UNIVERSITY of GUELPH

ONTARIO AGRI-FOOD INNOVATION ALLIANCE

research

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ADVANCING RESEARCH IMPACT

Beefing up Guelph's agri-food research and innovation

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2019–20 AGRI-FOOD YEARBOOK

Ontario

Long-standing partnership advances Ontario's agri-food sector

The Ontario Government and the University of Guelph share a deep commitment to the success of Ontario's agri-food sector.

Our government is dedicated and committed to research with support of the Ontario Agri-Food Innovation Alliance partnership. This partnership brings people and organizations together to research and develop the best and most innovative technologies available, making Ontario a world leader in agriculture.

Through our partnership, we're enabling the development of innovative products and best practices for farmers to improve the efficiency, sustainability and profitability of their farm operations.

These advancements are key to growing greater success in Ontario's agri-food sector.

We know that research and innovation will help to increase Ontario's ability to compete in world markets. They help to create jobs and strengthen Ontario's reputation as a global leader in agri-food research and innovation.

Many research successes over the years are a result of the Ontario Agri-Food Innovation Alliance, and this year's edition of the Agri-Food Yearbook highlights the latest outstanding accomplishments.

I'm very pleased to introduce this year's publication and to express my appreciation for the dedicated researchers and partners who have made these advancements possible.

Ernie Hardeman
Minister of Agriculture, Food and Rural Affairs
Government of Ontario

The University of Guelph is recognized internationally as a leading comprehensive and research-intensive institution. Part of that reputation stems from the power of our research partnerships, illustrated by the long-standing, unique alliance with the Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA).

Through the Ontario Agri-Food Innovation Alliance, we conduct research that supports and strengthens the agri-food industry regionally and worldwide.

Research supported by the alliance solves real-world challenges and yields meaningful innovations that ensure the success of the province's agri-food sector and that promote rural economic development throughout Ontario and indeed around the world.

The University of Guelph is committed to improving life by supporting the people, places and programs that generate solutions with global impact. Working closely with OMAFRA through the alliance, we help build strong rural communities and a prosperous, safe and environmentally sustainable agri-food sector in Ontario—now and for the future.

At Canada's food university, we're proud of our research and innovation accomplishments, and we applaud faculty, staff, students and partners united in our common mission: to improve life.

Franco J. Vaccarino
President and Vice-Chancellor
University of Guelph

Photos provided by the University of Guelph

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IMPROVE LIFE.

Advancing research impact

Cover photo: Beef Farmers of Ontario · Back cover photo: Martin Schwalbe

Cows will have access to pasture for all but a few months of the year at a new beef research facility being built near Elora.

A major platform for sustainability and profitability in the beef sector

"Our work at the beef station typically focuses on improving efficiency and growth, reducing the environmental impact of beef cattle, and management strategies to improve health and welfare."

—Prof. Katie Wood, head of beef nutrition research at the University of Guelph

Gillian Beatson and Owen Roberts

Construction of the $15.5-million Ontario Beef Research Centre is complete at the Elora Research Station.

This new cow-calf research centre is owned by the Government of Ontario, managed by the University of Guelph under the Ontario Agri-Food Innovation Alliance, and supported by the Beef Farmers of Ontario and the federal and provincial governments.

Two hundred acres of land is being repurposed to create pasture at the station and almost double the capacity for livestock on site.

"Our government is investing in beef research to help discover the latest technologies and information and share them with farmers, so they can adopt new practices to stay competitive," says Ernie Hardeman, Ontario minister of agriculture, food and rural affairs. "When Ontario farmers adopt the latest science-based practices, they become more profitable, efficient and sustainable."

Malcolm Campbell, vice-president (research), says this initiative will improve research on beef cattle production, health and welfare. He says these renovations, along with the dairy research facility at Elora, will make Ontario a leader in bovine research facilities in Canada.

"We're proud to work with the government and industry to develop and support landmark achievements in research that will move the province's beef industry forward sustainably and profitably," he says.

Workers have constructed two new 5,530-square-metre cow-calf research barns and adjoining handling facilities and office. These barns will house up to 288 cows, nearly double the current capacity of the research station barns.

Cows will have access to the pasture for all but a few months of the year. Peter Milton, manager of research station operations at Elora, and his team began seeding and planting cover crops for the pastures last summer.

"What's different about these pastures is that they are very close to the new barns," he says. "The cows don't need to be transported very far to go out to graze. It will keep things very accessible for research and we will have a lot of capacity for replication on pasture… that's very valuable for improving accuracy on pasture-based studies."

On-site, more than 100 new automated Insentec and Calan Broadbent feeding head gates, which monitor and measure exactly when and how much a cow is eating, will also be added. This complements the 48 existing

Helping producers deliver safe, sustainable beef

Ontario is home to more than 9,500 beef producers and 240,000 beef cattle that sustain 61,000 jobs, from farm to table. Beef research at the University of Guelph supports the drive toward top-notch animal care and sustainable farming with a common goal: to deliver safe, high-quality beef to consumers

Dianne Priamo

Insentec feeders currently in use in the feedlot.

Tysson Amidon, foreman of the Ontario Beef Research Centre, says these feeding head gates use a specific radio-frequency chip technology embedded in the identification ear tags for each cow to record feed data. This technology will allow researchers to conduct individualized feed trials and track feed measurements for each cow.

Another major feature is the addition of two new solar-powered C-Lock Greenfeed Trailers. Animal Biosciences Prof. Katie Wood, head of beef nutrition research at the University of Guelph, says this equipment allows researchers to measure gas exchange in animals on pasture, and will support research aimed at reducing greenhouse gas emissions in a more applied setting.

"Our work at the beef station typically focuses on improving efficiency and growth, reducing the environmental impact of beef cattle, and management strategies to improve health and welfare," she says.

Wood says research trials, expected to commence once the facility is operational, will be multidisciplinary, designed for flexibility to accommodate many different types of research—genetics, animal health, nutrition, behaviour and welfare, and meat quality and safety.

And that's just what the industry needs, says Beef Farmers of Ontario president Joe Hill of Fergus.

"The facility gives the ability to conduct research on a meaningful and integrated scale," says Hill. "The advancement of beef research is integral to providing science-based information to maintain consumer confidence, and to ensure that the beef industry is globally competitive and ready to take advantage of current and emerging trade opportunities."

Discovering alternatives to antibiotics and ionophores in beef cattle

To improve feed efficiency, digestion and liver health, beef cattle may be given antibiotics and ionophores, which are antimicrobial compounds that improve intestinal function. Despite the potential health benefits that these substances provide to cattle, consumer perception of antibiotics and ionophores has challenged beef producers to raise livestock without them.

To help strike a balance between cattle health and consumer satisfaction, food science expert Prof. Benjamin Bohrer is searching for suitable, equally effective substitutes for antibiotics and ionophores that consumers will perceive more positively.

He's seen promise using both essential oils and organic acids to mimic the antimicrobial effect of ionophores. Optimal blends of essential oils as well as organic acids have been tested as alternatives to antibiotics, and Bohrer is studying their effects on feed efficiency and overall beef quality.

This innovation could also help reduce antibiotic use among herds, lowering the risk of bacteria developing antibiotic resistance.

Bohrer also sees the potential for essential oils and organic acids to have a positive effect on beef colour by slowing oxidation. This could extend shelf life of beef products by keeping them looking fresher longer.

PLEASE SEE NEXT PAGE

Photo: Beef Farmers of Ontario

Helping producers deliver safe, sustainable beef

CONTINUED FROM PREVIOUS PAGE

Selective breeding for improved herd productivity

Prof. Angela Cánovas specializes in beef cattle genomics involved in economically important traits.

In deciphering the cow genome, her studies focus on feed efficiency and emissions of methane, the greenhouse gas produced in the guts of cows and released primarily through belching.

Her research goal is to improve genetic selection by identifying genes responsible for these traits, so that producers can selectively breed their herds for more efficient, less emissive cattle.

"It is very important to make a conscious effort to translate research achievements into instructional material, and share advancements with producers and other industry stakeholders," says Cánovas.

Effective communication with producers could mean healthier, more environmentally friendly cows with reduced production costs, she says.

Optimizing cow health and production costs

By supplementing cost-effective, low-quality diets with specific nutrients, Prof. Ira Mandell hopes he can optimize cow health and production costs to benefit producers as well as their herds.

By strategically supplementing low-quality feeds with these nutrients, Mandell anticipates improved growth performance, body condition and reproductive performance while lowering costs for producers.

Mandell is also examining various pasture management strategies to increase performance in cow-calf production and cattle backgrounding.

Research improves animal care and sustainable farming methods—and, ultimately, provides quality Ontario beef for consumers.

Maternal protein supplementation during pregnancy to promote calf health

For Prof. Katie Wood, improved animal health and efficiency start even before calves are born. She studies metabolic pathways that influence feed efficiency and cow productivity, specifically the effect of diet on cow health and milk nutrient content.

Wood aims to shift the way producers think about feeding to focus on prepartum fetal programming—that is, stressing what cows consume during pregnancy, specifically in the last eight weeks before calving.

Colostrum is the first milk that mammalian mothers produce for their young after giving birth. This milk is vitally important to calf development as it contains antibodies that help calves develop their immune system, which is non-existent at birth.

Wood is investigating how a cow's diet before giving birth affects the nutrient and antibody levels in colostrum and, as a result, how well it nourishes the calves. As part of a long-term study, she is experimenting with protein supplementation to improve colostrum quality as well as maternal health.

"We're hoping to see that one of our supplementation strategies can actually benefit calf growth and their performance in the feedlot," says Wood.

So far, her research has shown a correlation between diet protein content and differences in colostrum composition and quality. By breaking down the metabolic processes behind this connection, Wood hopes to determine the optimal prepartum diet, one that will improve health of cows and calves alike.

Understanding disease development in calves for improved prevention and treatment

A staggering 54 per cent of beef calf mortalities on Ontario farms are caused by infection from the *Mycoplasma bovis (M. bovis)* bacterium, which can lead to respiratory diseases such as pneumonia. Although these bacteria pose no risk to humans, *Mycoplasma bovis* is taking its toll on cattle welfare. And Prof. Jeff Caswell wants to put an end to its destructive path.

Conventional therapies are ineffective in combatting the bacteria, resulting in many calves becoming infected. However, not all infected calves develop disease. Caswell is studying the development of lung-related diseases in cattle to understand why only certain calves become affected, as a step toward developing more effective methods of prevention and treatment.

Caswell hopes to determine how *M. bovis* damages lung tissue and how diseased lung tissue alters the immune response to the infection in calves. By better understanding the relationship between lung disease and this bacterium, he aims to limit its harmful effects to reduce disease prevalence in calves and the resultant economic impact on producers.

Photo: Beef Farmers of Ontario

Helping producers deliver safe, sustainable beef

Researchers can identify genes related to enhanced feed digestion traits in cattle like these.

Long-term surveillance of beef cattle to improve health management

Prof. Jessica Gordon is working to improve many aspects of beef cattle health. At the Ruminant Field Service clinic at the Ontario Veterinary College, she has a clinical duty to provide herd health, sick animal and emergency care services to beef cattle. Her work at the clinic also involves educating veterinary students to provide expert care to cattle.

Gordon collaborates with researchers in Alberta, Saskatchewan and Quebec as part of the Canadian Cow-Calf Surveillance Network (C3SN), a long-term study that collects baseline information on research areas important to the beef industry.

As part of C3SN, she is helping to create resources on herd nutrition and management, animal welfare, diseases and antibiotic use. The data collected throughout the project will help answer emerging research questions and educate producers on the most effective on-farm strategies.

Modifying the calf weaning process to reduce cow stress and adverse health effects

Animal behaviour and welfare expert Prof. Derek Haley is tweaking a novel alternative method of calf weaning he developed during his PhD studies. Deemed two-stage weaning, its intention is to reduce animal stress with the added potential of decreasing negative health outcomes. This means that the need for antibiotic use in calves could also be reduced over the current conventional weaning method.

Traditionally, weaning calves from their mothers involves complete separation of the two animals to different locations. This causes emotional distress for both the mother and the calf. As a result, they spend much less time eating as they spend time in search of one another.

Haley aims to determine the practical value of the increasingly well-established two-stage weaning method. Essentially, the mother and calf are kept together, but the calf is prevented from nursing by wearing a nose-flap and, in the presence of its mother, transitions to full independence more rapidly, eating and drinking in the same manner as its mother. The idea is that both animals will spend less time "mourning" and will instead continue to eat normally, reducing the stress and hopefully eliminating the adverse health effects caused by distress and malnutrition.

Haley is refining the two-step weaning process by modifying the nutritional management of calves to better match the dietary benefits of the milk that has been eliminated from their diet. He will then compare the health and productivity of two-stage weaned calves with those of calves that have been weaned conventionally. Haley's goal is to optimize this management strategy for producers and improve overall animal welfare.

Translating dairy cattle innovation to beef cattle

In the 1990s, Prof. Bonnie Mallard invented two technologies that have greatly improved dairy herd health management. The High Immune Response (HIR) technology and Immunity+ technology (see related story on p. 40) measure a cow's ability to fight disease, or the strength of their immune response. Dairy cows with higher HIR have lower risk of developing diseases such as mastitis and ketosis, and these individuals are then selected for further breeding.

Now, Mallard is developing her innovation into a screening tool that will aid beef producers in combatting herd illness. Bovine respiratory disease (BRD) is among the most harmful ailments in beef cattle, and Mallard wants to use HIR to identify animals with naturally occurring immunity to this illness. Selectively breeding cattle with genetic immunity to BRD would improve herd health and reduce the use of antibiotic treatment.

Once perfected, this innovation will reduce costs for producers and satisfy consumer desire for naturally healthier beef raised without antibiotics.

Photo: Owen Roberts

Focus on sustainability

Researcher dives deep into genomics to breed more cost-efficient, environmentally friendly cattle

Ariana Longley

Feed costs represent about 70 per cent of cattle producers' total expenses. Cattle are under the microscope for contributing to greenhouse gas emissions.

And breeding could address both matters.

That's what one University of Guelph researcher is doing, with help from the Ontario Agri-Food Innovation Alliance. Using genomics, she's identifying cattle that naturally use their feed more efficiently.

Prof. Angela Cánovas, Department of Animal Biosciences, is helping improve cattle feed efficiency (the ability to convert food nutrients into milk or meat) by combining new genetic techniques to select for more sustainable and feed-efficient cattle in breeding programs.

She believes that as cows become more effective at processing food, they could require less food and produce less waste.

That would naturally lead to lower feeding costs and greenhouse gas emissions.

"We're using the most novel technologies to identify genes affecting economically important traits," says Cánovas.

She's finding genes linked with improved feed efficiency traits, using genomics and production data from Ontario cattle. That involves a mix of new and innovative techniques to collect evidence for these connections.

One technique called transcriptomics compares gene expression rates between cattle with high and low feed-efficient traits like liver and muscle energy efficiency. Metabolomics looks at how metabolites are used within cells.

Another promising trait connected to feed efficiency is the bacterial makeup of the cow's rumen. Different groups of bacteria have varying abilities to break down and absorb nutrients from food. Researchers may use metagenomics to study the correlation between genetics and the associated bacterial profile. Using these methods, Cánovas identified which sets of genes correlate to certain bacterial profiles in cows that process food more efficiently.

Beef and dairy farmers can begin selecting for cattle with these genes in breeding programs to produce more efficient cows with smaller environmental footprints.

This research is funded by the Ontario Agri-Food Innovation Alliance. Additional funding was provided by Genome Canada and Beef Farmers of Ontario. This study was conducted in partnership with AgSights. Cánovas has also received support from the Alliance to share genetics information with the beef and sheep sectors.

Data about management practices and mortality rates are being retrieved from almost 60 Ontario goat farms.

What's happening to these kids?

Three-year study aims to unravel why goat kid mortalities happen

Sydney Pearce

To support the demand for goat products, University of Guelph researchers are involved in an intensive, three-year, Ontario-wide herd health and management study.

Prof. Cathy Bauman, Department of Population Medicine, and a team of researchers have surveyed or visited almost 60 goat farmers over the past 18 months to investigate mortalities and management practices among their herds.

The researchers are also wrapping up a project to conduct autopsies on all goat kids under four months of age that died on about half of the farms.

Typically, goat farms have either very high or very low mortality, but no one really knows why. Bauman's survey is looking for differences in management practices between these two distinct groups by asking questions about their stocking density, ventilation and other practices.

On-farm visits will serve to investigate these practices in real time.

Additionally, the autopsies will help reveal the common causes of death and the age at which the kids are at highest risk. The researchers will try to associate these causes with the management factors they identify.

From initial survey results, researchers believe that record-keeping and colostrum- and milk-feeding management may be weak areas and a good place to start investigating on-farm. Because many kids may be born

Photos: Richard Seck (left) · Ontario Goat (right)

in a short time, some farms are unable to keep proper records of births, illness and mortalities, resulting in a lack of vital information for producers and veterinarians and a hurdle to resolving the mortality issue.

Colostrum management is key as well—it's the first milk kids receive. They depend on colostrum to protect them from infections until they develop their own strong immune systems. The volume and quality of the colostrum fed may influence how susceptible kids are to infections.

Based on the autopsies, pneumonia, diarrhea and septicemia—overwhelming bacterial infections—are areas that need further research. Preliminary research also indicates that kids between the ages of seven days and weaning are at highest risk. Closer examination of the pathogens involved will help identify areas that can be targeted through vaccination, improved hygiene or management changes.

"Reducing kid mortality improves goat welfare, consumer perception of the industry and economic profitability," says Bauman. "Identifying key risk factors in kid mortality allows us to design effective intervention strategies and reduce antibiotic use and will result in an overall healthier industry."

Bauman is providing participants with funding to try using record-keeping software or a new paper form tailored for the goat industry to help farmers maintain their records more efficiently. She thinks this will help researchers collect data and improve record-keeping habits on the farms long-term, so producers will be better able to quantify and describe any mortalities, making it easier for veterinarians to help them resolve issues.

She says the industry is being proactive about this issue. "It's very interested in improving the health and welfare of its herds," she says. "No producer ever wants to lose any animals."

The research team will begin circulating observations and statistical results this fall and offer producer workshops starting in 2020.

Team members include Ontario Veterinary College dean Jeffrey Wichtel, professor emeritus Paula Menzies, Profs. Charlotte Winder and Robert Foster, graduate student Julia Kim, and undergraduate students Peyton Tam and Lauren MacNeil.

This research is funded by the Ontario Agri-Food Innovation Alliance. Additional funding was provided by Gay Lea, the Ontario Dairy Goat Cooperative and Saputo.

A natural approach to enhanced immunity

Combining various gut bacteria could help fight fatal disease in chickens

Sydney Pearce

Using chickens' gut bacteria to naturally enhance their immune system may be a new way to prevent and manage necrotic enteritis in the poultry industry, a disease that costs an estimated US$10 billion in losses globally each year due to death and reduced productivity.

Prof. Shayan Sharif, Department of Pathobiology, is creating a natural, effective treatment for necrotic enteritis by packaging helpful gut bacteria from healthy chickens into a probiotic that can be administered back into flocks to improve overall immunity.

He's exploring different methods of administering the probiotic, such as oral applications or injections into the egg, to create the most effective natural method to increase chicken immunity.

"This research is going to be of importance to poultry producers in terms of welfare, because healthy animals mean greater profitability," says Sharif. "It will also be of benefit to public health because we can reduce the use of antimicrobials and indirectly lower antimicrobial resistance."

Currently, antibiotics are used to prevent necrotic enteritis. However, they're being phased out because of their role in antimicrobial resistance, or microorganisms' natural ability to resist antibiotic treatment.

Antimicrobial resistance can occur due to excessive antibiotic use and can harm humans if the resistant bacteria transfer to people. Because of the requirement to phase out unnecessary antibiotic use, Sharif says, an alternative is needed more than ever.

To that end, he's packaging and testing various combinations of helpful chicken gut bacteria, which can help break down harmful pathogens, to see which most effectively reduce disease. Necrotic enteritis can be caused by bacteria such as *Clostridium perfringens*, so he expects effective combinations to contain bacteria that target and destroy these pathogens.

Once a successful probiotic is identified, it will be prepared for potential use in the industry.

"We are using cutting-edge technology to significantly increase poultry welfare and profitability, and help the industry as a whole," says Sharif.

This research is conducted at the Arkell Research Station and at the University of Guelph main campus, as well as at other facilities outside Guelph, in collaboration with researchers at the Hospital for Sick Children, the University of Alberta and the University of Prince Edward Island.

This research is funded by the Ontario Agri-Food Innovation Alliance. Additional funding was provided by the George Weston Foundation, the Canadian Poultry Research Council and the Agriculture and Agri-Food Canada cluster.

Supporting new antimicrobial use legislation

Training under way for veterinarians for small flock poultry medicine

Mya Kidson

Antimicrobials are drugs, including antibiotics, used to treat microbial infections. Federal legislation introduced in 2018 requires producers to obtain a veterinary prescription for antimicrobial medications used in animals, including all livestock and poultry. This improvement is intended to help limit the development of antimicrobial resistance. Legislators hope that involving veterinarians will help to ensure appropriate use of antimicrobials for all species.

Under this change, owners raising small flock poultry will now need to have a veterinarian to provide medical care for their birds. Some veterinarians will also need to expand their practice to provide care for poultry species.

To help support veterinary educational needs specific to small flock poultry medicine, the Ontario Animal Health Network (OAHN), including members of the University of Guelph's Animal Health Laboratory (AHL), provided resources and training for these veterinarians. These measures are intended to increase veterinarians' ability to diagnose, treat and mitigate the spread of poultry diseases during on-farm visits or consultations with small-flock producers.

Marina Brash and Kate Todd of the AHL worked with other members of the OAHN poultry network (Csaba Varga, Mike Petrik and Al Dam) and Sabrina McDonald from the Poultry Industry Council to organize a seminar for veterinarians in April. The seminar hosted Victoria Bowes as keynote speaker and served as an introduction to poultry disease diagnosis and treatment. Forty Ontario veterinarians participated in hands-on demonstrations about proper poultry care. Additional online lectures offered free by Bowes covered lab testing and treatment for specific disease syndromes, as well as flock health and management.

OAHN coordinator Todd says these resources are designed to help close the poultry health knowledge gap.

"This opportunity to assist veterinarians in providing the best care to their expanding patient base is an important initiative," she says. "These resources are being developed to support the continuing educational needs of mixed-animal or other species veterinarians in this area. Specialized poultry veterinarians won't typically be attending the small poultry flocks, and this is where non-poultry vets will need to step in and provide medical treatment for these birds."

Varga, a veterinarian with the Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA) who specializes in the prevention and mitigation of poultry diseases (and co-lead of the OAHN poultry network), notes that early detection and control of infectious diseases are critical and that a better understanding of the industry can lessen disease spread.

"Infectious poultry diseases are most often transmitted from one flock to another by infected birds, contaminated clothing and footwear or equipment," he says.

Avian influenza, a viral infection that can be spread through direct contact with a bird's bodily fluids, can be carried by domestic and wild birds (and may also be passed to humans). This highly contagious and severe respiratory disease can harm poultry flocks if not properly managed, and can have financial impacts for farmers and the Ontario industry.

Educational initiatives such as this seminar and lectures for veterinarians are an important step to support the growing number of small flock poultry farmers in the province.

Says Todd: "The Animal Health Lab is pleased to support the Ontario Animal Health Network as it moves forward with these endeavours."

Cheers to hardier vines

Helping Ontario's wine sector develop more cold-resistant grapevines

Gillian Beatson and Owen Roberts

The growth of the Ontario wine sector depends partly on grapevines' ability to withstand changing climate—in particular, the more unpredictable deep freezes that challenge the vines' ability to bounce back in the spring.

At the Simcoe Research Station, University of Guelph researchers are field testing several new grape rootstocks (the separate root system of a grafted grape vine) to discover whether a variety can better resist harsh winter elements found here by merely changing the rootstock.

Prof. Helen Fisher, Department of Plant Agriculture, is working with Riesling, Chardonnay, Cabernet Franc and Pinot Noir varieties to test this theory.

"The issue about expanding the acreage here is high vigour negatively affecting winter hardiness," she says. "We need grapes to live through the winter. Wineries and growers lose crop over most winters—it happens. But if we can reduce or minimize that loss, it would be wonderful."

Although the potential winter hardiness of any variety is genetically fixed, it can be modulated by the effect of the rootstock and the rate of growth. "If we use a rootstock derived from a native species—*Vitis riparia*—already evolved to survive highly variable southern Ontario winters, perhaps we can affect how fast the variety acclimates in the fall or how fast it de-acclimates in the spring," says Fisher. This could enhance the resilience of that variety to more changeable climate—more frequent early fall freezes, more severe mid-winter lows or more frequent early spring thaws.

For this research, Alireza Rahemi, a previous post-doctoral collaborator, collected 900 *Vitis riparia* clones from sandy soil regions all over Ontario. These included grape-growing regions such as Prince Edward County, Kent County, Norfolk County and Elgin County, as well as more northerly regions of the province.

Pinot Noir was grafted onto 12 of these clones selected for their low vigour and potential drought tolerance, properties considered important for emerging wine districts such as the Norfolk sand plains.

Fisher says the results will offer insight into whether these rootstocks will affect vine survival in unconventional growing regions outside the established Ontario wine districts.

"We know it is cold here and we know the *Vitis riparia* clones chosen for these rootstocks are already adapted to Ontario soils and weather," says Fisher. "The soil type and climate of the Norfolk region is very unique, so the information from the trials could be crucial for expanding wine grape growth in certain areas of Ontario where high vigour aggravates winter injury."

Bolstering this business could be very lucrative, as the wine industry contributes greatly to the economy of the province and country. The Canadian Vintners Association and the Winery and Grower Alliance of Ontario report that the Ontario wine and grape industry contributes $4.4 billion to the Canadian economy. The sector also generates thousands of jobs for Ontarians in retail, farming and product development.

"If these trials are successful, it will benefit Ontario wineries," says Fisher. "They will have greater winery productivity, and more importantly, more consistency in production if winter injury can be mitigated."

Trials are ongoing with these rootstocks. Fisher and the research team will continue to monitor the research vineyards over several winters.

This research is funded by the Ontario Agri-Food Innovation Alliance. Additional funding was provided by the Agricultural Adaptation Council through the Growing Forward 2 program, the Ontario South Coast Wineries and Growers' Association and Ontario Wine and Grape Research Inc.

Photo: Dave Peleschak

Research studies carried out at the Muck Crop Research Station enable farmers to find effective crop growth and pest reduction methods to maintain healthy crops.

Marvellous muck

Muck soil's loose particles let vegetables grow with ease

Ariana Longley

Hidden in plain sight—if that's even possible, with Ontario's bustling Highway 400 cutting through it—is one of North America's most influential vegetable field research facilities, the Government of Ontario's Bradford Muck Crops Research Station.

As field research stations go, it's hidden because it's relatively small. At just four acres, it's about the size of four football fields.

But knowledge mobilized from the muck station, located in the heart of the Holland Marsh, has given this small location big international recognition through research that enhances farming practices in unique muck conditions.

Muck soil is the organic black soil left after draining swamp or marshland. This moist organic substrate conserves water and releases plant nutrients. Loose soil particles allow root vegetables such as carrots and onions to grow big without much resistance from the soil.

That feature has helped farmers in the Holland Marsh, which covers 7,000 acres, produce more than $50-million worth of crops annually—accounting for nearly 15 per cent of Ontario's total vegetable production—including 85 per cent of Ontario's onions and 90 per cent of the celery produced in the province.

The Muck Crop Research Station's mission is to help farmers find ways to more effectively grow crops and deal with pests that might affect vegetable yield in this specific terrain. The soil's moistness, while promoting vegetable growth, can also help certain plant fungi and other organisms thrive, causing diseases such as leaf blight, cavity spot and clubroot.

"Sustainable production and integrated approaches to crop protection are the overarching themes here," says plant agriculture Prof. Mary Ruth McDonald, research program director for the Ontario Agri-Food Innovation Alliance. "Growers and consumers benefit from our research through consistent production of high-quality vegetables that are produced in a sustainable manner with minimum disruption to the environment."

Indeed, a report from the Friends of The

Photo: Ariana Longley

Preserving the landscape

Besides developing practical muck farming techniques and pest management strategies, researchers at Muck Crop Research Station explore how muck agriculture may affect the environment around the Holland Marsh. One approach involves adding phosphorus. Phosphorus is an essential nutrient for crops and may not be available when soils are cold early in the spring. Farmers must add phosphorus fertilizers to improve crop yield. Excess phosphorus may find its way into the sediments of adjacent lakes and rivers, causing water bodies to become eutrophic.

Plant agriculture professor Ivan O'Halloran is researching how much phosphorus is lost from Holland Marsh farms by comparing concentrations in sediment beside water bodies with those of the muck soils. He found that inorganic phosphorus was more likely to leave the fields and enter surrounding rivers than organic phosphorus. By identifying potential negative environmental effects of muck farming, these findings may suggest research to avoid these issues and preserve the Holland Marsh landscape.

Greenbelt Foundation says the techniques, tools and protocols developed at the Muck Research Station have reduced pesticide use in the Holland Marsh by about 40 per cent.

A key focus is the station's integrated pest management (IPM) program, specifically developed to assess and combat agricultural pest emergence in muck crop fields. Scientists and trained summer students join to perform twice-weekly field observations—looking for the presence of potential crop hazards like bacterial infections or insect infestations—after which the station releases a report informing farmers of diseases and pests that may present an imminent problem.

Equipped with this information, farmers can focus preventive measures on the most relevant threats.

In addition to preparing these reports, researchers involved in the IPM program develop novel technologies, pesticide application strategies and crop growing patterns to fight pests in the field.

Zachariah Tefler, the program's coordinator, identified the most effective pesticide to diminish weevil attacks on carrot crops. This treatment increased carrot yield by allowing plants to invest more resources into growth instead of defending themselves against insects.

"Information on the risk of disease development informs growers of when there is no need to apply sprays and allows for the correct timing of crop protection materials when needed," says McDonald. "Growers can also choose cultivars that are less susceptible to diseases or insect damage and use other crop protection approaches to produce high-yield and quality crops."

The station also produces an annual cultivar trial and research report of recent projects ranging from pest management strategies to innovative muck crop growing techniques to cultivar evaluations.

Cultivar evaluations describe varieties of crops typically grown in the Holland Marsh. Evaluations include records of physical characteristics like weight, colour and insect resistance that can help farmers make informed decisions about which crops to grow on their properties.

"The annual cultivar trial and research report is an important reference for growers in the Holland Marsh," says McDonald. "The report contains all of the leading-edge results that may not be published in other formats for months or years."

Research featured in this story was supported by the Ontario Agri-Food Innovation Alliance. Additional funding was provided by Fresh Vegetable Growers of Ontario, Bradford Cooperative Storage Ltd., Ontario Canola Growers, the Canadian Agricultural Partnership, Growing Forward 2, the California Garlic and Onion Research Advisory Board, and the California Fresh Carrot Research Advisory Board.

Photo: Amber Wood

The Greenbelt Plan actively prevents the conversion of rural land to urban development.

Improving our understanding of farmland loss in Ontario

Alyssa Logan and Sydney Pearce

The Ontario Greenbelt Plan has virtually eliminated the conversion of farmland to non-farm development within the area known as the Protected Countryside.

University of Guelph Prof. Wayne Caldwell, School of Environmental Design and Rural Development, says since the Greenbelt Plan came into effect, no approvals of official plan amendments have occurred within the protected countryside to convert rural land into urban developments.

He says that, before the plan was adopted, farmland conversion was a recurring activity.

And, he says, the impact is clear.

"The Greenbelt Plan has been remarkably successful in stopping the conversion of farmland within the Protected Countryside," he says. "From a farmland protection perspective, our research shows that the Greenbelt Plan has succeeded."

The Ontario Greenbelt Plan was created in 2005 partly to preserve prime farmland in the Greater Golden Horseshoe after officials had watched the number of farmers decline by almost 45 per cent since the 1970s.

Although it's stopped farmland conversion inside the greenbelt, some still question its merits.

Caldwell believes some people continue to see development occurring within the greenbelt, which actually reflects approvals that took place decades before 2005. Some see evidence of "leapfrog development," or development occurring outside the greenbelt. And others continue to resist the regulations established by the Greenbelt Plan.

"People may not see the Greenbelt Plan's success because it can take years before land is developed," he says. "Once the land is purchased, things like housing market declines, financial issues and waiting for approvals all slow down the rate of development."

Students who have worked on this research include recent PhD graduate Sara Epp and master's student Emma Drake. For counties and regions across the greenbelt, the students identified the presence and absence of official plan amendments, allowing for an accurate estimate of farmland losses into the future.

"By analyzing plans that are heading for development both before and after the Greenbelt Plan, we can see how much land has been lost since its initiation," says Caldwell. "Based on this research, we have documented the losses before and after the Greenbelt Plan—the conclusion being that the Greenbelt Plan has fundamentally shifted development patterns within the affected area."

He says even on the perimeter of the plan area, farmland loss has slowed as provincial policy forces developers to intensify within existing built-up and designated areas. That means there's less pressure on agricultural land.

This research is funded by the Ontario Agri-Food Innovation Alliance. Detailed results are available at: uoguel.ph/k9hhh and uoguel.ph/l166v.

Photo: Michael Manett

SOIL: THE NEXT FRONTIER

Owen Roberts

The relationship between agriculture and food is a natural one—at least for producers, who nurture it daily.

But the agri-food connection is increasingly becoming a "eureka moment" for the public, too. People are waking up to the realization that agriculture precedes food, and that what they see on their plate comes from complex agri-food systems. As they dig deeper into food production, they're realizing these agri-food systems depend to a great degree on soil health and preservation.

That's promoting a new public interest and fascination with soil, says Prof. Laura Van Eerd, who leads the sustainable soil management graduate research program at the University of Guelph Ridgetown Campus. She says the ball really got rolling when the United Nations declared 2015 the International Year of Soil. Initiatives such as World Soil Day, which had been around since the early 2000s, gained momentum. Soil started to become more a part of the conversation. Lately, that conversation contains some exclamation marks.

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People see dramatic examples of soil erosion and mismanagement all around them. They see drastic images of earth sliding down gullies or mountainsides, washing into lakes, seas and oceans. They see good farmland getting paved over or blowing away in dust storms. All this serves to pique their interest, at the very least. However, once they scratch the surface, they also see farmers trying to nurture the soil, conserve it and manage it.

They see grassroots initiatives such as the Ontario Soil and Crop Improvement Association (OSCIA) and the Ontario Soil Network, farmer-led extension aimed at increasing soil-building best management practices such as cover crops, minimum tillage and soil amendments. As a result, they're coming to understand soil is the most fundamental element of the agri-food system. They want to get involved and know more.

"They" also includes industry—seed companies, crop protection companies and other input suppliers aiming at ever-higher yields.

"Three-hundred-bushel-per-acre corn isn't going to come from a jug or a bag," says Van Eerd. "These kinds of yields will require years of investing in soil management."

To her, all this makes soil science "the next frontier."

Long-term research

Frontiers are rife with challenges and opportunities that require long-term approaches, which is how Van Eerd fashions her soil science research program. At Ridgetown, she oversees a continuous two-acre soil health research plot with her crew of three graduate students, five undergraduate students, a field technician and post-doctoral fellow.

That plot has been active since 2007. It's one of only a dozen long-term cover crop trials in North America that compare side-by-side soil management and plant production.

Over that time, she's had some amazing results.

Van Eerd and her crew have planted side-by-side cover crop plots 143 times, in grain cropping systems and processing vegetable systems. And 141 times, the cover crop plots have produced comparable or superior yields to those of plots without a cover crop.

"Three-hundred-bushel-per-acre corn isn't going to come from a jug or a bag. These kinds of yields will require years of investing in soil management." —Prof. Laura Van Eerd

"These figures are my 'eureka moments,'" she says. "Soil management is long-term, but we're showing it doesn't take a lifetime to see results."

Van Eerd, who also serves as a research program director for the Ontario Agri-Food Innovation Alliance, is seeing her own research program grow even further.

In 2018, she became part of a North America-wide initiative called the Soil Health Institute, dedicated to long-term soil health evaluation. Researchers in Canada, the U.S. and Mexico look at 30 soil health indicators and share results that they hope will benefit producers throughout their network.

As well, she was one of three research recipients of a $500,000 donation to the University of Guelph to support soil health outreach in Ontario, an initiative called Soils at Guelph.

All this excitement about soil science means more graduate student opportunities and more jobs. Van Eerd's program exposes students to a unique blend of soil and plant science. That's led graduates from her program and other agriculture programs at the University of Guelph to jobs in a variety of fields in government, academia and industry.

Opportunities

For example, self-described "soil nerd" Aaron Breimer is general manager of Veritas Farm Business Management in Chatham, Ont. He graduated from the University of Guelph in 2001 with an agriculture degree.

"When it comes to an agronomic crop plan, the soil is the foundation for everything else we want to implement and achieve," says Breimer. "I believe that every farm operation, farm field and management zone within a field is unique. To me, this means that every crop plan has a unique foundation that comes from researching the uniqueness of that specific soil."

He believes soil science has very specific applications related to profitability. "Yield is limited by whatever nutrient or soil characteristic is in the tightest supply for the crop," he says. "In other words, all things being equal when it comes to weather, soil science

Photos: Rafael Santos (preceding page) · Praveen Saxena

"When it comes to an agronomic crop plan, the soil is the foundation for everything else we want to implement and achieve."
—Aaron Breimer

is the limiting factor to increase yields."

Add in the complexities involved with soil science—which Breimer describes as physical properties, chemical makeup and biological processes—and every soil test becomes its own unique mystery.

"Trying to unlock the mystery is a great challenge, and cracking those challenges is incredibly rewarding," he says.

Laura Biancolin graduated from the University of Guelph in 2016 and now works as a program analyst for the OSCIA.

Soil became a big part of her academic life in a fourth-year project analyzing two funding models used to support the adoption of practices that reduced phosphorus losses into drains and creeks.

"It opened my eyes to the multitude of research projects, grant programs and pilot projects in southern Ontario, all with the goal of reducing nutrient losses through improved soil health," she says. "The project introduced me to the farmers that are self-starters, take risks and try out practices with the end goal of creating a system that is economically and environmentally sustainable."

Biancolin thinks there's a huge role for communicating about soil—the impact farmers can have on it, and the impact of soil organic matter and soil structure on soil fertility, nutrient cycling, erosion and compaction, and resilience to climatic variables.

"I believe more people would be drawn to soil science if they understood its significance and the amount of time it takes to build organic matter and improve soil structure," she says.

She encourages students interested in a soil science career to make connections: go on farm tours, talk to neighbours, communicate with local associations and networks, connect with the Ridgetown researchers and Ontario Ministry of Agriculture, Food and Rural Affairs extension staff, she suggests.

"The soil world is small and welcoming," she says, "and the opportunities and directions are endless."

From his travels to Haiti as a University of Guelph plant agriculture master's student, Cameron Ogilvie learned that soil health is vital—no matter where on this planet you farm or how much land you have.

"I travelled there for some service projects

and witnessed a lot of deforestation and soil degradation, worsened by poverty and trade embargoes," he says. "I realized then the importance of soil systems for subsistence farmers. If you can't afford external inputs such as synthetic fertilizers, pesticides, you are left to depend on a healthy soil system."

At U of G, Ogilvie studied cover crops' effects on soil physical properties and soil water dynamics. He was intrigued by questions such as: What comprises thriving soil? What untapped potential do soils have to boost agroecosystem productivity? How much can a healthy soil reduce dependence on external inputs? How much can soils be managed to suppress disease and weed populations? How much can soils be managed to improve crop water supply? Can better soil management increase profitability?

To him, all this makes soil science challenging, interesting and rewarding.

"Agronomy would be a simple science if soil wasn't part of the equation," he says. "It's the 'black box' of agroecosystems."

Ogilvie is now the outreach and communications coordinator for the Soils at Guelph Initiative. Soils at Guelph is a new outreach initiative of the University of Guelph to connect soil researchers with farmers and consumers from across the province.

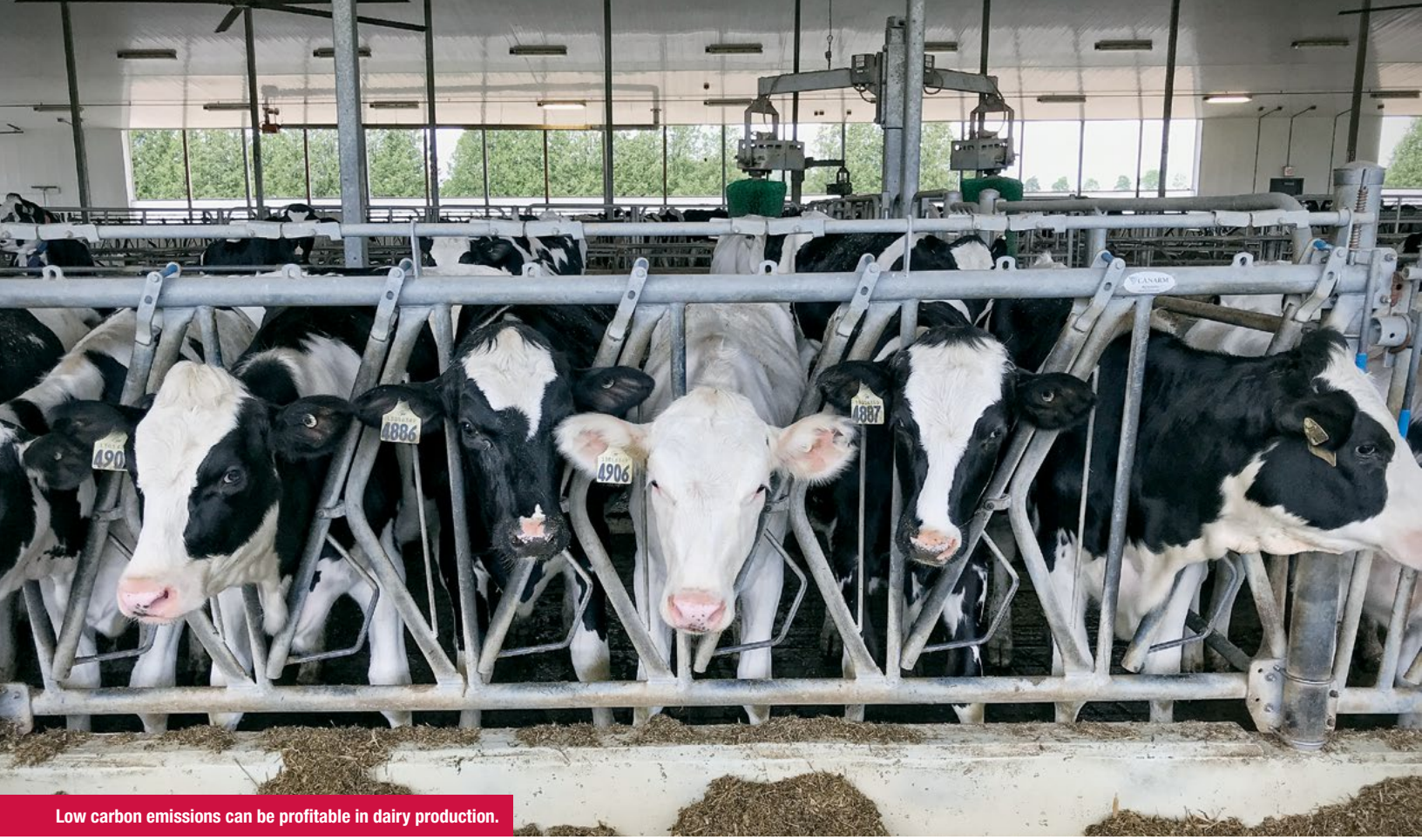
Van Eerd says these kinds of questions and initiatives show the potential of soil science.

"Everyone in agriculture is looking for good people to hire and there are many jobs for undergraduates, so they may be less likely to go for a master's or doctorate," says Van Eerd. "But all around, the need for soil research and conservation is being emphasized. We'd like students to consider graduate opportunities in soil science. It's the next frontier."

This research is conducted at the University of Guelph Ridgetown Campus.

This research is funded by the Ontario Agri-Food Innovation Alliance. Additional funding was provided by Grain Farmers of Ontario and the Ontario Processing Vegetable Growers.

This story originally appeared in *Ontario Grain Farmer* magazine (February 2019), a publication of Grain Farmers of Ontario.



Low carbon emissions can be profitable in dairy production.

It pays to be environmentally friendly

Carbon footprint-friendly dairy farming leads to a healthy planet…and a healthy bottom line

Sydney Pearce

Being a carbon footprint-conscious dairy farmer improves the planet *and* farm profitability, say University of Guelph researchers. They've determined that environmental best practices, such as manure management, also improve producer profit margins.

Research associate Susantha Jayasundara and Prof. Claudia Wagner-Riddle, School of Environmental Sciences, collected production data from dairy farms across Ontario and classified them as having a high or low carbon footprint.

They found that, on average, low carbon footprint farms profited by more than $1,200 more per cow than high carbon footprint farms. This adds up to a huge surplus profit with multiple cows in a herd.

"We want farmers to know that being sustainable and reducing your carbon footprint doesn't imply an economic penalty," says Wagner-Riddle. "In fact, it's actually the opposite and I hope this information may provide enough incentive to initiate that change."

Farms producing a low level of carbon emissions had a few key practices in common. These included using:

- Homegrown feed, especially high-quality forage (corn silage, alfalfa-grass hay)
- Feed management practices such as targeted group feeding and use of total mixed ration
- Shorter calving intervals and optimum heifer management.

When these practices are implemented by producers, sustainability is improved, from both environmental and economic perspectives.

"Sustainability is more important than ever, and the dairy industry as a whole is working towards improving greenhouse gas emissions," says Wagner-Riddle. "This knowledge alleviates economic pressures and hopefully allows farmers to make the changes they need to make."

Understanding carbon footprint

Carbon footprint consists of all greenhouse gas emissions expressed as carbon, produced by activities associated with production of a certain product, such as milk. These emissions trap heat in the atmosphere, contributing to climate change and global warming if not properly managed.

This research was conducted in collaboration with Prof. Alfons Weersink, Department of Food, Agricultural and Resource Economics, and Tom Wright, OMAFRA.

This research is funded by the Ontario Agri-Food Innovation Alliance.

Photo: Amber Wood

Big plans for micropropagation

Samantha McReavy

Efforts to replace agriculture and food imports with homegrown products are arising in even the most specialized market segments, such as micropropagated trees.

Micropropagation uses small parts of plants instead of stem or root cuttings, allowing more trees to be grown faster. This innovation is important—demand for apple root stocks and varieties is predicted to reach more than two million plants per year for at least the next decade.

Currently, most micropropagated trees come to Canada from Europe or the United States. Unfortunately for producers here, inconsistent delivery, poor plant quality, loss during transportation and currency fluctuation are regular frustrations.

University of Guelph plant agriculture professor Praveen Saxena thinks there's a better way. Working with the Gryphon's LAAIR (Leading to the Accelerated Adoption of Innovative Research) program, he and research associate Mukund Shukla at the Gosling Research Institute for Plant Preservation have developed an efficient commercial-scale technology for micropropagating apple trees.

This technology includes a unique nutrient medium, container and bioreactor-based culture system—that is, a manufactured device that supports a biologically active environment in which plant cells or tissues can thrive. The conventional technology for micropropagating plants hasn't changed much. Traditional containers and bioreactors are universal and not optimized for specific plant species and can handle only a few growing conditions.

That's where Saxena's bioreactor comes in. It provides optimum growth conditions with increased control over parameters, such as temperature, light and availability of nutrient medium, which increase growth and numbers of the apple saplings.

He says that, ultimately, this technology will allow Ontario growers to meet apple tree demand and expand apple production. And it's very economical: he says trees can be multiplied at half or even one-third of the cost of traditional methods depending on the variety.

Unique nutrient medium offers unparalleled support for apple tree growth.

Photo: Praveen Saxena

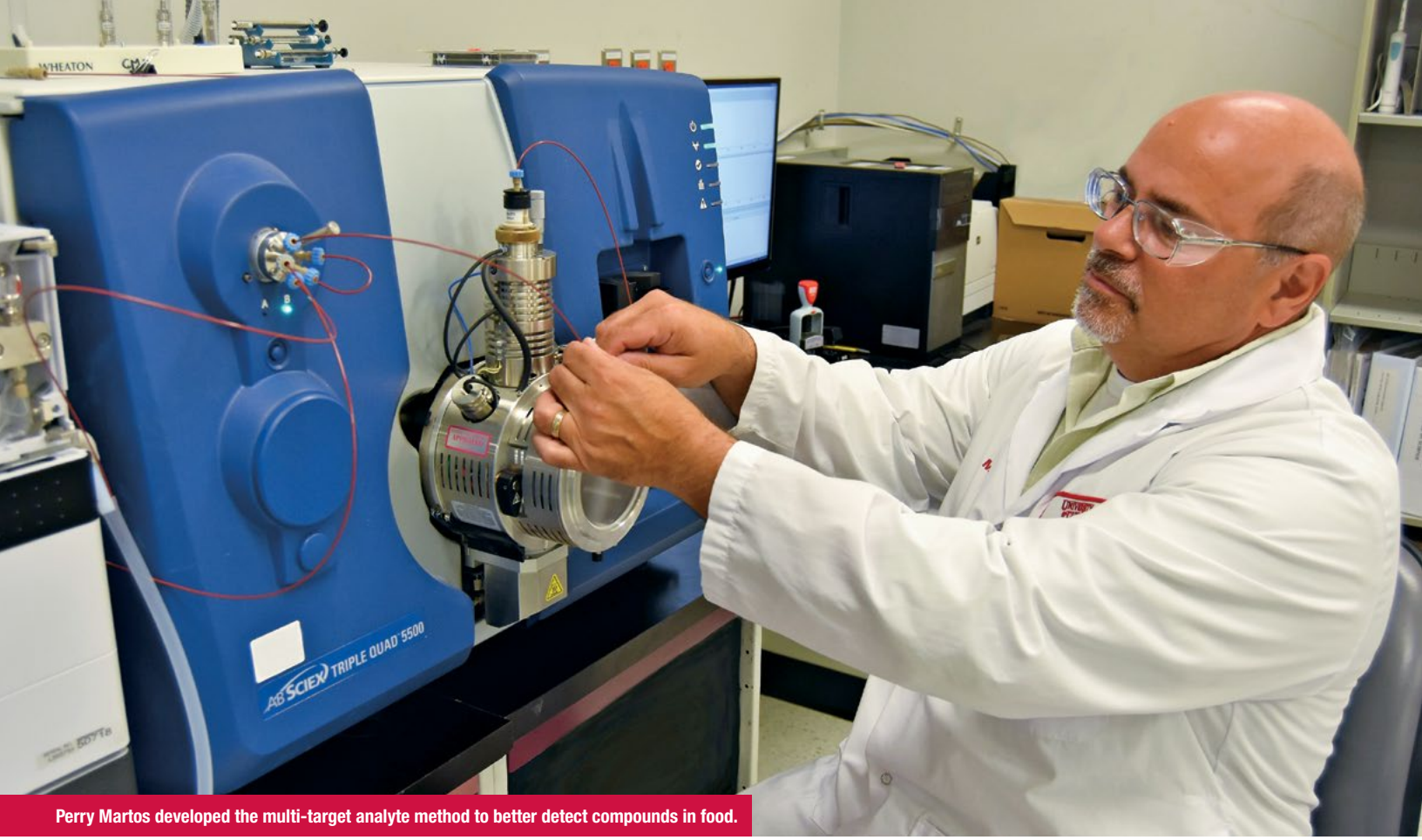
The process starts with a small growing bud on a source plant. The bud tissue goes into the bioreactor, where it develops a small shoot, which multiplies to generate many more. Once these new shoots develop further, roots begin to grow, and the plant is ready to be planted in soil in a greenhouse or in the field until it is large enough to be sold as a tree. For an apple tree, this process can take 14-18 months.

Micropropagation technology also offers employment opportunities for students who wish to pursue a horticulture career, says Shukla.

"Increasing Ontario's micropropagation industry will provide apple trees faster to growers, and open more positions as research assistants, lab assistants and interns," he says.

Shukla and Saxena have created a new micropropagation device called Plant Tissue Culture Plus (PTC+) to propagate a wide range of trees, ornamental and medicinal plants. Another priority for micropropagation is hazelnut trees—they're in high demand from candy manufacturer Ferrero Canada, which is trying to develop a vibrant hazelnut industry in Ontario. And like apple growers, Ferrero Canada can't get a reliable supply of micropropagated trees elsewhere.

This research is funded by 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.



Perry Martos developed the multi-target analyte method to better detect compounds in food.

Less environmental impact found through new analytical method

Samantha McReavy

Veterinary drugs and pesticides detection in food tested at the U of G Agriculture and Food Lab (AFL) has been improved through a new method that increases the number of detectable compounds in samples while using a more environmentally friendly compound to reduce the impact of volatile emissions.

Perry Martos, senior research scientist and manager of chemistry research and development at the AFL, worked with research scientist Charles Wroblewski to develop the process. The multi-target analyte method improves detection of veterinary compounds in meat, milk and honey while significantly reducing the testing method's environmental footprint.

Developing the method required six months of extensive research to demonstrate its environmental advantages over those of the previous process.

Identifying compounds in food is necessary to ensure they are regulated within government standards.

The researchers used methanol in their analytical approach, preferable to the current approach that uses a far more toxic solvent called acetonitrile.

"There is a lot of toxic waste that will be avoided by developing the method in a more environmentally friendly way," says Martos. "Other jurisdictions can borrow from what Ontario is doing."

Here's how the multi-target analyte method works.

In food safety laboratories, such as the AFL, researchers analyze samples of food for veterinary drugs and pesticides.

Normally, their compound separation equipment uses acetonitrile to analyze the samples so the compounds can be detected. These compounds include pesticides, antibiotics, mycotoxins (toxic compounds produced by fungi) and pharmaceutical drugs.

One test can take about 20 hours. Traditionally, testing requires about 1 kg of acetonitrile per analysis.

This all adds up. Food safety labs such as the AFL can have many analytical instruments. Each instrument they use can generate about 200 kg of acetonitrile vapour a year, which can ultimately become an airborne waste product during analysis of samples.

"We shouldn't generate kilograms of waste looking for nanogram quantities of compounds," says Martos.

The new method cuts acetonitrile use by more than half for one step and eliminates it from another step. "It wasn't simple to switch to methanol, but it was worth it." Methanol breaks down much faster in the environment —acetonitrile has a half-life of 1½ years, while methanol's half-life is less than 10 days.

Martos plans to further refine the method to run faster and with even less methanol and ultimately eliminate the need for acetonitrile.

The development of the multi-target analytical method was funded by the Ontario Agri-Food Innovation Alliance.

Photo: Samantha McReavy

Helping camelina catch on

This durable and versatile crop has potential for Ontario farmers

| Mya Kidson

A so-called ancient oilseed called camelina is attracting attention in Ontario. Researchers believe it has potential as a superb cover crop here and are field testing it now in research plots in Simcoe, Winchester and Ridgetown.

Camelina, a member of the mustard plant family, originated in Europe. It was first identified in Canada in the mid-1800s. It's realized significant growth in Western Canada over the past decade among producers who appreciate its winter hardiness and versatility.

Camelina seed meal is an approved feed ingredient for broiler and layer hens. Camelina oil is approved for use in farmed salmon and trout feed, replacing the wild-sourced fish oils and proteins currently used.

Camelina oil also has a potentially significant consumer market. Chefs like its light, nutty, earthy taste. It's been certified a novel food by the federal government. Its oil has an unusually well-balanced fatty acid profile and a stable shelf life of up to two years. At 246 C, it has the highest smoke point of any popular cooking oil by far.

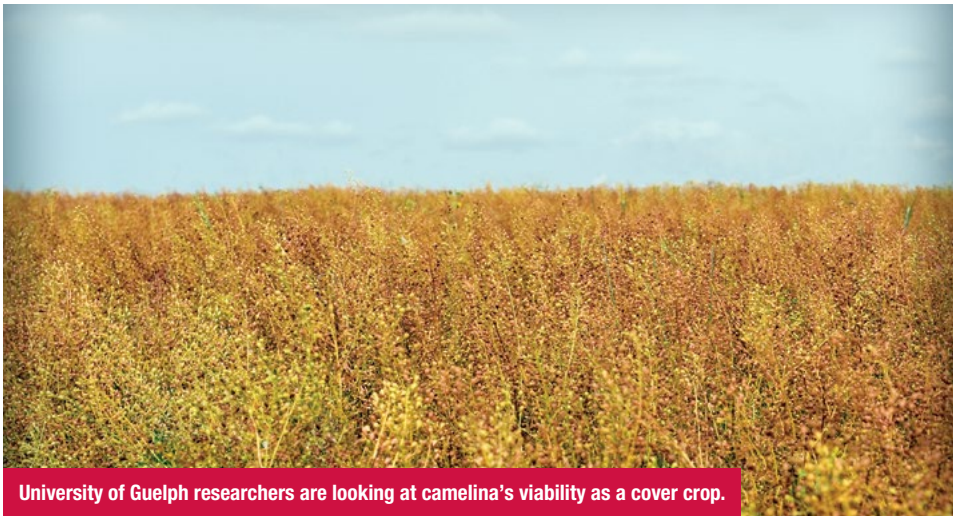
Industrial crop specialist Jim Todd from the Ontario Ministry of Agriculture, Food and Rural Affairs is supporting a research team studying camelina's ability to thrive in Ontario. He says its robust features and ability to withstand extreme weather conditions make it a suitable fit for changing climate, particularly as a winter cover crop.

Over the last decade, this robust crop has developed significance in Western Canada.

Cover crops help improve soil quality by maintaining soil nutrient and moisture content in winter.

"Camelina is a very promising oilseed," says Todd. "It has already been shown to flourish in Western Canada and our Ontario plots are showing great potential for success as well."

Todd has come across a few challenges, notably seed germination and weed pressure. Poor germination can result from factors including sub-par seed health, inclement weather conditions at planting or planting into less-than-ideal soil conditions. The crop is usually quite competitive once it's established, but a poor camelina stand will suffer from increased weed pressure. That ultimately reduces seed yield. The research team is looking at camelina field plots to figure out how to overcome these challenges.



University of Guelph researchers are looking at camelina's viability as a cover crop.

Team members include Profs. Rene Van Acker, Doug Young, Holly Byker, bioproducts specialist Mahendra Thimmanagari, research technicians Rachel Riddle and Peter White, and Linnaeus Plant Sciences oilseeds research team leader Deb Puttick.

This research is funded by the Ontario Agri-Food Innovation Alliance. Additional funding was provided by Linnaeus Plant Sciences.

Photos: Three Farmers Foods Inc.

Tackling Ontario's $12-billion food waste problem

Samantha McReavy

Ontario's food system follows a linear model, meaning that our food waste has an end point and is not being repurposed as it would be in a circular economy. As a result, Ontario is saddled with a whopping $12 billion in food waste across the entire value chain, from farmers to retailers to households.

University of Guelph researchers are working to identify areas that will help the province reduce food waste's economic impact.

To start this initiative, a team led by Prof. Kate Parizeau, Department of Geography, Environment and Geomatics, and Prof. Mike von Massow, Department of Food, Agricultural and Resource Economics, convened a two-day workshop to bring together representatives of various food sectors—including stakeholders, farmers, retailers, consumers and municipalities—to create a research agenda for reducing food waste.

Participants identified eight opportunities to help tackle Ontario's food waste:

- Improve household food literacy
- Incorporate imperfect or "ugly" foods
- Increase food recovery for non-human use such as composting
- Optimize portion sizes to reduce waste
- Coordinate policy and governance
- Clarify best-before dates (how food is stored impacts shelf life)
- Increase food diversion for consumption
- Reduce food waste at the consumer and non-consumer levels.

This information is being used to help guide research project development. Parizeau and her team are working to better understand where, why and how much food is wasted across the value chain.

Additionally, the team is involved with community-engaged scholarship, such as evaluating food waste diversion efforts at The SEED Guelph (a program that addresses food issues in the community) and working

Illustration: ThinkLink Graphics

with the Ontario Food Collaborative to reduce food waste. Parizeau was also involved in the successful $10-million Guelph-Wellington Smart Cities Challenge competition.

"Our research will play an important role in limiting food waste by changing consumer attitudes, influencing policy changes and social values," says Parizeau.

Others involved in this study are Prof. Ralph Martin, Department of Plant Agriculture, and Prof. Evan Fraser and master's student Amy DeLorenzo, both of the Department of Geography, Environment and Geomatics.

This research is funded by the Ontario Agri-Food Innovation Alliance.

New and improved crop varieties and germplasm developed at the University of Guelph generate profits and promote sustainability

FEATURE

Planted firmly in Ontario's economy

| Robyn Meerveld

Perhaps one of the greatest benefits from germplasm development at the University of Guelph is the most difficult to measure—the security of knowing that Ontario has a bountiful supply of home-grown field crops, fruit and vegetables that it can share with the world.

Germplasm development also contributes to our lives in ways we don't see. Crops like corn and soybeans are bred for an increasingly wide range of industrial products, from fuels (biodiesel and ethanol), automotive parts, packaging and consumer products, to industrial chemicals, paints, lubricants, fibres and even pharmaceuticals. These "green" components help reduce the petrochemical content of industrial and consumer products and increase recycling and composting options.

The University of Guelph has the most prolific germplasm development programs in the country, with the widest range of crops under development for food, feed and industrial purposes. More than 500 plant varieties have been developed since the late 1800s, with breeders carefully selecting and crossing generations of crops to make them hardier, healthier and higher-yielding.

Yearly, the University's plant breeders develop, test and release new field crop, fruit and vegetable varieties. These are grown by thousands of producers in Ontario and throughout North America.

U of G breeders work closely with industry and government to learn exactly what improvements are needed in the field, factory or supermarket. Financial contributions from producer and grower organizations, and their collaboration in testing new lines, help ensure the new varieties are adopted quickly, returning the financial investment sooner.

Those breeders also work closely with the University's key provincial partner, the Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA).

Over many decades, they have addressed emerging issues and opportunities, from management strategies for droughts or pesticide resistance, to creating soybean and wheat varieties tailored to export markets in Europe and Japan.

"The Ontario Tender Fruit Growers have been working in partnership with the University of Guelph for many years to bring new tender fruit varieties to the marketplace. Local breeding programs are an essential long-term commitment and process to ensure only the best selections, from an economic and consumer demand perspective, are released."
— Sarah Marshall, manager, Ontario Tender Fruit Growers

VEGETABLES

More than 150 new varieties of fruits and vegetables have been developed by University of Guelph breeders. One of many outstanding successes is Guelph Millennium asparagus developed by Prof. Dave Wolyn, which increased yields by 40 per cent compared to existing varieties. It now comprises more than three-quarters of the Ontario crop, and is popular as far away as Michigan, Washington State and the U.K. And Guelph's Yukon Gold potatoes? Their popularity persists decades after they were developed.

Annual value of Ontario crop: $1.9 billion

FRUITS

Although the harvested area of fruit crops has declined, the total farm value of Ontario fruit crops rose by 124 per cent between 1985 and 2017. Guelph breeders have contributed to this success by developing improved varieties of cherries, plums, strawberries, raspberries, nectarines, peaches, pears and plums.

Prof. Jay Subramanian has recently completed studies of two new early season peach varieties—20+ years in the making—that will help Ontario growers get a jump on imports and avoid weather risks later in the season. He's also developed two new yellow plum varieties that will stretch the season by maturing both earlier and later than existing varieties. The plums are larger, with better shelf life and superior resistance to black knot, a common disease.

Annual value of Ontario crop: $280 million

FOOD- AND FEED-GRADE SOYBEANS

More than three million acres of soybeans are grown annually in Ontario for food, feed and industrial uses. That makes it the largest acreage field crop in the province. About 60 per cent of the harvest is exported, much of it to southeast Asia.

Amazingly, soybeans didn't exist in Ontario as a crop until the 1920s, when U of G breeders developed varieties suitable for provincial growing conditions. In the last three

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Photo: Grain Farmers of Ontario (opposite)

The exacting specifications required for many industrial uses for soybeans are a challenge for plant breeders.

$950 million

Approximate annual economic impact of germplasm developed at the University of Guelph

500

Number of plant varieties that have been developed at U of G since the late 1800s

CONTINUED FROM PREVIOUS PAGE

decades, more than 60 new varieties have been released. OAC Kent has been one of the most popular, highest-yielding, non-genetically modified varieties in Ontario. It's also created an estimated $2-billion market for growers.

Prof. Milad Eskandari of the University's Ridgetown Campus is developing food-grade soybean cultivars resistant to soybean cyst nematodes (SCN) that yield well in soybean-growing areas of the province. He estimates that SCN damage costs Ontario soybean growers more than $30 million each year. And it's not just a pest of soybeans: SCN can infect fields of dry beans as well.

Annual value of Ontario crop: $1.7 billion

"Grain Farmers of Ontario strongly values the University of Guelph public breeding programs that develop new varieties of crops like food-grade soybean and wheat. Their focus on adaptation to the Ontario environment and their flexibility to breed for smaller, high-value export markets like food-grade soybean help improve Ontario grain farmers' competitiveness in the global marketplace."

—Josh Cowan, manager of research and innovation, Grain Farmers of Ontario

WHEAT

Winter wheat is Ontario's third largest crop, after soybeans and corn. Fusarium head blight (FHB) is considered the biggest problem facing wheat producers across Canada. The fungus produces a toxin that can be fatal to livestock, and too much in a crop can render it worthless. Agriculture and Agri-Food Canada estimates fusarium has cost Canadian producers $1.5 billion in lost income since the mid-1990s.

Researchers in the University's wheat breeding program, previously led by the late Prof. Ali Navabi, aim to understand the genetic basis of wheat resistance to FHB, and to incorporate resistant lines in the breeding pipeline. The University will soon release a new line with improved yields and resistance to stripe rust, a fungal parasite and another disease of economic significance to Ontario wheat. Winter wheat varieties grown in Ontario currently have wide variation in their susceptibility to stripe rust.

Annual value of Ontario crop: $477 million

DRY BEANS

The common dry bean is a staple food for more than 300 million people worldwide. Beans are beneficial for human health and the environment and are particularly important for healthy soils. Because they can fix atmospheric nitrogen in the soil, they reduce the amount of nitrogen fertilizer needed by other crops planted later.

The University's bean breeding program focuses on developing high-yielding, disease-resistant varieties for Ontario growers. It's led by Prof. Peter Pauls, who in collaboration with Agriculture and Agri-Food Canada has developed common bacterial blight-resistant lines (OAC Rex, Rexeter, Mist, Lighthouse, Shock) as well as varieties like Bolt that resist currently prevalent forms of fungal anthracnose. Most recently developed varieties Fathom, Apex and Argosy combine resistance to both diseases.

U of G varieties in other market classes, such as the dark red kidney bean Dynasty, light red kidney bean Inferno and white kidney bean Yeti, have shown excellent yields in trials in Ontario, Michigan, North Dakota and Minnesota. The yield increase of these three varieties alone was calculated to provide an additional $143 per acre to growers.

Overall, Ontario dry bean yields have nearly doubled between 1985 and 2014, thanks to the work of agronomists and public and private bean breeders.

Annual value of Ontario crop: $115 million

Photo: Grain Farmers of Ontario (top)

Growing new Ontario industries

MacKellar Farms is working with Ridgetown Campus to develop edamame soybeans.

Novel propagation techniques and products are growing new businesses and "public good" benefits

EDAMAME
On dinner tables soon

Edamame soybeans are tasty, nutritious and increasingly in demand among Canada's ethnically diverse consumers. Currently, most edamame is imported, but MacKellar Farms of Alvinston, Ont., has seen the opportunity to grow this specialty crop closer to home.

Prof. Milad Eskandari at the Ridgetown Campus works with industry collaborator and edamame grower MacKellar Farms to produce varieties adapted to Ontario's climate and pests. The first varieties from their collaboration will be on Canadian dinner tables shortly.

CANNABIS
Consistency is the key

Working with several cannabis industry partners in Ontario, Profs. Max Jones, Youbin Zheng and Mike Dixon have focused on genetics and breeding of the plant.

They're using tissue culture methods to grow the plants in a sterile, controlled environment. That's the best way to meet industry's need for healthy, clean plants, and Health Canada's stringent and wide-ranging requirements from pests and disease to heavy metals. Tissue culture can also help in propagating genetically identical plants or introducing new genetic variation for desirable traits.

But like all living organisms, genetically identical plants are unlikely to remain the same when grown under different environmental conditions. Those differences can include the levels of hundreds of medicinal compounds in cannabis, including cannabinoids, terpenes and flavonoids. U of G's Controlled Environment Systems Research Facility offers the precise conditions needed to develop standardized medicinal compounds in the plant.

HAZELNUTS
A new, high-value crop

Growing hazelnuts is a new opportunity for Ontario. U of G researchers have teamed up with Ferrero Canada and growers in the Ontario Hazelnut Association to produce hazelnuts for Canadian markets, which

PLEASE SEE NEXT PAGE

$1.3 million

Annual royalties for plant germplasm developed in the University of Guelph's breeding programs

"With an ever-growing worldwide focus on plant-based protein, it's important for Ontario growers to have access to dry bean varieties that have been developed specifically for our growing conditions. The bean breeding program at the University of Guelph plays a crucial role in ensuring our growers produce the highest quality beans that Ontario has become known for, at a price competitive with other international growing regions. Guelph's world-renowned program also trains the next generation of dry bean experts, many of whom will go on to ensure the viability of Ontario's dry bean industry."

—Mike Donnelly-Vanderloo, chair, Ontario Bean Growers

Photo: MacKellar Farms

CONTINUED FROM PREVIOUS PAGE

include customers of Ferrero Canada's Brantford, Ont., facility.

Fully grown plantations may produce an estimated profit of more than $2,000 per acre at current market prices for hazelnuts.

Prof. Adam Dale has tested varieties for consistently high yields, disease tolerance, cold resistance and nut quality. To produce the massive numbers of plants that will be required, Prof. Praveen Saxena developed a micropropagation technique using bioreactors to produce hazelnut trees and ship them anywhere in the world. The technology is currently being trialled by industry collaborator Upper Canada Growers Ltd. of Niagara-on-the-Lake and Essex County, Ont.

INDUSTRIAL SOYBEANS
For bio-based materials

Plant-based raw materials such as corn and soybeans can be more environmentally friendly in manufacturing than their oil-based counterparts. But industry and breeders alike are challenged by the exacting specifications required for many industrial uses. Bio-based raw materials must perform consistently and just as cost-efficiently to be incorporated into production lines, a fact that soybean breeder Prof. Istvan Rajcan keeps foremost in mind.

Profs. Amar Mohanty and Manju Misra at the University's Bioproducts Discovery and Development Centre have collaborated with Ontario industries to create hard plastic and foam materials from U of G-bred soybeans that meet those exacting specifications. These are used to manufacture auto parts such as panels (up to 20–30 per cent soy), storage compartments and seats, and consumer products including containers, packaging and coffee pods.

Rajcan has recently developed a promising industrial soybean variety with application in North America's billion-dollar coatings industry. It has a higher level of linoleic acid than commodity soybeans, making it more functional in alkyd resins (used in protective coatings), and with the added advantages of faster drying, lighter colour and greater hardness than other oils.

LEGUMES
Higher nutritional value

Legume crops like clover and dry beans contribute to soil quality by fixing atmospheric nitrogen in the roots. This reduces the amount of nitrogen fertilizer required.

Bean breeder Prof. Peter Pauls has studied the nitrogen-fixing ability of many varieties and is looking to improve their ecological benefits by increasing the genetic diversity of beans.

His team's research will also contribute to human health. He's investigating the biochemical control of folate in dry beans (an important B vitamin) and collaborating on work to determine dry beans' effects on gut health and their antioxidant characteristics. The goal is to develop bean germplasm that's even more nutritious.

SUSTAINABILITY
Resistance to nematodes

Almost all soybeans grown in Ontario have the same limited number of genes that provide resistance to soybean cyst nematode (SCN). And in every soybean field, a few SCN variants are unaffected by these genes. Such limited resistance increases the risk that unaffected SCN variants will flourish. In fact, it's already happening in some U.S. states and in southwestern Ontario.

Prof. Milad Eskandari of the University's Ridgetown Campus is breeding new genetic sources of SCN resistance from exotic soybean varieties into high-quality, high-yielding soybean cultivars for Ontario. By tapping into the genetic potential of the crop rather than depending on pesticides, the Ontario soybean industry can continue to be an important and sustainable contributor to agriculture in the province.

BIODIVERSITY
Safeguarding germplasm

Plant breeding plays an important role in supporting biodiversity—something that is difficult to monetize but is widely recognized as critically important to healthy ecosystems. As biodiversity declines globally, researchers at the Gosling Research Institute for Plant Preservation (GRIPP) are taking steps to safeguard the germplasm of endangered Canadian native species such as American elm, chestnut and ash trees. All three species have been decimated by disease.

GRIPP researchers cryopreserve plant material from remaining healthy tree specimens that appear to have been disease-resistant for later propagation and replanting. This tissue culture regeneration is an especially useful method of preserving plant material with desirable genes that may not be passed on through seeds.

"Ferrero uses only the highest quality hazelnuts in our consumer products. We are pleased to collaborate with the University of Guelph and the Gosling Research Institute for Plant Preservation as they work toward understanding and developing high-quality hazelnut trees adapted to Ontario growing conditions. These activities have been key to the Ferrero project's success, and support our company's objective to source locally wherever possible."
—Barb Yates, agronomy lead, North America, Ferrero Canada Ltd.

Prof. Manjusri Misra (second from right) leads a research team that utilizes food waste to make bio-plastic packaging.

Toward greater sustainability

Bioengineering researchers are converting food waste into compostable packaging

Mya Kidson

Canada's ever-growing population is accumulating food waste—currently, more than half of the food produced in Canada ends up in the garbage.

A research team at the University of Guelph is finding ways to convert food waste into compostable packaging through bioengineering.

Prof. Manjusri Misra, School of Engineering, and her research team are searching for ways to use non-food biomass and innovative production processes to create sustainable packaging.

Misra's team has used non-edible agricultural residues such as oat and rice hulls—as well as low-value products from industrial processes—to make bio-plastic packaging through compounding, injection moulding, film processing, thermoforming or 3-D printing.

The researchers aim to demonstrate how food waste can be used for sustainable packaging purposes. This promotes the concept of a circular economy, when developing greener plastic materials.

Misra says bio-based products are economically and environmentally beneficial and may substitute single-use, non-degradable plastics that dominate landfills.

"Although it might take a while to be commonplace for consumers and industries to adopt this more sustainable practice, the outlook is promising," says Misra. "Some of the possibilities we are working on now weren't possible 10 years ago."

Bio-composites are materials that combine biofibres or other bio-based fillers with plastic resins. This approach reduces the amount of plastic used, the cost, and improves the sustainability. Several wastes from industrial food processing, e.g., tomato skin, potato skin, grape pomace, apple pomace, coffee chaff, spent coffee and tea, are being tested for bio-composite applications in Misra's lab.

This research also considers challenges to product implementation, aiming to develop price-competitive solutions, that require collaboration with industry partners.

"Looking to the future, there is lots of work to be done, but there is great potential for commercial use," says Misra.

Misra's research team includes an extensive group from across the University of Guelph in engineering, plant agriculture, geography, food science, management, and food, agricultural and resource economics, as well as researchers from McMaster University, Western University and provincial and federal research labs.

This research is funded by 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 the Ontario Ministry of Economic Development, Job Creation and Trade.

Photo courtesy of: Manjusri Misra

New roots for the rubber industry

Natural rubber demand continues to grow, but supply may not keep up with future needs. That's where Russian dandelion shows potential

Mya Kidson

Natural rubber farms, such as those growing guayule shrubs and Pará rubber trees, can't support the increasing global need for this strategic commodity, but the economy can't run without it. And down the road, climate change may contribute to decreased growth of these rubber-producing plants.

Although synthetic rubber exists for small-scale applications such as garden hoses, it's unable to replace natural material for use in many large-scale uses, such as airplane tires. That's because natural rubber has better physical properties than the synthetic alternative.

Now, an unlikely alternative is getting a serious look: Russian dandelion. Latex from this plant might help support a Canadian natural rubber industry, says University of Guelph researcher Prof. Dave Wolyn, Department of Plant Agriculture. He's working to enhance its viability in Ontario's climate and create a potentially profitable new crop for the province's farmers.

In field trials, Wolyn has increased Russian dandelion's rubber concentration from five per cent to nearly 10 per cent by selective breeding. Previous research suggests 10-per-cent rubber concentration is the point at which extraction becomes efficient.

"Breeding is showing great results and the Russian dandelion is showing potential for being a viable crop in the future," he says.

Wolyn hopes his research can increase rubber yield and crop growth of Russian dandelion, generate wide interest from tire manufacturers and other industries, and prove profitable for Ontario farmers.

This research is funded by the Ontario Agri-Food Innovation Alliance. Additional funding was provided by Bridgestone Americas Center for Research and Technology.

Photo: Dave Wolyn

Integrating science and business in agri-food

HQP program helps develop leadership for the agri-food sector

| Amia Khosla

Tools such as the Highly Qualified Personnel (HQP) program play a big role in developing future leaders for the agri-food sector. This program provides industry access, educational opportunities and funding to students with promise in research excellence.

One such student is Nicole Weidner, a PhD candidate in the biomedical sciences program. She's garnered success through the HQP program in at least two ways: with the global animal nutrition company Alltech, and within the University. Her experiences have made her an active participant in the animal nutrition community.

"Many graduate students don't get the opportunity to see the innovation that happens as a result of their research," says Weidner. "Getting to see my work applied and understanding how it improves life gives me a new perspective and has positively impacted my view of research. I owe a lot to the HQP program for getting me here today."

A graduate course called The Integration of Science and Business in Agri-Food Systems is the first step that the Ontario Agri-Food Innovation Alliance offers to meet the demands of the ever-changing agri-business sector. This course helps HQP scholars gain a dynamic understanding of business and science before entering industry placements.

The course also enriches the leadership skills of HQP scholars by connecting them in the classroom with industry leaders as guest speakers, and by fostering connections through networking events.

Nicole Weidner: Dog models shed light on vitamin D intake, a major health-related question in humans.

"Getting to see my work applied and understanding how it improves life gives me a new perspective and has positively impacted my view of research. I owe a lot to the HQP program for getting me here today."
—Nicole Weidner

Building on the in-class work, the program facilitates an internship for HQP scholars. Weidner undertook her internship with Alltech, an industry leader in animal nutrition. There, she worked on projects related to the feed and gut health of production animals like poultry and swine.

The results were presented at the Poultry Science Association annual meeting and the International Poultry Scientific Forum, giving her experience with preparing materials for scientific conferences

After completing their internships, students return to their PhD projects, with their stipends funded by the Ontario Agri-Food Innovation Alliance. Weidner's doctoral work in the Food for Health program uses a canine model to study the role of vitamin D in osteosarcoma, lymphoma and mast cell tumours that could also affect humans.

Here's the key to this research. It's believed that dogs—unlike humans, who can also produce vitamin D in their skin during exposure to UV light—can obtain vitamin D only from their food. That makes them a good model system for tracking vitamin D intake.

Weidner and the research team found that dogs with certain cancers have lower vitamin D concentrations in their blood. The research team is now looking at links between blood vitamin D concentrations and inflammatory markers in the dogs, based on findings published about humans.

Clearly, Weidner's HQP experience has been diverse.

"As a PhD student, I really value the industry connections I've made from the HQP program," she says. "Gaining such industry experience is very rare for doctoral students, but it means I can move on after my graduation to an industry position or to continue on in academia. I know that this program will play an integral role in ensuring my success after graduation."

Weidner's PhD has been co-advised by Profs. Adronie Verbrugghe and Anthony Mutsaers.

The HQP program is funded by the Ontario Agri-Food Innovation Alliance and the University of Guelph's Food from Thought program.

Funding for the vitamin D – canine cancer project was provided by the Ontario Veterinary College's Pet Trust, Royal Canin SAS and an American Academy of Veterinary Nutrition/ WALTHAM Research Grant.

Photo: Amber Wood

An eye toward biosecurity

Researchers find mostly low levels of disease in backyard poultry flocks…but caution should prevail

Samantha McReavy

Backyard poultry flocks are becoming increasingly popular in Ontario—14,000 such flocks are registered with the Chicken Farmers of Ontario. And it's well known that many more unregistered flocks exist.

But that can be a problem. Large commercial producers have experience with disease management, but many small flock owners don't. In that case, flock management becomes a biosecurity matter.

"There are concerns that backyard poultry flocks may be reservoirs for disease which could potentially spread to commercial flocks," says research team leader Prof. Leonardo Susta, Department of Pathobiology. "We want to know what diseases the flocks carried and what it means for the welfare of these animals."

The researchers conducted a study to generate a baseline understanding of disease prevalence in Ontario's small backyard poultry flocks. Diseases they looked for included Newcastle disease virus, avian influenza virus and various bacterial pathogens.

The team collected 160 questionnaires and performed necropsies on 245 birds.

Their results showed that no reportable diseases (a disease that is required by law to be reported to government authorities) were identified in the submitted flocks.

Only low levels of salmonella, a potentially zoonotic bacterium, were detected.

However, more than half of deaths in the backyard flocks were found to be caused by infectious diseases, including numerous respiratory infectious agents and Marek's disease virus.

Susta says these high disease levels may reflect lack of vaccination and lack of biosecurity experience among some small poultry flock owners.

Numerous birds were also found to be carrying campylobacter, a bacterium that does not cause problems in chickens but causes gastrointestinal disease in people. He says this underscores the importance of biosecurity when handling poultry.

The researchers are using these findings to create educational materials about disease detection and prevention for veterinarians and small flock owners. They also want to provide educational resources to owners to further protect commercial flocks from potential biosecurity issues.

Others involved in this research are Nancy Borchu, Doctor of Veterinary Science student, and Michele Guerin, Department of Population Medicine; poultry veterinarian Csaba Varga from the Ontario Ministry of Agriculture, Food and Rural Affairs; and Animal Health Lab pathologist Marina Brash.

This research is funded by the Ontario Agri-Food Innovation Alliance. Additional funding was provided by the Animal Health Laboratory through the Ontario Animal Health Network.

Poultry health resources can help prevent the transmission of poultry disease like avian influenza, which can have grave impacts on the poultry industry if spread from smaller to larger flocks.

Photo courtesy of: Ontario Veterinary College, University of Guelph

Jeffrey Rau of Ruminant Field Services helps students transition from veterinary school to the workplace.

Developing Ontario's future veterinarians

Alyssa Logan
and Sydney Pearce

The pressure to chart a post-graduation path can be daunting for fourth-year veterinary students. But programs like Ruminant Field Services (RFS) are reducing that stress by preparing veterinarians to join the workforce with confidence.

As part of the Ontario Agri-Food Innovation Alliance, the Veterinary Capacity Program (VCP) provides support for RFS, a learner-centred initiative that allows students to combine academics and real-world skills through working with a practising veterinarian.

VCP provides annual funding to the Ontario Veterinary College (OVC) to help prepare veterinary graduates with an emphasis on animal agriculture, emergency preparedness, food security and animal-related public health.

Jeffrey Rau, a veterinarian at OVC and member of RFS, has worked with the program since 2010 and is dedicated to helping students who choose to pursue food animal medicine.

During their fourth and final year of veterinary school, students select the stream of medicine they want to specialize in. As with the vast number of opportunities in human medicine, veterinary students have several options. They can specialize in food animal, rural community practice, equine or small animals.

Students who pick the food animal or rural community practice stream have RFS as a core requirement of their program. They are paired with a veterinarian like Rau and take part in visits to local commercial farms. Such calls fall into one of two categories— herd/flock health management or emergencies.

With herd health calls, students will look at issues like nutrition, reproduction, udder health and pregnancy diagnoses. Common emergencies include difficulty in birthing and metabolic and infectious diseases.

Rau says both types of calls provide valuable experience that help students feel more confident and capable in their medical and surgical abilities. Students work their cases from start to finish—they review the history of the animal and herd, make a diagnosis, develop a treatment plan and follow up to make sure that the animal is improving as expected.

One of the most valuable aspects of the program is teaching students to communicate with their clients.

"Communication skills are fundamental when working with clients, no matter what field you are in," says Rau. "RFS helps students develop their skills and knowledge to project a sense of care for the work that these farmers are doing. They care about what the farmer cares about."

As part of the team, students learn about the culture and language of farming. When a student knows the vocabulary and pressures of farm life, farmers feel at ease and can trust that their herds are in knowledgeable hands.

Students in first, second and third years can also volunteer to join these visits. The OVC wants graduates to have a well-rounded experience working with all sorts of animals, including large animals like those seen in the RFS program.

The groups are small—usually 3-4 people—so that everyone gets a chance to work and develop their skills. Final-year students mentor and guide junior veterinary students. Rau says the hope is that students will learn about veterinary medicine in the agriculture and food sector and see that this is just one of many routes available to them.

Funding support for the RFS program is provided by the Ontario Agri-Food Innovation Alliance.

Photos: Joshua Wooddisse (above) · Amber Wood (right)

From veterinarian to researcher

Taika von Königslöw works to improve best practices for antibiotic treatment in calves

Could the use of selective antibiotic treatment strategies at veal operations decrease the opportunity for bacteria to develop antimicrobial resistance?

Taika von Königslöw, a doctor of veterinary science candidate in the Department of Population Medicine, is looking at prudent use of antibiotics for calves upon arrival at veal operations.

While antibiotic use plays an important role in animal health and welfare in individual or group medical scenarios such as disease treatment or outbreak prevention, reducing overall use can help prevent bacteria from developing antibiotic resistance.

Researchers want to develop strategies to reduce overall antibiotic use to improve animal health without sacrificing animal welfare. The Veterinary Capacity Program actively supports these researchers, such as von Königslöw, by providing funding and support, as for Ruminant Field Services. The program aims to provide solutions for provincially significant animal health topics and raise the standard of veterinary care and public health, specifically by improving antibiotic practices.

Von Königslöw is interested in metaphylactic use of antibiotics, which focuses on control and prevention of outbreaks and illness. A calf that has recently arrived at a veal facility is at high risk of disease infection and the group is at high risk of an outbreak, usually because of the stress of being moved into a new area with different feed and housing and exposure to new animals.

"Think of it like a preschool classroom," says von Königslöw. "When kids first go to school, you can almost guarantee that they are going to come home sick with something."

Currently, farmers may choose to treat all calves with antibiotics when they arrive at a veal facility—a blanket treatment approach to prevent and control disease during this high-risk period. But researchers are working toward helping farmers identify those calves that are at highest risk of getting sick and treating only those calves, allowing for more selective treatments and lower antibiotic use at arrival.

Selectively treating those at highest risk of pneumonia and diarrhea would reduce antibiotic use and decrease antibiotic resistance.

Reducing overall use of antibiotics would make farmers more cost-efficient, reduce their risk of promoting the development of superbugs and enable them to raise healthy calves, says von Königslöw.

Funding for this research was provided by the Ontario Agri-Food Innovation Alliance.

Researcher Von Königslöw wants to reduce antibiotic use in veal calves through selective treatment strategies

High-quality, fibre-rich dough in the works

This research supports the quest for healthful frozen dough products

Alicia Bowland

Frozen dough products allow consumers to combine convenience with the pleasant experience of preparing fresh food at home. Consumer demand in Ontario for high-quality and healthful frozen dough products has steadily grown over the years, making dietary fibre-enriched dough increasingly important.

Professor Iris Joye from the University of Guelph's Department of Food Science is focusing on increasing the dietary fibre content of frozen bakery products in grocery stores.

Enriching the dough recipe with dietary fibre largely serves two purposes:

- **Increase the dietary fibre intake of Canadian consumers.** "On average, adults require 30 to 35 grams of fibre per day, but we typically only consume about half of this recommended intake level," says Joye. "Fibre consumption, however, is essential for bowel regularity, blood cholesterol level and weight control. Bread is one of the simplest ways to consume fibre."

Frozen dough offers convenience for consumers…but what about fibre?

- **Improve the quality of frozen dough products.** Freezing dough or par-baked bread often leads to structural damage. This is caused by freezing of water in the product, a process that leads to the formation of large ice crystals and damages food texture and structure. Incorporating dietary fibre in the dough recipe may reduce the formation of ice crystals and better preserve the appealing food texture and structure.

Joye's research team isolates and characterizes fibres from wheat bran, barley, oats, flax seed and quinoa to find out which component creates the most delicious and attractive fibre-enhanced frozen dough product.

Each serving of bread made by the research team contains at least two grams of fibre and is created without any unnatural additives. The only recipe changes studied were the fibre types and the dough water content.

Once an optimal product has been created, Joye's team plans to conduct a consumer sensory study to measure consumer satisfaction before piloting the product in grocery stores with the help of interested industry partners. She hopes the final result will be a bread that's rich in fibre and delicious.

This research is funded by the Ontario Agri-Food Innovation Alliance. Raw ingredient donations were provided by industry partners. Collaborators include Profs. Lisa Duizer, Doug Goff and Dalia El Khoury and the University of Guelph's John F. Wood Centre for Business and Student Enterprise.

Photo: Dianne Priamo

Swine research advancements are shared annually to improve translation and transfer across the pork industry.

Pork research network supports multimillion-dollar industry

Samantha McReavy

As food production becomes more complex, research results—and the dissemination of those results to end users—become even more important. Helping share research information is one role of the Ontario Swine Research Network (OSRN).

The network provides multiple platforms for the swine industry to collaborate and discuss current research and initiatives. It also aims to increase awareness and understanding of recent studies, and highlights swine research at the University of Guelph.

"OSRN is important because it brings a variety of people involved in the swine industry together to enhance and improve research," says Prof. Terri O'Sullivan, Department of Population Medicine, and network director.

The research-intensive Ontario pork industry benefits from those efforts. That industry contributes almost 13,000 full-time equivalent jobs and $850 million a year worth of products.

To improve swine research translation and transfer across the industry, O'Sullivan and her collaborators—research assistant Karen Richardson and student veterinarians Hannah Golightly and Enise Decaluwe-Tulk—hold an annual Swine Research Day. The annual event brings together students, researchers, producers and other industry members to discuss current research and to hold the Centralia Swine Research Update Legacy poster and oral presentation graduate student competitions.

Speakers present their research in accessible form. Attendees from farmers to stakeholders are encouraged to ask questions and participate in the discussion. Researchers use this event to learn about current swine studies, to network and to develop collaborations.

Research results and proceedings from the event are available on the OSRN website. The network provides tools such as educational webinars, interviews with researchers, research updates and information about the annual event.

A listserv for people interested in learning about new swine research and OSRN activities numbers more than 160 registered participants. If you are interested in joining the listserv, visit the OSRN website.

OSRN activities will further knowledge translation on current research advancements and enable industry members to engage in discussions, form connections and pursue collaborations.

O'Sullivan plans to develop short research update pages with accessible information on current or recently completed studies.

This research is funded by the Ontario Agri-Food Innovation Alliance. Swine Research Day was sponsored by industry supporters.

The OSRN website can be found at: uoguelph.ca/osrn.

Photo: Ontario Pork

The USEL program offers industry-relevant experience to students while advancing agricultural sectors, such as the goat sector.

The Undergraduate Student Experiential Learning program

U of G student discovers agriculture industry through goat reproduction research

Dianne Priamo

Ontario's goat sector is growing by leaps and bounds, and that's where field research can be helpful. Agri-food researchers spend time in the field to become familiar with their topic of study. This allows them to learn what producers are facing as they work toward sustainable production.

In summer 2018, former U of G honours agriculture student Oluwatimileyin Abolarin began researching the intricacies of goat production in Ontario, finding ways to make it more competitive and profitable. Through the Undergraduate Student Experiential Learning (USEL) program, he received mentorship for research to close this knowledge gap in the industry.

"My goal was to help producers on the research end by determining which out-of-season breeding methods are most effective," said Abolarin.

Under the guidance of the Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA) dairy specialist Marlene Paibomesai and Department of Animal Biosciences Prof. Eduardo de Souza Ribeiro, Abolarin analyzed more than a decade's worth of Ontario goat milk price and production data.

His findings aligned with those of previous literature: more than 60 per cent of goat kid births occur during the short-day breeding season—the season with the least amount of light per day. This yearly pattern results in a surge in goat milk production during the months following the breeding season and low production during the rest of the year.

Abolarin then interviewed Ontario goat milk producers to see how they overcome this seasonal breeding challenge and the associated economic impacts on milk production caused by fluctuating supply.

Based on his dialogue with producers, he found that a variety of out-of-season breeding strategies are being used across the province.

Abolarin's summer research placement was a start toward determining the optimal breeding strategy. He hopes future research on breeding methods will be done to determine the most efficient strategy for out-of-season breeding.

"If researchers determine the most effective breeding methods, then this information can be given to producers, especially those who are new to the dairy goat industry, using knowledge mobilization strategies," he says. "This would allow dairy goat products to remain available and affordable all year round, benefiting both producers and consumers."

Through his participation in USEL, Abolarin also discovered his interest in animal reproduction. The lactation curves and milk data figures he generated are now being used in the U of G animal reproduction course to teach students about reproductive seasonality.

"The many career opportunities I discovered within the agriculture industry were for sure the greatest takeaway," Abolarin said about USEL. "The program opened my eyes completely."

About the USEL program

The Undergraduate Student Experiential Learning (USEL) program was established in 2010 by the Agricultural Development Branch of OMAFRA in cooperation with the Ontario Agricultural College. It's aimed at third-year undergraduate students, to support their personal and professional development while addressing knowledge gaps in the agri-food industry and enhancing the working relationship between OMAFRA and U of G.

Oluwatimileyin Abolarin studies non-traditional breeding season methods for goats for greater productivity.

Photos: Dianne Priamo (opposite) · Courtesy of: Oluwatimileyin Abolarin (right)

High Immune Response technology is taking a foothold in the industry, thanks to a team led by Prof. Bonnie Mallard (left) and Lauri Wagter-Lesperance.

HIR technology carries big benefits for dairy producers looking to naturally improve herd health and reduce veterinary treatment costs

Building their best herd

Joey Sabljic

Treating sick cows is never fun, for either the animal or the farmer. Just ask dairy producer Brad Hulshof. While he's in the barn tending an animal, everything else he has to do around the farm takes a back seat. Plus, it's costly—producers like Hulshof invest about $1,800 in life's usual necessities (particularly feed) from the time a calf is born, up until the animal calves in turn and starts producing milk. Add the cost of extraordinary veterinary treatment to the mix, and that number can climb appreciably.

At the same time, growing antimicrobial resistance is a major concern. Producers are losing tools for fighting illnesses and infections like mastitis, pneumonia and scours that can cripple herd health.

Those are among the reasons Hulshof uses a University of Guelph-developed technology called High Immune Response (HIR) to breed and build a healthier herd that's naturally more resistant to disease.

"We jumped on [the HIR technology] aggressively because we knew if we could breed better, healthier cows from genetics, it would help us down the road," says Hulshof. "For us, it's been amazing to see theory on paper turning into a practical, on-farm solution."

Photo: Karen Mantel

Researchers work closely with calves to help prevent antimicrobial resistance through genetics.

HIR technology is a patented testing procedure and management tool developed by Ontario Veterinary College Prof. Bonnie Mallard and a team of co-inventors.

HIR identifies dairy cattle with genetically superior immune systems and enhanced disease resistance.

Producers can use HIR to make informed management decisions that naturally improve herd health and animal well-being and productivity, while reducing antibiotic and disease treatment costs.

HIR co-inventor Lauri Wagter-Lesperance says getting HIR market-ready involved years of collaboration with producers like Hulshoff to test, validate and improve the technology in dairy herds.

"We knew we had to be strategic in our approach to bringing HIR from the lab bench to the barn," she says. "It all started with working with producers to understand their herd health and management needs. And what we found was that producers were highly interested and willing to make the investment in HIR if it meant they could sustainably breed healthier animals and reduce treatment costs over the long term."

In 2012, HIR was commercialized through Semex Alliance; it is now marketed as Immunity+ in more than 120 countries.

Semex Alliance has a lineup of special Immunity+ sires that have been identified—using the HIR technology—that carry a genetic profile associated with a high immune response. Semen from these sires is made available to producers who want to breed superior health characteristics and disease resistance into their herds.

Industry data show that daughters of Immunity+ sires have lower mortality and disease rates than those of non-Immunity+ sires.

Hulshof says he has seen the benefits of HIR in his own herd over the past six seasons of breeding with Immunity+ sires.

"The Immunity+ calves that grow up are healthier. You seldom see them sick. If they do get sick, they bounce back much quicker than usual," he says. "Given what we've seen, I don't think we'd go back to breeding with non-Immunity+ sires at this point."

Hulshof adds that using semen exclusively from Immunity+ sires has required no radical shifts in his overall breeding approach. Rather, with genetic variation among the Immunity+ sires, he can make other genetic gains in milk production and body composition alongside immune response and disease resistance.

"The transition to using Immunity+ sires and genetics has been pretty seamless. It's not just a niche thing," he says. "We're able to achieve what we want from both a health and production standpoint and maintain good genetic diversity in our herd."

So what's next on the HIR technology front?

Wagter-Lesperance says Mallard's research team members are evaluating HIR for use in beef cattle herds to help fight bovine respiratory disease, the costliest and deadliest disease in beef cattle raised on feedlots. Much of their effort is focused on developing a genomics test—similar to their work in dairy cattle—that would help identify cattle with a genetic profile associated with high, average and low immune response.

The team is also evaluating how the various immune response phenotypes in dairy and beef respond to climate change, in order to identify climate-resilient animals. This research is supported by the Canada First Research Excellence Fund through U of G's Food from Thought project.

Wagter-Lesperance is also leading research into HIR colostrum. So far, she's found that

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How are cows identified to have high immune response?

Cows can be evaluated two ways: 1) by direct immune response evaluation over a 15-day period that includes a blood sample and immunization; or 2) by a genomics test, which involves the collection of DNA from a tissue sample or from a hair follicle or blood sample. This genomics test was developed from a Canada-wide study funded by NSERC-CRD of 5,000 cows evaluated for immune response phenotype over 15 days, and was associated with base pair differences of DNA collected from hair follicle samples. The information from this study can accurately and quickly predict whether an animal will express a high, low or average immune response phenotype.

The genomics test is now available to producers in more than 14 countries with Semex Alliance through the Semex Elevate program. Although other genomics tests exist, the Immunity+ female genomics test is the only one that can accurately predict immune response phenotype and identify disease-resistant females. The immune response phenotype is a trait whose heritability is similar to that for milk production, allowing producers to significantly improve herd health by identifying Immunity+ females and using Semex Immunity+ semen.

Photo: Richard Seck

Building their best herd

CONTINUED FROM PREVIOUS PAGE

high immune response cows produce a higher concentration of specific antibodies within their blood and colostrum in response to immunization or infection.

When calves receive colostrum from their high immune response mothers within the first six hours of life, they receive an immune system boost of antibodies and cells that can help calves respond better to vaccinations as they grow. Wagter-Lesperance says producers might bank (or freeze) colostrum from their high immune responder cows and feed it to the newborn calves in their herd that have been identified as average or low immune responders.

"We want to create a product that producers can use to give their calves the best possible start to life," she says. "We're also promoting animal health and well-being in a completely natural way by offering the highest-quality colostrum possible."

Wagter-Lesperance adds that HIR colostrum could eventually be made available to producers as a product that's guaranteed and verified to come from high immune response cows with better health and well-being.

Besides helping newborn calves, HIR colostrum and milk from HIR cows could one day benefit humans as well, by enhancing the development of immune systems and intestinal health. This could lead to new natural health products or milk products designed to help fight chronic illnesses.

Hulshof is excited about what the future of HIR technology could hold.

"Being able to market and sell HIR milk as a natural health product could lead to new markets and opportunities opening up," he says. "I believe that the possibilities of this technology are huge, and we're excited as producers to be on the cutting edge."

This research is funded by the Ontario Agri-Food Innovation Alliance. Additional funding was provided by a Natural Sciences and Engineering Research Council – Collaborative Research and Development grant and industry partner Semex.

Beat disease, eat your beans

Researchers develop motivators for bean consumption in older adults

Ariana Longley

Beans and other legumes are vital, affordable, nutrient-dense keys to reducing risk of disease, such as obesity and diabetes. That's especially true for Ontario's aging population—in Canada, a quarter of all citizens are 65 years or older and naturally prone to health challenges.

To effectively promote the benefits of beans, researchers set out to benchmark and encourage bean consumption in older adults.

"Beans can help older adults optimize the aging process," says Prof. Alison Duncan, Department of Human Health and Nutritional Sciences.

Duncan and her team administered 250 questionnaires and ran 10 focus groups in Guelph and area to capture elderly people's feelings, knowledge and cooking abilities with beans.

Their findings were surprising—only half of participants regularly ate beans, despite knowing about their tremendous health perks.

Her advice?

Duncan and her team identified three bean barriers among study participants: not knowing how to prepare beans, experiencing bloating or abdominal discomfort after eating them, or not considering them part of their traditional diet.

Keen on beans

Make beans more a part of your diet with these three steps:

1. **Think outside the box and include beans in other meals and snacks.**
2. **Enjoy many different varieties of beans such as navy, black, white kidney, red kidney and lupin.**
3. **Add small amounts of beans to your diet and gradually work your way up to having them several times a week.**

The researchers developed an infographics seminar and a cookbook to teach seniors how to integrate beans into their meals.

These infographics summarized the study results and included information about beans' positive effect on health.

The cookbook outlines a two-week meal plan to serve as a reference for including beans in seniors' diets. The book details easy-to-make bean-based recipes based on different ethnic backgrounds.

For a more hands-on approach to promoting beans, Duncan and her team hosted free seminars about meal preparation for elderly people in a fun and encouraging environment.

This research was conducted along with graduate students Kati Doma, Emily Farrell, Victoria Soucier and Erin Leith-Bailey. This research is funded by the Ontario Agri-Food Innovation Alliance.

You can access the cookbook at the following link: uoguel.ph/e7p94.

Photo: Dianne Priamo

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The Ontario Agri-Food Innovation Alliance is working to advance research and innovation for the benefit of Ontario's agri-food sector.

The Alliance supports people, places, and programs that create made-in-Ontario solutions to today's most pressing agri-food challenges — solutions that will have global impact now and well into the future.

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