



UNIVERSITY OF ALBERTA
DEPARTMENT OF AGRICULTURAL,
FOOD & NUTRITIONAL SCIENCE

2016-2017

ANNUAL REPORT





Mission Statement

To serve the community through excellence in teaching and research in efficient and sustainable agricultural production, value-added processing, food safety, human health, and to improve the health and quality of life.

Contents

5 HUMAN NUTRITION

Public can now benefit from Human Nutrition Research Unit
Alumni Profile: Kathleen Hernder
New Dietetics Specialization Program fully accredited
Nutrition students rave over new food theory course
Study identifies bacteria with longer-than-normal persistence in our gut

13 ANIMAL SCIENCE

Precision feeding chickens is a breakthrough technology
Giving infants antibiotics may affect development of their pancreas
Alumni Profile: Mark Phoa
A workhorse of a resource

19 FOOD SCIENCE AND BIORESOURCE TECHNOLOGY

Microwaves convert seed oils into valuable chemicals faster
Predicting and halting pipeline corrosion
Alumni Profile: Mandi Hoke
Construction of Forge Hydrocarbons biofuel production plant set to start

25 PLANT BIOSYSTEMS

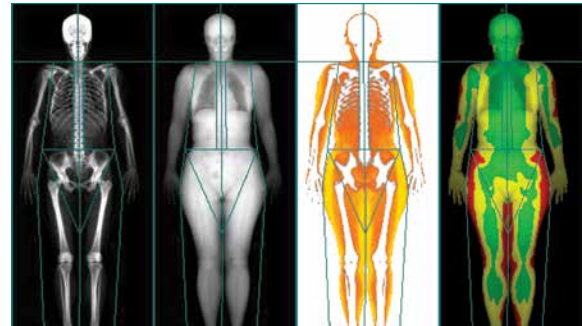
Scientists give cereal producers hands-on training to improve yields
U of A's rangeland scientists gain access to two important new study areas
Alumni Profile: Tanner Pollack
ALES Range Team hauls home top awards as coach retires
Expert on canola and wheat diseases awarded Killam Annual Professorship

32 2016-17 HIGHLIGHTS

Excellence and impact in food
Nutrition researchers attract prestigious awards
Lloyd Dosedall honoured posthumously for his expertise in field-crop pests

36 FACTS AND FIGURES

Partners and Funders 2016-17
By the numbers



COVER PHOTO: The Bod Pod in the Human Nutrition Research Unit measures body composition. See story on page 6.

Message from the Chair

With pleasure, we present the 2016–17
Annual Report for our Department of Agricultural,
Food & Nutritional Science

It's been another excellent year in our department as we continued to provide solutions that are based on solid science and have had an impact on Alberta and around the world. Highlights for this year include enhancing our facilities to support research in human nutrition, discovering relationships between antibiotic use in early life and pancreatic development, creating methods to rapidly convert plant oil or to prevent pipeline corrosion, and augmenting facilities to support research and collaboration in range science.

Our success is built on our stellar faculty and staff who continue to teach and train students and post-doctoral fellows. Together, they conduct leading-edge research and teaching, with the support of our many partners, including NSERC, Alberta Agriculture and Forestry (formerly ALMA), Alberta Crop Industry Development Fund (ACIDF), Alberta Health Services, Alberta Innovates Bio Solutions, and industry partners who have funded research projects and strategic initiatives such as the Livestock Gentec, the Poultry Research Centre and an NSERC-Industrial Research Chair.

Indeed, AFNS's commitment to excellence is seen in the strengths of our education and research programs, partnerships and connections with our community, and in the impact of our amazing students who continue to win competitive scholarships and awards. Our education programs continue to evolve, for example, with a new course in the newly accredited Dietetics Specialization that trains up to 50 future registered dietitians annually. Our future is bright as our undergraduate student numbers remain strong, especially for the Nutrition and Food Science, and Agriculture/Animal Health programs.

In this report, we share some of our newest stories. We look forward to continue to work with all of our partners to provide solutions that have a local and global impact.

Sincerely,

Ruurd Zijlstra

CHAIR, DEPARTMENT OF AGRICULTURAL,
FOOD & NUTRITIONAL SCIENCE





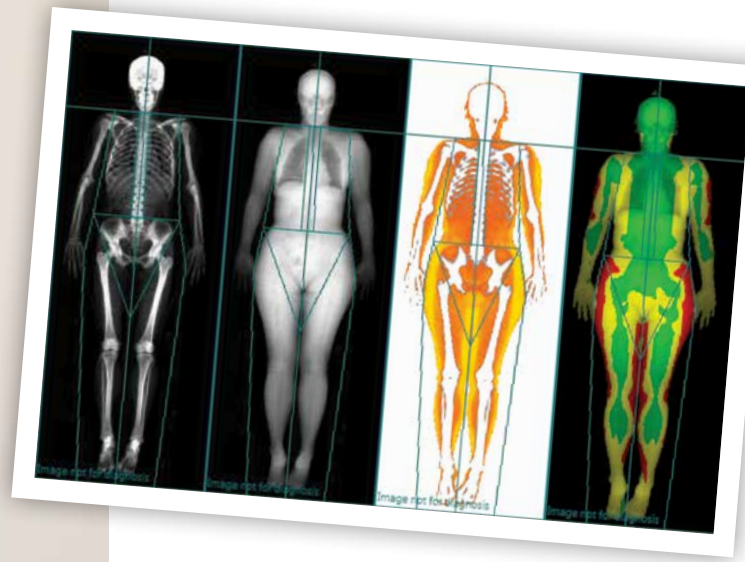
HUMAN NUTRITION

HEIDI BATES Director, Integrated Dietetic Internship | **RHONDA BELL** Human Nutrition | **JEAN BUTEAU** Human Nutrition | **CATHY CHAN** Human Nutrition | **ANNA FARMER** Community Nutrition | **CATHERINE FIELD** Nutrition and Metabolism | **RENÉ JACOBS** Human Nutrition | **DIANA MAGER** Clinical Nutrition | **VERA MAZURAK** Nutrition and Metabolism | **CARLA PRADO** CAIP Chair, Nutrition, Food and Health | **SPENCER PROCTOR** Metabolic and Cardiovascular Diseases | **CAROLINE RICHARD** Nutrition Immunology | **DONNA VINE** Human Nutrition | **JENS WALTER** CAIP Chair, Nutrition, Microbes and Gastrointestinal Health | **NOREEN WILLOWS** Community Nutrition

THE PUBLIC CAN NOW BENEFIT FROM HUMAN NUTRITION RESEARCH UNIT

Its state-of-the-art equipment tests
metabolism, body composition





People in Edmonton and area who are struggling to lose weight, and those who need to maintain muscle mass due to chronic conditions or because they are athletes, now have access to one of the world's best-equipped analysis labs.

The Human Nutrition Research Unit is offering precise reports to the public on their specific energy metabolism (the calories they burn) and their body composition (their ratio of lean-to-fat mass) through four state-of-the-art pieces of equipment, when the machines are not in use for research.

"We offer highly specialized and individualized assessments of their needs," said **Carla Prado**, the director of the unit and the Campus Alberta Innovates Program Chair in Nutrition, Food and Health. "I think that's the future, individualized care, because one size does not fit all."

With those assessments in hand, people can ask their dietitian or other health professionals for focused plans to tackle their particular issues, she said.

The unit's ability to measure body composition precisely is an immensely powerful tool that nutrition science has recently realized is critical, said Prado. "People can have the same weight yet have a different ratio of fat and lean mass and that can change the kind of intervention needed."

As well, a poor lean-to-fat ratio puts people at risk for chronic diseases such as diabetes and other health problems,



said Prado. It's also a factor associated with poor physical function, physical disability and poor quality of life, she said. Hospital stays of people with low muscle mass also last longer; those patients don't heal as quickly, and they are likely to develop post-surgery complications.

"Many people who look normal on the scale have very low muscle mass," she said. "So it's a hidden condition that needs sophisticated assessment."

Private clinics might own one or two measuring devices, but the Human Nutrition Research Unit's suite consists of four extremely high-tech and expensive pieces of equipment.

They include the only whole body calorimetry unit in Canada accessible by the public. The hotel-like room allows researchers to collect an extremely accurate measure of a person's resting metabolic rate (how many calories a person uses while at rest) during a typical hour.

A metabolic cart in the unit also measures resting metabolic rate, albeit with a hood that is worn while lying on a bed, and not as accurately as the whole body calorimetry unit.

For measuring body composition, the unit has a Bod Pod, a seated chamber that calculates density by measuring body volume, body weight and changes in air pressure. Very soon, the unit will also offer a dual X-ray machine (DXA) that scans a body to measure its lean muscle-to-fat composition.

There is no need for a physician referral, but bookings are limited.

In addition to the public, researchers beyond Prado's team are also benefiting from the equipment's accessibility. The Department of Mathematical Sciences is currently using it to create a mathematical model that can predict calorie use for marketable personal devices, and other researchers are testing a protein powder's ability to speed up metabolism.



Carla Prado

Prado is also developing online training for off-site researchers to become certified in the testing techniques her team has developed.

"We are internationally recognized as leaders in body composition assessment," she said. "Over the past two years we've had more than 20 researchers from all over the world visit to see how we do it." ■

ALUMNI PROFILE

KATHLEEN HERNDER '13 BSC **NUTRITION AND FOOD SCIENCE WITH** **INTEGRATED DIETETIC INTERNSHIP**

CURRENT POSITION

Kathleen owns Pulse Nutrition YK and is the only registered dietitian seeing clients in private practice in Yellowknife, Northwest Territories. She works from an interdisciplinary health clinic and via video conferencing, for clients in NWT, Nunavut and Alberta.

WHAT SHE DOES

Kathleen concentrates on evidence-based nutrition counselling, using mindfulness to help clients understand when they are truly hungry, how to regulate their meals and to develop other healthy strategies. "The idea is to stop the focus on weight and have people focus on their internal cues about eating for hunger and satiety, and to find ways of coping with emotions other than food," she said.

She also offers diabetes management as a certified diabetes educator, has additional training in bariatrics and in the management of irritable bowel syndrome, and advises in sports nutrition.

Her corporate clients include Diavik Diamond Mine, where she has showed staff the connections among stress, sleep and eating, and worked with kitchen staff to improve meal options.

HOW HER CAREER EVOLVED

After her integrated internship—which included placements in long-term care facilities and in acute-care and out-patient clinics—Kathleen became a regional dietitian in Northern Alberta. Stints in a diabetes and a bariatric clinic in other northern communities followed. She opened her own practice in Yellowknife in August 2016.

HOW AFNS PREPARED HER

"My education gave me a well-rounded view of the many different areas of dietetics and the background to look critically at the evidence," she said. "One of the best things I learned was how to examine a research paper and determine its limitations and implications for my practice."

Instructor Heidi Bates, who directs the internship program, runs a private practice and speaks about nutrition on radio and television, was an important role model. "Dietitians can do a lot of things," said Kathleen. "I found that really inspiring."

One of the best things I learned was how to examine a research paper and determine its limitations and implications for my practice



New Dietetics Specialization Program fully accredited

Students benefit from added courses, direct entry

The program that puts University of Alberta students firmly on the route to becoming a registered dietitian in Canada passed a full accreditation review in February 2017, while winning high praise for its depth, its enhanced standards and its improved entry process.

“We were told that we have a top-notch program, with incredible faculty and resources that make it one of the most comprehensive programs across Canada,” said **Anna Farmer**, academic lead of the new Dietetics Specialization and Honours Program.

In 2013, Partnership for Dietetic Education and Practice, the body responsible for national accreditation of dietetic education programs, changed its standards and added several required knowledge and practice competencies for the academic program and for the dietetic internships. Students need both elements—a completed dietetics specialization and an internship—before they can apply to take the organization’s Canadian Dietetics Registration Examination, the final step before becoming registered dietitians through a provincial regulatory body such as the College of Dietitians of Alberta.

So the U of A’s BSc Nutrition and Food Science program (NUFS) began adding new courses and improving others. At the same time, it decided to upgrade how students get on the path to becoming dietitians. Previously, nutrition majors applied during their third or fourth year



Student Paulina Blanco Cervantes

to the Integrated Dietetics Internship, which they completed after earning their NUFS degree. The new Dietetics Specialization program is a direct entry model—students apply just once, for acceptance to both the degree program and the internship.

“It’s actually helped students plan better,” said Farmer. “They start earlier knowing they’re going to be a dietitian. It reduces stress and competition while they’re in the program. Another benefit is that they continue to have student status, which allows access to scholarships, whereas in internships you had to justify student status in each case.”

In the Dietetics Specialization program, students now start doing short practicums in their second year to develop their professional practice. They go into clinical, acute care or rural settings to work with clients under the supervision of registered dietitians. The work they do can range from counselling to developing therapeutic meal plans for clients with diabetes.

“Each year, they do a little more, until in their final year there are no academic courses, just the practicum courses,” said Farmer.

The first cohort of students enrolled in the new Dietetics Specialization program started in September 2016. The last cohort of



Nutrition students rave over new food theory course

Applied skills will be invaluable professionally,
personally

Over and over, students call it the best course they've ever taken.

"It ended up being my favourite class of the year," said **Heather Chappell**, who is in her first year of Dietetics Specialization. "These skills can be applied to real life and to helping people."

So what is it?

"A hands-on course held in a lab that's like a kitchen," says **Anna Farmer**, who developed the new Applied Foods Theory NUFs 250 course, which teaches everything from how to safely handle raw meat to how to make panna cotta (an elegant Italian dessert of sweetened cream and gelatin).

The course is one of several new requirements for the new Dietetics Specialization program, which comprehensively trains students to be registered dietitians. The course is also open to students in the general stream of the Nutrition and Food Science program.

"It brings to life a piece that was missing," said Farmer, a nutrition professor and academic lead for the Dietetics Specialization. "We were teaching a lot about nutrition and metabolism, but we eat food, not nutrients. So it helps to have an understanding of the social and cultural details of eating."

Following completion of an online self-study component to understand the theory, during each week's lab students get elbow-deep in cooking food on a different weekly theme. They work

through stocks, broths and sauces to eggs, meat, fish, breads and vegetables. They practise creating typical meal plans and also plans for limited budgets; they learn how to modify recipes for different diets, including vegetarian, gluten-free, dairy-free or those that adhere to certain religious or cultural practices.

Chappell liked the practice of culturally adapting recipes because the knowledge gained is so fundamental. "It helps us to better understand the types of oils and sweeteners, or types of grains different people would be using."

After they prepare the food, students also evaluate it—what went wrong and what went right—which teaches them how to discuss food in practical terms with clients, and also how to write about it meaningfully, said Farmer.

Many students are living at home or in a student residence and do not have to prepare their own food, so even basic knife skills or the magical properties of yeast are a revelation, she said.

"You need these skills to be a good teacher and an educator," she said.

At 28, Chappell has been cooking her own meals for years, but the course constantly surprised her, whether she was learning what's inside convenience foods, how to build meals from a food bank hamper, or how to make tasty meatballs from dried vegetable protein.

"This class forced me to use new ingredients and learn how they work in terms of science." ■

students able to apply for the integrated internship will go through in March 2018.

The U of A's program for training dietitians is the largest in Canada and its students have one of the highest success rates at the Canadian Dietetics Registration Examination, said Farmer, who expects nothing less in the future.

"We have the top food science researchers teaching those courses, and nutrition is taught by the leaders not only in the country but in the world. That's complemented with intensive partnerships with Alberta Health Services and other community and health facilities across Alberta." ■



Jens Walter

Study identifies bacteria with longer-than-normal persistence in our gut

Discovery could help scientists adjust or reintroduce beneficial organisms

In a surprising outcome, scientists who introduced live probiotic bacteria to the human gut saw them persist there for as long as six months instead of the normally expected two weeks.

The discovery is groundbreaking because bacteria currently used in commercially available probiotic products do not persist in the human gut.

"The study opens the door to being able to specifically modify the human microbiome," said **Jens Walter**, the Campus Alberta Innovation Program Chair for Nutrition, Microbes and Gastrointestinal Health in the faculty.

"If a species (of bacteria) is missing, we may be able to reintroduce it," said Walter, who is also the supervising author of the study.

That's welcome news because it's already known that due to our modern diet and antibiotics, as much as 70 per cent of the diversity of bacteria living in our microbiome has disappeared.

Scientists believe that this lack of diversity is contributing to a number of diseases, including obesity, Type 2 diabetes and coronary heart disease.

"Modulating or changing this microbiome might provide the opportunity to treat or improve these diseases," said Walter.

The bacteria involved in this study was a newly developed probiotic called *Bifidobacterium longum* AH1206.

Probiotics are live bacteria included in food or supplements that are marketed for a number of health-improving claims. Although the idea to stably implant lactic acid bacteria into the human gut was first proposed in a 1907 book by pioneering immunologist Eli Metchnikoff, virtually all research that followed after did not provide evidence that this was actually possible.

So when Walter was asked by a company to test the safety of strain AH1206, he took on the task hoping to

determine how the already resident gut microbiome influences the fate of the incoming bacterial strain.

His team was especially interested in strain AH1206, because it belongs to a bacterial species that is a dominant core member of the human microbiome. Most commercially produced probiotics do not contain bacteria that are key players in the human gut because they are difficult to mass produce and still maintain viable in food products.

With a strain of *Bifidobacterium longum*, Walter hypothesized that he might see extended persistence in the human gut. However, the result exceeded his expectations, as the strain persisted from 88 to 200 days in approximately 30 per cent of individuals.

Since virtually all studies in the probiotic field have been performed with bacteria that have been selected more for historic and practical reasons and not based on ecological criteria, Walter says that the findings of this study warrant further research into the health effects of gut microbes that are native to the human microbiome.

"This study says that if you use an organism adapted to this ecosystem, it might be possible to precisely modulate the bacterial community. And that could definitely lead to improvement of therapeutic strategies."

Researchers on the study included Walter's post-doctoral fellow Ines Martinez, as well as researchers from the University of Nebraska, University College Cork, the University of Parma and the University of Minnesota. It is published in the journal *Cell Host & Microbe*. ■



ANIMAL SCIENCE

JUDD AIKEN Prion Disease | **DIVAKAR AMBROSE** Reproductive Physiology and Management | **BURIM AMETAJ** Ruminant Nutritional Immunology | **LORNE BABIUK** Immunology, Pathogenesis, Virology, Molecular virology and Vaccinology | **DAN BARREDA** Immunology | **URMILA BASU** Manager, Lab and Genomics and Proteomics Unit | **CLOVER BENCH** Applied Ethology/Animal Behaviour | **HEATHER BRUCE** Carcass and Meat Science | **WALTER DIXON** Molecular Biology | **MICHAEL DYCK** Reproductive Physiology/Biotechnology | **CAROLYN FITZSIMMONS** Beef Genomics | **LELUO GUAN** Functional Genomics and Microbiology | **JOHN KENNELLY** Dairy Cattle Nutrition and Metabolism | **DOUG KORVER** Poultry Nutrition | **CHANGXI LI** Bovine Genomics | **MASAHITO OBA** Dairy Nutrition and Physiology | **ERASMUS OKINE** Cattle Nutrition and Metabolism | **GRAHAM PLASTOW** Animal Genomics | **FRANK ROBINSON** Poultry Management/Physiology | **MICHAEL STEELE** NSERC IRC, Ruminant Nutrition | **PAUL STOTHARD** Bioinformatics | **RICHARD UWIERA** Veterinary Pathology | **ZHIQUAN WANG** Beef Quantitative Statistical Genetics | **CRAIG WILKINSON** Director of Animal Care | **BENJAMIN WILLING** Canada Research Chair, Epigenomics/Nutrigenomics | **RUURD ZIJLSTRA** Ingredient Evaluation and Carbohydrate Nutrition | **MARTIN ZUIDHOF** Poultry Science/Bioeconomic Modeling

PRECISION FEEDING CHICKENS IS A BREAKTHROUGH TECHNOLOGY

UAlberta invention improves chicken flock uniformity and production

The world's first system that instantly measures a chicken's weight and its exact feed need is returning information about cage-free chickens at a level of detail never before achieved.

The Precision Broiler Breeder Feeding System was designed by poultry researcher **Martin Zuidhof**, who, since 2013, has run it through four pilot tests and four full experiments at the Edmonton Research Station on the University of Alberta South Campus.

Over- and underweight chickens produce fewer chicks, said Zuidhof, so feed restriction to achieve a predetermined target body weight has become standard industry practice for feeding broiler breeders.

"However, competition for feed results in poor flock uniformity," he said.

His precision feeding system allows each free-run bird to enter a feeding station and perch on a platform that weighs the chicken. Using a radio frequency identifier on the bird's wing, the system recalls such information as the bird's target weight and when it last fed. If a bird weighs less than its target weight, it dispenses a small amount of feed. If there's no need for the bird to eat at that

moment, the chicken is gently removed from the station.

Zuidhof and his team have perfected flock uniformity by successfully feeding free-run birds exactly what they need to grow to a target weight. Although researchers were hoping that precision feeding would increase chick production from each hen by 10 per cent, some changes in management are still needed for this to be realized.

"Feeding multiple meals per day appears to alter the birds' metabolism in a manner that makes the industry standard target body weights too low for some hens to become sexually mature," said Zuidhof.

"The most likely solution will be an increase in the amount breeders are fed. Such a change would be welcome, because the degree of feed restriction recommended for optimal chick production from broiler breeders has been criticized for welfare reasons."

As well as monitoring and dispensing individual feeding exactly, the system creates labour savings for the producer who does not have to weigh each bird individually or feed the males and females separately.



Such a system has not been viable before now, because the technology cost per animal unit did not make sense for poultry. Zuidhof said he was able to overcome this obstacle because of the decreasing cost of technology, an increasing sense of urgency around broiler-breeder management issues and a diverse pool of funding.



Martin Zuidhof

His research has been supported by the Alberta Livestock and Meat Agency (ALMA), Alberta Innovates-Bio Solutions, the Agriculture and Food Council of Alberta, the Canadian Hatching Egg Producers, Alberta Hatching Egg Producers, DuPont, the Poultry Industry Council, Alberta Chicken Producers, Canadian Poultry Research Council, Cobb-Vantress Inc., and Aviagen Broiler Breeders.

In addition to perfecting the appropriate body weight targets or level of feed intake to ensure that birds receive the nutritional and metabolic cues required to begin laying

eggs, Zuidhof's next plans are to improve the training protocols to ensure that no birds are left behind by the system, and then test it in a commercial setting. ■



Giving infants antibiotics may affect development of their pancreas

New study helps explain the link to future risk of metabolic disease

Children who receive antibiotics in the first months of life are more likely to become obese, according to several large population-based studies. Now, a new AFNS study shows that changes in the development of the pancreas might explain why those same children are more likely to develop metabolic diseases like Type 2 diabetes.

"It's not our intention to say, 'stop using antibiotics for kids who need it for infections,'" said microbiologist **Ben Willing**, senior author of the study. "But part of our hope is that if we can understand what is driving these negative outcomes we can come up with strategies or alternatives [for treatment]."

Willing and his fellow researchers in the Department of Agricultural, Food and Nutritional Science wanted to know why many epidemiological studies show an association between infants who received antibiotics and increase their body mass index, and their subsequent risk of being overweight by the time they reach the age of 12, which is a strong predictor of metabolic diseases in adulthood.

Using an animal model, they found that giving amoxicillin—a commonly prescribed antibiotic that fights ailments such as ear infection—in the first weeks of life adversely affected the subject's oral glucose tolerance test, which is

used to test if diabetes or pre-diabetes is present. This inability to metabolize glucose was seen five weeks after they stopped administering the antibiotic, even though the microbes in the gut had reverted to normal.

"[The findings] suggest that the microbes are actually programming the host in that early period," said Willing.

During the first six months after birth, the microbiota in the gut are unstable and susceptible to environmental changes, the study's authors say, which might explain the timing. However, the mechanism that causes this programming to occur is not yet clear. The researchers believe it's tied to the development of the pancreas because the pancreas produces insulin, which in turn tells cells to take up glucose. Indeed, they have seen that antibiotic exposure causes changes in the development of the pancreas and in the survival of pancreatic cells.

"Now we need to understand if the programming is caused by specific microbes, or something they produce that gives us these differences in pancreatic development," said Willing.

The study is published in *Scientific Reports* and was supported by grants from the Canadian Institutes of Health Research and Canada Research Chair program, with student funding from Alberta Innovates Technology. ■



A workhorse of a resource

Barney teaches students anatomy and practical skills

Horses are BIG, and Barney, the horse that lived in **Leanna Greenwich's** office for about six months this academic year, proves it.

Barney is a full-sized, anatomically correct, fibreglass model of a black Arabian stallion, and he is the new star of Greenwich's Introduction to Equine Science course.

For learning about the anatomy and physiology of a horse, Barney is better than the real thing, said Greenwich, director of animal care for the Faculty of Agricultural, Life & Environmental Sciences—especially for urban students who've had little to no contact with horses. "They are able to study its anatomy without the emotional distraction of an actual animal," she said.

Weighing about 22.5 kilograms—compared with a live horse's 450 kg—the arresting model is the most practical, cost-efficient and humane way for students to understand how a horse is put together.

Students can see and feel the position of his tendons and ligaments, and compare his head to a real horse skull to

understand how far back its teeth extend. Ducking under his abdomen, they instantly understand why specialized X-rays are necessary for such a large girth. Greenwich can show them where a horse's ovaries and uterus are, where to check for a pulse, how to examine a horse for diseases, how to bandage its limbs, and how to vaccinate.

Horse anatomy is a fine foundation for the study of cattle or swine, said Greenwich. The scapula (shoulder blade), humerus (forelimb) and radius/ulna (forearm) are all comparative anatomically.

Such a useful teaching tool is ordinarily quite expensive, with low- to medium-fidelity models costing about \$3,000 and more sophisticated ones (with removable sides allowing access to internal organs) running to more than \$35,000.

Greenwich, who began teaching the one-semester course last September, cajoled the loan of Barney from Delaney Veterinary Services near Sherwood Park where he is an advertising feature when not in school. "He balances the need of horses for peace and quiet, and the needs of our students," said Greenwich. ■



FOOD SCIENCE AND BIORESOURCE TECHNOLOGY

MARLENY ARANDA-SALDAÑA *Food/Bio Engineering Processing* | **MIRKO BETTI** *Muscle Food Science and Processing* | **DAVID BRESSLER** *Fermentation and Bio/Food Engineering* | **HEATHER BRUCE** *Carcass and Meat Science* | **LINGYUN CHEN** *Canada Research Chair, Plant Protein Chemistry and Technology* | **JONATHAN CURTIS** *Lipids and Analytical Chemistry* | **MICHAEL GÄNZLE** *Canada Research Chair, Microbiology and Probiotics* | **LYNN MCMULLEN** *Food Microbiology* | **LECH OZIMEK** *Dairy Processing Technology and Food Product Development* | **ROOPESH SYAMALADEVI** *Food Safety and Engineering* | **FERAL TEMELLI** *Food Process Engineering* | **AMAN ULLAH** *Utilization of Lipids, Polymer/Material Chemistry* | **THAVA VASANTHAN** *Grain Science and Technology* | **WENDY WISMER** *Sensory and Consumer Science* | **JOHN WOŁODKO** *AITF Strategic Chair in Bio and Industrial Materials* | **JIANPING WU** *Food Protein Chemistry*

MICROWAVES CONVERT SEED OILS INTO VALUABLE CHEMICALS FASTER

New approach also improves efficiency and cost

By using microwaves to convert plant oils and waste cooking oil into fine chemicals, researcher **Aman Ullah** has hit upon a faster, more efficient and cheaper process than the conventional thermal heating approach.

Fine chemicals are pure or near-pure chemical substances that are manipulated for use in a variety of products in an array of industries, including chemicals, plastics, pharmaceuticals, bio-medicals and cosmetics. They have high value, but are expensive to produce.

Currently, about 90 per cent of these fine chemicals are created from petroleum. In recent years, scientists have tried to create fine chemicals from renewable resources such as oils, using various approaches. But doing it efficiently and rapidly is challenging, said Ullah, a chemical scientist in the Department of Agriculture, Food and Nutritional Science. Generally reactions are carried out in organic solvents, requiring a high amount of the catalyst and longer reaction times, which limits the viability of those processes.

Using microwaves solves each of those issues.

Microwaves are electromagnetic radiations in the frequency range between infrared and radio waves. When hit by microwaves, oils act like dipoles (a molecule in which positive electric charge is separated from negative charge) and they try to align themselves with the changing electric field.

The direction of an electric field changes at different frequencies, but with extremely rapid changes in direction (2.45 billion times per second in a typical microwave), the dipoles can't keep up. Instead, energy is generated in the form of heat, through molecular friction and dielectric loss (the dissipation of energy).

This microwave dielectric heating is an environmentally benign process that has several advantages compared to using conventional heating for chemical conversions. It produces high-energy savings, higher yields in shorter times, direct heating of a species and uniform heating.



Ullah is still determining exactly how much faster and cheaper his method can be, but if previous reports of microwave use in other applications are an indicator, it will be at least two-fold, and as much as 100-fold, he said.



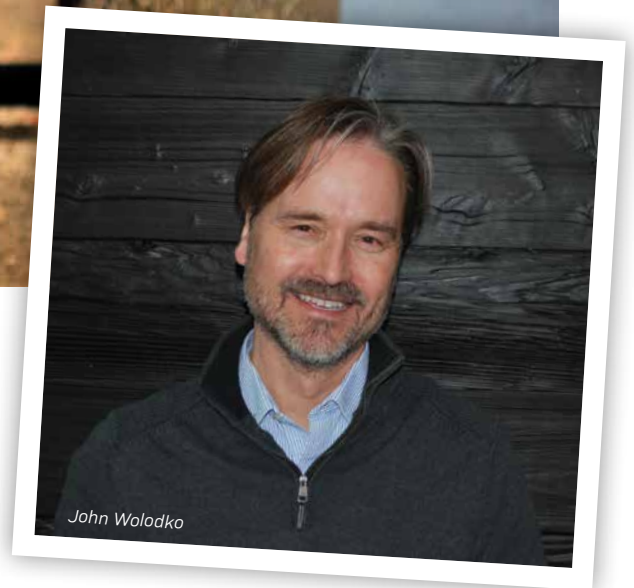
Aman Ullah

In addition to extracting the chemicals from plant biomass, Ullah is also applying microwaves to waste cooking oil, and is recording very high conversion percentages there, too—although the oils must first be purified of food particles.

Patents for his microwave-assisted method are pending in the U.S. and Canada. In mid-2017, Ullah takes delivery of two custom-made microwave reactors that he'll use to scale up his process at Agri-Food Discovery Place, a world-class

small-scale pilot processing facility at the University of Alberta, with the goal of creating a commercial spinoff in two to three years.

Support for this project came from Alberta Innovates Bio Solutions. ■



Predicting and halting pipeline corrosion

Bioresource researcher **John Wolodko** is trying to improve the integrity of pipelines by predicting and preventing microbial-influenced corrosion.

MIC, as it's known, is the activity of bacteria and other microbes that make them more corrosive to metal. The microbes feed on nutrients found in waters and soils and modify the local chemistry.

Wolodko, the Alberta Innovates-Technology Futures Strategic Chair in Bio and Industrial Metals, is using modern genomics to understand how the thousands of different microbial populations interact, and to then develop predictive models and tools to prevent the problem.

In early 2017, his researchers began taking samples from a wide range of environments, including offshore platforms,

upstream pipelines and transmission pipelines. Feeding the data about different chemistries, temperatures and other physical characteristics into a database, the researchers will look for trends.

MIC causes about 20 per cent of corrosion in metal infrastructure, and is estimated to cost the oil and gas industry \$3 billion to \$7 billion annually in maintenance, repairs and replacement. It also attacks other infrastructure globally (bridges, culverts, tanks, ships) to the tune of \$2.5 trillion.

Wolodko's project, funded by Genome Canada with a \$7.8 million grant, is co-led by Lisa Gieg in the Department of Biological Sciences at the University of Calgary and Faisal Kahn in the Faculty of Engineering at Memorial University. ■

ALUMNI PROFILE

MANDI HOKE '12 MSc

Food Science & Technology

CURRENT POSITION

Product development technologist at Kitchen Partners, a custom-prepared food provider that supplies entrees, sauces, salad dressings, soups, dips and other stirred foods to Canadian chain restaurants, grocery store delis and large-scale catering operations.

WHAT SHE DOES

Hoke provides customers with tailored menu solutions: she matches and improves existing products and creates original on-trend and traditional recipes. Her role includes interviewing clients on their needs, recipe invention and improvement, nutritional breakdowns, food presentations, trial runs and perfecting scale-up for mass production.

"We focus on using fresh ingredients and minimizing the use of preservatives wherever possible," she said. Her overarching challenge is to create appealing prepared dishes that are consistent in taste and quality at every location they are sold.

HOW SHE GOT HERE

With her food microbiology specialization, Hoke found work as a research scientist at Ceapro, using proprietary microbiology-based procedures to increase beta glucan in oats, and testing the microbial activity of plant extracts from different feed stocks. Her solid base of food science knowledge plus professional lab experience was an ideal foundation for product development.

HOW AFNS PREPARED HER

Studying food from so many perspectives at once—food fundamentals and quality, sensory science, meat science, food microbiology and food product development—was empowering, said Hoke. So was the constant rigour of giving presentations, both in class and for industry professionals.

"It wasn't just memorizing and regurgitating things in exams," she said. "It was, 'we taught you this, now how would you apply it in this situation?'"

WHY A FOOD SCIENCE CAREER ROCKS

"If you're scientifically minded, food science is fascinating," she said. "Food scientists can do quality assurance, develop packaging, make food safe, make it better quality, make it taste better. Potentially, they can make food much better."

*If you're scientifically minded,
food science is fascinating*





David Bressler

Construction of Forge Hydrocarbons biofuel production plant set to start

Method to create fuel from waste oils ready for commercializing

A \$25 million dollar production plant is scheduled to begin construction near Sarnia, Ont. this fall, paving the way for commercializing renewable diesel made from waste fat, in a process that was developed at the University of Alberta.

The innovative method to convert animal fats, cooking grease and other low value fats and oils into hydrocarbon fuels was invented 12 years ago by bioresource scientist **David Bressler**, director of the Biorefining Conversions Network in the Department of Agricultural, Food and Nutritional Science.

The technology can produce renewable diesel fuel with 90 per cent less greenhouse gases than conventional fuel.

In 2016, Forge Hydrocarbons, a spinoff company in which Bressler is a partner and the lead scientific advisor, received a \$4.2 million grant from Sustainable Development Technology Canada to help build the plant.

The Ontario plant will be Forge's first commercial-scale manufacturing facility, with a production start planned for late 2018. It will produce renewable liquid hydrocarbons at a capacity of 19 million litres annually. That represents a significant increase over the 200,000 litres per year that have been produced at Forge's Edmonton pilot plant, where Bressler's team has been developing the method and its scale up for three years,

with investment from Western Economic Development Canada and the Alberta Livestock and Meat Agency.

"The transition from benchtop to commercial reality was only possible due to a close partnership and the leadership of the on-site Forge team through the pilot trials, with the support of the City of Edmonton and the Alberta Innovates system," said Bressler.

Bressler is not the first scientist to convert renewable feedstocks into fuel, but he is the first to do it cost effectively. The trick lies in how oxygen is released from lipid molecules to create hydrocarbons, which produce energy when combusted.

Petroleum companies have used hydrogen and a mineral catalyst to remove the oxygen, producing what is known as "green diesel." Hydrogen and minerals are expensive, however, and require a clean feedstock such as canola that is also of high value. Bressler's method, done with high-temperature chemistry, needs neither a catalyst nor clean feedstock.

First, animal fat or crop-seed oil is heated with water at a high temperature to create fatty acids and glycerol. The glycerol is removed and the fatty acids are heated again, at more than 400 C, until the oxygen within them is released. That makes the fatty acids into hydrocarbons that can be further processed to become various fuels, including gasoline.

"We can use really dirty fuels like brown grease (used cooking oil), and tall oils, which are the oils from trees when they separate out the pulp," said Bressler.

The resulting fuel is also a "drop-in biofuel," chemically indistinguishable from petroleum-based fuel. It does not need to be blended with petroleum-based diesel, the way that ethanol does.

Earlier basic research elements of the project were funded by Alberta Innovates, BioFuelNet Canada and NSERC—the Natural Sciences and Engineering Research Council of Canada. ■



PLANT BIOSYSTEMS

EDWARD BORK *Mattheis Chair in Rangeland Ecology and Management* | **CAMERON CARLYLE** *Rangeland Ecology* | **LINDA HALL** *Environmental Biosafety and Integrated Weed Management* | **BARRY IRVING** *Manager, Research Stations* | **NAT KAV** *Biochemistry and Biotechnology* | **JOCELYN OZGA** *Plant Physiology and Horticultural Science* | **HABIBUR RAHMAN** *Canola Breeding and Research* | **DEAN SPANER** *Plant Breeding and Organic Agriculture* | **STEPHEN STRELKOV** *Plant Pathology* | **RANDALL WESELAKE** *Canada Research Chair, Agricultural Lipid Biotechnology* | **RONG-CAI YANG** *Statistical Genomics and Quantitative Genetics*



Cereal crops "lodging."

SCIENTISTS GIVE CEREAL PRODUCERS HANDS-ON TRAINING TO IMPROVE YIELDS

Field school is a collaboration between UAlberta, Lakeland College and province

Cereal growers in Alberta who want to increase their yields potentially as much as 40 per cent can learn how this year, during a hands-on field school created by a unique team of researchers.

The event is the brainchild of **Linda Hall**, a University of Alberta plant scientist, her former student **Laurel Perrott** (now a research agronomist working at Lakeland College), and **Sheri Strydhorst**, a research scientist at Alberta Agriculture and Forestry and an adjunct professor at UAlberta.

The three believe that although breeders have certainly created new varieties of cereal crops capable of higher yield potential, producers now need to improve their agronomic practices to allow those varieties to reach that potential.

"The world needs more food, and cereals are really important for our cattle industry and for human consumption," said Hall, explaining why she and her team are so focused on increasing yields of oat, barley and wheat.

In east-central Alberta there are frequently years where soil moisture is available and bumper crops can be achieved, yet it is exactly those conditions that also pose risks to cereal crops, said Hall.

"Cereal diseases can develop and plants can 'lodge,' which means that they grow so tall they fall over, it becomes



Linda Hall, right, assists a producer.

difficult to harvest them and yield is lost," she said.

It takes several years of multi-site research to determine if improved practices can deliver consistent results. This team has already completed three years of such study in the central Alberta at Barrhead, Lakeland and St. Albert.

Practices such as timely applications of nitrogen fertilizer, fungicides and plant growth regulators are now ready to be implemented by growers.

Over each of five daylong field schools, held at the St. Albert Research Station, producers will learn skills such as crop staging and when to apply fungicide, and observe how good practices work in synergy.

"We expect to have at least 250 to 300 people in total to view research trials and get extra training," says Strydhorst. "Hands-on training and presentations from subject-matter experts are some of the best tools we have to equip farmers and agronomists with the information they need to grow higher yielding, more profitable crops."

Several grain marketing, agriculture product and grower groups are participating.

The Alberta Wheat Commission, Alberta Barley, Alberta Oat Growers, and Alberta Crop Industry Development Fund support both the research and extension activities. ■

U of A's rangeland scientists gain access to two important new study areas

Onefour and Stavely Research Ranches will test conservation, biodiversity questions



Two historic research ranches in southern Alberta have officially changed hands and that's giving scientists from the University of Alberta assured access to study two large rangelands.

The land areas are the Onefour and Stavely Research Ranches, located in the southeastern corner of the province and southwest of Nanton, respectively. Established by the Canadian government in 1927 and 1947, they were dedicated to ranch and livestock fieldwork until Agriculture Canada decided three years ago to close them.

In December, the signing of the memorandum of understanding was announced between the University of Alberta and Alberta Environment and Parks, which will allow these working landscapes to be managed by the province of Alberta and be reborn as centres concentrating on improving rangeland management, promoting long-term rangeland economic and environmental sustainability, and conserving biodiversity.

"The Onefour and Stavely research substations have been essential in developing rangeland management as we know it in western Canada," said Shannon Phillips, minister of environment

and parks. "The University of Alberta has played an essential part initiating and conducting the research on both sites. "The memorandum of understanding will help ensure the future of these vital facilities," she said.

"Having reliable access to large-scale rangeland landscapes is critical to improve our fundamental understanding of rangeland ecology and function, and ultimately identify beneficial management practices for those relying on and using these areas," said **Edward Bork**, Mattheis Chair in Rangeland Ecology and director of the Rangeland Research Institute.

"These areas will be used to understand how to optimize and sustainably use forage production, better protect Alberta's prairie biodiversity, including species at risk, as well as mitigate risks and challenges posed by threats such as climate change, all with the intent of ensuring native grassland conservation."

The institute already conducts studies at the Kinsella and Mattheis Research Ranches in central and southern Alberta, but adding the new ranches vastly enriches the scope of its work.

"While Mattheis and Kinsella are very good exemplars of the mixed-grass and parkland regions respectively, they do



Oneil Carlier, minister of agriculture & forestry

not represent the most arid prairie regions of Alberta (as Onefour does), nor the more humid and biodiverse grasslands of southwestern Alberta (Stavely), where climate, soils, and associated vegetation are unique," said Bork.

"All four ranches combined now provide four contrasting environments in which to test questions of relevance to ranchers and rangeland managers."

The U of A intends to also maintain long-term studies that the federal government started many decades ago.

"Long-term studies are difficult and costly to undertake, yet their results are especially important. They provide novel insight into how grasslands withstand or recover from chronic stress," said Bork.

The Onefour Research Ranch encompasses more than 40,000 acres and the Stavely site occupies 960 acres. ■

ALUMNI PROFILE

TANNER POLLACK '07 BSC

AGRICULTURE RANGELAND AND PASTURE MANAGEMENT

CURRENT POSITIONS

Based in High Prairie, Pollack works at three agriculture-related jobs: since 2008 he's owned an agronomy consulting business affiliated with Agri-Trend called Solar Agri Services; in 2013 he and his wife Christie opened Christie's Gardens and Greenhouses; and throughout he's co-run a livestock and grain farm with his parents.

WHAT HE DOES

For his consulting business, Pollack helps farmers plan and strategize how to best allocate their resources effectively, which includes consulting on soil sampling, fertility planning and pesticide management, and crop scouting (assessing performance, monitoring weed and insect issues). At the greenhouse, he handles plant health, including implementing biological controls. At the farm, he's involved in every aspect, from planting to harvesting to calving.

HOW HE GOT HERE

After university, Pollack worked in agricultural retail for a local agricultural inputs dealer for a year while farming his parents' wheat, barley, canola and beef operation. When his wife saw the local potential for a large greenhouse offering bedding plants, shrubs and event spaces, he signed on as a partner.

HOW AFNS PREPARED HIM

His work has mirrored his university career, where he was able to follow his interests and study an array of subjects, including animal science, plant science and agricultural economics.

"There's a demand for good people in all segments of the agriculture industry," said Pollack. "That was one of the reasons I felt this ag program would work—anywhere I'd go, there would be options. That's what the program is set up for, to become one of those good people."

There's a demand for good people in all segments of the agriculture industry





ALES Range Team hauls home top awards as coach retires

Wins include first place in plant identification

For more than 30 years, instructor **Barry Irving** has ensured that University of Alberta environmental conservation students always excel at an international competition that tests their knowledge of plants and range management.

Irving received the W. R. Chapline Land Stewardship Award for his outstanding contribution to promoting this science at the Society for Range Management's annual conference in February.

With Irving coaching the ALES Range Team, it has won more than 160 award placements, including 35 first-place finishes for either an individual or the team.

To make the team, members must enrol in Irving's 400-level class in Environmental Conservation Science from September to December.

The class itself is tough, since Irving challenges students to be competitive in both portions of the exam, both the Plant Identification Test and the Undergraduate Range Management Exam or URME, whereas many schools concentrate on one or the other.

Students also devote eight to 12 extra hours a week of their own time, studying plants and reviewing problem types, and peer coaching each other. After they finish the semester they keep working through January, bumping up weekly practice tests from one to two.

All that preparation instilled not just knowledge but killer time-management skills, said conservation biology student **Ryan James**, who propelled the team to first place in the Plant ID test with his first place individual score.

"You just have to find time for all that stuff, because with plants you can't just leave them for a week," he said. "You start forgetting them quickly."

The Plant ID test is just what it sounds like, but harder—participants must identify 100 different species of plants from samples as tiny as a seed or root, with only one minute of viewing per sample. To master it, students learn a possible 200 species of plants grown on North American rangelands.

The ALES team also won third place in the written portion of the competition, the Undergraduate Range Management



Barry Irving

Exam, or URME. It's a demanding test of all the information an undergraduate might have encountered over the four years of a typical degree in range management, and features both multiple-choice questions and problems that require interpretation.

"You have to do 100 questions in two hours and some of those questions require a number of calculations," said James. The highest-ranking ALES student was **Kale Scarff**, who placed fourth.

Irving has now retired from coaching the ALES team, but will be creating the Plant ID exam for all participants in next year's competition in Nevada.

In the High Combined Individual Category (individual scores for both the Plant ID and the URME), ALES took third, fourth and fifth, with James, **Sylyanne Foo** and Scarff bringing those home, respectively.

Sweetening all of these victories, in the Plant ID exam the team defeated its archrival, Mexico's Antonio Narro Agrarian Autonomous University, marking only the third time in 25 years that Narro has not won the Plant ID exam. The ALES team was first all three times, twice in the last three years. ■



Stephen Strelkov

Expert on canola and wheat diseases awarded Killam Annual Professorship

Stephen Strelkov, an authority in plant pathology and the significant threat of clubroot disease in canola crops, has received a 2016 Killam Annual Professorship.

Strelkov's achievements include identifying new strains of the clubroot pathogen that are capable of causing disease on resistant canola varieties, and developing new methods to characterize and classify these strains for use in resistance breeding activities.

"This award provides nice recognition for our program, serving to highlight some

of our achievements and contributions in understanding and managing important plant diseases," said Strelkov, a professor in the Department of Agricultural, Food and Nutritional Science.

He and his team have also increased understanding of how the clubroot pathogen spreads. For example, by analyzing DNA extracted from dust samples, they showed for the first time that clubroot spores can be quantified and measured in windborne dust. That's significant because it demonstrates that windborne dissemination of clubroot can occur, in addition to other mechanisms of dispersal such as movement of infested soil on farm machinery.

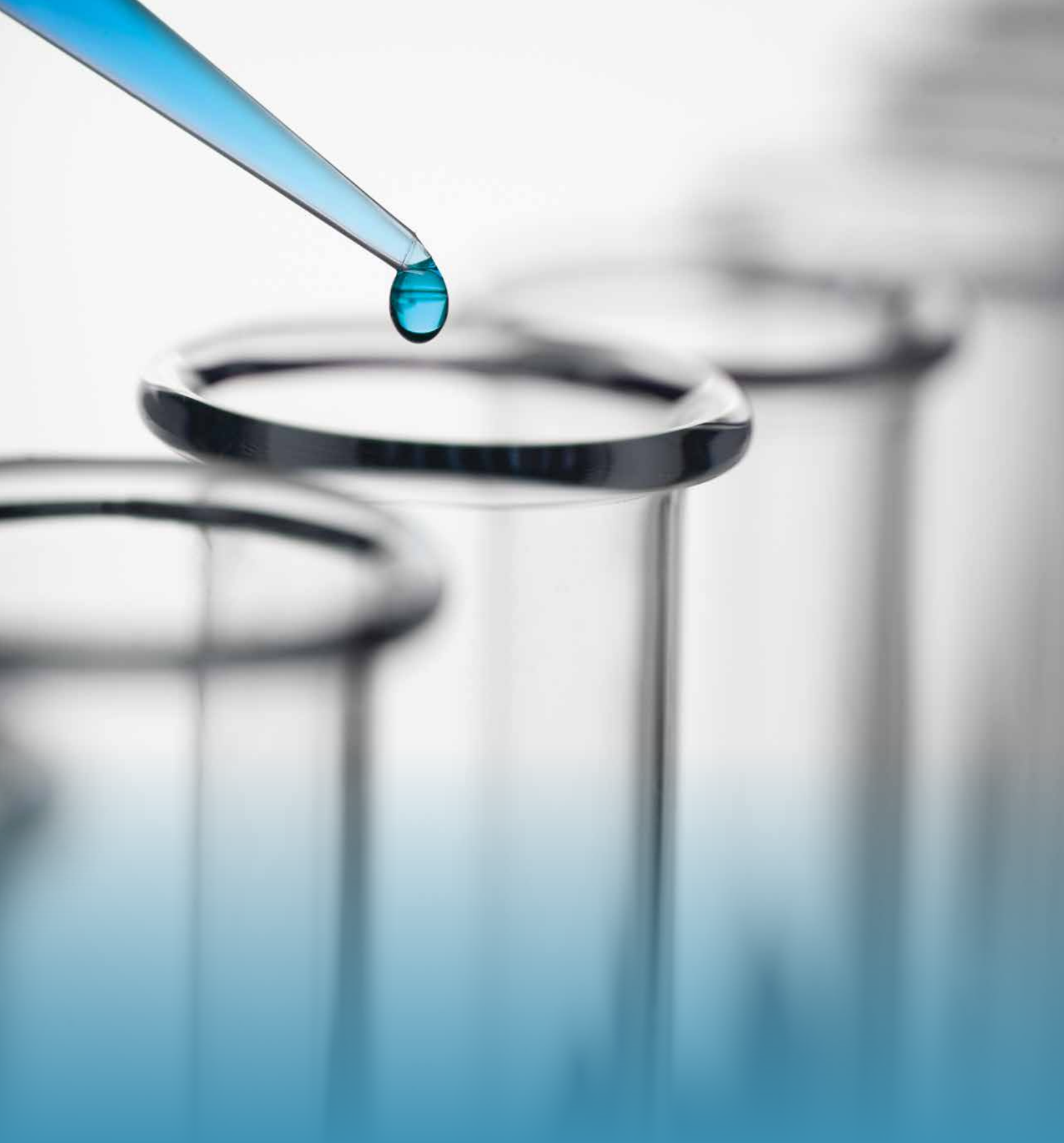
The pathogen spores can stay dormant in the soil for up to 20 years, waiting for enough moisture and the presence of host roots to germinate and cause infection. This makes management of the disease challenging, highlighting the importance of long-term

strategies to understand and control this pathogen.

In addition to his work on clubroot, Strelkov also works on various other plant diseases including tan spot of wheat. His research on tan spot is focused on understanding the molecular basis of fungal virulence.

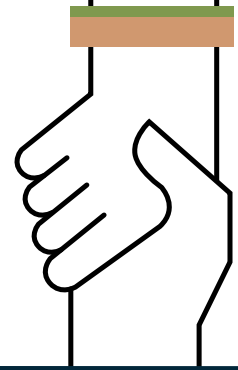
"Over the next year, we will continue to work on field crop pathology, with a particular emphasis on clubfoot of canola and tan spot, a major disease of wheat," he said.

The Killam awards are granted to faculty members based on the quality of their scholarly activities. They were established in 1991 as part of a generous bequest by Izaak and Dorothy Killam that includes scholarships, fellowships and professorships at the University of Alberta and other Canadian universities and institutions. The awards are meant to encourage advanced study and increased scientific achievement. ■



HIGHLIGHTS

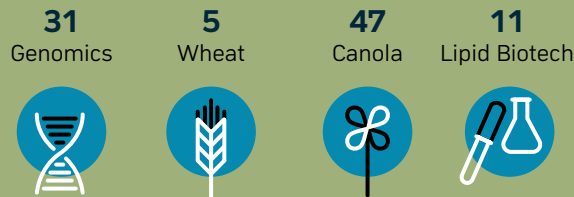
EXCELLENCE + IMPACT IN FOOD



FACULTY EXCELLENCE

- 4 Canada Research Chairs
- 2 Campus Alberta Innovates Program Chairs
- 1 NSERC Industrial Research Chair

COMMERCIALIZED TECHNOLOGIES + CROP VARIETIES



IMPACT HEALTH + WELL-BEING



4,000+

copies sold of the *Pure Prairie Eating Plan* meal planning book, written by U of A faculty.

IMPACT ECONOMIC PROSPERITY

Incorporating blackleg and clubroot disease resistance into canola cultivars has **contributed an estimated \$275M to the Alberta economy.**

IMPACT COMMERCIALIZATION

BIONEUTRA INC.
Established commercial oligosaccharide production in Edmonton based on close collaboration with U of A. Their principal product currently produces **sales revenue over \$10M per year, which they project to grow by 20% per year.**

IMPACT CULTURAL ENRICHMENT

Through a collaboration of over a decade with Alexander First Nation, **community co-researchers have been empowered as advocates to promote healthy and traditional foods in their community.**

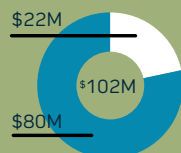


IMPACT ENVIRONMENTAL SUSTAINABILITY

Over 10 years, U of A genomics work has helped improve beef feed conversion efficiency by 30%. In other words, the same amount of beef can be produced using 70% of the animals, 81% of the feed, and 88% of the water.



IMPACT ATTRACTING R+D INVESTMENT



LIVESTOCK GENTEC
\$22M in core funding has leveraged an additional **\$80M in research grants**, \$16M of which is from industry or international sources.

MAJOR PARTNERS + FUNDERS

Provincial and national industry associations for

- pulses
- canola
- dairy
- eggs
- beef
- poultry
- pork
- wheat
- barley

Local and provincial Government

- City of Edmonton
- Alberta Agriculture and Forestry
- Alberta Innovates
- Alberta Health Services
- Alberta Prior Research Institute

Federal Government

- NSERC
- CIHR
- Agriculture and Agri-food Canada
- Health Canada
- Canadian Food Inspection Agency

Health Charities

- Canadian Diabetes Association
- Alberta Diabetes Foundation
- Heart & Stroke Foundation



Rhonda Bell and Catherine Chan

NUTRITION RESEARCHERS ATTRACT PRESTIGIOUS AWARDS

Nutrition researchers **Rhonda Bell** and **Catherine Chan** became the University of Alberta's 2016 Community Scholar winners for the continued impact their self-published *Pure Prairie Eating Plan* has had across the country.

Although they developed the monthly menu plan to help people manage Type 2 diabetes, it offers a way of eating that is good for almost everyone. It combines elements of the Mediterranean Diet and Canada's Food Guide, emphasizing vegetables, fruit, whole grains and balanced proteins.

With support from agricultural groups, promotions by the Alberta Diabetes Foundation and Alberta Diabetes Institute, and even a nod in the book *The Cure for Everything* by U of A health law researcher and author **Tim Caulfield**, the plan is now in use across Canada and beyond.

More than 4,000 copies have been bought by the public and health-care professionals. Alberta Health Services used it during a pilot project community kitchen for seniors, and Health Canada uses it in programming for Aboriginal communities in Alberta.

Bell, an expert in nutrition and diabetes, also received the prestigious Earl Willard McHenry Award from the Canadian Nutrition Society in May 2016. The award applauds those who have exerted influence on each of education, leadership, research and public awareness in the field of nutrition. ■



Lloyd Dosedall honoured posthumously for his expertise in field-crop pests

Lloyd Dosedall, a former ALES professor who was renowned internationally for his expertise in controlling pests in canola and other crops, has received a posthumous award from the Canadian government.

The 2016 Gold Harvest Award recognizes the significant contributions he made to the federal department of Agriculture and Agri-Food Canada in the category of innovation, collaboration and service excellence.

Dosedall was honoured as a member of the Entomology Field Guide Team, which developed and published a field guide in 2015 titled *Field Crop and Forage Pests and their Natural Enemies*

in Western Canada. It documents 25 years of emerging pests, new science and new pest management technologies, including biological control and biopesticides.

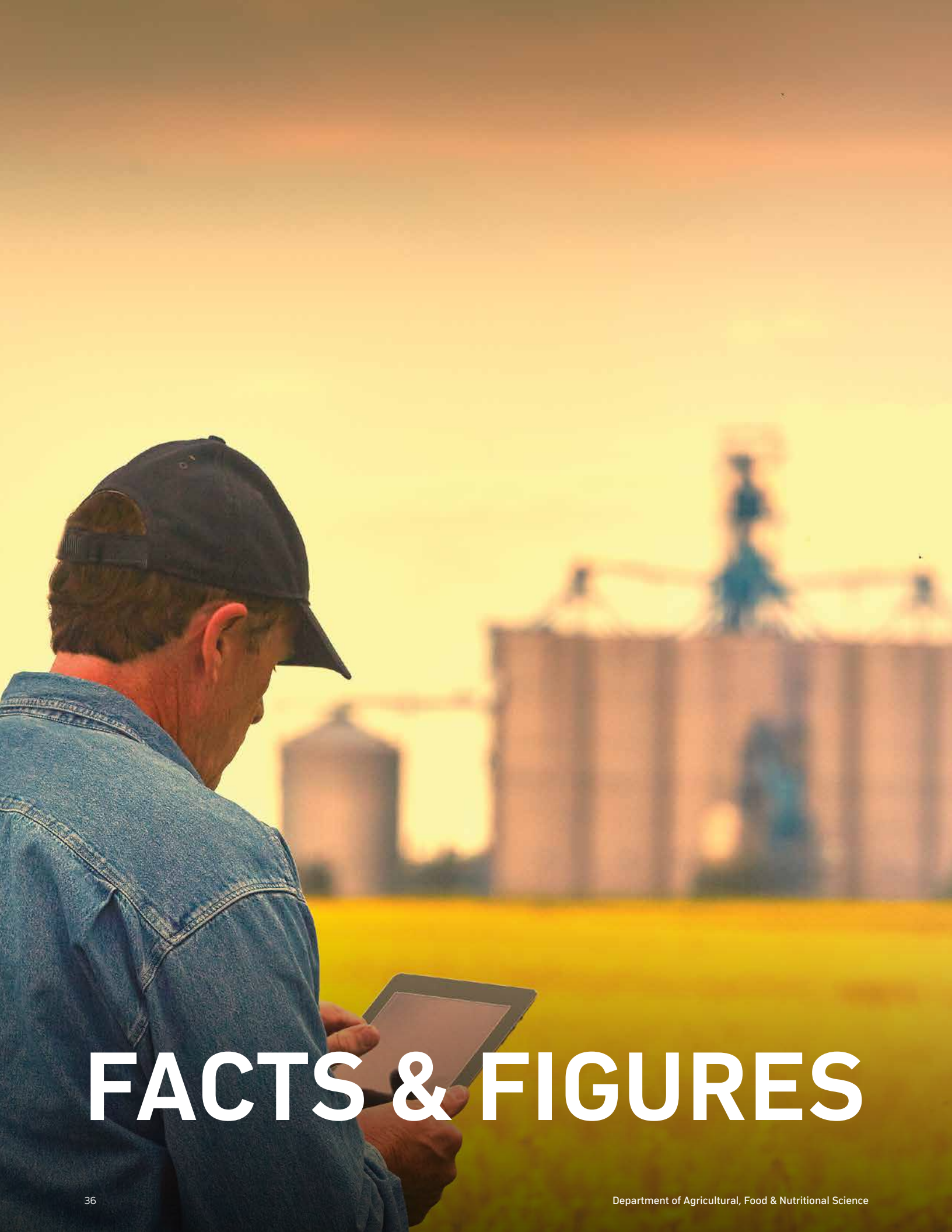
Just 61 years old when he died of cancer in 2014, Dosedall left an enormous legacy of practical solutions for crop producers' problems. Among his foremost accomplishments was helping to develop several pest-resistant canola varieties by identifying germplasm resistant to root maggots and cabbage seedpod weevils.

"This allows breeders to have a wider genetic pool as they develop cultivars every year," said **Héctor Cárcamo**, a research scientist at Agriculture

and Agri-food Canada and a longtime collaborator of Dosedall's.

Dosedall's field screening of root maggot and seed pod weevil resistant canola confirmed in the west that these resistances were active countrywide. His research also helped reduce the impact of significant pests in canola, peas and cereal, and he developed strategies for using beneficial insects, predators and parasites to control pests naturally.

By studying insect-host interactions, insect invasion patterns and shifts in insect biodiversity, Dosedall also sensitized the agricultural community to the need to both protect and learn more about beneficial organisms. ■



FACTS & FIGURES

PARTNERS AND FUNDERS 2016–17

Agriculture and Agri-Food Canada
Agriculture Funding Consortium:

- Alberta Barley Commission
- Alberta Canola Producers Commission
- Alberta Chicken Producers
- Alberta Crop Industry Development Fund
- Alberta Innovates-Bio Solutions
- Alberta Livestock Meat Agency Ltd
- Alberta Milk
- Alberta Pulse Growers Commission
- Alberta Wheat Commission
- Egg Farmers of Alberta
- Western Grains Research Foundation

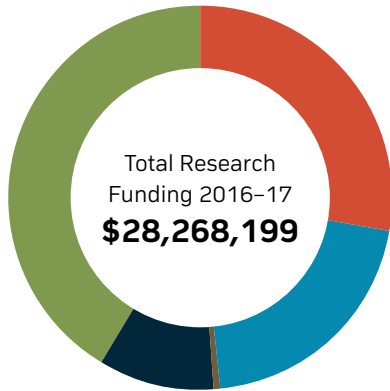
Alberta Agriculture and Forestry
Alberta Biodiversity Monitoring Institute
Alberta Hatching Egg Producers
Alberta Health Services
Alberta Innovates-Health Solutions
Alberta Innovates-Technology Futures
Alberta Oat Growers Commission
Alberta Pork
Alberta Turkey Producers
Alimentary Health Limited
Almased Wellness GmbH
ATCO Electric Ltd.
BASF Canada Inc.
Bayer Crop Science Inc.
BC Dairy Association
Beefbooster Inc.
Beef Cattle Research Council
BioLargo Water, Inc.
Burnbrae Farms Ltd.
Canada Foundation for Innovation
Canada Research Chairs
Canadian Beef Breed Council
Canadian Celiac Association
Canadian Charolais Association

Canadian Dairy Network
Canadian Food Inspection Agency
Canadian Foundation for Dietetic Research
Canadian Hatching Egg Producers
Canadian Institute of Health Research
Canadian Liver Foundation
Canadian Poultry Research Council
Canadian Sheep Breeders Association
Canadian Swine Research and Development Cluster
Canola Council Canada
Cargill Limited
Ceapro Inc.
Climate Change and Emission Management Coproration
Cobb-Vantress Inc.
Crop Production Services (Canada) Inc.
Dairy Farmers of Canada
Dairy Farmers of Manitoba
Dalhousie University
Danisko UK Ltd.
Diamond V Mills Inc.
Ducks Unlimited Canada
Egg Farmers of Alberta
Egg Farmers of Canada
Egg Processing Innovations Cooperative
Engage Agro Corporation
Forge Hydrocarbons Corporation
Genesis Inc.
Genome Alberta
Genome Canada
Genome Prairie
GrainFrac Inc.
Healthy Cow Corporation
Heart and Stroke Foundation of Canada
Higher Education Commission of Pakistan
Hypor LP

Ingredion Inc.
International Life Sciences Institute
Kellogg Company
Kaiser Foundation Research Institute
Lallemand Animal Nutrition
Lilydale Inc. – A Sofina Foods Company
Maple Leaf Foods Inc.
Michael Foods, Inc.
Mitacs Inc.
National Centre of Excellence BioFuelNet Canada
National Pork Board
National Research Council of Canada
Natural Sciences and Engineering Research Council of Canada
OatDeal the Healthy Choice Inc.
PIC USA Inc.
Pioneer HiBred Production LP
PolicyWise for Children & Families
Prairie Oat Growers Association
Prostate Cancer Canada
Royal Embassy of Saudi Arabia
Saskatchewan Canola Development Commission
Saskatchewan Milk Marketing Board
Saskatchewan Pulse Growers
Saskatchewan Wheat Development Commission
Schlumberger Foundation
SERIDA
Soy 20/20
Syngenta Canada Inc.
Teagasc – Agriculture and Food Development Authority
The State of Queensland – DSITI
University of Calgary
W.A. Grain and Pulse Solutions
Westgen

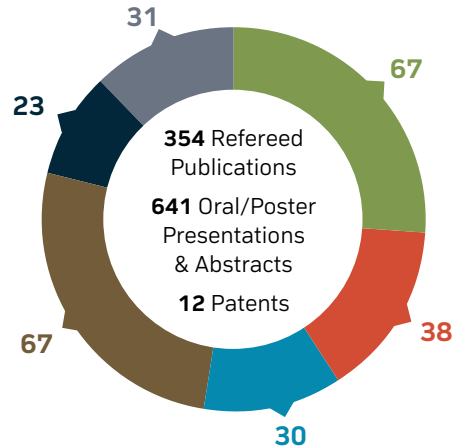
BY THE NUMBERS

RESEARCH FUNDING



▶ Alberta Provincial Government	\$7,926,060
▶ Federal Government	\$5,809,876
▶ Other Government	\$104,036
▶ Industry	\$2,792,995
▶ Other	\$11,635,232

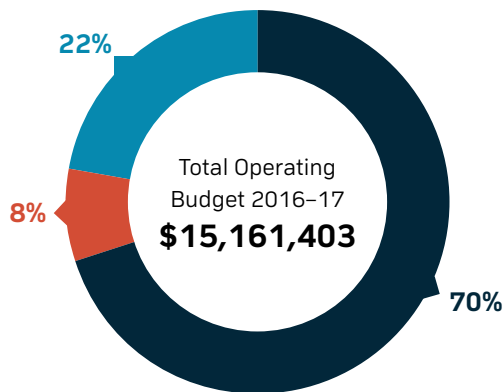
ACADEMIC STAFF



▶ Professors*	▶ Post-Doctoral Fellows
▶ Adjunct Professors	▶ Research Associates
▶ Professor Emeriti	▶ Visiting Scientists/Students

* including AAFC and ARD academic work affiliates/cross and joint appointments

OPERATING BUDGET

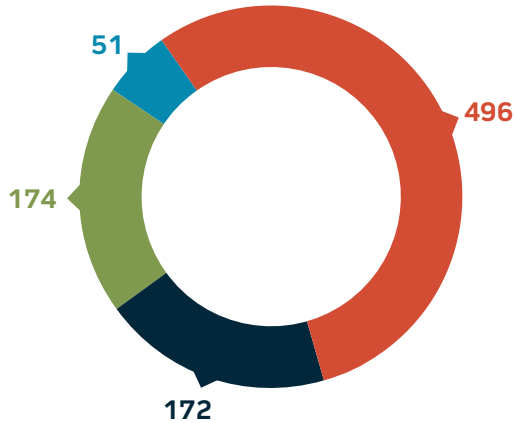


▶ Academic, Administrative and Teaching Support	70%
▶ Central Laboratories	22%
▶ Research Stations	8%

TECHNOLOGY TRANSFER

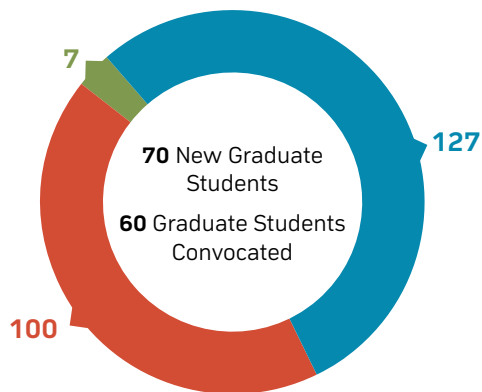
09	Commercial Agreements (Licenses & Options)
06	Technologies with Patent Protection Initiated
37	Technologies that Received Investment by TEC Edmonton, Inventors, etc.
32	Material Transfer Agreements

UNDERGRADUATE STUDENT ENROLMENT



- ▶ BSc in Nutrition and Food Sciences
- ▶ BSc in Animal Health
- ▶ BSc in Agriculture
- ▶ BSc in Agriculture/Food Business Management

GRADUATE STUDENT ENROLMENT



- ▶ Doctoral Students
- ▶ Masters Students
- ▶ Visiting Students

CENTRAL LABORATORIES

- ▶ Agri-Food Material Science Unit
- ▶ Agriculture Genomics and Proteomics Unit
- ▶ Food Science Facilities
- ▶ Nutrition & Metabolism Facilities
- ▶ Human Nutrition Research Unit
- ▶ Plant Growth Facilities

OFF-CAMPUS RESEARCH FACILITIES

- ▶ Agri-Food Discovery Place
- ▶ Alberta Poultry Research Centre
- ▶ Crops & Land Resources Unit
- ▶ Dairy Research and Technology Centre
- ▶ Laird W. McElroy Metabolism & Environment Research Unit
- ▶ Swine Research and Technology Centre
- ▶ Enclosed Composting Facility
- ▶ Feedmill
- ▶ Ministik Field Station
- ▶ Roy Berg Kinsella Research Ranch
- ▶ St. Albert Research Station
- ▶ Mattheis Research Ranch

