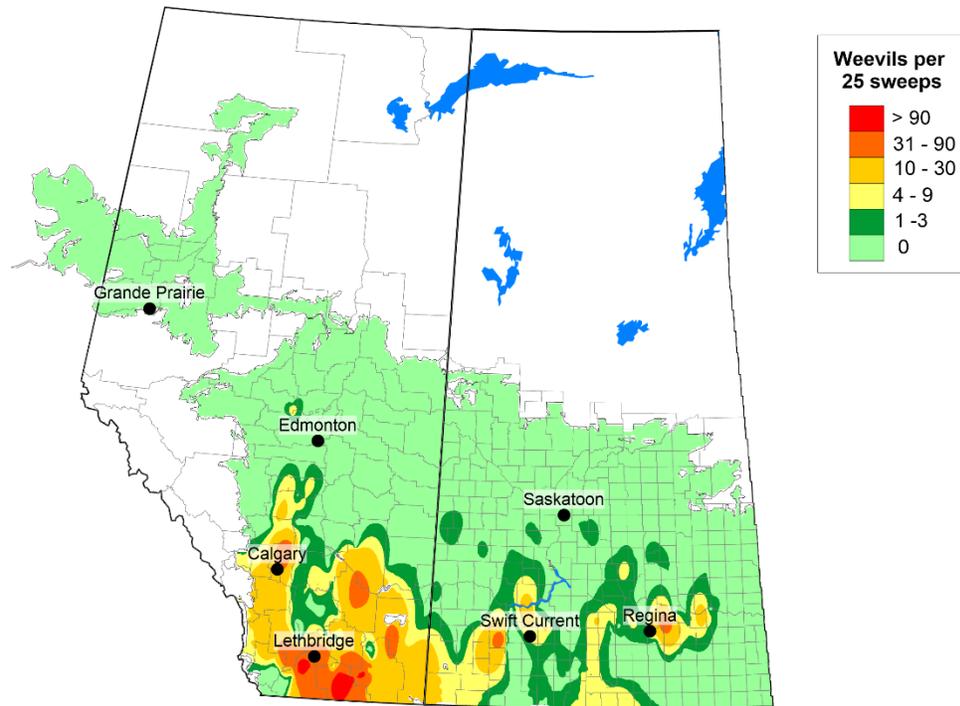
**Figure 3.** Estimated grasshopper population densities in late summer and early fall 2023 in western Canada; areas with high grasshopper densities in 2023 are at risk of high grasshopper densities and associated damage in 2024, based on knowledge of the life history of the primary pest species, including *Melanoplus sanguinipes* (migratory grasshopper) (map by Jon Williams, AAFC-Saskatoon).

## Wheat midge 2023 Survey



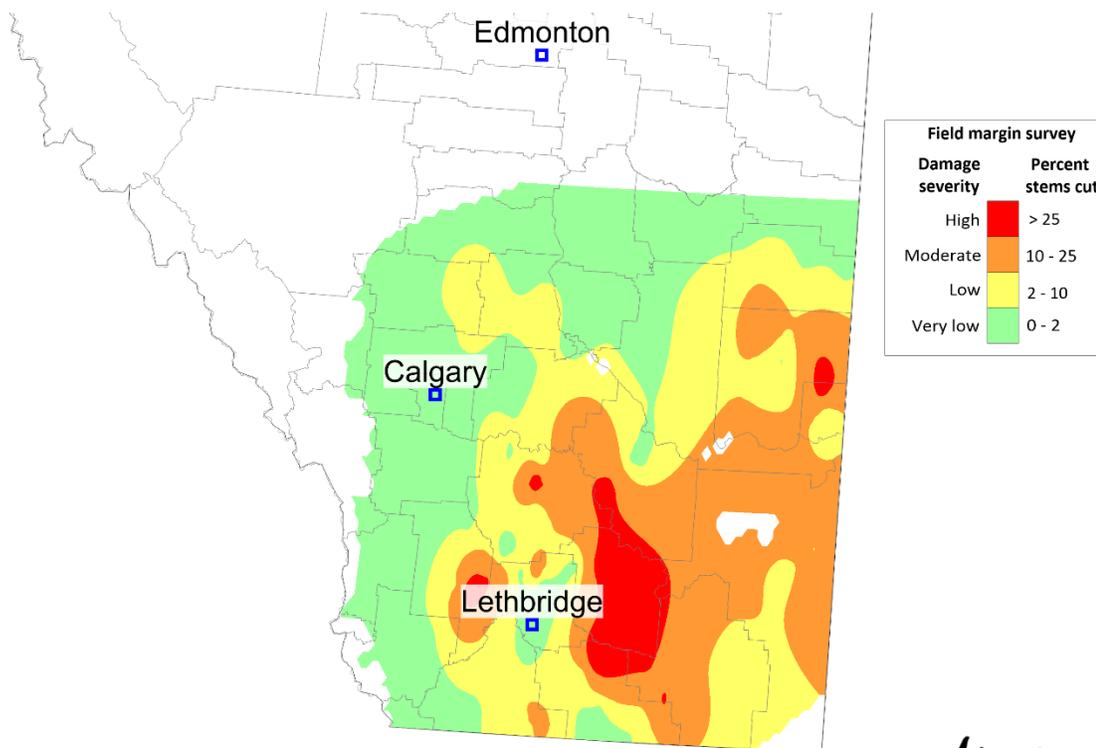
**Figure 4.** The densities of unparasitized wheat midge (*Sitodiplosis mosellana*) cocoons in soil samples collected in fall 2023 during the annual wheat midge survey. Risk of wheat midge damage to wheat in 2024 will depend on spring weather conditions but farmers should be especially vigilant in areas of the prairies where wheat midge larval cocoon densities exceeded 600 midge/m<sup>2</sup> during the fall 2023 survey. White areas on the map were not sampled in 2023 and only irrigated fields in southern Alberta were sampled in 2023. Also note that all regions where wheat midge have occurred in the past could be at risk of wheat midge damage in 2024 if it is a wet spring because wheat midge larval cocoons can survive in the soil for multiple years (map by Jon Williams, AAFC-Saskatoon).

### Cabbage Seedpod Weevil 2023 Survey



**Figure 5.** Cabbage seedpod weevil (*Ceutorhynchus obstrictus*) distribution in Saskatchewan and Alberta based on a sweep net survey conducted in *Brassica* sp. fields in 2023. No cabbage seedpod weevil were detected in the Peace River region in 2023. Cabbage seedpod weevil is now present in Manitoba, but was found in very low numbers in only a few fields in 2023 (map by Jon Williams, AAFC-Saskatoon).

# Wheat Stem Sawfly 2023 Survey



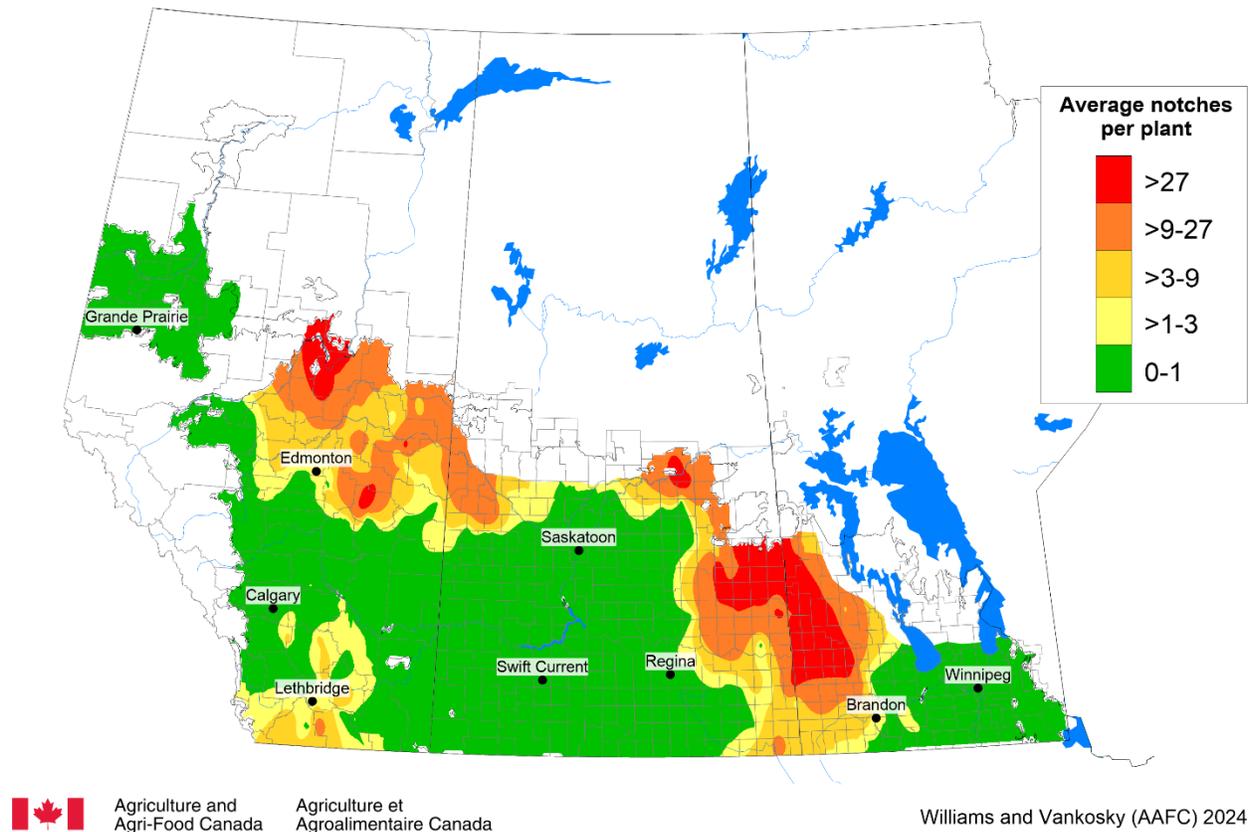
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**Figure 6.** Wheat stem sawfly (*Cephus cinctus*) distribution in Alberta in 2023 based on results of a survey of cut stems in wheat fields counted after harvest (map by Jon Williams, AAFC-Saskatoon).

## Pea Leaf Weevil 2023 Survey



**Figure 7.** The distribution of pea leaf weevil (*Sitona lineatus*) in Alberta, Saskatchewan, and Manitoba in 2023, based on a plant damage survey conducted in the spring in field pea crops (map by Jon Williams, AAFC-Saskatoon).

**Objective 1c.** In 2023, an updated bioclimatic model for cabbage seedpod weevil was completed. A manuscript to describe the development and validation of the updated cabbage seedpod weevil (and that describes the development of a model for canola) is currently being prepared for submission to a peer-reviewed journal.

**Objective 2a,b.** Insecticide resistance testing was conducted for cabbage seedpod weevils (collected from two sites in southern Alberta) and diamondback moth larvae (collected from three sites in central Alberta). Additional replicates of the insecticide resistance bioassays from the sites sampled in 2023 and from additional sites identified in Years 2 and 3 of this project are needed to ensure accuracy of the results. Future sampling and bioassays in 2024 and 2025 will benefit from lessons learned in 2023. Once more bioassays have been completed, then work will begin to address Objective 2c.

**Objective 3.** In 2023, the project continued to leverage existing Prairie Pest Monitoring Network information resources and published Weekly Updates (n=16) and Insect of the Week articles (n=16) throughout the growing season. A new information resource developed by the Canadian Plant Health Council was also publicized using the PPMN website and was featured in two Weekly Updates. The “Priority Insects” poster raises awareness of potentially invasive insects to western Canada, including several field crop pests. Prairie Pest Monitoring Network collaborators used Twitter/X to highlight observations made in the field in 2023 and other important insect information, and many project collaborators took part in the weekly Alberta Bug Chat (#abbugchat) conversation on Twitter/X.

Since 2019, we have been working with the Agri-Geomatics team at AAFC to contribute to the existing Crop Metrics and Story Maps tools that estimates crop yields based on seasonal weather. We continued this collaboration in 2023, focusing on insects including diamondback moth, wheat midge, and grasshoppers.

During the 2023 growing season, PPMN collaborators took pictures that will be used to develop a library of insect images. Work started to update monitoring protocols that were not updated between 2018-2022 and to translate some of the protocols to French. A new monitoring protocol for canola flower midge (*Contarinia brassicola*) was developed and included in a Weekly Update in 2023. Work will continue during the remainder of this project to enhance existing information tools and to build new information resources.

### **Interim Conclusions**

1. Project collaborators from across western Canada conducted annual surveys for pea leaf weevil, cabbage seedpod weevil, wheat stem sawfly, wheat midge, grasshoppers, bertha armyworm, diamondback moth and swede midge. Survey results are currently being mapped and prepared to post on the Prairie Pest Monitoring Network website (<https://prairiepest.ca>). Importantly, no cabbage seedpod weevil were detected in canola fields in the Peace River region and no swede midge were detected in pheromone traps set up across the prairies.
2. A refined bioclimate model for cabbage seedpod weevil and a new model for canola (its primary host plant) was developed and validated. A manuscript is currently being drafted for submission to a peer-reviewed journal.
3. Project collaborators contributed to 16 Weekly Update articles and 16 Insect of the Week articles during the growing season, attended outreach events, and were interviewed for media articles (news, magazines, radio). Grasshoppers were of particular interest in 2023 as grasshopper population densities continued to increase and more evidence of economic impacts related to grasshopper feeding were observed.
4. A new monitoring protocol for canola flower midge is now available and other protocols are being updated. The protocols will be translated to French during this project lifespan.
5. Issues with collections and insecticide resistance bioassays have been worked out, and new procedures will be implemented for bioassays moving forward.
6. 2023 marked the 20<sup>th</sup> year of the canola survey in the Peace River region, led by the IPM program at AAFC-Beaverlodge. The annual canola survey monitors pest and beneficial insect populations in early-flowering canola. To date, the cabbage seedpod weevil has not expanded its geographic distribution in Alberta into the Peace River region.