RESEARCH PRIORITIES
GRAIN FARMERS OF ONTARIO

Revised June 2026

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**; **Weeds, Diseases 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.

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:

- *Develop **integrated** **weed, disease, and insect pest management strategies** that consider multiple management options, biology and epidemiology of the pest, and prevention of pest resistance to trait and pesticide control measures. Of particular interest are projects addressing **tar spot in corn** and **white mould in soybeans**.*
- *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 effective **crop residue management practices** to minimize residue challenges, and maximize crop production, profitability and environmental sustainability under minimal tillage/no-till.*

These three key priorities are also included within the more comprehensive list of research priorities, classified by priority area, below.

Grain Farmers of Ontario
679 Southgate Drive Guelph ON N1G 4S2
Tel: 1-800-265-0550 www.gfo.ca

Agronomy and Production Priorities

Nutrient management

- Improve tools for making nitrogen, phosphorus, and potassium rate decisions, including better understanding the synergistic interactions among macronutrients and other nutrient inputs.
    - Generate data to support updates to Ontario nutrient rate recommendations, with an emphasis on nitrogen in small cereal crops, particularly wheat. (*new priority for 2026*)
- Optimize plant use efficiency and profitability of nutrients, particularly nitrogen, phosphorus, potassium, sulfur, and calcium (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.
    - Improve timely decision support for making in-season nitrogen rate adjustments by determining the need for top-ups (e.g. accounting for rainfall and nitrogen losses) and optimizing upfront nitrogen application for effective later-season supplementation.
- Generate updated nutrient uptake curves for corn to reflect modern hybrids, yield potential, and growing conditions, supporting improved synchronization of nutrient supply with crop demand. (*new priority for 2026*)
- Develop an agronomic understanding of spoon or pulse feeding nitrogen application strategies in corn throughout the growing season including crop response, nutrient availability, uptake, and loss dynamics, and soil-plant interactions under high frequency, low-dose nitrogen applications that could be carried out by drone or robot technologies. *(new priority for 2026)*
- Integrate 4R practices for commercial fertilizer with other nutrient sources (e.g., cover crops, manure, biosolids, biologicals, and soil supplied nutrients (factoring in organic matter, soil structure and texture, which can affect nutrient access and availability)) to refine application rates.
- Evaluate the efficacy of nitrogen inhibitor products under various Ontario field conditions (e.g., different soil textures), including comparisons among products with differing active ingredient concentrations. *(new priority for 2026)*
- Identify how manure can best be utilized in minimal till/no-till cropping systems to balance crop productivity and nutrient losses (e.g., into standing cover crops).
- Develop new, standardized, high-throughput in-field soil and tissue sampling and testing methods to assess nutrient levels with greater accuracy, efficiency, and timeliness, supporting real-time decision making.
- Identify critical soil and plant tissue micronutrient levels to update Ontario nutrient application recommendations.
- Develop a standardized accredited Ontario sulfur test.

Soil management

- Identify optimal standard and innovative tile drainage practices in terms of return on investment (ROI), impacts on nutrient losses (e.g., P), and the interaction of soil texture.
- Develop strategies to optimize soil structure and minimize and remediate impacts of soil degradation (e.g., shallow and deep soil compaction, loss of soil organic matter, and erosion, considering the influence of tillage systems, crop rotations, and biological inputs on soil structure over time). Focus on demonstrated cost-benefit analysis (factoring soil type into economics).
- Develop cost-effective soil health testing procedures (particularly the biological component) which can identify production systems that improve long-term soil health and resilience of Ontario crop production.
- Assess the validity and interpretation of soil health assessment tools to corroborate lab analyses of soil health indicators with field performance.

Integrated systems approaches to crop management

- Advance production systems to maximize profit, maintain or build soil health, improve crop resilience and reduce GHG emissions & nutrient losses (e.g., factoring in crop rotation, fertility, biologicals, tillage system, and seeding). Consider the interactions among inputs, specific cropping practices, and environment for increased production, soil health and sustainability.
- Develop effective crop residue management practices to minimize residue challenges, and maximize crop production, profitability and environmental sustainability under minimal tillage/no-till (considering impacts on crop establishment, pests (e.g., slugs, European corn borer), and pathogens).
- Develop innovative cropping systems (e.g., intercropping winter wheat and soybeans, double-cropping soybeans, biostrip till systems, integrating soybeans into rotations north of New Liskeard, etc.) that meet market demands and can provide an opportunity for more crop diversity on challenging soils (e.g., heavy clay, sand, first-year row cropping on new land put into production, etc.).
- Determine the ROI of innovative irrigation technologies that integrate fertility management to optimize nutrient delivery and water use efficiency.
- Identify and validate best management practices for effective integration of cover crops into field cropping systems with a focus on economic and environmental benefits.
- 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 and tools to advance life cycle GHG accounting of Ontario grains (e.g., tools for refining estimates of soil organic carbon across temporal and geographic scales; data that can improve the accuracy of emission factors used to calculate N_2O emissions from fertilizer use and crop residue by crop and cropping system (including complete crop rotations)).
- Update herbicide compatibility and residue data for common replant and/or double cropping scenarios (e.g., plant back intervals) to ensure crop safety and prevent exceedance of herbicide maximum residue limits (MRLs) that could impact market access.

Precision agriculture tools, technologies & modelling

- 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 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.
- Develop simple on-farm research protocols and statistical methods to facilitate site-specific decision support tool development and validation.
- Develop methods to translate farmer-generated and precision agriculture data into reliable agronomic insights, including approaches for ground-truthing, validation, and interpretation to support on-farm agronomic recommendations. *(new priority for 2026)*
- 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.
- Validate drone technology for efficiency and precision in agricultural practices (e.g., for seeding, to improve application coverage consistency, imagery, etc.).
- Determine how to effectively implement innovative sprayer technology (e.g., nozzles, drones, variable rate sprayers, autonomous sprayers, etc.) to maximize ROI and opportunities to improve efficacy and reduce pesticide load.
- Develop crop models for Ontario grain crops that can be utilized in the development of YEN and Ontario Corn Agronomy Network (OCAN) programs to more suitably evaluate current yield potential (e.g., generating data such as water use, light energy capture, conversion efficiency, harvest index, etc. to support crop modeling).

Weeds, Diseases, and Insect Pests Priorities

- Develop integrated weed management strategies that consider management and prevention of herbicide resistance (e.g., mechanical weed control, biological weed control), the biology of specific weed species, and how cropping system components like soil fertility, soil health, cover crops, and crop rotations influence weed seed return and control of common weeds.
    - Key weeds include waterhemp, *Palmer amaranth* (and other emerging *amaranth* species), Canada fleabane, lamb's-quarter, giant ragweed, common ragweed, perennial sow-thistle, foxtail, pigweed, wild carrot, bluegrass, ryegrass, and horsetail.
- Develop integrated disease & insect pest management strategies that consider management and prevention of trait and pesticide resistance, the biology and epidemiology of specific diseases and insects, and the influence of crop rotations, cover crops, crop inputs, soil health, biologicals, and natural enemies on insect pest and disease dynamics.
    - Key diseases and insect pests include tar spot in corn, *Fusarium* in wheat and barley, *Gibberella* in corn, corn rootworm, western bean cutworm, soybean cyst nematode (SCN), white mould, soybean sudden death syndrome (SDS), European

corn borer, 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, cereal leaf beetle, and true armyworm.

- Evaluate the efficacy and consistency of control of generic and proprietary herbicide, fungicide, and insecticide products against the most problematic weeds, diseases, and insect pests under Ontario field conditions. *(new priority for 2026)*
- 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 weeds, diseases (e.g., red crown rot), and insect pest risks (e.g., corn leafhopper) 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, 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 (e.g., *Bt*-resistant European corn borer) to identify changes in population structure and resistance to management strategies.
- Develop rapid, cost-effective predictive/diagnostic tools for farmers to improve pest management decisions.

Crop Quality and Utilization Priorities

Grain drying

- Explore new/revolutionary grain drying technologies to substantially improve grain drying efficiency, improve profitability of grain production, and reduce GHG emissions.

Grain quality

- 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.
    - Identify agronomic factors influencing soybean protein levels and evaluate production practices that can help improve soybean protein levels in herbicide tolerant soybeans to ensure competitiveness in end-use and export markets. *(new priority for 2026)*
- Identify simple and cost-effective grain storage and monitoring practices that maintain grain quality (e.g., by reducing moisture, minimizing spoilage, avoiding insect impacts,

etc.) and reduce waste (e.g., grain bags).

Grain 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

Variety & trait development

- Develop high-yielding, high-quality, disease-resistant barley oat, soybean (non-GM), and wheat (specifically, soft red winter wheat, hard red winter wheat, and hard red 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 tar spot in corn, *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), *Phomopsis* in soybean, European corn borer, 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.
- 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 tolerance to excess moisture, etc.).
- Assess wheat varieties for their relative tolerance to preharvest sprouting and α-amylase expression levels to identify varieties with reduced risk of having low falling numbers at harvest.

Variety selection tools

- Enhance variety performance trials and tools for variety selection (e.g., tar spot resistance screening, Gibberella ear rot resistance screening, straw yield of small cereals, etc.).