

Breeding & genetics



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.



Patience pays off


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.

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

 **\$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.

 **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.



“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

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



“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

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



“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



Livestock

Ontario Agri-Food
Innovation Alliance
Breeding & genetics

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



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)



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.



\$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 of its kind in Canada.



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.

“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

Asparagus

Ontario Agri-Food
Innovation Alliance
Breeding & genetics

New asparagus varieties help save Ontario sector



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

PHOTO: BRUCE SARGENT

Asparagus

Ontario Agri-Food
Innovation Alliance
Breeding & genetics

New asparagus varieties help save Ontario sector



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



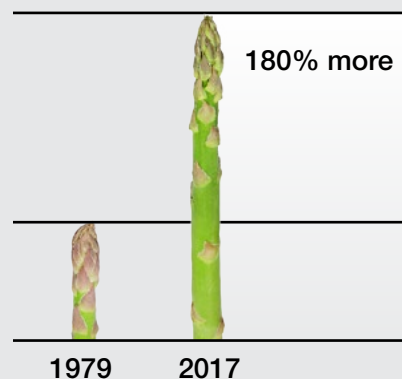
Tier I, Tier II



Asparagus Farmers
of Ontario, Fox Seeds

Improved yield

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

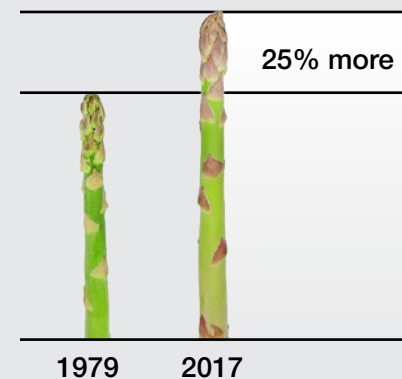


Three new asparagus varieties released
since 2000: **Guelph Millennium**, **Guelph
Eclipse** and **Guelph Equinox**

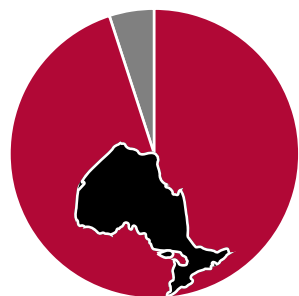


Increased domestic production

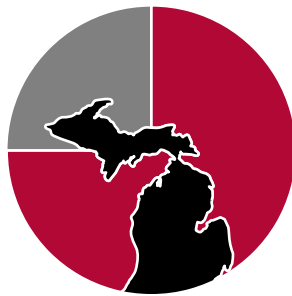
1,383 hectares of asparagus
harvested in Ontario



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

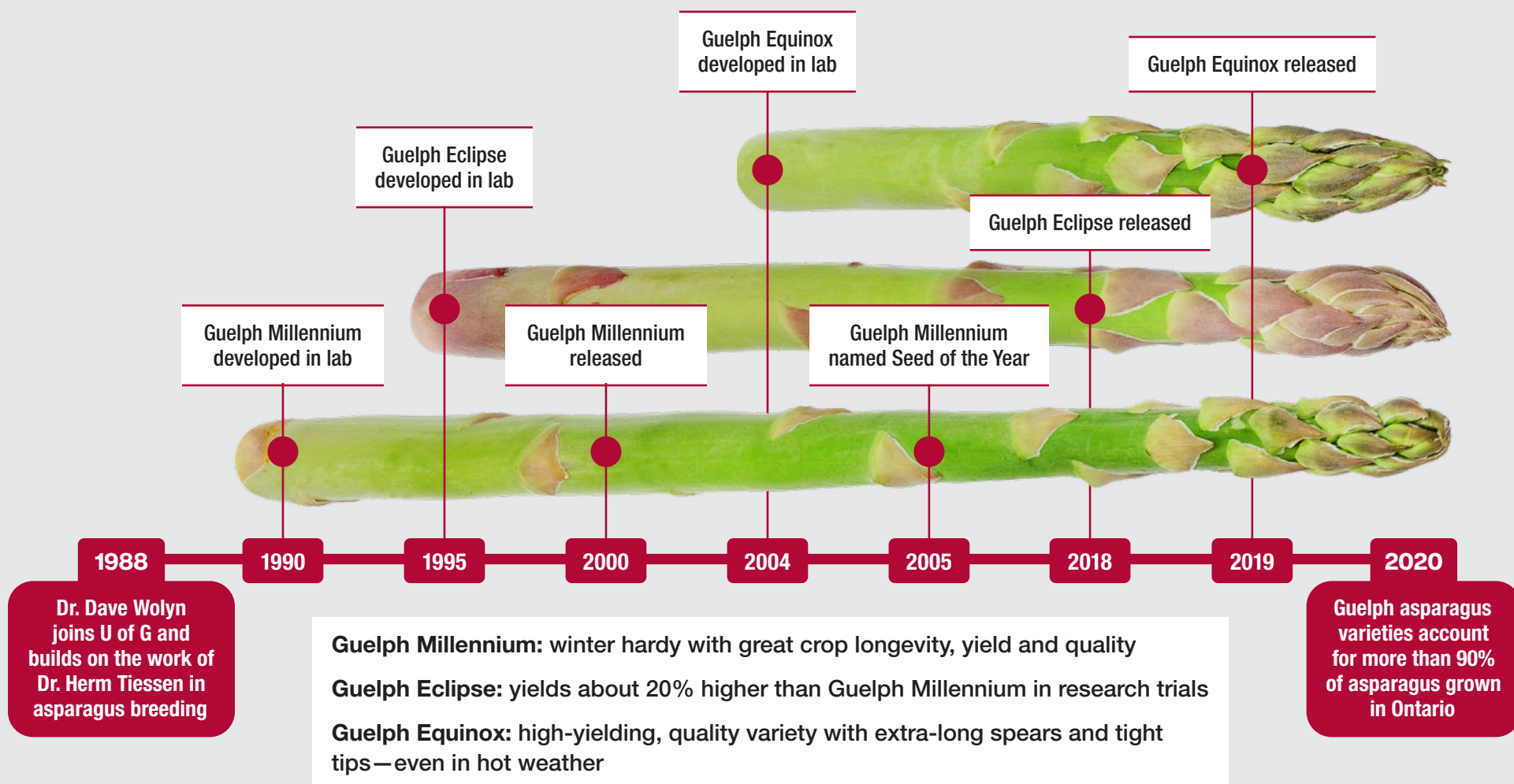
“Guelph Millennium has truly been the saviour
of the North American asparagus industry,
without question.”

— Ken Wall, co-owner, Sandy Shore Farms, and chair,
Fox Seeds

Time, patience and expertise

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.



Soybeans

Ontario Agri-Food
Innovation Alliance
Breeding & genetics

Seeds of success



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

PHOTO: BRUCE SARGENT

Soybeans

Ontario Agri-Food
Innovation Alliance
Breeding & genetics

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).



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



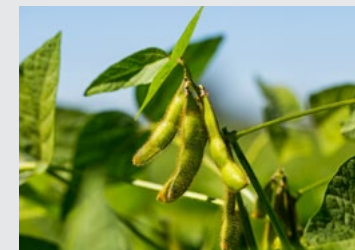
Grain Farmers of Ontario,
SeCan, Canadian Field
Crops Research Alliance,
Organic Council of
Ontario, Japanese Food
Soybean Company, AAFC,
USDA, Ontario Soybean
and Canola Committee

\$130M

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).

\$740K

Licensing revenue in 2019–20



OAC Bruton:
the leading SCN-
resistant soybean
variety in Canada

Developed by
Eskandari and
released in 2018,
OAC Bruton has
built-in resistance
to soybean cyst
nematode.



SEED OF THE YEAR
recognizing public seed research

80+

Soybean varieties
developed by Rajcan
and Eskandari

IMPACT



**Two Seed of the
Year awards**

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

“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

108

Active soybean
licences,
encompassing 156
varieties currently
held by U of G's
Research Innovation
Office

Dry beans

Ontario Agri-Food
Innovation Alliance
Breeding & genetics

Breeding better beans boosts agri-food sector



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

Dry beans

Ontario Agri-Food
Innovation Alliance
Breeding & genetics

Breeding better beans boosts agri-food sector




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



↑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.

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.



“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

21

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

↑15%

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

Tastefully tailored in Ontario



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.

Horticulture

Ontario Agri-Food
Innovation Alliance
Breeding & genetics



Peaches



U of G researchers,
technicians, highly
qualified personnel



Vineland Research and
Innovation Centre



Tier I, Tier II



Tender Fruit Evaluation
Committee, Vineland
Research and Innovation
Centre



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



Horticulture

Ontario Agri-Food
Innovation Alliance
Breeding & genetics



U of G researchers,
technicians, HQP



• Ontario Crops Research
Centre – New Liskeard
and Simcoe sites

• Superior Plant
Upgrading and
Distribution (SPUD) Unit
at the Ontario Crops
Research Centre – New
Liskeard



Tier I, Tier II



Berry Growers of Ontario



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

Strawberries



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)

Horticulture

Ontario Agri-Food
Innovation Alliance
Breeding & genetics



Potatoes



U of G researchers,
technicians, HQP



• Ontario Crops Research
Centre – Simcoe

• Superior Plant
Upgrading and
Distribution (SPUD) Unit
at the Ontario Crops
Research Centre – New
Liskeard



Tier I, Tier II



Ontario Potato Board,
Agriculture and Agri-
Food Canada, Ontario
potato growers



Yukon Gold potato

Created at U of G and
released in 1981, Yukon Gold
was named one of the top
five university-developed
innovations from the past
100 years by the Council of
Ontario Universities.

\$112M

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.

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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.*