



RESEARCH PRIORITIES GRAIN FARMERS OF ONTARIO

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Investment in research is a long-term strategic initiative of the Grain Farmers of Ontario for the benefit of all barley, corn, oat, soybean, and wheat farmers. Ontario's grain farmers have sponsored and participated in decades of practical research that has resulted in economic gains and improved agricultural sustainability for Ontario farmers and the Ontario environment. Our goal is to invest in research and support innovation and knowledge transfer that will enhance farmer member profitability and sector competitiveness.

Grain Farmers of Ontario aims to address the research needs for barley, corn, oat, soybean, and wheat through four overall priority areas: **Agronomy and Production**; **Weed, Disease and Insect Pests**; **Crop Quality and Utilization**; and **Breeding and Genetics**. Within each priority area, Grain Farmers of Ontario invests funds in projects of high priority to Ontario farmers, strives to maximize public sector research investment, and encourages private sector research investment. One notable change this year is that we have incorporated into several priorities additional components pertaining to carbon and greenhouse gas emission (GHG) impacts.

Each year Grain Farmers of Ontario identifies specific priorities toward which it would like to target increased research investment. This year, Grain Farmers of Ontario is placing a particular emphasis on research proposals targeting the following research priorities:

- *Integrate **4R nutrient stewardship practices for commercial fertilizer with other nutrient sources** (e.g., cover crops, manure application, biosolids) and validate 4R practices to improve farm profitability and reduce N losses and GHG emissions per unit of crop production.*
- *Develop **integrated weed, disease, and insect pest management strategies** that consider multiple management options, biology of the pest, and prevention of pest resistance to trait and pesticide control measures.*
- *Explore **revolutionary grain drying technologies to substantially improve grain drying efficiency** and explore **agronomic solutions for drydown** to improve profitability of corn production and reduce GHG emissions.*
- *Quantify the impact of standard field practices on soil health and develop strategies to profitably improve or maintain **soil health**.*

Additional research priorities are listed below for each of the four overall priority areas.



Agronomy and Production Priorities

- Optimize plant use efficiency and economics of nutrients, particularly nitrogen, phosphorus, potassium, and sulfur (e.g., 4R nutrient stewardship), and validate the effectiveness of 4R practices on farm, including their impact on nutrient losses, opportunities for reduced nutrient application requirements, reduced GHG emissions, and improved water quality.
- Integrate 4R practices for commercial fertilizer with other nutrient sources (e.g., cover crops, manure, biosolids) to improve profitability and reduce GHG emissions per unit of crop production.
- Develop a standardized accredited Ontario sulfur test.
- Improve soil health testing procedures (particularly the biological component) to cost-effectively identify production systems that maintain and improve long-term soil health and resilience of barley, corn, oat, soybean, and wheat production.
- Develop strategies to minimize and remediate impacts of soil degradation (e.g., shallow and deep soil compaction, loss of soil organic matter, water/tillage erosion).
- Identify production systems that maximize profit, maintain or build soil health, improve crop resilience and reduce GHG emissions (e.g., factoring in crop rotation, fertility, tillage system, and seeding).
- Develop innovative new cropping systems (e.g., intercropping winter wheat and soybeans, relay cropping soybeans into a standing crop, bio-strip till systems, innovative cropping sequences, increased diversity, etc.) that improve productivity, profitability, and soil health, reduce GHG emissions, and provide an opportunity for more crop diversity on challenging soils (e.g., heavy clay, sand, etc.).
- Develop integrated systems approaches to crop management that consider the interactions among inputs, specific cropping practices, and the biological activity in the soil for increased production and sustainability.
- Identify profitable and sustainable agronomic solutions that facilitate crop drydown to reduce the post-harvest grain drying cost and carbon footprint.
- Identify and generate Ontario-specific datasets to assist with accurately calculating the carbon footprint of Ontario grains (e.g., N₂O emissions from crop residue by crop and cropping system (including complete crop rotations), addressing environment and soil type contributions; fuel usage on farm).
- Identify and validate best management practices for effective integration of cover crops into field cropping systems to provide economic and environmental benefits.
- Develop and validate site-specific/variable rate production practices that improve efficiency of inputs, support ecosystem services, and contribute to overall farmer profitability, demonstrating actual return on investment (ROI).
- Apply precision agriculture technologies and emerging statistical methods to agronomy research designs to better understand site-specific agronomy, ultimately supporting site-specific decision support tool development.
- Identify the ROI (economic and environmental) of new autonomous equipment and disruptive-scale technologies that can add value to Ontario farms in the near-mid-term.



Weed, Disease, and Insect Pests Priorities

- Develop integrated weed management strategies that consider management and prevention of herbicide resistance, the biology of specific weed species, and how cropping system components like soil fertility, soil health, cover crops, and crop rotations influence recruitment and control of common weeds.
- Develop integrated disease & insect pest management strategies that consider management and prevention of trait and pesticide resistance, the biology of specific diseases and insects, and the influence of crop rotations, cover crops, crop inputs, soil health, and natural enemies on insect pest and disease dynamics.
 - Key diseases and insect pests include *Fusarium* in wheat and barley, *Gibberella* in corn, white mould, corn rootworm, western bean cutworm, soybean cyst nematode (SCN), soybean sudden death syndrome (SDS), corn nematodes and other nematodes, foliar pathogens (e.g., stripe rust, Northern corn leaf blight, powdery mildew, oat crown rust, etc.), seedling diseases, spider mites, slugs, soybean aphid, and true armyworm.
- Evaluate new variable rate sprayer technology for ROI and targeted spraying opportunities to reduce pesticide coverage and load on-farm.
- Develop effective management strategies, including forecasting tools, for mycotoxin producing pathogens (*Gibberella*, *Fusarium*), insect pest vectors (e.g., western bean cutworm) and associated fungal toxin accumulation (e.g., DON) in the field and in stored grain.
- Develop strategies to address emerging weed (e.g., waterhemp, *Palmer amaranth*), disease (e.g., tar spot in corn), and insect pest risks (e.g., corn rootworm) from changing weather patterns, potential foreign introductions, and new resistant populations.
- Assess performance of herbicide programs when few control options exist for specific weed species or cropping systems (e.g., non-GM soybeans, wild oat in cereals, weed control systems without glyphosate or other at-risk active ingredients to meet market requirements).
- Identify, protect, and promote beneficial microbes and insects to manage weeds, diseases, parasitic nematodes, and insect pests in cropping systems.
- Survey and monitor economically important and emerging weeds, diseases (and *Fusarium* DON glycoside dynamics), and insect pests to identify changes in population structure and resistance to management strategies and develop predictive tools to improve management decisions.

Crop Quality and Utilization Priorities

- Explore revolutionary grain drying technologies to substantially improve grain drying efficiency, improve profitability of corn production, and reduce GHG emissions.
- Identify grain quality improvement opportunities to increase the farm-gate value of grain for specific end uses or identity-preserved markets.
- Identify production practices that improve grain quality for specific end uses leading to value-added markets, including feed, food and bioproducts.



- Develop new bioproducts, with industry support, from barley, corn, oat, soybean, and wheat (e.g., industrial products, fuel, and bioplastics) linked to existing and emerging market opportunities that would eventually use at least 40,000 MT/year of *Ontario* grain, or provide price premium opportunities for Ontario's grain farmers, or increase the value and sustainable use of crop residues.

Breeding and Genetics Priorities

- Develop high-yielding, high-quality, disease-resistant barley, oat, soybean (non-GM), winter wheat and spring wheat varieties adapted for Ontario.
- Develop competitive new varieties for value-added, identity-preserved markets that provide significant economic opportunities for Ontario's grain farmers.
- Improve genetic resistance to important diseases and insect pests in Ontario including *Fusarium*/DON (and DON glycosides) in wheat and barley, *Gibberella*/DON (and DON glycosides) in corn, white mould, western bean cutworm, soybean cyst nematode (SCN), soybean sudden death syndrome (SDS), corn rootworm, corn nematodes and other nematodes, foliar pathogens (e.g., stripe rust, Northern corn leaf blight, powdery mildew, oat crown rust, etc.), seedling diseases, soybean aphid, and true armyworm.
- Develop effective *Gibberella* ear rot resistance screening protocols for corn hybrids.
- Identify effective breeder-friendly markers and resistance genes for *Gibberella* ear rot of corn.
- Identify and breed for environmental stress tolerance traits that will enable crops to perform well amid a changing climate (e.g., prolong grain fill period in wheat, barley, oat during high temperatures in June; improve soybean grain fill capability under August drought conditions; improve winter survival of winter wheat and winter barley).
- Improve variety performance trials and tools for variety selection.