YEAR OF PULSES

SPRING / 2016

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Dean Spotlight: Mary Buhr

Walking the walk

When Mary Buhr became a dean, the notion of 'spare time' went out the window—but not her passion for research.

Mary Buhr had one condition before agreeing to become dean of the College of Agriculture and Bioresources.

"I said, 'I want to keep my research program going.' And they said, 'Oh, really?'"

Good question. Where exactly do you find time for leading-edge research with 11-hour-plus workdays, events three evenings per week and weekends spent catching up on paperwork?

"I carve out time where I can, which would be three to five hours a week actively focused on my research," said Buhr, an expert in sperm physiology. "I have a wonderful team and we meet once a week. I have huge difficulty in keeping up with all the scientific literature, but I try."

But why? Is the work week not long enough?

"Well first, the research we're doing is really exciting," she said (see accompanying story). "And if my team wasn't making a good contribution to the field we're in, I would stop because it would just be a waste of everybody's time."

But there are other reasons, all of them tied to Buhr's vision of the college as both a "research engine" and a top-drawer learning institution.

"Research-intensive means our faculty not only teach, but also produce brand-new knowledge," she said. "In our case, that means improving agricultural productivity—particularly in this province, but also the world in general."

Attracting and keeping top researchers is a little easier when the dean is getting funding from a prestigious agency (in Buhr's case, the Natural Sciences and Engineering Research Council, or NSERC).

"Everybody in the college, and the university, was aware that I had received that funding," she said. "And that sends the message that high-quality, high-tech research is a priority."

Faculty also know that the boss hasn't forgotten what it's like in the academic trenches.

"It's really important because it continually reminds you of the amount of work involved, the time it takes to write papers and grant applications, and all the frustrations and challenges," said Buhr. "When you're facing it personally, you appreciate what it's like for someone with a huge number of grad students and a huge number of research grants."

Buhr also believes that researchers bring something extra to the classroom.

"You can go in and talk about what you did in the lab this week and you can talk about what it takes to produce strong research," she said. "We are walking the walk, and that influences the way you teach students about how to critically assess information and ask questions."

In an age when it is so easy to be taken in by persuasive bloggers, there is nothing like learning from researchers who challenge themselves every day in their labs, said Buhr.

"We seek the kind of people who don't get stopped when an idea doesn't work. Those people who say, 'Wow, that's interesting. How can I take this setback and use it to move this research along?' That's the creative process. That's why you're a scientist." ■

GLENN CHEATER

DAVID STOBBE

Unravelling a mystery

The moment of conception is a surprisingly mysterious affair, but solving this puzzle has big implications.

Mary Buhr is an expert on sperm—and a bit of a film noir buff.

So if 'membrane-based signalling pathways controlling sperm capacitation' does not paint a picture in your mind, she suggests imagining a mysterious character going down a shadowy back alley.

"The sperm is wearing a disguise and a hat pulled down low and knocking on a door with a little grill in it," she said. "When the grill opens, he takes off the hat and disguise and shows who he really is. And then the door opens."

That moment when the disguise comes off is capacitation, a series of molecular changes that allow the head membrane of a sperm to first fuse with and then penetrate the egg. The rough outline of the process has been known since the days when wisecracking gumshoes and femme fatales still ruled the box office, but the precise details remain a mystery.

"Basically, the egg has to recognize the sperm as being of her species and being healthy before the egg will let the sperm in to fertilize," said Buhr. "What we don't know is what those specific molecules are and how they function."

Artificial insemination has been a tremendous boon to livestock breeding because you can freeze sperm from top males and send it around the world. The result is offspring that produce more meat or milk, utilize feed more efficiently or have other desirable attributes.

"The problem is that when you store these little guys, you're freezing them to -196°C and some don't live through the process," noted Buhr. "We're thinking that if we can identify the molecules that are crucial for fertility, then we could custom design a cryoprotectant—a freezing solution—targeted specifically to protect those molecules."

That could also be huge in the effort to save endangered species.

While the reproductive biology of livestock (such as details of the estrous cycle or where to place sperm) is very well known, that is not the case for wild animals. And collecting sperm from wildlife (think elephants or cheetahs) is not the easiest thing, either. So being able to preserve sperm is critical—you do not want to be unthawing this extremely valuable genetic resource decades from now and discover it isn't viable because of freezer burn.

Better cryopreservation would also help honeybees, the major pollinator of agricultural crops. The honeybee sector suffers big losses each winter and has been plagued by colony collapse disorder in recent years. Replacing those lost colonies means importing new ones from the U.S., which can also bring in varroa mites (a deadly parasite), diseases and Africanized, killer bee hybrids. Using bee semen tested for genetic purity and presence of disease bypasses all those problems.

"You just overwinter and then inseminate the queen and—presto—we don't have to import colonies anymore," she said. "The problem, again, is that bee semen is incredibly hard to preserve."

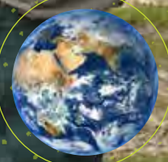
Being a specialist in sperm physiology has led Buhr into areas she never imagined, but that makes it all the more interesting, she said.

"There's not a whole lot of people working with sperm but what we're learning can be applied in many areas, so it really is important work." ■

Connected to Mother Earth

Alumni Profile: Brady Highway

Whether it is bears, wildfires or Cree teachings, Brady Highway brings a deep and different knowledge to managing natural resources.



There is not even a hint of anger or bitterness in his voice as Brady Highway talks about the racism he encountered when he first started university.

GLENN CHEATER

But the sense of wonder is evident when the 36-year-old describes how different it was in the Renewable Resource Management Program at the University of Saskatchewan.

Highway grew up in the Cree community of Pelican Narrows in northeastern Saskatchewan and was in his early twenties when he attended university in Nova Scotia. At the time, the Mi'kmaq people of Burnt Church First Nation were asserting their right to catch and sell lobster, which escalated into a fierce, sometimes violent, confrontation with Nova Scotia fishermen, the RCMP and Ottawa.

"I remember all these students were on the fishermen's side and even some of the professors," he recalled. "This wasn't my battle, but I do stick up for treaty rights, and the federal government was so heavy-handed towards the Mi'kmaq.

"And I'm hearing all these bigoted comments and thinking, 'I can't take listening to this every day. Maybe education isn't for me.'"

Despite that, a decade later Highway decided to pursue his bachelor of science. He still marvels at the experience.

"One day I find myself in a class (Natural Resource Management and Indigenous Peoples) where all these same issues are coming up, but all of a sudden the lens had been changed," he said.

"(Professor) David Natcher was talking about the duty to consult with First Nations peoples and the duty to accommodate before huge resource development projects go ahead. These were concepts that when I was younger, you would have said, 'Wouldn't it be nice if one day…'

"Now he's saying, 'This is how it's going to be going forward.' It was absolutely profound. It was just one of those really, really powerful moments when you realize, 'Yeah, I'm in the right spot right now.' It was pretty cool."

There was also something deeper taking place—a recognition that 'growing up in the bush' brings a deep and different understanding of ecology than you get from textbooks and field studies.

"At first I was a little apprehensive about speaking up, first because I'm an Aboriginal and second because I'm an old bugger who is at least 10 years older than most in the class," said Highway. "But I started taking a few chances, getting involved in the classroom conversation and talking about some of the lessons I learned growing up on the land.

"It might be things I learned as a kid while picking berries—Cree names for the seasons and what they mean—or what's going on when an animal appears stressed. I'd pipe up and eventually was encouraged to share these teachings. I wasn't expecting that," he said.

"Professors were asking me to take an extra 30 minutes and expand on my presentation or lead a discussion on bear safety or fire behaviour."

One could not ask for a better instructor on either of those topics. The grandson of a Hudson Bay guide, Highway lived in small remote communities with his father, a teacher. Summers were spent on the land, often in the company of his grandmother, who spoke only Cree. At age 18, he was hired by Parks Canada, given "a flashlight and a uniform" and responsibility for patrolling part of Yoho National Park.

"It was a dream job; I had my cowboy hat pulled down low and am sashaying through the mountains thinking, 'I've pretty much got 'er made'" he said. "Then one day I ran into a grizzly bear. It was about 14 feet away and already standing up on its hind legs.

> "I took a couple of steps back, got down on one knee to look submissive, and when I looked up he was halfway up this moraine. He was so fast, he just exploded out of there. I was absolutely humbled by this animal."

Highway would go on to fight wildfires across Saskatchewan—somewhere between 200 and 250—eventually leading crews of up to 20 people into situations where a single miscalculation could have deadly consequences. When you're in an area that has been "saved" from forest fire and is filled with old, half-dead and tinder-dry trees waiting to go up in flames, you appreciate resource management in a very different way, he said. To this day, Highway can take in the health—and what's called the 'fuel load'—of a forest in a glance.

Since graduating in 2013, he has traded the bush for treeless Churchill, Man., where he's the visitor safety and fire operations coordinator at Wapusk National Park—a.k.a. the guy who makes sure the polar bears don't get you.

"Polar bears and wildfires," he said with a laugh. "The two things in my life that scare the wits out of me, and I've ended up making my career of them."

The park attracts visitors from around the world, and no one goes out on the hauntingly beautiful tundra without at least one armed bear monitor. ■

KARLYN DZIK

Future promise

Scholarships benefit students and the economy

"I feel privileged to be part of the strong and growing agriculture industry," said Jacqueline Toews, a third-year crop science student in the College of Agriculture and Bioresources and recipient of the Saskatchewan Wheat Development Commission (Sask Wheat) Essay Award.

Toews has found her place in the agriculture sector and scholarships like the one she received from Sask Wheat are helping her grow her roots.

Sask Wheat, a producer-led organization established to build a platform for growth in the province's wheat industry, is contributing $10,000 towards undergraduate scholarships and $100,000 towards graduate scholarships annually.

This commitment supports four undergraduate awards of $2,500 each, providing a significant offset to tuition costs. The graduate scholarships are exceptional in that they are intended to fully support recipients through completion of their graduate programs.

The first four undergraduate recipients include Hannah Friesen, a second-year crop science major; Devan Guenter, a third-year crop science major; Andrew Reddekopp, a third-year agronomy major; and Toews.

For Toews, the award will help "in attaining my crop science degree—a degree that will help me take knowledge back to my family farm and my community to incorporate more sustainable and innovative practices on our farm and the farms of other producers."

JACQUELINE TOEWS, KEN ROSAASEN AND ANDREW REDDEKOPP AT THE BEAN FEED AWARDS GALA, NOVEMBER 2015.

DAVID STOBBE

"These students are the next generation of producers and researchers and we want to see them involved in issues related to wheat production early on," said Bill Gehl, Sask Wheat Board Chair.

"The financial contributions to education and research by the Saskatchewan Wheat Development Commission and various others are not only appreciated, but also important for further growth of the agriculture industry," added Toews.

Gehl explained the scholarships are intended to encourage and support new research and innovation, the undergraduate and graduate levels, that will benefit wheat producers in Saskatchewan.

"We want to engage students and get them thinking more about wheat research and issues facing the wheat sector," he said.

Recipients of these scholarships were selected on academic merit as well as an essay based on wheat research. In their essays, the students were required to describe how an area of research has or could benefit the wheat sector while also describing a current challenge facing the wheat sector and how it may be addressed by research.

"The essays of the undergraduate scholarship recipients clearly indicate our agriculture students have an excellent understanding of the issues facing wheat producers," Gehl said. "This generation is well on its way to being leaders in the agriculture sector." ■

247 Undergraduate Awards
111 Graduate Awards

Total amount of scholarships, bursaries and awards funding
$1,684,595

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Undergraduate Spotlight: Logan Pizzy

Farming for the future

BRITTANY STEVENS

DAVID STOBBE

Logan Pizzey left behind his family farm to pursue a degree in agriculture, knowing the skills he would develop would make him an asset to the family business.

"It was never a question coming out of high school that I would get an ag degree," he said. "Growing up on a farm and working with my family, it seemed like an important next step."

His family owns and operates a pedigreed seed farm in Binscarth, Man. He grew up working closely with his father and grandfather harvesting wheat, barley, oats, forage peas and commercial-grade canola that they marketed directly to other farmers and producers.

"Although I knew what I wanted to study, I had no idea how vague that was until I got here," he said. "There were so many course and program offers to choose from." Pizzey will graduate this year with a degree in agribusiness and a minor in crop production—both of which offer immense real-world value to his future on the farm.

Coming to the U of S was an easy choice. While the ability to tailor a degree to fit his needs certainly motivated his decision, the university's proximity to the farm helped make the transition from farm to classroom a little bit easier.

"It's nice to be able to go back during harvest to help my dad and grandpa," he said, noting that being able to apply his coursework to real-world issues has been beneficial to the entire operation.

Specifically, Pizzey credits his fourth-year agribusiness venture management course as a catalyst for his success. "My group was able to use some of the skills we learned in our finance and operations management courses such as linear programming and financial analysis tools to develop a business plan," he explained.

"The whole experience has been positive. Lots of students get degrees that they don't know what to do with. I'm so fortunate my degree will allow me to do what I love.

"Sometimes you wonder why you're learning something, or whether or not you will ever need to know it," he said. "Being able to execute these skills allows us to see how practical they actually are."

As he enters his final semester, Pizzey is considering graduate school—a decision he knows will have even stronger impact on his future. "It's hard being away from home," he said. "But I know that continuing my research will only give me more insight into the complexities of running a farm."

Currently writing his fourth-year thesis on the competitiveness of grain shipping in the Great Lakes, he hopes to walk away with a clearer understanding of the policies necessary for governing a high production farm, like the one his family operates.

"My studies have definitely made me a more critical thinker," he said. "Now when I read articles I question whether or not economic theories align, or whether or not the statistical methods are credible, or whether or not the proposed policy change is likely to bring about the benefits it intends to." The ability to see the bigger picture and assess issues from all angles is perhaps the most valuable skill he has learned. "As a new generation of decision makers in the agribusiness industry, it's really important that I be critical and informed," he said. "Especially in this age of information, where we are constantly being bombarded with claims and new ideas."

With this mentality, Pizzey is confident that his studies will prepare him for a successful career in farming. "I'm definitely a farmer at heart," said Pizzey. "Farming is my family's livelihood, and I can't wait to take everything that I've learned to help the business grow." ■

The grass can be greener

Q & A WITH BRUCE COULMAN

Forage breeding doesn't get much love, but Bruce Coulman knows it is key to healthy ecosystems and feeding the world.

Critics contend livestock, especially cattle, use land that could produce food. What's your response?

Beef cattle get about 80 per cent of their nutrients from forages, much of it perennial forage grown on land not suited for crop production. Land planted to a perennial cover increases organic matter in the soil, and prevents both soil and water erosion.

Our natural grasslands here were once grazed by vast herds of bison and evolved under grazing. You can overgraze, but well-managed grazing is actually beneficial to the ecosystem.

New forage cultivars play a role in that and you have developed more than 20 new cultivars. Please talk about one.

One is hybrid brome grass, created from two brome species. Smooth brome is a good hay species, producing most of its growth in spring and early summer. Meadow brome doesn't have the high productivity of smooth brome early in the season but regrows well. They're fairly closely related, so can be crossed, but it took many years of selection to produce productive hybrids. The first crosses were actually made in the late 1970s. In 2000 we released the first dual-purpose variety of hybrid brome and then a second one in 2003, and these have been very popular with producers. They can take a first cut of hay and then later graze those fields.

The gains from new forage varieties are often quite small, but a perennial forage crop lasts many years. If a new variety gives a five per cent productivity increase, you get that five per cent increase every year. So over time, the gains become quite significant.

Grasslands cover about 25 per cent of the land on the planet and 70 per cent of agricultural land. You've come to know one grassland on the other side of the globe very well, haven't you?

I started teaching forage crop production at the Inner Mongolia Agriculture University in 2002. Since then I've been there every year but one. Inner Mongolia is about the size of Saskatchewan and Alberta put together, and about 70 per cent is grasslands.

DAVID STOBBE

> "To meet the demand for animal products, we have to get more productivity from agricultural land, and that includes improving the quantity and quality of feed."

GLENN CHEATER

The number of livestock—cattle, sheep, cashmere goats—has increased greatly over the past 25 years. This has led to some serious overgrazing and degradation and erosion, even to the point of desertification. This is a big issue because in Beijing, which isn't that far away, dust storms in the spring are fairly common.

All this has led to restricted spring grazing on some land, and other areas have been closed off and the herders resettled. This is no small deal. Not only do you ruin the livelihoods of many small herders, but you have serious ecological consequences from not managing grazing lands properly. Part of the response has been to plant billions and billions of trees, but in the drier areas there never were trees, so there's concern the water table may be drawn down and this effort may fail.

However, there's also been an effort to manage the resource better through things like fencing off land and implementing rotational grazing. Producers are being encouraged to produce hay, partly by using high-yielding species. Hay is important as a feed source in the winter, but especially in the spring when native grasses are just starting to grow and can be really damaged if you graze them then.

Does this play into a larger issue, namely feeding a global population heading towards nine billion people?

Yes. China has a growing economy and greater affluence, and that means there's more demand for meat and milk. This demand is going to increase in China and elsewhere, but there is not going to be any great increase in land for agriculture of any sort. So to meet the demand for animal products, we have to get more productivity from agricultural land, and that includes improving the quantity and quality of feed.

Food security is the goal of another project in Ethiopia you are involved with.

The collaboration with Hawassa University started in 1997, funded by a series of International Development Research Centre (and other federal government) grants. Initially, it was about capacity building by creating graduate programs, but about 10 years ago the focus shifted, specifically to pulse production.

Southern Ethiopia has a rainy season in spring, summer, and fall, and then a dry season in late fall and winter. The main crops are wheat, corn and a cereal called teff, and after harvest the land is left idle until the next spring. But chickpeas can grow on the residual moisture after the main crop is harvested—and because it is a legume, it adds nitrogen to the soil.

As well, including pulses in people's diets helps prevent the malnutrition and stunting in children we see in that region. So there have been programs to educate Ethiopians on how to cook and use chickpeas and other pulses, and promote their use.

Now we're trying to scale this up, with the goal of getting 70,000 farmers to grow pulses. I've previously been involved on the scientific advisory board of this project, but my new role is more focused on project management.

So you are involved in food security efforts both on the crops and forage side. Do you think people appreciate the importance of the latter, particularly when it comes to forage breeding?

The simple answer is no, and this is precisely why we've seen budgets for forage breeding slashed over the years, not just in Canada but elsewhere. We have about 15 forage researchers in Canada now—about 30 per cent of what we had in the 1980s. I quite expected that when I retired, I wouldn't be replaced with another forage breeder.

But in recent years, we've seen more funding. The Beef Cattle Research Council has increased its funding for forage research and so has Saskatchewan's Agriculture Development Fund. And in May 2014, the university hired Bill Biligetu as a forage breeder. So I'll be turning the program over to him.

Can forage breeding make a difference in the lives of people?

In an indirect way, yes. Improving the productivity and quality of forage through breeding will lead to more livestock production. This will increase the availability of nutritious meat and milk for the world's population. ■

What lies beneath

Can you rebuild a forest on an oil sands mine? That is the work of a lifetime for soil scientist Bing Si.

Alberta's oil sands are infamous among environmentalists, even likened to Hiroshima by rock legend Neil Young.

GLENN CHEATER

However its open-pit mines are also the site of one of the most ambitious ecological restoration projects ever attempted. It is the work of a lifetime for U of S soil scientist Bing Si, an expert in soil water dynamics.

"I'm good at the theory of soil water and the physics of soil," said the soft-spoken 52-year-old. "But I wanted to apply the theory and, if I can, make a difference for the environment. That's why I was keen to jump into the reclamation industry."

Only about three per cent of the oil sands—4,800 square kilometres—are close enough to the surface to be mined and only one-sixth of that area has been stripped of what is called the 'overburden' (the layer of soil, sand, rocks and organic material) so mining can take place. But 800 square kilometres is still a huge area and while the oil industry has nice videos of reclaimed land (77 square kilometres so far), creating a functioning, natural ecosystem is not as simple as trucking in the overburden, spreading it around and planting some trees.

"It's not easy because we want to preserve the biodiversity and have a similar composition of the forest," said Si. "You need to understand why a certain type of forest grows on a certain type of soil."

While boreal forests are much less diverse than their tropical cousins, they are not monocultures. Sometimes you find stands of aspen mixed with jack pine and sometimes aspen and spruce. Both require different amounts of soil water. And if it is just jack pine—the cacti of northern forests—you know you are in a very dry area indeed. And yet the topsoil will look similar in all three areas.

"Why is the vegetation above the soil so different?" asked Si. "What we found was a minor layering of different-sized soil particles, and this layering of fine and coarse particles affects the movement of water. When it slows down the infiltration of water, it is basically storing it in the soil so plants can utilize it."

Of course, three types of trees do not a forest make. Mosses, lichens, sedges, small shrubs, flowering plants and many other types of vegetation help create tiny ecosystems that all play a role within the larger one. And, of course, water movement is key to sustaining the fens and bogs that abound in this boreal landscape.

All of this must be taken into account when reclaiming a mine site.

"For example, if you mix the soil very well, then the water will move very well and you will have a dry forest," said Si. "If you have more heterogeneity, you can have more water storage, but if the vegetation uses all the water, then the wetlands will be dry. Movement of water is very important."

So what is the recipe for recreating a boreal forest?

Google does not have an answer to that, so you have to learn the old-fashioned way: monitor reclamation efforts to see what works and what does not. But that does not do a lot of good if you do not know what is going on beneath the surface.

But how on earth—so to speak—can you do that?

The short answer is to shoot electromagnetic waves through the ground, and measure how they behave. Such measurement can reveal the amount of water in the ground and even its temperature—and that is all an expert in soil water dynamics needs.

The first such instruments appeared in the 1980s when Canadian Clarke Topp stuck stainless-steel probes into the ground and largely invented something called time domain reflectometry. Technology has advanced since then, which is a good thing since Si and other U of S researchers have one of the largest 'test plots' in the world—a 43-hectare reclamation site near Syncrude's Aurora mine (one of nine open-pit oil sands operations).

When the area was being reclaimed, four 200-metre-long fibre optic cables were laid under the surface at different depths. By firing a laser beam down the cables and measuring changes in the beam's frequency, they can get temperature readings every metre.

They are also using a nifty device called COSMOS (Cosmic-ray Soil Moisture Observing System) that tracks neutrons. These subatomic particles are constantly bombarding Earth and penetrating the ground. But when a neutron hits a hydrogen molecule, a portion of it (called a fast neutron) bounces back.

"COSMOS is a box with two tubes—one measuring how many fast neutrons are hitting the soil and one measuring how many are reflected back," said Si. "Since most of the hydrogen in the soil is in water, we can use this ratio to determine how much water is in the soil."

Since just one machine—a steal at $20,000—covers virtually the entire study site, researchers can create a picture of how water is moving through the subsurface. But while the technology is impressive, there is no getting around the fact that this is long-term research.

"The natural landscape is relatively new, but it still took 10,000 years to evolve," said Si. "Can the landscape be restored? Based on the knowledge that we have now, I don't think we can answer that question with 100 per cent confidence. We will have to monitor this artificial landscape for many years to see how it evolves."

It has been nearly 16 years since Si came to the U of S and began working with Lee Barbour, a geological engineering professor whom Si describes as the world's leading reclamation expert. Now he says training the next generation of researchers is just as important as his own studies.

"We need to train our future scientists to deal with this problem," he said. "So through research and through training graduate students, yes, I think I am making a difference." ■

Transforming the Prairies

the Third Act

Wheat and canola are the long-reigning king and queen, but healthy, soil-building pulses are coming on strong.

First came King Wheat, and then canola—the Cinderella crop—turned the land golden. And now the rise of pulse crops has the Prairies on the brink of a third agricultural makeover.

GLENN CHEATER

KIRSTIN BETT AND SABINA BANNIZA

DAVE STOBBE

"Our goal is to have pulses in a one-in-four year rotation—let's say 20 per cent of the landscape," said U of S plant scientist Kirstin Bett. "We're at 12 per cent, so we're not there yet. But we want to offer every producer at least two species of pulses so they can include these legumes in their rotation."

Pulses (dry peas, lentils, dry beans, chickpeas and faba beans) pack a triple punch: affordable protein for a global population heading towards nine billion, a 'superfood' with multiple health benefits and a nitrogen-fixing crop that builds soil.

It's a win-win-win with just a teensy problem—plant breeders will need to develop new varieties that are better yielding, can thrive in areas where pulses are not traditionally grown and are resistant to a host of diseases.

It is a tall order, until you consider the record of Bett and her colleagues at the U of S Crop Development Centre (CDC). Since releasing its first pulse—the Laird lentil—in 1978, the centre has produced more than 200 pulse varieties.

"There were no pulses to speak of in the 1970s until Al Slinkard (the centre's first pulse breeder) came and began breeding peas and lentils suitable for Saskatchewan," noted Bett, a dry bean breeder.

That work fuelled an explosion of pulse acres on the Prairies—about 3.9 million acres of lentils and 3.7 million acres of dry peas were grown last year. But Bett and her fellow breeders (Bert Vandenberg, Tom Warkentin, Bunyamin Tar'an and plant pathologist Sabine Banniza) cannot rest on their laurels if pulses are going to capture one-fifth of the West's 70 million crop acres.

And there is always the danger of going backwards. One of the centre's earliest successes was chickpeas, which went from 10,000 acres in 1996 to more than a million in 2001. By last year, it was just one-tenth of that amount.

"Declining prices were a factor, but disease played a major role," said Banniza. "We had major infestations of ascochyta blight."

Disease is literally a problem that comes with the territory: plant millions of acres of any crop and disease pressure skyrockets, especially if you plant the same crop on the same field every two or three years. Today, one of the biggest threats is a root rot (first discovered in Saskatchewan in 2012 and now known to be widespread) caused by an organism called *Aphanomyces* that attacks peas and lentils.

"If you go into areas where they have a lot of problems, you can see a very clear trend between how often they grow a pea crop and the incidence of root rot," noted Banniza. "The more frequently you grow a crop, the greater the chance you'll have disease problems."

Still, farmers' practices don't lessen the pressure on Banniza, Bett and their colleagues. Growers continuously demand improved disease resistance, varieties better suited to the northern plains and a host of other things (such as larger chickpeas that fetch higher prices on world markets). And the challenge is made all the greater by the fact that pulses originated in tropical or subtropical regions.

Bett laughed as she describes the challenges of growing beans on the Canadian Prairie.

> "Our goal is to have pulses in a one-in-four year rotation—let's say 20 per cent of the landscape."
>
> Kirstin Bett

"First of all, you can't plant them before the ground is warm enough, so you have to wait until the last week of May, and then you need them to come out of the ground quickly," she said. "Because traditional varieties are often sensitive to day length, they typically don't flower until there are 12-hour days—and guess what?—we don't get those until the day before harvest. They're also super sensitive to frost. So yeah, they're a lot of fun."

Lentils have the opposite problem—the long days of June make them want to flower soon after emerging from the soil. But obviously neither crop would be grown here if the day-length sensitivity issue could not be solved. In the case of dry beans, there is a gene that turns off that function but in turn presents a new challenge: that gene must be present in every breeding line of new potential varieties.

"Because we see each other all the time and our breeding programs are integrated, we sort of pollinate each other with new ideas."

Sabine Banniza

But the CDC pulse team has a secret weapon: each other.

"We're not the largest pulse research team, but we're one of the most concentrated teams anywhere," said Banniza. "Australia has more pulse breeders, but they're spread across the country.

"Because we see each other all the time and our breeding programs are integrated, we sort of pollinate each other with new ideas."

She points to genomic sequencing as an example.

"I'm surrounded by plant breeders and one of the things all plant breeders do these days is map genomes," she said. "So one day, I thought, 'Why don't I try this with a fungus?' It's not something that's normally done and if I didn't work with plant breeders, I probably never would have thought of that."

It was an inspired idea. One of the biggest banes of plant breeders is that resistance can be incredibly short-lived, especially when farmers tempt fate by growing a variety too often.

"If you understand what makes a fungus virulent, what genes are involved, and how quickly they change, then you have a better understanding of how good your resistance is and how long it might last," said Banniza.

Another example of their team approach is KnowPulse, which Bett described as "a breeder-friendly web portal you can use without knowing anything about databases."

"It's basically a whole suite of tools that allow us to look at data in a whole bunch of different ways," she said.

Although knowpulse.usask.ca is never going to rival Google, even a non-scientist can appreciate how useful it could be. Just as you might want to find a store in your neighbourhood, a plant breeder might be interested in a gene that inhibits a particular enzyme. Type that into its search engine and you can not only find all the genes in the database that are similar, but also their base-pair sequences and even, in some cases, where they are located on a chromosome of a similar plant.

The old saying is plant breeding is like a lottery, said Bett, adding that 99 per cent of all the crosses you make "will break your heart."

But having a tight-knit group that is constantly looking for an edge has allowed CDC pulse breeders to punch well above their weight.

"It's not cheap to develop a variety," said Bett. "It takes a good 10 years from the time I make a cross to getting it out on the landscape. So the more you can increase efficiency—either in costs or time—the better."

Ushering in the next big transformation in Prairie agriculture is no small task, and while wheat, corn and rice will remain the world's main food staples, the future for pulses is bright, adds Banniza.

"There is more awareness of food in general, and pulses have so many benefits—they have a very good chance of being right up there." ■

2016 INTERNATIONAL YEAR OF PULSES

Our pulse history

1972

Crop Development Centre (CDC) hires experienced pea breeder Al Slinkard from the University of Idaho.

1973

Fifty potentially adapted lentil lines are chosen from USDA gene bank and increased.

1974

Lentils are grown in replicated plots and evaluated for yield, height, weight, coat colour, cotyledon colour and other agronomic traits.

1976

First Saskatchewan pulse producer organization (Saskatchewan Pulse Crop Growers Association) - was formed.

1978

First breeder seed plot of Laird lentil is grown on the farm of Don Tait of Elrose, Sask.

1979

Chickpeas are identified as a crop which can be grown in Saskatchewan, and development of varieties and production begins at the CDC.

1980

Eston, a small-seeded lentil variety, is released.

1981

Outlook faba bean is licensed for use in Canada.

1982

Canada becomes the second-largest exporter of lentil crops.

2016 INTERNATIONAL YEAR OF PULSES

Pulse Crops developed by the Crop Development Centre:
BEAN 41 CHICKPEA 24 FABA BEAN 7 LENTIL 75 PEA 67

Our pulse history CONTINUED...

1984
Producers voted to institute a mandatory, non-refundable check-off to fund projects to develop the industry. Formed Saskatchewan Pulse Growers (SPG).

1986
Higher-yielding Bellevue pea variety is registered, named in honour of the oldest pea-growing area in Saskatchewan.

1987
Lentil acres reach 240,000 hectares.

153,780 hectares of peas are grown in Saskatchewan, making it the leading province in pea production.

1988
Green manure type-Indian Head released.

1989
Rose, a red cotyledon lentil, is registered.

1990
Pinto bean breeding program initiated at the CDC.

1991
Canada becomes the largest exporter of green seed lentils.

Faba bean cultivar development is officially terminated from the CDC strategic plan.

Segregating lentil lines are grown in a Chile winter nursery for the first time.

1992
New class market of low tannin lentil is developed. CDC Gold is the first low tannin variety.

1993
Germplasm of Spectrum specialty seeds is brought into CDC pulse breeding program.

1994
Canada becomes the largest lentil exporter in the world.

1997
CDC Milestone released as first ascochyta-resistant lentil.

CDC and SPG sign important agreement: SPG to market all CDC pea, lentil, bean and chickpea varieties.

1998
Laird lentil reaches one million acres in Saskatchewan.

1999
CDC Mozart first semi-leafless pea variety released.

CDC Pintium first pinto bean suitable for short season environment.

CDC hires a second pulse breeder to intensify the field pea breeding effort.

2000
CDC recruits a pulse pathologist to support the pulse breeding programs.

2003
CDC Frontier is first kabuli chickpea with significant aschocyta blight resistance.

CDC re-starts their faba bean research.

2005
The world's first lentil varieties resistant to imidazolinone herbicides is released.

2006
CDC intensifies its chickpea breeding program by recruiting a full-time chickpea breeder.

2007
CDC Maxim red IMI lentil released and becomes most widely grown worldwide

CDC Striker becomes most widely grown green pea cultivar in Western Canada

2008
Canada's first slow darkening pinto bean variety is released.

2010
CDC Sol-first commercially grown yellow bean north of the 49th parallel.

First small seeded faba bean for human consumption recommended for market.

2012
CDC Meadow becomes most widely grown pea cultivar in Western Canada.

2013
Laird Lentil wins Seed of the Year honour.

CDC Frontier chickpea genome is sequenced.

2015
Lentil genome sequencing project is completed.

DAVID STOBBE

BRITTANY STEVENS

Graduate Spotlight: Janna Moats

Got milk?

The farm-to-fork connection that is changing the face of dairy

Growing up on a mixed farm outside of Regina, Sask., inspired a passion for agriculture in Janna Moats at an early age.

The first in her immediate family to obtain an agriculture degree at the University of Saskatchewan, Moats' interest in animal nutrition was sparked by her experience working on a variety of dairy farms. Seeing the direct connection between what animals eat and the human benefit, she knew she wanted to learn more.

After completing her undergraduate degree (BSA) in animal science in 2012, Moats accepted a research position with the feed manufacturing company O&T Farms in Regina.

In this role, Moats provided technical support to customers and helped co-ordinate research initiatives. Inspired to use her skills to build on her own passions and interests, she returned to the U of S in 2013 to pursue graduate studies in ruminant nutrition.

Moats' research is a collaboration between the College of Agriculture and Bioresources and O&T Farms, with additional funding from SaskMilk and the National Research Council. Under the supervision of David Christensen and Timothy Mutsvangwa in the Department of Animal and Poultry Science, Moats examines how the nutritional value of milk is affected when dairy cows are fed a supplemented flaxseed diet.

Canada is the world's largest producer of flaxseed, producing nearly 40 per cent of the global yield. Flaxseed contains high levels of omega-3 fatty acids, which are known to benefit both animal and human health.

Using Holsteins from the U of S herd, Moats compares benefits of feeding cows a control diet and those fed diets supplemented with unprocessed or extruded flaxseed products.

Having seen an increase in omega-3 fatty acid content in milk when cows were fed the extruded diet, Moats is encouraged by the initial results and is hopeful the final outcome will lead to development of value-added dairy products in Saskatchewan.

"I truly believe our province has the potential to become a leader in the omega-3 dairy product production," said Moats. "Implementing extruded flaxseed into the diets of dairy cattle could benefit all levels of the supply chain by creating new markets and increasing the availability of essential nutrients for consumers."

Last July, Moats presented her research at the American Dairy Science Association's joint annual meeting in Orlando, Fla. Her presentation earned her first place in the three-minute thesis competition and second place in the graduate student research poster competition. The opportunity granted her invaluable exposure and helped showcase Saskatchewan's agricultural presence on an international scale.

"Having our research receive that kind of international recognition was such an exciting and humbling experience," she said.

Moats is the recipient of many awards and scholarships. Notably, she received the Saskatchewan Innovation and Opportunities Scholarship, awarded to graduate students whose research topics are thought to enhance the province's agriculture industry.

Building on the relevance of the farm-to-fork mentality, Moats hopes to apply her knowledge to developing innovative animal feed programs to improve animal performance as well as the nutritional value of food products for consumers.

"The impact animal nutrition can have on the quality of the food we produce has always been an area of interest for me," she said. "Combine this with the importance of consumer nutrition, and it's easy to see that this research opportunity was a natural fit." ■

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Canadian Feed Research Centre receives gift from the class of 1966

Alumni from the college class of 1966 collectively donated approximately $15,000 towards the Canadian Feed Research Facility located in North Battleford. As permanent recognition of their generosity a plaque commemorating this contribution will be installed at the facility during the summer.

Alumni Profile: Parthiba Balasubramanian

Dreams do come true

How a passion for pulse breeding brought Parthiba Balasubramanian from Tamil Nadu to Saskatoon

Some field trips really are better than others.

Although it was 26 years ago, Parthiba Balasubramanian's voice rises in excitement as he describes his class tour of the International Crops Research Institute for the Semi-Arid Tropics near Hyderabad, India.

"To tell you the truth, I forgot I was in India when I went there," recalled Balasubramanian. "This is a huge research facility with scientists from all over the globe. The way they interacted with us, the way they presented their research, the facility itself—it was amazing."

Then and there the 20-year-old undergrad decided he somehow would find a way to go abroad to pursue his dream.

"I realized that if I wanted to work in an institute like that, I needed to be exposed to another culture, different teaching methodology and all that. I said, 'I must find a way. I must.'"

It was a tall order for a young man from a modest background. But a year later, a graduate scholarship—what he called "the other piece of the puzzle"—would bring Balasubramanian to the University of Saskatchewan, where he would obtain his master's and PhD degrees and go on to become a leading breeder of dry beans with Agriculture and Agri-Food Canada.

"It was for $12,000 a year for two years. Without that scholarship, I would not have been able to come to Canada, that's for sure," he said. "There was no way that I, or my parents, could do that."

Saskatchewan was a big transition 20°C is considered chilly in his home state of Tamil Nadu—and most of what Balasubramanian knew about his new home came from a pamphlet put out by the U of S International Student Office.

The weather, of course, was a surprise—"You don't know what -25 C is like until you experience it"—but so was the warmth of his welcome.

"I had really good professors and really good friends, both Canadians and other foreign students, who made my life so much better in Saskatoon," he said.

That good start launched a stellar research career. His specialty is dry beans, the third-most widely grown pulse crop in Canada. Over the past 40 years, the Prairies have become a world powerhouse in peas and lentils, accounting for roughly one-third of world production and more than half of global trade. The area suitable for beans—and there are a bewildering number of varieties—is small in comparison and most go to specialty markets in Europe, the U.S., and Japan.

But there is huge potential both to expand production and to serve markets in Latin America, Asia and Africa. The trick is to find varieties better suited to the Prairies and also appealing to international customers. The latter isn't easy. In addition to the big three agronomic traits—yield, maturity and disease resistance—Balasubramanian must also breed beans that are the right size, shape and colour.

"If a bean doesn't look good when it's dry, then you cannot expect it to look good when it's processed," he said. "The visual appeal of the dry seed is extremely important."

"I needed to be exposed to another culture, different teaching methodology and all that. I said, 'I must find a way. I must.'"

GLENN CHEATER

Then there is 'seed coat integrity'—not so fragile that it will crack and split, or so thick that it won't soak up water. On top of that, there is the problem of beans getting mushy when cooked and canned—something Balasubramanian has been working on since his student days at U of S. That is why his lab in Lethbridge looks a bit like an industrial kitchen, and is acquiring a state-of-the-art rotary retort for canning.

It all adds up to a very tall order: high yields; maturity in 105 days or fewer; resistance to white mould and bacterial blight; right size and shape; a nice colour that doesn't fade too much in storage or when cooked; a robust seed coat that doesn't crack but still soaks well; and looks good when coming out of a can.

And ideally you want to have all of that for each of the varieties grown in Canada: pinto, great northern, yellow, black, small red, pink, kidney (dark red, light red and white) and cranberry bean.

In short, there is more than enough work for Balasubramanian, who is one of just a handful of bean breeders in the country. But while the task is large, so are the benefits.

Although humans have been growing and eating pulses for 10,000 years, the legumes have long flown under the radar in the western world but that is changing. This year has been designated by the United Nations as the International Year of Pulses to raise awareness of how vital they are to the future of humanity. Because they fix nitrogen and improve soil, pulses are at the forefront of sustainable agriculture, and because they are so nutrient-dense, they are key in the battle against malnutrition and preventing illnesses such as cancer, diabetes and heart disease.

The enthusiasm he showed when talking about that long-ago field trip returns when Balasubramanian talks about pulses and their future. He speaks excitedly of the pulses showing up on the menu when researchers gather at conferences and how his wife recently made a blueberry cake in which half of the flour was replaced by pureed white kidney beans.

As it happens, beans are not a staple in India, and his favourite pulses were yellow and green peas.

"But I eat beans now," he quickly added. "The thing about India is that pulses are part of the culture and a tradition, just like potatoes are here because they are something you have at Thanksgiving, Christmas and family occasions. Somehow we have to make pulses part of the tradition here."

Improved pulse varieties play a key role in that. They've allowed production to greatly expand and that has given rise to pulse growers' associations that are both funding more research and promoting consumption.

"Researchers and growers are working together to do everything they can to bring pulses into the mainstream," says Balasubramanian. "It's only a matter of time." ■

The billion dollar disappearing act

All eyes were on the railways when 'grain gridlock' hit the Prairies, but Richard Gray was following the money

GLENN CHEATER

It was September, 2013, and at a farm near Indian Head, Saskatchewan, Richard Gray watched wheat flood into the combine hopper.

"We realized within 20 minutes it was actually yielding far better than it looked," recalls Gray, a head-turning 15 bushels an acre more than they were expecting.

Gray owns the farm with his son and is its head marketing guy. He's also a professor in the Department of Agricultural and Resource Economics at the University of Saskatchewan. It was the academic that saw clouds looming that would soon slip billions of dollars from farmers' pockets.

"All the reports (from across the Prairies) were that crops were looking very good," Gray says. "I knew if they turned out to be bumper crops, it was going to tax the transportation system to the limit. There was no way they would be able to move it all in a year."

Gray had to make the call: haul now, or wait.

"We decided to deliver most of our wheat crop directly to the elevator," he says. "Within a month or less, all the elevators were pretty full."

Normally, 'selling off the combine' means taking less, as prices are usually lowest at harvest. But this record-smashing 94-million-tonne behemoth wasn't normal. Bins quickly filled, and the excess went into grain bags or was simply piled on the ground and covered with tarps.

A harsh winter made things worse. In extreme cold, trains must be shorter and travel more slowly. Soon dozens of empty grain freighters were anchored on the West Coast, awaiting delivery. Farmers howled in protest, demanding Ottawa force CN and CP Rail to move more grain. Their ire may have been partly misplaced.

Gray followed the money, specifically something called basis. This is what farmers pay grain companies to handle and transport grain to port.

"My colleagues and I started hearing some numbers about port price and elevator price, and there was a huge gap," he says. "Farmers were selling grain well below port prices and it was costing them an awful lot of money."

Gray didn't know exactly how awful, so he and his colleagues hastily organized a symposium to have a look.

Meanwhile, the federal government issued an order-in-council requiring the railways to each move 500,000 tonnes of grain weekly or face fines of $100,000 per day. But Gray says the "much broader issue" was being ignored.

"This went well beyond what the railways were doing. These basis levels were not a few cents or few dollars a tonne higher than normal – they were $50 to $100 higher. That's an awfully big number."

Multiply those per-tonne costs by 103 million tonnes sold during the two years it took to export that record crop and you get $6.5 billion. Gray says that's the conservative estimate—it could easily have been a couple of billion higher.

Cue more farmer outrage? Actually, reaction was mixed.

"For a lot of producers, it was like, 'Well, there's nothing I can do about it,'" Gray says. "Some said, 'Surely, there's something wrong with your calculations,' but others said, 'We need to push on this.'"

> "Farmers were selling grain well below port prices and it was costing them an awful lot of money."

And push is what they did. SaskWheat, which commissioned Gray's report, made the lost billions its top federal election issue. The Producer Shipper Coalition (made up of several leading provincial farm groups) made it the centrepiece of its presentation last year to a blue-chip independent federal panel reviewing rail transportation.

"Farmers are very good problem solvers," Gray says. "If they're made aware of issues and have the right information, they can be a big part of the solution. To bring about changes, you need producers who are informed."

Gray advocates boosting capacity—everything from more railcars and longer sidings to faster unloading and more grain storage at ports. He's made the case for an independent body able to co-ordinate grain movement when the next mammoth crop comes along, and it will.

Bad years now produce bigger harvests than the 'bin busters' of a generation ago. Without more capacity and a referee to prevent grain gridlock, "the wheels will fall off very quickly," Gray says. But it will take time.

"Typically, there's a slow change in people's perceptions and then those perceptions become more widely held beliefs, and then slowly there's change after that," Gray says.

But when change does happen, no one throws a parade for the economist who brought the issue to light. Groups cite the big payback from research, often using figures from Gray's extensive work in this area.

"I've seen (my) numbers show up a lot of times, but it's not like breeding a new variety of wheat, where you can say, "That's mine, I did that,'" he says.

But it's all about "framing the debate" so people are thinking and talking about the issues that matter.

"Accounting isn't an end in itself. It's useful to draw attention to the issues so you can actually find solutions. That was the focus right from the start." ■

DAVID STOBBE

SAGA
SASKATCHEWAN AGRICULTURAL GRADUATES' ASSOCIATION INC.

Honorary Life Member 2015
Dale C. Blair, Diploma of Agriculture 1961

Dale Blair was born on July 3, 1940 on the family farm at Drake. He received his education at Bloomfield Elementary School and Lanigan Central High. In 1961, Dale received his Diploma in Agriculture from the University of Saskatchewan.

Dale married Janet Marshall on April 13, 1963. Their first winter was spent in Fort St. John, B.C., where Dale worked on the rigs and Janet nursed. They returned to the family farm in 1964 as the fourth generation of full-time farmers partnering with Dale's father, Sandy, brother, Ron, and family in the mixed farming operation named Blair Farms. The brothers were the second generation to be involved in the family business after Sandy set up Blair's Fertilizer Company. Several years ago, they sold the fertilizer business to their respective sons and families and dissolved Blair Farms.

A new partnership was formed with Dale's son, Scott, and family, called Blair's West Land and Cattle Company. The farm today crops about 5,000 acres and maintains a herd of 300 cows. Blair's West received the Commercial Angus Breeder Award of the Year in 2000 and Commercial Simmental Breeder of the Year Award in 2011. Dale was recognized this year at the Commercial Sale at Agribition with a tribute for his contribution to the commercial cattle industry.

Dale was active in the agriculture industry and his community. He was on the founding committee of the Saskatchewan Simmental Association, served on its board of directors for many years and was president of the association. He imported some of the first Simmental cattle from Switzerland and France, earning the nickname "Simmental Barn Boss" at Agribition in the 1970's. Dale was also a director on the Canadian Simmental Board. He served on Pound-Maker Agventures board of directors for 27 years acting as chairman for many years. Locally, he served on many committees acting as president of the Drake & District Recreation Board, Drake Minor Hockey, Last Mountain Minor Hockey and Long Lake Senior Hockey League. He was awarded the Citizen of the Year trophy in 1985 for Drake. Dale served on the Provincial Agriculture Review Board until his death in October last year. He was always interested in improving technologies with implement manufacturers.

Dale and Janet had four children (three sons and one daughter), nine grandchildren and one great-granddaughter. Their sons have followed in their father's footsteps and all attended the College of Agriculture and Bioresources at the University of Saskatchewan. Today, they are all active in either farming or the fertilizer business. The grandchildren are following the family tradition respecting education and sports. Dale has left an exemplary history of agricultural innovation, respect for education and community involvement.

A MESSAGE FROM THE PAST PRESIDENT:
Bryan Harvey, College 1960

The Saskatchewan Agricultural Graduates Association (SAGA) is the oldest college alumni association on campus. Established more than 80 years ago, it has grown from about 100 members to more than 2,000.

Our primary purposes have not changed in all these years: to support and serve the needs of graduates of the College of Agriculture (now Agriculture and Bioresources) and the University of Saskatchewan. We accomplish this support in a variety of capacities including financial support from individual members and close collaboration with the University of Saskatchewan Alumni Association in furthering the interests of the university.

In October 2015 we proudly launched our newest website, saskaggrads.com. The website is where alumni and members will find news of upcoming events, the SAGA newsletters and updates on the latest happenings in the college.

SAGA sponsors a reunion event each January. At that event we present Honorary Life Memberships to people who have made outstanding contributions to Saskatchewan agriculture, the college and/or the SAGA such as Dale Blair. Nominations of worthy candidates for this award can be sent to any member of the executive.

If you are not already a member, please consider joining this great network which includes some of the key people in various aspects of this vital industry. An annual membership is $10, or consider a lifetime membership for $100.

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