Ontario Agri-Food Innovation Alliance
Research Impact Case Study

Breeding & genetics

Photo courtesy of Fox Seeds
Research breeds better plants and animals for Ontario

Breeding relies on genetics and heritability to produce new varieties of plants and to select animals with beneficial traits. Researchers undertake this long-term, detailed work to help produce healthier, more efficient livestock and higher-yielding, disease-resistant crops.

Through the Ontario Agri-Food Innovation Alliance, the Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA) invests in breeding and genetics research to support Ontario’s agri-food sector.

The people, places, programs and partners of the Alliance work together to improve plants and animals for the benefit of farmers and consumers across the province.

Look for these symbols to learn how Alliance investments return value to Ontario.

People

Our people are innovators, researchers, thought leaders and problem solvers. We work with partners across the agri-food sector to meet challenges and address emerging opportunities for the benefit of Ontario.

Places

Our places enable research, innovation and laboratory testing. Alliance investment in research centres provides Ontario’s researchers with a critical platform for innovation.

Programs

Our programs support discovery, learning and outreach for the benefit of all Ontarians. Programs provide project operating funds to researchers who in turn deliver quality, impactful results, all while training the next generation of agri-food innovators.

Partners

Our investment in people, places and programs attracts partnerships from across the agri-food sector. Industry, government and academic partners collaborate with U of G researchers to deliver benefits to the entire agri-food sector.
Breeding and genetics research takes time. Publicly funded plant breeding and genetics research programs give researchers and sector partners the time and resources they need to produce new, high-value plant varieties and animal genetics that support the agri-food sector.

- **$950M**
  Estimated annual economic impact of germplasm developed at the University of Guelph

- **$130M+**
  Value of bull semen from Immunity+® line in the first six years on the market. Immunity+® is a Semex dairy product developed using High Immune Response technology, created at U of G.

- **↑50%**
  Increase in productivity of major agricultural crops in Canada since 1990. Plant breeding has contributed to these gains by delivering new varieties with higher yields and improved traits like disease resistance and stress tolerance.

- **Up to 25 years**
  Time it takes for a new plant variety to move from the lab to farmers’ fields

- **500**
  Number of new plant varieties developed at U of G over the past 120 years
Collaboration: Key to breeding success

The Ontario Agri-Food Innovation Alliance investment in people, places and programs attracts partnerships from across the agri-food sector. Industry, government and academic partners collaborate with U of G researchers to deliver benefits to the entire agri-food sector.

141 organizations and businesses have supported breeding and genetics research at U of G since 2008.

496 collaborators have been involved in Alliance-funded research projects since 2008.

281 highly qualified personnel (HQP) trained

91 master’s students

50 doctoral students

42 post-doctoral researchers

98 undergraduate and co-op students

“I work regularly with the Ontario Tender Fruit Marketing Board – it is like an inseparable marriage. Along with my breeding crew and reps from the nursery, packaging industry, VRIC and growers, we formed the Tender Fruit Evaluation Committee.”

— Dr. Jay Subramanian, professor, Department of Plant Agriculture, U of G

“At Lactanet, we aim to offer the best possible genetic evaluations to the dairy industry. To do that, we continually need to improve and expand our services so that the industry can make better decisions. Research is critical when developing new evaluations or improving existing ones.”

— Gerrit Kistemaker, manager of genetic evaluations, Lactanet

“Just knowing that we get good, repeatable, reliable information in trials that is not tied to specific companies is invaluable.”

— Paul Cornwell, seed and research manager, Hensall Co-op
Ontario’s agri-food research centres

Ontario’s network of agri-food research centres is a key platform for honing the next generation of barn- and field-tested innovations. This network offers plant breeders and animal geneticists access to consistent, stable environments for the detailed work of breeding. For plant breeders, the network covers soil types and micro-climates across the province of Ontario—ensuring new plant varieties that are truly homegrown.

“We would not have led the project [Efficient Dairy Genome] without the research stations... Without the research station, we would have zero records for methane emission and feed efficiency.”
—Dr. Flavio Schenkel, professor and director, Centre for Genetic Improvement of Livestock, Department of Animal Biosciences, U of G

“You can’t overstate the importance of having those stations available ... for research....It’s key to have the same location, same set of variables around that research year over year, so that results are really comparable in order to measure differences and progress over time.”
—Jeff Reid, general manager, SeCan
# Making an impact

1. **Genetic technologies advance livestock sector**
2. **New asparagus varieties help save Ontario sector**
3. **Seeds of success**
4. **Tastefully tailored in Ontario**
5. **Breeding better beans boosts agri-food sector**
Genetic technologies advance livestock sector

Ontario Agri-Food Innovation Alliance investment in University of Guelph expertise has led to many of the breeding advancements that are making an impact on swine, dairy and beef farms across Ontario.

Genetics and genomics research now fuels on-farm decision-making, giving producers the tools to select animals with desirable traits—from a strong immune system to improved feed efficiency—that enhance the health of their herds and the productivity, profitability and environmental sustainability of their operations.

“The outcome of the breeding research at U of G provides us with new or improved genetic evaluation methods. We can then implement these and provide improved genetic evaluation results to the dairy industry. This allows the farmers to make better breeding decisions, which then results in genetic improvement of Canadian dairy cows.”

—Gerrit Kistemaker, manager, Genetic Evaluations, Lactanet
**Livestock**

**Ontario Agri-Food Innovation Alliance**
**Breeding & genetics**

**INPUTS**

- **U of G researchers, technicians, highly qualified personnel**
- **Ontario Dairy Research Centre, Ontario Beef Research Centre, Ponsonby General Animal Facility, Animal Health Laboratory**
- **Tier I, Tier II, HQP, Gryphon’s LAAIR**

- **Swine**: Canadian Centre for Swine Improvement, Ontario Pork
- **Dairy**: Lactanet, Canadian Dairy Network, Genome Canada, Semex
- **Beef**: Beef Farmers of Ontario, Beef Improvement Ontario (now AgSights)

**IMPACT**

**80+ countries**

High Immune Response technology, developed by U of G’s Dr. Bonnie Mallard, allows producers to select inherently healthier dairy cows. Commercialized by Semex as Immunity+®, the technology is now available in more than 80 countries.

**Genetic markers for healthier hogs**

Genetic markers identified by U of G’s Dr. Brandon Lillie have been incorporated into an innovative and cost-effective genotyping chip that can help screen for more than 50,000 genetic variants, helping producers select healthier hogs.

**Dairy genome project promises enhanced on-farm efficiency**

U of G researcher Dr. Flavio Schenkel is co-leading an international team of experts to incorporate feed efficiency into genetic evaluation of dairy cows, which could save dairy producers $108 million per year in feed costs and reduce the carbon footprint of dairy production.

**Genetic test for tenderness**

U of G researcher Dr. Stephen Miller identified a genetic marker that impacts beef tenderness. This discovery is now part of a technology that has been patented, commercialized and used throughout North America.

**$5 savings for every $1 invested**

U of G researcher Dr. Allan King (retired) adapted a test to identify boars with a genetic abnormality that leads to smaller litters. The test—now offered through the start-up company Karyotekk—leads to $5 in savings for every $1 invested. The test is the only one if its kind in Canada.

“Professor King’s work is a really good example of how research eventually ends up in the field. He now has his own lab where he does karyotyping directly for genetic suppliers for the boars that are entering into artificial insemination units.”

— Rod de Wolde, general manager, Ontario Swine Improvement
In 2000, the release of a new variety of asparagus called Guelph Millennium helped bolster a struggling asparagus industry in Ontario and the United States. Hardier than other available varieties and able to survive Ontario winters, Guelph Millennium soon took hold in Ontario, Michigan and Washington State. It was the first of three “Guelph” asparagus varieties released between 2000 and 2019. Together, these varieties have been heralded for saving the region’s asparagus sector.

Long-term, stable investment from OMAFRA—combined with industry collaboration and University of Guelph research expertise—brought these three new asparagus varieties to market, allowing the $25-million Ontario asparagus sector to bring homegrown goodness to consumers in Ontario and around the world.

“Without the research station availability and the Alliance funding, there would be no asparagus breeding program.”
—Dr. David Wolyn, professor, Department of Plant Agriculture, U of G
New asparagus varieties help save Ontario sector

**Inputs**
- U of G researchers, research technicians, highly qualified personnel
- Ontario Crops Research Centre – Simcoe
- Superior Plant Upgrading and Distribution Unit at the Ontario Crops Research Centre – New Liskeard
- Tier I, Tier II
- Asparagus Farmers of Ontario, Fox Seeds

**Impact**

**Improved yield**
Asparagus yields increased by 514 kg/ha between 1979 and 2017.

**Three new asparagus varieties released since 2000:** Guelph Millennium, Guelph Eclipse and Guelph Equinox

**Increased domestic production**
1,383 hectares of asparagus harvested in Ontario

**Guelph varieties dominate the marketplace**
- >90% of acreage in Ontario in 2020
- 75% of Michigan’s asparagus patches in 2020

**↑$1.2M**
Growth in asparagus exports between 2013 and 2017 thanks to improved yield and acreage

“Guelph Millennium has truly been the saviour of the North American asparagus industry, without question.”
—Ken Wall, co-owner, Sandy Shore Farms, and chair, Fox Seeds
Breeding new plant varieties takes time, patience and expertise. Consistent funding from OMAFRA means that expert U of G breeders have the space and support to do what they do best—develop new, high-quality plant varieties tailored to Ontario.

Here’s how three Guelph asparagus varieties were developed over 30+ years.

**Guelph Millennium:** winter hardy with great crop longevity, yield and quality

**Guelph Eclipse:** yields about 20% higher than Guelph Millennium in research trials

**Guelph Equinox:** high-yielding, quality variety with extra-long spears and tight tips—even in hot weather

Dr. Dave Wolyn joins U of G and builds on the work of Dr. Herm Tiessen in asparagus breeding

Guelph asparagus varieties account for more than 90% of asparagus grown in Ontario
Canada is a world leader in soybean plant breeding, renowned for high-quality, food-grade varieties with superior genetics sought after on the international market. Canadian soybean exports amounted to $2.6 billion in 2020, with Ontario supplying much of the export market.

Canada’s success on the international market is due in no small part to the publicly funded soybean breeding program at the University of Guelph, which has released more than 280 new varieties since 1970. Today, U of G-bred varieties account for nearly 50 per cent of the food-grade soybeans grown in Ontario and shipped around the world—a true Ontario solution with global impact.

“First and foremost, my main goal is to cater to Ontario soybean growers, to provide them with good genetics to grow in their fields.”
—Dr. Istvan Rajcan, Department of Plant Agriculture, U of G
Two U of G professors, Dr. Istvan Rajcan and Dr. Milad Eskandari, have released more than 80 soybean varieties combined during their tenure at U of G (Rajcan joined the faculty at U of G in 1998, Eskandari in 2013).

**Inputs**
- U of G Researchers, technicians, highly qualified personnel
- Ontario Crops Research Centre – Woodstock, Ridgetown and Simcoe sites
- Agriculture and Food Laboratory
- Tier I, Tier II

**Inputs**

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<th>$130M</th>
<th>$740K</th>
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<td>Farm gate value of U of G-bred soybeans in 2019 (U of G-bred varieties were planted on an estimated 200,000 hectares in Canada in 2019).</td>
<td>Licensing revenue in 2019–20</td>
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**Impact**

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<th>OAC Bruton: the leading SCN-resistant soybean variety in Canada</th>
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<td>Developed by Eskandari and released in 2018, OAC Bruton has built-in resistance to soybean cyst nematode.</td>
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**Seed of the Year**

- **2008**: OAC Kent
- **2013**: OAC Bayfield

**Two Seed of the Year awards**

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<td>Active soybean licences, encompassing 156 varieties currently held by U of G’s Research Innovation Office</td>
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“The better genetics that the University of Guelph has been able to continually come forward with allows the whole industry to adopt those and integrate their own traits. Having U of G there as a strong source of base genetics has really allowed the whole industry to continue to make significant progress.”

— Jeff Reid, general manager, SeCan
Dry edible beans are a nutritious, high-value crop. Ontario-grown dry beans, including white (navy), kidney, cranberry, black, otebo and adzuki accounted for $133 million in farmgate receipts in 2020.

A big part of this success story is the publicly funded bean breeding program at the University of Guelph, made possible by the Ontario Agri-Food Innovation Alliance.

Long-term provincial investment in research funding, technicians and infrastructure has attracted substantial investment from the Ontario bean industry and the Federal Government. New bean varieties bred for improved disease resistance, yield and product quality.

“The primary value of the breeding program is economic... it keeps us competitive with higher-yielding and better-quality beans.”

—Mike Donnelly-Vanderloo, chair, Ontario Bean Growers
Breeding better beans boosts agri-food sector

INPUTS
U of G researchers, technicians, highly qualified personnel
Ontario Crops Research Centre – Elora, Woodstock, Ridgetown and Winchester sites
Tier I, Tier II, HQP
Ontario Bean Growers, Hensall Co-op, Agriculture and Agri-Food Canada, Pulse Canada

IMPACT

Advancing research
OAC Rex was the first Canadian bean variety to have its full genome sequenced, leading to important discoveries about the genetic basis of desirable traits.

↑24%
Dry bean licence revenues continue to grow—up 24% in 2019–20 compared to 2018–19—largely on the strength of Dynasty.

↑2x
Ontario dry bean yields nearly doubled between 1985 and 2014, thanks to the work of agronomists and bean breeders, including those at U of G.

↑15%
The red kidney bean variety Dynasty developed at U of G increases yield by 15% compared to other kidney bean varieties.

21
New bean varieties developed and commercialized at U of G by Dr. Peter Pauls and Tom Smith since 2003.

"Dynasty has taken a huge portion of the marketplace. It represents about 90 per cent of the Ontario kidney bean market and roughly half of the North American acreage. It has had the most impact of any single variety."
—Paul Cornwell, seed and research manager, Hensall Co-op

Ontario Agri-Food Innovation Alliance
Breeding & genetics
Dry beans
Ontario farmers grow more than 125 fruit and vegetable crops, contributing $4.2 billion to the Ontario economy, supporting 90,000 jobs and accounting for one-third of Canada’s fruit and vegetable production.

High-quality plant varieties suited to Ontario’s soils and climate are the foundation of a successful domestic fruit and vegetable sector. Public breeding programs lead to the creation of new, tailored varieties that support Ontario’s domestic food supply and export markets.

A focus on three distinct crops—peaches, strawberries and potatoes—tells the story of how stable, long-term public funding from OMAFRA and other government partners combines with University of Guelph research expertise and collaboration across the value chain to produce a resilient, home-grown fruit and vegetable sector.
Peaches

Vee Blush peach variety
Bred in 1991 and released in 2013, this early market peach variety has grown in popularity and helped Ontario producers pivot in response to evolving market demands after the last major canning plant in Niagara closed in 2008. Producers have planted an estimated 34,000 trees since 2017 and Vee Blush accounts for 20% of the early market peaches grown in Ontario.

6
New peach varieties released by Dr. Jay Subramanian since 2003, with more expected over the next decade.

“There is a conscious effort to improve outreach. I talk to farmers all the time—they are my primary clientele. Because of Alliance KTT expectations, we were able to reach out to other clientele in the supply chain. I didn’t have much contact earlier with packaging or other by-products of this value-added industry, but now I do.”

— Dr. Jay Subramanian, professor, Department of Plant Agriculture, U of G
Strawberries

Extended strawberry season
Day-neutral strawberry varieties produce fruit from late May to mid-October. U of G researcher Dr. Adam Dale tested these U.S.-bred varieties to select berries that would work in Ontario’s soils and climate and be “fruitful” for Ontario growers.

“A seasoned Ontario grower told me recently that the idea of day-neutral strawberries becoming really important to our market was laughed at. And now, they are a large part of the industry and are growing.”
—Kevin Schooley, general manager, Berry Growers of Ontario

20%
Day-neutral strawberries now account for 20% of strawberry production in Ontario.

Some of the June-bearing strawberry varieties developed by U of G researchers

Governor Simcoe (1985)
Sapphire (2002)
Serenity (2003)
Summer Gem (2013)
U of G researchers work with AAFC to assess how new potato varieties will fare in Ontario, helping to support Ontario’s $112M chipping and fresh potato market.

“Our potato breeding program is a collaborative, four-way partnership between AAFC, OMAFRA, U of G and industry. Without any one of them, there wouldn’t be a potato breeding program in Ontario. Having the Alliance on board with us is critical.”

—Dr. Al Sullivan, professor (retired), Department of Plant Agriculture, U of G
The Ontario Agri-Food Innovation Alliance is a collaboration between the Ontario Ministry of Agriculture, Food and Rural Affairs and the University of Guelph.

CORRECTION NOTE: In an earlier version, this Impact Case Study identified 12 new peach varieties released since 2003 when in fact only six varieties have been released.