UNIVERSITY of GUELPH

OMAFRA – UNIVERSITY OF GUELPH PARTNERSHIP

research

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Ontario

2016 AGRI-FOOD YEARBOOK

MAKING AN IMPACT

Inside: How the OMAFRA–U of G Partnership improves food, farming, and the environment

Partnership underpins Guelph's standing as Canada's food university

I am delighted to highlight some of the great work being done as part of the Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA)–University of Guelph Partnership.

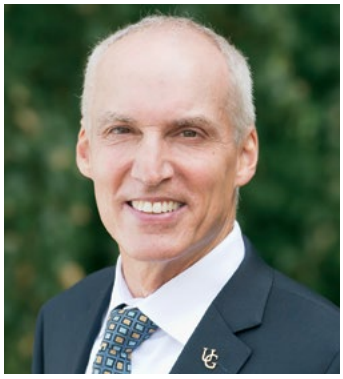
Partnership research is at the heart of Ontario's agri-food sector – a sector that is innovative and dynamic, and that is one of the foundations of our economy. Consumers also continue to count on our agri-food sector to deliver high-quality, safe food produced to increasingly high social, environmental and ethical standards.

In this issue you'll see how the OMAFRA–U of G Partnership is improving the health of our communities, our environment and our economy. Through partnership-funded research, we are improving nutrient intake for seniors, developing more green technologies, investigating cost-effective strategies for wastewater treatment and growing more diverse crops in Ontario.

OMAFRA and U of G are working together to foster innovation and generate results that will shape not only our agri-food sector but also Ontario's future. By encouraging students to become innovators to address gaps and overcome barriers to the application and commercialization of technologies in the Ontario agri-food sector, the OMAFRA–U of G Partnership offers the opportunity to truly change people's lives.

I look forward to continued research excellence in the years to come.

Jeff Leal
Minister of Food, Agriculture and Rural Affairs



The University of Guelph has developed a strategic framework that will guide us into the future. We've consulted widely with our stakeholders and consistently heard a strong message that will resonate with the agricultural sector: Guelph is Canada's food university.

Nearly 20 years ago, Guelph's rich history in agriculture and food evolved into a formal partnership agreement with the Ontario Ministry of Agriculture, Food and Rural Affairs. The partnership represented a sea change for agricultural research in Ontario, supporting studies that have covered the agri-food continuum from farm to table, including environmental sustainability, nutritional awareness and animal welfare.

In 2017, the partnership will celebrate its 20th anniversary. Through the years, it's catalyzed jobs and spinoff companies, new crop varieties, healthier animals, safer food and a better environment. It promotes a cohesive, progressive research environment that in agriculture and food has no parallel in Canada… in fact, most people who know the sector say there's nothing like it anywhere in the world.

Our diversity in agricultural and food research is unique in Ontario. And it helps make clear our path forward: providing a solid research foundation for safe, affordable and wholesome food for Ontario, Canada and the world. It's a return on investment that is enduring and priceless.

Franco J. Vaccarino
PhD, FCAHS
President and Vice-Chancellor

Top photo: iStock.com/Arpad Benedek

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Ontario officials and industry work together to stave off H5N2 avian flu epidemic

Above photo courtesy of Bruce Chessell/*Woodstock Sentinel-Review*/Postmedia Network · Top: Joanne Pearce/SPARK

Contributors

The Ontario Ministry of Agriculture, Food and Rural Affairs–University of Guelph Agri-Food Yearbook is written and coordinated by participants in the University's Students Promoting Awareness of Research Knowledge (SPARK) program.

Amber Hutchinson

A PhD student from Uxbridge, Ont., Amber Hutchinson looks into research by Profs. Shai Barbut and Alejandro Marangoni on developing healthier types of saturated fats, which could lead to nutritious meat alternatives. **Read more on page 13.**

Kyra Lightburn

Kyra Lightburn, a fourth-year organic agriculture student from Nanoose Bay, B.C., discusses Prof. Ian Tetlow's research on using local plant starches to reduce our environmental footprint. **Learn about Tetlow's cost-effective technique on page 11.**

Joanne Pearce

Joanne Pearce, a recent English and biology grad originally from Oakville, Ont., interviewed Prof. Tina Widowski on her work with enriched housing systems for poultry. **Read about how innovative technology will help minimize risks to bird health and welfare on page 17.**

Rachael Piccoli Kuschke

A bachelor of commerce co-op student and originally from Guelph, Rachael Piccoli Kuschke writes about research conducted by Prof. John Devlin on how communities can work together to promote local economic development. **Read more on page 8.**

Alaina Osborne

Senior SPARK writer and fourth-year studio art major Alaina Osborne coordinated this issue of the agri-food yearbook. Originally from Guelph, she investigates Prof. David Wright's research on a wine-making by-products to help improve treatment for diabetes. **Read more on page 33.**

Sydney Pearce

OVC writer and animal biology student Sydney Pearce hails from Mississauga, Ont. She explores Prof. Mary Ruth McDonald's research on protecting vegetable crops in Ontario from fungal diseases. **Read more on page 36.**

Additional contributors to this issue: **Alyssa Logan**, **Karen Mantel**, **Robyn Meerveld**, **Rebecca Moore**, **Joey Sabljic**, **Liz Snyder** and **Anna Wassermann**

Photos: SPARK

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Highlighting the partnership for research, laboratory and veterinary programs between the Ontario Ministry of Agriculture, Food and Rural Affairs and the University of Guelph

On the Cover

Ontario is home to many kinds of farms, all sharing the need for healthy, productive soil. From that soil comes the bounty that makes Ontario agriculture stand out, such as Yukon Gold potatoes (pictured on cover), developed at the University of Guelph 50 years ago. The research agreement between the University and the Ontario Ministry of Agriculture, Food and Rural Affairs helps support new crop variety development, improvements to livestock production, environmental sustainability—and the most productive soil in Canada. Read how the partnership supports soil health research on page 28.

Photo: Dean Palmer

Innovating in Ontario

This green roof at the University of Guelph is entirely made in Ontario, from the substrate blocks to the plants grown at the Smart Green Technologies Inc. greenhouse in Prince Edward County.

Companies marry university research with entrepreneurial spirit

By Rebecca Moore

Persistence, passion and drive: these are just some of the characteristics needed by entrepreneurs. But these traits are nothing without an innovative idea — the new product or novel process that represents the perfect combination of intellect, ingenuity and market demand. Fuelled by their unique expertise, U of G researchers are helping convert high-quality research funded by the OMAFRA – U of G Partnership into marketable products. The impact is job creation, and promotion of Ontario universities as centres of higher learning and incubators for new ideas that promise to help society meet the ever-changing demands of the 21st century.

Photo: Joanne Pearce/SPARK

Innovating in Ontario

Improving green roofs with new technology

Green roofs — roofs partially or completely covered by plants — are becoming more popular in urban landscapes because they help manage stormwater and reduce heating and cooling costs while making cities greener — literally. A former Guelph researcher is combining research with engineering savvy to make these structures more accessible, efficient and affordable.

Greg Yuristy, former member of the University of Guelph Green Roof Research team, has brought a lighter, easier-to-install green roof to market with his company, Smart Green Technologies Inc. (SGT). Over the past year, it's become a one-stop shop for green roofs, poised to help meet the increasing demand for renewable and energy-saving technologies.

The Guelph connection goes deep. The company uses hydroponic techniques developed by Guelph Green Roof Research Program leader Prof. Youbin Zheng to grow its plants. With conventional technology, plants for green roofs are grown on outdoor mats. This process is lengthy: It can take up to one year, and produces mats so heavy that one-metre-square segments often have to be carried by four workers, making installation cumbersome and difficult.

But the unique hydroponic technique developed by the Guelph research team means plants can reach maturity within four to five weeks and they're much lighter. The resulting plant mats weigh only half a pound per square-metre segment, making installation significantly easier than conventional mats.

The company also designed lighter and easier-to-install substrate blocks that support the plant mats. These patented blocks are easily installed as a series of hard square segments that eventually turn to soil once they receive enough moisture.

And it's all made in Ontario, from the substrate blocks to the plants grown at the company's greenhouse in Prince Edward County. Last year SGT hired 13 people to meet the demand for its green roofs, and the company's future continues to look rosy — or, better yet, green.

Competitive Green Technologies makes biowaste valuable

Competitive Green Technologies is proving that one person's trash is another's treasure, one product at a time.

This company licenses bio-composite resin formulations developed at the University of Guelph's Bioproducts Discovery and Development Centre (BDDC). These resins are made from undervalued or "waste" biomass streams, including perennial non-food grasses grown on arid land and food processing industry waste.

These bio-composite resins are now used in a number of products, including decorative planters, storage trays and, most recently, single-use compostable coffee pods and automotive parts.

The coffee pods, called PurPod100, are the first to be certified compostable by industrial composting. The key to making a compostable coffee pod is the structural plastic ring. Prof. Amar Mohanty, Department of Plant Agriculture and School of Engineering, and his research team developed a ring made from bio-composite resin made partly from coffee chaff, the dried skin of the coffee bean.

PurPod100 is produced in partnership with Club Coffee, and is certified 100 per cent compostable in industrial facilities by the Biodegradable Products Institute (BPI). Using the compostable structural plastic ring, the resin for which is manufactured by Competitive Green Technologies, PurPod100 is now available at nearly 3,000 Loblaw stores across Canada and in Kroger Stores in the United States.

Photo (top left): courtesy of Greg Yuristy

PlantForm's technology can produce antibodies for about 10 per cent of the cost of conventional methods.

From plants as medicine to plants making medicine

Plants such as milk thistle have been used for millennia to treat disease and promote good health. Now a Guelph-based start-up is enlisting plants to make medicine, and its choice of plants is one not traditionally associated with good health.

PlantForm Corp., established in 2008, uses tobacco plants to manufacture monoclonal antibodies used to treat a host of diseases, ranging from cancer to HIV.

Guelph researcher Chris Hall is one of the company's founders and now its chief scientific officer. The company has 22 employees working to bring the plant-based technology platform, called vivoX-PRESS, to market.

PlantForm's technology is a welcome alternative to expensive mammalian-cell production systems that are currently the industry standard. PlantForm's technology can produce antibodies at approximately 10 per cent the cost of conventional methods. Such creative approaches could be a key factor in helping hold down rising health-care costs.

PlantForm's research pipeline contains an array of plant-made medications that are biosimilar (generic) versions of existing medications on the market. Its first product — a plant-made version of the breast cancer drug Herceptin (trastuzumab) — has been proven as effective as the commercial antibody in animal studies. Human clinical trials are expected to begin in 12 to 18 months.

PlantForm is staying active with an assortment of research and development projects, including a Government of Canada contract to produce an antibody being studied by Defence Research and Development Canada as a treatment for exposure to the toxin ricin.

Harvest One Agritech: Local research for global good

Ontario farmers benefit from a globalized marketplace. But shipping food comes with many challenges. Food spoilage, either in transit or in storage, can mean huge losses. But technology developed by Guelph researchers is now poised to help reduce these losses in the global food marketplace.

Plant agriculture professors Gopi Paliyath and Jay Subramanian discovered a plant-based compound called hexanal that inhibits a key enzyme involved in food spoilage. The product can be sprayed on trees or applied directly to fruit after it's picked to help delay spoilage by up to six weeks.

Slowing food spoilage is a benefit for producers and consumers alike: In advanced countries such as Canada, in aggregate 40–60 per cent of produce is either lost due to damage or discarded at various levels of the value chain, including those lost at the consumer level.

A start-up company is now betting on the benefits of hexanal. Harvest One Agritech licensed the technology from the University of Guelph and is working with regulators to bring hexanal-based products to a number of markets, including Canada.

But hexanal-based products could have a global appeal: In an IDRC-CIFSRF project, Guelph researchers have already teamed up with colleagues in Asia, East Africa and the Caribbean to use hexanal-based products. This will help extend the shelf life of fruit and reduce spoilage, enabling producers to get their products to market.

In advanced countries such as Canada, in aggregate 40–60 per cent of produce is either lost due to damage or discarded at various levels of the value chain, including those lost at the consumer level.

Top photo courtesy of PlantForm · Right: PaintedLens/Shutterstock.com

Hillside Festival and four other cultural festivals in Guelph and region have collaborated to create tourism recognition with the "Guelph Fab 5" brand.

Building the regional economy from the community up

Collaboration improves economic development

"There's a lot of interest in the potential of regional collaboration, but the difficulties in carrying out these actions are quite significant."
– Prof. John Devlin

New information technologies and shifting demographics are among the changes that are leading many regions to search for ways to work together to promote local economic development.

That's why University of Guelph Prof. John Devlin, School of Environmental Design and Rural Development, worked with a team of researchers from the University of Waterloo to uncover the successes, failures and barriers to collaborative efforts across North American regions, to determine best practices.

"There's a lot of interest in the potential of regional collaboration, but the difficulties in carrying out these actions are quite significant," says Devlin.

Researchers interviewed representatives of 185 organizations to discover how they worked together to stimulate the local economy with initiatives such as food maps, tourist attractions and festivals.

Devlin found that urban-rural dynamics, governance, leaders and champions, relationship-building and resources were the key themes of economic development.

Devlin aims to continue promoting and improving regional collaboration among citizens by determining what drives people who successfully work together to improve their economy.

– Rachael Piccoli Kuschke

Funding for this project is provided by the OMAFRA–U of G Partnership.

Devlin's research team found six key themes related to collaboration and regional economic development:

1. The region's **history and identity** are critical
2. The region's **urban-rural dynamics** can strongly influence the approach
3. **Accountable governance and diverse structures** are important in shaping the strategic direction of regional development initiatives
4. **Leaders and champions** play a critical role in creating support
5. **Relationship-building** is key to the success and acceptance of regional development initiatives
6. Financial and human **resources** enable collaboration

Go with the flow

Cost-effective strategies for waste-water treatment

For small rural towns, living in the shadow of a larger municipality may not be such a bad thing when it comes to treating municipal waste.

University of Guelph researchers are studying options for collaboration between smaller towns such as Rockwood and cities like Guelph to share the costs of waste-water treatment, including equipment, pipes and personnel.

According to Prof. John FitzGibbon, Environmental Design and Rural Development, these small rural towns have difficulty finding support for water infrastructure, which is why finding strategies to minimize their costs is essential.

One strategy being analyzed by FitzGibbon is collaboration between small towns. Building one treatment plant among two or more communities can save these towns thousands of dollars.

Another strategy being assessed by FitzGibbon is the role played by privately owned and operated communal water services in rural municipalities. On one hand, development of private water service provides additional tax dollars without the public costs of providing water supply and waste-water management. Conversely, if the owner-operator defaults on operation and maintenance of these systems, they become a liability that the municipality must assume. Initial findings suggest that the development of an effective responsibility agreement is the key to successful management of the development of private water services.

"Proper, cost-effective waste-water treatment is essential for improving human health, maintaining the environment and providing economic assistance to municipalities who need it," says FitzGibbon.

– Anna Wassermann

This research is in collaboration with the Rural Ontario Municipal Association, and graduate students Paul Simon, Ben Kissner, Stephanie Worron and Hugh Simpson.

Funding for this project is provided by the OMAFRA – U of G Partnership.

Photo courtesy of Niagara Region

Better Internet for better farming

Faster and more reliable Internet access could result in increased use of innovative agricultural technology, job growth and sustainable livelihoods for farmers, according to one University of Guelph researcher.

Prof. Helen Hambly Odame, Environmental Design and Rural Development, is heading the Regional and Rural Broadband (R2B2) project. It aims to assess current broadband (high-speed Internet) policies and potential benefits of much faster and scalable Internet in remote, rural areas across southwestern Ontario and the Niagara region.

"Rural areas tend to have gaps in Internet connection due to companies looking only at population density while overlooking the area's profitability," says Hambly Odame. "This affects the communities' telecommunications access, their ability to use digital technologies and their capacity to promote their businesses to a wider local market and certainly to an international market."

Initial results from a pilot study show that, without Internet access, producers are limited to using less efficient technology that does not rely on the World Wide Web.

The R2B2 project has a 20-year rollout. Researchers are collaborating with the Southwestern Integrated Fibre Technology (SWIFT) Network, an organization working to install ultra-high-speed, fibre-optic broadband for all of southwestern Ontario and Niagara. Together, they are building awareness of inadequate Internet access in rural areas and determining the benefits of high-speed Internet access. To date, total project costs are estimated at nearly $300 million, with $180 million approved by the federal government and the province in July 2016. The additional project costs come from the municipalities and the private sector.

– Sydney Pearce

The R2B2 research is conducted in collaboration with SWIFT, Western Ontario Warden's Caucus, Region of Niagara, and Agriculture and Agri-Food Canada.

Funding for this research is provided by the OMAFRA – U of G Partnership.

Reducing dairy-related greenhouse gases

Every little bit helps when it comes to reducing greenhouse gas emissions, and researchers at the University of Guelph's School of Environmental Sciences have some suggestions about how to help.

For example, they've found that completely emptying livestock manure storage systems is a relatively simple but effective method of reducing methane emissions to less than half of those produced by partially emptied systems.

Applying manure in the spring closer to crop planting, as opposed to the fall, avoids winter nitrogen losses.

They've also determined that anaerobic digestion (which uses microbes to break down manure in tanks that exclude oxygen to produce biogas) can mitigate methane emissions by up to 60 per cent when compared with liquid storage systems. It's expensive, but effective.

"Our findings show some methods are useful for reducing carbon emissions which incur few additional costs for farmers, and some others may become more popular if a price is put on carbon," says researcher Prof. Claudia Wagner-Riddle.

This research is part of Canada's commitment to reduce greenhouse gas emissions, which was made at the Copenhagen climate change summit in 2009. Globally, agriculture contributes about 14 per cent of greenhouse gas emissions.

"Even small actions like covering stored manure with straw or increasing the fat content of dairy rations a few per cent can reduce the amount of emissions associated with a dairy operation," says Wagner-Riddle.

Additional strategies include applying manure in the spring closer to crop planting, as opposed to the fall, to avoid winter nitrogen losses. Producers can also avoid adding excess nitrogen to crops by performing soil tests, which determine how much nitrogen is already available in the soil. And separating solids ("food" for methane-producing microbes) from liquid manure can help reduce emissions by about 30 per cent.

Research results are being summarized into fact sheets to be made available to producers through the Dairy Farmers of Canada website, dairyfarmers.ca.

Contributors to the project include Profs. John Lauzon and Kari Dunfield, School of Environmental Sciences; Bill Van Heyst, School of Engineering; Alfons Weersink, Dept. of Food, Agricultural and Resource Economics; Robert Gordon, Wilfrid Laurier University; Ermias Kebreab, University of California-Davis; Karen Haugen-Kozyra, Viresco Solutions; William Salas, Applied GeoSolutions; Tom Wright and Chris Duke, Ontario Ministry of Agriculture, Food and Rural Affairs; and many graduate students and post-doctoral researchers.

Funding for the project has been provided by the OMAFRA–U of G Partnership. Additional funding was provided by the Agricultural Greenhouse Gas Program/ Agriculture and Agri-Food Canada and Dairy Farmers of Canada, Dairy Farmers of Ontario, Alberta Milk, Alberta Agriculture and Forestry, Ontario Federation of Agriculture, and Ontario Soil and Crop Improvement Association.

Biomaterial industry growth can be supported by agricultural sector

"Entrepreneurs in Ontario's agricultural sector are the potential manufacturers of biomaterials." – Prof. Alfons Weersink

Ontario's agricultural sector can easily meet the plant fibre needs of the emerging biomaterial industry, researchers have found.

The global biomaterial industry – based on products manufactured from renewable, biologically based resources – is expected to grow by more than 15 per cent in the next few years. This growth is primarily fuelled by consumer demand for greener products.

"Entrepreneurs in Ontario's agricultural sector are the potential manufacturers of biomaterials, and they should be provided with necessary assistance so the industry is able to take root and grow," says Prof. Alfons Weersink of the Department of Food, Agricultural and Resource Economics (FARE).

"Ontario has sufficient biomass along with the other resources necessary to supply the most optimistic projected needs of a future biomaterials sector."

Led by Weersink, a research team has been looking at policies and strategies to hasten the development of an agriculture-based biomaterial industry in Ontario.

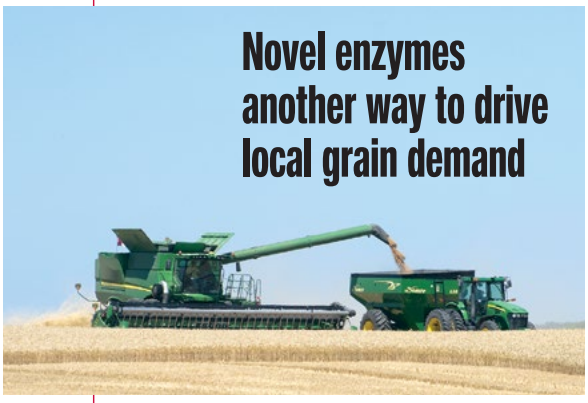
Miscanthus and switchgrass – perennial grass crops already grown in Ontario on commercial scales – have been identified as the primary biomass raw materials for the emerging biomaterials industry.

Knowing Ontario can produce enough biomass resources, the next step toward developing a functioning local biomaterials economy includes establishing agricultural biomaterial manufacturing firms to supply local markets.

Collaborators for this research include Aung Oo, Sarnia Lambton Research Park; Mahendra Thimmanagari, OMAFRA; and Ken Poon and Nafis Muntasir, FARE.

Funding for this project is provided by the OMAFRA–U of G Partnership.

Novel enzymes another way to drive local grain demand



Novel bacterial enzymes being developed at the University of Guelph that change the chemical structure of starch will improve market share for local grain producers and continue to make industrial products like paint, paper and plastics more environmentally friendly.

Prof. Ian Tetlow, Department of Molecular and Cellular Biology (MCB), is developing enzymes that fix starch molecules in their cooked, gelatinous form for use in industrial applications.

When gelled plant starches are incorporated into products, they can offer properties such as viscosity and lubricity as well as freeze-and-thaw stability.

"Our completely new enzymes prevent cooked starch molecules from re-solidifying when they cool," says Tetlow. "This will broaden the variety of starches that can be used for industrial purposes to include more locally grown grains, increasing markets for Canadian grain growers."

Until now, companies requiring industrial starches have had to use plant sources that are slow to re-solidify and are typically grown in tropical climates. These starches are considered difficult to source and expensive to transport.

Plant starches are sought-after because they are biodegradable and renewable and can replace petroleum-based substances in many industrial products.

Using local starches will decrease the environmental footprint and manufacturing costs of the products they are used to create, says Tetlow.

"Local plant starch options will positively impact the bioeconomy by benefiting producers that innovate biomaterial alternatives," says Tetlow.

Collaborators for this research include Lilya Nasanovsky, PhD candidate in MCB, and master's student Jessica White.

Funding for this project is provided by the OMAFRA–U of G Partnership. Additional funding is provided by the Gryphon's LAAIR funding program.

All stories by Kyra Lightburn

Photo (left): iStock.com/SimplyCreativePhotography
Right: courtesy of Bioproducts Discovery and Development Centre

Aerial view of southern Ontario, Halton Hills area.

Turning greenhouse waste into energy

Biocarbon, a potential fuel to heat greenhouses, is made from plant matter – leaves, stems and vines of greenhouse plants – that is abundant in greenhouses, is costly to dispose of and has no resale value.

Using fossil fuels to heat greenhouses is expensive and environmentally unsustainable.

But how about heating them with plant waste from the greenhouses themselves?

That's what Prof. Animesh Dutta, School of Engineering, is working toward. He's producing a fuel-flexible boiler (heater) that can use a variety of unconventional yet readily available fuels in an efficient way.

One such fuel is called biocarbon. It's made from plant matter – leaves, stems and vines of greenhouse plants – that is abundant in greenhouses, is costly to dispose of and has no resale value.

Biocarbon is normally made by a process called dry torrefaction, in which the plant matter is heated to temperatures of 200–300 C for up to two hours to create a solid substance resembling charcoal.

However, this method produces a biocarbon containing high amounts of alkali earth metals, which increase the risk of agglomeration and corrosion, reducing its combustion efficiency and performance.

Instead, Dutta uses hydrothermal carbonization (HTC). The plant matter is submerged in hot, condensed water in an enclosed system under moderate temperature and pressure for up to 30 minutes.

This method reduces the alkali earth metals by 80 per cent and creates a more energy-dense biocarbon that can produce an amount of heat comparable to that of fossil fuels, with fewer greenhouse gas emissions.

But Dutta doesn't want to stop there. This research is continuing to optimize the HTC process to produce a biocarbon to treat greenhouse process water containing nutrients. The water would pass through a biocarbon-packed column, producing clean water and leaving behind nutrient-enriched biocarbon. The biocarbon could be used as an organic growth substrate for greenhouse crops as well as for carbon sequestration in soil.

"Biocarbon is an ecofriendly and cost-effective alternative to fossil fuels," he says.

Currently one challenge to the quick adoption of this technology lies in greenhouse boilers, which are not set up to burn biocarbon. But considering that boilers are a 30-year investment for growers, Dutta believes it's cost-effective to convert them to use other fuels. He and his research team hope to incorporate the HTC system and converted boilers into local greenhouses for testing by 2018.

Funding for this project is provided by the OMAFRA–U of G Partnership.

All stories by Amber Hutchinson

Photo: Olga Gabai/Dreamstime.com

A robot that lends a hand in greenhouses

The labour-intensive task of harvesting and pruning has become a challenge for greenhouse vegetable growers, making up to 30 per cent of their overall costs.

Can robots help?

Prof. Medhat Moussa, School of Engineering, thinks so. He's developing a robot system he hopes will be able to harvest, package and de-leaf greenhouse crops without assistance from humans. A prototype is currently being put to the test by harvesting tomatoes, peppers and cucumbers—Ontario's main greenhouse crops—in Leamington greenhouses.

The robot uses specialized visioning technology to first determine whether a vegetable is ripe, then devises a plan to collect and package the vegetable.

That sounds impressive enough, but these robots aren't just for harvesting. For example, disease can sweep through a greenhouse and quickly wipe out an entire crop. It is impossible for one scout – one human scout, that is – to visit each plant every day, so generally plants may be screened for disease only once a week.

A robot, however, would have much more capacity to do so. Moussa is working on developing a system that will allow the robot to more frequently collect data on all plants in the greenhouse to monitor for disease.

Once the fully developed robot hits the market, it has the potential to reduce labour costs and labour shortages, and pay for itself in five years.

Funding for this research is provided by the OMAFRA – U of G Partnership. Additional funding is provided by the Natural Sciences and Engineering Research Council.

Canola oil meets processed meat

Saturated fats are associated with several negative health effects, including cardiovascular disease. In food processing, though, these fats have come to serve a critical function, providing a solid structure and desired texture for foods such as ice cream, salad dressing and meat products.

Some say incorporating mono- or polyunsaturated fats would reduce the amount of saturated fat in processed foods. However, their liquefied state makes it impossible to achieve the consistency offered by saturated fats.

That's where food science professors Shai Barbut and Alejandro Marangoni come in. They are working to make processed meats more healthful by incorporating canola oil (high in mono-unsaturated fatty acids) into a gel called organogel, to attain processing properties similar to those of saturated fats, but with a healthier profile.

Organogels are formed when canola oil is combined with a natural polymer such as ethylcellulose – a derivative of cellulose in plants – and heated briefly to 140 C. The end result mimics the solid properties of animal fat, which canola oil on its own cannot deliver.

Results from taste and texture panels, recently published in the *Journal of Food Science* and *Meat Science,* have given a thumbs up to organogels incorporated into meat products. Barbut and Marangoni estimate these healthful alternative meat products will be on the market in about two years.

Funding for this project is provided by the OMAFRA-U of G Partnership.

Top photo: Medhat Moussa · Right: CGissemann/Shutterstock.com

Leaving the LAAIR

Three years after its formation, the Gryphon's LAAIR program is seeing a bold return on investment.

Rebecca Moore

Researchers have brought new products to market, secured private-sector funding and created jobs — all after leaving the Gryphon's LAAIR.

The LAAIR program (an acronym for Leading to the Accelerated Adoption of Innovative Research) provides two types of grants to help turn ideas into marketable products. Product Development Grants (up to $25,000) are provided to help researchers assess whether a promising technology is marketable, and Commercial Development Grants (up to $125,000) help a great new product reach the market.

Researchers pitch their ideas to a panel of industry experts and business managers — we call them Gryphons — who select the most promising ideas.

"Investment in the Gryphon's LAAIR program has yielded exceptional returns," says Rich Moccia, former associate vice-president, research (strategic partnerships). "Participating researchers have not only produced world-class innovations, they have honed business skills that will aid in the transfer of technology to the benefit of society for years to come."

After three years of funding, the University — and Ontario — are already seeing a return on investment.

Funding for the Gryphon's LAAIR program is provided by the OMAFRA–U of G Partnership and Growing Forward 2, a federal-provincial-territorial initiative.

Photo illustration: LINDdesign
Photos: iStock.com/Gile68 · iStock.com/adisa

Small particle, big payoff

A laboratory curiosity with the potential to turn into a wonder ingredient has attracted the attention of pharmaceutical companies, cosmetics manufacturers and food producers.

Prof. John Dutcher, director of the University of Guelph's nanoscience program and Canada Research Chair in Soft Matter and Biological Physics, received LAAIR funding to transform a serendipitous discovery into PhytoSpherix, a nontoxic, biodegradable, highly soluble and uniform nanoparticle derived from sweet corn.

This tiny molecule is attracting the attention of many industries, from pharmaceutical companies to cosmetics manufacturers. Its versatility is linked to its unique structure: PhytoSpherix particles are composed of tightly bound sugar molecules, and strongly bind water yet remain stable in solution. These properties make them particularly attractive to the cosmetics industry.

In addition, because the nanoparticles are uniform in size, they can predictably enter cells, which has attracted the attention of pharmaceutical companies that may be able to use the compound for drug delivery.

Bolstered by a $125,000 commercialization grant during the first Gryphon's LAAIR in 2014, Dutcher is working with Mirexus Biotechnologies, a spinoff company out of his University of Guelph laboratory, to focus on the commercialization of PhytoSpherix. The company has raised more than $7M in investment and now has its eye on expansion: It recently hired a new vice-president of engineering to oversee the establishment of the company's first manufacturing plant.

PhytoSpherix, a nanoparticle derived from sweet corn, is attracting the attention of many industries, from pharmaceutical companies to cosmetics manufacturers.

Bringing new flavour to local brews

A beer's flavour is not only a reflection of the grains but is also the result of the yeast that transforms malt and hops into a golden pint. The strain of yeast used in beer production has a big impact on the flavour of the finished product, and the majority of Ontario's best local beers are still produced using yeast cultures imported from the United States.

That's where Escarpment Labs comes in. It's a University of Guelph spinoff company, bringing local Ontario yeasts to Ontario breweries.

After receiving LAAIR funding in 2015, Prof. George Van der Merwe, along with researchers Richard Preiss and Angus Ross, set out to give Ontario breweries a new edge by providing homegrown Ontario yeast cultures.

Escarpment Labs is now putting its stamp on Ontario beer and helping microbreweries develop unique local flavours. Craft brew enthusiasts are already enjoying the unique twist – the company is supplying microbreweries all over the province with its unique regional yeasts.

Maximizing crop yields with innovative irrigation

With growing concerns over water security, University of Guelph professor Rene Van Acker, research associate John O'Sullivan and lab technician Peter White are studying the use of underground irrigation on corn crops to maximize yield and minimize water use.

Subsurface drip irrigation is an innovative irrigation system that allows for controlled moisture release into the soil. The technology is new to Ontario and holds great promise.

For example, besides leading to more efficient irrigation, it can be used to deliver a precise mix of fertilizer for optimal growing conditions. Case in point: corn. It's one of Ontario's main cash crops, but yields can be severely affected by drought conditions.

After receiving LAAIR funding in 2014, Van Acker partnered with A&L Laboratories, one of Canada's largest agriculture and environmental laboratories, to produce sensors that can provide farmers with real-time details about existing moisture and chemical composition in their corn crop's soil.

Left photo courtesy of LAAIR · Right: iStock.com/logoff

A truly homegrown rootstock product

The fertile soil of Ontario is ideal for apple production. But most of the one million new rootstocks used in the province each year come from international suppliers. Prof. Praveen Saxena, Department of Plant Agriculture, with help from LAAIR, has collaborated with industry partners to help make Ontario apples a truly homegrown product.

Apple trees are not grown on their own roots. Instead, a tree is grafted onto rootstock that controls its growth. Most new rootstocks are being imported from the United States and Europe.

Saxena applied to the Gryphon's LAAIR program in 2014 to commercialize technology and methods to manufacture apple tree rootstocks. Since then, he has partnered with Harster Greenhouse, a commercial propagator of horticultural species, and Mori Nurseries, the largest wholesale nursery in Canada, to perfect his methods – called micro-propagation – that will allow nurseries to quickly produce disease-free rootstock for local producers.

Growing the rootstock here will reduce the risk of importing diseases from other countries. In addition, rootstocks can be bred to suit the particular growing conditions of the province.

Following your gut

LAAIR helps produce first-ever microbiome therapeutic for pigs

Human well-being depends significantly on gut health, or on how well microorganisms in your intestines function. And, it turns out, the same goes for livestock — if their gut is not operating optimally, their overall performance is impaired.

This multi-species microbiome ecosystem for piglets populates their intestines with a host of healthy microorganisms and helps them gain weight, fight infection and maintain good health.

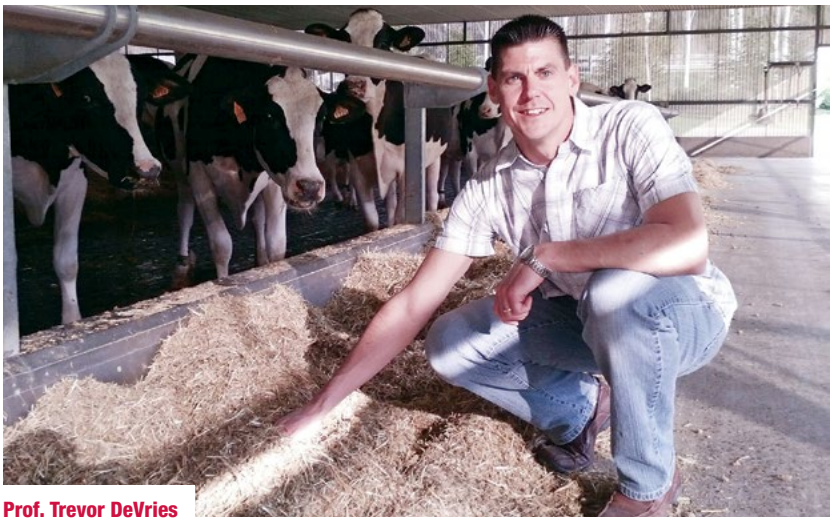
Prof. Emma Allen-Vercoe, Department of Molecular and Cellular Biology, has designed a multi-species microbiome ecosystem for piglets that will populate their intestines with a host of healthy microorganisms. It will help them gain weight, fight infection and maintain good health.

Scientists like Allen-Vercoe are increasingly linking the composition of the intestinal microbiome to a number of health outcomes in both animals and humans, including the ability to stave off disease. The restricted diets of conventionally raised pigs combined with antibiotic use mean their microbiome may be less diverse and make the pig less able to gain weight and more vulnerable to disease.

The microbiome developed by Allen-Vercoe and other researchers contains a number of microorganisms selected from pigs raised in ideal natural environments. The product is the first of its kind and has entered animal trials to determine its impact on pig health and production.

New Jersey-based company Phibro Animal Health is completing the trial.

Left photo: Saxena · Right: Dusan Petkovic/Shutterstock.com



Prof. Trevor DeVries

Dairy cow behaviour reveals health issues

Dairy cow behaviour plays an important part in improving cow productivity, health and welfare, U of G researchers say.

"Producers can reduce the incidence of problems and learn to use early identification methods that will contribute to overall good health," says Prof. Trevor DeVries, Department of Animal Biosciences.

DeVries has found that dairy cows that spend less time at the feed bunk, and so eat less, are also less likely to be found ruminating (chewing cud). This reduction in rumination behaviour has been found to be associated with the risk of a dairy cow developing subclinical ketosis—a health condition that is hard to spot but that reduces milk cow health.

When and where dairy cattle stand and lie down can also impact dairy production. Standing or lying in dirty environments increases the likelihood of mastitis, the persistent inflammation of udder tissue.

DeVries' findings suggest dairy producers can improve cow health and production by carefully monitoring cow behaviour in their housing environment, whether in free-stall or tie-stall barns.

Funding for this project is provided by the OMAFRA–U of G Partnership. Additional funding is provided by the Natural Sciences and Engineering Research Council.

Genetic markers help identify boar taint

Boar taint, the unpleasant taste or odour found in the meat of uncastrated, mature male pigs, affects meat quality in pork production.

For more than 25 years, Prof. Jim Squires, Department of Animal Biosciences, has been investigating what causes it and how to reduce it, most recently by trying to breed it out. Breeding for reduced boar taint would also eliminate the need to castrate pigs, which is the current method for preventing boar taint.

Squires has identified genetic markers in boar taint genes and used them to identify low boar taint in purebred Duroc, Yorkshire and Landrace lineages. Now, he's using these same markers to evaluate crossbred offspring, to select against genes in commercial swine that lead to boar taint.

Funding for this project is provided by the OMAFRA–U of G Partnership. Additional funding is provided by the Canadian Centre for Swine Improvement, Ontario Swine Improvement, Centre de développement du porc du Québec and the Western Swine Testing Association.

All stories by Joanne Pearce

Rebuilding poultry housing from scratch

Millions of Canadian hens are getting new homes.

Over the next 15 years, conventional cages for poultry will be phased out as the Egg Farmers of Canada pledge to end the use of conventional cages. The cages will be replaced with a variety of enriched housing systems. That means better welfare standards for egg-laying hens than for those associated with conventional cages.

That also means nearly 90 per cent of Canadian barns will need to change.

Prof. Tina Widowski, director of the Campbell Centre for the Study of Animal Welfare and current Egg Farmers of Canada Research Chair in Poultry Welfare, is helping the industry respond. She's investigating design aspects of the enriched colony cages with the goal of enhancing nest, perch and scratch use, and looking at ways to reduce health risks in non-cage systems.

"With new housing technology, we can optimize systems and minimize risks to bird health and welfare," says Widowski. "One area we are focusing on is the rearing experience for young chicks and pullets, which can have lifelong effects on their well-being."

The focus on both rearing and system design will take into account the behaviour and health of the hens, such as reducing keel (breastbone) damage, frequently seen in laying hens.

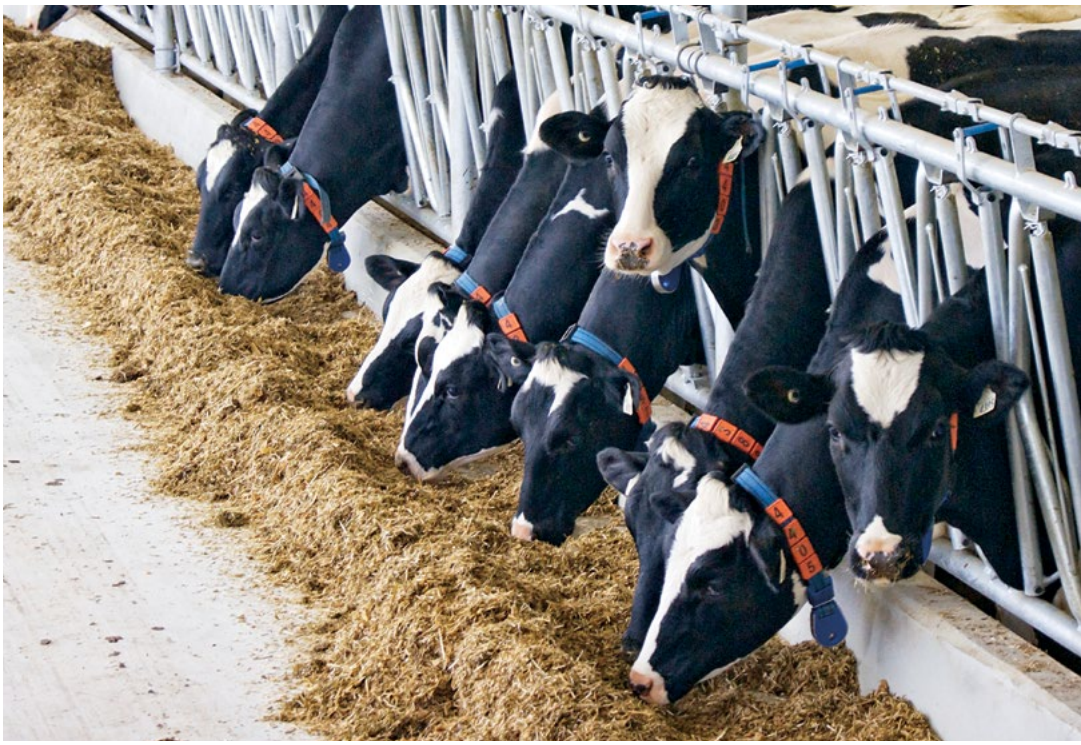
This research was conducted with PhD candidates Teresa Casey-Trott and Michelle Hunniford.

Funding for this research is provided by the OMAFRA–U of G Partnership. Additional funding is provided by Egg Farmers of Canada, NSERC, Poultry Industry Council, Egg Farmers of Ontario and individual industry partners.

Harnessing natural immunity to reduce antimicrobial use

Joey Sabljic

Antimicrobial-resistant diseases are an ongoing concern for Ontario's livestock producers. In response, University of Guelph researchers are developing innovative new methods and tools that will allow producers to harness their animals' natural immunity against serious diseases, and pinpoint the animals in a herd that are the most resistant to disease.



Predicting highly immune dairy cow populations

When dairy cows get mastitis infections, it's not only a major health concern but also a costly problem in veterinary treatments and lost milk production.

University of Guelph pathobiology professor Bonnie Mallard is leading a project that has, over two decades, led to the development and creation of HIR (High Immune Response) technology.

HIR is a test that gives dairy producers the ability to identify animals in their herds that are able to mount a strong immune response to defend against diseases.

"These animals don't need that much therapeutic help or treatment in terms of antibiotics or anything else because they are naturally more resistant to diseases," says PhD student Mehdi Emam, who is working on the HIR project with Mallard.

"The high immune responder animals get sick less frequently and the severity of the disease is also reduced even if they do get sick."

The current HIR test requires technicians to make three separate visits over a 15-day period to a farm in order to test the animals' immune response through a patented immunization method and by collecting blood and skin thickness measurements.

Knowing which cows have the strongest, most resilient immune systems can also help producers tailor their breeding programs to create stronger, healthier herds.

However, Emam says the next major phase of the HIR project aims to eliminate the need for on-farm testing and visits entirely.

Rather than physically test dairy herds, producers will send hair follicle samples from their animals to genotyping centres. From there, genetic information from the samples is sent to the HIR researchers for analysis.

"Producers are routinely doing genotyping and using that information to improve their breeding and milk production," says Emam. "So, the idea is that we're not introducing additional work or cost on the farmer's end."

Once the genotypic information is sent to the HIR team, it is cross-referenced with genetic information the researchers have gathered from a reference population they're creating from 5,000 cows across Canada that have undergone the HIR test.

Knowing which cows have the strongest,

Photo: D3 Impact

most resilient immune systems can also help producers tailor their breeding programs to create stronger, healthier herds.

By comparing the genetic information from a given animal with the genotype information from the reference population, Emam and the HIR research team will be able to quickly and accurately predict whether or not the animal's genotype will express a high, average or low immune response phenotype — even before the calf is born.

"By combining the genotying and phenotyping in the reference population, we get a very valuable set of information that lets us predict the phenotype, or how the animal's immune response genes will actually be expressed," says Emam.

Emam and the HIR team are also taking an in-depth look at the thousands of genes both directly and indirectly responsible for influencing whether a cow will express a high, average or low immune response. As Emam explains, they're looking for the genetic "turning points" in the road that determine what kind of immune system an animal will have.

"Using advanced technology, such as next generation sequencing, we've already begun the process of identifying how the genes directly and indirectly responsible for shaping an animal's immune response will work with each other," he says.

Funding for this research is provided by the OMAFRA – U of G Partnership. Additional funding is provided by the Natural Sciences and Engineering Research Council and Semex Canada.

Boosting beef cattle immunity against bacterial pneumonia

For young beef cattle, moving from their mother and herd of origin to the feedlot is one of the most stressful transitions of their early lives — and one that can take a serious toll on their immune systems.

According to pathobiology professor Jeff Caswell, these calves' immune systems are weakened by a number of stressors that leave them susceptible to bacterial pneumonia, the leading cause of illness and death in Ontario feedlot cattle and the main reason for therapeutic antimicrobial use in feedlots.

"The young calves miss their mothers, their social groups are disrupted, and being transported across the province or country is a major stressor as well," he explains. "And because the calves are being mixed with animals from other sources while they're in the feedlot, they share viruses that can predispose them to bacterial pneumonia."

Caswell, working with PhD candidate Laura Bassel, is looking for a way to naturally stimulate or "kick-start" a calf's natural immune response so that the animal will be better equipped to fend off diseases in feedlots.

The researchers already know that normal, healthy calves have strong "innate immunity" — natural barriers and antimicrobial substances in their bodies, including the nasal cavities and upper airways — that help prevent harmful bacteria from colonizing the lungs and causing infection.

"People, for example, are exposed to bacteria such as *E. coli* in their daily environment but often don't get sick, as the body makes antimicrobial peptides that fight off infection," explains Caswell. "As well, our tracheas are coated in cilia, tiny hair-like organelles that sweep harmful bacteria out of our lungs, and cells deep in the lungs find and ingest any bacteria that make it that far."

Many of the bacteria that cause pneumonia in cattle can also be found in healthy animals. Under normal circumstances, the natural defence mechanisms are sufficient to prevent disease. However, when healthy young calves are put under stress and exposed to several types of viruses, their immune systems reach a breaking point that leaves them wide open to sickness and premature death.

What Caswell and his team want to do is restore the "suppressed" immune response to a level where their natural immunity would once again be effective at warding off diseases.

"Our work is testing the idea that stimulating their innate immune response would actually make the calves more resistant to the pneumonia-causing bacteria," he says.

The researchers working with experimental groups of calves at the Elora Dairy Research Centre and the Elora Beef Research Station break up pneumonia-causing bacteria and deliver them by aerosol into the calves' lungs to stimulate their innate immune response.

After stimulation, the calves are monitored for signs that their bodies are mounting a response to the treatment, from regularly checking their temperatures, respiration and heart rates to monitoring changes in their white blood cell counts and performing lung ultrasounds to see whether any respiratory infection develops. The treatment's effectiveness in preventing disease and ensuring weight gain will be examined.

Ideally, Caswell says, this immune-stimulating treatment could be given to cattle on arrival at the feedlots — the time when they are at highest risk of getting sick — and could reduce the number of animals that need antimicrobial treatment.

Funding for this research is provided by the OMAFRA – U of G Partnership. Additional funding is provided by the Natural Sciences and Engineering Research Council of Canada and Zoetis.

No easy answers to antibiotic alternatives

Efforts to reduce antibiotic use and move to alternative antimicrobial products such as zinc are mainly driven by the concern that overuse of antibiotics promotes antimicrobial resistance.

However, research by graduate student Mackenzie Slifierz, population medicine professor Robert Friendship and Scott Weese, Pathobiology, showed that alternative antimicrobial products such as zinc can be associated with an increased prevalence of bacteria carrying multiple antibiotic resistance.

Specifically, this research showed that the increased likelihood of finding methicillin-resistant *Staphylococcus aureus* in pigs was related to the use of high levels of zinc in pig starter rations.

This underlines how complicated antimicrobial resistance can be, and that moving to "antibiotic-free" production might produce unexpected consequences.

– Robyn Meerveld

Funding for this research is provided by the OMAFRA – U of G Partnership.

Decision-making tool helps health professionals deal with zoonotic disease

Steps for using the disease prioritization tool

1. Rank each disease criterion
2. Assign a weight to each criterion according to importance
3. Select a group as a baseline model to apply individual weighting
4. Select a sub-group of diseases you would like to prioritize from the drop-down list
5. Generate scores for the diseases selected in Step 4
6. Generate a chart based on results

A new zoonotic disease decision-making spreadsheet provides a shared platform for policy-makers and health professionals to use when deciding which zoonotic diseases to prioritize for disease control and prevention strategies.

Population medicine professor Jan Sargeant, director of the Centre for Public Health and Zoonoses, and post-doctoral researcher Victoria Ng, developed the tool with stakeholder input. It builds on their previous research to determine the relative importance people place on different criteria that can be used to prioritize zoonotic diseases.

"It gives people the opportunity to explore how their decisions on the importance of different criteria influence what disease they might prioritize," says Sargeant.

The spreadsheet considers 21 criteria that fall into one of three themes: human-related disease criteria, animal-related disease criteria and degree of scientific understanding of a specific disease. Users rank and assign weight to each criterion to help determine their own prioritization protocol.

Sargeant says with limited resources available to address every zoonotic disease, there is a need for transparent and scientifically justified methods of prioritization to help various health organizations or commodity groups determine which disease to handle first.

Access the tool online at ovc.uoguelph.ca/cphaz/resources under the title Zoonotic Disease Prioritization Tool.

—Joanne Pearce

Funding for this research was provided by the OMAFRA – U of G Partnership.

Rapid technology for safer drinking water

A fast-acting, inexpensive molecular test is being designed to help improve drinking water evaluation.

Ontario regulations target *E. coli* and coliforms (common bacteria found in water) to help water treatment technicians know whether there has been an incidence of fecal pollution. But once they're found, it's difficult to pinpoint the source and nature of the pollution – humans, livestock or wildlife, for example.

To help solve this problem, Prof. Marc Habash, School of Environmental Sciences, used a test that accurately searches for another group of bacteria called Bacteroides, present in the intestines of animals, which can indicate fecal pollution in water.

"Bacteroides can be differentiated between ranges of hosts," says Habash. "So this kind of analysis is adding to the toolbox that we use for evaluating and eventually managing Ontario drinking water."

The test uses a method called polymerase chain reaction (PCR), which "amplifies" small segments of DNA, to help researchers in their analysis.

In a 10-month field trial, several sites on the Grand River watershed were monitored. The Bacterioides associated with humans were found mostly in urban areas. Those associated with cattle were found mainly in rural areas.

These results helped confirm the feasibility of the test, particularly important where urban and rural areas overlap.

Collaborating on this project were Profs. Hung Lee and Jack Trevors, who developed the original test, and the Ontario Ministry of Environment and Climate Change.

Funding for this project is provided by the OMAFRA – U of G Partnership.

Photo: Vit Kovalcik/Shutterstock.com

Animal disease cost-benefit framework helps quantify risks

A new cost-benefit framework developed by U of G researchers will help policy makers and the agri-food sector evaluate how effective specific animal disease interventions or surveillance approaches are, and decide which of them should be prioritized.

Prof. Mike von Massow, Food, Agricultural and Resource Economics, is creating a framework to help policy-makers evaluate variables that can be difficult to measure, such as probable outcomes of disease outbreaks, in a consistent, comparable way.

The approach standardizes the criteria by putting economic values on the different components.

"The framework lets you quantify the impact of your choices," says von Massow. "Looking at the effectiveness of these different costs and benefits can help us identify the best way of minimizing risks."

Economically, the cost of lost product is easy to quantify, but how do you quantify the long-term impact such an outbreak has on beef consumption?

The "cost" categories in the framework include direct financial costs from performance loss, long-term costs and implementation costs.

Von Massow says the benefit categories can be harder to define, considering that the conventional idea of a benefit — a positive outcome — isn't always the case in cost-benefit analyses. For example, sometimes benefits are not entirely without loss — in a disease outbreak, perhaps only half a herd must be sacrificed, instead of a whole herd. That's not what some would call a positive outcome, but it's better than the alternative.

And what about long-term costs? In 2001, Europe saw a massive outbreak of foot-and-mouth disease that resulted in large numbers of cows and sheep euthanized. Economically, the cost of lost product is easy to quantify, but how do you quantify the long-term impact such an outbreak has on beef consumption? How do you quantify public perception on the industry or the company?

Questions such as these exemplify some of the choices von Massow's framework seeks to quantify.

Alongside these categories is a series of specific, real-life examples that participants can compare their choices against and check boxes that allow readers to organize their choices in a clear and consistent way.

Von Massow says the framework will help guide producers on what questions they should be asking in emergency management decisions, as well as how they might be able to quantify their outcomes.

–Joanne Pearce

Collaboration on this project comes from University of Guelph research associate Rob Anderson and Prof. Mustafa Canbolat, Business, Administration and Economics, at State University of New York. Funding for this research is provided by the OMAFRA – U of G Partnership.

Photo: Modfos/Shutterstock.com

EMERGENC

Ontario officials, industry work together to stave off H5N2 avian flu epidemic

Robyn Meerveld

The H5N2 avian influenza that arrived in Ontario in April 2015 posed a serious threat to Ontario's poultry industry. Through the winter and spring of 2015, this version of bird flu had ravaged turkey and layer farms across the American Midwest. Believed to have been spread by migratory birds and waterfowl, the virus was termed highly pathogenic because of the mortality levels it caused in infected flocks.

Here in Ontario, the University of Guelph's Animal Health Lab (AHL) had been in regular contact with its American and international colleagues who track foreign animal diseases around the world. The disease would arrive in Ontario — sooner or later — and the lab was determined to be ready.

Just two weeks earlier, the AHL had met with the Canadian Food Inspection Agency (CFIA) to review their joint emergency response plan, including a simulation exercise planned to test it out. Like the 2014 outbreak of porcine epidemic diarrhea virus (PEDV) in Ontario's swine industry, the AHL would again play a key role in early containment and mitigation of the avian influenza by providing rapid testing of large numbers of samples, and protocols to ensure accurate, up-to-the-minute communication of results.

On the Easter weekend of spring 2015, the first red flag for avian influenza in Ontario was raised by a poultry veterinarian in southwestern Ontario. The vet had contacted the AHL about unusually high mortality in a turkey flock. Despite the holiday weekend, AHL officials took quick action. After discussing the clinical signs observed by the vet, they requested that samples of the birds be sent to Guelph for testing. They then alerted the chief veterinary officer at the Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA) of a potential avian influenza outbreak.

Within 24 hours, AHL's tests confirmed the diagnosis. H5N2: a highly pathogenic avian influenza. Their emergency

Photo courtesy of Bruce Chessell/*Woodstock Sentinel-Review*/Postmedia Network

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On Monday, April 13, 2015, Canadian Food Inspection Agency workers placed several Woodstock-area poultry farms, including this one just west of the city, under quarantine because of an outbreak of avian flu.

Ontario's outbreak of highly pathogenic avian influenza in 2015 was quickly contained, with minimal disruption to the province's poultry industry. The Midwest American states were not as fortunate, resulting in euthanasia of millions of birds.

Saving the turkey export market

Canada's turkey production is worth almost $400 million annually (farm cash receipts). Ontario produces about 35 per cent of the total. Most of this country's turkeys are shipped to the U.S., making it an extremely important export market.

When H5N2 avian influenza appeared in Ontario in April 2015, it was critical that the outbreak be managed according to internationally recognized protocols to minimize trade disruption and restore Ontario's "avian influenza free" status as quickly as possible.

That's exactly what was done, which meant that shipments of Ontario turkeys from outside of the quarantine zones were halted only briefly – for less than a week, in fact – before resuming exports to the U.S.

– Robyn Meerveld

response plan was immediately rolled out. That meant notifying the many government, industry and research partners who needed to know, and ramping up their testing capacity. Measures were put in place for isolated handling of incoming poultry samples. Together with the Canadian Food Inspection Agency (CFIA) and OMAFRA, media conferences were held and poultry producers were advised to use extra vigilance in their biosecurity measures.

The CFIA then took the lead on establishing a quarantine perimeter around the affected farm, humanely disposing of birds, and overseeing the disinfection of the barns and equipment, all according to international guidelines for dealing with disease outbreaks. Over the next two weeks, AHL confirmed positive test results on two more farms in the same geographic area, and additional quarantines were imposed by the CFIA.

In the following weeks, AHL continued to play an important role in resolution of the outbreak. It provided testing that would allow the quarantines to be lifted after a 21-day waiting period of no new cases, and Ontario's avian influenza-free status to be regained after three months — both important international milestones for complete resumption of trade. In the end, the outbreak was successfully confined to three sites in Ontario, all close to each other. And although a total of 29 farms were affected by the quarantine, the fallout could have been far worse.

South of the border, the same avian influenza epidemic was the largest ever experienced in U.S. history. The U.S. Department of Agriculture reported that between December 2014 and June 2015, more than 48 million domestic poultry birds in 15 states were affected. It caused an estimated $3.3 billion in economic losses nationwide.

In Ontario, the outbreak had again tested the AHL's capacity as a first responder to a foreign animal disease outbreak. It tested the lab's surge capacity to rapidly scale up for handling large numbers of potentially infectious samples, while safely maintaining business continuity for its other clients. It tested AHL's communications protocols with a wide range of audiences — and no room for error or misinterpretation of data or messages. AHL proved to be up to the task, and was a component of the successful containment and mitigation strategy.

What's next on the horizon? The scientists at AHL aren't sure, but they do know that preparation will again be key to a rapid and effective response. In the meantime, they'll continue to keep a watchful eye on the movement of zoonotic pathogens around the world, so they can be ready for the next outbreak... not if, but when it occurs.

The AHL receives funding from the OMAFRA–U of G Partnership.

Poultry Network defends against disease

The Ontario Animal Health Poultry Network is one of 10 networks in the province designed to improve the health of major livestock species, wildlife and companion animals though coordinated preparedness, early detection and response to animal disease.

With members from OMAFRA, U of G's Animal Health Lab, the Ontario Veterinary College, and private veterinarians, the poultry network was ready to act when H5N2, a highly pathogenic avian influenza (HPAI), first appeared at an Ontario poultry farm in spring 2015.

The network's main objective was to alert poultry producers to the disease and equip them with information to help keep their farms HPAI-free. Using social media, podcasts and radio interviews, the network was able to reach small flock owners with the information they needed to mitigate the spread of the disease.

Photo courtesy of Bruce Chessell/*Woodstock Sentinel-Review*/Postmedia Network

Under development:

Reliable identification tests for *E. coli*

Robyn Meerveld

In 2014, Ontario shipped $780-million worth of red meat to the U.S. To continue to do so for certain meat exports, Canadian abattoirs will need a reliable test that proves the meat is free of toxin-producing *E. coli*.

Escherichia coli (or *E. coli*) bacteria are widely distributed in nature. More than 700 distinct types (also called serotypes) have been identified. Most strains are harmless, and some are beneficial.

But others are responsible for outbreaks of food-borne illness. One particular group produces Shiga toxin, nasty substances which are very similar to the toxins produced by the *Shigella dysenteriae* bacteria that cause dysentery. These Shiga toxin-producing *E. coli* (or STEC) are the ones most often reported as the cause of food contamination.

The most notorious of the STEC group is the O157:H7 serotype. It can be easily identified with current laboratory tests. Of the many that produce the same toxin, at least six other serogroups of STEC are considered significant. They are more difficult to identify because they don't have any unique biochemical characteristics to distinguish them.

The current laboratory process of identification is not always reliable. In the case of an outbreak or suspected contamination, reliable identification, time and confirmation of the pathogen involved are key to containing the situation.

The need for accurate identification has recently become more compelling. Current Canadian regulations under the Food and Drug Act require certain beef products exported to the U.S. be certified free of the top seven STEC strains. In 2014, Ontario shipped $780-million worth of red meat to the U.S. To continue to do so for certain meat exports, Canadian abattoirs will need a reliable test that proves the meat is free of these top seven STEC.

Dr. Shu Chen of U of G's Agriculture and Food Lab (AFL) has been working with Dr. Roger Johnson of the Public Health Agency of Canada to solve this problem. Together they have recently developed a comprehensive approach to detect and identify the STEC serogroups from foods. But the approach needs to be validated before it can be accepted for Canadian food safety regulations.

Using an OMAFRA Food Safety Research Program grant, the new approach will now be tested against the existing reference procedures. If it's proven to be valid, it can be made available to the Canadian food industry and laboratories, ensuring reliable results, saving time and money, and reducing risk to the public.

The AFL receives funding from the OMAFRA–U of G Partnership.

Photo: iStock.com/pictore

A 2011 algae bloom in Lake Erie caused in part by phosphorus runoff.

Creating a sustainable approach to phosphorus fertilizer management

Losing phosphorus, an important nutrient for plants, can impact the environment and farmers in different ways. But it's difficult to create a best management practice that covers all situations.

Fluctuations in phosphorus runoff are due to numerous factors: soil properties, time of year, precipitation, source of phosphorus, timing and method of phosphorus application, crop development or land topography.

Ridgetown campus Prof. Ivan O'Halloran, School of Environmental Sciences, examined the year-round fluctuations of phosphorus that ended up in water systems via tile drains from farms and rural areas.

O'Halloran found fluctuations in phosphorus runoff due to numerous factors. These include soil properties, time of year, precipitation, source of phosphorus, timing and method of phosphorus application, crop development or land topography.

These environmental factors make it difficult to apply a universal strategy for mitigating phosphorus loss.

For example, to see an agronomic impact such as reduced crop production, a producer would need to lose about 30 to 40 kilograms/hectare of phosphorus.

But a significant negative environmental impact could be caused by less than one kilogram/hectare of phosphorus loss.

This difference in impact can lead producers to misguidedly apply generalized phosphorus management techniques that may not suit their land. Instead, O'Halloran encourages Ontario producers to manage phosphorus loss on an individual basis, according to the conditions on their farm, to maximize the economic gain possible with phosphorus and simultaneously minimize adverse environmental effects.

– Joanne Pearce

Collaborating on this research were Merrin Macrae at the University of Waterloo and her graduate student Vito Lamb, T.Q. Zang and Yutao Wang from Agriculture and Agri-Food Canada, and cooperating farmers who offered their land for field studies.

Funding for this research was provided by the OMAFRA–U of G Partnership. Additional funding is provided by the OMAFRA-COA, Fertilizers of Ontario, Agriculture and Agri-Food Canada, The Land Improvement Contractors of Ontario, and Grain Farmers of Ontario.

Photo courtesy of NASA

Making progress toward effective poultry emission control strategies

Poultry producers can reduce levels of harmful ammonia gas on their farms by 60 to 70 per cent, according to new research.

A research team led by Prof. Bill Van Heyst, School of Engineering, applied a treatment called poultry litter treatment (PLT) in turkey operations to convert ammonia gas into safer chemical compounds, such as ammonium.

PLT consists of acidifying chemicals that reduce pH levels in poultry litter (a mixture of feed, feathers, droppings and other material used as bedding). Producers can apply PLT using a spreader to evenly distribute the treatment across the litter.

Ammonia gas is produced when poultry litter interacts with moisture in the air. In high enough concentrations, exposure to this gas can lead to dire health consequences, including difficult breathing and blindness in birds.

"Research to find the best emission control strategies is imperative for maintaining the health and well-being of farmers, as well as their birds," says Van Heyst.

He's now comparing PLT with other emission control strategies, such as centralized heat exchange systems. He will also compare results from turkey operations with broiler chicken operations to determine whether certain strategies offer better results.

– Anna Wassermann

This research is in collaboration with graduate student Dave Wood. Funding for this project is provided by the OMAFRA–U of G Partnership. Additional funding is provided by the Canadian Poultry Research Council and the Poultry Industry Council.

Mayflies emerging from the water.

Study: Neonicotinoid insecticides and aquatic environments

Neonicotinoid insecticides, or "neonics," have become one of the most widely applied insecticides in agriculture in North America—and concern over potential risks to terrestrial and aquatic organisms is increasing.

A wide range of reactions to neonics exists within different groups of aquatic organisms. From highly sensitive organisms such as mayflies to less sensitive fish species, organisms typically react differently. So it's tough to make a sweeping statement about the effects of neonics.

It's tough to make a sweeping statement about the effects of neonics.

Prof. Paul Sibley, School of Environmental Sciences, and his students are investigating the effects of neonics in short- and long-term exposures in collaboration with the Ministry of Environment and Climate Change aquatic toxicology unit lab.

"If we can first understand what effects these pesticides have in the environment, then we can adjust management practices to suit the organisms that will be impacted by the chemical," says Sibley.

Sibley's studies focus on species in aquatic environments, where he and other researchers will monitor the concentrations of neonicotinoids and assess the sensitivity of a variety of aquatic species.

The researchers hope to use this information to develop specific water quality criteria that will help determine the risk of harm to aquatic life from the use of pesticide products containing neonicotinoids.

"Pesticides are critical for feeding our world, but we need to use them in a safe way. The point of this research is to first establish the safest level of usage and, from there, develop a better management regime for neonicotinoids," says Sibley.

– Alyssa Logan

Funding for this project is provided by the OMAFRA–U of G Partnership. Additional funding is provided by the Ontario Ministry of Natural Resources and Forestry and the Ontario Ministry of Environment and Climate Change.

Photo: iliuta goean/Shutterstock.com

Understanding soil health

Joey Sabljic

Getting the full scoop on soil health involves more than just a quick glance at what's being grown on the surface. Rather, it requires a better understanding of a complex relationship including cover crop use, microorganism populations and cropping systems. To this end, the OMAFRA – University of Guelph research partnership has been working toward a better understanding of how Ontario farmers can keep soils as rich and fertile as possible while aiming for sustainable high yields that will feed a growing population.

Give winter wheat a spin in crop rotations

Corn and soybean rotations have tended to dominate Ontario's farming landscape, but when it comes to long-term soil health, University of Guelph researchers found that these simple corn-soy rotations have reduced yield and lower soil organic matter, and are more susceptible to drought than more complex rotations.

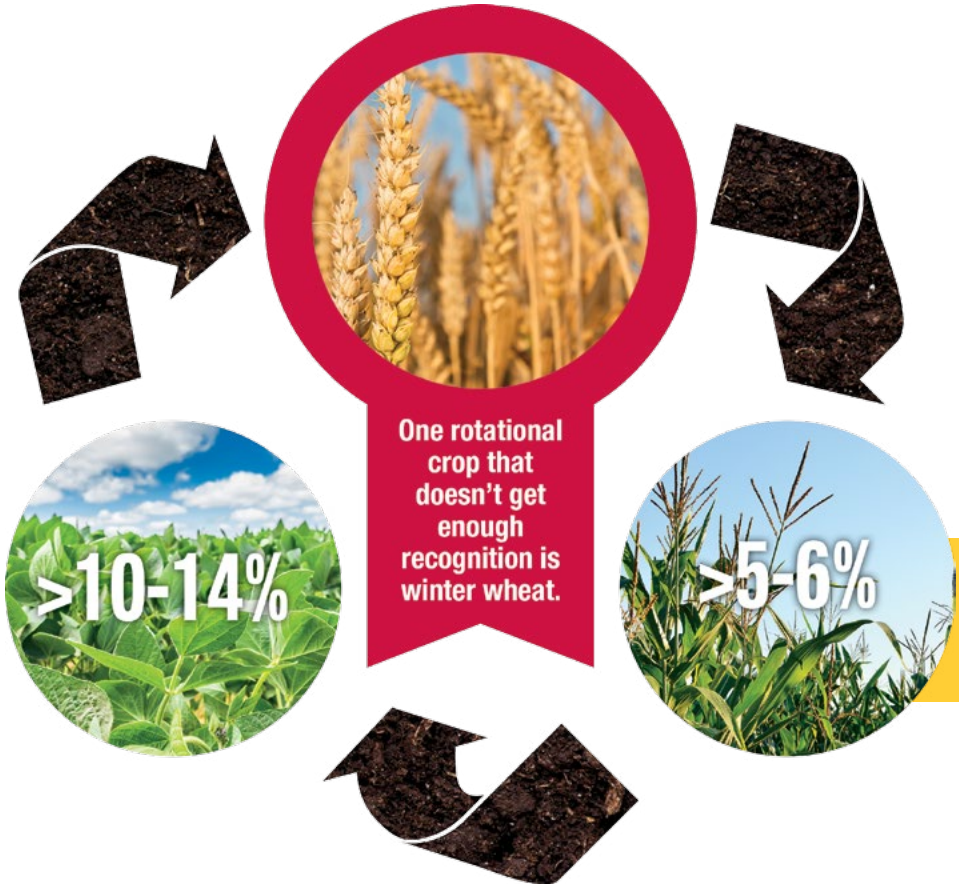
Plant agriculture professor Bill Deen leads a research team that has been looking at Ontario crop production systems and crop rotations to find out which provide the most benefits to long-term soil health and productivity.

What they've found from their own studies, as well as by looking at data from more than three decades of long-term rotation trials at the University of Guelph's Elora Research Station, is that simple rotations have more pronounced negative impacts on the environment and soil health.

"Simple rotations are not preferred from an environment or soil health perspective, and may not be most profitable either," says Deen. "When you consider the economic value of complex rotations in terms of yield increases, reduced nutrient requirements and yield stability, then complex rotations just might be more profitable."

One rotational crop that doesn't get enough recognition, he argues, is winter wheat. Deen says including winter wheat in rotations can provide several major soil health benefits — including increases in soil organic matter — and resilience to environmental stresses, such as drought.

Winter wheat can also help set the stage for planting a cover crop, such as red clover, which adds nitrogen and beneficial



Adding winter wheat to a crop rotation can provide a 5 to 6 per cent yield increase in corn and a 10 to 14 per cent yield bump in soybeans.

Funding for these projects is provided by the OMAFRA–U of G Partnership.

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"While everyone says cover crops are good for the soil, there are very few long-term studies that actually measure meaningful changes in soil organic matter or compare the performance among different cover crops." –Prof. Laura Van Eerd

organic matter to the soil. Winter wheat is generally harvested in late July or early August, giving growers a few months to plant a cover crop and produce valuable biomass. Corn and soybeans, however, are harvested late in the season, which makes it very difficult to obtain sufficient growth required to realize a benefit from a cover crop.

Ultimately, the numbers in favour of winter wheat speak for themselves. Deen says that, even by conservative estimates, adding winter wheat to a crop rotation can provide a 5 to 6 per cent yield increase in corn and a 10 to 14 per cent yield bump in soybeans. "If you're a grower, and you are serious about soil health, you really need to consider rotation diversity, and winter wheat is a good option for this," he says.

Finding the right cover crop combination

Are cover crops all they're cracked up to be when it comes to improving soil health? According to a University of Guelph researcher, the simple answer is "yes." But which cover crops should farmers plant for the biggest benefit? The answer to that question lies deeper below the soil surface.

Laura Van Eerd, a professor in the School of Environmental Sciences at the University of Guelph's Ridgetown Campus, is leading a series of long-term trials to determine which cover crops — or cover crop combinations — contribute the most to soil health from chemical, physical and biological perspectives.

"Growers use cover crops for various reasons, including for soil health," says Van Eerd. "While everyone says cover crops are good for the soil, there are very few long-term studies that actually measure meaningful changes in soil organic matter or compare the performance among different cover crops."

She is leading a research team comparing several cover crops, including radish, rye, oats, forage pea and hairy vetch, with a no-cover crop control. Each cover crop is planted during the fall after the main cash crop is harvested and then studied to see its impact on the following year's crop yield and quality.

Using their long-term trials at Ridgetown Campus, Van Eerd and PhD student Inderjot Chahal are taking a closer look at several different soil health indicators to see whether they can detect differences based on cover crop use.

So far, they've found that crop yields are as good as or better with the cover crop than without. They also saw that a cover crop mixture of oilseed radish and rye offers the biggest boost in beneficial soil organic carbon. Without a cover crop, soil organic carbon levels were lowest.

Van Eerd has also been looking at comparing cover crop planting date (early August to early September) with cover crop growth, nitrogen uptake and the following year's yields.

From their results so far, she says, there was no impact on the following year's yields, despite large differences in cover crop growth.

"What the research indicates is that it's more important to have a cover crop growing, than when you plant the cover crop," says Van Eerd.

She adds that this research suggests that timing of planting may be less important, and stresses the benefits of growing cover crops.

As part of the next phase of her work to understand how cover crops affect soil health, Van Eerd is working with environmental sciences professor Kari Dunfield to look at the biodiversity of fungi and bacteria living within the soil.

"Through our long-term trials, we're hoping to get a better understanding of what's happening in the soil with different cover crops."

Photo courtesy of Laura Van Eerd

The effects of climate change on farming

Joey Sabljic

ONTARIO'S RURAL AREAS AND COMMUNITIES are constantly changing and evolving, due to a variety of factors—employment opportunities, population shifts and energy prices among them. But one of the biggest factors influencing rural Ontario's future will be climate change, as it creates new opportunities and challenges for farmers and food production. The OMAFRA – University of Guelph Partnership has supported several research initiatives dedicated to understanding the effects of climate change, and how farmers and rural communities can adopt sustainable practices that will allow them to thrive, create strong local food systems and manage new challenges.

Rural communities can become stronger and more resilient through localization—that is, building up local food networks that more closely connect farmers to consumers—and cut back on the need to transport goods over long distances.

Rural communities that can cope with climate change

Climate change can—and will—reshape the way these communities live, work and cope with the future whether they're prepared or not. So, what's the way forward?

Prof. Wayne Caldwell, School of Environmental Design and Rural Development, along with several graduate students, is studying how rural communities across the province are adapting and adjusting to make themselves more resilient in the face of climate change and unpredictable energy costs.

"Climate change is tricky because you'll get events that happen slowly over time, like milder winters, and our tendency is to not clue into the gradual changes taking place," says Caldwell. "This adds to the challenge of building awareness and

Photo: iStock.com/fotoVoyager

appreciation of what rural communities could and should be doing to adapt and cope for the future."

Caldwell and his research team paid visits to rural communities, conducted numerous interviews and published a book in 2015, *Planning for Rural Resilience: Coping with Climate Change and Energy Futures*, along with a toolkit containing a number of strategies, best practices and examples of sustainable economic development.

One major area for development that Caldwell identifies in his book and toolkit is in agriculture and food production. He explains that rural communities can become stronger and more resilient through localization — that is, building up local food networks that more closely connect farmers to consumers — and cut back on the need to transport goods over long distances.

Localization, says Caldwell, could help Ontario's rural communities avoid feeling the economic pressures over uncertain fuel prices.

"It doesn't make sense to have food transported over such huge distances when there could be local sources made available," he says. "Fossil fuels are currently quite abundant in North America, but they're still a non-renewable resource that will become constrained at some point in the future."

Caldwell says that most goods and services — food, in particular — produced at a local level reduce rural communities' dependence on large urban centres. Keeping food production closer to home also creates jobs and long-term employment opportunities that could help stem the flow of people away from rural areas.

"There are opportunities for different forms of agriculture that not only create employment opportunities but stronger connections between people and the food they consume," says Caldwell.

There could be an extra generation per year of bean leaf beetle under future climate change scenarios.

Warmer temperatures bring more bean leaf beetles

Longer, warmer growing seasons caused by climate change could benefit many crops, including corn and soybeans. But according to University of Guelph environmental sciences researcher Rebecca Hallett, those conditions could also create a better environment for more field pests to survive the winter and thrive in the spring.

To get an idea of how a warmer climate could affect pest populations, Hallett — along with environmental sciences professor Jonathan Newman and Prof. Art Schaafsma from the University of Guelph's Ridgetown Campus — focused on the bean leaf beetle, a pest that feeds mainly on soybean leaves and pods.

"The bean leaf beetle is a significant pest that can cause economic losses and can also carry several bean pod viruses that affect soybean quality," says Hallett. "Up until this point, not very much was known about the bean leaf beetle in Ontario, but more and more evidence pointed to the pest growing more abundant."

Hallett and her team first needed to find out how many bean leaf beetle generations were present in Ontario fields, as more generations feeding during the season can add up to bigger yield losses. Results from their lab and field developmental studies indicated the presence of only one generation of bean leaf beetles in southwestern Ontario under current climatic conditions.

Over a three-year period, the researchers also collected bean leaf beetles from soybean fields and allowed them to overwinter in cages. They then used three different warming and snow cover combinations in a bid to determine whether warmer fields (4 C above typical winter temperatures) or snow acting as an insulating layer had a major effect on the number of adult bean leaf beetles emerging in the spring.

What they eventually found was that bean leaf beetles exposed to warmer ambient temperatures emerged two weeks earlier. This, they say, could allow for an extra generation per year of bean leaf beetle under future climate change scenarios.

Hallett says that overwintered bean leaf beetle adults normally emerge in the spring and will generally feed on nearby alfalfa before laying eggs in soybean fields. Their offspring emerge as adults and feed on soybean plants primarily when they are at the pod filling stage, and then enter leaf litter for overwintering. A second generation would create a whole new set of headaches for farmers.

"Right now, there's a very specific time when farmers need to watch out for bean leaf beetle feeding," she says. "But if we have two generations of beetles during the season, those soybean plants will get hit at the vegetative stage by one generation and then again at the pod filling stage by the next generation."

With temperatures steadily growing warmer in Ontario, Hallett says growers can expect to contend with at least one additional generation of bean leaf beetles during the season. In comparison, warm soybean growing areas in the southern United States regularly see three bean leaf beetle generations.

With future climate playing a major role in the distribution and abundance of invasive species, Hallett and her research team developed a bioclimatic model, which they used to explain the bean leaf beetle's current range as a result of current climatic conditions.

Then, with the help of three different global circulation models, the researchers projected to the 2080s to figure out how current insect populations and global climate trends could shape the insects' range and abundance.

Hallett says that two of their three projections indicate that continued northward expansion of bean leaf beetle is likely to occur in Ontario, with much of the province becoming suitable for establishment and growth of the bean leaf beetle under future climate conditions.

Funding for this research is provided by the OMAFRA-U of G Partnership.

Photo: Cara McCreary

Cheers to grape pomace

Wine-making by-product could improve treatment for diabetes and insulin resistance

Medications that are prescribed to treat Type 2 diabetes can cause unpleasant side effects — weight gain, cardiovascular disease and even bladder cancer. But new research shows resveratrol, a compound found in the pomace (skins and seeds) of red grapes, may help mitigate these effects and prevent diabetes from developing in the first place.

Prof. David Wright, Department of Human Health and Nutritional Sciences, fed obese mice grape pomace, pure resveratrol or a common anti-diabetic drug to investigate how each treatment could lead to improved conditions for people with obesity, insulin resistance and Type 2 diabetes.

Extracting resveratrol from grape pomace could lead to a supplement.

Resveratrol, in combination with the anti-diabetic drug metformin, showed a marked effect on improving glucose metabolism that was greater than for either compound alone, says Wright.

"Our finding has implications from the health, food processing and environmental standpoints," says Wright.

This research is in collaboration with Prof. David Dyck and graduate student Scott Frendo-Cumbo.

Funding for this project is provided by the OMAFRA–U of G Partnership. Additional funding is provided by the Canada Research Chairs program and the Natural Sciences and Engineering Research Council.

Reducing blood sugar levels with agri-food by-products

Researchers have discovered three natural gums — from the hulls of flaxseed, yellow mustard and fenugreek — can lower glucose and insulin in the blood when included with a meal. This is welcome news as Type 2 diabetes rates soar in Canada.

A gum is a water-soluble fibre, which can help improve how glucose and insulin behave in the bloodstream. It's popularly believed that the more concentrated the fibre, the slower the glucose is broken down.

However, Prof. Doug Goff, Food Science, says his team's research showed that the most important factor in glucose breakdown is the way fibre behaves in the digestion process.

The researchers created three different puddings with varying concentrations of gum fibre for participants at risk for Type 2 diabetes.

At the same time, they embarked on an in-vitro study to test the chemical effect of fibre from the research plants on the breakdown of starch and diffusion of glucose.

In both cases, fibre slowed down the diffusion process and resulted in lower levels of blood glucose.

Next, researchers will look for opportunities to introduce these fibres into food, without negatively affecting the product for consumers.

All stories by Alaina Osborne

Funding for this research is provided by the OMAFRA-U of G Partnership. Additional funding is provided by Agriculture and Agri-Food Canada, the Natural Sciences and Engineering Research Council and Natunola Health.

Vitamin-and-mineral powders get low scores from long-term residents and caregivers

Residents of long-term care facilities, their families, nutrition managers and stakeholders have spoken: adding powdered essential nutrients into residents' diets isn't a desirable option.

Researchers led by Prof. Lisa Duizer, Department of Food Science, created a vitamin-and-mineral powder that could be added to residents' food prepared in a long-term care home. Their goal was to help individuals in aging populations by improving their quality of life using a food-first strategy.

They found some resistance to the idea of a separate substance being incorporated into meals. As well, some food preparation personnel were worried about the responsibility of safely adding or excluding the powder from the residents' food.

Those were important findings. Research has shown that poor food intake (which occurs for a number of reasons, including age-related problems with chewing and swallowing) results in more than 30 per cent of older adults living in long-term care facilities becoming malnourished. Many more may be at risk for the condition.

Researchers are looking to combat this issue by improving the diets of senior residents who are deficient in micronutrients such as vitamin D, calcium and B12.

As a result of this feedback, Duizer will test the feasibility of modifying recipes to contain nutrient-rich ingredients.

Funding for this project is provided by the OMAFRA–U of G Partnership.

Photo: iStock.com/RapidEye

Growing Ontario's economy with local consumer options

Liz Snyder

Anita Stewart, Canadian food advocate and University of Guelph Food Laureate, says local food is better for the planet, keeps our producers and processors in business, revives the agri-food industry and defines who we are.

No wonder local food is so big in Ontario.

Here, the agri-food industry helps define the economy, too, generating $36 billion a year in gross domestic product and sustaining about one in every nine jobs across the province.

Premier Kathleen Wynne has challenged the sector to make even more of an impact and keep dollars in Ontario communities by satisfying the changing tastes and values of Ontario consumers.

That's where the OMAFRA – U of G Partnership comes in, putting the province in good stead to meet these goals. From organic soybeans to strawberries that are available year-round to novel ornamental flowers, products developed by researchers are giving local choices to consumers and producers.

Funding for this research is provided by the OMAFRA-U of G Partnership. Additional funding is provided by Organic Council of Ontario, Homestead Organics, Roger Rivest Marketing Ltd., Loblaw Chair in Sustainable Food Production, and AAFC and OBGA through the Growing Forward 2-Agricultural Innovation program.

Organic soybean developed for market demand

Consumer demand for organic soybeans is growing. Today, 150 of the 830 organic growers in Ontario are producing soybeans. But they've been growing soybeans bred for conventional farms...until now.

Prof. Istvan Rajcan, Plant Agriculture, and graduate student Torin Boyle have set out to find a soybean variety that will perform well in both organic and conventional farming conditions — and then create a breeding program with that seed.

"It's a consumer choice and we need to service that need. And it helps to diversify agriculture in Ontario," says Rajcan.

To meet this goal, breeding and production conventions had to be examined and re-evaluated by the researchers. Rajcan says the soil on organic farms is different from conventional farm soil; to be certified organic, a farm has to go through several years of no traditional inputs, such as chemical fertilizers.

Production and cropping practices are also different. Organic farming practices use a more diverse crop rotation than conventional farms. They don't use chemicals. Even row width is different between the two.

Rajcan and Boyle selected 30 non-GMO, food grade varieties of soybeans to represent genetic diversity, or genetic differences that translate into performance differences. They then tested their breeding program on an organic farm to understand genetic differences between organic and non-organic adapted cultivars. They believe this approach will lead to a greater number of high-yielding, organic-adapted cultivars.

Ontario strawberries all year round — almost

Ontario's strawberries are succulent and packed with vitamin C. But their season is short-lived, leaving consumers little choice but to purchase imported berries off-season.

From the middle of May into October, strawberries have yet to reach the same level of production as California, where the berries are produced 11 months out of the year.

Prof. Adam Dale saw the potential to increase the present $22-million farm-gate value of the Ontario berry industry by extending the length of the Ontario production season to encourage year-round employment and increase domestic market share.

To do this, Dale has adapted day-neutral strawberry varieties to Ontario conditions by combining Ontario varieties with day-neutral varieties from California and short-day varieties from Florida.

"Ontario strawberries have adapted to hot summers and cold winters. They go to sleep when it's hot out, and can handle frost in the spring. Florida varieties grow through short days and don't go to sleep. Together they make plants that don't go dormant and are winter hardy," says Dale.

With these new berries, Dale is also investigating more cost-effective and environmentally friendly management practices, with the aim of increasing the berry revenue in Ontario by $6 million each year.

Sourcing native Ontario plants

Ontario's flower industry is facing increased competition from imports, and Ontario growers lack a source of new and unique varieties.

At the same time, hot summers and water restrictions make it difficult to keep non-native plants thriving.

Prof. Al Sullivan, Plant Agriculture, has taken on the challenge of breeding beautiful native plants such as prairie blazing star that also require less water and fertilizer.

He had to find the best plants to work with.

"When I started this, I thought I would be the Indiana Jones of native plants, but that's impossible to do. You can't go onto people's property and collect plants," says Sullivan. "I went to retailers and wholesalers of native plants and seeds — they did the collecting and harvested seeds."

Sullivan and his team looked at plants they knew had good esthetic qualities and were also drought-tolerant. When they found plants that had the characteristics they wanted, they put them into their breeding program to optimize traits such as height, blooms and disease resistance.

Sullivan says putting native plants in a landscape mix not only brings beauty but also money into Ontario's economy.

"It's a balance of trade. Right now it's not in our favour — we pay royalties to others outside of Canada. If we could provide people with native gardens, our growers benefit and money comes back to Ontario."

"Ontario strawberries have adapted to hot summers and cold winters. They go to sleep when it's hot out, and can handle frost in the spring. Florida varieties grow through short days and don't go to sleep. Together they make plants that don't go dormant and are winter hardy." — Prof. Adam Dale

Strawberry production in Florida

Photo courtesy of Adam Dale

A superb spinach crop can be ruined by fusarium.

Fighting back against fungi

Researcher combats fungal diseases affecting Ontario vegetable yields

It's already hard enough to get kids — and even adults — to eat vegetables. But now, plant disease is taking some of those vegetables off the table, too.

Over the past five years, Ontario vegetable crop yield has fallen because of two fungal diseases: fusarium and stemphylium.

Prof. Mary Ruth McDonald has found that the ill effects of fusarium on spinach can be lessened by adding nitrogen to the soil and also by crop fumigation.

Fusarium renders spinach and carrots unmarketable, while stemphylium affects asparagus and onions.

Fusarium in spinach is activated by hot temperatures and can produce a total crop loss. A related species causes black spots on carrots. In some trials, up to half of the carrots were unmarketable.

Rising temperatures are making fusarium an increasingly prominent problem.

For its part, stemphylium lowers shelf life and reduces crop yield. It also causes unappealing purple spots in asparagus and reduces bulb size in onions.

Prof. Mary Ruth McDonald, Department of Plant Agriculture, along with several graduate students, is addressing these diseases.

McDonald has found that the ill effects of fusarium on spinach can be lessened by adding nitrogen to the soil and also by crop fumigation.

She also discovered that stemphylium on asparagus is reduced by optimizing fungicide and fertilizer quantities, along with disease forecasting (monitoring leaf wetness and temperature).

"Ensuring that farmers produce high yield and high quality has implications all along the food chain," says McDonald. "When crops are readily available, it maintains steady prices for consumers and reduces dependency on imported vegetables."

This research was conducted in collaboration with several grower cooperators.

Funding for this research is provided by the OMAFRA–U of G Partnership. Additional funding is provided by the Bradford Cooperative Storage Ltd., TriEst Ag Group Inc. and Syngenta Canada. Funding was also provided by the HQP program of the OMAFRA–U of G Partnership for Brian Collins, Selasi Tayyiah, Jennifer Foster and Dr. Ahmed Abdel-Magid.

All stories by Sydney Pearce

Photo: Africa Studio/Shutterstock.com

Oats and rye are best choices for cereal forage production

Cereal forages, such as oats and rye, can offer producers a nutritious and high-quality feed for cattle and sheep, according to new research.

In 2012, many of Ontario's cattle and sheep producers had to find alternative forage sources due to an unusually dry spring and early summer that reduced the yields of their regular forages, such as alfalfa and corn silage. This prompted Prof. Bill Deen, Plant Agriculture, and research assistant Ken Janovicek to explore the quality and yield of rye, wheat, triticale, barley and oat cereal forages.

Researchers found that oats produced significantly higher fall-harvested forage yields than other mid-summer planted cereals. This may be because oats generally had less disease.

Rye had faster spring growth rates compared to the other winter cereals, resulting in spring forage harvest dates that were about seven to 10 days earlier than the other cereals. Earlier harvest dates associated with rye make forage available to become feed earlier and also increase yield potential of the next crop planted following harvest.

Researchers are also interpreting nutritional quality data to determine whether differences exist among the various cereal crops. Preliminary results suggest that, when compared at the same development stage, there is little difference in nutritional quality among the various cereal crops. All are capable of producing good-quality forage, but oat and rye are capable of producing more of this quality forage.

"This research will provide producers Ontario-based information regarding likely yields and nutritional quality of cereal forages harvested either in mid-fall or late spring," says Janovicek.

This research was performed in collaboration with A&L Laboratories, cropping systems specialists Peter Johnson and Scott Banks, livestock sustainability specialist Christoph Wand and dairy cattle specialist Tom Wright.

Funding for this research is provided by the OMAFRA–U of G Partnership. Additional funding is provided by the Ontario Forage Council and Beef Farmers of Ontario through the Ontario Farm Innovation Program and the Ontario Soil and Crop Improvement Association.

Feeling blue over red clover crops

Researcher tackles patchiness in this important cover crop

Red clover can substantially reduce the amount of nitrogen fertilizer required for the subsequent corn crop, yet its use has declined in recent years due to various stresses, such as drought, causing inconsistent and patchy crops. U of G researcher Cora Loucks, Department of Plant Agriculture, is trying to help restore this green manure to a place of prominence.

"Red clover has a high nitrogen credit, which makes it ideal to precede crops with a high nitrogen demand such as corn," says Loucks. "We want to encourage farmers to use this crop more frequently in their rotation plans."

Patchy cover crops force producers to fully fertilize fields for the following crop. This can create areas of high nitrogen when fertilizer is added on red clover. These high-nitrogen areas produce nitrous oxide emissions that are almost five times as toxic as methane, and the excess nitrate leaches into groundwater.

Loucks is developing new strategies to create uniform coverage. Currently, she's analyzing data to identify varieties of red clover that are better able to cope with stresses that crops face, specifically by comparing double-cut and single-cut clover.

This research was conducted in collaboration with Profs. Bill Deen and Ralph Martin.

Funding for this research is provided by the OMAFRA–U of G Partnership. Additional funding was provided by Loblaw Companies Ltd. and Grain Farmers of Ontario.

Photos: AsyaPozniak/Shutterstock.com (left) and Tischenko Irina/Shutterstock.com (right)

Veterinarian Dr. Kelly Barratt works with Ontario dairy farmers such as Carman Weppler (pictured here with his daughter Rea) of Clifford, to help implement “proAction,” a program that includes traceability, animal care and welfare, environmental stewardship and biosecurity.

Veterinarians are trusted advisers for farm and industry

Karen Mantel

When Dr. Kelly Barratt graduated from the University of Guelph's Ontario Veterinary College (OVC), she didn't anticipate that her passion for food animal medicine would eventually include a role in industry-led initiatives.

As a veterinarian and co-owner with Heartland Veterinary Services, a mixed animal practice in southwestern Ontario, Barratt focuses on large animals — including dairy, equine and small ruminants. She values her interactions with food animal producers.

"In practice, you are the expert. Producers rely on you to examine their animals, make a diagnosis and recommend treatment, taking into consideration the type of medication, antimicrobial issues and withdrawal times, only using these treatments when necessary," says Barratt, who graduated from OVC in 2005.

Involvement with organizations such as the Dairy Farmers of Ontario (DFO) and the Ontario Association of Bovine Practitioners "allows me to think about animal health and food safety issues at a different level, while providing more interaction with industry partners," she adds.

In a new part-time role with the DFO, Barratt is assisting with the Ontario implementation of the "proAction" initiative, a Dairy Farmers of Canada program that includes traceability, animal care and welfare, environmental stewardship and biosecurity.

Veterinarians have expertise in these areas, and farmers look to their herd veterinarians for advice and coaching with these initiatives, says Barratt.

She credits her clinical training at OVC, especially on-farm opportunities with OVC's Ruminant Field Service (RFS) practice, with providing a solid footing as she embraces these new opportunities.

Externship program is critical to teaching mandate

Fourth-year doctor of veterinary medicine students spend their entire final year completing rotations in various areas of clinical veterinary medicine through the OMAFRA – U of G Partnership-funded Veterinary Clinical Education Program, beginning with an eight-week externship at a rural veterinary practice that works with food animals and/or equine as well as companion animals.

The RFS practice is critical to our teaching mandate, says Prof. Todd Duffield, professor in OVC's Population Medicine department. The rotation includes lots of hands-on experience for food animal stream students with visits to farm clients for herd health checks and to the Elora Dairy Research Innovation Centre to practise physical exams and fine-tune diagnostic and clinical skills.

Over the past two years, a day at the Ontario Livestock Exchange, the largest sales barn in Ontario, has been added. "This has become a really important part of our program," adds Duffield. "Student veterinarians not only learn more about cow management and animal care and welfare, they see clinical cases they may not otherwise see during a regular farm service rotation."

Additional food animal rotations focus on beef, small ruminants, dairy nutrition and more advanced dairy topics such as udder health, heifer, reproductive health and transition cow management, as well as a dairy herd problem-solving rotation bringing together student veterinarians from OVC and Michigan State University's College of Veterinary Medicine.

With the latter, students spend one week focusing on Ontario dairy herds and one week in Michigan at Green Meadows Dairy with the farm's 3,300-cow milking herd.

"There is tremendous value in the interaction between the students from the two countries and the differing milking systems," says Duffield. Students spend time on-farm with the producer, herd veterinarian and OVC faculty gathering information before working as a group to solve herd-level issues.

Barratt, who participated in the problem-solving rotation as a student, sees the benefits even more clearly today when her practice welcomes this rotation to client farms.

"As a practising veterinarian, I continue to learn from the faculty and students who bring their knowledge of up-to-date research and clinical procedures," she says.

The Veterinary Clinical Education Program receives funding from the OMAFRA–U of G Partnership.

Photo: Lachlan Weppler

Learning, research, knowledge mobilization and more

| Robyn Meerveld

For more than three decades, OMAFRA has supported the health of livestock in Ontario through the training of veterinarians, livestock veterinary research and the dissemination of knowledge to the industry. OMAFRA's Veterinary Clinical Education Program (VCEP) at the Ontario Veterinary College has played a fundamental role in upholding Ontario's reputation for production of healthy animals and safe, quality foods.

Today, as we have come to better understand the relationships between animals, humans and our shared environment, the realm of veterinary medicine has expanded. Veterinarians not only provide direct, hands-on animal care but are also increasingly involved in the development of public policy for human health and the environment. VCEP supports all of these important functions.

IMPACT Ontario's livestock contribute about $20 billion to the provincial economy annually.
Veterinarians care for the health of more than 218 million dairy cows, swine and poultry in Ontario.

VCEP training supports:

- Externship placements
- One-year specialty internships
- Post-graduate training
- Food animal and rural community veterinary streams for 4th-year students

VCEP animal care through:

- OVC's Health Sciences Centre
- Mobile veterinary farm services for ruminants and swine

VCEP research and knowledge mobilization in:

- Livestock production (animal health, animal welfare)
- Summer career opportunities and research experience program

IMPACT Improved public health through monitoring and research of zoonotic diseases.
More than 60 per cent of new and emerging infectious diseases — including Lyme, West Nile and SARS — are transmitted between animals and humans.

VCEP supports:

- Centre for Public Health and Zoonoses
- Collaboration with U of G's Animal Health Laboratory for disease surveillance and diagnosis

VCEP research and knowledge mobilization in:

- Emergency management (foreign animal disease, food safety)
- Livestock production (environmental ecosystem impact)

Automated approach could save millions of litres of water

Researchers improve irrigation practices in Canadian nurseries

| Rachael Piccoli Kuschke

Canadian nurseries account for almost four per cent of total water use in Canada and experience a lot of nutrient runoff in the production process. To reduce runoff and water consumption, Jared Stoochnoff, graduate student and recipient of OMAFRA's Highly Qualified Personnel (HQP) scholarship, and Prof. Mike Dixon, School of Environmental Sciences, are developing cost-effective technologies and management.

Preliminary results suggest that typical watering practices lead to over-irrigation. This increases the rate of water and fertilizer runoff, which can affect local watersheds.

However, if trees are not watered enough, they suffer drought stress, which can result in reduced growth.

The researchers believe automated irrigation schedules based on tree water requirements as predicted by daily environmental conditions could be used to conserve millions of litres of water each year.

Graduate student Jared Stoochnoff at work in the nursery with a stem psychrometer.

They're using stem psychrometers (PSY), sensors that attach directly to the tree's water conducting tissue, to monitor the tree's water status (stress) levels in real time. This allows them to reliably determine when the trees actually need water, as opposed to watering on a fixed, often daily, schedule.

Stem psychrometers allow researchers to reliably determine when the trees actually need water, as opposed to watering on a fixed schedule.

However, the sensors they're using are relatively expensive and can be difficult to manage, which prevents nurseries from directly taking up this technology.

So to create a more affordable and easily managed solution for nursery growers, researchers have deployed conventional meteorological sensor technology (i.e. weather stations), along with other sensor technologies that measure soil moisture levels.

Combined, these data are used to characterize the relationship between the trees' water status and the prevailing environmental conditions. With this information, researchers can automatically schedule irrigation based on actual tree requirements rather than an arbitrary daily schedule.

Results suggest that growers can significantly reduce the amount of water used, as well as runoff, while still maintaining high productivity.

Funding for the HQP Scholarship Program is provided by the OMAFRA–U of G Partnership. Additional funding for the project is provided by the Gosling Research Institute for Plant Preservation, the Canadian Nursery Landscape Association, Landscape Ontario, Root Rescue Environmental Products, Connon Nurseries CBV Holdings Ltd. and ICT International PTY Ltd.

Photo courtesy of Jared Stoochnoff

Fighting ketosis: There's an app for that

Researchers bring advances in science to dairy farmers' smartphones

Rebecca Moore

A new smartphone app designed to synthesize on-farm ketosis monitoring data and promote regular ketosis testing is helping move best-available science from lab bench to barn floor.

Ketosis — a metabolic condition caused by an energy deficit — affects up to 40 per cent of all dairy cows in Canada. It can lead to reduced milk yield, impaired reproduction, weight loss and fever, and increases the risk that cows will develop other health conditions, such as metritis and mastitis.

The condition also comes with a significant price tag: a recent U of G study found each case of ketosis costs farmers more than $200 in treatment costs and production losses.

Prof. Todd Duffield, Department of Population Medicine, recommends weekly on-farm testing to allow for quick identification and treatment of the condition. But most farmers do not have rigorous on-farm ketosis monitoring programs. Instead, many rely on regular dairy herd improvement tests to monitor for ketosis. These tests are given only every 30 to 40 days and may miss the period when a cow is most susceptible to ketosis: the first two weeks after calving. Even when producers conduct more frequent on-farm monitoring, their results are often recorded in a notebook, making herd-level analysis and data sharing difficult.

Duffield is hoping to change this practice and sees an opportunity to translate best-available science to farmers using a familiar tool — the smartphone and an app called iKetone. By providing farmers with an app that stores and synthesizes ketosis monitoring data, he hopes to remove a barrier to regular testing and make data analysis and treatment easier.

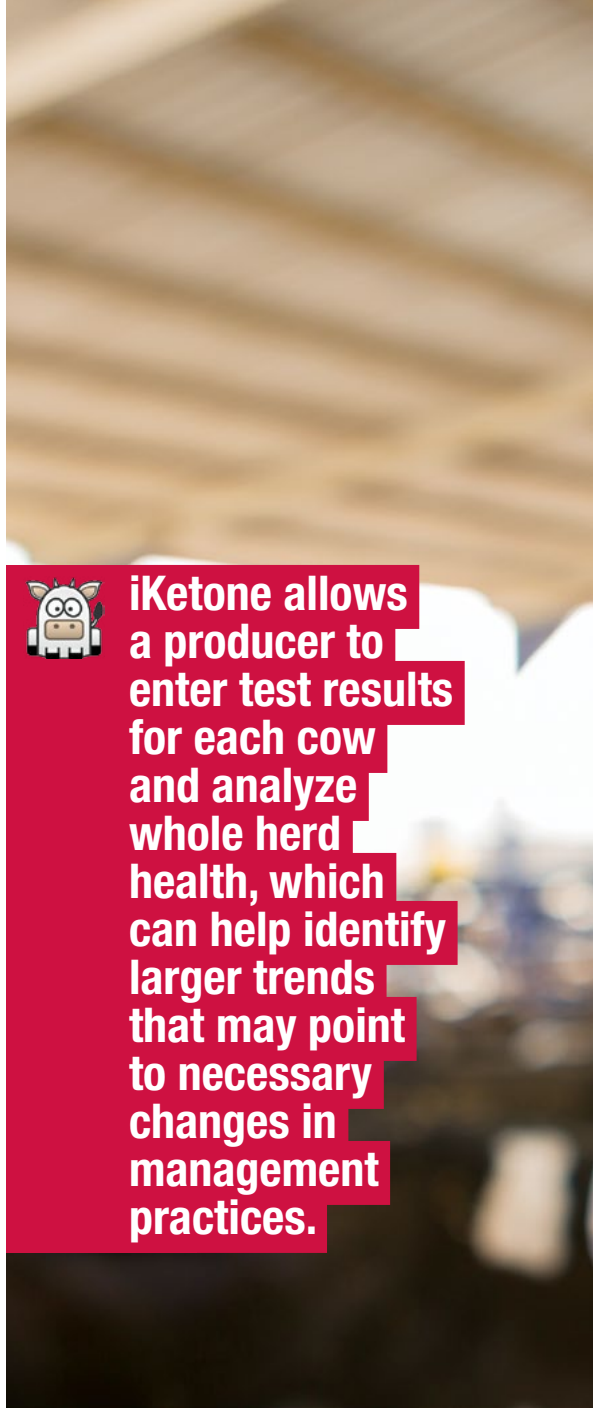
"The majority of farmers have a smartphone and they carry it with them all the time," says Duffield. "This presents an opportunity for researchers to translate their work for easy on-farm use."

Duffield teamed with Profs. Rozita Dara, School of Computer Science, and Stephen LeBlanc, Population Medicine, and with a software developer to create iKetone. It allows farmers to easily record and track on-farm ketosis test results and converts them into easy-to-understand herd trends.

For Duffield, the need for increased monitoring is reflected by the prevalence of the disorder. Despite the wealth of research on ketosis and ketosis prevention, the frequency of the condition is not declining.

iKetone allows a producer to enter test results for each cow and analyze whole herd health, which can help identify larger trends that may point to necessary changes in management practices. The app also allows a producer to share the data with a nutritionist and veterinarian, creating a virtually connected community of care to support overall herd health.

"The biggest advantage to frequent testing is a herd-level approach to monitoring," says Duffield. "Herd-level testing is proactive and not reactive. Being proactive promotes good health instead of just reacting to instances of poor health."



iKetone allows a producer to enter test results for each cow and analyze whole herd health, which can help identify larger trends that may point to necessary changes in management practices.

A precise approach to total mixed rations

The OMAFRA–U of G Partnership supports precision agricultural technologies that make use of apps to give producers information at their fingertips.

One of the earliest examples was environmental sciences professor Rebecca Hallett's Aphid Advisor app. It's helped farmers decide when it's best to treat for soybean aphids, a nasty pest that can devastate a crop.

Now, Prof. John Cant and his team in the Department of

Photo: iStock.com/fatihhoca

Animal Biosciences – working with OMAFRA's dairy specialist and several Ontario dairy producers – are using similar smart technology to address the challenge of nutrient variability in feed for dairy cattle.

The challenge for dairy producers is that dry matter and nutrient contents of the total mixed rations (TMR) prepared on the farm can vary considerably from day to day.

The perceived risk of feeding too little protein or phosphorus is often handled by feeding excesses of both.

This can have significant negative impacts. Milk production can suffer, and unnecessary expense is incurred by farmers. In addition, the excess nitrogen and phosphorus raise levels in manure, which is a concern for precipitating algal and bacterial blooms in the Great Lakes.

Various companies have recently introduced hand-held near-infrared (NIR) scanners that measure dry matter and nutrient contents of feed ingredients in mere seconds. Cant's app for mobile devices will retrieve nutrient density data from hand-held NIR scanners, calculate appropriate ingredient weights for the day, and send them wirelessly to third-party TMR mixers.

This will improve the precision of feeding dairy cows, and reduce the economic and environmental consequences of over-feeding nitrogen and phosphorus.

Ontario dairy producers were introduced to the project at the FarmSmart conference in Guelph earlier this year. Two companies that produce hand-held NIR scanners have joined the project as collaborators.

– Robyn Meerveld

Cant's app for mobile devices will retrieve nutrient density data from hand-held NIR scanners, calculate appropriate ingredient weights for the day, and send them wirelessly to third-party TMR mixers.

Funding is provided by the OMAFRA – U of G Partnership and Growing Forward 2, a federal-provincial-territorial initiative.

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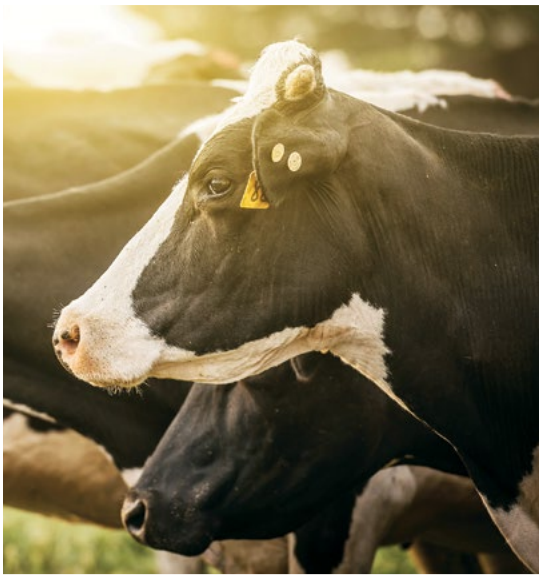

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