Agknowledge

UNIVERSITY OF SASKATCHEWAN
COLLEGE OF AGRICULTURE AND BIORESOURCES

FALL / 2016

Battling nature's 'nasty' side

Natacha Hogan knows very well that natural isn't always nice—in the case of mycotoxins, it's a multi-billion-dollar problem.

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Growth spurts

HENRYTYE GLAZEBROOK

Training the next generation of experts

DAVID STOBBE

In the more than 100 years since the University of Saskatchewan's College of Agriculture and Bioresources was founded in 1909—then bereft of the latter portion of its title—the college has continued to evolve and expand.

Aside from the obvious changes, including the opening of the Agriculture Building in 1991, core programming at the college has adapted to fit the changing needs of the industry. What was once a college heavily weighted toward instructing its students with a traditional connection with farming, programming within the college has expanded and transitioned to include the wide breadth of what comprises modern agricultural production, together with the management of the environment and associated bioresouces.

"A number of years ago the college recognized that we weren't just production agriculture focused—that our expertise spans issues surrounding agriculture, environment, resource management, food processing and more," said Fran Walley, associate dean, academic with the college.

"Agriculture remains as important as ever and many courses and programs continue to have a production orientation particularly in the areas of animal science and agronomy. However, the scope of our programs has expanded to include environmental science, renewable resource

Students taking a hands-on approach to learning in the Kanawayihetaytan Askiy program.

management, food and bioproduct science and others that expand far beyond production agriculture.

> "We want to provide students with every opportunity to succeed in an industry that is in a nearly continuous state of change."
>
> **FRAN WALLEY, ASSOCIATE DEAN, COLLEGE OF AGRICULTURE AND BIORESOURCES**

"Although production agriculture remains an important core, we have a number of programs that reflect the diversity of research areas and scholarship within the college."

These days AgBio has four bachelor of science degree programs in agribusiness, agriculture, animal bioscience and renewable resource management, alongside four diploma programs and two certificates.

"We want to provide students with every opportunity to succeed in an industry that is in a nearly continuous state of change," explained Walley.

"The agriculture industry evolves and changes at a rapid pace. Farming in the prairies has changed rapidly in the past few decades from smaller family farms to really intensive operations where the operators require specialized skills spanning everything from sustainable crop production, environmental management, to marketing," she said.

"It's a new world for farming."

The college has been shaped by a desire to create opportunities for experiential learning. The idea, said Walley, is to offer students the chance to spend time away from chalkboards and books, and gain a real hands-on understanding of the work they have been studying.

"Experiential learning is really important. You can learn a lot in a classroom, and that's critical learning, but when you're actually seeing it and feeling it—literally doing the hands-on work in the field or the lab or wherever—those are often the experiences that really stay with a student and shape them," she said.

As the college has evolved, Walley has noticed students taking a keen interest in courses centred around the environmental impact of agriculture. The trend, she said, seems natural.

"Agriculture and managing our environment really do go hand in hand. There is a recognition that in order for us to be successful in areas of agriculture, we have to be concerned about our environment, water security, what's happening in terms of the climate, how we're managing our bioresources," she said.

"Those things are all inextricably linked when we're talking about managing the environment around us so that we can foster sustainable food production systems."

The introduction of new diplomas in Aboriginal lands governance and in Aboriginal resource management is consistent with the evolution of college programming.

Walley said the move to diploma programs in Aboriginal land management is one that's equally beneficial to both students and the U of S as a whole, creating an environment where learning is more openly available and more easily encouraged.

"I think it's really important," she said. "We have different kinds of university students now who are here for all sorts of different reasons. We want our programs and programming to be flexible enough to allow students to have many different routes into our college and into our programs," she said.

In all its changes, Walley said one constant has remained steadfastly in focus for the College of Agriculture and Bioresources: to help students become champions of their field.

"Our goal is to train our students to be the leaders of the future—in agriculture, in food production, in managing our environment. These are important times, and we need people to be able to take on those many challenges that we are facing."

And as the field of agriculture continues to change, she believes the college will adapt alongside it to meet the new and exciting challenges that lay ahead.

"There is a constant evolution in our programs and individual courses," she said. "It is definitely an evolving industry and in many respects a very high-tech industry. The people we're training need to be able to operate at that very high level when they leave here." ■

Enrolment for 2016–17

Degrees
1,109

Diplomas
103

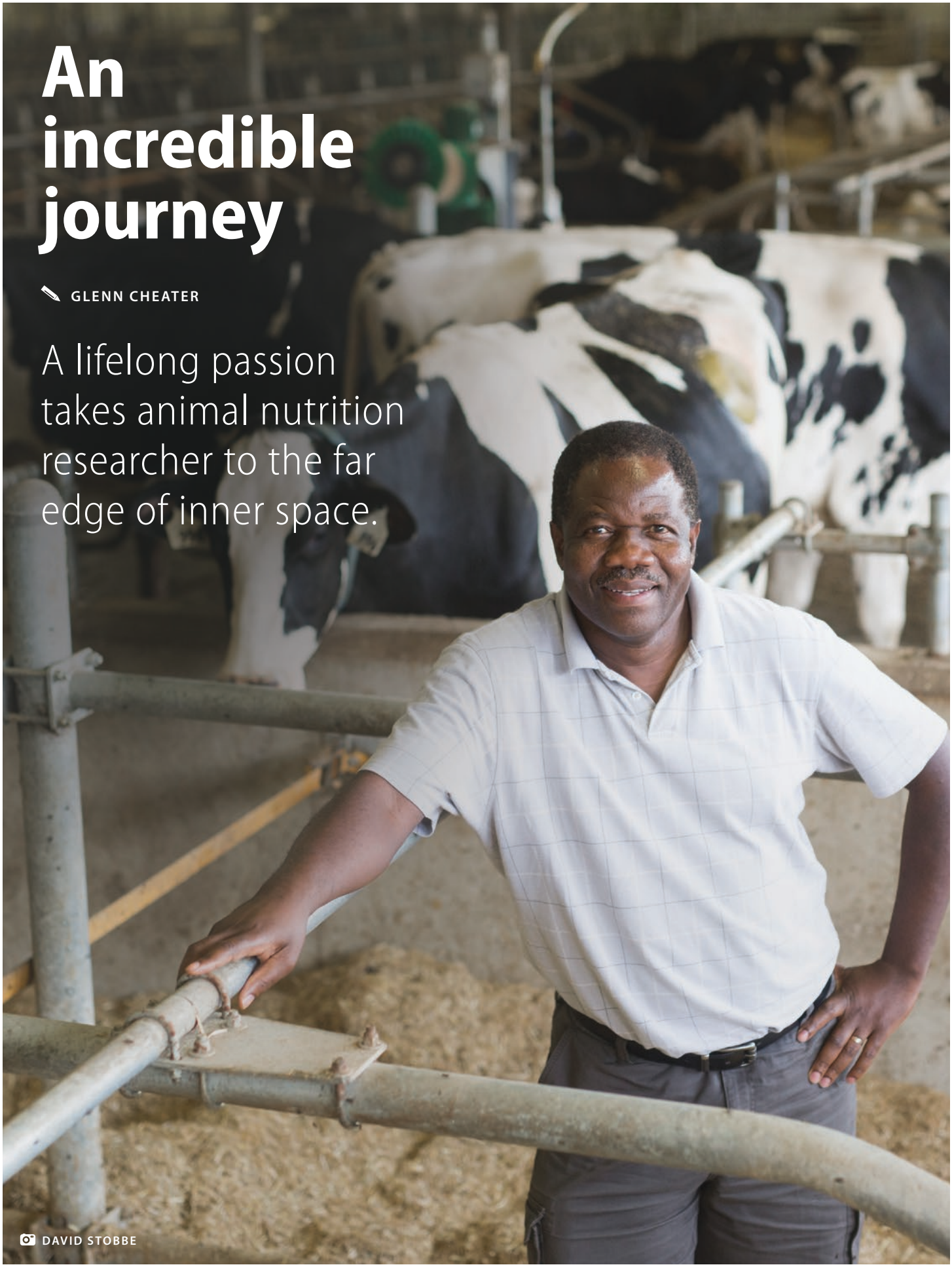
Certificates
22

Exchange students
17

An incredible journey

GLENN CHEATER

A lifelong passion takes animal nutrition researcher to the far edge of inner space.



DAVID STOBBE

If improving feed efficiency in cattle sounds a little dull, take a few steps down the road Tim Mutsvangwa has travelled. It's quite a journey.

It starts in the 1970s in a tiny village in Zimbabwe where centuries' old practices still reigned; passes through an era of research that once seemed high tech but is now antiquated itself; and then into the depths of inner space where the secrets of a can-you-believe-it molecular dance are being laid bare.

Mutsvangwa grew up in Harare, but spent school holidays in the village of Mureverwi, helping his mother with chores such as milking indigenous Zebu cows.

"These are draft animals and produce very little milk—just enough for household consumption," recalled the professor of ruminant nutrition and metabolism, who came to U of S in 2003.

Since it was all he knew, Mutsvangwa assumed three to six litres of daily milk production was normal. He was astonished when he learned Holsteins produce more than 30 litres.

"When I realized that some cows were producing so much more, I was very intrigued," he said. "I wanted to know what's the difference between the cows I'm milking now and those cows. So I became interested in genetics and nutrition, and that's what got me into animal science and animal nutrition."

At the University of Zimbabwe, Mutsvangwa quickly learned there was one place above all others—the Rowett Research Institute in Aberdeen, Scotland—for a young man eager to learn the science of animal nutrition.

"My teachers had been trained at the University of Aberdeen and they used to talk about these big names—we would read papers published by these big names and use textbooks they had written," he said.

When he won a British Council Scholarship, there was no question where he wanted to go.

"All of a sudden these big names were my instructors—it was quite inspiring," he said before adding with a laugh, "I actually had one of them autograph a textbook he wrote. I still have it—it's sitting on a shelf in my office."

But while the work was groundbreaking, feed efficiency research in those days was largely limited to feed and weigh trials. High-tech meant assessing feed digestion via fistulated cows (in which a surgically placed and removable plug gives access to the rumen, the first of a cow's four stomach chambers). Again, a lot was learned from this technique, but research technology in biology has rocketed far, far beyond that.

While Mutsvangwa was doing his PhD in Guelph, previously unknown protein molecules were discovered in the tissues of humans and other mammals that would become the focus of his work. Urea transporters are prime examples of the marvellous ingenuity of Mother Nature. It's long been known that microbes in the gut produce ammonia, which is toxic, and that the liver converts it to benign urea, which is then moved to the kidneys and whisked out of the body in urine.

But the burning question was: How? How did urea pass through the liver membrane, the walls of blood vessels, and into the kidneys? The discovery of urea transporters (there are several groups of them) would give scientists the answer, albeit one that's hard for non-scientists to imagine.

When asked for a layman's description, Mutsvangwa laughed again.

"You're putting me on the spot here," he said. "They're basically proteins and because of their amino acid composition, they have a certain shape when expressed in different tissues. They also have receptors that attract whatever molecule they're supposed to transport across certain types of cell membranes."

Imagine an intricately shaped grappling hook designed so that only one type of molecule will 'fit' into it. This particular device can lock onto a urea molecule, move it out of the liver, and into the bloodstream and then into the kidney. Once there, it changes shape, causing the urea molecule to be released.

It's all part of a larger system with a simple purpose: Take a poison (ammonia), turn it into something harmless (urea), and then get it out of the body as efficiently as possible.

But since discovering urea transporters, researchers have found something rather bizarre in cattle and other ruminants—they've turned the system on its head by using this waste product to produce milk, grow fetuses and build muscle.

"Ruminants are faced with times when nitrogen in their diets is very deficient," said Mutsvangwa. "They have evolved a way to take urea from the bloodstream and recycle it. There are types of transporters that move urea into the digestive tract where it is used by microbes to produce amino acids. Those amino acids are then recovered when the microbes are digested.

> "Ruminants are faced with times when nitrogen in their diets is very deficient. They have evolved a way to take urea from the bloodstream and recycle it."
>
> TIM MUTSVANGWA

"Basically it allows the animal to have a second, third, and fourth opportunity to use nitrogen that would otherwise be excreted."

It's a very neat trick, and one that Mutsvangwa and his team want to exploit.

"This is just me thinking well into the future," he said. "But once we have a good grasp on how these urea transporters and aquaporins (another membrane transport protein) are controlled, then we can maybe manipulate the expression (number) of them. And the more of them you have, the less urea in the urine. That has an obvious environmental benefit and, at the same time, you improve feed efficiency."

The latter, by the way, is pretty dismal—70 per cent to 85 per cent of the protein fed to cattle ends up in manure or urine. But it's now conceivable that one day, Mutsvangwa or those following in his footsteps may dramatically alter that equation by developing a feed additive that greatly boosts the number of these transport proteins and their recycling ways.

It sounds like science fiction, but the scientist who once milked Zebus knows full well that just because something is unimaginable doesn't mean it's not possible. ■

Dilemma in aisle three

GLENN CHEATER

Jill Hobbs is peering into the enigmatic ways of today's shoppers and how they're revolutionizing the food business.

You find them in every grocery store aisle—shoppers blinking perplexedly at ingredient labels, others filling their carts with trendy products promising better health (or a healthier planet).

These commonplace acts fascinate Jill Hobbs, a self-described foodie.

"How do consumers make these decisions?" asked the U of S agricultural economist, an expert in consumer behaviour and food supply chains.

"Do they think them through ahead of time? Do they take a cognitive shortcut and just say to themselves, 'I trust this or that celebrity or what my friend says and I'm just going to buy whatever she or he recommends?' Or do certain types of labels grab their attention?"

Take eggs, for example, which hold a special place in her heart. As a girl growing up in the U.K., Hobbs sold brown eggs from the family farm in the neighbouring village—although the choices were limited in the extreme.

"You could buy big eggs or small ones," she said at a conference earlier this year before treating her audience to a tsunami of egg offerings she had discovered during a recent trip home.

Of course, there were regular free-range eggs (one company markets 'happy eggs'), but you could also get free-range from heritage breeds ($3 for a half dozen laid by Columbian Blacktails

DAVID STOBBE

and nearly $5 for six Old Cotwold Legbar eggs). Or perhaps you'd prefer free-rangers from East Anglia or Wales; ones from chickens fed corn (for 'golden' yolks); eggs that support charitable causes; omega 3 eggs; or ones promising more selenium. Hobbs' favourite is a brand called Ella Valentine that sells large eggs in bright pink cartons and promises "these big beauties will make your cakes fluffy and your desserts delicious."

In one sense, it's all good fun.

"For some consumers, these attributes are very important and they're willing to pay more for them while for other consumers, they're not," noted Hobbs. "The market is good at sorting these things out."

And it's been doing a lot of sorting lately. Grocery and restaurant chains are not only tracking consumer preferences like never before, they're also rushing to appeal to those who want something different, even if that means turning their supply chains on their ear. And more and more consumers are paying premiums for products they believe, rightly or wrongly, have special benefits.

"Understanding how consumers make these decisions both before they go to the store and when they're there, getting hit with all this information, is pretty important," said Hobbs, who joined the U of S faculty in 1999.

"Researchers are now trying to dig down into how consumers make decisions and what influences them—what we call food values and cultural cognition. How do people process information about science and food issues?"

It's a tangled web, and getting more so as Facebook, Twitter and other social media offer persuasive individuals and celebrities-turned-health-experts an extremely powerful platform to influence others.

> "Clearly social media is pretty influential in terms of spreading information. Whether it's accurate information, of course, is a whole other issue."
>
> JILL HOBBS

"Clearly social media is pretty influential in terms of spreading information. Whether it's accurate information, of course, is a whole other issue," she said. "Then you have terms like 'natural,' which really don't mean anything. I could put the word natural on any product because we don't have a regulatory definition of that term. So it's hard for consumers to know what is a credible claim and what's just a marketing ploy."

But there are problems with the sober and responsible alternative: government-approved labels.

Canada has a stringent system for deciding what goes on labels, but they're not exactly consumer friendly. Every year, Hobbs conducts a little experiment with her fourth-year agricultural marketing systems class. She passes around a few products, such as canned vegetables and maple syrup, and asks her students what the product grade information on the labels (terms such as Canada Fancy or Canada Choice) means.

"Even though they are closer to the ag industry than most consumers, most of them don't know," she said. "I'm not surprised by that. It's a good example of having too much information on a label that's not all that useful to consumers."

Another issue arises when it comes to health claims. Again, federal regulators do a good job to ensure any claims are supported by science, numerous studies and "the benefits come from consuming the product in normal amounts," said Hobbs. But it's a slow and cumbersome process.

"On the other hand, the U.S. has a looser regulatory system that allows what's called 'qualified health claims,' so you can have claims with a whole bunch of qualifiers," she added. "It's been criticized because it weakens the health claim. You need to have a balance—one that protects consumers but also encourages industry to bring products to the market that have real health benefits."

And behind all of these issues, she explained, is the fact we are all so different. We care deeply about food but in many different ways—and you can't look at someone's background and predict what they care about.

"You can't make blanket statements that consumers are concerned about x, y and z," said Hobbs. "Some are very motivated by environmental issues; some people are very focused on health; some are very busy and want convenience; and for some, it's about price. But you can't simply classify those interests by age, gender, education or those sorts of social demographics."

So perplexed shoppers and impulsive ones will continue to populate our grocery stores for many years to come. And the list of things they are concerned about will only get longer, said Hobbs.

"This is a trend with a whole bunch of different dimensions—animal welfare, food safety, traceability, GMOs and so forth," she said. "And even as new issues emerge, there will always be more percolating in the background." ■

An alternative perspective

HENRYTYE GLAZEBROOK

Sitting down for class in Lundholm, Sweden, Nathan Ruff said he was stunned to see what a country can accomplish when it makes renewable energy resources a priority.

Though he hails from Canada, Ruff had travelled to the Scandinavian country as a part of a student exchange program offered through the University of Saskatchewan. The experience, he said, opened his eyes to the potential of alternative energy sources.

"Coming from somewhere like Saskatchewan, renewables aren't viewed the same way. They're seen as if the technology isn't there yet or they're too expensive and we can't afford them," Ruff said.

"It's exciting to go to another part of the world and see so much of their electricity coming from wind when here we just can't muster it. It makes you wonder what mechanisms might be in place that make this seem like such a more viable option for somewhere like that."

Ruff is an undergraduate student in the resource economics and policy program offered through the U of S College of Agriculture and Bioresources. Though he now says it has become a personal passion, Ruff said he first started exploring his choice of study simply because he had begun developing a grim outlook toward the study of general economics he had previously been enrolled in.

"I was very interested in economics, otherwise I wouldn't have taken it, but I felt like there was something missing. At the end of the day, I just wasn't sure if a four-year undergrad in the subject was something I wanted to do," he said.

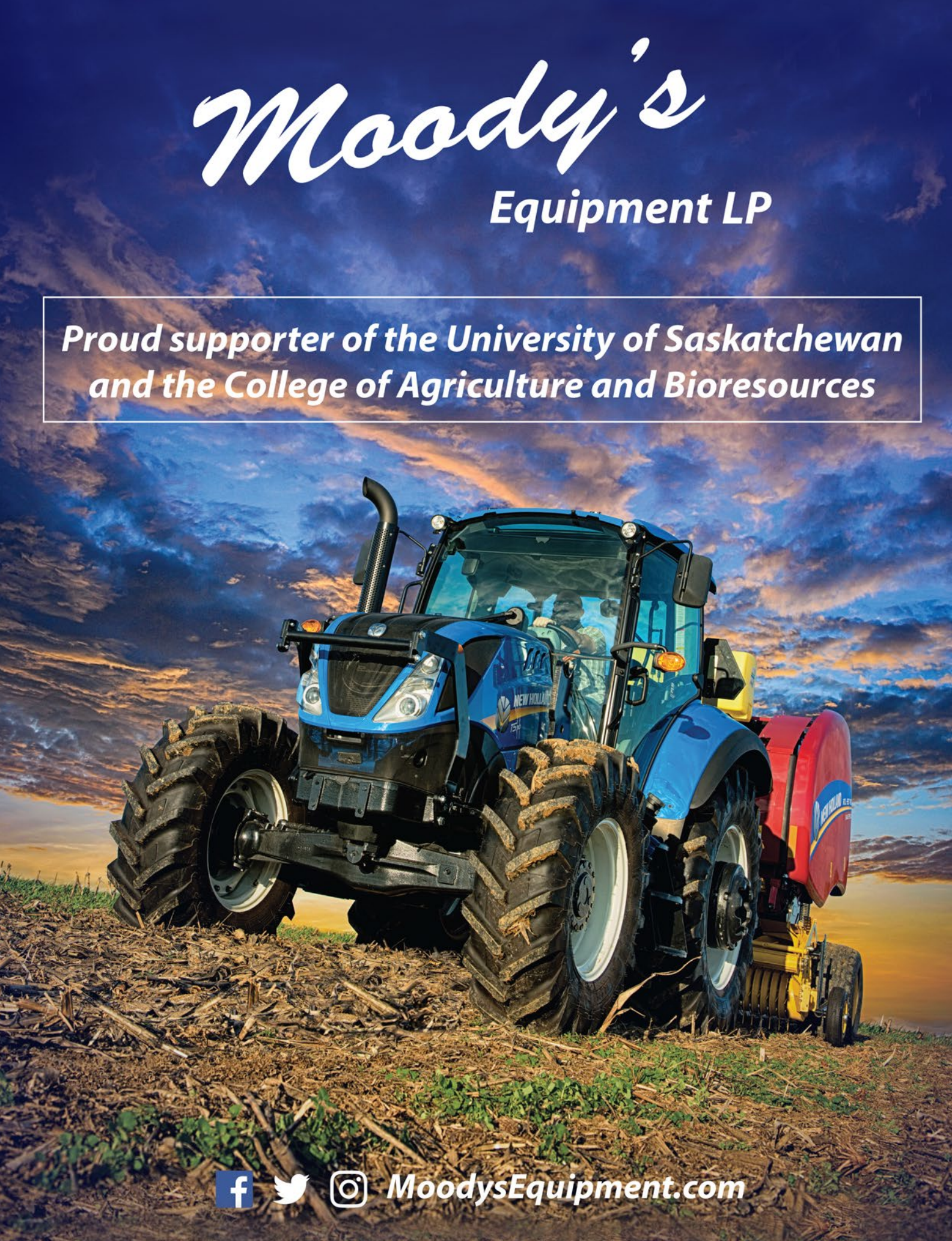
"I did some searching around and I discovered this program which incorporates my interest in economics but also my interest in natural sciences and the resource sector. It was a bit of an aha moment when I read about the program."

With regular classes out for the summer, Ruff spent this past summer helping educate those younger than him through AgBio Discovery, a program aimed at introducing young children to the advantages and opportunities offered through agriculture.

If he's being honest, Nathan Ruff didn't initially get involved in agriculture to make Earth a better place. These days, though, that goal has become one of the driving forces behind his academic career.

"I didn't go into the program thinking, 'Oh, this is something that will help me change the world.' But that is something that, if it's not at the top of people's agenda right now, it should at least work its way up there in the future and create new opportunities for people to make a difference," he said.

"As a society, the direction we head in the future is not so much a matter of where we want to take things; it's where we have to take things. We have to become more green and environmentally sound and be stewards for the environment." ■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It really is who you know

GLENN CHEATER

Farming isn't just about tractors and seeds—networking is becoming the driving force in modern agriculture.

Eric Micheels describes how he came to U of S as "one of those connected stories."

"I was doing my PhD at the University of Illinois," said the Wisconsin native. "One of the faculty members did her master's degree at the University of Saskatchewan and she had just got the posting for the job here from her network when we bumped into each other in the hallway, and she said, 'Hey Eric, you should apply for this.'"

Being connected is such a normal, everyday thing, most of us never think about it. But Micheels has not only thought about it a great deal, he's measured it in a group of people not particularly known for networking: farmers.

"Farmers with an entrepreneurial mindset are also the ones who look past the farm gate for answers to problems they have," said the assistant professor in the Department of Agricultural and Resource Economics. "They might consult more broadly than most, not just copy what their neighbours and friends are doing. Many even look outside of agriculture."

As it turns out, the world needs farmers to be very good at networking.

"The issues that farmers face today are no different from the ones they've faced for hundreds of years," said Micheels. "They're trying to do more with less. The number of mouths to be fed is going


DAVID STOBBE

up. However, resources—such as the amount of farmland in North America—aren't increasing, but decreasing."

What's different today is that the supply of silver bullets for increasing global food supply is getting low. In the past, things such as mechanization, vastly higher-yielding grain varieties and a suite of very effective agri-chemicals relegated the Malthusian nightmare of mass famine to the 'no worries there' category.

Future advances will be of a different sort.

"New technologies are different today because adoption is only the first step," said Micheels, who grew up on a dairy farm. "For example, go back to the introduction of hybrid corn—the only thing that really changed was what you were putting in the corn planter, and you got most of the gains right off the bat.

"But with big data or really advanced technology where you have to get one system to talk to another, it's a lot more than just writing a cheque. It's the same for all sorts of businesses today. There's all this data coming at you so fast, the technology is changing all the time, and it may not work perfectly. It all adds up to a lot of uncertainty."

That means future progress will depend on the innovators—the ones willing to tackle steep learning curves and take things to the next level. So who are the innovators in farming?

"We still have this notion that size is important—we think the largest farms are doing all the latest and greatest things," he said. "But if you think more broadly on what innovation is, size shouldn't be that important. After all, you see farmers of all sizes making changes and striving to get better."

> "The issues that farmers face today are no different from the ones they've faced for hundreds of years. They're trying to do more with less."
>
> ERIC MICHEELS

Micheels actually designed a survey to measure farmers' ability to innovate, known in economics lingo as absorptive capacity—the ability to assimilate and integrate new information.

"Think about a farm with a new program for gathering data for making agronomic decisions or for marketing," he said. "When you sit down with the rep trying to sell you that product, you have to first be able to see how it would make sense for your farm. That's assimilation.

"The next part is integration: How am I actually going to put this technology into practice? The salesperson will give you examples of how other farmers use the technology, but you have to figure out how to use it on your farm."

The best and fastest way to do that is to turn to others who are adopting the same technology and applying it in their business. But for that, you need networks.

Micheels' survey profiled farmers' networking ability. A market research firm canvassed several hundred Prairie farmers and asked a series of questions such as: How many farmers do you regularly talk to about your operation? How many suppliers, consultants and advisors? How many days a year do you spend at workshops and conferences?

The answers varied wildly. Some said zero to all of the above and the norm was pretty low, too—one or two advisors, a handful of farmer confidantes, five or so days at conferences or workshops. Others, from farms of all sizes, gave answers that were five or 10 times higher.

One of the goals of this work is to dispel the notion that being on the cutting edge is only for big and well-off operations. It also shows why it's critical to get off the farm—both to be exposed to new ideas and, equally importantly, to connect with other inquisitive, forward-thinking individuals.

"You might hear something first at a field day or workshop, or see something in a farm magazine or on Twitter, but you're going to rely on your personal network to get the low-down on it."

His survey supports what many, including Micheels himself, see happening in agriculture. He notes younger farmers (including kids he grew up with who are now farming) are generally "bolder" than their parents, well-connected and open to new ideas. Across agriculture, there seems to be a thirst to push the boundaries of what's possible. (After all, he noted, while the rest of society waits for driverless cars, auto steer is now pretty much standard equipment in tractors and combines.)

"We're going to be more data-driven—we're just seeing the tip of the iceberg of that," he said. "The speed at which we use data and actually have it make sense to us is going to improve. We're also going to be more connected—from the processors to people who handle it right through the farmers and to the plant breeders." ■

Solving food issues in the Arctic

KRIS FOSTER

Wild food could help solve food insecurity in the North.

Across the Arctic there is a food crisis.

The hope of getting anything fresh is remote. If a shipment of food from the South is delayed, food prices steadily rise day after day—a can of tuna can sell for as much as $8. For all the beauty found in the Arctic, the food crisis certainly paints an ugly picture.

"For me as a visiting researcher this is an inconvenience but these conditions are tragic for northern residents who have become increasingly food insecure," said David Natcher, professor in the Department of Agricultural and Resource Economics.

Because of cost, quality or availability, "it is nearly impossible for northerners to purchase a healthy food basket from commercial outlets," said Natcher. "When Inuit elders are forced to scavenge in the Iqaluit dump, you know there is a problem."

A plate full of problems

Food insecurity in the North is an issue Natcher has been looking at for a number of years. Back in 2014, he was part of an expert panel commissioned through Health Canada that explored the issues of food security to determine the scope of the problem in the North.

Natcher said the panel's report revealed a dire situation.

"Some of the starker findings include that Aboriginal households across Canada experience food insecurity at a rate four times the Canadian national average," Natcher explained. "Fifty-four per cent of Aboriginal households in Canada are considered food insecure."

The Inuit population in Nunavut has the highest food insecurity rate for any Aboriginal population in a developed country—90 per cent of Inuit children regularly experience conditions of hunger, with as many as 60 per cent often going an entire day without eating, Natcher said.

"The health implications stemming from these conditions include increased rates in anaemia and delayed physical and social development, high prevalence of diabetes and increasing rates of obesity."

The report also noted that access to wild foods by Aboriginal peoples can help in significant ways to mitigate these conditions, while providing for the nutritional, social and psychological needs of Aboriginal peoples.

"We found that those households that have regular access to wild foods are significantly less vulnerable to food insecurity and health-related illness. Unfortunately, Aboriginal access to wild foods is not being achieved by all households in the North."

There are myriad reasons for this, including changing dietary preferences within Aboriginal populations, changes in the physical environment, cost and limited household incomes, changing employment patterns, resource extraction and climate change.

"While the factors limiting Aboriginal access to wild foods are complex and don't have simplistic causation, Canada has the resources to fix this problem… But it will take political, public and local will to make the positive changes that are necessary."

Into the wild

Natcher believes the commercialization of wild food represents a partial solution to food insecurity in the North.

More attention needs to be paid to the localization of country food such as caribou, seal, char, duck, muskox and other northern agriculture, he said. "This could lessen reliance on food from the South," which is a big part of the food insecurity problem in the North to begin with.

In March 2016, Natcher was asked by the Arctic Council–Sustainable Development Working Group to lead an international research project on the opportunities and constraints to the commercialization of wild foods in the Arctic.

The project will assess the potential for increased production and added value of food from the Arctic, with the overarching aim of improving food security and enhancing the social and economic conditions of communities in the North.

"The top priorities of this project are food security and local economic development," said Natcher. "At the end of three years we hope to have a plan in place that will lead to more sustainable and culturally appropriate food systems for northern communities that help to lessen their reliance on food from the South."

Natcher, a cultural anthropologist by training, will collaborate with colleagues in the Colleges of Agriculture and Bioresources, Law and the Edwards School of Business to address these complex challenges from a multidisciplinary perspective.

"Food producers in the Arctic regions are often faced with challenging environmental conditions, poor or costly infrastructure, limited entrepreneurial capacity and long distances to export markets. Climate change is also creating additional uncertainties for commercial and wild food production system," said Natcher.

Full meal deal

Natcher believes this project could not only partly address issues of food insecurity, but also bolster local economic development in some northern communities. "Once we can enhance food production in the North for the North, then we can look at creating links for North to South food production."

However, Natcher said the group is aware of how culture can affect the project's success and will pay special attention to the unique situations and priorities in different regions of the Arctic.

"It will be necessary to consider whether new and commercially based food-producing markets are compatible with the cultural values of northern Indigenous peoples," he said. "If they are not, commercial opportunities stand little chance of success—regardless of market demand. This can't be another project where solutions are devised in the South and imposed in the North."

Natcher acknowledged that the idea of commercializing wild foods in the Arctic is not new. Others have recognized the potential for making wild foods more readily available in northern commercial outlets. However, Natcher noted that a limitation of these past efforts has been the scale at which the issue has been addressed.

What sets this project apart, he said, "is the level of involvement from the local to the international levels." This includes all major Arctic Indigenous Peoples' organizations—Inuit Circumpolar Council, Gwich'in Council International, Arctic Athabaskan Council, Saami Council, Aleut International Association and Russian Association of Indigenous Peoples of the North—and all Arctic member states—Canada, United States, Russia, Kingdom of Denmark, Finland, Norway, Sweden and Iceland.

Through this level of involvement Natcher believes the commercialization of wild foods can help to overcome the serious conditions many northerners experience in gaining access to healthy, affordable and culturally appropriate foods.

The project is expected to be finished by March 2019. ■

Battling nature's 'nasty' side

GLENN CHEATER

DAVID STOBBE

Mycotoxins disrupt life itself, and finding how to combat their devilish ways is a passion for Natacha Hogan.

When told the subject of her research has a bit of an alien predator vibe, Natacha Hogan is quick to agree.

"Oh, I like that," said the assistant professor in the Department of Animal and Poultry Science. "When you look at the structures of these mycotoxins, some really are scary looking. Many are very complex structures with multiple rings fused together and many functional groups hanging off the sides. They sort of look like spiders."

Hogan's view may be coloured by knowing what mycotoxins do.

These poisonous substances are produced when fungi infect a plant—although their purpose is a subject of debate. Researchers have noted greater volumes are produced when growing conditions are poor, such as when plants suffer from heat stress or insect damage. When plants activate response mechanisms to deal with the stress or damage, they open themselves up to fungal colonisation and mycotoxin accumulation. One theory is that mycotoxins actually prevent the host plant from making enzymes that combat the fungi, which allows it to spread.

That's a little creepy, but things get worse—much worse—when mycotoxins are ingested.

"When these toxins get into animal cells, they can do a lot of nasty things," said Hogan. "They affect the ability of animal cells to make proteins. So rapidly dividing cells are most dramatically affected—such as immune cells, ones during early embryonic growth and cells that line the gut."

Along with reduced growth, decreased immune function and reproductive issues, deoxynivalenol or DON (one of several mycotoxins produced by *Fusarium* fungi) can cause nausea and vomiting—which is why it's often called "vomitoxin." It also causes diarrhea, abdominal pain and fever. In humans, it can cause acute gastroenteritis, and also affect growth and immune function. That's why most countries rigorously test for DON levels in human food, and have strict limits on allowable levels—one part per million in North America, half that in Europe and Asia. There are also maximum levels for livestock feed, but since lesser grades are used for animal feeds, the potential for problems is much greater.

The economic impact in the livestock sector is measured in the billions annually, and that has spawned a global effort to develop fusarium-resistant cereal varieties, come up with effective ways to keep fusarium-damaged grain out of feed and protect animals who ingest it.

Hogan's passion is learning how mycotoxins wage their terrible war on living organisms.

"I love trying to understand what goes on in an animal when toxicity occurs," she said before quickly adding, "I know that sounds horrible. But it's fascinating to look at how normal physiology works and then what happens when you have a compound that disturbs that."


DAVID STOBBE

> "This is one of the biggest issues in Western Canada for both grain and livestock producers—we've had what you might call some bumper years for fusarium in recent years."
>
> NATACHA HOGAN

It was this fascination that persuaded the Prince Edward Island native to abandon her long-held dream of becoming a large animal vet and instead pursue a PhD in toxicology. She initially worked on man-made, industrial toxicants, but mycotoxins and their effect on livestock gave her a chance to marry her two interests.

Her work includes finding acceptable risk thresholds for mycotoxins in feed and reducing contamination by using state-of-the-art seed-sorting technology to physically remove fusarium-infected kernels from feed batches. But another focus is testing feed additives designed to prevent the cells of animals from absorbing mycotoxins like DON.

"The tricky part is that the last thing you want to do is change the nutritional value of feed and alter the uptake of vitamins, minerals, and energy sources," she said. "So there's a lot of work being done to figure out what we can add to feed that can remove, detoxify, or prevent the uptake of mycotoxins, but does not bind to nutrients in feed."

Anything showing potential to reduce their toxicity is being tested. That list includes physical, chemical and biological methods, products derived from clay, diatomaceous earth, microorganisms and even the cell walls of yeast.

"Several manufacturers make these kinds of products," she said. "For example, protein and lipid constituents on yeast cell walls provide binding sites for DON molecules. This prevents absorption of mycotoxin into cells, across the gut wall and distribution throughout the body. Adding yeast can improve immunity, increasing resistance to infection and regulate the micro-environment of an animal's digestive tract. So yeast and its components can protect against mycotoxin toxicity from multiple angles. Or at least that's the idea."

Unfortunately, there's another problem.

"When you make feed from grain, you can have a whole complement of mycotoxins," said Hogan. "So one product may only prevent absorption of one type—which is great, but the best product will have binding and detoxification ability against a wide range of mycotoxins."

But while the task is huge, so is the resolve.

"This is one of the biggest issues in Western Canada for both grain and livestock producers—we've had what you might call some bumper years for fusarium in recent years. It's certainly a concern for producers, veterinarians, toxicologists and industry."

The incidence of fusarium spikes in wetter years, but the overall trend since the turn of the century is up. That's likely a result of the increasing popularity of one of the most positive developments in Prairie agriculture in recent decades—no-till farming. Leaving straw and other plant material on the surface of a field reduces erosion and boosts soil health, but it also provides fungi with a refuge from soil micro-organisms that feed on them.

And scientists know there are lots of fungi producing a vast range of mycotoxins—more than 300 are now known and more are being discovered all the time as detection methods improve.

But Hogan is hopeful the threat of these nasty organisms can be contained.

"What's really great is that mycotoxin research is often a collaborative effort between academia, industry and government," she said. "Everyone wants to find the smoking gun, the way to overcome the risk that mycotoxins pose to animal production and human health." ■

Divide and conquer

DAVID STOBBE

COLLEEN MACPHERSON

Zoe Gillespie is always looking a few years down the road, and what she sees is the chance to benefit human health through her work in nutrigenomics in the College of Agriculture and Bioresources.

The master's student in the Department of Food and Bioproduct Science is studying the interface between genetics and nutrient-sensing pathways within cells. These pathways provide the cell with instructions on how to proceed—grow, die, divide, rest. In this case, those instructions are based on the nutrients entering the cell. By looking at how the genetic pathways respond to drugs that are known to inhibit the process, Gillespie hopes to uncover the fundamental biology behind how the pathways are influenced, knowledge that can be applied to improving the lifespan and health of cells.

"The two drugs we're looking at are commonly used, one to treat Type 2 diabetes and the other as an immunosuppressant after organ transplant," Gillespie explained. "They 'trick' the cell into believing there are fewer or no nutrients, and there are results showing positive outcomes—that the cells live longer and are healthier. If we understand how that works, we can find better ways of altering the pathways and that could have great spinoff benefits for human health."

It is the kind of research that requires asking a lot of questions, she said, "a lot of whys, whens and hows," but that is exactly what drew Gillespie to science in the first place.

Raised in Tunbridge Wells, U.K., southeast of London, Gillespie did a biomedical science undergrad degree at Brunel University London where she was bitten by the research bug.

"The first thing I did was grow cells in an incubator. I got to see them live, take them through experiments, look at them under a microscope. Cells are cool," said Gillespie.

Brunel was also where she met her current supervisor, Christopher Eskiw, who was a faculty member there. Gillespie said she expressed an interest in his work and Eskiw invited her to join his lab. When he moved to the position of assistant professor of food and bioproduct science at the University of Saskatchewan in 2013, Gillespie was offered a graduate position in Canada and realized she had an opportunity.

"I hadn't given any thought to coming to Canada but there was not much grad funding in the U.K. at that time," she said. "And I looked up the U of S online. It looked beautiful, like Hogwarts. I thought it would be silly to say no."

Gillespie will complete her master's degree soon, and will then move into a PhD program. It will be similar work with nutrient-sensing pathways but she will be focusing on Hutchinson Gilford Progeria Syndrome, a premature aging disease.

Despite the fact it is a long way home to visit family, Gillespie is content to continue to pursue her passion in Saskatoon.

"When you do research, you're always going to be able to learn new things. That's what I like to do." ■

Local flavour

COLLEEN MACPHERSON

Life is rarely a straight path, and that can be a good thing.

Two College of Agriculture and Bioresources graduates entered university with single-minded intentions: Candace Ippolito to take her knowledge back to the family beef operation; and Caitlin Olauson to explore issues around food security. But both found their degrees opened up new, and unexpected, possibilities.

Ippolito and Olauson have moved into the world of entrepreneurship, making statements about their beliefs in the importance of good food made from locally sourced ingredients. While their circumstances differ, their stories converge when both women talk about the relationships they established while students at the University of Saskatchewan (U of S). The people at the college were pivotal in setting them both on the path to success.


DAVID STOBBE

Candace Ippolito

Growing up on the family farm near Kisbey in the southeast corner of Saskatchewan, Candace Ippolito developed a love for food and a love for the food business at the same time.

"My grandmother was the first nose-to-tail cook I knew and I've always had an appreciation for good, wholesome food," said Ippolito who, with her brother, is a fourth generation primary beef producer. When it came time for university, "I only applied to one program—animal science—because I knew it would benefit me as a producer and as someone who is part of the industry."

After graduating in 2002, Ippolito worked at various jobs in animal nutrition and feed but felt more could be done to create links between producers and consumers. She related to a story about wanting to cook a Saskatchewan meal for out-of-country visitors but was not able to find what she needed.

"As producers, we're always great ambassadors for good food that starts with great ingredients, and as producers, we're producing those ingredients, but where do you get them?"

Six years ago, Ippolito got the chance to advance the farm-to-fork movement and venture into what she called "the business of agriculture" when she and three silent partners bought the SaskMade Marketplace in Saskatoon from the Saskatchewan Food Processors Association. The store's mandate is to be the link between producers and consumers with both products and information.

"Whatever you need as a consumer, I want to be that bridge," she said. The store currently offers almost 6,000 products from about 150 vendors. Ippolito said her clientele is "all over the place—millennials who are conscious spenders, families looking for wholesome food, foodies who want ingredients for scratch cooking and a small number of tourists (about 20 per cent of the store's products are giftware)."

Knowledgeable staff make themselves available to answer questions, and producers can often be found in the store cooking everything from appetizers to desserts with their products. The store also offers recipes "that can excite people about the raw ingredients and scratch cooking."

In addition to providing products and education to consumers, SaskMade Marketplace serves as a resource for entrepreneurs with new product ideas.

"We're very much where people come to cut their teeth with their products," Ippolito said, adding she does quite a bit of business coaching in addition to running the company.

As for the future, Saskatchewan is the land of opportunity when it comes to growing the agriculture value chain, she said. "We need to take common ingredients and introduce them to new palates in creative ways, and we need to continue to have meaningful conversations with consumers" to help people understand the farm-to-fork link.

Ippolito said the College of Agriculture and Bioresources helped set her on the entrepreneurial path. "I met lifelong friends there and learning about where they came from, their experiences, really created the idea that anything is possible. It got me fired up about community and encouraged me to look beyond the jobs that were already there."

Caitlin Olauson

PROVIDED BY CAITLIN OAULSON

Caitlin Olauson described her journey into the world of business as "accidental," the result of a single class in her final year of a food science degree program in the College of Agriculture and Bioresources.

"I went into the college wanting to do food security research," said Olauson, who grew up on a grain farm outside of Saskatoon. "But in my final year, I took a product development class with Professor Michael Nickerson and for the first time I was able to mix my science knowledge with a creative outlet to meet a need."

For that class, Olauson and two other students formulated a snack bar from homegrown ingredients that won the local Pulse Canada Mission ImPULSEible competition in 2011, the year she graduated, and took second place at the national level.

"At the time, business seemed like a cruel world," and the snack bar went no further. "Then, about 18 months ago, a friend who owns a restaurant in Saskatoon encouraged me to get back into development," said Olauson. "She even said I could use her kitchen."

From that opportunity came The Local Bar, a formulation of lentils, flax, quinoa and saskatoon berries lightly sweetened with honey. Olauson sold the bars out of her friend's restaurant, and the obvious next step was to set up "a real business."

Teaming up with her sister Julie Gryba, Olauson hired a designer to work on packaging, got a lawyer and a business advisor, developed a business plan and a year ago, incorporated Olauson Food Products. Using ingredients sourced from across the province, The Local Bar went into production at the Saskatchewan Food Industry Development Centre.

"The first few production cycles were pretty stressful," she said. "You're investing thousands of dollars a day."

A second bar—sour cherry and dark chocolate—has been added to the product line, which is sold online and through an expanding list of retail outlets.

"Saskatoon is really amazing for supporting local entrepreneurs," she said.

The company is now eyeing other markets across Canada and "we want it to be authentic so we're sourcing ingredients from the location where the bar will be sold. We won't compromise with our suppliers," she said, "or our ideals. The Local Bar is not just a business; it's a statement about what you want from your food system."

Recognizing the challenges of producing food products, Olauson is setting up a new business, a commercial kitchen space "where everyone can share what they've learned and be a catalyst to help new food entrepreneurs get off the ground." She wants to provide others with the support and encouragement that has been so beneficial to her. The Local Kitchen is scheduled to open in November.

Even with all the demands of business, Olauson has not lost touch with her original education goal and is currently in her second year of a master's in food security program at the U of S.

"I hadn't planned on starting two businesses and doing a master's but they were opportunities that I couldn't pass up." ■

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Planting the seeds of success

COLLEEN MACPHERSON

When seeding begins next spring in the University of Saskatchewan fields, machinery operators will be seeing red, but it's just the colour of Morris Industries' newest and most technologically advanced agricultural equipment at work.

The Saskatchewan company, headquartered in Saskatoon, recently provided seeding equipment with a market value of more than $450,000 in the form of a zero-cost lease to the College of Agriculture and Bioresources, a gift that builds on a long-standing and mutually beneficial relationship between the two organizations. For Morris President Ben Voss, the arrangement is as much about a shared commitment to food security as it is about getting seed into the ground.

"One of our company values is that we're here to help feed the world," said Voss, a U of S engineering graduate who remains involved in his family farm near Spiritwood, Sask. "We made this commitment with no strings attached. The university has identified the innovations we're doing and can now use that as a platform to do important research because a crop's potential is determined the day it's seeded."

Outfitted with Input Control Technology for precision seeding and fertilizer application to maximize yield potential, the new Morris equipment replaces versions donated in 2006.

"It was time to upgrade," Voss said, "and this was an opportunity to renew our previous arrangement. And, if the university is using our products, that's a strong signal to the world that locally produced equipment is the best available."

Providing the U of S with the latest in seeding equipment will help ensure researchers can see the advancements being made within the industry, he added, and that they have that technology to test with new crop varieties and seeding protocols. It also gives Voss and his colleagues the chance to show potential customers the machinery in action.

Voss also believes it is important that students, whether they are in soil science, crop science or engineering programs, get first-hand exposure to the latest the industry has to offer.

The idea that companies like Morris can bring those technologies to the university typifies the way the relationship between industry and academia has evolved over time.

"Universities have unique resources like labs and testing facilities that are still very important," said Voss, "but pure discovery, which used to be very prominent, is less so now that innovation is happening on a global scale. Today, companies are sometimes

ahead of universities so they need us to come to the table with guidance on trends and innovation, and to provide true validation of commercial potential."

How companies like Morris Industries collaborate with the U of S may have changed "but the door of the university is always wide open," Voss said. And it opens both ways.

"On the product side, it's about seeing innovation in action in the university fields. If they're doing experimental work on campus with another partner, we want them to be using our equipment.

"On the other side of the equation is how that equipment is made, the innovation in the factory." That is where connecting with researchers in areas like materials science and automation in manufacturing has enormous benefits.

Looking back over the history of his company, Voss said maintaining a strong relationship with the U of S had contributed significantly to the company's success in the field but it has been just as important in the factory.

George Morris set up Morris Rod-Weeder Co. Ltd. in 1929 in Bangor, Sask., to produce and sell his revolutionary rod weeder. What made it revolutionary was Morris' design of the world's first automatic trip that springs up over stones, and then lowers back into the ground to continue working.

As the company grew and required more production capacity, Morris needed engineers, accountants, lawyers and others, and he found them at the U of S, explained Voss. Today, a large percentage of Morris' employees are U of S graduates, bringing expertise to all parts of its operation—marketing, administration, legal, human resources, engineering and commerce. The company has a corporate agronomist doing multi-year projects with the U of S on seed and fertilizer placement as well as soil science studies, and it provides summer employment for university students.

"We have an ongoing interest in alumni and recruit heavily at the U of S," he added, "because graduates are future employees and customers of ours."

Morris Industries operates production facilities in Yorkton, Sask. and Minnedosa, Man. and its product line includes air seeders, drills and carts, packers, harrows and bale-handling equipment. Depending on production demands, its workforce numbers between 200 and 300 people including head office staff.

Looking to the future, Voss is enthusiastic about more partnerships with the College of Agriculture and Bioresources, and with the Global Institute for Food Security at the U of S, in a joint effort to address the challenges of improving crop yields and reducing inputs for farmers.

"Let's find projects," he said. "Let's work together." ■

Charting a third way

Forget ideology—tomorrow's agriculture will be an organic-conventional mash-up.

GLENN CHEATER

In the either/or divide between organic and conventional agriculture, Chris Willenborg refuses to take sides. Or rather, he picks both.

"Too often as growers, and sometimes as scientists, we get stuck in our own ideologies," said the U of S weed scientist. "When I look to the future when it comes to weed control, I see using approaches from both worlds."

That future has already arrived in Willenborg's lab. He points to—with considerable pride—a body of work that includes expanding the range of herbicides for farmers, but also employing approaches such as using bugs and rodents to combat weeds.

Take, for example, his lab's work on sulfentrazone. It's one of those hard-to-pronounce chemicals that's easy to vilify—it kills weeds by bursting cell membranes and persists in the soil for weeks. But it's not carcinogenic and studies haven't found toxic effects until you increase exposure to 300 times what you would encounter while spraying.

Willenborg's research team, in collaboration with industry, proved it was also safe to grow canola a year after applying sulfentrazone, which will potentially allow it to be used more often.

"A fairly significant part of what I do is finding new uses for existing herbicides," he said. "Herbicides are—by far and away—the most effective form of weed control."

But before pigeon-holing Willenborg, consider a comment he makes moments later.

"Farmers tend to view pesticides as the first line of defence, but I believe we need to flip that attitude around," he said. "They should be the last line of defence—a tool you use to deal with those weeds that haven't been taken out by other management practices."

> "There's a growing number of people who are realizing we can blend the philosophies of organic and conventional."
>
> CHRIS WILLENBORG

And for Willenborg, that starts with the weed seedbank—the countless millions of seeds that lie dormant on every field, waiting for the right conditions before germinating and starting a new cycle of infestation.

"It's increasingly being recognized on a global basis that it all starts with the shedding of weed seeds," he said. "I use the old saying 'One year seeding is seven years weeding' to remind people that weed seeds can lie dormant for years and if you don't deal with them now, you'll have to do something about them later."

And one of the things you can do comes straight out of the Mother Earth handbook—work with nature.

"There are a lot of seed predators: song birds, rodents such as voles and mice, and also insects," he said. "We don't usually think about invertebrates, but they are the greatest consumers of weed seeds. Although it's really hard to get real-world estimates of how much insects consume, some U.S. studies have found they can consume 40 per cent to as much as 80 per cent of the weed seedbank for certain weeds."

One of Willenborg's grad students has zeroed in on carabid beetles, a voracious but little-known bug, which is highly effective at gobbling up seeds of common weeds such as volunteer canola and stinkweed.

But once again, Willenborg's research efforts transcend the dividing line between organic and conventional. Another way to manage the weed seedbank is to spray herbicides on crops just prior to harvest. Conventional farmers use this process, called desiccation or harvest aids, because it causes crops to ripen evenly and earlier. But the herbicides are also taken up by weeds that "escaped" previous control efforts, and some herbicides can affect the viability of the seeds they are about to shed.

However, more spraying can also mean fewer insects. Then again, if you also grow cover crops—another favourite in the organic farming toolkit—it tends to significantly boost carabid numbers.

His approach, in short, is a mash-up—using both organic and conventional practices to build hybrid systems. It's all driven by a pragmatism acquired on his grandfather's farm in Wakaw, Sask. Save for when he was getting his doctorate, Willenborg spent every spring and fall that he could on the farm helping sow and harvest the crops.

So he views all of his work through "the farmer's lens"—the tight windows for getting the job done and the even tighter economic margins. But he also looks at the rise of herbicide-resistant weeds—there are now more than 60 in Canada alone—and sees that a new approach is needed.

He's not alone. Earlier this year, Saskatchewan Pulse Growers donated $2 million to his weed science program, praising both his work on herbicides and his efforts to develop a "robust strategy for long-term weed management."

"There's a growing number of people who are realizing we can blend the philosophies of organic and conventional," he said. "We can draw from both systems, and that's where the real long-term sustainability of agriculture lies." ■

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