OMAFRA–University of Guelph Partnership

Research magazine

2012–13 Agri-Food Yearbook Edition

This tobacco yields gold

Researchers find natural, low-cost cancer treatment from the most unlikely of sources P. 13

Prof. Chris Hall

INSIDE:
How investments in research are yielding impressive returns

Ontario

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Changing Lives Improving Life

RETURN ON IN

This partnership creates wealth and sustains jobs

BY OWEN ROBERTS

The best partnerships benefit both parties — and that's exactly what happens with the agreement between the University of Guelph and the Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA).

It's having tremendous impact on the province, providing innovative knowledge for Ontario's agri-food industry and helping to protect our health and environment.

"The past five years have been challenging economic times in Canada and beyond," says Rich Moccia, associate vice-president, research (strategic partnerships) for the University of Guelph. "This partnership has maintained its return on investment while providing critical services to the people of Ontario, which speaks volumes about its quality, sustainability and importance."

This year has been distinguished by a cornucopia of good news for the partnership.

This past summer, for example, the Ontario Alliance of Food Processors reported food and farming had become the province's top dog. Food processing (around $40 billion) and farming (around $10 billion) in Ontario now generate just over $50 billion a year in revenue, according to the alliance. That compares favourably with $43.6 billion for motor vehicle manufacturing. And when direct employment is considered, that standing is even stronger: the 317,000 jobs represented by food processing and farming far outdistance motor vehicle manufacturing, with about a 10th as many jobs.

In October, The Impact Group named the University of Guelph the leading university in Canada for inventiveness, based on the number of annual invention disclosures. The partnership was central to that title — the vast majority of disclosures (65 per cent of all disclosures at the University, in fact) are for plant germplasm and involve OMAFRA funding, mostly through the partnership. This germplasm is mobilized by industry and results in $2 billion in crop production every year.

"Nothing is more important than a safe, wholesome food supply," says Moccia. "It creates jobs and provides the kind of foundation from which a province can grow. These and other studies point to the province seeing a superb return on investment from the partnership. They underline the true value of the entire agri-food sector." R

PHOTOS: SHUTTERSTOCK & ISTOCK

VESTMENT

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Innovation is a catalyst for agriculture and food

It is a pleasure for me to welcome you to the pages of *Research* magazine's Agri-Food Yearbook.

Research and innovation have long served as a catalyst for our agriculture and food sector. Through partnerships among industry, government and academia, we can ensure that our leadership in these important areas continues into the future.

There are many examples in this issue that support my ministry's three key areas of focus — increasing competitiveness and productivity, increasing local food consumption and bringing an open-for-business approach to our activities.

I am pleased to make note of the cover story about Prof. Chris Hall's research using tobacco plants to produce an antibody-based drug for breast cancer treatment. This is just one example of the promising research being conducted at the University of Guelph — research that has the potential to bring positive results for Ontarians.

I trust that you will enjoy reading this issue and learning about the high quality of research being conducted.

Ted McMeekin
Minister of Agriculture, Food and Rural Affairs

Collaborations lead to benefits for Ontario

I am pleased to share with you the 2012–13 *Research* magazine's Agri-Food Yearbook, which highlights the many benefits of the partnership between the University of Guelph and the Ontario Ministry of Agriculture, Food and Rural Affairs.

Here you will read about incredible innovations and collaborations leading to tremendous social, economic, environmental and health benefits for all Canadians.

These breakthroughs stem from the OMAFRA – U of G Partnership, created to help turn research knowledge and results into practical solutions to challenging issues.

During the past couple of decades, the partnership has produced safer food, better disease monitoring and prevention, and new products and technology. It's also been a huge contributor to the economic success of Ontario's $50-billion-a-year agri-food industry.

Beyond dollars and cents, the partnership is also an investment in people and in the future. The support provided by this partnership enables explorations and discoveries that improve the lives of Canadians and make Ontario a leader in innovation.

Alastair J.S. Summerlee
President and Vice-Chancellor
University of Guelph

PHOTO: SHUTTERSTOCK

Contributors

The University of Guelph *Research* magazine is written and co-ordinated by students involved in the University's Students Promoting Awareness of Research Knowledge (SPARK) program.

SPARK students are involved throughout the Agri-Food Yearbook's production process.

1 Matt McIntosh

Matt McIntosh is a fourth-year political science student with an appreciation for nature. He grew up on a cash-crop farm near Leamington, Ont., so he's well aware of the costs associated with crop production. His story on a new tool designed to help farmers decide which green-energy technologies make the most economic sense for their farm appears on page 6.

2 Anthony Ngai

Anthony Ngai, a fourth-year accounting student from Markham, Ont., can often be found browsing the food selection at the local farmers' market. Read his story on page 28 about how researchers are trying to build up networks and resources to establish bountiful and successful food networks in rural Ontario communities.

3 Joey Sabljic

Yearbook co-ordinator and English student Joey Sabljic of Guelph believes fresh bread is the key to any successful meal. He reports on how U of G researchers are working to incorporate healthier starches that can reduce the risk of diabetes and colon cancer into breads and other baked goods. Read more about it on page 14.

4 Andrea Seccafien

Fourth-year international development student Andrea Seccafien of Guelph is both an avid baker and a self-proclaimed health nut. So she was excited to learn about efforts underway to develop a trans-fat-free, soy-based baking fat that can be used in puff pastries such as danishes and croissants. Read the full story on page 25.

5 Natalie Osborne

Biomedical science graduate Natalie Osborne grew up on a dairy farm just outside Guelph, where her dad often commented that she drank more milk than the calves. See her story on page 26 about new antioxidant-enriched milk with the potential to prevent diseases such as cancer and diabetes.

6 Katy Jonker

Third-year marketing management (co-op) student Katy Jonker from Oakville, Ont., likes her eggs — and plenty of them. On page 22, she writes about how researchers are developing caging systems that improve hen welfare while keeping costs sustainable for producers and consumers alike.

SPARK

7 Samantha Beattie

Fourth-year international development student Samantha Beattie, who hails from Hamilton, Ont., is no stranger to the great outdoors. She discovered how Ontario's air quality could be improved while interviewing Prof. Mike Dixon about his work on regulating ammonia emissions from poultry barns. For the full story, turn to page 8.

8 Katharine Tuerke

Psychology and neuroscience doctoral candidate Katharine Tuerke of Oshawa, Ont., enjoys cooking with fresh summer tomatoes. To keep tomato quality high, researchers are trying to boost the plants' immunity against bacterial diseases such as speck and spot. Read more about their work on page 23.

PHOTOS: SAMANTHA BEATTIE EXCEPT NO. 7 BY NATALIE OSBORNE

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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

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OMAFRA–U of G Partnership

COVER PHOTO: MARTIN SCHWALBE

Personalizing on-far

BY MATT MCINTOSH

Green technologies such as solar panels and anaerobic digesters sound good on paper, but do they make economic sense for Ontario farms?

That's what Guelph researchers want to help farmers determine. They're creating a free online support tool to help make the transition to environmentally friendly technologies as efficient and cost-effective as possible.

U of G engineering professor Bill Van Heyst, along with graduate students Stephanie Shaw and Dan Roth, has partnered with OMAFRA and the Poultry Industry Council to create a program called the Complimentary Energy Decision Support Tool. It's known by its acronym, CEDST.

CEDST is designed to provide easy access to information about the green technologies available to farmers, the associated costs and which ones would best suit individual farms.

"Each farm is different, so a single prescription just doesn't work," says Shaw. "A free one-stop website for this kind of thing will help lessen the headache of building a more efficient operation."

The researchers describe CEDST as a multifold calculator. Farmers can log on and plug in information about their farm — such things as size, location, crop and livestock varieties, and type of on-farm structures. The program then compiles a list of green technologies that could make the operation more environmentally friendly, outlines the potential costs associated with each option, and estimates how much money the farmer could save by investing in them.

For example, farmers who want to generate their own power using a windmill or solar panels — or simply save on heating and cooling through better insulation — can use the support tool to easily compare price tags and the return-on-investment period between each option.

In its calculations, CEDST takes into account factors such as current material costs, installation and whether or not government support exists for the green technology in question.

The program also makes use of Google Earth, allowing farmers to more accurately identify their property lines and assess their building size.

To ensure CEDST is as accurate as possible, the researchers compare the information provided by their program with data from other industry-standard renewable-energy calculators on the market.

The amount of information amassed in the CEDST database is substantial. Shaw and her colleagues have already developed calculators for the program's solar photovoltaic, geothermal, wind and energy-conservation components. Next, they plan to provide details about solar thermal and anaerobic digesters before the program is made available to farmers online.

"There's substantial connection between the different parts of the CEDST program, which should make it even more accurate and easier to use," says Shaw. "It really is going to be a very user-friendly and all-encompassing tool, so farmers and homeowners will not have a problem using the program."

Funding for this project was provided through the OMAFRA–U of G Partnership.

m green technology

Decision-making software being developed by Guelph engineers will help producers make the jump to green technology

PHOTO: ISTOCK

Research associate Tom Graham (left) and Prof. Mike Dixon have developed a new user-friendly sensor to help producers accurately and affordably manage their ammonia emissions.

Managing ammonia with new sensor technology

BY SAMANTHA BEATTIE

Managing ammonia affordably and efficiently is a challenge. The most simple, cost-effective methods — such as exhausting ammonia from barns into the surrounding environment — affect air quality and human health, while altering water and soil pH.

Producers are always looking for new ways to mitigate and reduce ammonia emissions. Right now, spot checks (using glass tubes filled with chemicals that change colour based on the amount of ammonia in the air) are the most common method of measuring ammonia. But spot checks don't meet the needs of producers because they simply can't provide constant information to properly regulate ammonia levels.

In response, U of G plant agriculture professor Mike Dixon is working with Guelph research associate Tom Graham and technician Jamie Lawson to develop an inexpensive, accurate ammonia measuring system.

"Currently, ammonia management isn't easy unless producers have huge budgets and lots of technical skill," says Dixon. "If they don't, then they have little control over their ammonia output and will be unable to meet future regulations. We're trying to help."

The researchers are modifying existing sensor technology to take accurate ammonia measurements. These sensors can be incorporated into a control system that alters ventilation rates and other remediation technologies. Instead of costing tens of thousands of dollars — as conventional systems do — Dixon predicts this system will cost less than $1,000.

Right now, the team is finishing the sensor and working on getting temperature and humidity corrections honed for the best accuracy possible.

"This sensor technology meets our technical and economic objectives and means that producers can put dozens throughout their livestock facilities to get a very good idea of what's coming out of the barn," says Graham.

This research is being done in conjunction with other ammonia mitigation projects underway at U of G. In the Department of Chemistry, for example, scientists are developing electrochemical methods to increase wet scrubber efficiency. Dixon and Graham say their sensor could be connected to these scrubbers to automatically turn them on and off when needed.

- Also collaborating on this project is Prof. Steve Leeson of the Department of Animal and Poultry Science.
- Funding for this project is provided by the OMAFRA–U of G Partnership. Additional funding is provided by Ontario Centres of Excellence and the Natural Sciences and Engineering Research Council.

PHOTO: SAMANTHA BEATTIE

Car plant

Soybeans can be used to make parts for the auto sector

BY MATT MCINTOSH

Farmers could soon have a new market for their soybeans, thanks to University of Guelph research incorporating cheaper green substitutes for petroleum products in auto manufacturing.

Engineering professor Manju Misra and plant agriculture professor Amar Mohanty have created hard plastic and foam auto parts containing 20 to 30 per cent soy. These soy-based compounds can be used to create components and levers for car seats, interior panels and storage compartments.

The petroleum products currently used by the auto industry are non-renewable. And given today's unpredictable, ever-fluctuating oil prices, soy oil and fibre can be an economically sound and environmentally friendly alternative for carmakers, says Misra.

In addition, soybeans are widely cultivated in Ontario, the heart of manufacturing in Canada. That gives soybean producers a natural advantage.

"Soybeans are a cheaper, more sustainable source of industrial material, and it takes significantly less energy to turn them into usable parts," she says. "Applying this resource to the automotive market will open doors for producers."

To create this market, the researchers first had to learn which soybean oils were most suitable for making hard plastic and foam. Plant agriculture professor Istvan Rajcan tested the fatty acid oil qualities of 15 genetically modified and conventional soybean varieties.

From there, Misra and her team were able to create an epoxy resin from the soy oil, then test it using vacuum-assisted resin transfer moulding, which uses air pressure to compress the epoxy resin over layers of strong biofibres, then shape it into an auto part.

The fibres give the plastic strength while the epoxy holds the fibres together and properly distributes weight and stress throughout the finished part.

Misra and her team want to eventually replace the maximum amount of synthetic compounds, but she says parts made from 100 per cent soy oil are still a work in progress. For the time being, however, the researchers have found that using soy stalk fibre as reinforcement is further increasing the total amount of soy component in the final biocomposite plastic to as much as 70 per cent.

"Functionalized soy oil itself just doesn't have the structural integrity of synthetic products, so using too much can cause weakness," she says. "But at the same time, 20 to 30 per cent is still very beneficial environmentally and economically to producers and the auto industry. We can only improve from here."

■ Funding for this project is provided by the OMAFRA–U of G Partnership. Additional funding is provided by Grain Farmers of Ontario and the Manitoba Pulse Growers Association.

PHOTO: ISTOCK

Big applications

Versatile, environmentally friendly corn particles could serve many purposes

BY NATALIE OSBORNE

Ontario cornfields could one day be the source of not only food, feed and fuel but also eco-friendly paints, age-defying super-moisturizers and non-toxic drug treatments — all thanks to tiny particles discovered in a University of Guelph lab.

The particles are sugar polymers — sugar molecules bonded together. Their unique properties make them a promising platform technology with myriad applications. Researchers are generating these revolutionary new particles from Ontario corn.

They say the particles could serve as non-toxic, biodegradable replacements for engineered nanoparticles or petroleum ingredients. This could make any product more environmentally friendly, be it paint, cosmetics or even biomedical treatments.

"The way the sugars are arranged gives them unique physical and chemical properties," says physics professor and project leader John Dutcher. "There are enzymes within the body and within the environment that can naturally break down these particles, so you don't have to worry about them building up in the environment."

Like many scientific discoveries, the particles were created by accident. One night, a post-doctoral researcher was performing a complicated chemical procedure for an unrelated physics and microbiology project. He noticed that the waste product looked peculiar, so instead of throwing it out, he put it on a shelf. The post-doc was Anton Korenevski, now a research associate in Dutcher's Polymer Surface and Interface Group.

Eventually, Dutcher and his team took a closer look at the mysterious substance, using high-magnification microscopes. They were amazed to see perfectly rounded, uniformly sized spheres.

They're so tiny, it would take half a billion particles to cover the head of a pin. Because they're all the same size and have uniform surface chemistry, they are easy to modify for almost any use. To pave their way into greener paint products or safer medical tests, researchers must optimize the particles' natural renewable source — southwestern Ontario corn.

Originally the particles were made from another, less readily available biomass, but researchers discovered a way to produce them from corn sugar. Dutcher and his team are now working with OMAFRA corn specialist Greg Stewart to determine which corn varieties and harvesting practices yield the most particles. Last year, they harvested 200 kilograms of kernels and analyzed the particles produced.

For some varieties, the particle content was very high — up to 25 per cent by mass of the weight of the corn kernel. Researchers also evaluated the physical and chemical features that make the particles unique.

One of those features is a remarkable ability to retain moisture, says Dutcher. This makes the particles a good candidate for use in cosmetics and personal-care products, an industry that generates $300 billion a year internationally. In fact, the particles retain moisture much better than the ingredients used in current high-end moisturizing products, he says. The market for personal-care product ingredients alone is expected to grow to $8 billion by 2014.

Because the particles are made from natural sugars, they could replace synthetic, potentially toxic particles used in biomedical applications, says Dutcher. The sugar particles could be modified to act as what are called delivery vehicles, carrying drugs or diagnostic agents to target sites throughout the body.

In addition, solutions of the particles are highly efficient at scattering light, which makes them attractive ingredients for paints and cosmetics, where they could replace petroleum-based components, he says.

And unlike regular starch-based products, the particles have very low viscosity in solution.

"Think of the particles as hard spheres," says Dutcher. "In water, they act like billiard balls, bouncing off one another without sticking. This means you can add a large amount to a solution before it becomes a gel, which is useful if they need to be piped around a factory."

He and his team have named them PHYTOSPHERIX™ polysaccharide particles. A start-up company, Mirexus Biotechnologies Inc., was created to guide their marketing and production.

Pilot trials have advanced the manufacturing process from lab to industry scale, successfully producing about 70 kg of particles under food-grade conditions and ready for sale. Researchers are working with potential customers to tailor the particles for specific applications.

- Late microbiology professor Terry Beveridge was co-collaborator on the original project. Other team members include Korenevski and Erzsebet Papp-Szabo.

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

PHOTO: MARTIN SCHWALBE

for small molecules

…all from Ontario corn

Prof. John Dutcher holds corn-derived sugar polymers that could be used as a main ingredient in various consumer products and pharmaceuticals.

Here's a sweet deal

Converting farm biomass sugars into consumer goods will help environment, consumers, farmers

BY ANTHONY NGAI

Natural sugars drawn from farm biomass such as cornstalks, soybean husks, tree stumps and woodchips could one day be used to create environmentally friendly consumer goods, says a team of University of Guelph researchers.

Prof. Marcel Schlaf of the Department of Chemistry has found that these biomass sugars hold great potential to become substitutes for fossil fuels and other synthetic chemicals currently used to produce everything from household electronics to furniture and office supplies.

Biomass sugars can also be transformed into highly valuable chemicals that could be used to power factories, homes, businesses and even city-wide transportation systems, says Schlaf.

"It's very hard to produce consumer goods that are environmentally friendly and cheap, but we are working towards achieving the building blocks for these products."

He and his research team know that to make biomass sugars useful, they need to start small by changing the sugars' molecular structure to create a substance similar to crude oil.

This involves transforming biomass sugars by reducing their oxygen content — also known as deoxygenation — a key process in making them usable for the chemical and fuel industries. That way, the sugars don't react with each other or other chemicals during the manufacturing process.

Currently, the ability to convert biomass into useful chemicals is limited, says Schlaf, but once the process is refined — probably over the next decades — high-capacity biorefineries will be able to convert large amounts of biomass into chemicals to fit a variety of demands.

Manufacturing consumer goods and fuels from biomass sugars will be cleaner and cost-effective, with fewer natural resources being harvested, he says. Consumers may see cheaper consumer goods and lower fuel prices, and farmers will have another way of turning their agricultural wastes into fuels to sustainably power their own farm equipment and operations.

"We should move towards a system where we use non-edible biomass for the production of fuel and consumer goods because it's cheaper, more environmentally friendly and sustainable," says Schlaf. R

- Collaborators on this research include students and staff in the Department of Chemistry.
- Funding for this project is provided by the OMAFRA-U of G Partnership.

PHOTO AND ILLUSTRATION: THINKSTOCK

Tobacco goes pink

Using tobacco plants to help fight cancer

BY KATHARINE TUERKE

Prof. Chris Hall and research assistant Kenny So are modifying tobacco plant genes to produce low-cost cancer-killing antibodies.

Tobacco is notorious for causing cancer, but now it's helping to fight it.

Tobacco plants are being modified to create a biosimilar version of the breast cancer antibody trastuzumab (trade name Herceptin), which stops tumours from growing and encourages the body's immune system to attack. The low-cost alternative antibody is being positioned as a product that can help cut healthcare costs, particularly when Herceptin's patent expires in three years.

Trastuzumab made using tobacco plants is slated to be on the market in 2016. Scientists have just completed testing in mouse models and found that the plant-based antibody was as effective in reducing the size of breast cancer tumours as the animal-based Herceptin.

Prof. Chris Hall of the School of Environmental Sciences at the University of Guelph developed the recombinant antibody technology used to create the plant-produced antibody. A Guelph firm, PlantForm, is licensing this technology, which would see tobacco plants serve as a host for the production of therapeutic antibodies.

"Traditionally it costs $450 million to produce 5,000 litres of an animal-cell-based antibody," says Hall. "We can build a 12-acre facility with equipment and equivalent amount of antibody for $80 million."

Typical drug production involves using bioreactors such as large fermentation chambers to grow organisms such as bacteria and yeast, which are used to produce antibodies or vaccines. But PlantForm uses tobacco plants as a substitute bioreactor by genetically engineering its plants to include genes that make the antibody.

Tobacco plants are used for several reasons. Their molecular biology and genetics are well understood, and they have the same cell system as humans. They're also economical to grow because they can produce large quantities of antibodies on a small footprint. And because tobacco plants aren't part of the food chain, there's no danger of spreading bacteria into the food supply.

"Using tobacco plants as bioreactors produces life-saving antibodies faster, more easily and more cheaply than traditional systems," says Hall.

Here's how the process works. As the tobacco plants grow (in controlled-environment greenhouses), scientists cultivate a bacterium that transfers the antibody's genetic information into the plants. Each plant is dipped in the bacterium, then a vacuum is used to push it into the plant. Within eight days, the antibody is expressed in 90 per cent of the plant. Harvest follows.

With the mouse-model testing now complete, the next step is to put the antibody through human clinical trials.

From this current work, Hall and his team also plan to develop several low-cost plant-made alternative antibodies designed to combat colorectal cancer, head and neck cancer, and HIV/AIDS. R

- Hall holds the federally funded Canada Research Chair in Recombinant Antibody Technology.

- Funding for this project was provided by the OMAFRA–U of G Partnership. Additional funding was provided by the Natural Sciences and Engineering Research Council, Ontario Centres of Excellence and the National Research Council of Canada Industrial Research Assistance Program.

PHOTO: MARTIN SCHWALBE

Healthier starches for everyday diets

Guelph researchers seeking ways to mass-produce 'resistant' starches

BY JOEY SABLJIC

The way to a healthier population is through its stomach. And for many, that journey starts and ends with starch, an essential carbohydrate that makes up about 75 per cent of people's daily calorific intake.

That's why University of Guelph molecular and cellular biology professors Michael Emes and Ian Tetlow have partnered with Maple Leaf Foods to create a natural supply of healthier "resistant" starches that can be incorporated into the diet through baked goods.

"Starch makes up so much of people's everyday diet, we can have a major impact with resistant starches and promote healthier eating," says Tetlow.

Unlike regular starches, resistant starches don't break down quickly in the small intestine — they "resist" the digestive process. This means their sugars aren't absorbed as rapidly into the bloodstream and don't raise blood-sugar levels. That can help reduce the risk of Type 2 diabetes, a disease that's becoming all too common in younger Canadians.

Resistant starches also carry their benefits to the lower gut, where they can provide a source of energy for beneficial gut bacteria, which help maintain a healthy colon and reduce the risk of colorectal cancer.

The main sources of starch in the diet are cereals such as wheat and corn. Emes and Tetlow are trying to understand how a corn plant's genes and enzymes — its inner starch-production factory — work together to create resistant starches. They're hoping this will eventually enable them to naturally breed corn plants that produce resistant starch.

Researchers are incorporating healthier "resistant" starches into breads and other baked goods.

Tetlow says local growers could reap major benefits from growing resistant-starch corn plants to supply a rising demand in the food industry.

The researchers know, however, that the ultimate success or failure of resistant starches comes down to taste, which is why they're also working with Maple Leaf Foods to make sure the resistant starches translate into tasty, appealing foods.

"We're trying to change starches in ways that are more useful," says Emes. "For many people, it's got to be the same texture, it's got to have the same taste, but at the same time, it needs to be better for you."

- Also involved in this work are Profs. Emma Allen-Vercoe of the Department of Molecular and Cellular Biology, Elizabeth Lee of the Department of Plant Agriculture and Alison Duncan of the Department of Human Health and Nutritional Sciences.
- Funding for this project is provided by the OMAFRA–U of G Partnership. Additional funding is provided by Maple Leaf Foods.

TOP PHOTO: ISTOCK · CORN: THINKSTOCK

Mite-killing fungi protect honeybees

Pollinators' $1-billion contribution to agriculture in jeopardy

BY KATY JONKER

Declining honeybee populations are being blamed in part on the *Varroa destructor* mite, a parasite that's wreaking havoc on Ontario's natural pollinators.

It's a big problem because honeybees are credited with anchoring the estimated $1-billion portion of the agricultural sector that depends on insect pollination every year.

Over the past five years, honeybee population losses in hives across North America have been as high as 37 per cent. To address this problem, Alice Sinia, a PhD entomology student at U of G, is working with Prof. Ernesto Guzman, School of Environmental Sciences, on an environmentally friendly pest-control method centred on naturally occurring insect-killing fungi.

Sinia says developing technology that can help save honeybees is critical for preserving the health of crops that feed livestock and humans. Because so many agricultural products rely on crop pollination, "helping the bees is like helping ourselves," she says.

Varroa mites are about the size of a pinhead, button-shaped and reddish-brown in colour with eight legs. They attach themselves to bees and feed on the hemolymph ("bee blood"). Often, several mites will feed on a bee, larva or pupa at the same time.

If not treated, varroa mite infestations can wipe out entire colonies.

In recent years, the mites have developed widespread resistance to pesticides such as acaricides, typically used by beekeepers to protect their hives. So Sinia and her team are trying new approaches with insect-killing fungi species.

Many of these fungi have already been used in other agricultural sectors but never in beekeeping. Like other fungi, they produce spores that infect the mite by penetrating its exoskeleton. Once inside the mite's body, the fungi grow and destroy the pest from the inside.

In a laboratory, the researchers evaluated 10 fungal isolates from three fungi species to determine which were most effective against the mite. They found that each isolate caused significant mite mortality. The next step was to select the most effective isolate from each species for further evaluation in the lab and field.

The researchers are now studying the fungi for any negative effects on honeybee adults and broods. They also want to determine which isolates are the best at forming spores and best-suited for the transfer and application techniques beekeepers would use.

Sinia says healthier, fuller colonies will mean more return for beekeepers' honey and less time spent maintaining hives.

"We need the final product to be easy to use so that beekeepers can utilize our research as quickly and easily as possible," she says.

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

Natural fungi are being used to protect bee colonies from devastating varroa mite infestations.

PHOTO: ISTOCK

A BOLD approach

DNA barcoding could help Ontario's greenhouse industry control unwanted pests

BY NATALIE OSBORNE

Ontario has one of the largest greenhouse sectors in the world, producing flowers, fruits and vegetables that are sold across Canada and internationally. But if agricultural pests accompany the products, they'll be refused at foreign borders. These invasive "quarantine" pests are known to interfere with production and even compromise human health.

That's why University of Guelph professor Robert Hanner, associate director for the Canadian Barcode of Life Network, is using DNA barcoding technology to identify and track harmful greenhouse pests.

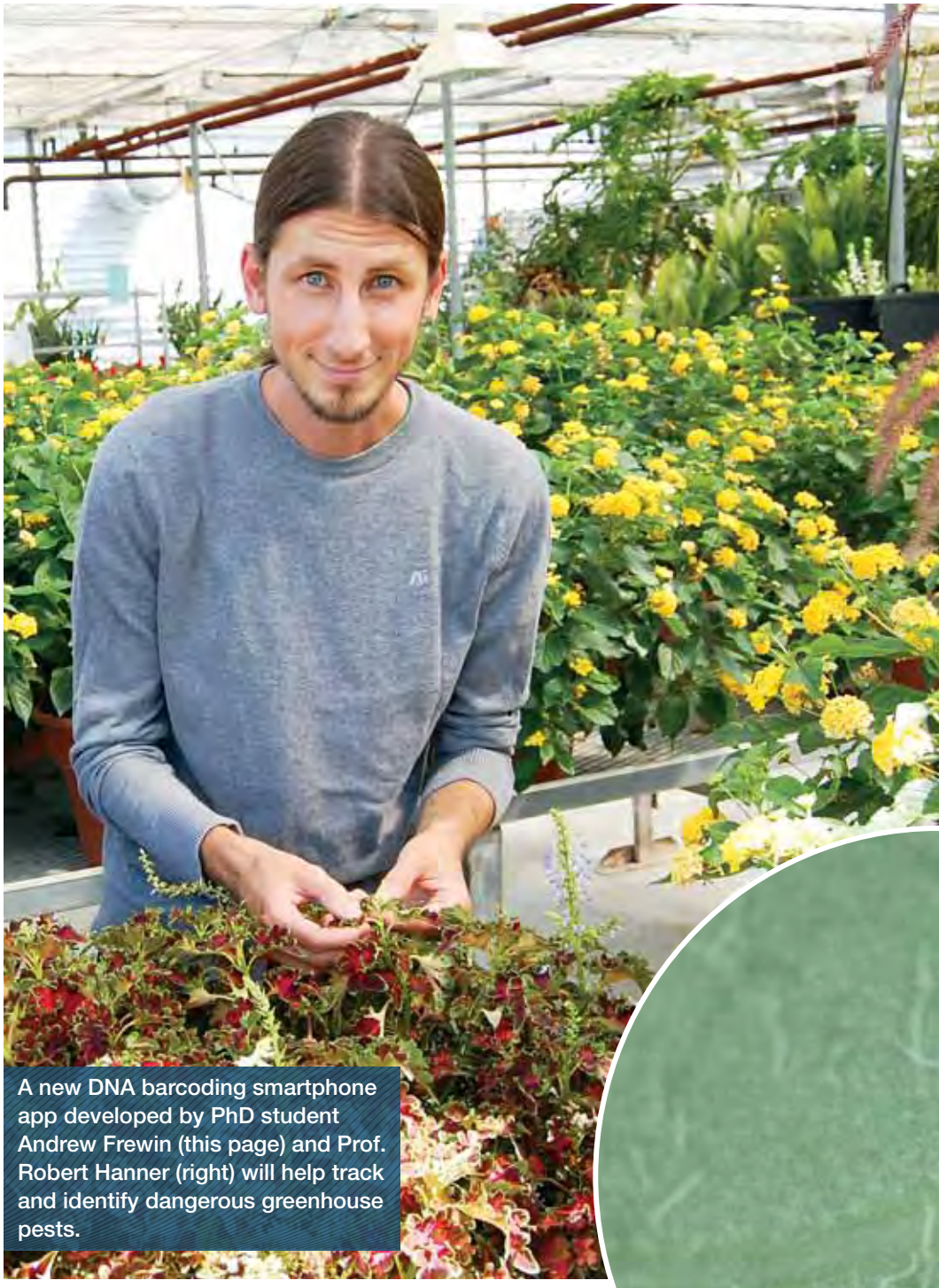
Barcoding uses short standardized gene sequences to classify and catalogue species in the Barcode of Life Data System (BOLD).

Researchers are genetically profiling expert-identified specimens of varied pest species to build a barcode "reference sequence library" of greenhouse pests and the parasites that prey on them. Once complete, it can be used as a surveillance tool to identify invasive and harmful insects. Many Ontario greenhouses bring in plant segments, or "cuttings," from international sources to propagate and distribute across Canada. Without rapid and accurate screening methods, producers could unknowingly bring in quarantine pests along with the cuttings.

"Our greenhouse sector has grown so large and diversified that greenhouse complexes can act as 'island habitats' where exotic and quarantine pests can establish and potentially travel between different commodities," says Hanner.

His student Andrew Frewin has developed a method of barcoding insect remains recovered from cuttings.

When it comes to emergency pest management, knowing where and when a specimen was found is just as important as determining what it is. That's why researchers developed the smartphone application "DNA Barcoding Assistant." This app gives researchers vital information about a specimen before it reaches the lab.



A new DNA barcoding smartphone app developed by PhD student Andrew Frewin (this page) and Prof. Robert Hanner (right) will help track and identify dangerous greenhouse pests.

to pest control

Greenhouse pest managers collect unknown insect samples in special vials, each labelled with a unique QR code. They scan this code into the app, which automatically captures the date, time and location where the specimen was collected and allows them to take a photo of it. All this information is then linked to the specimen on BOLD.

Because the app provides crucial information about the collected specimen, epidemiologists can pinpoint and track a potential pest invasion, helping to predict where and how it may spread.

"With BOLD we can provide OMAFRA with a secure online database containing the identity and location of pest and quarantine species," says Hanner. "This information can be archived and monitored to prevent potential outbreaks."

Currently, greenhouse pest managers rely on visual clues to identify pests. But recognizing them throughout the various stages of their life cycle is challenging. Pest managers often have no way to tell the beneficial insects from the potentially harmful and may spray pesticide as a precaution.

Unnecessary pesticide use can cost producers money, contribute to pesticide resistance and increase the risk of exposing consumers to unwanted chemicals.

"One of the things that make DNA barcoding so powerful is its ability to identify pests in any life stage," says Hanner. "Since there's DNA in every cell of every organism, we can easily identify eggs, larvae or even fragmentary remains."

Barcoding can also confirm the identity and efficacy of "biocontrol" agents — beneficial insects that naturally prey on greenhouse pests. This is done by barcoding the insects' stomach contents to make sure they're eating the pests.

The ability to reconstruct food webs in greenhouses helps researchers understand the pests' invasion dynamics and is one more way barcoding technology can improve productivity in Ontario's greenhouse industry.

- Graeme Murphy, an OMAFRA greenhouse floriculture integrated pest-management specialist, is collaborating on this research.
- Funding for this project is provided by the OMAFRA–U of G Partnership. Additional funding is provided by Flowers Canada Ontario.

PHOTOS: SAMANTHA BEATTIE

PARTNERS FOR

IMPROVING COMPETITIVENESS AND PRODUCTIVITY

Robots get a grip on greenhouse produce

Intelligent vegetable-harvesting robots could emerge as a revolutionary technology for the Canadian greenhouse industry. U of G researchers say these machines have the potential to decrease labour costs by up to 70 per cent, improve the market quality of vegetables and enhance the supply chain, giving Canadian greenhouse growers a competitive edge.

Engineering professors Medhat Moussa and Hussein Abdullah have created what they call the Guelph Intelligent Greenhouse Automation System (GIGAS). Paired with a robotic manufacturing arm, GIGAS can identify and pick ripe tomatoes, as well as perform de-leafing and pruning operations. This cuts down on plant waste dramatically and boosts vegetable quality.

GIGAS works by mimicking a human arm's movement. A special "gripper" with three aluminum and steel fingers moves in a pinching motion to pluck tomatoes, while three palm-sized cameras work together to guide the arm towards the ripest tomatoes.

The researchers believe GIGAS could soon help position Canadian greenhouse growers as an increasingly reliable, attractive source of produce.

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

Two-stage weaning reduces calf stress, boosts productivity

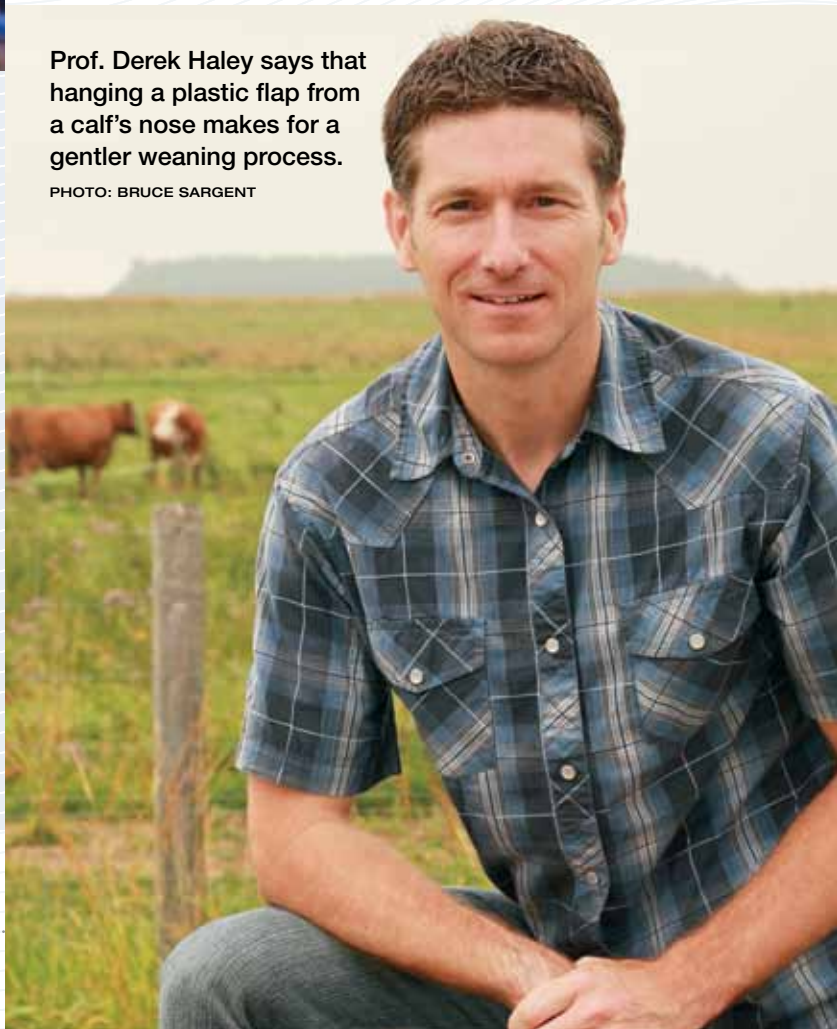
A simple plastic nose flap may revolutionize the way beef cattle are weaned.

By hanging the flap from a calf's nose, producers can significantly reduce many of the problems associated with traditional weaning methods, such as bawling, pacing and reduced feed intake.

U of G population medicine professor Derek Haley says the device offers a more gradual, less stressful alternative for weaning compared with the traditional approach of abruptly separating a calf from its mother.

The nose flap is simple and humane. It blocks the calf's mouth when it reaches for its mother's teat but doesn't interfere when the animal lowers its head to graze or feed. This means the calf can continue to benefit from being close to its mother. Later, when the two are separated, the flap is removed.

Haley says reducing stress as much as possible during the earliest stages of an animal's life will make for a more productive animal with significantly fewer health-related problems as it grows and develops.



Prof. Derek Haley says that hanging a plastic flap from a calf's nose makes for a gentler weaning process.

PHOTO: BRUCE SARGENT

PROGRESS

Ontario

University of Guelph
Changing Lives Improving Life

OPEN FOR BUSINESS AND NEW MARKETS

The Ontario Food Terminal provides opportunities for ethnocultural vegetable farmers such as Rosario Riga to market their produce.

Connecting the huge ethnic vegetable market with buyers

For Ontario's diverse ethnocultural vegetable producers, one of the greatest challenges is integrating into the market. That's where the Ontario Food Terminal comes into play. As the primary distribution centre for the Greater Toronto Area, this hub provides crucial connections for more than 3,000 produce buyers and sellers.

Ethno-Cultural Vegetables Ontario (ECVOntario) researchers, led by U of G environmental design and rural development professor Glen Filson, have found the terminal is a main key to fulfilling what they have identified as a $61-million-a-month opportunity for Ontario farmers.

Two of the terminal's advantages are price and quality. Local produce helps lower transportation costs by more than 75 per cent for consumers. And then there's freshness—produce at the terminal is often sold the same morning it's harvested.

Filson and ECVOntario researchers plan to continue helping farmers work closely with the Ontario Food Terminal to offer a concentrated, safe and fresh supply of locally grown produce for the marketplace.

Breeding to beat the bottom line

Bacterial cold-water disease, caused by the bacterium *Flavobacterium psychrophilum*, is a deadly condition that hurts production for Ontario rainbow trout farmers. No commercial vaccine is available, and aquatic veterinarians have a limited repertoire of antimicrobials to manage disease outbreaks.

This disease presents an economic challenge because its biggest impact is on fish weighing less than five grams, and the value of such fish is low. That means treatment must cost less than the fish is worth.

A cost-effective, practical solution to the problem is to breed for disease resistance, says U of G pathobiology professor John Lumsden.

Lumsden is trying to identify fish with greater resistance to the disease. To do so, he introduces the disease agent to specific "families" of fish and assesses their resistance. He hopes this approach will aid the Ontario agri-food sector by providing tools to reduce antimicrobial use, while minimizing the economic impact of a major production-limiting disease.

INCREASING CONSUMPTION OF LOCAL FOODS

More local food for Ontario hospitals

Bringing more locally produced food into Ontario hospitals and long-term-care facilities could be the basis for fresher meals and improved patient care, say University of Guelph researchers.

But tight budgets, concerns about food-safety regulations and limited availability prevent many hospital food-service managers from buying more from local farmers and producers. Instead, they tend to stick with conventional big food suppliers, which they believe offer larger, cheaper and more consistent quantities.

Profs. Paulette Padanyi and Vinay Kanetkar of the Department of Marketing and Consumer Studies are leading a team dedicated to finding ways to increase consumption of local food across Ontario's health-care system by 20 per cent by 2015.

They say current production and storage technologies make local produce, meat and dairy available in large quantities year-round, which will create a fresh and consistent food supply for hospitals going forward.

PHOTO OF ROBOTIC ARM: BRUCE SARGENT · ETHNOCULTURAL VEGETABLE PHOTO COURTESY OF BRUCE NICHOLAS · RAINBOW TROUT: DAVID BEVAN · HOSPITAL: THINKSTOCK

Mobilizing regional reso for rural development

BY SAMANTHA BEATTIE

New regionalism may be the way forward for rural economic development in Ontario, say researchers.

Rural communities can gain strength by working regionally, bringing together more diverse interests, resources and expertise than would be possible if they worked individually, say University of Guelph rural planning and development professor John Devlin and University of Waterloo environmental management professor Tara Vinodrai.

Some U.S. states and Canadian provinces are already incorporating regional strategies into their rural planning to mobilize resources, to meet a variety of interests and to ultimately create self-sustaining communities. Now, with support from OMAFRA, Devlin and Vinodrai want to learn how increased regional development can be successfully implemented in rural Ontario, too.

"There's a lot of optimism about the potential success Ontario could have implementing regional strategies, so we want to find examples showing how successes emerge in practice," says Devlin. "Our primary goal is to provide ideas that can eventually inform governmental policy."

He says regional collaboration could result in more financial resources and expertise. These resources could go towards anything from pursuing new businesses or co-operatives for job creation to offering more health and education services — whatever's needed to take advantage of a region's unique resources, endowments and features.

Such grassroots collaboration may also mean that people from many organizations have a vested interest in the region's development, increasing their dedication and the project's chances for success, Devlin says.

He and Vinodrai are looking at six case studies — food systems in California's Sacramento Valley and British Columbia's Okanagan Valley, regional development agencies on Vancouver Island and Nova Scotia's Cape Breton Island, and innovation networks in North Carolina and Ohio.

For each case study, the team will analyze multi-level collaborations. For example, provincial or municipal governments could be working with regional authorities, non-governmental bodies or industry partners.

Devlin says Ontario is in the early stages of considering a

urces

regional development strategy. Although regional municipalities and ministries exist to promote regional programs, there isn't a provincial regional policy in place.

"The hope is that, by analyzing these examples, we will find very specific regionally located initiatives," he says. "It's not about having general programs that do the same things everywhere, but rather about stimulating lots of different efforts to generate regional economic development in many different ways."

- Also involved in this project are University of Waterloo professors Paul Parker, Steffanie Scott and Amelia Clarke.
- Funding for this project is provided by the OMAFRA–U of G Partnership.

PHOTO: ISTOCK

Researchers say that anaerobic digesters such as the ones pictured are best for larger-scale dairy farms. PHOTO: THINKSTOCK

More bang for your muck

BY ANTHONY NGAI

A movement is afoot towards more sustainable production methods and reduced waste in farming. Equipment such as anaerobic digesters that convert manure and other organic farm waste into usable energy are being touted as a solid investment.

Now, a new study out of U of G finds that anaerobic digesters do make economic sense — but only for farmers with larger operations.

Master's graduate Robert Anderson, along with Profs. Alfons Weersink of the Department of Food, Agricultural and Resource Economics and Don Hilborn of OMAFRA, is looking at the costs and benefits of building anaerobic digesters on various-sized dairy farms. Anaerobic digesters can reduce the odours emitted by farm waste and lessen the environmental impact of production.

But along with the benefits come costs.

"Anaerobic digesters are more common in the developing world because they convert farm waste into energy that provides fuel for heating and cooking," says Anderson. "But in Canada, they are very expensive to build because of the scale and complexity necessary for electricity production."

The research team used data provided by OMAFRA and the Agri-Energy Producers' Association of Ontario to calculate the net profit a farm could make by using anaerobic digester technology. They found that dairy farms in general tend to reap the most benefits, particularly if they have more than 600 cows.

That's because manure from dairy cows produces more energy with an anaerobic digester than manure from other livestock does. And with a bigger supply of animal waste at their disposal, larger operations can quickly recoup their initial investment through energy production and utility savings.

For smaller operations, anaerobic digesters aren't financially feasible because of the large initial capital investment required, says Anderson. Plus, the technology isn't advanced enough to produce a sustainable amount of energy from small amounts of farm waste, he says.

Just 10 anaerobic digesters are currently operating in Ontario, but they're gaining in popularity, with 20 more being built to accommodate the growing demand.

Anderson and his colleagues have created an online tool to help farmers determine whether an anaerobic digester is a worthwhile investment for their own operation. Using production information provided by a farmer, the tool calculates the estimated potential net profit from energy sales compared with start-up and operating costs. The tool can be found at bioeconproject.com.

- Collaborators on this research include OMAFRA biogas systems program analyst Chris Duke; Prof. Bill Van Heyst, School of Engineering; Prof. Getu Hailu, Department of Food, Agricultural and Resource Economics; and Prof. Claudia Wagner-Riddle, School of Environmental Sciences.
- Funding for this research is provided by the OMAFRA–U of G Partnership.

A chicken-and-egg solution

Enriched cages are cost-effective way to improve welfare of laying hens

BY KATY JONKER

From left, graduate students Jeanine Santos Da Silva and Michelle Hunniford, research assistant Linda Caston and Prof. Tina Widowski are assessing "enriched" cages, which can improve animal welfare and keep production costs down.

Legislation and retailer trends surrounding conventional caging systems for laying hens are changing globally. There's more emphasis on animal welfare, while keeping up with market demands.

In response, U of G animal and poultry science professor Tina Widowski and her research team are assessing a more economical and sustainable housing alternative for hens.

They call them enriched or "furnished" cages because they give hens a more liveable and spacious alternative to the smaller "battery cages" that are commonly used.

"If you compare the different systems, furnished cages seem to be the most economically viable alternative, as well as one that really supports bird welfare," says Widowski.

She notes that new enriched caging systems offer increased space per hen and other features — such as perches, a nesting area and a scratch mat — that let birds exercise natural behaviours. At the same time, the birds are still contained enough to allow farmers to closely manage their health and nutrition.

Alternative housing systems for poultry vary in production costs. Non-cage systems such as free-range and free-run provide the most space and opportunities for hens to exercise, nest, scratch and dust-bathe, but they can drive up production costs. Free-range systems put birds in a more natural environment outdoors, but because of Canada's cooler climate, time outside is limited and production can be lower.

Layered aviary systems with multiple tiers furnished with feeders, drinkers and nests on each level provide better freedom of movement for larger flocks, but hens are at higher risk of injury from other birds and can fall from upper tiers. And because the birds are in close quarters, disease and pecking outbreaks can spread faster and be more difficult to contain. Plus, in all non-cage systems, feed costs are higher because exercise uses up energy that would otherwise go into eggs.

A big challenge is keeping the cost of production in line, says Widowski. Figures from Europe, where enriched caging has been widely adopted in commercial production, show that allotting more space to birds boosts production costs by eight per cent. But it also results in healthier, more productive hens, she says.

The researchers are now housing various numbers of hens in small and large versions of the enriched cage to measure how space allowances and group numbers affect egg production and bird welfare.

They're also rearing chicks in standard cages and in a rearing aviary to determine the best way to raise them for the system and to get the birds used to the new environment.

So far, says Widowski, egg production has been on par with that obtained in conventional cages, and most hens are adapting well to the new environment. The team hopes for lower mortality rates and less feather pecking and stress among the birds, compared with when they are cageless and kept in large groups.

Results of the study will be available to producers by 2013 and will be presented at producer conferences, research days, public lectures and the annual general meetings of Egg Farmers of Canada and the Poultry Industry Council.

Helping tomatoes fight disease naturally

Researchers manage bacterial disease by tweaking immune response

BY KATHARINE TUERKE

Master's student Rochelle Tazhoor and Prof. Paul Goodwin are testing plant defence activators that will help tomatoes fight diseases from the inside out.

Tomatoes are highly susceptible to bacterial diseases, and few options are available to control the problem. Copper bactericides are currently used, but these may fail if the diseases become too severe or if the bacteria can tolerate copper. Soon, however, tomato plants may be able to fend for themselves against bacterial diseases such as speck and spot without the help of conventional pesticides.

University of Guelph environmental sciences professor Paul Goodwin, plant pathologist Cheryl Trueman and master's student Rochelle Tazhoor are testing how different plant defence activators improve the management of bacterial diseases.

"Turning up the plant's immune response before the pathogen attacks helps the plant build a faster, stronger resistance to disease," says Goodwin. "Our goal is to develop a comprehensive package for producers on how to efficiently use defence activators to control speck and spot under Ontario's growing conditions."

Plant defence activators work something like vaccines in animals—they trigger resistance against disease. The activators crank up the plant's natural immune response by tricking it into perceiving that it's being attacked. If the plant is later infected by bacteria, it already has some defences ready, which will limit pathogen spread and reduce disease symptoms.

"Boosting the plant's own resistance will provide all tomato farmers, but especially organic farmers, with a new approach to controlling bacterial speck and spot," says Goodwin.

In the lab, he and Tazhoor inoculate tomato plants with bacteria about a week after the plants have been treated—or not treated—with a defence activator. Then they count the number of lesions per leaf to see how much disease has developed. They're also examining the effect of various application methods and concentrations of defence activators, and they want to know if altering a tomato plant's defence system will translate into changes in its gene expression.

In addition, the researchers are investigating how well defence activators control speck and spot in the field.

Trueman is in the final year of a three-year study comparing the use of defence activators in tomato plants with the traditional control method of applying copper bactericide alone. So far, the results show that defence activators may be a promising alternative. No reductions in tomato yield or quality have been observed.

Funding for this project was provided by the OMAFRA–U of G Partnership. Additional funding was provided by Syngenta Crop Protection Canada and the Ontario Tomato Research Institute.

Also working on this project are population medicine professor Michelle Guerin, animal and poultry science professor Steve Leeson, Stephanie Torrey of Agriculture and Agri-Food Canada, Leanne Cooley of Gray Ridge Egg Farms, research assistant Linda Caston, and graduate students Michelle Hunniford, Eugenia Herwig and Jeanine Santos Da Silva.

Funding for this project was provided by the OMAFRA–U of G Partnership. Additional funding is provided by Egg Farmers of Canada, the Poultry Industry Council and Clark Ag Systems/Farmer Automatic.

PHOTOS: KATHARINE TUERKE

Don't wait for weeds

Use pre-emergent crop protection to fight weed stress

BY ANDREA SECCAFIEN

Prof. Clarence Swanton says producers need to get the jump on weeds by applying herbicides early.

The effort it takes for corn and soybean plants to beat weeds can leave them weak, discoloured and more vulnerable to other environmental stressors such as drought. Commercial crops don't need that kind of competition, and producers don't want to lose any of their yield potential or profits.

To help crops out, University of Guelph plant agriculture professor Clarence Swanton is leading a research program with Profs. Lewis Lukens and Elizabeth Lee to understand how corn and soybeans change their physiology when weeds are nearby.

Research leading up to this project showed that corn and soybean plants can detect weeds growing around them with no physical contact, through what's known as light signalling.

When a weed invades a plant's growing space and sunlight, the plant reacts by changing the growth rate and structure of its root system. Energy that would normally be used for root growth is instead diverted to the plant's stem to push itself above the invading weeds.

As a result, the plant is weakened because the underground support from the root system — something that's vital for stress tolerance — is no longer enough to help the plant withstand environmental or pest-related problems.

To avoid this, producers should do early weed control, says Swanton. Applying pre-emergent herbicides at the seedling stage (rather than when the weeds have already taken hold) allows plants to grow stronger, he says.

"Some farmers wait to spray weeds, but our data suggest that they're changing the yield potential by the minute the longer they wait to spray."

Indeed, a plant's growth trajectory is changed every time it's exposed to stress, he says.

"Exposing crops to stress is a slippery slope, with every stress shifting a plant closer to its breaking point. A single stress doesn't affect yield potential on its own, but a buildup of stresses makes the plant more vulnerable to damage or collapse."

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

INSET PHOTO: ANDREA SECCAFIEN
BACKGROUND PHOTO: THINKSTOCK

Take out the trans

This soybean oil eliminates trans fat in pastries

BY ANDREA SECCAFIEN

Puff pastries such as croissants and danishes get their characteristic melt-in-your-mouth fluffy layers of dough from the properties of harmful trans and saturated fats, which have been shown to increase the risk of cardiovascular heart disease. Now, University of Guelph researchers are swapping out the trans fats with a heart-friendly, cost-effective and tasty alternative.

Food science professor Alejandro Marangoni and post-doctoral research associate Nuria Acevedo are working with General Mills to develop healthier fully hydrogenated fats from locally grown soybeans. These fats could replace the trans-fat-heavy shortening (also called laminating fat) currently used in puff pastries.

There's a catch, however. For this soy-based fat to work in pastries, it needs to have just the right structure and texture. Fat itself is made up of liquid oil and countless tiny crystals clustered into bunches. The liquid oil is trapped inside by a sponge-like network of the crystals. This helps the fat maintain its shape and be usable in baked goods.

"We focus on structuring liquid oil in improved conventional and non-conventional ways, without the use of trans or saturated fat, to give it body and improved nutrition," says Marangoni.

Puff pastries can contain up to one-third fat coming from the large amounts of partially hydrogenated oil or saturated fats traditionally found in laminating fat. Partially hydrogenating oils produces a harmfully high content of trans fatty acids, but it creates a perfectly structured semi-solid fat ideal for laminating fats.

If fully hydrogenated and liquid soybean oil were used, the laminating fat would not contain any trans fat. In addition, the saturated-fat content would be reduced by half. Better still, it would provide the required texture and functionality.

Marangoni knows the food industry and consumers won't accept an expensive alternative to trans fats. That's why the ingredients and techniques used to produce the soy-based baking fat need to be fully accessible to producers and inexpensive for consumers.

Currently, most shortening contains palm oil, but the new-found use for soybean and canola oil could benefit Ontario farmers.

The finished soy-based laminating fat Marangoni created has been tested by a Guelph bakery, with success. It's now being assessed by multinational food companies in industrial settings in Canada, Europe, the United Kingdom and Mexico.

"Using this fat in places where danishes and croissants are especially popular will help prevent heart disease and obesity by reducing the amount of trans fat consumed, without losing quality or increasing cost," he says.

■ Funding for this project was provided by the OMAFRA–U of G Partnership. Additional funding was provided by the Advanced Foods and Materials Network and General Mills.

PHOTO: THINKSTOCK

Drink to your health

Researchers are boosting antioxidant levels in milk by feeding cows organic selenium.

New antioxidant-enriched milk could reduce tumour growth

BY NATALIE OSBORNE

What if you could fight cancer with a glass of milk? Or help prevent diabetes by eating cheese?

University of Guelph researchers have developed milk enriched with the antioxidant mineral selenium by feeding its organic form to dairy cows. They say this value-added dairy product can provide a safe and organic source of antioxidants for consumers and may even stave off major diseases such as cancer and diabetes.

Animal and poultry science professor John Cant and his team are examining how selenium-enriched milk affects insulin sensitivity and tumour growth. They're feeding various doses of selenized milk proteins to animal models and have found they reduce the size and progression of breast cancer tumours.

"Selenium produces antioxidant enzymes that protect cells from damaging oxygen byproducts that can lead to cancer," says Cant. "Originally we fed it to dairy cows to protect their milk-producing cells. Now we want to see if that milk can benefit the people who drink it."

First, Cant and PhD student Scott Cieslar fed cows an organic selenium-enriched yeast with high levels of selenomethionine so the mineral would be incorporated into the milk protein itself. This makes it safer and more bioavailable for human consumption.

Graduate student Jenny Warrington fed four levels of the selenized milk proteins to mice with human breast cancer. Researchers then measured mammary tumour growth.

They found that the more selenium-enriched milk a mouse's diet contained, the smaller its tumour size. Mice fed the highest level of selenium had the smallest tumours.

With this promising effect, the researchers want to see if their selenized milk could prevent another serious disease — Type 2 diabetes.

Selenium's relationship with diabetes is not well understood. Members of the research community disagree on how selenium interacts with insulin, a gut hormone that regulates the metabolism of fats and sugars. Some studies claim the mineral improves insulin function; others find that function is impeded.

Graduate student Priska Stahel fed varying levels of selenium-enriched milk to healthy and diabetic rats. One "super selenium" level far exceeded the mineral's daily requirement. Cant and his team want to see whether this level will reduce or enhance insulin production, secretion and sensitivity. They don't have results yet, but if the selenized milk proteins do provide therapeutic benefits for cancer and diabetes, a variety of value-added dairy products could follow, including ice cream, yogurt and cheese.

Adding selenium to the diet of dairy cows can also improve udder health and milk production, according to the team's earlier work. The mineral protects the milk-producing cells in a cow's mammary glands, reducing the drop in milk production that usually occurs about 10 weeks after calving.

"Supplementing with selenium is a simple and inexpensive way for dairy producers to improve their animals' health and milk production," says Cieslar. "And it may even create a unique new dairy product that provides significant health benefits to consumers."

- Collaborators on this project include Prof. Brenda Coomber, Biomedical Sciences; Prof. Vern Osborne, Animal and Poultry Science; and Alltech Ontario technical specialist Silvio Miranda.
- Funding for this project is provided by the OMAFRA–U of G Partnership. Additional funding is provided by Dairy Farmers of Ontario, the Natural Sciences and Engineering Research Council and Alltech.

PHOTO: ISTOCK

Learning by doing

Experiential learning program trains future agri-food professionals

BY JOEY SABLJIC

Career opportunities are plentiful in the Ontario agri-food industry. A University of Guelph project just entering its third year is getting senior undergraduates ready to take advantage of those opportunities by giving them first-hand work experience.

Prof. Andy Robinson, chair of Guelph's Department of Animal and Poultry Science, is working with Joanne Handley, OMAFRA manager of sustainable production (dairy cattle, swine and poultry), on the program, which puts students to work on several OMAFRA and U of G priority agri-food initiatives.

"The students basically hit the ground running," says Robinson. "They are mentored by Guelph researchers and OMAFRA Agriculture Development Branch field staff through the whole process, and then we're able to quickly get a sense of what their strengths are."

The program is targeted at third- and fourth-year Ontario Agricultural College students and runs from May to September. Students go through an application and interview process just as they would for a regular job.

Five students are selected for the program. Over the summer, they head out into the field with their OMAFRA mentors, help review research results, assist on applied research projects and deliver information to agri-food stakeholders.

The students' project choices are as varied as the agri-food sector itself. They could be working on anything from pest control in hops and herbs to livestock management.

Funding from the OMAFRA–U of G Partnership's Knowledge Translation and Transfer Program also allows Robinson and Handley to put strong emphasis on developing communication and knowledge-transfer skills. The key role of the students is to share research findings by designing electronic materials such as online newsletters and website content and making presentations to producer groups and other stakeholders.

As for the future of their experiential learning program, Robinson and Handley hope to expand it beyond the summer and to incorporate more students.

"We're putting together the next generation of highly qualified individuals," says Handley. "We hope to be giving them hands-on experience and exposure to the many employment opportunities available to them within the agri-food industry."

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

Education, outreach put calf care at forefront

An innovative knowledge-sharing program is being developed to communicate the importance and benefits of good calf health to Ontario dairy producers.

Retired population medicine professor Ken Leslie, project manager Vivianne Bielmann and project co-ordinator Tom Wright call the program Calf-ETERIA. Leslie says that means "using calf health and productivity as a template for an evaluation of translation and extension of research information for agriculture."

Calf-ETERIA aims to identify and evaluate the best traditional and new educational methods to show producers how they can reduce treatment costs and enjoy higher milk production from healthier replacement calves.

The researchers engaged producers in two different educational activities: traditional management club meetings and web-based learning modules. The activities were intended to encourage farmers to implement, share and perhaps change their management techniques.

Followup visits with participants will allow the researchers to evaluate the effectiveness of each type of information delivery. This will give them a clearer picture of the best calf-health practices, as well as the best ways to share them with producers.

"We want to provide another way for farmers to easily access calf-health information," says Bielmann. "We also want to show how they can benefit financially through implementing this knowledge."

— Matt McIntosh

TOP PHOTO: THINKSTOCK · BOTTOM: ONTARIO FARM ANIMAL COUNCIL

Fostering food

Researchers creating toolkit to help communities develop sustainable food hubs

BY ANTHONY NGAI

With today's growing interest in the local food movement and in creating more sustainable food systems, community-based food hubs can play an important role in ensuring that Ontarians have access to fresh, safe, tasty and affordable foods.

Food hubs are collaborative partnerships built up over a number of years among community groups, government, producers, retailers and residents working to strengthen a community's food infrastructure. They currently exist in places such as Toronto, Guelph, London and Waterloo Region.

But not all communities in Ontario have the same level of support when it comes to building strong food systems. Realizing this, Prof. Karen Landman from the School of Environmental Design and Rural Development and a province-wide research team are creating a toolkit to assist communities in building their own successful food hubs, while understanding unique barriers that each community faces and how to overcome them.

"We want to help rebuild the local infrastructure between farms and consumers to create a sustainable, healthy and fair food system," she says.

According to studies by the American National Good Food Network, healthier communities and food hubs go hand in hand. People inside the hubs also have more access to fresh and affordable foods, as well as a stronger, more close-knit relationship with local producers.

Although food hubs have taken hold in more resource-rich regions of Ontario, many rural communities across the province face barriers in setting up the proper infrastructure for an efficient and sustainable food hub.

Landman says some barriers can stem from the communities' geographic location or from the lack of community capacity.

The researchers are aiming to bring down these barriers with their toolkit, to reflect the best practices and successes certain communities have experienced and how they can be adapted to others.

Community members will be able to use the toolkit by learning from other models about practices that build capacity and reflect local resources.

"This toolkit will help Ontarians to have improved access to local, fresh, nutritious foods, while sustaining the economy and environment," says Landman.

The researchers plan to present a prototype of the toolkit at upcoming local food and urban agriculture conferences. There, it will be critiqued and fine-tuned, in hopes that it can be improved to work equally well for different communities across Ontario.

- Collaborators include Prof. Alison Blay-Palmer from Wilfrid Laurier University as well as a team of faculty members and students across the province. The project involves collaboration with non-governmental organizations, four provincial government offices and an international partner located in the United Kingdom.
- Funding for this project is provided by the OMAFRA–U of G Partnership. Additional funding is provided by the Social Sciences and Humanities Research Council.

New user-friendly website makes research accessible

The OMAFRA–U of G Partnership generates a wealth of new knowledge every year. One of the best ways to get that information to users is electronically…and now that knowledge transfer is being mobilized more than ever, thanks to the redesigned partnership website.

The website's user-friendly interface, customized search and easy navigational features help get science out of the lab and into the hands of those who need it.

With participation from OMAFRA's Research and Innovation Branch, four partnership websites have been redesigned and brought under one umbrella for easier access to information and research results.

"The new site showcases what we have already done and highlights the capacity of what the partnership will help us achieve next," says Rich Moccia, associate vice-president, research (strategic partnerships).

The website provides real-time access to research results and the latest agri-food and rural research information. Other innovative features include Knowledge Translation and Transfer instructional videos, a calendar of events and highlights of how OMAFRA–U of G Partnership research is making an impact.

As well, users can now access the site from their smartphone and tablet.

Check out the new website at www.uoguelph.ca/omafra_partnership

—Katharine Tuerke

PHOTO: ISTOCK

hubs FOR THE FUTURE

Prof. Karen Landman is creating a toolkit that will help rural communities across Ontario build up strong local food supply chains.

PHOTO: MARTIN SCHWALBE

Program opens doors for bioproducts career

HQP program graduate Sara Bonham researches and develops new bioplastic products.

BY KATY JONKER

With non-renewable petroleum-based resources destined to deplete, global concerns rising over climate change and plastic waste escalating to more than 200 million tons annually in North America, demand is high for alternative types of sustainable packaging materials.

Sara Bonham, a graduate of the Highly Qualified Personnel (HQP) Scholarship Program offered by the OMAFRA – U of G Partnership, is answering the call for greener materials.

Bonham, a food science and agricultural chemistry graduate with an M.Sc. in biological engineering, is a research and development associate with Polymer Specialties International Ltd. (PSI) at its state-of-the-art laboratory, pilot plant and manufacturing facilities in Newmarket, Ont. There, she researches new bioplastics, biocomposites and petro-based plastic blends, and assists multinational companies with scale-up trials for commercialization.

Bonham credits the HQP program for helping her get to this point. "The HQP program was a really great resource for me, and I would recommend anyone complete their graduate studies at Guelph. It provided me with relevant real-world experience as well as the tools I needed to transfer my skills to the industry with credibility."

Each year since 2009, the program has provided about 25 U of G graduate students with opportunities to complete their research while learning to network and improve their business skills. This, in turn, gives employers a crop of experienced and qualified students to choose from.

Bonham says the coursework associated with the HQP program, UNIV 6050: Integration of Science and Business, allowed her to gain an entrepreneurial perspective on marketing her research and identifying needs in the industry.

While completing her master's degree and UNIV 6050 coursework, she found that the food and automotive industries lacked cost-effective compostable packaging films produced from non-petroleum-based resources. Further studies revealed that products such as plastic water bottles, yogurt packaging, fresh-food plastic and even steering wheel covers and car seat material could be made more sustainably.

During her master's studies, Bonham worked with engineering and plant agriculture professors Manju Misra and Amar Mohanty to create cost-competitive sustainable packaging for the food and automotive industries using agricultural residues from crops such as soybeans.

She then applied her lab work to an industry setting during a four-month work term as a packaging engineer intern at General Mills. While there, she looked for ways to reduce the costs of bioproducts while improving their quality.

This internship, as well as the HQP program, allowed Bonham to tie her research and experience together, which led to her current job at PSI.

She says her goal is to continue developing sustainable biomaterials that will be widely embraced and used in the marketplace and the general public.

■ The HQP Scholarship Program is funded through the OMAFRA – U of G Partnership. Bonham's research is also funded by the Hannam Soybean Utilization Fund.

PHOTO: MARTIN SCHWALBE

Swine disease surveillance system engages producers

BY SAMANTHA BEATTIE

Livestock disease surveillance systems are invaluable industry tools for keeping track of zoonotic diseases, which can be transferred between animals and humans. But to be effective, the systems need the participation of producers, who are the front-line observers of their animals' health.

Tim Blackwell, OMAFRA's lead veterinarian for disease prevention in swine, and Ontario Veterinary College student Paisley Canning set out to see if implementing an Ontario swine surveillance program is practical for OMAFRA or producers.

The researchers did a pilot study with producers from almost 5,750 Ontario farms. The producers submitted mortality numbers from the five swine production areas — farrowing, breeding, gestation, nursery and finishing.

To make the data submissions as easy as possible, Canning created a smartphone application, but he also gave producers the option to send in their data using email, fax or mail. Once the researchers began receiving data regularly, the producers received discounted veterinary and diagnostic services.

Blackwell says an incentive for producers was having access to the data. After the two-year program was complete, the team returned each farm's compiled data to the producer.

The team also held interim producer meetings, where producers would receive a summary of their own mortality data as well as the average mortality data from all herds. This way, they could compare their practices with those of other producers to figure out what they might change to decrease mortality rates.

The researchers say they focused on mortality rates rather than cause of death because an actual cause can be difficult to establish with certainty on a farm.

The project was considered a success, with more than 90 per cent of the enrolled producers submitting data for seven out of 10 weeks.

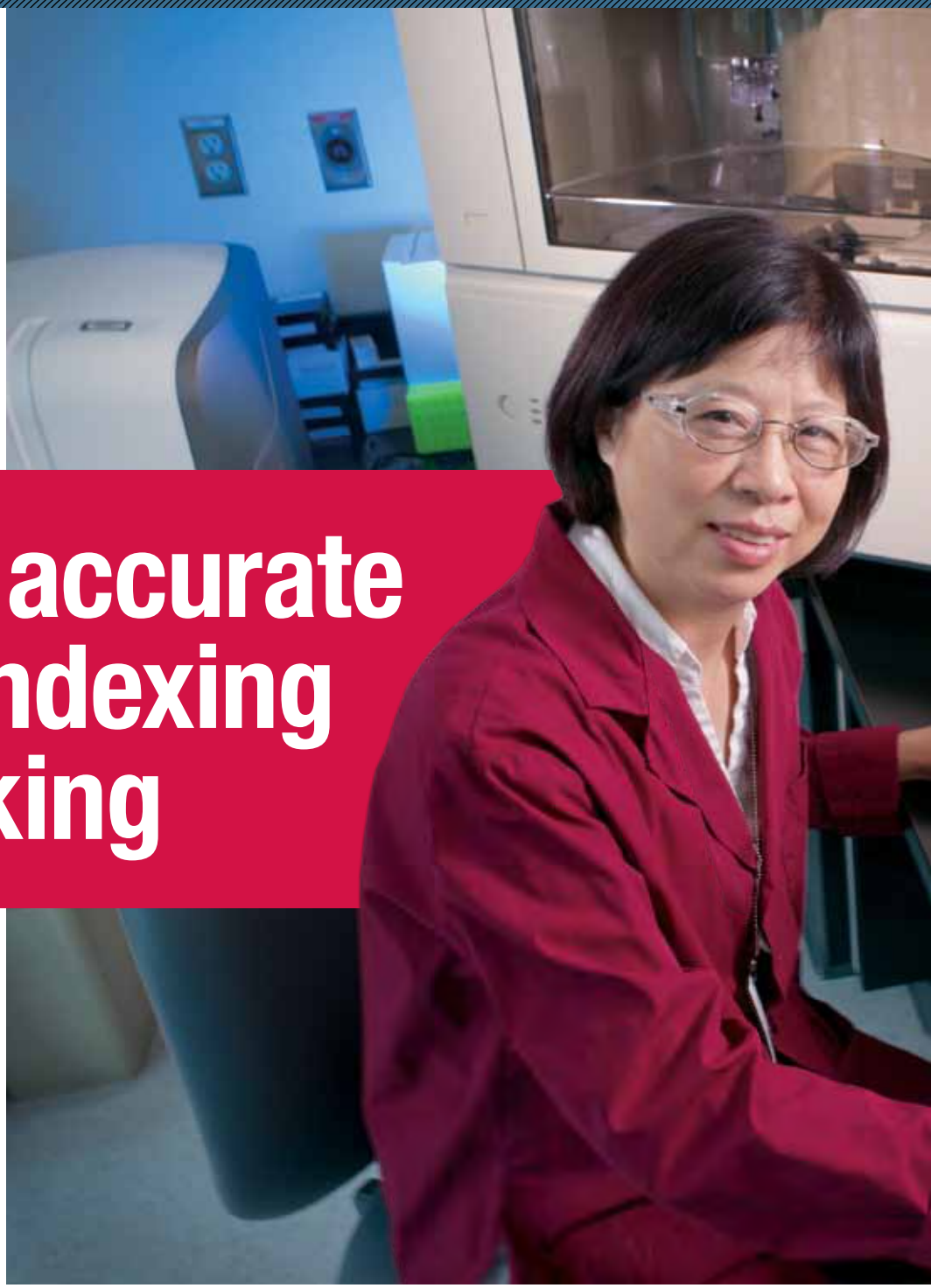
Blackwell says establishing an on-farm disease surveillance system is important because it allows for the earliest possible detection of new or emerging swine disease. New diseases are rare, however, so he and his team need to be able to keep producers involved and engaged over the long term.

"This pilot project has helped us establish principles for future surveillance programs," he says. "This includes preferred submission methods and appropriate incentives to encourage long-term enrolment and regular reporting."

Others involved in this research were OMAFRA surveillance analyst Kathy Zurbrigg and the Animal Health Laboratory.

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

PHOTO COURTESY OF ONTARIO PORK



Fast and accurate *Listeria* indexing and tracking

BY JOEY SABLJIC

Timing is everything, especially when contamination of food with *Listeria* bacteria is suspected. Public health and food inspection agencies need to act quickly, and knowing what kind of *Listeria* they're dealing with helps protect Ontario consumers by stopping outbreaks at the source.

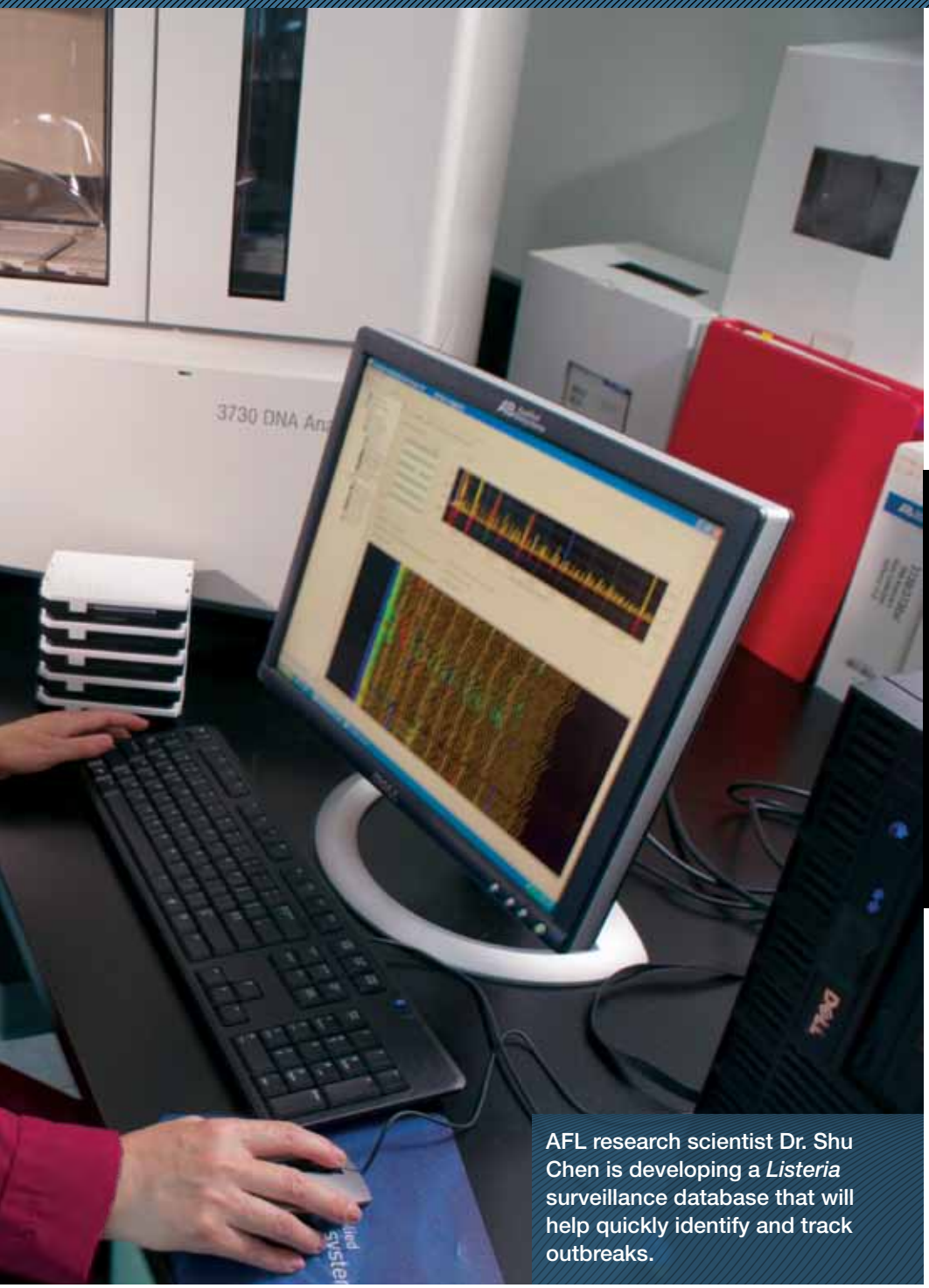
The current standard method, pulsed-field gel electrophoresis, is effective in bacterial strain tracking but can be cumbersome because of time limitations. There is need for a faster method of developing molecular fingerprints.

Now, scientists at the University of Guelph's Agriculture and Food Laboratory (AFL) are creating a cost-effective *Listeria* strain characterization tool and database that will allow food and health agencies to quickly and accurately identify and track specific *Listeria* strains in the event of contamination or an outbreak.

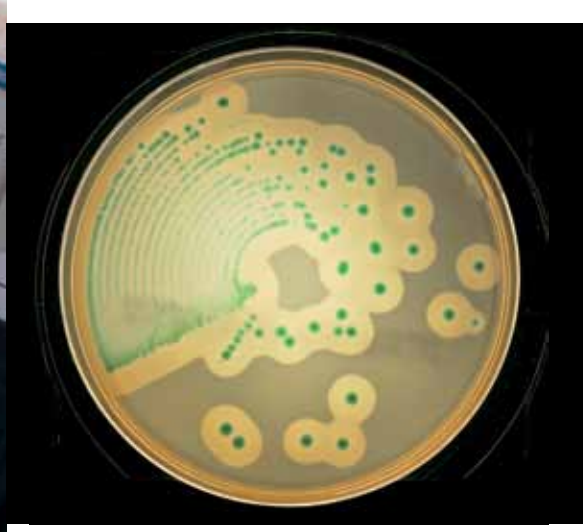
Dr. Shu Chen, a senior scientist and manager at the laboratory, is leading a research team to develop a multiple-locus variable-number tandem-repeat analysis (MLVA) methodology and database for *Listeria monocytogenes*. The MLVA database is similar to a criminal fingerprint database, except that it's devoted to cataloguing, tracking and identifying the strains of the roughly 2,500 *L. monocytogenes* isolates that have been collected at the AFL through OMAFRA – U of G Partnership programs and other testing programs over the past 15 years.

"We're trying to create a more proactive approach to *Listeria* testing," says Chen. "We shouldn't be waiting until after an outbreak has already happened to know which strain of *Listeria* we're handling."

She and her colleagues obtain *Listeria* isolates from samples from industry partners or government agencies such as OMAFRA and the Public Health Agency of Canada; they also receive *Listeria* isolates from Public Health Ontario and



AFL research scientist Dr. Shu Chen is developing a *Listeria* surveillance database that will help quickly identify and track outbreaks.



Health Canada. From there, using a technique called polymerase chain reaction, they generate an MLVA fingerprint for each isolate.

This technique allows a researcher to analyze multiple well-defined regions within each *Listeria* strain's genetic code to determine its genotype.

Once they've analyzed the *Listeria* strain, an MLVA string number, similar to a barcode, is calculated and used to assign its genotype. This string number and other relevant information, such as the type of food product, swab or other sample type the isolate was obtained from, are entered into the database. Having this MLVA tool available will allow food inspection and public health agencies to quickly and easily identify the subtle differences between *Listeria* strains.

The MLVA methodology and database also allow Chen and her team to incorporate an element of traceability to assist food safety and outbreak investigations. For example, if the strain of *Listeria* identified in a human case matches the MLVA of food products in the historical database, an investigator can further explore possible links between the present case and those types of food product or specific food producers or processors.

Chen and her AFL team plan to make the MLVA methodology and database available for use by related government agencies. Each agency's lab will be able to use the tool to analyze *Listeria* isolates and add the MLVA information to the database.

"We want to build a cross-laboratory network that will contribute to — and help to build up and strengthen — the database on an immediate, real-time basis," says Chen.

Collaborating agencies are OMAFRA, Public Health Ontario, Health Canada, the Public Health Agency of Canada, the Canadian Food Inspection Agency and the Ontario Ministry of the Environment.

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

PHOTO: MARTIN SCHWALBE · PHOTO OF *LISTERIA*: UNIVERSITY OF GUELPH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Clinical rotations: they teach what textbooks can't

BY ANDREA SECCAFIEN

Students in the food-animal stream of the Ontario Veterinary College's doctor of veterinary medicine (DVM) program are getting a head start on their careers with hands-on experience through clinical rotations. They spend the entire final year of the program working in a variety of clinical settings.

Population medicine professor Todd Duffield says this gives students an invaluable opportunity to gain the knowledge and skills expected of entry-level veterinarians.

"Having hands-on clinical-practice experience and access to live animals is of paramount importance for becoming clinically competent in food-animal veterinary medicine," he says.

Although the DVM program gives students a solid foundation, Duffield found they weren't getting enough clinical experience outside the classroom. They needed more opportunities to do medical diagnosis, gain surgery experience and improve technical skills such as pregnancy diagnosis to increase their readiness for the working world.

One Ontario veterinarian who stepped up to offer food-animal students those opportunities is 1987 OVC graduate Ray Reynen of Heartland Veterinary Services in Listowel. Small groups of students visit Heartland in rotations to get hands-on experience with clinical cases, routine herd health visits and surgery. They also learn about dairy nutrition and practical approaches to herd problem solving.

Duffield says the relationship with Heartland is a win-win situation for all involved.

"The students' knowledge is put to the test in dealing with day-to-day issues and diagnosing herds, but the clinic also benefits from having the University contribute its expertise. The students build strong networks, and some go on to be hired by Heartland post graduation."

Brett Gamble, a recent OVC graduate who participated in the Heartland rotations and also did a two-month externship at a local veterinary practice, says she quickly learned that real-life experience is far different than sitting in a lecture hall.

"This was a priceless experience for me," she says. "I felt much more prepared going into my first job as a veterinarian after getting out to farms and veterinary clinics and applying what I learned in the classroom."

Because practical experience is so important for future veterinarians, OVC also offers first- and second-year food-animal students an opportunity to get out in the field, says Duffield. For the past three years, they've been able to team up with senior students on farm services to get early exposure to food animals and the daily experience of working in a veterinary practice.

■ The Veterinary Clinical Education Program is funded by the OMAFRA – U of G Partnership.

Dairy rotations led by Prof. Todd Duffield give DVM students like Brittany Scace hands-on, day-to-day veterinary experience working with actual farm clients.

PHOTO: ANDREA SECCAFIEN

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