Activity 17

Wheat Midge: Enhanced Surveys and Wheat Resistance Traits to Preserve the Sm1 Gene

Lead Researcher
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This research activity, led by Tyler Wist of Agriculture and Agri-Food Canada (AAFC) in Saskatoon, SK. aims to increase our understanding of Orange Wheat Blossom Midge (wheat midge) through midge population and damage surveys in farmers' fields across Western Canada, midge behaviour monitoring, plant breeding and field experiments.

This research builds upon the investigator's experiences and previous research. Funding through a previous Canadian Agricultural Partnership (CAP) resulted in the discovery of a mechanism behind oviposition deterrence (prevents insects from laying eggs) in several wheat varieties. Research funded by the Agriculture Development Fund (ADF) evaluated wheat varieties in breeding programs with promising resistance to wheat midge.

The pheromone trap surveys are built upon many years of research by many scientists. Furthermore, wheat populations have been genetically mapped, and this research team is now evaluating the midge damaged kernels to identify the genetic region associated with new and improved oviposition deterrence.

The wheat midge has high potential to reduce yield. Wist consistently finds greater than 50 per cent yield loss because of wheat seeds damaged by midge larvae feeding and yield losses up to 90

KEY TAKEAWAYS

- **The wheat midge has high potential to reduce yield**
  - It has consistently been found to cause greater than 50 per cent yield loss due to wheat seeds damaged by midge larvae feeding
  - Yield losses up to 90 per cent have been recorded
- **Funding through a previous CAP resulted in the discovery of a mechanism behind oviposition deterrence (prevents insects from laying eggs) in several wheat varieties**
- **On-going surveying activities provide valuable information on where midge is in Western Canada and how much there is**
  - Pheromone trap data across Western Canada for two growing seasons have been collected with hotspots of wheat midge activity identified
  - Over 38,000 male midges were caught in traps
- **The wheat variety 'Vesper' has a new genetic region making it unattractive for wheat midge females to lay their eggs on**
  - Seed has been increased in green houses
  - It has been planted in field experiments to evaluate tolerance to wild wheat midge pressure and determine the location of the genetic region responsible for reduced wheat midge pressure
- **Updated understanding of the effect of precipitation on wheat midge dormancy breaking**
  - A sustained rain event, one that will thoroughly wet the soil, is needed for wheat midges to break dormancy
- **Next steps for this research are to extract midge larvae from wheat heads that were collected from fields, to rear parasitic wasps and begin plant breeding initiatives**

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A wheat midge pheromone trap at dusk which is when wheat midges fly. PHOTO: TYLER WIST

Various grades of wheat midge damage on wheat kernels. The damage is worse in kernels to the right. PHOTO: TYLER WIST

per cent have been recorded.

This research has three main objectives: first to survey wheat midge and couple this information with known larval populations, crop damage, and yield loss, second to develop new and improved genetic resistance to wheat midge, and three to produce a wheat variety with multiple resistance genes to wheat midge.

This research is being done at the AAFC Research and Development Centres Saskatoon with Wist, Brandon, MB. with Santosh Kumar, and Swift Current, SK. with Richard Cuthbert. Researchers from the University of Manitoba with Curt McCartney in the Department of Plant Science and Alejandro Costamagna in the Department of Entomology, are also on the research team.

To date this research activity has collected pheromone trap data across Western Canada for two growing seasons and hotspots of wheat midge activity have been identified. Over 38,000 male midges were caught in the traps. The investigators have started to collect data on larval densities in wheat heads and midge damaged kernels from select fields that had been monitored with the traps.

The wheat variety 'Vesper' which was increased in green house breeding initiatives, which has a new genetic region making it unattractive for wheat midge females to lay their eggs on. It was then planted in field experiments to evaluate their tolerance to wild wheat midge pressure and locate the new genetic region.

The next step for this research is to extract midge larvae from wheat heads that were collected from the field to rear back parasitic wasps and to begin plant breeding initiatives including the cross breeding of new wheat lines to stack genetic resistance.

Through the pheromone trap network these researchers have advanced our understanding of how precipitation triggers the break in wheat midge dormancy. It's established by previous research that a minimum of 25 millimetre (mm) (just under one inch) of precipitation is required to break wheat midge dormancy, however, in northeast Saskatchewan the researchers measured 32 mm of rainfall in May with no break in dormancy. Once the weather data was explored further, the 32 mm of precipitation in this area was from small but frequent rain events.

The investigators have concluded that for wheat midge to break dormancy a sustained rain event is required, one that will thoroughly wet the soil. This understanding and information coupled with the ongoing pheromone trapping initiatives, plant breeding activities, and entomological studies will pave the way to develop better tools and management strategies to control wheat midge.