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HITTING PAY DIRT

Healthy soil yields dividends

Pages 12-18

2020-21 AGRI-FOOD YEARBOOK

Ontario 



Investing in innovation for real-world returns

I am very honoured to introduce this year's Agri-Food Yearbook.

Ontario is a world leader in agri-food research, and I am proud to see some of the advancements that are being made in the sector. I want to express my strong appreciation to the many researchers and partners that make these developments possible.

The Ontario Ministry of Agriculture, Food and Rural Affairs and the University of Guelph are long-standing partners that support the Ontario Agri-Food Innovation Alliance. The important work being done continues to develop innovative products and best practices for our farmers to improve the efficiency, profitability and sustainability of their operations and to support strong rural communities.

I know that this past year has not proceeded as anyone had expected, but it has emphasized the importance of responsive and robust food systems. Research and innovation will help to strengthen these systems, create jobs and further reinforce Ontario's agri-food reputation on the global stage.

Over the years, the Ontario Agri-Food Innovation Alliance has resulted in many research successes, and this year's edition of the Agri-Food Yearbook highlights just some of those latest accomplishments.

Thank you all for your dedication, and I wish you all continued success in the coming years.

Ernie Hardeman

Minister of Agriculture, Food and Rural Affairs
Government of Ontario



Welcome to Canada's food university, where our shared mission is to improve life.

At the University of Guelph, we are leaders in research and teaching to support the agri-food sector in Ontario, Canada and around the globe and to address some of the most pressing issues facing our world today.

Through cross-campus collaborations, our experts work to create a safe and sustainable global food system that ensures health and prosperity along the food chain from farmers to consumers. Those collaborations include our One Health approach that brings together varied disciplines to tackle global challenges at the intersection of human, animal and environmental health.

Our research partnerships extend to numerous organizations beyond campus and include our long-time alliance with the Ontario Ministry of Agriculture, Food and Rural Affairs. With OMAFRA funding provided through the Ontario Agri-Food Innovation Alliance, our experts solve real-world challenges and generate ideas and innovations that support and strengthen the agri-food sector locally and worldwide.

We take pride in the achievements of our researchers, teachers, students and partners at the University of Guelph. I encourage you to learn more about how agri-food research and innovation at U of G helps to ensure better lives for us all.

Dr. Charlotte Yates

President and Vice-Chancellor
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Research builds resilience

The Ontario Agri-Food Innovation Alliance believes research and innovation are at the heart of a dynamic, competitive and sustainable agri-food sector—at home and around the world. But research also breeds resilience in unpredictable ways.

Long-term, stable investment in agri-food and rural research—like the investment made through the Ontario Agri-Food Innovation Alliance—helps fuel innovative solutions to unexpected, pressing challenges and makes the agri-food sector nimbler and more responsive when these challenges have been overcome.

The stories on the first four pages of this publication show how existing research paths were quickly adapted to meet needs stemming from COVID-19. Mental health resources for farmers will help producers cope with new COVID-19 stressors. Research into avian influenza has been tweaked to gather data

about the disease. And hospitals have a quick, effective way to decontaminate personal protective equipment used on the front lines.

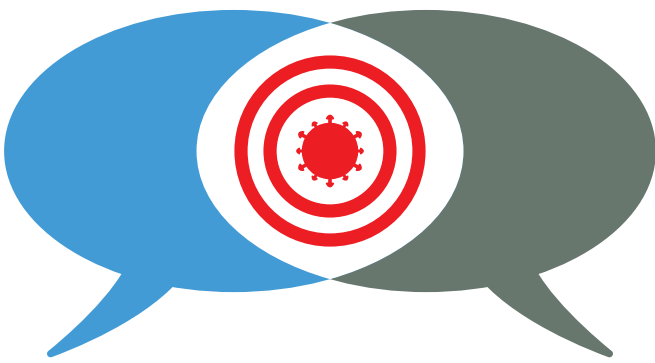
“University of Guelph researchers tackled challenges related to the COVID-19 pandemic head-on, demonstrating agility and resourcefulness to devise innovative solutions,” says Dr. Malcolm Campbell, vice-president (research). “Thanks to the ongoing, stable investment from the Ontario Ministry of Agriculture, Food and Rural Affairs, Alliance-funded research has yielded unexpected dividends in the face of a crisis, benefiting the agri-food sector and Ontarians and generating local solutions to global COVID-19 challenges.”



Hospitals have a quick, effective way to decontaminate personal protective equipment used on the front lines, thanks to Alliance-funded research.

Monitoring the spread of COVID-19 over Twitter

This social media tool can help detect pandemic hot spots



| By Mya Kidson

Social media gives us more than just a platform to share photos and status updates with friends and family. It also helps researchers and public health officials track outbreaks of infectious disease such as COVID-19.

A veterinary and computer science research team led by professors Dr. Rozita Dara, School of Computer Science, and Dr. Shayan Sharif, Department of Pathobiology, has developed a system using artificial intelligence (AI) and machine learning to detect outbreak locations and predict infectious diseases’

capacity to spread further.

Originally focused on tracking global outbreaks of avian influenza, the research has recently expanded to use social media to predict waves of COVID-19.

“Even with the distribution of vaccines, early warning systems are important,” says Sharif, “because they can help minimize the spread to different areas.”

An early detection system using social media or Google searches shows promise for tracking other fast-spreading diseases besides COVID-19.

For avian flu, AI has been used to gather tweets mentioning the disease; these tweets are then sorted and analyzed to show where the disease is spreading.

For the coronavirus causing COVID-19, AI has been used

to detect tweets containing keywords for signs and symptoms such as fever, aches and shortness of breath, helping researchers look for early indications of a rise in cases and, potentially, new waves.

The system allows researchers to gather valuable information about signs and symptoms even before laboratory results are determined. This data may then be used by officials to apply appropriate public health guidelines, which may involve closing borders or limiting the opening of non-essential businesses.

The research on avian influenza is funded in part by the Ontario Ministry of Agriculture, Food and Rural Affairs through the Ontario Agri-Food Innovation Alliance.



Online mental health supports are more important now than ever.

Helping farmers cope with the pandemic

| By Karli Longthorne

The COVID-19 pandemic has taken a toll on mental health in rural Ontario—particularly on farmers. University of Guelph research has shown farmers are already at high risk for conditions such as depression and anxiety. The pandemic has exacerbated stressors related to their jobs, including food chain disruptions, temporary foreign worker shortages, low grain prices and a dearth of rural mental health professionals.

To help address poor mental health in agriculture, University of Guelph professor Dr. Andria Jones-Bitton, Department of Population Medicine, and post-doc Dr. Briana Hagen have partnered with the Canadian Mental Health Association, Ontario division, to make their “In the Know” training available across the Ontario agricultural community. It’s the continuation of research that began in 2015; Jones-Bitton is considered a leader and pioneer in this field.

In the Know’s goal is to develop mental health literacy among farmers and the people who work with them. The training is

intended to increase knowledge of common mental illnesses, help people recognize the associated signs and symptoms and connect them with appropriate resources for help.

“As we continue to adapt to COVID-19 and bounce back from the restrictions and the negative impact it has had, mental health literacy will be really important now and in the future,” says Jones-Bitton.

This program can also help users start a conversation with someone who may be struggling with mental health challenges and connect them with appropriate supports. Farmers have described a number of barriers to seeking help for mental illness, such as challenges in connecting with their family doctor or specialized counselling services at a distance.

In a recently published report, “Rural mental health during COVID-19,” Jones-Bitton and Dr. Kathleen Kevany, a professor at Dalhousie University and the president of the Canadian Rural Revitalization Foundation, recommended that these supports be moved online during COVID-19.

However, Jones-Bitton notes that poor internet access in many rural areas remains a

barrier to online help.

“There are very few things that are as integral to a healthy population and environment as agriculture, with farmers being responsible for providing safe, high-quality food,” she says. “And we know that they experience a high degree of stress related to poor mental health, largely in relation to the production of that food, so it’s important that farmers are provided with the support that they need and deserve.”



Dr. Andria Jones-Bitton

In the Know was funded by the Egg Farmers of Ontario, Ontario Pork, Ontario Sheep Farmers, the Ontario Federation of Agriculture, and the Ontario Ministry of Agriculture, Food and Rural Affairs through the Ontario Agri-Food Innovation Alliance.

Trillium Mutual donated \$50,000 to the Canadian Mental Health Association, Ontario division, to partner with researchers in sharing In the Know with Ontario agricultural communities.

The rural mental health report is available at crrf.ca/ri-mentalhealth.



One Clean Flow device can sanitize up to 800 N95 masks per hour.

Front-line workers get boost with food scientists' sanitizing technology

Inspired by the call to help battle the coronavirus, U of G researchers adapted their food safety technology to decontaminate N95 masks. The mask-sanitizing unit, Clean Flow Healthcare Mini, was born.

| By Dianne Priamo

When U of G food scientists Dr. Keith Warriner and Dr. Mahdiyeh Hasani heard about front-line workers' battle to secure personal protective equipment (PPE) to shield themselves from the COVID-19 virus, a light went on. They thought they could help—and they did.

The story starts nearly 15 years ago, when Warriner developed a food safety technique called

the gas phase-advanced oxidation process. It generates highly antimicrobial hydroxyl radicals from the ultraviolet degradation of hydrogen peroxide and ozone.

This process was commercialized in 2015 as the Clean Flow system and used to decontaminate apples destined for candied apple production, through a collaboration with Paul Moyer of Moyers Apple Products. Clean Works Inc., a company established by Moyers Apple Products

and Court Holdings, refined the technology. The Clean Flow system found applications in decontaminating a broad range of fresh produce, from lemons to strawberries.

Flash forward to 2020 and the COVID-19 pandemic. Inspired by the call to help battle this virus, Warriner and Hasani adapted the technology to decontaminate N95 masks. The Clean Flow Healthcare Mini—a mask-sanitizing unit—was born.

Say hello to more automated shopping

It's effective at limiting contact in grocery stores during the pandemic

I Mya Kidson

Technological advancements in shopping systems, particularly automated shopping, have shown value during the COVID-19 pandemic. Dr. Simon Somogyi, a professor in the School of Hospitality, Food and Tourism Management, has looked at consumer behaviour patterns in grocery stores and how technological advancements can limit contact between shoppers.

Self-checkout machines were originally established in grocery stores to speed up shopping and increase convenience for consumers. In the pandemic, the machines also help eliminate direct interaction with cashiers and can reduce contagion risk if regularly cleaned.

For customers hesitant to shop in-store, food box subscriptions have been a great alternative, says Somogyi. People can order online, and their food box is shipped directly to their door, contact-free. Food boxes such as HelloFresh and Goodfood allow people to choose recipes and receive pre-measured ingredients to reduce food waste.

Somogyi says further logical advancements he expects to see in retail store environments include “smart” packaging. Also called intelligent packaging, this technology involves real-time data enabling companies to identify and track objects with identification tags.

With support from the Gryphon’s LAAIR program, he is learning how customers use their smartphones and other devices to scan tags and instantly pay for products instead of purchasing them at a checkout lane.

Consumers wary of in-store shopping have also driven a rise in online food sales. Numerous stores and restaurants now offer curbside pickup and delivery options. Online shopping also enables smaller businesses to adapt to less-than-optimal conditions.

These alternative shopping methods are convenient and improve safety during the pandemic, says Somogyi, adding that automated shopping is likely here to stay.

This research is funded by the Ontario Ministry of Agriculture, Food and Rural Affairs through the Ontario Agri-Food Innovation Alliance.

“My thoughts went right to our technology,” says Warriner. “It ticks all the boxes on what constitutes an ideal mask decontamination method, and I knew the research could make a difference.”

Proper sanitation is essential when reusing PPE such as masks. Warriner’s device can sanitize up to 800 N95 masks in one hour, all without damaging the integrity of the masks. After being tested and approved for mask decontamination by Health Canada in April 2020, Clean Flow units were delivered to hospitals and health-care facilities across the country.

Clean Works, the Niagara-based company that produces Clean Flow, increased production to meet the growing demand. As well, it’s expanding to a new facility in St. Catharines, partly supported by the Ontario Moving Forward Fund. The expansion will create at least 20 new jobs as manufacturing ramps up.

Warriner believes that his innovation could be further modified to handle other types of PPE or even health-care items like face shields, goggles, catheters or surgical gowns, in addition to consumer goods such as electronics. A Niagara go-kart track is even using the system to decontaminate crash helmets.

Warriner says the applications are endless. “It’s a gentle process. It’s waterless, it’s effective and it’s very quick.”

This research was funded by Mitacs, Ontario Centres of Excellence, the Natural Sciences and Engineering Research Council, and the Ontario Ministry of Agriculture, Food and Rural Affairs through the Ontario Agri-Food Innovation Alliance.



Self-checkout machines reduce contact between shoppers and employees.

“The pandemic has created challenges when it comes to implementing safety protocols in stores,” says Somogyi. “COVID-19 has shown us the value of alternative shopping methods when physical distancing measures need to be implemented.”

Grocery stores are an essential business, so they were required to quickly change their operations to allow for physical distancing when the pandemic started. Some turned to self-checkout machines and online food box subscriptions.

Sampling wild bee pollinators in commercial fruit crops

Wild bee communities in Ontario apple orchards can assist in pollination services

| Dianne Priamo

Apple crops rely on pollinators to reproduce, so growers often spend thousands of dollars every year to house and manage honeybee colonies. However, previous studies have shown that, when diverse and abundant, wild bees can provide significant pollination services in orchards. Depending on the apple variety, growers may be able to use fewer hives or none at all.

Working with OMAFRA staff, researchers from the University of Guelph set out to explore wild pollinators in Ontario orchards and to encourage management practices that will help these species thrive.

In summer 2019, undergraduate student Sisley Irwin worked with OMAFRA specialists Hannah Fraser and Kristy Grigg-McGuffin and Dr. Nigel Raine, School of Environmental Sciences, to assess native bee abundance and diversity in Ontario apple orchards. They focused on observations and collections through the bloom period of the ‘Gala’ variety as well as collections of co-blooming varieties.

“We wanted to develop baseline information on who the various visitors to apple blossoms might be,” says Irwin. “Knowing which native bees are present in these fruit crops can provide an opportunity to encourage best management practices to support the native species and their needs.”





Native pollinator species better suited to local climate and weather conditions may be more effective than managed honeybee colonies.

Previous Ontario orchard studies showed scant wild bee activity, but the sampling methods underestimated both abundance and diversity of those pollinator species. Irwin’s study, conducted on four Norfolk County orchards, used more extensive sampling that accounted for variations in bee activity with bloom stage, apple variety, weather conditions and time of day.

The researchers identified 32 species among



Tips for encouraging pollinators

-  Make small changes to orchard management. Plant native flower species nearby and create field margins with open dirt patches.
-  Practise targeted integrated pest management, including using non-chemical alternatives when possible and avoiding spraying when bees are active.
-  Pollinators are more active on warm, sunny days. Consider this factor when evaluating native pollinator presence.
-  Sampling at the right time is important for successful pollinator assessment. Sample extensively throughout the bloom period and across multiple apple varieties.

the orchards. Certain orchards had more wild pollinators than others, possibly due to differences in the landscape ecology of the sites and pest management practices – factors that warrant further study.

“The landscapes between sites were different,” says Irwin. “Many of the wild bees represented in the surveys are ground-nesting species, and greater levels of available nesting habitat can be critical in maintaining these populations.”

“By assessing populations of wild pollinators on their own farms and making small changes in management of their surroundings, growers can improve native bee success and improve pollination on their orchards,” says Irwin.

This research project was funded by the Ontario Ministry of Agriculture, Food and Rural Affairs through the Ontario Agri-Food Innovation Alliance.



Research on parasitic wasps by Dr. Rebecca Hallett (inset) can help mitigate swede midge invasions in canola crops.

Making wasps feel at home — that’s good for canola

| Owen Roberts and Rob O’Flanagan

In 2012, northern Ontario canola farmers noticed an unusual pest creeping into their fields, one they’d never before seen—and one that didn’t respond to conventional pesticides.

While they didn’t know what it was, it quickly became clear it was decimating their production. They needed help, and they turned to University of Guelph entomologist Dr. Rebecca Hallett.

That outreach turned into a productive partnership. Through lab and field work, she and her team not only identified the pest as the swede midge but proceeded to work with growers to create a sustainable, environmentally friendly management plan—which now includes using parasitic wasps that prey on the midge.

The knowledge growers gained from Hallett’s work also prompted them to expand their acreage of fall-planted winter canola. This crop grows quickly in the spring and is hardy enough by the time the swede midge arrives—around the second or third week in June—that it can withstand insect pressure.

Cache Bay-area grain and oilseed farmer Hubert Beaudry, president of the Ontario Canola Growers’ Association, says Hallett’s research has made a big difference to the industry.

“Dr. Hallett’s research helped growers understand the life cycle of the swede midge and encouraged us to manage the pest in a more economically and environmentally friendly way, by adopting best management practices that are more efficient than using chemical control to manage swede midge,” he says. “The discovery of a parasitic wasp was also great news that swede midge could eventually be controlled biologically.”

In the School of Environmental Sciences, Hallett focuses on agricultural ecosystem health through improved pest management.

“The goal is always to develop management programs that can reduce pest populations below levels that are economically damaging and to do that by minimizing reliance on pesticides,” she says.

She’s interested in all things related to herbivorous insects and agroecosystems, including chemicals in plants that influence insect interactions, factors affecting the suc-

cess and population dynamics of invasive insects, and impacts of natural enemies on pest populations.

One aspect of her work with canola has involved studying the invasive parasitic wasp that attacks the swede midge. Along with the Ontario Ministry of Agriculture, Food and Rural Affairs, she’s looking at the impact of the wasp on the pest population and how to make canola fields more hospitable to the wasp.

Another aspect of her research looks at providing wasp food sources, such as nectar-providing plants like sweet alyssum—attracting more of the insects to canola fields and enhancing their longevity.

Hallett is also an expert in the pepper weevil, which decimates pepper crops in the greenhouse industry, and the cyclamen mite, which damages strawberry crops. In current studies, she hopes to improve detection methods and reduce pest damage.

Hallett’s research was funded in part by the Ontario Canola Growers Association and the Ontario Agri-Food Innovation Alliance, a collaboration between the Government of Ontario and the University of Guelph.



Farmer-researcher Heather Newman holding a Chantecler chicken. In 2019 Newman tested a reduced protein ration diet on her Chantecler chickens, a dual-purpose bird and one of Canada's only heritage breeds of chickens.



Farmer-researcher Ronaldo Eleazar. Eleazar and his wife, Myriam, conducted a screening trial in 2020 to narrow down varieties of amaranth that grow well in southern Ontario. They will continue their investigations with a randomized, replicated multi-farm variety trial of the top varieties in 2021.



Farmer-researcher Ryan Spence and farm apprentice Becky Porlier seeding peas and oats in late August 2019 as part of Spence's randomized complete block trial looking at no-till broccoli production in northern Ontario.

Farmer-led research programs highlight on-farm innovation

“No one knows their farm better than the actual farmer,” says Dr. Erin Nelson. “And no one knows the specific issues that go on at the farm more than the actual farmers do.”

| Mya Kidson

Field trials on the farm follow applied research projects once they leave the lab bench. Field trials are a great way to gather on-farm perspectives, and the province-wide network of research centres owned by the Government of Ontario through its agency, the Agricultural Research Institute of Ontario, is home to many innovative field studies.

A complementary approach is for producers to take the lead

in developing research questions and conducting projects on their own farms, working in cooperation with a support organization.

Dr. Erin Nelson, Department of Sociology and Anthropology, and her team—Dr. Sarah Hargreaves, research director with the Ecological Farmers Association of Ontario (EFAO); Alexandra English, executive director of EFAO; and Dr. Anne Bergen, director of Knowledge to Action Consulting Inc.—are analyzing the impacts of such programs on the participating

farmer-researchers and on others who learn about the on-farm research results.

“No one knows their farm better than the actual farmer,” says Nelson. “And no one knows the specific issues that go on at the farm more than the actual farmers do.”

The farmer-led research approach has its roots in the global South, particularly Latin America. More recently, the methodology has grown in popularity around the world, including in Canada.

The EFAO has been at the forefront of bringing farmer-led research to Canada, initiating a program in 2016. To date, the organization has supported more than 70 farmers in conducting more than 100 scientific trials on their farms; its efforts were recognized with a 2019 Excellence in Agriculture Award from the Ontario Ministry of Agriculture, Food and Rural Affairs.

Creating opportunities for farmers to take the lead on research projects means they can target specific challenges that may not present themselves in wider studies—and they can do so in a way that is practical for their farm and transferable to others. Ontario is rich in diverse and unique agriculture, along with varying soil types, microclimates and many agricultural commodities. On-farm studies accommodate that variability, says Nelson.

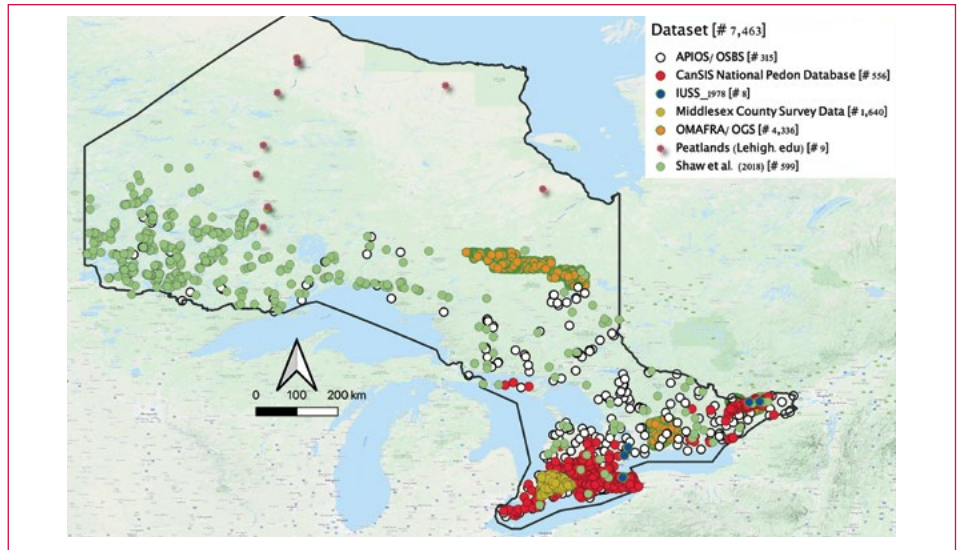
This research also allows farmers to collaborate with each other and to have researchers visit to discuss challenges and opportunities. Since their most trusted source of information is other farmers, farmer-led research has knowledge transfer built in and farmers feel confident to share their findings after going through the rigorous steps to conduct research.

As for the effectiveness of this approach, Nelson and her team have surveyed 140 farmers connected to EFAO’s farmer-led research program and are compiling the results now.

“The farmers are the backbone of this work,” she says. “They’re doing incredibly innovative things on their farms.”

The full research reports, including audio summaries by farmer-researchers, can be found at efao.ca/research-2020.

This research project is funded in part by the Ontario Ministry of Agriculture, Food and Rural Affairs through the Ontario Agri-Food Innovation Alliance.



This image shows the points across Ontario where soil data is available. Dr. Asim Biswas will use this data to develop provincial maps.

Digital mapping offers a sharp view of Ontario soil

Maleeka Singh

Soil mapping provides farmers and policy makers with detailed information on the condition and characteristics of land. Traditional soil mapping, in which a surveyor collects soil samples and maps their locations, was an important first step toward better soil conservation and environmental sustainability.

However, it doesn’t provide the kind of broad picture now possible through digital soil mapping based on greater computational power and availability of environmental data.

Digital soil mapping offers an array of advantages such as a more objective approach to characterizing soil and the ability to predict soil condition and properties.

“Traditional soil mapping is like painting with a big brush,” says Dr. Asim Biswas, a professor in the School of Environmental Sciences. “Digital soil mapping can help us create a standardized and unified soil map across Ontario with granularity.”

Digital soil mapping allows for fine resolution, using mathematical models, statistical calculations and satellite data to create a soil database and understand the factors that control soil development.

Biswas and his team aim to create an

Ontario Soil Information System and Ontario soil map at 100-metre resolution, meaning each pixel is 100 metres by 100 metres. They hope to complete the project by early 2022.

To create the soil database and a data-sharing protocol, Biswas and his team have collected more than 7,500 data points across Ontario. This will help farmers and policy makers develop appropriate policies to prioritize soil management, including soil conservation policies.

Biswas expects his findings to be available online to policy makers, conservation authorities, farmers, scientists and the public.

Asim Biswas’s research team includes students and researchers at the University of Guelph as well as collaborators from the Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA); Agriculture and Agri-Food Canada; the Ontario Ministry of the Environment, Conservation and Parks; McGill University; Dalhousie University; University of Saskatchewan and international partners.

This research is funded by the Natural Sciences and Engineering Research Council, the Canada-France exchange program, the Indo-Shastri exchange program and OMAFRA through the Ontario Agri-Food Innovation Alliance.

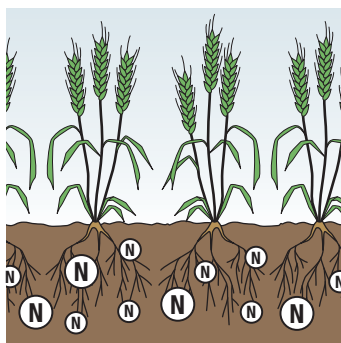


Years of data collected from long-term rotation test plots can inform best practices for farmers.

Celebrating 65 years of long-term rotation research

| Caitlin Ford

Changes in soil productivity can take years to manifest, which means on-farm trial and error for different rotations is challenging for farmers to conduct independently. That's where long-term research comes in, to help farmers have the healthiest soil, highest yield and greatest profits.



The overall goal for these test plots is to improve crop resilience and benefit the agri-food sector by lowering costs, increasing profits and improving soil health.

Decades-long investigations have been conducted at the Ontario Crops Research Centres in Ridgetown and Elora. These government-owned stations have been operating long-term rotation plots (LTRPs)—fields that rotate between a number of different crops—to study improvements in commodities produced there.

The overall goal for these test plots is to improve crop resilience and benefit the agri-food sector by lowering costs, increasing profits and improving soil health.

The research centres where these test plots are located are owned by the Agricultural Research Institute of Ontario

and managed by the University of Guelph through the Ontario Agri-Food Innovation Alliance. University of Guelph researchers have been measuring crop performance at the Ridgetown and Elora sites for 25 and 40 years, respectively.

With 65 combined years of LTRP research data available, farmers are able to see the tangible benefits of crop rotation without the need for every farm to conduct its own trial.

Dr. Bill Deen, a professor who recently retired from the Department of Plant Agriculture, ran experiments at the Elora site from 2000 to 2020. He oversaw numerous long-term projects including a rotation trial that began in 1980, a tillage trial started in 1976 and a nitrogen in maize trial started in 2008.

“Whenever you’re looking at cropping systems’ effects, they have to be compared side by side in the same environment, otherwise you start comparing across environments and they become

confounded,” he says. “That is the real value of the LTRPs—you can compare the impact of system changes within a given soil and system environment.”

The results of LTRP trials at the Elora and Ridgetown sites have shown great success in determining which rotations yield the healthiest crops and soil. This research has specifically determined that adding a small grain cereal like wheat into soybean and corn rotations is especially beneficial.

Other key findings include improvements in nutrient return, drought-resilient crops, improved cover crops and increased available nitrogen in the soil. These results translate to direct cost-saving benefits for farmers who can expect increased yields of crops that are more resilient during dry seasons and require less fertilizer to grow.

“Society will benefit if agriculture strongly adopts rotation diversity,” said Deen. “A good sustainable system has to start with rotation diversity. Good rotations increase yield, and LTRPs definitely provide insights into what constitutes a resilient cropping system.”

For more information, visit uoguelph.ca/alliance/crop-rotation.



Stable soil, high yields and sustainability

| By Dianne Priamo

For decades, researchers carrying out long-term crop rotation trials have found that diversification improves yield stability. Now, a long-term study is under way at the Ontario Crops Research Centre—Elora using new technology to investigate the mechanisms at play in the soil that account for these improvements. The ultimate goal is to determine best practices for producers.

Since 2016, Dr. Claudia Wagner-Riddle, research technician Sean Jordan, their collaborators and a team of graduate students from the University of Guelph have observed the effects of different crop rotations and cover crops using 18 soil lysimeters—one-square-metre cylinders embedded 150 cm into the soil to give unique insight into water gain and loss. This study is the first of its kind in North America.

“There’s evidence that diverse crop rotation pays off long-term, but it’s not clear why that’s the case,” says Wagner-Riddle, a professor in the School of Environmental Sciences. “We speculate that it’s related to water, so the soil lysimeter facility is the perfect way to investigate this factor and its effects on the soil.”

Sensors embedded in each lysimeter at five depths help the researchers “see” soil water tension, carbon dioxide concentration, temperature and electroconductivity. Water samples are also collected at these depths to measure nitrate and phosphate content, while air sampling occurs at the soil surface to monitor greenhouse gas flux.

The sensors yield millions of data points every day, with processing and quality assurance overseen by research associate Shannon Brown.

“The biggest challenge is the constant technical operation of this facility,” says Wagner-Riddle. “It takes many people to make sure



Soil lysimeters give insight on soil health, air and water quality.

everything is working, but the reward is that we get a very comprehensive data set.”

The 18 lysimeters are split between two soil types: loamy soil extracted on site and sandy soil from around Cambridge, Ont. A number of plots in each soil type use a conventional crop rotation of soybean-soybean-corn, while the others use a more diverse rotation of soybean-winter wheat-corn with cover crops planted in the off season—a mix of oats, daikon radish, crimson clover or rye grass.

The researchers intend to continue studying the effects of crop rotation on a long-term basis. Although the project has undergone only one full crop rotation, data analysis from 2017 to 2018 revealed significant advantages in the diverse crop rotation.

Results from this period showed a remark-

able 70-per-cent decrease in nitrate loss in the diverse rotation using cover crops compared to the conventional crop rotation. Because it was a particularly wet year, nitrogen that would have leached from the soil was instead taken up by the cover crops and then remained in the soil as part of the plant biomass.

Wagner-Riddle says the results won’t be this striking every year. But the accumulation of these effects over time is expected to benefit producers economically by reducing fertilizer use and improving yield stability as the crops become more resilient to extreme weather events—not to mention the environmental benefits, like reducing nitrogen runoff into water sources and recapturing atmospheric carbon dioxide back into the soil.

“In the next few years, we expect to have some really interesting analysis coming out of this facility, which will help both producers and the environment,” says Wagner-Riddle.

Collaborators on this research include graduate student Jared LaPierre; co-adviser Dr. Hugh Henry,

Western University; the Ontario Soil and Crop Improvement Association; and Grain Farmers of Ontario. The lysimeter facility was funded by the Canada Foundation for Innovation and the Ontario Ministry of Research, Innovation and Science.

This project is funded by an NSERC Strategic Partnership Grant and the Ontario Ministry of Agriculture, Food and Rural Affairs through the Ontario Agri-Food Innovation Alliance.

The Ontario Crops Research Centre – Elora is owned by the Government of Ontario through its agency, the Agricultural Research Institute of Ontario, and managed by the University of Guelph through the Ontario Agri-Food Innovation Alliance.



M.Sc. student Matt Stewart at the long-term cover crop experiment.



A long-term look at cover crops

| Dianne Priamo

From mid-summer until the following spring, some Ontario fields lie fallow while others are covered with crops designed to rejuvenate the soil. University of Guelph researchers are investigating various combinations of cover crops to see which ones offer the best environmental and economic improvements.

This long-term study is being conducted at the Ontario Crops Research Centre sites in both Elora and Ridgetown, coordinated by plant agriculture professors Dr. Manish Raizada and Dr. Dave Hooker, respectively.

In total, they're overseeing more than 1,100 research plots. Numerous faculty members from the Department of Plant Agriculture and the School of Environmental Sciences are involved, with the potential for even more.

"We've created a research platform with this project," says Raizada.

Unlike other cover crop studies, Raizada and Hooker's research employs multi-mixes, or different combinations of cover crops among two crop rotations and two tillage systems in the long term. Three of Ontario's main field crops—soybeans, corn and winter wheat—are being grown in different rotations, followed by either a variety of cover crops or the same cover crop each year.

Factors being studied include drought resiliency, soil nitrogen status and organic matter, surface runoff, silage value and porosity—the ability of water to penetrate through the soil. The researchers are directly comparing the effects of multi-mixes and sole cover crops to

determine which rotations reap the greatest environmental benefit, while also providing economic value to grain producers.

So far, the project has undergone only a few complete crop rotation cycles. Although the benefits of cover crops are expected to accrue over a longer period, Raizada says, preliminary findings point toward improved nitrogen availability in the soil.

The researchers have also observed many similarities between the trials in Elora and Ridgetown. The breadth of temperature and weather conditions experienced between the two locations means the results of this research will apply to many temperate regions worldwide.

"I believe our findings will be quite generalizable, not just in southern Ontario but in temperate environments around the world," says Raizada.

Collaborators include Drs. Tejendra Chapagain, Bill Deen, Kari Dunfield, Erik Glemser, Peter Johnson, Ralph Martin, Kim Schneider, Laura Van Eerd, Claudia Wagner-Riddle and Anne Verhallen, and officials from the Grain Farmers of Ontario.

This research project is funded by Grain Farmers of Ontario, the Canada First Research Excellence Fund, the Natural Sciences and Engineering Research Council, and the Ontario Ministry of Agriculture, Food and Rural Affairs through the Ontario Agri-Food Innovation Alliance. The Ontario Crops Research Centre is owned by the Agricultural Research Institute of Ontario and managed by the University of Guelph through the Ontario Agri-Food Innovation Alliance.

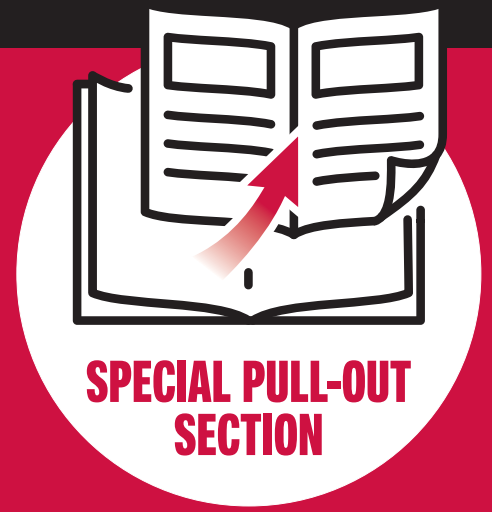
Answering cover crop questions

- Long-term crop and soil research at the Ontario Crops Research Centre sites in Elora and Ridgetown answers questions about soil health, tillage and environmental impact of cover crops.
- The findings from these trials are summarized in the tear-out infographic series Crop Rotation Counts (pages 15 to 18), created by the Ontario Agri-Food Innovation Alliance in partnership with Soils at Guelph.
- While crop rotation does count—for increasing yields, improving resilience during dry years, improving soil health and maintaining crop yield with less nitrogen applied—there are other established environmental benefits of cover cropping, such as reducing soil erosion, reducing nutrient loss, reducing pest populations and improving water management, in addition to sequestering soil carbon and potentially mitigating climate change.



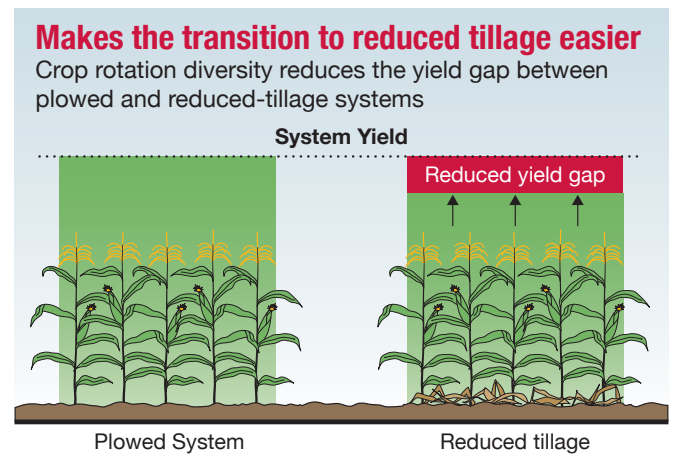
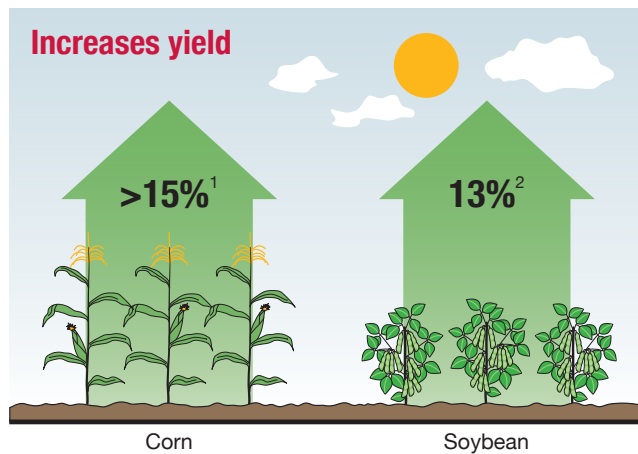
Higher yield

Improve yield of corn and soybean by adding a small grain cereal (e.g., winter wheat) or a forage crop to your farm's corn-soybean rotation. Not only do you reap the benefits of improved yield, but research also shows that these rotations help ease the transition to reduced tillage and enable the inclusion of cover crops.

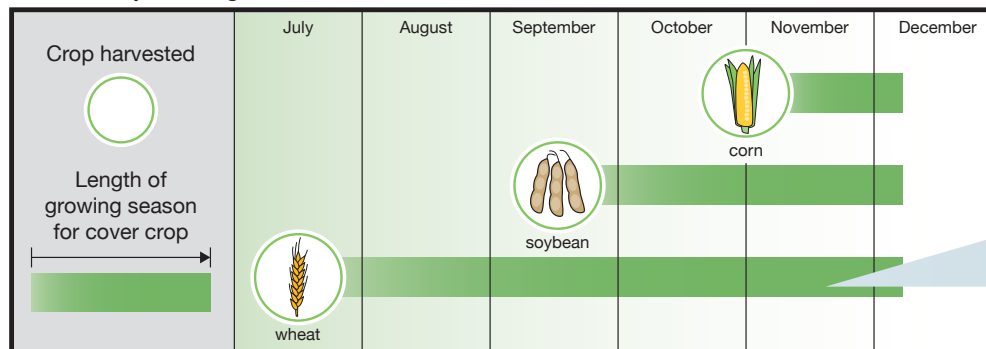


SPECIAL PULL-OUT SECTION

Benefits of adding a small grain cereal or forage crop to your corn-soybean rotation:



Cover Crop Growing Seasons



Facilitates inclusion of cover crops
Earlier harvest date of wheat provides more time for cover crop to grow before the winter

Sources:

- Gaudin A.C.M., Janovicek K., Deen B., Hooker D.C. (2015). Wheat improves nitrogen use efficiency of maize and soybean-based cropping systems. *Agriculture, Ecosystems and Environment* 210:1-10.
- Gaudin A.C.M., Tolhurst T.N., Ker A.P., Janovicek K., Tortora C., Martin R.C., Deen W. (2015). Increasing crop diversity mitigates weather variations and improves yield stability. *PLoS ONE* 10(2):e0113261.



Want to dig deeper?
Read the scientific papers, available at uoguelph.ph/crop-rotation.



IMPROVE LIFE.

The Ontario Crops Research Centres in Elora and Ridgetown are part of the province-wide network of research centres owned by the Government of Ontario through its agency, the Agricultural Research Institute of Ontario. The centres are managed by the University of Guelph through the Ontario Agri-Food Innovation Alliance.

Infographics created by the Ontario Agri-Food Innovation Alliance in collaboration with SOILS AT GUELPH.

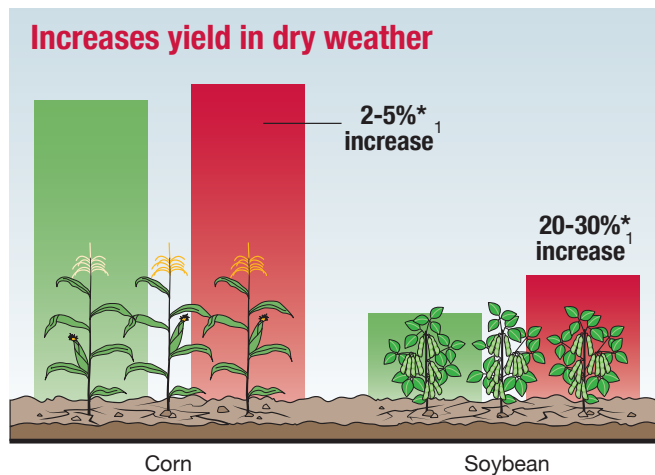
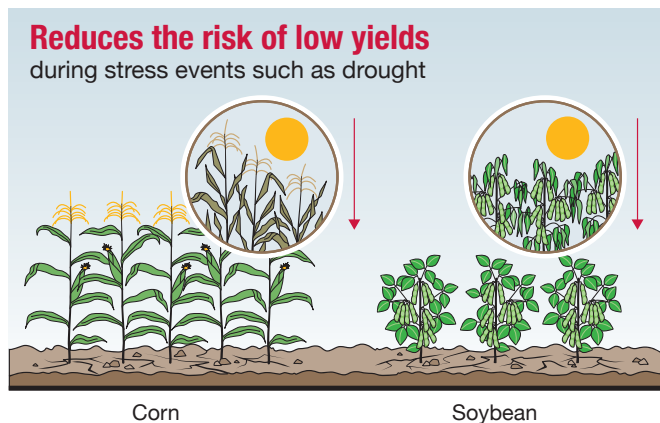
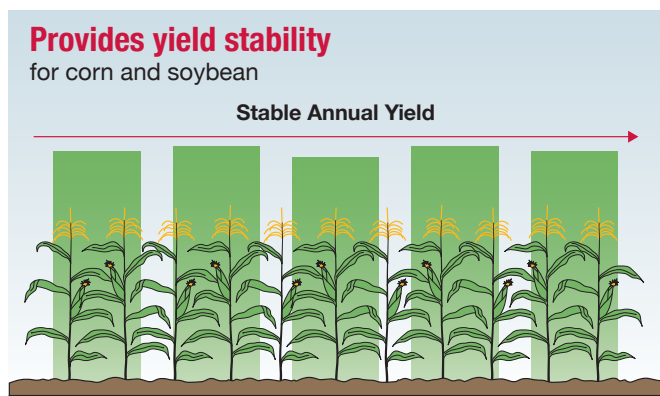




More resilient during dry years


Prepare for drought years by adding a small grain cereal, such as winter wheat, to your farm's corn-soybean rotation. Research shows that during dry years, corn and soybean yields are higher and more stable when they are part of a rotation with cereals or forage crops. There is also a lower risk of crop failure when these rotations are practised. You can't predict the weather, but you can increase your farm's resilience to drought.

Benefits of adding a small grain cereal or forage crop to your corn-soybean rotation:



Rotations:
■ corn-soy ■ corn-soy-wheat * depending on the tillage system

Sources:
¹ Gaudin A.C.M., Tolhurst T.N., Ker A.P., Janovicek K., Tortora C., Martin R.C., Deen W. (2015). Increasing crop diversity mitigates weather variations and improves yield stability. *PLoS ONE* 10(2):e0113261.

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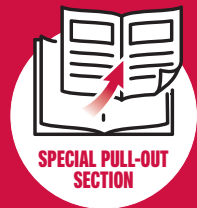


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Infographics created by the Ontario Agri-Food Innovation Alliance in collaboration with SOILS AT GUELPH.

IMPROVE LIFE.



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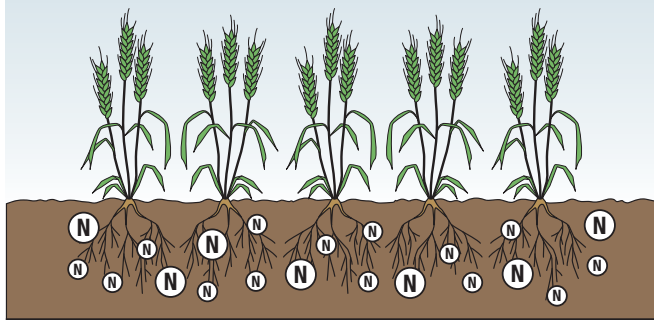
Improves soil nitrogen-use efficiency

Reduce your dependence on nitrogen fertilizer for corn by adding a small grain cereal (e.g., winter wheat) to your farm's corn-soybean rotation and underseed it to red clover. Research shows that rotations with wheat and red clover have more available soil nitrogen for your corn crop. Reduce expenses and avoid paying for increasingly costly fertilizer by improving your rotation.

Benefits of adding a small grain cereal to your corn-soybean rotation:

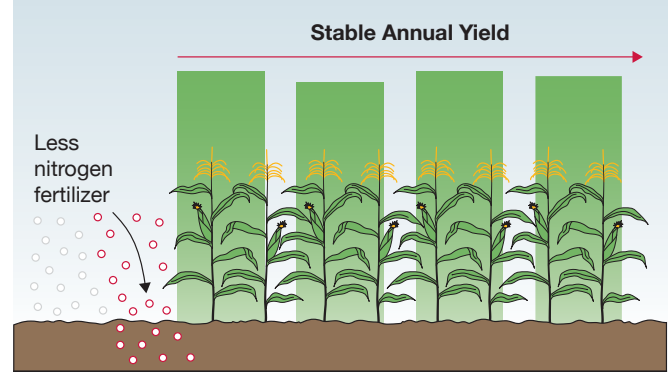
Increases available soil nitrogen

partly because winter wheat increases soil organic matter and improves soil health



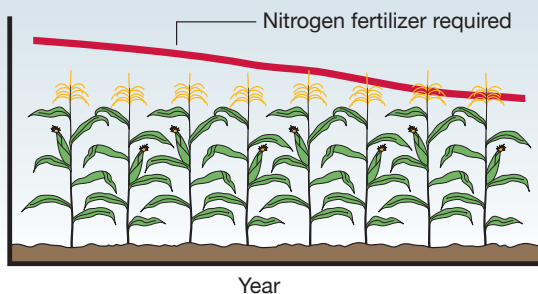
Maintains crop yield

with less nitrogen applied



Reduces fertilizer costs

thanks to reduced dependence on nitrogen fertilizer



Sources:

- 1 Van Eerd L.L., Congreves K., Hayes A., Verhallen A., Hooker D. (2014). Long-term tillage and crop rotation effects on soil quality, organic carbon, and total nitrogen. *Canadian Journal of Soil Science* 94:303-315.
- 2 Gaudin A.C.M., Janovicek K., Deen B., Hooker D.C. (2015). Wheat improves nitrogen use efficiency of maize and soybean-based cropping systems. *Agriculture, Ecosystems and Environment* 210:1-10.



Want to dig deeper?

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Infographics created by the Ontario Agri-Food Innovation Alliance in collaboration with SOILS AT GUELPH.



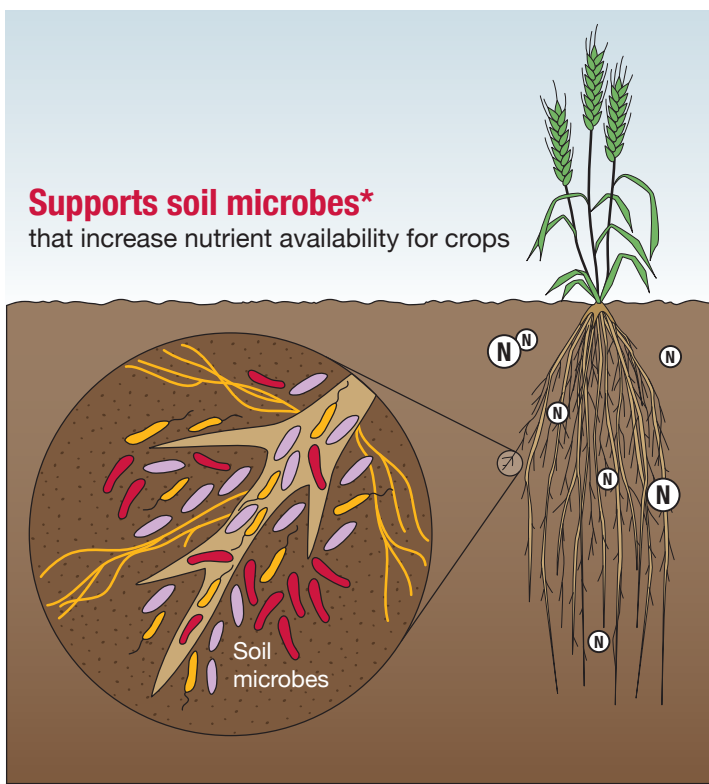
IMPROVE LIFE.



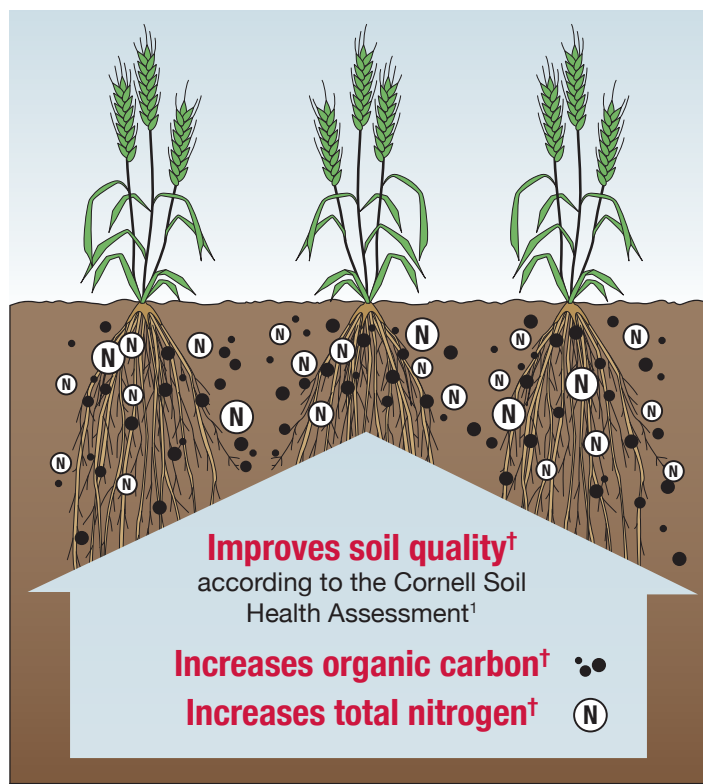
Improves soil health

Improve soil quality by adding a small grain cereal (e.g., winter wheat) or a forage crop to your farm's corn-soybean rotation. Research shows that these rotations increase overall soil health. When you add winter wheat into your rotation and combine it with reduced tillage, it leads to higher levels of total nitrogen and organic carbon in the soil and benefits soil microbes. Make your farm more resilient and improve soil health for the future of your farm by diversifying your rotation and reducing tillage.

Benefits of adding a small grain cereal or forage crop to your corn-soybean rotation:



* Crop rotation with small cereal or forage crop



† Crop rotation with small cereal or forage crop + reduced tillage

Source:

1 Van Eerd L.L., Congreves K., Hayes A., Verhallen A., Hooker D. (2014). Long-term tillage and crop rotation effects on soil quality, organic carbon, and total nitrogen. *Canadian Journal of Soil Science* 94:303-315.



Want to dig deeper?

Read the scientific papers, available at uoguelph.ca/crop-rotation.

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Infographics created by the [Ontario Agri-Food Innovation Alliance](http://OntarioAgri-FoodInnovationAlliance.ca) in collaboration with [SOILS AT GUELPH](http://SOILS.AT.GUELPH.ca).



IMPROVE LIFE.



Dr. Laura Van Eerd's long-term cover crop experiment at Ridgetown Campus



Economics suggests cover crops can pay off

| Dianne Priamo

The costs associated with cover crops—seed, equipment and labour—may deter farmers from using them. But field trials at the University of Guelph have demonstrated that in the long run, certain cover crops can boost yields of main crops and offset these costs.

In 2007, Dr. Laura Van Eerd established two field studies at the Ontario Crops Research Centre—Ridgetown, implementing five cover crop treatments—a control (no cover crop), oats, radish,

cereal rye and a mixture of radish and cereal rye—in a rotation consisting of processing vegetable crops and grain crops.

Her colleague Dr. Richard Vyn used yield data from each of the eight years, as well as the additional costs, to determine economic impacts.

On average across all crops, the radish and radish and rye mixture sparked increases in yield and profit. However, once broken down into crop types, yield increases were found only in processing vegetable crops while the grain crops showed no increase in yield, resulting in lower profits.

These results suggest that while there's an economic benefit from cover crop use over the eight years, grain producers may need financial incentives to plant cover crops on their farms.

“In order to accurately inform producers on the impacts of cover crops on their bottom line, I think it really is key to expand this research to more locations across Ontario,” says Vyn.

Van Eerd's research is now focused on evaluating how soil carbon gains observed in this long-term cover crop experiment might contribute to crop resiliency to weather extremes, such as drought tolerance.

This research was funded by the Natural Sciences and Engineering Research Council, Mitacs Elevate program, Grain Farmers of Ontario, Ontario Processing Vegetable Growers, and the Ontario Ministry of Agriculture, Food and Rural Affairs through the Ontario Agri-Food Innovation Alliance. The Ontario Crops Research Centre—Ridgetown is owned by the Agricultural Research Institute of Ontario and managed by the University of Guelph through the Ontario Agri-Food Innovation Alliance, a collaboration between the Ontario government and the University of Guelph.



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Dr. Manjusri Misra in the Bioproducts Discovery and Development Centre.

Biocomposites make vehicle manufacturing greener

Biocomposites combine bio-based fibres with plastic resins to create new materials that are more sustainable. Fibres come from sources normally considered waste, such as apple pomace and corn husks as well as soy-based oil and proteins.

| Maleeka Singh

Plastic has helped the automotive industry trim millions of kilograms of fuel-wasting weight from vehicles and keep production costs in check. But as the spotlight falls on other environmental aspects of car and truck manufacturing, the University of Guelph is showing leadership in creating eco-efficient materials that can further reduce costs and waste.

Biocomposites combine bio-based fibres and other bio-based materials with plastic resins to create new materials that are more sustainable. Bio-based materials come from renewable sources, including wheat straw, corn husks, and soy and corn processing co-products.

These biocomposites are being used in injection moulding and 3-D-printing appli-

cations to make complex automotive components sustainably, quickly and accurately.

“Biocomposites and bio-based materials can substitute for conventional plastic materials in commercial applications to improve sustainability,” says Dr. Manjusri Misra, a professor in the School of Engineering and Tier 1 Canada Research Chair in Sustainable Biocomposites. A lead researcher in the University’s Bioproducts Discovery and Development Centre (BDDC), she is cross-appointed in the Department of Plant Agriculture.

This technology supports the circular economy, in which waste is eliminated or reduced through reusing, recycling and repurposing materials. Misra and her team aim to create biocomposite substitutes for intricate plastic vehicle parts, including parts for consoles and door panels.

“The goal is to provide a reduced carbon footprint on the part of the vehicle and lighter-weight options that reduce fuel and energy consumption over the lifetime of the vehicle,” says Misra.

She says 3-D polymer biocomposites with natural fibres can function like petroleum-based plastics for automotive applications. However, there are challenges in ensuring that materials meet industry requirements for automotive applications, including quality and safety standards for all components.

The U of G team has a proven track record in bioproduct development, including another class of products designed to reduce plastic pollution, notably in landfills and the world’s oceans. Well-known, award-winning bioproducts developed by the BDDC include the world’s first certified compostable coffee pods and a headlight housing part in the 2020 Ford Lincoln model.

Misra’s research team for this 3-D-printing project includes co-principal investigators Dr. Amar Mohanty, director of the BDDC and professor in the Department of Plant Agriculture (cross-appointed in the School of Engineering); and Dr. Jun Yang, a professor at Western University. Industry collaborators are Ford Motor Co., Competitive Green Technologies, Ontario Biomass Producers Co-operative Inc., MixShop Inc., Bioindustrial Innovation Canada and the University of Guelph’s Research Innovation Office.

This research is funded by the Ontario Ministry of Agriculture, Food and Rural Affairs through the Ontario Agri-Food Innovation Alliance.



Wes Chase (left) and Dr. Marcia Chiasson (right) at the Ontario Aquaculture Research Centre.

New collaborative streams for aquaculture research

| Otaiba Ahsan

For more than two decades, the Ontario Aquaculture Research Centre in Alma, Ont., has been a vital resource for research conducted by faculty at the University of Guelph and by experts in the Ontario aquaculture industry. Today, the centre supports the province's rainbow trout aquaculture industry with new studies, and it's seeking ways to diversify Ontario's fish offerings so consumers have more variety.

"We are actively looking for new collaborations and new research ideas," says manager Dr. Marcia Chiasson. "We're open for business."

Chiasson has her eye on alternative aquaculture species that have piqued Ontario

consumers' interest, including whitefish, perch and walleye. The centre has primarily focused on rainbow trout and Arctic char, contributing significantly to the increase of those species in aquaculture operations. Now the market is growing, and the research centre wants to grow with it.

To date, more than 180 research projects designed to facilitate, develop and commercialize fish farming in Ontario have been carried out. Researchers have focused on fish health, culture methodology, breeding, genetics and reproductive physiology.

Underlining its value to the industry, the Ontario Aquaculture Research Centre is the only major research facility in the province dedicated to aquaculture, whose farmed species are valued at \$37.7 million. The

industry's total economic contribution to Ontario is \$122 million a year.

"Our facility has been the backbone of the fish production research program in the province," says Chiasson.

The Ontario Aquaculture Research Centre is owned by the Government of Ontario through its agency, the Agricultural Research Institute of Ontario, and managed by the University of Guelph through the Ontario Agri-Food Innovation Alliance.

The Ontario Aquaculture Association, the University of Guelph's Department of Integrative Biology and the Ontario Animal Health Network are frequent collaborators with the research centre.

Understanding the pig gut microbiome will help producers manage their herds

| Otaiba Ahsan

Anationwide team of researchers, co-led by Ontario Veterinary College faculty members from the University of Guelph, are pursuing the discovery of beneficial gut bacteria populations that can improve overall health and growth performance in pigs.

Dr. Vahab Farzan, Dr. Brandon Lillie and Dr. Robert Friendship are more than halfway through their five-year study, designed to help producers raise healthy pigs more efficiently through better knowledge of their gut microbiome.

The project might ultimately help to reduce feed costs, which

account for about 70 per cent of the cost of raising a pig.

“We are optimistic that by discovering beneficial gut bacteria in pigs, we will be able to help pig farmers tremendously in the long run,” says Farzan.

For their study, researchers have collected thousands of fecal samples from 24 farms in Alberta, Saskatchewan, Manitoba, Ontario and Quebec. They collect seven samples per pig throughout their lives from birth to market. By weighing the pigs at each stage, the team hopes to identify which bacterial populations were most important in the animals’ development.

The researchers use a genetic sequencing method to determine

which bacterial populations are present in the pig gut microbiome. (A microbiome consists of all microorganisms—such as bacteria—in a particular environment.) They are now focusing on better understanding that microbiome.

Ultimately, they hope to find bacteria that promote pig health and growth, and lessen farmers’ reliance on antimicrobial drugs, in turn reducing antimicrobial resistance.

“Our hope is to have what we discover down the line assist in the development of a probiotic that promotes the growth of beneficial bacterial populations found in pigs, ultimately cutting farmers’ costs,” says Farzan.

This research is funded by Swine Innovation Porc. Other co-leaders on this project are Dr. Andrew Van Kessel and Dr. Mathew Links from the University of Saskatchewan, and Dr. Ben Willing from the University of Alberta.

In Ontario, livestock at the Arkell Swine Research Facility serve as one of the herds in this study. The facility is part of the research centre network owned by the Government of Ontario through its agency, the Agricultural Research Institute of Ontario, and managed by the University of Guelph through the Ontario Agri-Food Innovation Alliance.



Discovering beneficial gut bacteria can improve pig health and reduce pig rearing costs.



Dampened inflammatory responses in cattle may protect them from bacterial pneumonia infections.

A new approach to preventing and controlling pneumonia in beef cattle

| Karli Longthorne

Conventional wisdom suggests that the best way to prevent pneumonia in beef cattle is to boost the animal's immune response—the capacity to recognize and defend against bacteria, viruses and harmful substances—during the transition period when calves are placed together in feedlots.

But the University of Guelph's Dr. Jeff Caswell, professor in the Department of Pathobiology, Dr. Laura Bassel and Dr. Joanne Hewson and other collaborators, along with staff at the Ontario Beef Research Centre, are challenging this view.

They've found that dampening cattle's inflammatory responses may be a better way to prevent bacterial pneumonia from taking hold.

"Our findings could potentially change the strategy for how we go about preventing pneumonia in beef cattle by informing the development of methods to reduce inflammation in the respiratory tract as an alternative

to antibiotics," says Caswell.

He and his team have carried out experimental trials with beef cattle since 2014 at the Ontario Beef Research Centre located in Elora, Ont.

They used 60 auction calves considered to be at high risk for respiratory disease. Half of the animals were introduced to killed bacteria; the other half received a saline placebo.

"We expected the ones who got the killed bacterial solution to be protected from the disease because we thought it might boost their immune response, but they ended up developing more severe disease," says Caswell. "This shows that inflammation in the respiratory tract of healthy calves seems to adversely affect how they deal with bacterial infection, which makes the pneumonia worse."

This finding changed their thinking about how pneumonia develops in feedlot cattle. Previously, the industry assumed that risk factors like stress and viral infection lead to immunosuppression, resulting in turn in bacterial pneumonia. But they now say that

instead of—or in addition to—immunosuppression, it may be greater inflammation that leads to pneumonia's harmful effects.

Caswell and his team will now examine the biological processes linking inflammation in the respiratory tract and the onset of pneumonia in healthy beef cattle as well as other factors that make calves more likely to develop inflammation. They'll also examine major environmental risk factors for respiratory disease in dairy calves.

This research study was funded by Beef Farmers of Ontario, the Canadian Cattlemen's Association, the Natural Sciences and Engineering Research Council of Canada, Zoetis, and the Ontario Ministry of Agriculture, Food and Rural Affairs through the Ontario Agri-Food Innovation Alliance. The Ontario Beef Research Centre is owned by the Government of Ontario through its agency, the Agricultural Research Institute of Ontario, and managed by the University of Guelph through the Ontario Agri-Food Innovation Alliance.



Microhazels

Scaling up hazelnut propagation by reducing production time

| Mya Kidson

Hazelnuts are touted as an exciting crop for Ontario, prompted by candy manufacturing giant Ferrero Canada's decision to locate a production plant in southern Ontario and help expand the industry.

All this has led University of Guelph researchers to find ways to optimize hazelnut propagation for production on a commercial scale.

Plant agriculture professor Dr. Praveen Saxena specializes in *in vitro* technologies and mass production under controlled environmental conditions. Recently, he's focused on scaling up locally adapted hazelnut tree production through advanced micropropagation methods.

In micropropagation, plant tissue is used to multiply thousands of plants rapidly. In contrast to conventional propagation methods, micropropagation is fast and offers year-round production of genetically identical, disease-free plants. In general, micropropagated plants perform better than traditionally propagated plants.

And the method allows researchers and plant breeders to clone a plant with desirable traits such as cold tolerance and get enough plants for further research experiments.

Saxena says the optimized micropropagation technology, developed at U of G's Gosling Research Institute for Plant Preservation (GRIPP), can be operated on a commercial scale for mass production of preferred hazelnut cultivars. "This can fulfill the growing demands of the Ontario agri-food industry," he says.

Typically, hazelnut plants are propagated abroad and imported to Canada, mainly from Europe and the United States. However, crossing international borders takes its toll, and these plants often arrive in Canada in poor condition.

Saxena and research associate Mukund Shukla developed an advanced micropropagation technology suitable for use by Ontario hazelnut growers. This system comprises a bioreactor using liquid culture medium to support highly efficient hazelnut propagation.

Saxena's advanced technology offers more control over plant growth requirements such as nutrient medium availability, temperature and light. The ability to further control growth conditions using this method not only accelerates growth to shorten production cycles but also reduces costs of growth medium and labour.

"Advanced micropropagation technology supports increasing demands for the local agri-food industry," says Shukla. "And we've been able to expand our research to more than just hazelnut trees to propagate fruit trees as well as ornamental and medicinal plants." Examples of such value-added species include apple rootstocks, hops, echinacea, ginger and orchids, all of which will benefit tremendously from the high efficiency of micropropagation for scaling up plant production to meet market expectations.

Over the years, Saxena's team at GRIPP has used these advanced micropropagation techniques to produce threatened plant species, such as Hill's thistle. As with hazelnuts, micropropagation can allow vegetative propagation of Hill's thistle to occur faster, especially because seed propagation has limitations.

In micropropagation, plant tissue is used to multiply thousands of plants rapidly. It's fast and offers year-round production of genetically identical, disease-free plants.

Saxena's GRIPP team has also developed technologies to freeze and maintain plant tissues at an ultra-low temperature of -196 C. Such frozen tissues can be used to micropropagate plants for replenishing dwindling populations of

plants under threat of extinction. This technology, called cryopreservation, also provides safe banking of valuable crop varieties for future use in the event of total crop loss.

This research project is funded in part by the Ontario Ministry of Agriculture, Food and Rural Affairs through the Ontario Agri-Food Innovation Alliance through the Gryphon's LAAIR program. Additional funding was provided by the Natural Sciences and Engineering Research Council and Ontario Centres of Excellence.



Dr. Adam Dale's team has identified a number of hazelnut varieties that can grow successfully in Ontario.

Simcoe research centre helps growers establish 1,000 acres of hazelnuts

| Karli Longthorne

Since 2008, Ferrero Rocher's Brantford, Ont., plant has worked with University of Guelph researcher Dr. Adam Dale, Department of Plant Agriculture, and his team at the Ontario Crops Research Centre – Simcoe to develop a significant, profitable hazelnut acreage.

And they've succeeded.

"Because of the Ontario Crops Research Centre – Simcoe, we are fortunate to be able to say we can profitably grow hazelnuts in Ontario," says Dale.

Researchers have been able to identify Ontario-hardy hazelnut varieties, rapidly propagate plants and establish nearly 1,000 acres of trees.

The research centre provides ideal soil and climatic conditions for this crop. Ontario varieties must be blight-resistant and winter-hardy.

Dale says growers can cultivate hazelnuts wherever apples flourish. "Hazelnuts and

apples have similar mechanisms that protect against winter frost."

Other researchers involved in the project include John Zandstra, Ridgetown Campus, who is testing hazelnut varieties across Ontario, and plant agriculture professor Dr. Katerina Jordan, who is investigating eastern filbert blight in a hazelnut trial at Simcoe.

This research project is funded by the Ontario Centres of Excellence, the Agricultural Adaptation Council, Growing Forward 2, Ontario Genomics Institute, the Agricultural Innovation Program of Agriculture and Agri-Food Canada, and the Ontario Ministry of Agriculture, Food and Rural Affairs through the Ontario Agri-Food Innovation Alliance.

The Ontario Crops Research Centre–Simcoe is owned by the Government of Ontario through its agency, the Agricultural Research Institute of Ontario, and managed by the University of Guelph through the Ontario Agri-Food Innovation Alliance.

Explore research at Ontario's agricultural research centres

Researchers and agri-food industry partners can leverage a unique network of research centres across Ontario. The centres, which are owned by the Government of Ontario through its agency, the Agricultural Research Institute of Ontario, and managed by the University of Guelph, support research that fuels real-world field tests not possible anywhere else.

Research at these centres promotes agri-food discoveries, validates laboratory findings, stimulates further research and collaboration, and provides valuable information for Ontario's agri-food sector. Summaries of current studies are available on the Ontario Agri-Food Innovation Alliance website at uoguelph.ca/alliance.

Fighting antibiotic resistance in Ontario dairy cattle

| Robyn Meerveld

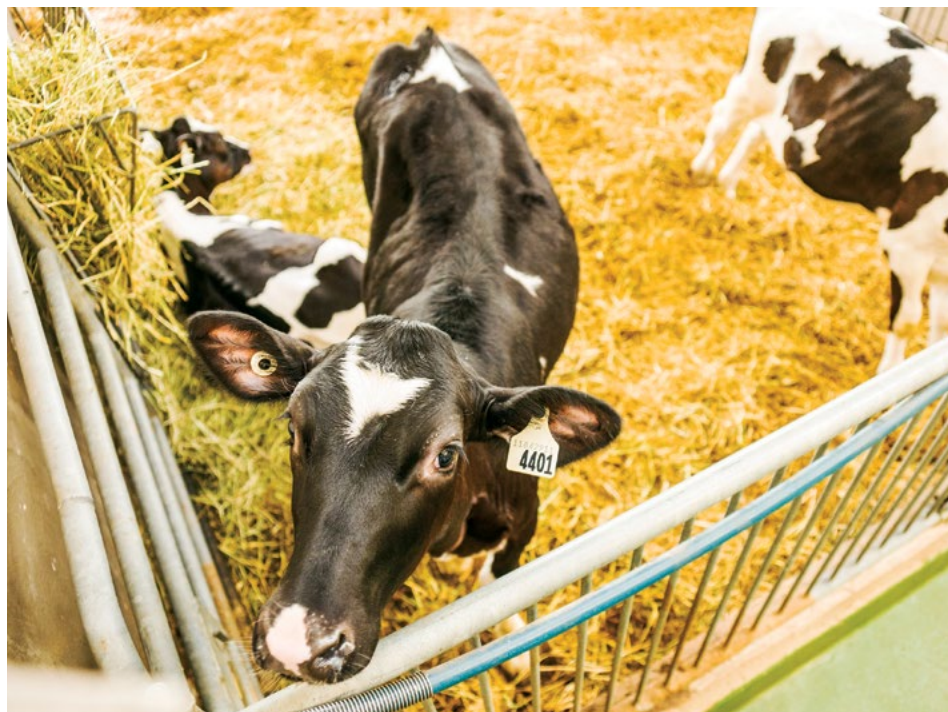
Antibiotics are a cornerstone of modern medicine for both humans and animals. But their widespread overuse has contributed to the development of “superbugs” that are increasingly resistant to antibiotic treatments.

Globally, agricultural use accounts for about 70 per cent of all antibiotics produced, many of them important to human health. The livestock industry has come under scrutiny for potentially contributing to antimicrobial resistance, as countries everywhere try to slow this alarming global trend.

Canada has recently developed a national action strategy calling for increased surveillance of all antibiotic use—to identify what, where and why the drugs are being deployed.

At U of G’s Animal Health Laboratory, a research project of the Ontario Animal Health Network (OAHN) led by Dr. Dan Shock focused on gathering this information for dairy cattle production, one of the province’s largest livestock sectors.

For timeliness and efficiency, the research



team worked with two Ontario veterinary practices that together serve 68 dairy producers. These producers represent a sample of the 3,000-plus dairy farms in the province.

Researchers gathered data from sales records of the veterinary antibiotics dispensed (including classifications of the drugs and levels of active ingredients in each) and dairy herd numbers at each farm. Confidentiality was maintained throughout the study.

The methodology was simple and straightforward, but the results were significant. Details are posted on the Ontario Animal Health Network website, oahn.ca.

The survey findings provided a snapshot for government policy makers and industry leaders of current antibiotic use in dairy cattle—including those medications that are critical to human health.

For the dairy producers and their veterinar-

“With the knowledge from this survey, veterinarians and producers can develop a responsible strategy to reduce antibiotic use in Ontario dairy herds.”

—Dr. Dan Shock

ians, the results served as a benchmark to compare antibiotic use on their farms to other (anonymous) farms of similar size. It also gave them a starting point against which to judge the success of future disease prevention efforts they might implement on their farms.

That knowledge will be essential as they work together to balance optimum animal health with reduced antimicrobial use.

The OAHN research team shared these findings with other Ontario dairy cattle veterinarians at the association’s annual meeting, allowing more producers and veterinarians to benefit from the results.

This research was funded by the Ontario Ministry of Agriculture, Food and Rural Affairs through the Ontario Agri-Food Innovation Alliance.



How safe is our milk?

Canadian milk and milk products contain no antibiotics. That’s the law. Strict and lengthy withdrawal periods are mandatory for dairy cows if antibiotics have been used to restore them to health.

These requirements are protected in legislation and enforced through rigorous, ongoing testing.



Microgreens can be grown with limited space and resources.

These micro-veggies are poised for major impact

| Otaiba Ahsan

More food, less space: that's the mantra of those trying to figure out how we'll feed future populations as arable land becomes less available.

One answer is microgreens, vegetable greens that are picked directly after the first leaves have developed—specifically, after sprouting of the cotyledons, which are the initial leaves that are visible after successful germination of the seed.

Just like conventional crops, microgreens need research-based approaches to help them flourish.

And that's where Department of Food Science PhD candidate Oday Alrifai comes in. He's studying the nutritional quality, enhanced flavour and appearance of microgreens grown under LED lighting.

"With the global population being projected to reach new heights by the year 2050, more

space and resources will be required for cultivation," says Alrifai. "We hope to inspire the up-and-coming generation on the importance of growing your own vegetables with space and resource limitations, and help contribute to the global effort of improving vegetable nutrition while cutting down on resource use."

Microgreens can be grown in limited space with LED lights, which are relatively inexpensive and readily available. Alrifai works with eight varieties of microgreens from the cruciferous family, including radish, mustards and mizunas.

Early results indicate that with more amber light from LED technology, the phytochemical content in the microgreens also grows. Phytochemicals are antioxidants, popular with consumers and abundant in the crucifers Alrifai is studying.

He hopes ultimately to verify

the specific antioxidant and anti-inflammatory potential of these phytochemicals, so that microgreens can be tailored to meet individual nutritional needs. Alrifai says that the LED design and its impact on nutritional qualities could be used in vertical agriculture or high-tech chambers.

For his research, Alrifai is using state-of-the-art controlled environment chambers at the Agriculture and Agri-Food Canada (AAFC) Research Station in Harrow, Ont.

Alrifai received a Highly Qualified Personnel (HQP) scholarship. The HQP program is funded by the Ontario Ministry of Agriculture, Food and Rural Affairs through the Ontario Agri-Food Innovation Alliance and the University of Guelph's Food from Thought program. This research is supported by AAFC.

Skilled people make the agricultural sector successful

The Ontario Agri-Food Innovation Alliance helps build the future skilled workforce that will advance Ontario's agri-food and rural sectors.

The Highly Qualified Personnel scholarship program engages the next generation of agri-food researchers, policy makers and innovators to complete research that meets OMAFRA's research priorities.

The program, which is also supported by the University of Guelph's Food from Thought research program, provides specialized agri-business and workplace experience for master's and PhD students. Students work with industry, government and community partners to gain valuable experience and learn first-hand how forward-thinking research can be mobilized to have a positive impact on society.



Ontario-grown produce, like these vegetables at a Kingston, Ont., farmers' market, is among the safest in the world.

Food safety essential for market success

| Robyn Meerveld

Food grown in Ontario is among the safest in the world—and that’s not just a slogan. It’s a fact, because food testing and provincial food safety legislation are based on sound science.

The province relies on the scientific leadership and international accreditation of U of G’s Agriculture and Food Laboratory (AFL) to help keep Ontario-grown foods safe. The AFL provides scientific expertise to support the Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA) in setting food safety priorities, food testing and research needed to improve testing accuracy and efficiency.

Together, the AFL and OMAFRA food safety experts monitor international food safety news and changing food safety needs of Ontario, Canada and their trading partners.



A woman delivers fresh food in Toronto during the pandemic lockdown.

Baseline studies are an important step

A baseline study provides a snapshot of the level of a specified risk for a particular food at a given point in time.

The system starts with gathering data using baseline studies, often applying internationally accredited testing methodologies. The data can be tracked over time to see whether a risk exists and whether any risk is increasing or decreasing, and to support industries’ efforts to reduce food contamination.

For example, *Cryptosporidium* and *Giardia* are two pathogenic microbes commonly found in the environment. They find their

way onto fruits and vegetables and can cause illness if consumed.

Levels of these microbes on Ontario fruits and vegetables have been found to be almost negligible, due in part to baseline studies conducted by AFL over four years and outreach by OMAFRA to ensure Ontario producers know of the potential for contamination.

Baseline studies inform inspection staff, who can share the best methods for contamination reduction with food growers and processors, as part of normal inspection and advisory services.

For example, when OMAFRA wanted to confirm the effectiveness of food safety measures at

provincially inspected abattoirs, the ministry designed a baseline study to measure pathogens on eviscerated and prepared carcasses right before they enter the cooler. The AFL conducted the testing associated with the baseline.

Based on the test results, OMAFRA then developed a range of approved measures for provincially inspected abattoirs to employ as part of their mandatory microbial control intervention plans.

Capacity and competitiveness

Baseline studies are just the start. The AFL also supports OMAFRA food safety surveil-

lance and monitoring programs, and develops and improves testing methodologies.

Beyond serving the province’s current food safety needs, this broad capacity enables the province and industry to pivot as consumer preferences, trading requirements and food safety hazards change.

Safety and success for Ontario’s food industry, at home and abroad, depend on it.

The Agriculture and Food Laboratory receives funding from the Ontario Ministry of Agriculture, Food and Rural Affairs through the Ontario Agri-Food Innovation Alliance.

Small-town clinic offers big-time experiences

Northern Ontario mixed animal practice sees veterinarian tackle a wide range of cases

| Joey Sabljic

Leaving the city behind to start your career in small-town northern Ontario might seem like a path less travelled. But for Dr. Marialisa Laurella—a 2011 Ontario Veterinary College graduate—the North is exactly where she wanted to be.

She says the decision to move north was driven by the opportunity to hone her skills while tackling a wide range of challenging small- and large-animal cases.

“I knew I wanted to work in a more isolated community where there wasn’t a referral clinic nearby,” she says. “If I worked in a bigger city, I might never get to do the more complicated surgeries, as they tend to get referred out. But here, I handle the tougher cases myself.”

“Here” is the close-knit community of Fort Frances, where Laurella has worked as a front-line veterinarian at the Nor-West Animal Clinic, a mixed animal practice, since graduating. It’s the only veterinary practice serving Fort Frances and surrounding area.

The clinic wasn’t actively hiring when she applied. But her résumé caught the eye of the practice owner, OVC alumnus Dr. Dan Pierroz, whom she calls a kindred spirit.

“We seemed—right off the bat—to have very similar mindsets as to how we wanted to practise and work with animals,” says Laurella. “That to me was way more important than being in a big city where there are a lot of amenities. I knew I’d found a practice owner that was both a great boss and mentor.”

Pierroz received support to hire Laurella through the Veterinary Capacity Program offered by the Ontario Agri-Food Innovation Alliance that helps fourth-year veterinary students fine-tune their skills through an eight-week placement in a large or mixed animal practice.

Laurella didn’t have to wait long to see front-line action. Within the first two weeks, she was invited to scrub in for an extracapsular repair to a dog’s torn cranial cruciate ligament.

The procedure involves using a special suture material in place of the damaged ligament to help stabilize the dog’s knee joint.

It was just a taste of things to come, as Laurella – one of two vets on the Nor-West team at the time—found herself splitting the caseload with Pierroz, while also handling after-hours emergencies.

She says her experiences underline why veterinarians in underserved regions like Fort Frances need to be ready to handle anything that comes through the door—large farm animals, dogs that have suffered bear attacks, injured wildlife and even the odd sick bearded dragon.

“In rural practice, you kind of have to be able to handle it all,” says Laurella. “We’re definitely generalists, though I personally enjoy doing surgeries, particularly orthopedic work. We’ve had to become proficient in doing

those surgeries so we can offer the kinds of services owners and animals wouldn’t have access to otherwise.”

For other grads looking to follow her path, she offers this advice: the front-line mixed animal practice life offers up a stiff challenge that isn’t for everyone.

“If you’re looking for more of a nine-to-five job, it’s probably not the practice for you,” she says. “But for me, I’ve been extremely fortunate to find a place and a community where the work is never boring, and where I truly enjoy practising.”



Dr. Marialisa Laurella at her practice in Fort Frances, Ont.

What does a typical day on the front line in a mixed animal practice look like for Laurella?

Aside from the regular slate of vaccinations and ear infection treatments, she might spay and neuter pets, perform an emergency late-night surgery on a dog that’s eaten a piece of plastic, conduct a post-mortem on a sheep that died unexpectedly, or sedate and treat an agitated horse with a leg laceration.

Today, after more than nine years of practising, Laurella has seen her confidence grow to the point where she is now mentoring another recent veterinary grad from the Western College of Veterinary Medicine.

But she still recalls her first few touch-and-go months on the job handling on-call emergency cases.

“When I was handling the after-hours, on-call cases as a new hire, it was daunting,” she says. “It definitely took a few months to not feel anxious when the phone rang. Gradually, after a few calls that go well, you learn not to panic, to trust your instincts and take things case by case.”



93
accredited tests

Laboratory Services Division received accreditation for 93 tests by the Standards Council of Canada



34
new tests

Laboratory tests developed or improved by AHL scientists



385
researchers

U of G researchers engaged in research supporting OMAFRA priorities



78
new projects

Research projects awarded operating funding to drive innovation in the agri-food sector



15
D.V.Sc. students trained

VCP supports doctor of veterinary science students engaged in OMAFRA priorities



50
HQP scholars

The HQP scholarship program engages the next generation of agri-food researchers, policy makers and innovators

Growing Ontario solutions

Read about how the Ontario Agri-Food Innovation Alliance provides evidence-based solutions to the challenges facing our province

For those interested in research, numbers are informative: yields improved; disease decreased; tests were 99.9 per cent accurate.

But numbers don't tell the whole story: Will the new practice work locally and on-farm? Is it feasible at a commercial scale? What do the data mean? What difference does it make to Ontario producers and consumers?

Growing Ontario Solutions is an annual report of the Ontario Agri-Food Innovation

Alliance, a long-standing collaboration between the Ontario Ministry of Agriculture, Food and Rural Affairs and the University of Guelph. It reports on key outcomes generated by people, places and programs supported through the Alliance, including the important numbers we track to make sure we deliver value to Ontarians.

This year, *Growing Ontario Solutions* tells the stories “behind the numbers” to show how the Alliance is making an impact. It tells the stories of the people persevering

with ingenuity to continue essential work during a pandemic; of creative and driven scholars sharing ideas and learning skills to address the future needs of the sector; and of research that has been translated from lab, field or barn to make a difference on-farm and on grocery store shelves.

We hope you will read these stories—and more—that show how the Alliance generates local solutions with global impact. Read *Growing Ontario Solutions* online at uoguelph.ca/alliance/GOS.

Ontario
Agri-Food
Innovation
Alliance

GROWING ONTARIO SOLUTIONS



BEHIND THE NUMBERS

How the Alliance drives impact in Ontario

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ANNUAL REPORT 2019/20

Ontario

