Activity 11

A Cooperative Approach to Improving Canadian Eastern Soft Red Winter Wheat (CESRW) to Strengthen Agriculture Sector Resilience

Lead Researcher
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This research activity, led by Helen Booker of the Department of Plant Agriculture at the University of Guelph, will develop new Canadian Eastern Soft Red Winter (CESRW) wheat varieties for Eastern Canada. This research is a continuation of winter wheat breeding initiatives funded through the *Canadian Agricultural Partnership* (CAP) specifically associated with breeding activities at the University of Guelph. This current cluster funded research activity, however, involves three winter wheat breeding programs that are working together on variety development for Eastern Canada. The investigators are interested in high yield, better winter hardiness, and superior resistance to Fusarium head blight (FHB), powdery mildew, and wheat rusts.

Winter wheat variety development is critical to the success of the grain industry. Long-term crop rotation studies done at the University of Guelph observed that winter wheat in rotation with corn and soybean increased row crop yield and improved the soil's structure and biological activity. Winter wheat is a cover crop over the winter, and greater adoption in the existing rotations that are dominated by corn and soybean will benefit soil quality and carbon sequestration on farms in Eastern Canada.

This research also addresses plant health to reduce crop protection inputs through development of CESRW varieties rated moderately resistant/resistant to important diseases such as FHB, wheat rusts (leaf, stripe, stem), and specific to Eastern Canada, powdery mildew. Canada has a legislated maximum tolerated level of mycotoxins produced by FHB. Wheat, corn, and barley crop residue can host Fusarium species that infect all three of these crops. Improved winter wheat FHB resistance will reduce the inoculum in residue, thereby facilitating the expansion of crop rotation options for farmers. Improved crop productivity and profitability by breeding for genetic resistance to disease will support farm economic sustainability and encourage

KEY TAKEAWAYS

- **This research activity will develop new Canadian Eastern Soft Red Winter (CESRW) wheat varieties for Eastern Canada**
  - The research is focused on high yield, better winter hardiness, and superior resistance to Fusarium head blight (FHB), powdery mildew, and wheat rusts
- **The 2024 field experiment research was challenging but good for selecting new material with genetic resistance to diseases**
  - This was the first time researchers observed heavy infection of FHB in some agronomic plots
  - There was heavy stripe rust infection in some lines which let researchers distinguish susceptibility or resistance among the breeding material
- **At the Elora Research Station, the investigators attempted to create conditions for natural infection by growing spreader rows or plots in their breeding nursery which are older varieties with high susceptibility to diseases such as powdery mildew or rusts**

The winter wheat Fusarium head blight nursery.
PHOTO: ZHANGHAN ZHANG

Wheat yield trial plots.
PHOTO: ZHANGHAN ZHANG

more diversified rotations with winter wheat which provide many environmental benefits and greater return on investment for farmers in Eastern Canada.

This activity will lead to the development of new CESRW varieties for Eastern Canada that are adapted to a changed and changing climate that are better adapted to their target environments in Eastern Canada. This will lead to a more competitive small grain cereal option for crop rotations with corn and soybean.

This research consists of sub-programs for each of the winter wheat variety development programs in Ontario, where Lily Tamburic-Ilincic manages the breeding program at the University of Guelph, Ridgetown Campus, Helen Booker manages the breeding program at the University of Guelph Main Campus, and Gavin Humphreys directs the breeding activities at Agriculture and Agri-Food Canada (AAFC) Ottawa Research and Development Centre.

The investigators have coordinated breeding activities from parent selection using material with important plant traits available in Canada, planned cross combinations to bring together the beneficial characteristics of both parents, and will evaluate the offspring of each hybridization at each of their breeding nurseries. Using advanced breeding techniques common or unique to each program they will identify breeding lines with superior traits and bring these forward as candidates for registration in either Ontario, Quebec, and/or the Maritime provinces.

The 2024 field experiment research was challenging but good for selecting new material with genetic resistance to diseases. This was the first time Booker observed heavy infection of FHB in some agronomic plots. They also had heavy stripe rust infection in some lines and were able to distinguish susceptibility or resistance among the breeding material.

At Elora, the investigators attempted to create conditions for natural infection by growing spreader rows or plots in their breeding nursery which are older varieties with high susceptibility to diseases such as powdery mildew or wheat rusts. Booker also hosts one of the three inoculated Fusarium nurseries in Ontario at Elora. By using inoculum sprayed onto the heads of plants grown in rows at and around the time of flowering, this, along with mist irrigation, they can create the optimal conditions for high disease pressure. In 2024 they had good disease expression at the inoculated Fusarium nursery which was very useful for identifying genetic resistance in their breeding material.

Threshed wheat heads from selected second generation plants have been planted indoors over the winter, with seedlings then transferred to the vernalization chamber. ‘Winter’ indoors will then be created for the third plant generation. At this stage individuals are tissue sampled and screened with trait specific DNA molecular markers and lines with favourable or beneficial genes will only advance to the next generation in their breeding pipeline. They also plan to cross combine material in the following spring, parental lines with be grown indoors and vernalized over the ‘winter’ for crossing in March.