Monitoring, forecasting, risk warning systems for field crop insects in the Canadian prairie ecoregion

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Poster number : 26

Introduction

- The Prairie Ecoregion contains a large expanse of cultivated land; about **29 million hectares of crop are planted each growing season**. Insect pest outbreaks are periodic/cyclical in nature.
- Production risks from insect pest outbreaks can be minimized through a **coordinated monitoring program that provides decision-support to the agriculture industry** in a timely manner.
- Monitoring of beneficial organisms is critical to their conservation and to the development of reduced-risk strategies for management of pest species.
- Climate change, new agronomic practices and new crops affect pest populations and diversity of beneficial arthropods.
- **Knowledge and tools to monitor field crop insects assist the agriculture industry in the mitigation of threats against crop production and environmental health of prairie agro-ecosystems**.

Objectives

The **Prairie Pest Monitoring Network** is an area-wide, coordinated program designed to keep the Canadian agriculture industry informed of crop production risks from pest species and to highlight and conserve their natural enemies. The objectives are to:

- develop and implement standardized monitoring protocols,
- develop populations forecasts and risk warnings for major insect pests,
- develop population database and analyze factors influencing arthropod populations,
- develop tech-transfer tools to efficiently relay field crop insect pest risk and research-based management techniques.

Pests

- Bertha armyworm (*Mamestra configurata*)
- Cabbage seedpod weevil (*Ceutorhynchus obstrictus*)
- Cereal leaf beetle (*Oulema melanopus*)
- Diamondback moth (*Plutella xylostella*)
- Grasshoppers (Acrididae)
- Lygus bug (*Lygus* spp.)
- Pea leaf weevil (*Sitona lineatus*)
- Swede midge (*Contarinia nasturtii*)
- Wheat midge (*Sitodiplosis mosellana*)
- Wheat stem sawfly (*Cephus cinctus*)

Natural enemies

Macroglenes penetrans wheat midge parasitoid

Diadegma insulare diamondback moth parasitoid

Tetrastichus julis cereal leaf beetle parasitoid

Entomophthora sp. grasshopper disease

Peristenus digoneutis lygus bug parasitoid

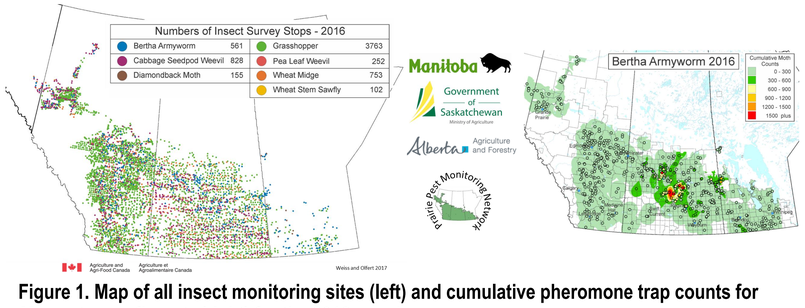

Figure 1. Map of all insect monitoring sites (left) and cumulative pheromone trap counts for *Mamestra configurata* (right) for the 2016 growing season.

Methods

- Wind trajectory model output and sentinel pheromone traps (diamondback moth)
- Area-wide network of pheromone traps (bertha armyworm, wheat midge)
- Plant damage assessments (pea leaf weevil, cereal leaf beetle, wheat stem sawfly)
- Sweep-net samples (adult cabbage seedpod weevil, lygus bugs)
- Area samples (adult grasshoppers)
- Soil core analysis (overwintering wheat midge larvae)
- Spatial analysis systems (map formatted phenology models and insect distribution/density)
- Bioclimate models (assess potential establishment of pests and natural enemies)

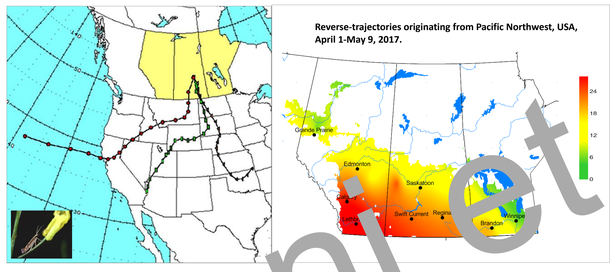

Figure 2. Long-range wind movements during 30 wind trajectory model identify potential *Plutella xylostella* introductions (left) used to produce reverse-trajectory map summaries.

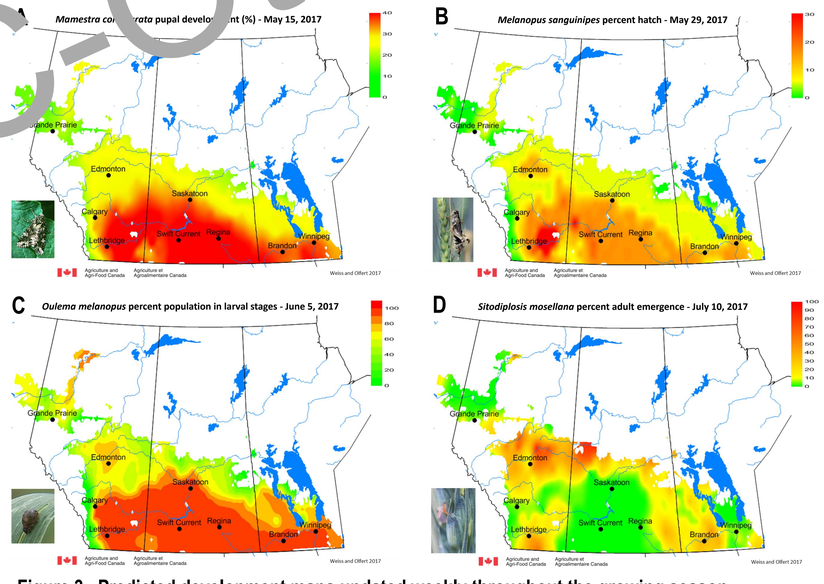

Figure 3. Predicted development maps updated weekly throughout the growing season supporting in-field deployment of *Mamestra configurata* pheromone trap deployment (A); in-field scouting for *Melanoplus sanguinipes* nymphs (B); in-field scouting for *Oulema melanopus* larvae (C); in-field scouting for *Sitodiplosis mosellana* adults (D) across the Canadian prairies.

Results: Research-Based Information and Updates

- Standardized monitoring protocols developed and implemented (Western Forum 2014; Prairie Pest Monitoring Network Blog 2017).
- Timely risk warnings in map format (provincial and regional) with interpretive text and published on internet sites, in agricultural publications, presented at agricultural trade shows (Western Forum 2014; PPMN Blog 2017).
- Bioclimate models described potential distribution and relative abundance of pest and beneficial species (Haye et al. 2012).
- Monitoring of beneficial organisms contributed to conservation and to development of reduced-risk strategies (Olfert et al. 2009).
- Industry informed of new or emerging pest problems in timely manner via Network participants and development of a Blog (PPMN Blog 2017).
- Bioclimate models incorporating environmental and biological data used to predict occurrence of pest and natural enemy stages then summarized into Weekly Update e-bulletins also organized into Blog Posts to keep agricultural industry informed (PPMN Blog 2017).
- Publication of Identification and Management Field Guide to support arthropod monitoring and identification (Philip et al. 2015).

- ***Blog subscription for updates!***

Conclusions

The market impact of successful implementation of this project contributed to preserving and enhancing the economic and environmental benefits of agro-ecosystems in western Canada. Producers, who were able to minimize agricultural input costs, and minimize environmental impacts, are more viable and competitive in the agricultural marketplace. There are few constraints to adoption of these technologies.

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***Acknowledgements*: Thanks to provincial and industry co-operators for their support and monitoring efforts! Thank you to David Giffen, Ross Weiss and our AAFC staff who contribute to the Network's ongoing monitoring, mapping and database development. Thank you to the many field crop insects who keep us busy!**