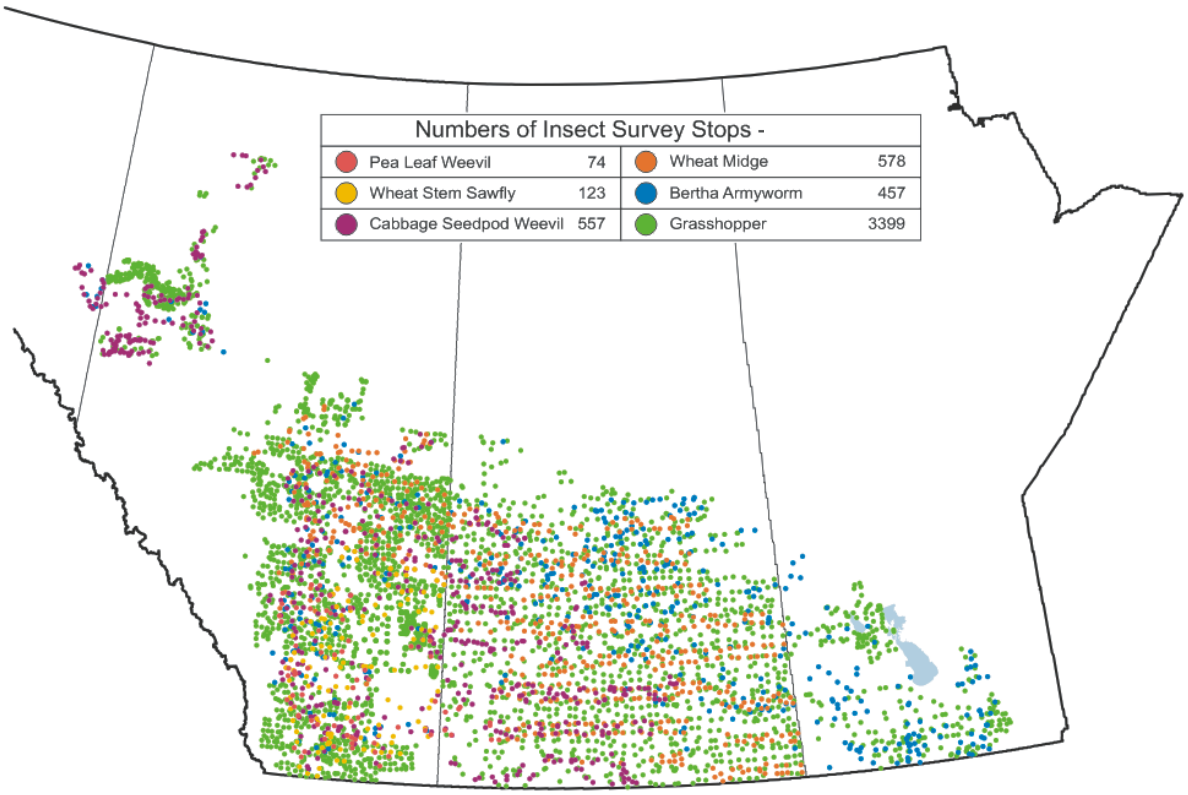
PROJECT DETAILS

- **Title**: Development of reduced-risk strategies through coordinated monitoring, forecasting and risk warning systems for insect pests of field crops
- **Funders:** Alberta Canola, Manitoba Canola Growers Association, and SaskCanola
- **Research program:** Canola Agronomic Research Program (CARP)
- **Principal investigator:** Owen Olfert, Agriculture and Agri-Food Canada (AAFC) Saskatoon and Jennifer Otani, Agriculture and Agri-Food Canada (AAFC) Beaverlodge
- **Collaborators/additional investigators:** Bob Elliot, Julie Soroka, Chrystel Olivier, Hector Carcamo, Peter Mason, Lloyd Dosdall, Scott Meers, Scott Hartley, John Gavloski, and Serge Trudel
- **Year completed:** 2012

Final report

Summary

A network of approximately 5000 insect pest monitoring sites were set up by the excellent team of collaborators across the Prairie Ecosystem again in 2012. These units included various types of traps (e.g. pheromone or sticky traps), specific to the 8 key pest species targeted in the study. Insect monitoring teams were established in respective provinces to coordinate the set-up of monitoring sites, training, data collection and tool delivery. Insect monitoring protocols were compiled to ensure that best monitoring practices were implemented to run the program. Near real-time weather information was obtained from Environment Canada on a weekly basis, and degree-days for the target pests were accumulated daily, and incorporated as part of the updates. Wind trajectories were analyzed to assist in predicting migration, and threat of, diamondback moth and leafhoppers from USA and Mexico to Canada. Moreover, potential new invasive species and their natural enemies were monitored and the risks/benefits were quantified.



All data relating to insect populations were compiled on a weekly basis during the growing season. The annual insect population data were directly incorporated into the insect population trend data base for analysis of factors influencing population increase and decrease. Spatial analysis systems were developed to accurately summarize the distribution and density of the pest populations. Technology transfer was in map format (prairie-wide, provincial and regional) accompanied with interpretive text. All insect forecast maps, risk warnings and weekly updates are compiled and posted on the Western Forum website: http://www.westernforum.org/IPMNMain.html

Near real-time weather was obtained from Environment Canada on a weekly basis, and degree-days for bertha armyworm, wheat midge and its parasitoid, grasshoppers and the West Nile mosquito were accumulated daily.

Find more information on this project and many other relevant canola studies on the Canola Research Hub.
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Spatial analysis systems were then used to transform weather data to a spatial format compatible with modeling insect population dynamics. Mathematical models for pest population establishment and growth were implemented on the basis of the near real-time weather data to develop risk warnings related to crop damage potential. The risk warnings were released at weekly intervals from May to the end of August, appropriate to the pest - crop situation.

A. Monitoring Activities and Results

a) *Bertha armyworm*. Collaborators monitored approximately 400 canola fields in Alberta, Saskatchewan, Manitoba and the BC Peace River in 2012 by installing pheromone traps in canola fields in mid-June and monitoring these traps through July to determine the time, distribution and density of adult flight. Environmental parameters were tracked throughout the growing season to quantify the accumulation of heat units required for moth emergence. Degree-day maps were provided on a timely basis to indicate regions of the prairies receiving enough heat units required for moth emergence. In addition, team members provided support and input into two new research initiatives related to BAW monitoring: (i) Erlandson et al. - : *Bertha armyworm: Genomics, population dynamics and biodiversity of pest and pathogens*; and (ii) Meers et al. - *Improving crop risk assessment tools for bertha armyworm*

b) *Diamondback moth*. About 75 sentinel sites were established annually across the prairies by installing pheromone traps in canola fields to determine the time, distribution and density of moth migrations from the USA and Mexico. Annual wind trajectory model output, purchased from Environment Canada, was analyzed on a daily basis beginning in April to assist in predicting moth migrations from southern USA and Mexico. Results from the sentinel sites and analysis of wind trajectories indicated that Diamondback moth threats to canola production initially were relatively significant in 2012, due to the early arrival of suitable wind currents in April. Fortunately, natural enemies reduced pest status.

c) *Cabbage Seedpod Weevil*. Canola fields were surveyed annually for the presence of weevil populations and their natural enemies. The number of fields surveyed was increased somewhat in 2012 due to the increased range of weevil populations. The range of weevil populations have continued to expand east and north during the span of this project. The northern extent of the weevil distribution appeared to have increased somewhat in 2012, with there were several new records of weevils well north of previous distribution (e.g. west of North Battleford).

d) *Wheat midge*. Approximately 600 wheat fields were sampled in fall of 2012 in Saskatchewan and Alberta to determine the distribution, density and rates of parasitism of midge cocoons in the soil. The samples are

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currently being analyzed. Environmental parameters were tracked throughout the growing season to quantify the accumulation of heat units required for adult midge and parasitoid emergence. Degree-day maps were provided to indicate regions of the prairies receiving enough heat units required for emergence of the pest to highlight areas of greatest and lowest risk to optimize pesticide intervention.

e) *Grasshoppers*. Approximately 3000 fields were surveyed in the fall of 2012 to estimate the population density, species composition and distribution of grasshoppers. Environmental parameters were tracked throughout the growing season to quantify the accumulation of heart units required for emergence of hatchling grasshoppers from overwintering eggs Degree-day maps were provided to identify areas of the region most at risk from grasshopper feeding. Just prior to freeze-up, grasshopper eggs were collected to quantify egg development (implications for spring hatch) and estimate the level of natural enemies.

f) *Pea leaf weevil*. This relatively new pest of European origin feeds on field peas and faba beans. It is common in pulse crops grown in north western USA and was first recorded in Alberta in 2000. In 2012, approximately 100 fields were surveyed to estimate risk of crop damage. The surveys indicated that the distribution of weevils had not altered significantly, however, crop damage levels were higher.

g) *Additional Pest Species*. (i) Leafhoppers (*Marcosteles* spp.). 2012 saw many field crops infected with Aster Yellows disease. The disease is caused by a phytoplasma that is transmitted by aster leafhoppers. Analyses of wind trajectories indicated that the sustained winds from southern USA and Mexico in early April, 2012, may have contributed to the high leafhopper population levels throughout the region. (ii) Cereal leaf beetle. Cereal leaf beetle (*Oulema melanopus*) is an alien invasive species native to Eurasia. This species was first discovered on the prairies in Alberta in 2005. Our survey of winter wheat in southwest Saskatchewan recorded very few adult specimens. However, new records for SK (Langenburg) and AB (south of Edmonton) were observed in 2012. (iii) Cutworms. Incidence of cutworm activity stabilized across the Prairie Ecozone in 2012. Symptoms of cutworm damage appeared in cereal and oilseed crops over an extended period during the summer, suggesting that the species complex may have expanded beyond the more common species (Redbacked; Pale Western; Dingy).

B. Risk Warnings Results

All data relating to insect populations were compiled on a weekly basis during the growing season. The annual insect population data were directly incorporated into the insect population trend data base for analysis of factors influencing population increase and decrease. Spatial analysis systems were developed to accurately summarize the distribution and density of the pest populations. Technology transfer was in map format

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(prairie-wide, provincial and regional) accompanied with interpretive text. Near real-time weather was obtained from Environment Canada on a weekly basis, and degree-days for bertha armyworm, wheat midge, grasshoppers and the West Nile mosquito were accumulated daily. Spatial analysis systems were then used to transform weather data to a spatial format compatible with modeling insect population dynamics. Mathematical models for pest population establishment and growth were implemented on the basis of the near real-time weather data to develop risk warnings related to crop damage potential. The risk warnings were released at weekly intervals from May to the end of August, appropriate to the pest - crop situation. Interest in early warning systems from other entomologists and plant pathologists continues to expand, the demand for wind trajectory data for invasive pests continued to grow in 2012. To date there are about 60 destination sites across Canada and 25 source sites in the US and Mexico that are assessed throughout the growing season every year. The daily wind trajectories are downloaded and compiled by the project team into a user-friendly database, allowing researchers both entomologists and plant pathologists across Canada to access timely reports for specific locations and pest species of interest.

Significant Accomplishments

This project has established a prairie-wide, coordinated insect monitoring program designed to keep the agriculture industry informed of the risks to crop production from pest species and to highlight/conserve their natural enemies. The production areas for field crops in Canada is extensive, especially the prairie eco-region that contains a large expanse of cultivated land; of the 71 million acres in crop, approximately 30 million acres of wheat and 11 million acres of canola are planted each growing season. When insect pest outbreaks occur in one area their impact is eventually felt across the entire region. A region-wide monitoring program is vital to keeping the agriculture industry informed of the risks to crop production from insect pests and the benefits of their natural enemies. Insect monitoring protocols were compiled and updated to ensure a 'best practice' approach was implemented in relation to pest surveys across the region. The timeliness of forecasts and risk warnings, as implemented by a coordinated Insect Monitoring Group, was a priority. Weekly pest and crop updates were provided electronically to industry, which in turn were posted on collaborator websites: E.g. Canadian Wheat Board, Western Grains Research Foundation and provincial government websites. Timely risk warnings were provided in map format (prairie-wide, provincial and regional) accompanied with interpretive text to farmers, extension personnel, pesticide applicators and pesticide manufacturers. In addition, potential new invasive species for Canada and their parasitoids were monitored and the risks quantified.

The market impact of successful implementation of this project contributed to preserving and enhancing the economic and environmental benefits of agro-ecosystems for the people of Canada. Producers who are able to minimize agricultural input costs and minimize environmental impacts, are more viable and

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competitive in the agricultural marketplace. There are no constraints to adoption of these technologies.

Dynamic forecasts and risk assessments contributed both to the extension aspects of the management system as well as to the decision-making process at the agro-industry and farm level. Risk assessments improved transfer and adoption of agricultural technology by providing current and relevant information. The impact and degree of adoption was reflected in the state of readiness of the industry to threats from these crop pests. The absence of the routine use of objective, scientifically sound methods of risk assessment and decision support tools by producers and industry leads to unnecessary pesticide application resulting in added input costs, lack of recognition of crops at risk, and increased anxiety in relation to pesticide-use decisions, while limiting the environmental stewardship of producers. Developing new technologies and fine tuning current risk assessment and decision support tools played a strategic role in promoting the adoption IPM. Routine use of risk assessment tools as part of an IPM approach resulted in more sensible pesticide-use decisions, leading to production systems with reduced input costs that address concerns regarding a safe, sustainable, and environmentally friendly food/bio-resource supply and potential negative impacts on beneficial species within the agro-ecosystem.

An added feature of the project, provincial health agencies became aware of the insect pest forecasts (using degree-day models) and requested consideration be given to adding the degree-day model for the West Nile Virus carrier, *Culex tarsalis* to our updates. In response, forecast maps of adult mosquito emergence were also produced to provide a weekly update of the areas most at risk from *C. tarsalis*. As a result, the public (most notably the rural population who are most at risk) were kept aware of the potential for adult mosquito activity within their region; highlighting the need for preventative measures.

Technology Transfer 2012

The Prairie Pest Monitoring Network received international attention in 2012. EuropeAid extended an invitation to be a keynote speaker on the topic of '*area-wide pest monitoring'* at an international scientific training workshop on integrated pest management in Pyongyang, DPRK. The objectives of the workshop were to: (i) share our scientific expertise in insect pest management with the agricultural community in a developing country; and (ii) exchange information related to the management of invasive insect pests that the two countries may already have in common. I was invited to present the Opening Address titled: Area-Wide Pest Monitoring - An IPM Tool. The EU policy for rural development in developing countries aims at reducing poverty, increasing food security and protecting natural resources.

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