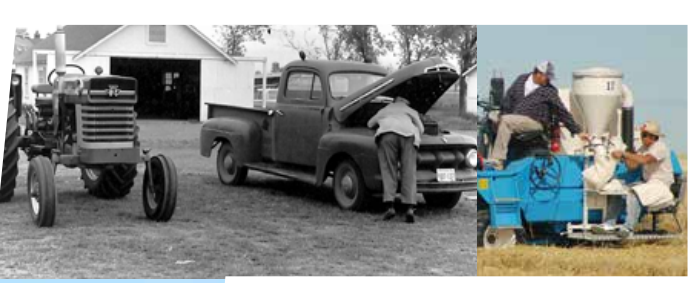
CROP DEVELOPMENT CENTRE
USASK










Success Grows our Future

We acknowledge we are on Treaty 6 Territory and the Homeland of the Métis. We pay our respect to the First Nation and Métis ancestors of this place and reaffirm our relationship with one another.

MISSION STATEMENT

Develop crop varieties that bring value to the agriculture sector, through the development and application of scientific knowledge and technologies, in partnership with stakeholders across the agriculture value chain.

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USASK

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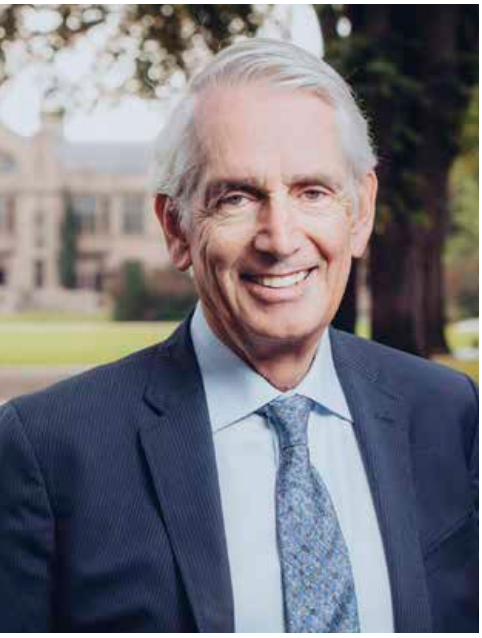


President Peter Stoicheff

Message from the President of the University of Saskatchewan

For half a century, our university's Crop Development Centre has helped producers in Saskatchewan and around the world diversify and farm more productively, profitably, and sustainably.

Remarkably, more than 500 new crop varieties have been developed, helping to make Saskatchewan and our university a leader in agricultural innovation for global food security.

Dominating commercial barley acreage by 1985, Harrington barley had a huge impact on the international malting and brewing industry. By the late 1980's, Laird lentil was the most widely grown lentil variety in the world. And CDC is now a global leader in the application of genomic research for crop improvement, having led international scientific breakthroughs in cracking the genetic codes for bread wheat and durum wheat, the source of semolina for pasta.

Most recently, CDC researchers led the international consortium of 95 scientists that sequenced 15 different wheat varieties bred around the world and were strongly engaged in the research that sequenced the genomes of pea, chickpea, oat, tepary bean and flax. Saskatchewan now leads the world in exporting peas, lentils, and chickpeas—staple foods in many fast-growing countries such as India, China, and Bangladesh.

CDC research expertise also includes crop diseases, end-use quality, and improved production practices such as replacement of summer fallowing with zero tillage which greatly increased seeded acreage—an estimated $50-billion impact on the Saskatchewan economy since 1970.

The CDC draws upon the expertise of its many collaborators throughout the College of Agriculture and Bioresources and across the campus, including at the university's Global Institute for Food Security.

Innovative CDC research means more land is being used to produce food, higher returns for producers, and more crop choices for producers everywhere. In short, thanks to the support of our partners in government, industry and producer groups, the CDC stunningly exemplifies our commitment to "be the university the world needs."

Peter Stoicheff
President and Vice-Chancellor

Message from the Dean of the College of Agriculture and Bioresources

Dr. Angela Bedard-Haughn (PhD)

As the Dean of the College of Agriculture and Bioresources, I'm honoured to speak about the Crop Development Centre and its value to Saskatchewan, Canada and the world. For 50 years, the CDC has been dedicated to creating resilient and successful crop varieties. Together with producers, the CDC is feeding the world today and building a sustainable future for generations to come.

The CDC has released more than 500 crop varieties in the last 50 years —an average of 100 for each decade. This is truly remarkable! It is a vital piece of the food industry and a champion of our prairie economy. Yielding economic growth, year after year.

The CDC brings diversity to fields around the globe through the science of agriculture and provides financial strength to our university, our producers, our partners and beyond. The CDC introduced pulse crops to Saskatchewan. Saskatchewan now leads the world in exporting peas, lentils, and chickpeas—staple foods in fast-growing countries such as India, China, Bangladesh, and northern Africa.

As you drive down prairie roads past fields of crops, remember many of those crops are grown with CDC seeds. What starts as a promising seed carefully selected by CDC breeders grows into food security, health, and sustainability for our planet.

Congratulations to the Crop Development Centre on a transformative 50 years, I can't wait to see what's next!

Angela Bedard-Haughn, PhD, PAg
Dean and Professor

Dr. Curtis Pozniak (PhD)

Dr. Yuguang Bai (PhD)

Message from the Director, Crop Development Centre and the Department Head, Plant Sciences

This year marks the Golden Jubilee of the Crop Development Centre. And we have much to celebrate! The CDC has released over 500 commercial varieties in over 40 different crop kinds and many have become industry standards. The CDC is also intimately linked to crop diversification and is a recognized name on Saskatchewan and western Canadian farms. We have evolved into a world-class centre, with a local, national and international reputation of success.

The strength of the CDC is rooted in our history and connections. Our integration within the Department of Plant Sciences and the College of Agriculture and Bioresources, and our connections with our national and international collaborators has been vital to our success. Our stakeholders, funders, and government are equally important and the long-standing partnership with the Saskatchewan Ministry of Agriculture and the commitment of producer commissions, industry partners, and growers have paved the way for our success. But our greatest strength is our people. They represent our collective knowledge, and skills, and it is our collective know-how and interpersonal connections that facilitates our innovation. They are deeply committed to their work and have an appreciation that the important work that we do has impact – for producers and society.

We are excited for the next 50 years of the CDC. We will continue to be a trusted partner and provider of varieties for both local and world markets and our research will continue to be leading edge and internationally recognized. Our work will be bold, deliberate, and strategic as we position ourselves as a leading constituent of the agri-food sector not only in Canada but also in the world.

It is an honor to lead the Crop Development Centre during these exciting times of celebration and reflection. We have prepared this magazine to not just mark the 50th year of the CDC, but to celebrate the achievements of our many researchers and to acknowledge our partners without whom none of this would have been possible. We hope you enjoy our many stories that celebrate our past, the present, and that look forward to our exciting future.

Dr. Curtis Pozniak (PhD)
Director and Professor

Dr. Yuguang Bai (PhD)
Department Head and Professor

Thank You!

As we celebrate our golden jubilee, we honour those whose support has made 50 years of innovation and success possible.

Thank you to our friends, partners and stakeholders!

CROP DEVELOPMENT CENTRE
USASK

Five decades of the CDC

1970s

1971 The Saskatchewan Government and National Research Council announce they will provide funding to develop a Centre of Excellence for crop breeding in Saskatoon with the mandate to diversify Saskatchewan agriculture. The Province of Saskatchewan agrees to cover capital costs with the construction of a Crop Science Field Laboratory.

1973 The winter cereals program begins research on direct seeding into undisturbed stubble fields with the goal to increase winter wheat survival rates.

1977 Mr. Fredrick Wesley Kernen, a local area farmer and former student of the College of Agriculture and Bioresources, donates two sections of prime agricultural and prairie land to the University with full jurisdiction to operate on the lands.

1978 Laird lentil, the first lentil variety released by the CDC is licensed for use in Canada.

Jack Messer, Saskatchewan Agriculture Minister, speaking at the official opening of the Crop Science Field Lab, Aug 1972

Winter cereal breeder Dr. D. Brian Fowler with visitors, 1973

The red barn located on the two sections of land donated by Fred Kernen, 1977

Laird Lentil, 1978

1980s

1980 Eston lentil is licensed for use in Canada.

1981 CDC researchers obtain a three year grant of Agiculture Canada's new crop development fund for research on chickpea production and management.

Chickpea research, 1981

1981 CDC researchers obtain a three year grant of Agriculture Canada's new crop development fund for research on canaryseed production and management.

1981 Harrington two-row malt barley is licensed for use in Canada.

1981 Lentil varieties Laird and Eston production in Canada increases to over 10,000 ha.

1981 Outlook fababean, the first fababean variety released by the CDC, is licensed for use in Canada.

1982 Calibre oats, the first oat variety released by the CDC, is licensed for use in Canada.

1982 Scout barley, the first two-row hulless barley variety released by the CDC, is licensed for use in Canada.

1983 Alden canaryseed, the first canaryseed variety released by the CDC, is licensed for use in Canada.

1983 Arcola durum wheat, the first durum wheat variety released by the CDC, is licensed for use in Canada.

1984 Tupper barley, the first six-row hulless barley released by the CDC, is licensed for use in Canada.

1986 The construction of the field headquarters at the Kernen Crop Research Farm is completed and the occupants move into the facility.

1986 Bellevue pea, the first yellow field pea variety released by the CDC, is licensed for use in Canada.

1986 Vimy flax, the first brown seeded flax variety released by the CDC, is licensed for use in Canada.

1987 Lentil varieties Laird and Eston production in Canada increases from 0 ha in 1969 to over 240,000 ha.

1988 Construction of the Agriculture Building begins with an official sod-turning event.

1989 Rose red lentil, the first red lentil variety released by the CDC, is licensed for use in Canada.

Harrington barley, 1981


Laird and Eston lentil varieties, 1981


Canaryseed research, 1981


Outlook fababeans, 1981


Dr Ron Bhatty and Dr Brian Rossnagel examining hulless barley, 1982

Calibre oat breeder seed plot, 1982


Arcola durum wheat, 1983


Rose red lentil, 1989

1990s

1990 Calibre oats is recorded as being grown on 253,000 ha or 50.3% of Saskatchewan oat acreage.

1990 Crop Development Centre begins naming new crop varieties with the CDC Prefix.

1991 CDC Kestrel winter wheat is licensed for use in Canada and winter cereals are showing great potential because of the uptake of reduced tillage conservation production systems.

1991 Construction is complete of the Agriculture Building and occupants take up residence in their new offices and laboratories.

1991 Canada becomes the largest exporter of green seeded lentils.

1994 Canada becomes the largest lentil producer in the world.

1995 The CDC has officially registered 79 crop varieties in 21 different crop types since its inception in 1971.

1995 CDC Marengo chickpea, the first desi chickpea released by the CDC, is licensed for use in Canada.

1995 CDC Expresso black bean, the first dry bean variety released by the CDC, is licensed for use in Canada.

1995 CDC Quattro fenugreek, the first spice crop variety released by the CDC, is licensed for use in Canada.

1996 The CDC celebrates its 25th year in operation.

1996 CDC Peko, the first green field pea variety released by the CDC, is licensed for use in Canada.

1997 CDC Yuma chickpea, the first kabuli chickpea variety released by the CDC, is licensed for use in Canada.

1998 Initiation of the CDC/CWB/GRL Japanese Food Barley Development project in collaboration with the All Japan Barley Processors Association.

1998 CDC expands their capability for quality screening of plant breeding materials hiring both an oilseeds and wheat quality specialist.

1998 The new seed storage facility at the Crop Science Field Laboratory is completed.

Construction of the Agriculture Building is complete and residents take up occupancy, 1991

Dry bean field trials, 1995

Dr. Al Slinkard examines a fenugreek plant, 1995

CDC Peko, 1996

CDC Yuma, 1997

The Crop Development Centre's oilseed and wheat quality specialists

1998 The Saskatchewan Pulse Growers purchases two quarters of land located at Floral, SK with the intended use to expand the CDC's pulse breeding effort.

1998 Drs Ron Bhatty and Al Slinkard retire from the CDC, making them the first of the original 'gang of five' scientists to leave the Crop Development Centre.

1998 CDC Falcon, CDC Harrier, CDC Clair and CDC Kestrel, as a group, represent the first agronomically adapted, winter hardy, high yielding, semi dwarf winter wheat cultivars developed in western Canada.

Dr. Rattan (Ron) Bhatty, 1998

2000s

2000 Construction of the Breeder Seed Facility at the Kernen Crop Research Farm is completed and residents of the building take up occupancy.

2000 The CDC research team expands with the addition of a pulse pathologist.

2002 CDC Gold flax, the first solin flax variety released by the CDC, is licensed for use in Canada.

2002 CDC Imagine wheat, the first CDC Clearfield® (imidazolinone herbicide resistant) wheat, is registered for use in Canada.

2002 CDC Orrin oat, the first CDC oat variety with crown rust resistance, is registered for use in Canada.

2002 CDC Fibar barley, a pure amylopectin waxy starch barley with high β-glucan, is registered for use in Canada.

2003 Researchers re-initiate the CDC fababean breeding program.

2004 CDC Go wheat, the first semi-dwarf CWRS wheat released by the CDC, is registered for use in Canada.

2004 CDC Sol-Fi oat, a high beta-glucan oat variety released by the CDC, is registered for use in Canada.

2004 CDC Cowboy, the first forage/low input barley released by the CDC, is registered for use in Canada.

2005 The addition of the pulse crop research facility at the Crop Science Field Laboratory is completed, official grand opening is held on November 9th.

2006 The CDC research team expands with the addition of a cereal and flax pathologist and a third pulse crop breeder responsible for the breeding of chickpea.

The Crop Development Centre's breeder seed facility, 2000

CDC Gold Solin flax, 2002

CDC Orrin Oat, 2002

CDC Fibar Barley, 2002

CDC re-initiates the fababean breeding program, 2003

2006 CDC Meadow yellow pea is released and by 2012 becomes the most widely grown pea variety in Canada.

2007 CDC Maxim red lentil is released and becomes the most widely grown lentil crop in the world.

2007 CDC Carter barley, the first double smut resistant hulless barley for organic grower.

2008 CDC Utmost wheat is the first wheat midge resistant CWRS cultivar released by the CDC.

2009 Two "slow darkening" pinto bean varieties are registered for use in Canada.

2009 CDC Hilose barley is the first high amylose hulless food barley cultivar released by the CDC.

CDC Utmost, 2008

CDC WM-2, 2009

2010s

2010 CDC PolarStar barley, the first LOXless malting variety released by the CDC, is registered for use.

2010 Construction of the Grains Innovation laboratory (GIL) is completed in 2009 and researchers have taken occupancy. An official grand opening for the GIL is held on June 28, 2010.

2011 The Crop Development Centre reaches its 40th year of operation, a milestone that is celebrated by staff, partners, and stakeholders at the Kernen Crop Research Farm.

2011 Wheat research receives $7.3 million by The Canadian Triticum Advancement through Genomics (CTAG) funded by Genome Canada, the Saskatchewan Ministry of Agriculture, and Western Grains Research Foundation (WGRF) to unravel the wheat genome.

2011 A three phase renewal of lighting, controllers and refrigeration systems in the controlled environment facility is underway.

2011 Researchers initiate the testing of soybean as a crop for Saskatchewan.

2012 Completed genome sequence of CDC Frontier kabuli chickpea (with international collaboration).

2012 CDC Prime purple wheat, the first high antho-purple seeded wheat variety released by the CDC, is licensed for use in Canada.

2014 The CDC research team expands with the addition of a forage breeding program.

Grains Innovation Lab contributors recognition board, 2010


Soybean testing is initiated by CDC researchers, 2011


A forage breeding program is added to the CDC, 2014

2015 CDC Teal, a wheat cultivar released in 1991 by Drs. Hughes and Hucl, is awarded Seed of the Year West.

2016 Results of an economic impact study show that CDC varieties have contributed $6.4 billion to prairie-wide agricultural productivity from 1991-2015.

2017 CDC Researchers develop a mass spectrometry rapid analysis to determine relevant compounds in fababean.

2018 Researchers in the CDC wheat program lead the international consortium that decodes the genome of bread wheat.

2019 Researchers in the CDC pulse program are part of an international team that completes the sequencing of the pea genome.

2019 CDC Copeland a two-row malt barley variety developed by Drs. Bryan Harvey, Brian Rossnagel and Eric Lefol, is awarded Seed of the Year West.

CDC varieties have contributed $6.4 billion to prairie agriculture

CDC durum wheat technicians analyzing results from a KASP assay

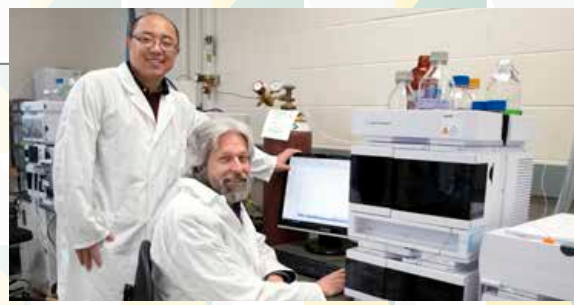
2020s

2020 Researchers in the CDC cereal and pathology group develop a fast and accurate method to identify toxins in cereal crops.

2020 Researchers in the CDC molecular pulse breeding program develop a mathematical model to predict lentil performance in growing locations around the world.

2021 The Crop Development Centre has officially released over 500 new crop varieties in over 40 crop types since its inception in 1971.

2021 The Crop Development Centre celebrates 50 years in operation.



CDC researchers develop a fast method to identify toxins in cereal crops, 2020

A sampling of varieties released by the CDC

UNVEILING: our new logo

It has been a long time coming. For 50 years, we have grown, evolved and become an inextricable part of the Department of Plant Sciences, the College of Agriculture and Bioresources and the University of Saskatchewan.

We are defined and driven by our values of trust, innovation and collaboration: quality and integrity from our labs to the field, to our fork, working hand in hand with producers, government and industry stakeholders. Our brand has developed organically, and it manifests in all we do.

The CDC's golden jubilee was the perfect opportunity to rebrand ourselves – to celebrate our past, our history - but to also look to the future. This is the ideal occasion to unveil our new CDC logo. We have distilled our core values and the ethereal essence of our brand in this strong visual representation that will carry us into the future.

The logo mark was formed from the letter forms "CDC". As if magnetic, these letters strategically come together to represent collaboration while the infinity symbol formed in the white space evokes boundless innovation. As a whole, this solid shape conveys openness and trust. The colours and font show our strong connection to the University of Saskatchewan, our new visuals will be part of the USask brand going forward.

Going forward, you will see our new identity wherever we have a public presence — our new website and on our new social media platforms — and on each and every product and communication coming out of the Crop Development Centre.

KERNEN FARM DONATION

In 1910, the University of Saskatchewan allocated 1040 acres to the College of Agriculture for a University farm. By the late 1960's, it had become apparent that additional facilities, staff and research lands were required if the College were to remain competitive and relevant in the changing agricultural landscape. However, land costs in the proximity of the University were on the rise and were sought after by developers for urban expansion.

In 1977, Mr. Fredrick Wesley Kernen, a local area farmer and former graduate and employee of the College of Agriculture made an offer to the University that became the largest gift ever by an individual at that time. To honor his parents, the late Frederick J. and Lucy Kernen, Mr. Kernen offered to gift two sections of prime agricultural land to the University, with full jurisdiction to operate on the lands. Included in the gift were 300 acres of native prairie land which were to remain un-tilled and be used for ecological research. At the time of the acquisition, the land was valued at $1000/acre for a total value of over $1.25 million. It would have been impossible for the University to have purchased a more suitably located research farm.

Today, officially referred to as The Kernen Crop Research Farm, the site is located at the intersections of Highways 5 and 41 on the quickly expanding east side of Saskatoon. Over the last 44 years, it has become the land which accommodates ecological studies, grazing studies, crop breeding, crop production and crop and weed management research in the Department of Plant Sciences and the Crop Development Centre. Managed on a four-year crop rotation, the cultivated area of the farm also generates revenue which helps support the cost of crop research and future development on the farm.

The old red barn that was located on the land at the time of acquisition collapsed in the late 1990's. In 1999, the lumber from that barn was donated to Habitat for Humanity to be used in new construction projects a fitting tribute to Mr. Kernen's act of giving.

Fred Kernen's barn was located on the donated sections of land.

1970s

A mission to transform Saskatchewan agriculture begins

BY KATHY FITZPATRICK

Dr. Larry Gusta (PhD), Crop Development Centre, in a controlled environment room, November 1976.

Field tour at the CDC research plots, August 1972.

Postcard-pretty fields of blue flax set against yellow canola, now as emblematic of Canadian prairie as wheat. Stubble poking through a snowswept expanse, ready to receive springtime's direct-seeded crop. Row upon row of ripening dainty-leafed lentils, Saskatchewan's newer green and gold.

In the past half-century, the western Canadian farm landscape has been transformed. Much of the credit goes to the Crop Development Centre at the University of Saskatchewan's (USask) College of Agriculture and Bioresources.

In its mission to generate new profit centres for producers, the CDC has added billions of dollars to the economy. Its impact has been "enormous", says barley breeder and former CDC director Dr. Bryan Harvey (PhD). The introduction of new crops to the region, and new varieties of old standbys, has helped spread financial risk, he says, balancing falling wheat prices with better-paying pulses, for instance.

Scarce funds on the farm and in crop research was the common element that led to the CDC's creation back in 1971. In the late 1960s a world glut had driven down the price of wheat, by far Saskatchewan's dominant crop back then. At the same time, the USask Crop Science Department was searching for more money.

As one of the CDC's leading wheat breeders Dr. Brian Fowler (PhD) wrote, the department's inability to raise enough money to conduct research, hire enough staff and attract graduate students were the "basic factors motivating initial efforts" to establish the CDC.

Faced with a budget cut in 1970, the College of Agriculture (as it was then called) set as its top three priorities undergraduate teaching, graduate teaching, and research – in that order.

But, "it was clear at this time that earlier fears had been justified and it would be next to impossible to finance research through the structure of the University," Fowler continued.

Harvey, who had returned from Guelph in 1966, recalls the Crop Science Department was "way understaffed for the responsibility that it had", considering Saskatchewan has almost half the arable cropland in Canada. There were only four people doing field work including himself, Harvey says, adding it was "unreasonable to expect us to cover the full spectrum of needs."

Meanwhile, the prairie farm crisis provided the rationale for a bigger push in agricultural research, particularly in Saskatchewan. At the time Saskatchewan was without "a major plant breeding

centre" according to the department's 1971 funding application to the National Research Council. Dr. Graham Simpson (PhD), then Acting Head of Crop Science, was the one to spot an NRC grant program as a promising funding source, Harvey recounts.

In its application, the department made the case that with agricultural markets changing rapidly, prairie farmers had to diversify and lessen their dependence on wheat, while at the same time improving traditional crops (wheat and barley in particular) to meet world demands. It was also argued that plant breeding is most effective when done where the resulting varieties are to be used, and Saskatoon was put forward as the logical location.

As Harvey recalls, at the time most of Agriculture Canada's wheat research was being done in Swift Current (in the drier southern prairie) and Winnipeg (where the focus was almost entirely on rust resistance). The northern prairie, with its shorter growing season and greater moisture, was not being serviced as well as it should been, he notes.

Mrs. G. Laird presents a cheque for $25,000 to the CDC for crop development research, January 1975.

"More crop research was a tough sell in the midst of a declining wheat market, but Harvey says the real risk in launching the CDC was the time required to develop and launch a new variety.

More crop research was a tough sell in the midst of a declining wheat market, but Harvey says the real risk in launching the CDC was the time required to develop and launch a new variety. Back then, it typically took 15 years or more. Success would take patience along with money.

The NRC approved $455,100 over three years to support research in three areas: feed barley; field peas and other new crops; and spring and winter wheat. Meanwhile, as Harvey recalls, Dr. Doug Knott (PhD) (Department Head from 1965 to 1975) persuaded the provincial government to contribute as well.

The Province agreed to cover the capital cost of the new Crop Science field laboratory, initially estimated at $260,000 and later reported to be $318,000. As well, the Province committed $200,000 annually for the first three years, and agreed to cover the CDC's operating budget after the NRC term grant expired.

In 1972, USask announced that an additional $100,000 had been set aside for growth room facilities to be built that summer. Five years later, Fredrick Wesley Kernen's large gift of farmland to USask led to the creation of the Kernen Crop Research Farm, another valuable resource for CDC crop breeders.

Simpson became the first director of the CDC. It was staffed with the initial six scientists: Dr. John Berdahl (PhD) (feed and food barley breeding), Dr. Al Slinkard (PhD) (pea breeding), Brian Fowler (winter wheat breeding and agronomy), Dr. Gordon Rowland (PhD) (new crop evaluation), Dr. Ron Bhatty (PhD) (quality analysis), and Dr. Larry Gusta (PhD) (cold hardiness physiology).

It was Slinkard's work on lentils that generated two of the CDC's earliest game-changing varieties before its first decade had passed, the Laird lentil (released in 1978) and the Eston lentil (1980). Lentils would vault from a minor crop in Saskatchewan to a major commodity, making Canada the world's top producer and exporter, with nearly all of the country's production coming from Saskatchewan.

A plot marker in 1976 reads "NEW CROP - LENTIL".

The CDC's next decade would be marked by many more launches and discoveries, impacting a broad range of domains from beer brewing to crop and soil management.

DR. SABINE BANNIZA (PhD)

BY ASHLEIGH MATTERN

MOLECULAR WARFARE: BATTLING ENEMIES INVISIBLE TO THE NAKED EYE

Professor Sabine Banniza, pulse pathologist at the Crop Development Centre, is in a battle against anthracnose, a foliar disease in lentils.

Her group has sequenced the genome of the fungus that causes the disease and researched how the molecules in the pathogens and the host plants interact with each other.

"We've done quite a bit of research into this little warfare at the molecular level," Banniza said. "When pathogens interact with the host plants, they are exposed to molecules from each other, which determine whether the plant will be susceptible and eventually develop symptoms or whether the plant actually manages to defend itself."

There are only two groups worldwide that are working in this area, and Banniza says the CDC has the strongest group. She is not aware of any other group internationally that has done such detailed work on this pathogen, even though it's an important issue in the United States, especially in the northern states where they grow lentils.

Banniza compares her work to the fight against illnesses like COVID-19: One of the reasons it's so difficult to fight a virus is that it keeps evolving, and she has the same challenges in her work.

"It's a constant race with pathogens and you hope to be ahead with whatever resistance you have."

Anthracnose has made headlines again recently because the causal pathogen is becoming insensitive to certain fungicides, so resistant varieties are needed more than ever, Banniza said.

'IT ALL HAPPENS AT THE MOLECULAR LEVEL'

Also like a virus, her adversaries are invisible to the naked eye. It was that challenging aspect of the plant pathology that first attracted her to the field. Insects you can see and count, but diseases are caused by microorganisms like fungi, bacteria, or viruses she said.

"I'm sort of attracted to small things in life because it all happens at the microscopic level."

Banniza grew up in northwest Germany in the lower Rhineland, a flat, empty landscape with no hills, "like Saskatchewan on a small scale," she said. She did an undergraduate degree in horticulture, where she first learned about pests and diseases, then moved to the U.K. to do her Masters degree in integrated pest and disease management.

"I understood very quickly that pests and diseases, and in particular diseases, are a major impediment to food production," she said. "They really cause a lot of damage to crops and it's very difficult for farmers to deal with them."

She did her PhD in plant pathology and worked as a plant pathologist in the U.K. before coming to the University of Saskatchewan for a postdoctoral position in plant pathology.

SASK. FARMERS OPEN TO THE SCIENCE

Having worked in many countries, Banniza says one of the things she particularly enjoys about working in Saskatchewan with the CDC is the close working relationship with farmers and producers. She said in Europe and the U.K., farmers were more skeptical of scientists.

"There is always this thinking that it's all too abstract, too theoretical to have any meaning in the field," she said. "When I moved here to Saskatchewan, I always found farmers much more open and interested in science compared to what I'd experienced before."

Those good relationships have made her work more enjoyable, and she says extension work where she goes out to talk to farmers is a fun part of her job.

"If I talk to colleagues in other countries, [extension work] is not part of their job, so they are pretty much detached from the field," she said. "It's always been important to the CDC and the people who work at the CDC to be out there listening and ensuring what we do has some impact."

Another disease impacting farmers right now is *Aphanomyces euteiches*, a plant pathogen responsible for Aphanomyces root rot, which was first confirmed in the province by Banniza and colleagues in 2013.

She has been working closely with Dr. Tom Warkentin (PhD) at the CDC to breed for resistance, and they expect to have a variety ready to release soon.

"Aphanomyces root rot is a very, very serious disease of pea and lentil, the two largest pulse crops in Saskatchewan," she said. "It's very difficult to control; farmers don't have many if any tools other than long rotations without pea and lentil."

BY ASHLEIGH MATTERN

COMMUNITY CONNECTIONS: BARLEY AND OAT BREEDER EXTENDS CLASSROOM TO FARMERS AND INDUSTRY

When CDC Bow, a malt barley variety, was released a few years ago, Maker's Malt grew the new variety, malted it and then distributed it to microbreweries in Saskatchewan to make a variety of beers as part of the "Bow Project."

"We had events in Saskatoon and Regina, and got many of the local brewers together," said associate professor Aaron Beattie, who participated in the project.

"It gave me a chance to tell the story of what the Crop Development Centre does. A lot of people even in Saskatoon don't have a great understanding of what the Crop Development Centre is or that it even exists; they have a well-known institution here that they may not be that familiar with."

Beattie is a barley and oat breeder at the CDC, but he doesn't spend his time cooped up in a lab. He conducts seminars and webinars with export customers, he appears on podcasts, and he interacts with farming organizations, sitting on national boards. During the summer, he likes to hold field days for private industry and farmers.

He sees this extension work as a branch of teaching — and he enjoys it. He was recently awarded the Dean's Award for Excellence in Outreach and Engagement for his extension work.

"I like talking to people outside the university," Beattie said. "When you're not talking to scientists; you have to put information into a palatable format that people will understand. I think I have a knack for that and I enjoy hearing the questions that come back from people — they're not always the questions you expect."

'THE BEER ANGLE IS ALWAYS FUN'

Beattie grew up in Regina, and his dad and grandparents had farms south of Moose Jaw, but he said he wasn't initially interested in agriculture. His undergraduate degree from the University of Waterloo was in genetics, with a focus on human genetics. It was during his Masters studies at the University of Guelph that he got into plant breeding.

"One of the fellows that was on my committee was a barley breeder and introduced me into that world," he said. "It grabbed my interest a little more. The beer angle is always a fun angle to get involved with."

Barley brought him back to Saskatchewan, too, as he did his PhD at USask with Dr. Brian Rossnagel (PhD), who was the prior barley and oat breeder.

Today, he breeds a number of different barley types, including malting barley, forage, feed and food barley, and on the oat side, he breeds forage oats and milling oats, "the kind you find in your Cheerios and oatmeal," he said.

In the barley program, they're aiming to improve disease resistance, quality, and yield, with a strong focus on the disease known as fusarium head blight, which produces mycotoxins.

DR. AARON BEATTIE (PhD)

For malting and brewing, creating varieties that are desirable for different markets is important, including large users like Anheuser-Busch as well as local brewers, who are looking for different qualities.

OATS: ANOTHER PLANT PROTEIN STAR

For oats, his program is aiming at improving disease resistance, quality, and yield, and they're paying particular attention to protein content because oats are used a lot in food products.

Pulse crops have been stealing the spotlight in terms of plant proteins, but Beattie says oats also have a lot of potential.

"Most people think of oat milk as one of the applications but there's a lot of interest [in] ... incorporating oat protein into different food products."

It has a healthy amino acid profile, and it's a low input crop, which is positive from an environmental standpoint.

The changing climate is also on his mind.

He's interested in the roots of these crops, such as how roots deal with stresses like salinity or the uptake of nitrogen, but roots are difficult to study simply because of their location on the plants.

"Especially as we try to think of things like climate change, the way the plant interacts with the environment above ground and below is critical to keep production stable," he said.

1980s

New CDC varieties are sown

BY KATHY FITZPATRICK

Dr. Gordon Rowland (PhD) speaking at a field day, 1981.

"I'm the luckiest guy in the world," pulse breeder Dr. Al Slinkard (PhD) says, eyes twinkling.

Skill and timing were the common elements that catapulted not only the green Laird lentil to market dominance, but also Harrington two-row malt barley and Vimy flax – two other early releases by the Crop Development Centre. In all three cases, their spectacular success was ushered in by superior traits combined with events such as droughts and crop failures of established varieties.

Arriving at the Crop Development Centre in 1972, Slinkard learned that here in Saskatchewan a couple of farmers had already tried growing lentils, "but they didn't know what they were doing and it sort of flopped." On top of that, the price was "ridiculous" Slinkard recalls: four cents per pound.

But in 1978, the year the Laird lentil was released, the Palouse area straddling Washington and Idaho states suffered an "unprecedented drought" he says. Buyers turned to Saskatchewan and the average price shot up to 35 cents per pound. Bruce Cheston, a farmer in the Grand Coulee area west of Regina, had grown two fields of lentils with a yield of 1800 pounds per acre, grossing more than $600 an acre "and here the wheat grower across the road (would be) lucky to get $100," Slinkard says.

That winter Slinkard criss-crossed the province giving talks to farmers three or four times a week, finding an eager audience. By the late 1980's Slinkard was able to report that the variety he developed, the Laird lentil "is the most widely grown lentil variety in the world."

The large-seeded Laird was quickly followed by Eston, a small-seeded green

Skill and timing were the common elements that catapulted not only the green Laird lentil to market dominance, but also Harrington two-row malt barley and Vimy flax – two other early releases by the Crop Development Centre.

Lab room, 1986.

lentil, released in 1980. Meanwhile, Slinkard writes, "detailed agronomic studies were conducted on seeding rate, seeding date, inoculation with nitrogen-fixing bacteria, weed control, fungicide seed-treatment, seedbed preparation, phosphate fertilization, salinity tolerance and Soil Zone adaptation."

Harrington barley, released in 1981, was next to capture world attention. The first high enzyme two-row malting barley suited to growing conditions in western Canada, Harrington came out during a world barley shortage, recalls Dr. Bryan Harvey (PhD) , who led the work to develop it.

Among its superior attributes, Harrington could be malted (germinated and dried) two days faster than other varieties, resulting in a 20 per cent boost in capacity at malting plants. And, because Harrington had no dormancy period before germinating, less storage area was needed at the malt plants. Its high-enzyme property, combined with the greater efficiency of a more uniform kernel size than six-row varieties, made it an attractive choice in countries such as China (which in subsequent decades would become the world's largest beer producer).

"It was obviously a success story that we could brag about," Harvey says, and made Saskatchewan "a major player" in exporting malting barley in terms of both quantity and quality.

Harrington was the number one two-row malt variety in western Canada from 1985 to 2001, according to certified seed supplier SeCan. At its peak, a USask publication notes, "Harrington took up 60 per cent of the barley acreage across Western Canada and 40 per cent in the United States."

In 1986 flax-breeder Dr. Gordon Rowland's (PhD) first variety, Vimy, was released. Saskatchewan producers soon saw how well it performed under drought conditions. This, and subsequent CDC varieties, would transform Saskatchewan from a bit-player to Canada's top producer.

Calibre oat, developed by Dr. Brian Rossnagel (PhD) and released in 1983, became another marquee variety, by late in the decade becoming the most popular in Saskatchewan, comprising one third of commercial acreage. Derby, released in 1988, was a further improvement. Together, they came to dominate in both Saskatchewan and Alberta into the following decade.

During the 1980's the CDC released many other crop varieties – hard red spring wheat, durum wheat, two-row and six-row feed barley, the first Canadian hulless barley, faba beans, red lentil, and a yellow field pea (Bellevue in 1986). By 1987, Saskatchewan would become the leading province in pea production, reaching 380,000 acres (from just 1,000 acres in 1967).

Kernen Farm, September 1986.

New projects included weed control, development of an edible oil flax, and an annual canarygrass breeding program.

Two facilities invaluable to the work of CDC staff were the Kernen and Goodale research farms, both developed from lands acquired by the university during the previous decade. The John Goodale farm, seven quarter-sections located southeast of Saskatoon near the tiny community of Floral, was purchased in 1972. The Kernen farm was the gift of two sections of land one mile east of Saskatoon on Highway 5 by Fred W. Kernen, a graduate of the College of Agriculture and part-time extensionist with the Department of Crop Science.

Dr. Herman Austenson (PhD), who became head of the Crop Science and Plant Ecology Department and also headed the Crop Development Centre (from 1975-83), negotiated the acquisition of both farms. Art Wenhardt, field superintendant at USask, also played a role in the Kernen negotiations. He became manager of Goodale, directing its transformation from run-down farm to research facility.

As for the Kernen land, Rossnagel says having been rented for many years, "it was a terrible weedy mess … We worked very diligently for about three or four years to get it into the condition that we could really

Crop Science Field Lab seed farm on Preston Avenue, August 1989.

use it for research purposes, plant breeding purposes in particular."

But once cleaned up, it "has been a major boon to all of the operations of the Crop Development Centre over my whole career."

Dr. Pierre Hucl (PhD), former interim director of the CDC, recalls that "we operated out of an ATCO trailer at Kernen – with limited plumbing options."

By the spring of 1986, the newly-constructed Kernen Field Headquarters building opened, providing much improved conditions as well as space to relieve overcrowding in the Crop Science Field Laboratory.

Meanwhile, the CDC was also helping to transform cropland across Saskatchewan, encouraging farmers to switch from summer fallowing to seeding into stubble. Slinkard writes that in the 1970's Cheston had already demonstrated that "lentils can be successfully grown on wheat stubble in the Brown and Dark Brown soil zones."

The work of plant breeder Dr. D. Brian Fowler (PhD) and plant physiologist Dr. Larry Gusta (PhD) on winter wheat was to lead in the same direction.

"The key to successfully overwintering winter wheat here is to keep the snow on the field," Fowler explains. "Of course the snow all blew off on the summer fallow fields."

Meanwhile, breakthroughs in the development of new winter wheat varieties would come in the subsequent decade.

Threshing faba beans at Preston, 1989.

BY ASHLEIGH MATTERN

QUALITY INSIDE AND OUT: FROM WILD GENES TO THE FOOD ON YOUR PLATE

Professor Kirstin Bett is researching how to use wild lentils to improve genetic variability — without the baggage that wild pulses bring along with them.

Wild pulses tend to grow low to the ground, making them hard to harvest mechanically, and the seed pods explode at maturity so you can't harvest the seed. The seeds are also on the small side, and they have dormancy issues so they don't germinate like a cultivated seed would.

On the upside, wild relatives tend to have good disease resistance.

"These plants have been growing out there, facing all the elements, without the benefits of any herbicide, fungicide and all of that good stuff that we protect our plants with, so they build up this resistance," Bett said.

Sometimes the wild varieties have a resistance to certain pathogens that the cultivated varieties have lost through breeding. In cultivated lentil varieties, there's no resistance to race 0 of the Anthracnose-causing pathogen, but there is resistance in some wild relatives.

Hailing from Ontario, Bett does lentil genomics work for the lentil breeding program at the Crop Development Centre. Understanding the genetics of wild pulses will help avoid the negative features of the crops while selecting for the positives.

From 2015-19, the lentil program had a Genome Canada grant to understand how varieties adapt to growing in nine locations around the world, and they currently have another grant to follow up on that study and look at quality traits.

"What we're doing is trying to develop … an understanding of the genetics, underlying key traits related to quality characteristics, both inside and outside the seed," Bett said.

DRY BEANS: A LUCRATIVE CROP

She's also the only dry bean breeder in Saskatchewan.

Dry beans are a warm season legume, not like the rest of the pulses the Crop Development Centre pulse group works with. Dry beans hail from semi-tropical areas and Bett says it's challenging to grow them on the fringes of agricultural land.

"They're quite sensitive to our day length, they don't like long days, and our season is super short," she said. "Beans hate the cold so you have to plant them late, and they have to mature early so they don't freeze in the fall."

They also don't like cold nights, and tend to stop growing overnight, so she breeds for lines that are not as affected by cool nights. She said one year the program grew its varieties in Mexico, and when it got close to zero, everyone was marveling at the Canadian beans that weren't affected by the cold temperature.

While it's not a huge crop, it is lucrative, and with plans to expand irrigation in Saskatchewan, there may be more opportunities to grow dry beans in the province.

DR. KIRSTIN BETT (PhD)

CREATING GOOD QUALITY FOOD

One success of her program was to introduce slow darkening pinto beans into the market. As pinto beans age, they get darker and they look less attractive. Darker pinto beans get downgraded.

"Back then, the number one pinto in western Canada was already darkening coming out of the field, and we discovered a line that retained it's bright background for much longer, so we dubbed it slow darkening," Bett said.

She said she spent "a few obsessive years" working out the genetics and finally figured out what the gene was. Slow darkening pintos are now in demand across North America.

"Most of us like seeing our varieties hitting the grocery stores," Bett said. "You know you had a hand in it and you're going to eat it."

She considers herself a foodie and does a lot of cooking. Especially when it comes to the lentil side of her work, she's excited about all the possibilities with that food.

"Everybody knows split red lentils and green lentils, but there are so many other types out there and so many things you can do with them," she said.

"People have re-discovered cooking especially with plant-based proteins. It's such a hot topic these days, it's not going to go away, and it's so great to participate on the leading edge of it so as to provide humans with the ability to eat good quality food."

DR. BILL BILIGETU (PhD)

BY ASHLEIGH MATTERN

THE IMPORTANCE OF FORAGE: HOW FOOD FOR ANIMALS CAN HAVE A POSITIVE IMPACT ON THE ENVIRONMENT

Dust bowls are a major issue in Inner Mongolia. The dust storms can damage ecology, environment and agriculture, but their impact can be mitigated through different agriculture practices.

These were some of the issues Associate Professor Bill Biligetu had in mind when he came to Canada to learn about forage crop breeding after completing an MSc in grassland management.

Biligetu grew up in Inner Mongolia in the northern part of China on a livestock farm where his family still grows forage.

"We have a nomadic living style, and grassland forages are a key component of our life and culture," he said.

His goal in coming to Canada was to learn how he could help the 5 million Mongolians in his home country.

"My original intention was going back home, but that didn't happen," he said.

Instead, Biligetu started a family in Canada and stayed. He completed his Ph.D. in 2009 and worked with Agriculture and Agri-Food Canada, and Saskatchewan Ministry Agriculture, then came to the Crop Development Centre (CDC) in 2014.

Through passing on the knowledge he's gained, he has been able to help his family — his brothers have a cattle ranch, and he says they're adopting some of his recommendations.

AN OLD PROGRAM WITH A BRIGHT FUTURE

The forage breeding program has a long history dating back to 1922. Biligetu says almost all Canadian bromegrass, crested wheatgrass, intermediate wheatgrass varieties are from this program. And those varieties are found not only in Canada, but in the northern part of the U.S., too.

The program was transferred to Agriculture and Agri-Foods Canada in the 1940s but has been at the CDC and Department of Plant Sciences since 2005. Last year, the program released its first CDC brand forage, CDC Torsion meadow bromegrass.

The CDC forage breeding program strives to develop superior forage genetics adapted to western Canada, Biligetu said.

It's also important environmentally, as Biligetu recognized early on through his experience in his home country.

"Perennial forage crops are crucial for improving soil nutrient levels, soil texture and regenerating the microbiome," he said.

DEEP ROOTS

You can see the forage above ground growth, but below ground is where most of the plant resides. Biligetu said most perennial forage roots can grow two to three meters deep, while the roots of annual crops are only in the top portions of the soil.

Perennial forages can also improve soil health because the system causes very little disturbance to the soil, and it can improve soil aggregates and beneficial microbial growth.

"Perennial forage should be an important part of crop rotations," Biligetu said. "When people are talking about crop rotation, the focus is on annual crops but there are long term benefits of perennials in crop rotations."

Those deep roots also help reduce greenhouse gas emissions through carbon sequestration, Biligetu said. Climate change will also be putting future pressures on crop production, including higher soil salinity and a higher risk of drought.

Droughts are a historical reality in western Canada and are expected to be more common due to the effects of climate change. But Biligetu notes it's been almost 100 years since the significant drought in the region.

"I've talked to many ranchers … and many of them told me they are not prepared for two years of severe drought."

He expects his future breeding focus to be developing more stress tolerant forage species, ensuring forage can thrive on marginal land and drier environments.

Besides forage breeding, training students is also an important highlight of his work at CDC. He has trained nine graduate students in the seven years he's been at the centre.

"That's an accomplishment when you see someone succeed," he said.

"My program at the CDC, is one of very few forage programs providing graduate training. … This is important because if you look at other cereal crops or annual crops, there are many programs, but in forage there are few programs."

Collaborations between CDC and Department of Plant Sciences: a story of success and inspiration

BY KATHY FITZPATRICK

Fans of sour cherry, haskap and apple varieties developed at the University of Saskatchewan (USask) have fruit breeder Dr. Robert Bors (PhD) and his technicians to thank. The USask Crop Development Centre (CDC) helped Bors grow his program to what it is today. It's just one example of the close and mutually beneficial working relationship between the Department of Plant Sciences in the College of Agriculture and Bioresources and the CDC, a unit within the department.

Bors, a plant sciences faculty member, turned to the CDC in the mid-2000s for help drafting contracts with commercial nurseries for his team's first fruit varieties. The CDC was instrumental in helping Bors identify prospective commercial partners who would successfully propagate and sell varieties, as well as collect the royalties which help support the fruit breeding program.

Dr. Bob Bors (PhD)

Bors' research funding increased exponentially, and he credits former CDC managing directors Dorothy Murrell and Kofi Agblor for the expansion.

"Dorothy and Kofi were both intensely proud that the fruit program gained momentum with their help," Bors said.

The CDC continues to keep Bors informed of potential changes to plant breeders' rights regulations and CDC faculty promote Bors's work within their networks.

Fifty years ago, the CDC was established with funding from the federal and provincial governments. Its mission was to develop new crop varieties to help diversify Saskatchewan agriculture. Plant breeders were hired to work on specific crops, and the CDC was strategically integrated within the plant sciences department to promote collective research and to support translation of research results into new varieties. Some plant breeding efforts of the CDC are performed by Plant Sciences Faculty, like those of Bors and plant sciences faculty member Dr. Kirstin Bett (PhD), whose focus is pulse crop genomics and dry bean breeding.

However, the collaborations between plant sciences and the CDC go beyond plant breeding. Researchers share expertise in disciplines like agronomy, pathology, entomology, physiology and genomics, biotechnology and digital agriculture to ensure future crop varieties provide higher returns to producers. They study end-use quality and food safety to ensure that the seed varieties released improve food security for a growing population.

Department Head Dr. Yuguang Bai (PhD) sees the CDC's positioning within the department as an advantage. The CDC is uniquely positioned to attract resources, he observed, while it also benefits from facilities and resources provided by the University, College and Department.

"The CDC is a fully integrated part of the department, and it is this integration

Dr. Yuguang Bai (PhD)

of many disciplines across the research spectrum that makes the CDC unique. Everything is shared," said Bai. This includes the use of facilities and equipment such as the AgBio Greenhouse, field farms and labs.

Equally important is the commitment of CDC faculty to teaching, training and outreach by a dedicated team of teacher-scholars. CDC and Department faculty together offer world-class multidisciplinary training and real-world experience in crop development programs that align well with the needs of industry.

Unique in Canada as an integrated crop breeding unit within a university department, the CDC "has not only remained productive and relevant in the last 50 years, it's grown to an internationally recognized crop improvement centre," Bai said. This is to the gain of the Department, the College, the University and the Province.

1990s

The beginning of funding partnerships

BY KATHY FITZPATRICK

As the University of Saskatchewan's (USask) Crop Development Centre (CDC) entered its third decade, challenging economic times gripped the country and the province. A recession and crippling government debt prompted widespread budget cuts at both the provincial and federal levels.

Grant Devine, Premier of Saskatchewan, and Allan Van Caeseele, president, Agriculture Students' Association, lead a team of two Clydesdale horses. Horses are pulling an antique plow for the official sod turning ceremonies of the Agriculture building, 1988.

> **...research, extension and funding partnerships with the private sector and non-governmental organizations continued to grow and develop, becoming all the more vital to the CDC's success.**

The impacts rippled down to the CDC, forcing it to adapt its own operations during the 1990s. Two projects, weed control and sustainable cropping systems, ended early in the decade. As well, two scientists and several support staff lost their jobs due to funding cuts. Meanwhile, research, extension and funding partnerships with the private sector and non-governmental organizations continued to grow and develop, becoming all the more vital to the CDC's success. Through it all, the CDC continued to make important research advances, aided by access to expanded infrastructure.

Flax breeder Dr. Gordon Rowland (PhD), who became director of the CDC in 1994, says the credibility the CDC established for itself in its first two decades of operation helped shield it from more drastic impacts of the economic downturn.

"A concentration of plant breeding expertise and facilities and land in one place in the province" combined to make the CDC "the greatest plant breeding and crop development organization ever established in Canada," Rowland says.

The CDC's close and co-operative working relationship with provincial government officials saved it from a severe cut that had been proposed for the 1992-93 fiscal year, roughly in the order of one-quarter to one-third of the CDC's total budget, Rowland recalls.

In discussions with the incoming administration following the 1991 general election, Rowland was assured the budget cut would not proceed.

"We had all the facts and figures to present to them. And so they understood," he says.

Rowland was the CDC's first dedicated director. Before then, the post was part of the duties carried out by the head of crop science. However, Rowland says the growth of both the CDC and the crop industry in Saskatchewan made the split into two positions necessary. His heavy schedule of meetings was such that "I don't think I sat down for those five years that I was director," he explains.

The impact of the CDC's work was again demonstrated by the surprise success of CDC Teal, an early-maturing and rust-resistant hard red spring wheat developed by Dr. Geoff Hughes (PhD) and Dr. Pierre Hucl (PhD), and released in 1991. Teal was better suited to the moister conditions of eastern Saskatchewan and Manitoba, and also offered better lodging resistance than older varieties Hucl says, but "we really didn't know what its success would be like."

However, Teal shot to stardom after the UK bakery Warburtons chose the variety as a key ingredient in its flour blend, due to its superior dough strength. As in many of the CDC's flagship varieties, luck and timing played their parts. Hucl says Teal was not intentionally developed for its greater dough strength. Meanwhile, the variety performed well in the field during the wet years that followed the eruption of Mount Pinatubo in 1991. By the late 1990s, Teal made up about one-fifth of wheat acres in Western Canada.

Agriculture Building, University of Saskatchewan (USask).

Teal's success helped give the CDC credibility to continue receiving funding for wheat breeding, Hucl notes, such as through volunteer producer checkoffs. Although revenue from checkoffs covered about a quarter of the wheat breeding program cost, it leveraged grants from other sources as well.

"Once that funding flowed, then other funders went 'oh, okay these folks have critical mass, they can achieve things,'" Hucl says.

Top personnel at the CDC had played pivotal roles in establishing producer checkoffs, or per-unit financial contributions. In the case of wheat and barley, checkoffs were deducted from sales through the Canadian Wheat Board, with funds administered and distributed by the Western Grains Research Foundation (WGRF). Dr. Herman Austenson (PhD) (who joined the crop science department in 1966 and was department head and CDC director from 1975 to 1982) had sought the support of both farmers and governments for such a system to finance research funding. His colleague Dr. Doug Knott (PhD) (head of crop science from 1965 to1975) had also promoted the idea of a province-wide producer checkoff. Austenson would go on to become executive director of the WGRF from 1989 to 1996.

As Rowland wrote in the CDC's 1995-96 annual report, the check-off was "an enormous boost to our cereal breeding efforts" in malting barley, feed barley, hulless barley, hard red spring wheat, Canadian Prairie Spring wheat, winter wheat and durum wheat.

The controlled environment facility can replicate growing conditions, light intensity, temperature ranges and humidity.

Meanwhile, during the mid-1970's pulse breeder Dr. Al Slinkard (PhD) and John Buchanan, Special Crops Agronomist with Saskatchewan Agriculture, had encouraged growers to form their own association.

In 1997 producer checkoffs funded an important agreement between the Saskatchewan Pulse Growers (SPG) and the CDC. In exchange for an annual grant of $340,000 from the SPG, the CDC assigned the marketing rights of all new CDC pea, lentil, bean and chickpea varieties to the SPG. Meanwhile, the SPG purchased two quarter sections of land near Saskatoon for

Dr. Brian Rossnagel (PhD) in a feed barley plot, 1997

MSc graduate student Lasantha Ubayasena, circa 1990s.

pulse crop research, renting it to the CDC for $1 per year.

Prior to that, the CDC had also secured a $2.6 million endowment from the Canada-Saskatchewan Agri-Food Innovation Fund to hire a chickpea and dry bean breeder. In May of 2000, a pulse crop pathologist was also added to the roster.

As well, the Saskatchewan Wheat Pool (SWP) entered into an agreement turning over breeding and testing of its hard red spring and durum wheat projects to the CDC. The SWP would provide funds to help finish off their material for release as varieties. Ownership of all the genetic material would revert to the CDC in 1998, while the SWP would retain first right of refusal to commercialize any of the varieties arising from its genetic material.

Hucl, who describes this as an early private-public partnership, says "in a way (it) was ground breaking without us really realizing the significance of it."

In landing agreements such as these, the CDC built on its history of partnerships with agencies and industry. An example is Quaker Oats' long-running support of the oat breeding program.

Also, a close working relationship between crop breeder Dr. D. Brian Fowler (PhD) and Ducks Unlimited that began in 1992 helped sustain producer interest in winter wheat. The crop's value to waterfowl conservation is this: Because winter wheat is planted in the fall then grows quickly the following spring, it provides secure habitat for nesting. (Dabbling ducks hatch their young away from wetlands, then lead them back to water.)

As for facilities, the CDC's move into the new College of Agriculture building in 1991 was a significant morale boost. Before then, CDC scientists worked in the university's Crop Science Building (which was to subsequently house archaeology and anthropology). Hucl recalls working from a "turret" in the old building with a "medieval slit window".

"I was stuck in this little cubby hole and then went into this beautiful brand new building with great facilities," including the Controlled Environment Facility (or, Phytotron, as it's also known), the largest and most state of the art in the country at the time, Hucl says. The CEF contains 183 environmentally controlled reach-in cabinets and walk-in rooms, which can be set to replicate growing conditions such as qualities and intensities of light, temperature ranges and humidity.

The new Agriculture Building also featured brand new labs, furnished with the aid of substantial donations. The college's new greenhouses, which opened in 1994, provided more space and improved growing conditions. CDC scientists also worked to develop and expand disease nurseries. Pathology (the science of causes and effects of diseases) is critical to plant breeding, Hucl explains.

Towards the end of the decade, the Field Laboratory at Preston and 108th was expanded with two new rooms, one for the winter wheat program and the other for the durum wheat program. Meanwhile, the former winter wheat trailers were dismantled to make way for a new seed storage building. It was to hold all of the seed that was to that point stored in the Field Laboratory, which had become overrun with mice.

The seed storage building's rodent-proof design was crucial in protecting staff from hantavirus. Spread by infected rodents, deer mice in particular, it can cause a deadly lung disease.

Although no deer mice specifically were found in the Field Lab, the presence of other mouse species "was really an impetus for us to say, okay, we need to have our seed in a facility with no running water, that's contained and we can control the mice," Hucl says.

As well, in May of 2000 a new Breeder Seed Cleaning Building at the Kernen Crop Research Farm was completed. The cost of around three-quarters of a million dollars was covered with funds from the Kernen Trust and royalties from the sale of CDC varieties. A $225,000 grant from the Saskatchewan Pulse Growers, matched by the Canada-Saskatchewan Agri-Food Innovation Fund, enabled the CDC to acquire the most advanced seed cleaning equipment.

Meanwhile, through the 1990s the CDC continued releasing new crop varieties. In addition to Teal, other notables include: CDC Kestrel (the first winter wheat developed at the centre); CDC Redwing (the centre's first red lentil); CDC Maria (the first hairless variety of canary seed, bred to prevent skin irritation suffered by farmers at harvest); CDC Mozart yellow pea; and CDC Bethune flax (known for its stable yields).

BY ASHLEIGH MATTERN

UNEXPECTED RESULTS: THE RISE IN POPULARITY OF PURPLE WHEAT AND CANARY SEED

It's not a colour you expect wheat to be, but Dr. Pierre Hucl's (PhD) purple wheat has started to make a name for itself worldwide.

"I didn't anticipate where it was going to go," said Hucl. "I thought, let's see if we can use this as a topping on multi-grain bread, but it's gone beyond that."

Now, the purple-coloured wheat has been used to make vodka and is a popular instant noodle colour in some parts of the world where purple is considered a lucky colour.

The idea for purple wheat was inspired when Hucl was looking for something to differentiate feed wheat while he was working at the Saskatchewan Wheat Pool. There used to be seven market classes of wheat for different end users, each with its own seed colour, shape and size.

"We were looking for different kernel shapes and colours as a differentiator, and I fell on purple wheat," Hucl said.

Anthocyanins are the pigments that gives plants red and purple colouring, and it can be found in berries, tomatoes and grapes. Hucl found he could double, triple or quadruple the amount of anthocyanin in the wheat bran through traditional plant breeding.

Hucl is still working on improving purple wheat today — namely the milling quality — because he was primarily focused on boosting pigment levels initially.

A GLOBAL EDUCATION

Hucl spent his summers in the French countryside with his grandparents, engendering an early interest in the natural world. His grandfather was the local postman in the French commune where they lived, and he would join him in his pickup truck as he made his rounds.

"We'd stop in all the little villages, hamlets and farms and visit so I kind of got exposed to local agriculture and horticulture and asked a lot of questions," he said.

The Montreal-born Hucl grew up in Europe and the Caribbean. He spent his elementary years in Switzerland, high school in Austria, and came back to Canada to finish high school and go to university.

He did his undergraduate degree and Masters at the University of Guelph, then worked for a couple of years as a research associate before coming to Saskatoon to do his PhD.

THE FIRST HAIRLESS CANARY SEED

Today, Hucl specializes in genetics and breeding of bread wheat for the short-season areas of Western Canada and the evaluation of alternative wheats and annual canarygrass.

One of his successes includes developing the first hairless canary seed.

Saskatchewan is a global leader in producing and exporting canary seed. The seed is primarily used as bird feed but has a growing market of people interested in it for its health benefits.

The older varieties of the crop have microscopic hairs on the hulls that enclose the seed; when harvesting, those hairs break off and can be irritating for the farmers.

DR. PIERRE HUCL (PhD)

In the 1980s, production was increasing but farmers were complaining about the itchiness of the crop.

"Our breeding objective was to see if we could eliminate the hairs," Hucl said.

Once that goal was accomplished, they realized these seeds could be used for human consumption and started to look at breeding a seed colour that would be more aesthetically pleasing to consumers.

Canary seed is now becoming seen as a health food, and is being purchased more widely for human consumption.

A LONG BATTLE WITH DISEASE AND PESTS

His current work also has a lot of emphasis on disease, he said, particularly fusarium head blight, which attacks cereal grain and forms mycotoxins.

Hucl says the disease has been a "bugbear" in wet years in western Canada now for more than 30 years because it's not consistent, showing up some years and not others and causing challenges with repeatability in their studies.

Some of the problems breeders are working on today stem back to the early 1900s, he said.

"Whatever pests you're dealing with, if you develop a resistant variety, the pests are going to find a way to overcome that resistance. ...

"They should come back and interview whoever might replace me 20 years from now — they'll be talking about the same things and the only things that will change are ... the new breeding and research tools of the day."

Three generations at the CDC

BY COLLEEN MACPHERSON

The history of the Crop Development Centre (CDC) is a celebration of plant breeding and how new varieties indelibly changed agriculture in Saskatchewan and around the world. It is also the story of individuals connected through teaching, learning and mentorship. The experience of Dr. Bob Baker, Dr. Pierre Hucl and Dr. Curtis Pozniak is but one example of the best students and mentors creating the best next generation, not unlike plant breeding itself.

Dr. Robert (Bob) Baker (PhD)
Emeritus Professor

When Bob Baker, a research scientist with Agriculture Canada in Winnipeg, was offered a position as a wheat breeder at the CDC, he saw it as an opportunity to move back home to Saskatchewan. More importantly though, it was a chance to pursue his passion for teaching.

Baker, who grew up near Pierceland, joined the CDC in 1978. "Although there were only about seven or eight professional people on staff, it was a time of growth for the centre," he said. "We were introducing pulse crops in those days, doing a lot of field research. It was quite a rewarding place to work."

It was also rewarding for Baker to supervise grad students who ultimately numbered more than a dozen before he moved to the then-titled crop sciences department in 1988 to take on heftier classroom teaching responsibilities. "For some reason, I loved teaching. I really enjoyed explaining difficult concepts to students, but I had no formal training as a (grad student) supervisor beyond what I had gone through at the University of Minnesota as a PhD student."

"Every student/supervisor relationship is a separate event," added Baker, "but I think a key element to a successful relationship is the design of research experiments. It's important to look at the question being asked, and to help students set up a research protocol that has a decent possibility of answering that question."

One of his most successful students was a young man from Ontario named Pierre Hucl. "His CV looked good and so I took him on," said Baker. "With Pierre, I found very early on, that the best approach was really to stay out of his way and let him get on with it. He was very self-motivated but I hope I did a reasonable job as his supervisor; you'll have to ask Pierre about that."

Baker's research into the interaction between genotype and environment built his reputation, as did his classroom teaching; he is still occasionally recognized by former students, most recently a pharmacist who took his undergrad statistics class.

Baker said he marvels at the talent he saw among CDC grad students, "many of whom have gone on to do great things. I feel very satisfied that I had a little part to play in their success."

Dr. Pierre Hucl (PhD)
Professor, CDC

When Pierre Hucl was working on his master's in plant science at the University of Guelph, he reviewed several papers on quantitative genetics, "and one was by this guy named Dr. R.J. Baker who was doing all the things I was interested in, so I wrote him a letter asking if he was looking for students." A November 1982 trip to Saskatoon to meet Baker was a bit of a shock, weather wise, he recalled, "but it was a good fit for the two of us."

The CDC had a lot of students when Hucl joined; he spent the first few months at a desk in a hallway "but I was happy to have a spot." As a grad student, "I was pretty independent but Bob was great as a supervisor. His door was always open and he never kicked me out. We also have the same birth date so it's one of those cosmic things."

After a stint with the Saskatchewan Wheat Pool, Hucl returned to the CDC in 1990 as a wheat breeder who, with his own grad students, emulated Baker in his approach. "I certainly have an open-door policy like Bob, and he was always very well organized so I did pick up on that from him too. I think it's important when you have new students who've never done research to have the project well mapped out because it's not textbook learning."

For Hucl, first impressions are important taking on students but he also keeps a close eye on master's students in the plant sciences department. "They're a known quantity and that helps because it's such a unique relationship - students are apprentices doing a paid job, and the supervisor is boss and mentor, and in some cases your friend, or not. It's a real balancing act."

Dr. Pierre Hucl ***continued***

That balance worked well with Curtis Pozniak who, on Baker's recommendation, arrived at Hucl's door in 1999 hoping to get into grad studies. "I had a project breeding for herbicide tolerance in wheat. Curtis' background was not perfectly aligned for the project, but there was something more to him, something in his thinking process, his need to understand principles and methodologies in his research, which is one reason he's been so hugely successful. But Bob was the same; he spent a large part of his career studying other people's statistical methods and debunking a lot of stuff."

Having spent 13 years as chair of the grad committee, Hucl appreciates good student/supervisor relationships because he's seen his share of troubled ones. "As chair, I tried to mentor junior faculty based on my own experience but you sometimes also have to be an arbitrator when conflicts arise, you sometimes have to have difficult conversations, and ultimately, you have to make an assessment about whether the relationship is salvageable or not."

The CDC being a relatively small group, Hucl believes success for both students and supervisors "boils down to drive and work ethic. You have to be a 'get on with it' person."

Dr. Curtis Pozniak (PhD)
Professor and Director, CDC

Curtis Pozniak had a plan – get an agronomy degree and "make my way back to the family farm near Rama". But he caught the bug for plant breeding doing summer jobs and that ultimately turned into "a bit of a fairy tale – farm boy makes good."

Pozniak's search for a grad studies position started with Dr. Bob Baker, then chair of the grad committee in the Dept. of Plant Sciences, who sent him to see Dr. Pierre Hucl. "Pierre and I chatted about a project he had in mind and it sounded like a good fit so I started working on my master's in 1999."

He described Hucl's approach to supervising him as the model for his own mentoring – "hands off but guiding, just a little push from behind." And it worked well; a year and a half into his master's, Pozniak was encouraged to move directly to a PhD program, a rare occurrence. The faculty I respected were saying it was a good idea so I thought, why not?" He was hired as the durum and high-yield wheat breeder even before he defended his PhD, and in 2003, began building his renowned research and breeding program. In July of 2020 , Pozniak was named director of the CDC.

As a supervisor, Pozniak first relies on a student's CV to demonstrate interest "but what I'm really looking for is a passion for what they do, coupled with common sense, and the ability to filter out noise and focus on the prize. That can be hard to identify in a CV."

Pozniak believes the best students are the ones who move the bar set by their mentors, "and that kind of drive is evident almost immediately."

In his years mentoring students, Pozniak said he has learned valuable lessons from them in return. "What I've experienced is that we all learn differently and you have to tailor the way you supervise to the individual. I took my own experience with Pierre as normal but that won't work for everyone."

He has also come to accept that everything does not have to be perfect. "In my own PhD, I really strived for perfection, but I recall a very frustrating experiment that wasn't working and I simply would not drop it. Finally, Pierre said, 'I'm dropping it for you.' It's important to remember that grad school is a training experience."

Despite the added director duties, Pozniak's research continues, as does his supervision of students. And while things like technological advances mean those destined to be plant breeders must learn how to use new tools, "but the basic building blocks Bob Baker taught me when I took his quantitative genetics class and the advice Pierre provided along the way remain. The fundamental principles are ultimately the same – you cross the best with the best, put them out in the field and select the best."

BY ASHLEIGH MATTERN

UNKNOWN FUTURES: PLANT PATHOLOGISTS PREVENTING DISEASE IN AN UNPREDICTABLE WORLD

Professor Randy Kutcher says the future is murky when it comes to plant pathology; the only thing you can really rely on is that things will change.

Kutcher is a cereal and flax pathologist with the Crop Development Centre, with a lot of his work focusing on the fusarium fungi, which is one of the biggest challenges with cereal production. He describes himself as an applied plant pathologist, usually looking at whole plants and crops as opposed to the fundamentals of disease at the cellular or DNA level.

He says it's hard to make long term forecasts in this line of work because the landscape is always changing — sometimes literally.

"If you look at the eastern part of the prairies, in Manitoba, there is a huge amount of soybean, and I would have never guessed it would have taken off to the extent it has so quickly," he said. "Southern Manitoba is now covered in soybean and increasingly in corn, and that really changes things for a disease like Fusarium head blight."

There are Fusarium pathogens that survive well in corn that might affect how growers manage wheat and barley.

Kutcher is familiar with the Manitoba landscape — he grew up in Dauphin, MB, working on his uncle and aunt's farm, previously his grandfather's, every spring before he found a summer job.

He's always had an interest in science, taking all of the science courses in high school, and that agriculture connection influenced his eventual career trajectory.

The promise of discovery is what excites him most about his work, he said.

"You can investigate little things that can take off and turn into big things."

THE IMPACT OF TECHNOLOGY

It's hard to predict what's going to take off, though.

Drones first came on the scene several years ago, and Kutcher said it seems like precision agriculture may be the future.

"Like any new technology, there's lots of ideas that it's going to change the world, but let's figure out what we can use it for first," he said.

There's still a lot of interest in management of crops using drones because the technology has come down in price, but the challenge is knowing what to do with the information you collect.

"You can take a lot of pictures but what do you do with it?" Kutcher said. "Sometimes the technology is there but our understanding of the biology has to catch up."

Sometimes changing technology or practices is what makes pathogens hard to predict.

In his grandfather's time, Kutcher said it was common to plough the soil "to death," but now most farmers are practicing some form of reduced or no till. These types of changes can drastically change the environment for plant pathogens.

"Tillage or lack thereof, has a big impact on the residue out there," he said. "What we're trying to do is understand the diseases themselves, and the pathogens that cause them. What impact do changes in technology have?"

DR. H. RANDY KUTCHER (PhD)

Those changes might change how the disease spreads, or it might create an opening for a new disease.

AN INTERCONNECTED WORLD

The challenges of changing landscapes aren't limited to the local environment, either — sometimes changes far afield can have an impact.

As part of his work, Kutcher has travelled to Ecuador and he says seeing how plants develop in other environments is also a learning opportunity. He says stripe rust is such a major problem in Ecuador that farmers there no longer grow much wheat even though they used to.

"They import most of their wheat, which is costly for them," he said. "If a pathogen changes, these are international problems. If you get mutations in plant pathogens, such as the pathogen that causes stripe rust, in the southern hemisphere, they're going to show up here eventually."

You never know how the market will change, either.

Biodiesel and alcohol were hot topics in 2008, driving up the price of ethanol grains, but only 13 years later, the attention seems to have shifted to electric vehicles.

More recently, a growing interest in plant-based diets may also change the demand for the crops farmers are growing.

The focus of Kutcher's studies is constantly shifting, keeping him on his toes.

"We're still not great at predicting the future. If a disease was a problem last year, will it be this year?"

He may not know the answer, but when the next problem is presented to him, he'll use all of the tools in his belt to figure out a solution.

2000s

A decade of growth and expansion

BY KATHY FITZPATRICK

Harvesting durum wheat.

As the Crop Development Centre (CDC) entered its fourth decade in the early 2000s, more challenges lay in store. Poor weather hampered both crop yields and research progress early on. As well, changes in funding models presented fresh financial challenges in the first half of the decade. Nevertheless, like a well-adapted crop variety, the CDC not only withstood the onslaught, it continued to flourish, sending out new shoots that would take its growth further and wider.

Drought in 2001 withered crops, but worse was to follow.

"The 2002 growing season was one of the most challenging in the history of the Crop Development Centre," wrote then-director Rick Holm in his 2002-2003 annual report. "Extreme drought throughout the early growing season, a severe plague of grasshoppers, frost in early August and a cool wet harvest season combined to play havoc with plant breeding programs, research plots and commercial crop production."

The 2002 drought prompted the CDC to acquire a second-hand wheel-move irrigation system for the seed farm field. It was purchased in June of that year and was running by early July "just in time to provide enough irrigation water to save the research material that growing season," said Kirk Blomquist, Superintendent of Field Operations

Even so, Holm recalled a "feeling of helplessness" about the weather and that only a limited area of the CDC's cropland was irrigated. He also remembered spending a lot of money trying to control the grasshoppers, "with some limited success".

Two years of poor yields in the CDC's commercial crops, combined with the cost of grasshopper control, resulted in less money for research. Several programs and positions were cut, cereal yield testing among them. However, Saskatchewan is "next year country" not only for farmers but for plant breeders as well. Conditions improved somewhat in the 2003 growing season, although April through June was dry and it was timely rainfall in early July that saved the breeding season. Holm wrote in the 2003-2004 annual report: "This continuing dry weather pattern reinforces the critical need to obtain

Crop Molecular Genetics laboratory.

Agriculture Greenhouses.

funding for the expansion of irrigated disease nursery facilities."

Saskatchewan is "next year country" not only for farmers but for plant breeders as well.

This need was fulfilled with the designation of Plant Sciences/CDC land along Preston Avenue in Saskatoon as the site for a new pulse crop disease nursery. In 2007, a mist irrigation system was installed. Soon after, an 1176-foot linear irrigation system was installed on land within the city limits, for use in both pulse crop pathology research as well as for early generation wheat and durum breeding material.

Holm also noted in his 2003-2004 report "the beginning of a significant change in the way Saskatchewan Agriculture, Food and Rural Revitalization (SAFRR) funds research at the University of Saskatchewan and in the size of the operational grant that will be made available to the Centre. The net result will be a significant reduction in the funding available to support our operations."

In the previous fiscal year, the provincial department provided a strategic research grant of $2.4 million, comprising close to a quarter of the CDC's $10 million budget (the balance coming largely from producer checkoffs, contributions from producer groups, royalties on varieties, industry, and Ducks Unlimited). The strategic research grant was changed to a $1 million operating grant and seven scientist-technician positions. Consequently, the winter cereal and stress physiology/ biotechnology programs lost their core funding from SAFRR, and the scientists who led them moved to faculty positions in the Department of Plant Sciences at the University of Saskatchewan (USask).

The two programs were closely linked, Holm noted. Winter cereals and plant physiology related to cold hardiness were two important targets when the CDC was created, he said, but "25, 30 years later after a lot of really good research had been done, winter wheat had not really established itself as a major crop … scientifically, it was very sound but the uptake by farmers just hadn't been there," so funding by SAFRR was redirected to other areas.

However, with the continued support of Ducks Unlimited, winter wheat breeder Dr. D. Brian Fowler (PhD) was able to wind down his program gradually, continuing development of new varieties into the following decade, before devoting full-time attention to cold tolerance in cereals.

The loss of the stress physiology program closely coincided with the patent application for the plant gene ROB5, which increases stress tolerance. Discovered in the early 1990s by plant physiologists Dr. Albert

Robertson (PhD) and Dr. Larry Gusta (PhD), it remained a focus of Gusta's work for the next 15 years and was subsequently licensed to a world-leading crop science company.

Even with these challenges, the CDC continued to grow in its fourth decade, fuelled by additional revenue from external sources. For example, support from Saskatchewan Pulse Growers (SPG) more than doubled with the renewal of its pulse breeding agreement with the CDC for a 15-year term.

The new funding model provided a gain in the form of a new cereal-flax pathology position. The CDC was able to hire a third pulse crop breeder, with co-funding from SPG.

In addition, royalty income grew to be "fairly substantial" said Holm. The federal Plant Breeders' Rights Act had come into force in 1990. By 2009-10, royalties to the CDC totalled about $900,000 – nearly matching the $1 million annual operating grant from the Saskatchewan Ministry of Agriculture. Royalties were re-allocated right back to the breeding programs, providing the necessary funding for growth and expansion.

The decade was marked by several other infrastructure improvements. A $2-million project lead by then Plant Sciences professor Dr. Doug Waterer (PhD) more than doubled the College of Agriculture and Bioresources' greenhouse space to 6,666 square metres. Completed in 2003, it was a significant boon to the CDC, and the propagation of plant breeding material remains the facility's largest single use.

In 2004, a $3 million expansion of the Crop Science Field Laboratory began, with support from the federal department of Western Economic Diversification, Saskatchewan's Agri-Food Innovation Fund, and many generous organizations and individuals. Completed in fall 2005, it provided an additional 1330 square metres of much needed space for the pulse breeding and research programs. Prior to the expansion "people were crammed into that building, they were just really short of space," said Holm.

In 2006, the federal and provincial agriculture ministers announced funding of $5 million for the addition of a 1,466 square metre Grains Innovation Laboratory (GIL). Several grower organizations and private sector seed companies also contributed funding to this project. Opened in 2009, it

Plant Sciences and CDC researchers at a Field Day at Kernen Farm, 2009.

includes a wet chemistry lab, a baking lab and a malting lab along with milling and grinding rooms.

GIL co-manager Dr. Gene Arganosa (PhD) says prior to its opening, crop quality testing was conducted in three different labs adjacent to each other on the third floor of D-Wing in the College of Agriculture and Bioresources Building. The samples had to be transported from the Crop Science Field Lab and back again. In some cases, the samples had to equilibrate to room conditions for two or three days before being analyzed. Having everything under one roof now has improved efficiency and the increased lab space has improved overall throughput.

Molecular marker technology helps CDC researchers select for desired traits more efficiently.

GIL staff handle thousands of samples every year, screening for traits that are important to the end users of the grains. "We generate the data that will enable the breeders to determine whether the line that they're dealing with will move forward in the breeding process or not," explained Arganosa. "Like a lottery, the more lines that you actually screen or seed, the more likely you're able to come up with a variety that will have quality traits that are better than or equal to the control varieties."

In 2007, for the first time in its history, leadership of the CDC passed to someone who was not a faculty member and already working within the organization. As the CDC expanded in scope, the dual roles of research and administration were thought to be too much for one person to oversee. Dorothy Murrell, a seed company executive and agrologist, became the first managing director.

Murrell recalls touring the CDC's facilities and "being completely astounded" by the enormous investment in plant breeding. "I came away feeling humbled," said Murrell.

A turn to new applications of technology also marked the CDC's fourth decade. Genome mapping and molecular markers helped breeders select for desired traits more efficiently. As well, work was underway on the use of doubled haploidy techniques in peas, chickpeas and lentils. Both Holm and Murrell mentioned the deep satisfaction they felt about the rapid uptake and leading roles taken by CDC scientists in new techniques and technologies to locate genes of interest and incorporate them into breeding lines. These are world-class, leading-edge scientists and programs.

Research goals shifted during this decade to include not only agronomic traits of interest to those growing and selling the crop, but also traits of interest to end users. A few examples: high beta glucan oats to reduce artery-clogging cholesterol; low glycemic durum to produce pasta with low glycemic index (helping to limit blood glucose levels, especially important for people with diabetes); and low phytate barley, primarily for use in hog feed, to reduce phosphate (a pollutant) in manure.

Calling her role at the CDC a highlight of her career, Murrell explained her main focus. "The resource base and scope of the CDC was a well-kept secret, unknown to many in industry when I began. One of my hopes when taking the position was to develop its profile with both public and private funding agencies and the agriculture value chain, so as to increase the impact that the CDC could have on agriculture in Canada and really, worldwide."

She noted there were private sector companies that did not want to run their own plant breeding programs, but wanted to sell varieties.

"They all felt they had a role to play to

bring good new genetics to farmers … They were interested in forming partnerships with breeding programs at the Crop Development Centre and other public sector agencies," said Murrell. Varieties were licensed to companies, which would then take them to market, carrying forward an approach that had been established in earlier decades. Royalties were then returned to the breeding programs.

"The Crop Development Centre scientists were ready to take up these partnerships. They saw benefit, not only in dedicated funding, but in the marketing potential for varieties which the value chain brought to the table," said Murrell. "These partnership agreements greatly increased funding for the CDC."

Checkoffs also expanded to cover virtually every crop kind including canary seed, bringing increasingly engaged crop producers to the CDC table as funding partners.

Meanwhile, throughout its fourth decade, the CDC continued to release new varieties at a brisk pace, including spring wheat and lentils tolerant to imidazolinone (a herbicide); waxy hulless food barley; low-phytate feed barley; durum low in cadmium (a toxic metal taken up from soil); and a Canadian western red spring wheat tolerant to the insect wheat midge.

To understand the CDC's impact after its first 40 years, one needed look no further than the fields across western Canada. Ninety-six per cent of chickpea acres, 95 per cent of lentil acres, 87 per cent of flax acres, and 75 per cent of winter wheat acres were seeded with CDC.

Holm attributed much of the success to the fact that the Province has funded crop research to the tune of "millions and millions and millions of dollars" over the years.

"That model is the envy of many universities, not just in Canada but elsewhere," said Holm. Holm is himself noted for his work to improve weed control in pulse crops. For that, as well as his efforts in establishing the pulse crop laboratory, he was recognized.

By the end of the CDC's 2000's, the passing of the crop research mantle from one generation to the next was well underway with a wave of retirements, and new arrivals, who would carry the work of their predecessors to new levels.

Marissa Janssen

NEW CDC MANAGER APPOINTED

The growth and success of the CDC required a new organizational structure to facilitate contract management, stakeholder engagement, branding and communications. In 2020, a CDC Manager position was created to support these priority areas and work jointly with the CDC Director, who oversees strategic direction, mission and vision of the CDC.

Marissa Janssen, LL.M was appointed to the role at the end of 2020. Originally from the Netherlands, Janssen earned a Master of Laws in international trade and investment law at the University of Amsterdam before moving to Canada. She brings a wealth of experience and a global perspective gained in leading industry and higher education organizations, serving most recently as Strategic Business Advisor, Human Resources at the University of Saskatchewan. As CDC Manager, Janssen is presently spearheading the CDC's year-long 50th Anniversary celebration and the development and unveiling of the CDC's new brand identity.

DR. CURTIS POZNIAK (PhD)

BY ASHLEIGH MATTERN

FINDING CLUES TO TRAITS IN DNA: NEW TOOLS MAKE PASTA WHEAT HEALTHIER AND SAFER

Professor Curtis Pozniak, Director of the Crop Development Centre compares his work sequencing the genomes of wheat varieties to sending your own DNA to be tested.

"You can appreciate that each one of us is different," he said, and it's the same with wheat.

"Each different variety has a unique fingerprint. Once we have the blueprints, we can compare them, and that is what is so powerful. You can compare the sequences and say, OK, this variety is different than this variety in terms of this gene or that gene."

Pozniak's program breeding durum and high-yield wheat is involved in sequencing the DNA of wheat varieties from around the globe, all with the aim of developing robust DNA tests to select for a range of traits, including disease resistance in wheat.

Making those comparisons can give you clues to which genes make which plants resistant to certain diseases, or which genes might influence agronomic performance or end-use quality.

"These comparative genomic studies are something that our program is world leading in, and we use that to develop diagnostic tools to help us with selection," Pozniak said.

His program is researching how to develop new tools to use in plant breeding to improve the efficiency of selection. In the past five years or so, he says they've published almost 20 different genome sequences of different wheat varieties.

There are more than 20 people supporting his program's plant breeding activities, working on developing new varieties with high yield potential and better disease resistance.

SAFER PASTA WHEAT

Durum wheat is primarily used for pasta, or dishes like couscous and bulgar. It's sometimes referred to as pasta wheat, and they're looking for specific characteristics that are in demand, like improving the texture and the yellowness of the pasta.

Up to 60 per cent of the durum traded globally is produced in western Canada.

"There's a good chance that if you eat pasta, it was produced from durum wheat grown right here on the prairies," Pozniak said.

Fusarium head blight is one of the biggest challenges for wheat right now, and Pozniak says durum is particularly susceptible.

He says a better part of his career at CDC has been identifying good sources of resistance and over the past 10 years, his program has made "substantial progress."

The disease produces mycotoxins that are harmful for human health and can result in a yield loss for producers if there's too much of it in a wheat sample.

"Having the resistance is not only important to protecting the yield but ensuring the health and safety of the product," Pozniak said.

LOOKING TO THE FUTURE

Pozniak grew up on a farm two and a half hours east of Saskatoon near Rama, SK. His intent had always been to go to university, get an agricultural degree, and return to the farm, but a summer job derailed his plans.

"I got positioned as a summer research associate with a few breeding programs and I became instantly hooked to plant breeding and genetics," he said. "I found it absolutely fascinating."

His experience during graduate school training at the CDC was the extra push he needed to move into a plant breeding position.

"It was fantastic training with wonderful mentors who recognized my strengths," he said.

Pierre Hucl was his PhD supervisor, and the director of the CDC who preceded him.

Now, Pozniak is leading the organization. He said he was attracted to the position as director because the centre has had a tremendous track record of success and much potential for future growth.

The Centre has released more than 500 varieties in its 50 years, and Pozniak said his vision is to expand the growth of the CDC in a sustainable way, and to ensure the infrastructure and stakeholder relationships are in place to ensure the continued development of varieties that would be in demand by growers.

"We need to look to the future — what will the ag-sector look like and what will be in demand? How do we stay on the leading edge of research so that we can continue to remain relevant as an organization?"

He also wants the CDC to continue to be recognized as a trusted brand, and to continue to foster relationships with collaborators and stakeholders.

"The strength of the CDC will continue to be our partnerships and recognizing we can not do everything ourselves. We must continue to foster relationships across the agri-food sector to ensure future success."

BY ASHLEIGH MATTERN

BRINGING ACADEMIC IDEAS TO REAL WORLD ECONOMIES

One of the things Professor Bunyamin Tar'an finds most exciting about working at the Crop Development Centre is that he is training future plant breeders. He likes to pass on his knowledge to the next generation, knowing that when he retires, there will be others to continue his work.

"What we're doing is different than the breeding programs in the private industry because we are academic — we also advise undergraduate students, masters students, and Ph.D. students doing research," he said.

Tar'an is a chickpea and flax breeder. He's originally from South Sumatra, Indonesia, and he came to Canada to do his MSc and Ph.D. in plant breeding and genetics at the University of Guelph in Ontario.

Teaching genetics and biotechnology to undergraduate students, he says sometimes their reaction is that it's a scary topic because they think it's going to be hard.

"Science is fun," he said. "This is the thing that we need to communicate for younger generations. Breeding is fun. You have the opportunity to learn from the genetic makeup into the actual crop performance in the field and making that connection."

He said he likes applying the knowledge of genetics and statistics to make crop improvements that can be seen in the field. Plant breeding allows him to see the full spectrum of the plant, from the DNA to how the plant grows in the field to the impact on humans.

"This is all part of the breeding," he said. "At the end of the day, we are also looking at the economy. How will this help the economy overall?"

HELPING THE FARMER'S BOTTOM LINE

Tar'an's work focuses on breeding and genetics, and on improving the crops to become a commodity that's profitable for farmers in western Canada, researching the best ways to manage the crops so they're successful and profitable.

Since he joined the Crop Development Centre in 2006, his program has released 13 chickpea varieties for growers in western Canada, and now 90 per cent of the chickpea varieties grown in western Canada are from the CDC.

Before these varieties were released, there were some chickpeas being grown in the province, but they were older varieties, some introduced from other countries, that were more susceptible to disease.

The problem of disease in chickpea is still evolving. One of the major challenges today is ascochyta blight, an aggressive fungal disease. In Saskatchewan, summers are cool and there's just enough rain to make it an environment conducive to this fungus.

"Chickpeas are traditionally grown in warm and dry areas from Turkey to the Mediterranean region, where it's well adapted," Tar'an said.

Chickpeas are also a long season crop, so maturity is another objective of the breeding program to make the plant better suited to Canada's short growing season.

DR. BUNYAMIN TAR'AN (PhD)

Disease resistance is also important to the farmer's bottom line: A crop that only needs to be sprayed twice a season costs less to produce than one that requires four to five applications.

THE ONLY FLAX BREEDING PROGRAM IN CANADA

Since spring 2021, he has also started working on flax. He was the interim leader of the flax breeding and research program after the former leader's departure.

It's the only flax breeding program in Canada as other such programs have closed down.

"Flax is lagged behind with other oil, compared to canola, but flax still provides the advantage of being a healthy oil and has a little less input cost than canola because flax is self pollinating and doesn't have the problem of clubroot," Tar'an said.

It provides a healthy oil, rich in alpha-Linolenic acid, an omega-3 fatty acid. His program will continue to increase the yield of flax, ease of straw management, and maintain the oil profile to address the need in the market for a healthy oil and other industrial applications.

His team is also aiming to lower the amount of cadmium, a metal that tends to accumulate in flax. European markets in particular are looking for flax with less cadmium.

Whether working on improving flax or chickpeas, Tar'an's focus is on bettering Saskatchewan, western Canada, and even the whole country, he said.

"When we produce the best products available to the world … we help the economy and the environment."

DR. ALBERT VANDENBERG (PHD)

BY ASHLEIGH MATTERN

CONSUMER DEMAND DRIVING INNOVATION IN LENTIL CROPS

Albert Vandenberg likes to travel, and wherever he goes, he takes the time to look for Canadian lentils in the grocery stores.

"I've never failed in recent years to find Canadian lentils in supermarkets," he said. "And I often know the company that supplied it."

Professor Vandenberg is a lentil and faba bean breeder at the Crop Development Centre, and he remembers a time when lentils were still considered "weird" as a crop in Canada.

He came to the University of Saskatchewan in 1983 after earning a Bachelor's and Master's degree from the University of Guelph.

At the time, there were only about 10,000 acres of lentils in the province.

"We went from having 10,000 acres to supplying 50 per cent of the world with lentils," he said. "It's a success story for the province."

There's consumer demand for lentils. Lentil consumption is growing at a faster rate than other pulse crops, he says, rising up to 10 per cent per year compared to two per cent per year for other crops. The only other pulse crop that's grown at the same rate is soybean, which is fed to animals.

Lentils are popular because they cook fast, making them a convenient food, and they're packed with nutrients.

"The world is starting to shift to more vegetarianism in the diet, and the younger generations are quite happy to not eat meat for environmental reasons," Vandenberg said.

BREEDING DELICIOUS NEW LENTIL VARIETIES

In his plant breeding program, as with any breeding program, he's looking to improve quality, disease resistance, and yield, but he's also trying to design completely new varieties consumers haven't seen yet in anticipation of them wanting it. He thinks people will want to see more varieties if they're cooking lentils more often.

"You don't want to have the same meal every night," Vandenberg said, noting that people who eat meat don't just eat beef every day. "It's the same with something like lentils, you change the lentil, you change the flavour."

Vandenberg knows this from experience: He's a vegetarian himself. He had his first introduction to lentils while living in South Asia.

"We're finally seeing interest in taking these crops, processing them here, and making food and ingredients that make it to the consumers — not just overseas but in our own economy," he said. "Lots of people are becoming vegetarians or vegans, and plant protein is front and centre."

FABA BEANS 'A SLEEPING GIANT'

Another crop he works on that's seeing interest from the plant protein industry is faba beans.

Faba bean has a lot of merit as a future component of our agriculture in Canada, he says, calling it "a sleeping giant."

"Sometimes people don't see what's right in front of them; that's how I feel about faba beans."

Faba bean has a compound called vicine that can cause anemia in people who have certain genetics. But his team discovered a molecular marker that allows them to efficiently track the low vicine gene during the breeding process. They made the discovery publicly available, and now almost every faba bean program in the world is switching over, he said. Faba bean also fixes more nitrogen than any other legume, making it a key rotation crop.

It's an ancient crop, too — the Roman farming system had faba beans in the crop rotation, giving them higher yields on other crops, and therefore the ability to feed armies.

"The consumer wants you as a farmer to use less pesticides and less carbon, and they want you to produce healthier food. How do you do all that? You do it with a crop rotation."

Having more crops that are profitable to put into crop rotations would help make that system more attractive to farmers, and Vandenberg says crop rotation is one of the most important technologies available for growing healthier food.

"We call it the Crop Development Centre and if I could change the name, I would change it to the Crop Rotation Centre."

Doing research in a pandemic

BY KATHY FITZPATRICK

COVID-19 has had a profound impact on workplaces around the world, and facilities the CDC relies on are no exception. Fortunately, through the valiant effort of managers and support staff, operations have carried on in the face of lockdowns and pandemic protocols.

In 2020 "we were probably one of the only groups on campus that were working at near-capacity during the growing season," said Kirk Blomquist, Superintendent of Field Operations for the CDC and the Plant Sciences Department in USask's College of Agriculture and Bioresources. It's his job to manage the crop fields and associated infrastructure.

With help from the university administration, Blomquist and his staff developed ways to safely conduct fieldwork. "Our staff have been absolutely phenomenal and very accommodating in working with us and helping us to implement these changes in workstyle and different policies," Blomquist said.

The hardest and biggest change was in lines of communication among staff, he explained. "We tried to silo everybody so that if there happened to be an outbreak in one certain crew it would minimize the effect on the other crews."

Over in the Controlled Environment Facility (also known as the phytotron, site of 183 growth chambers) operations were reduced significantly. During the early days of the pandemic, only projects that could not afford to be interrupted were allowed to finish their growth cycle.

Activity fell to about 35 per cent of capacity, slowly decreasing between April and August, said General Manager Adam Harrison. Later in the year he was able to slowly ramp up operations again to about 60 per cent capacity.

He found working through the pandemic tough at first, and lonely. "I don't think that I've ever experienced anything like that in my life."

Always having thought of himself as an introvert, Harrison found he missed the face-to-face contact that had been a regular part of his job.

Technicians carefully followed pandemic protocols while working in the laboratory.

But Harrison seized the opportunity to conduct top-to-bottom servicing of the chambers, with the assistance of a relief employee working evenings. They cleaned, inspected mechanical and electrical components, replaced lamps and generally made sure everything was working properly so that people and projects were protected. (In normal times, his work is focused more on operating and monitoring the chambers.)

"My goal was to make sure that everything was ready for when people were allowed to come back," he explained. The hours were long – he sometimes put in 18-hour days.

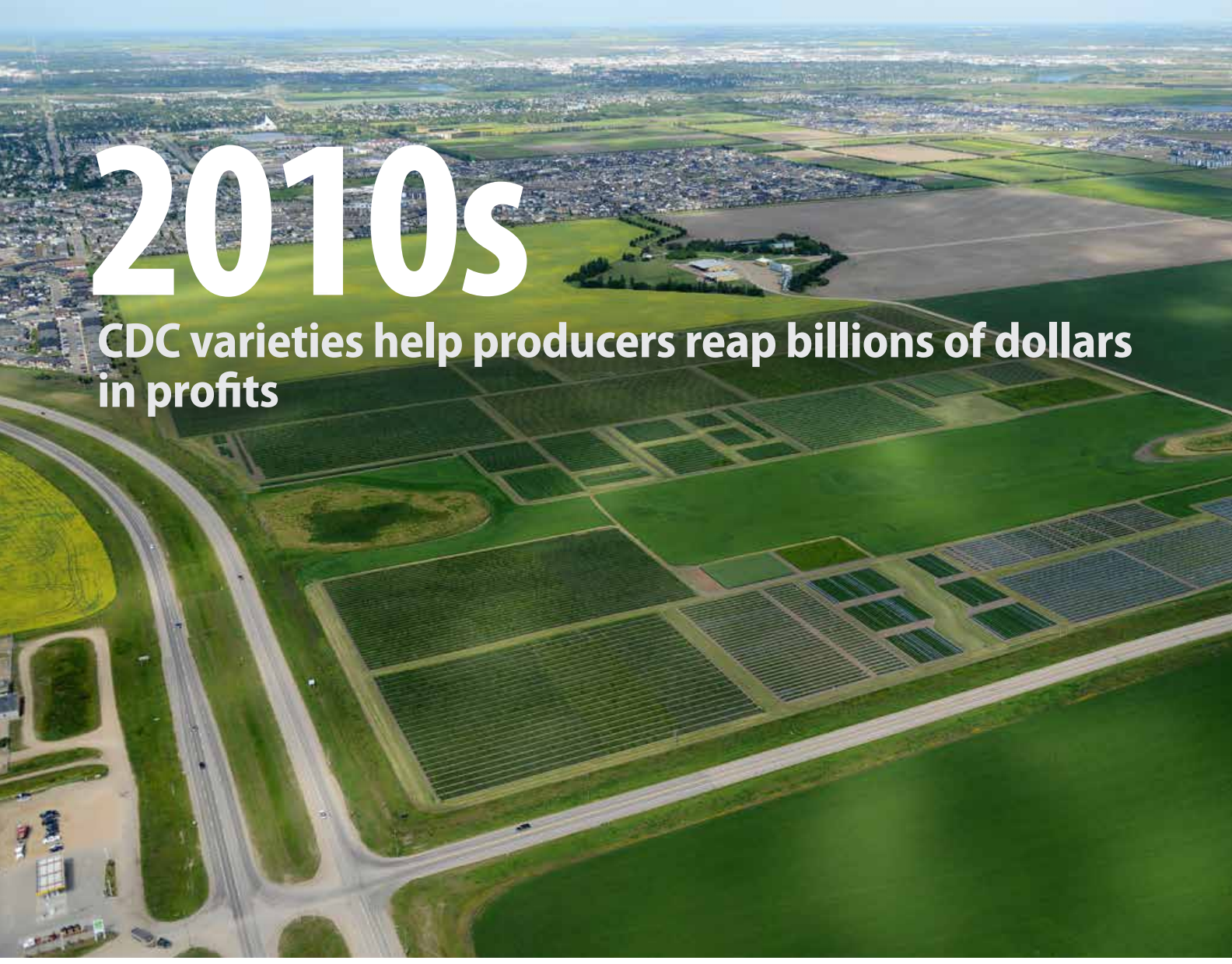
Ensuring the safety of people working in the phytotron, by seeing that equipment poses no danger, has always been a part of his job Harrison said. But with the pandemic came the added responsibility of ensuring that people kept a safe distance apart

There are other lessons learned: "people are definitely learning to be more efficient," Harrison noted, in part by working in shifts around the clock. However, while people are doing more with less, he also sees the stress and burnout. With the rollout of vaccinations, more people can return and alleviate the extra load some have been carrying.

As with most situations, there is an upside. CDC Director Dr. Curtis Pozniak (PhD) acknowledged that, for several months at least, the pandemic put everything on hold except the status quo.

"Sometimes it's okay to take a good breather, take a look at things and see where we want to go," he commented.

Having started his five-year term in July 2020, Pozniak also acknowledged he was getting his "sea legs" in the midst of the pandemic. It may take some time yet to assess COVID's full impact.



2010s

CDC varieties help producers reap billions of dollars in profits

Aerial view of Kernen Crop Research Farm.

BY KATHY FITZPATRICK

As the end of its first half-century neared, USask's Crop Development Centre (CDC) refreshed its aim. Integration of advanced technologies became the focal point of a new vision and five-year strategic research program. The CDC was to be "a world-class crop improvement Centre that delivers crop genetics for society," its mission to "develop crop varieties that bring value to the agriculture sector, through the development and application of scientific knowledge and technologies, in partnership with stakeholders across the agriculture value chain."

Long before its fifth decade of operation, the CDC had succeeded spectacularly in fulfilling its mandate: to improve the profitability of western Canadian farmers and the agri-food industry by improving existing crop kinds and developing new uses for them, as well as developing new crops. The new vision and mission built on that.

"A new platform for making improvements in crops," is how former managing director Dr. Kofi Agblor (PhD) spoke of genomics (the study of genes and their functions), and its importance in the work of the CDC. He was at the helm from 2012 to 2019, as the CDC was charting its path into the future.

A renewed emphasis on genomics, and scientific technology in general, reflects some of the most distinguishing work of the CDC's fifth decade. The 2010s were marked by ground-breaking projects to sequence the genomes, or map the genetic code, of several of Saskatchewan's most important crops.

Wheat breeders Dr. Pierre Hucl (PhD) and Dr. Curtis Pozniak (PhD) reaped international renown as co-leaders of the Canadian Triticum Advancement through Genetics Project (CTAG), whose team contributed to an international partnership aimed at sequencing the wheat genome, an effort coordinated by the International Wheat Genome Sequencing Consortium (IWGSC). CTAG's work also involved developing tools for targeted sequencing of Canada's best wheat cultivars, paving the way to identify gene sequences that contribute to desirable traits.

When the pair submitted their project proposal, Pozniak had been looking for an opportunity to build the infrastructure for genomic-assisted breeding. CTAG was when "we really got going with genomics," Pozniak explained.

CDC researchers visit with a producer at a field tour at Kernen Crop Research farm in 2014.

“For every dollar invested in CDC plant breeding, producers saw a seven-fold return

Pozniak went on to co-lead Canadian Triticum Applied Genomics (CTAG2) with Dr. Andrew Sharpe (PhD) Sharpe of the National Research Council Canada. CTAG2 led to the development of genomic tools for wheat “that were critical to develop DNA markers that we now use quite extensively in breeding,” Pozniak said. His team sequenced 15 different varieties, a sampling from different countries. Comparing them is important in understanding what makes them different from each other, and how they have been shaped by breeding.

Similarly, other CDC plant breeders forged ahead in collaborations to sequence lentil, pea, chickpea and flax genomes. Meanwhile, a CDC oat variety was the choice of a private sector partnership in its release of the first-ever sequencing of the full oat genome for use in open-source applications.

Important as these achievements are, Pozniak regards genome sequencing as an additional tool, not a replacement for the traditional plant breeder’s method of field-based selection. Meanwhile, he is also examining the potential of other emerging technologies, such as digital phenotyping, which includes the use of drones and special cameras to capture details in field trials that the human eye can’t see.

“Crop breeding is about managing resources, germplasm and technology and putting those together in the right package to identify superior varieties that we can transfer to producers,” Pozniak explained.

Pozniak now takes the lead in managing those resources. In July 2020 he became the CDC’s new director, taking the reins from Hucl, his mentor and interim managing director. The role at the top has once again been split in two, with the appointment of Marissa Janssen as CDC Manager. Pozniak is focusing on the organization’s strategic agenda and vision, while Janssen is overseeing management of the CDC brand and its day-to-day operations. “If we’re going to continue to grow as an organization, now is the time to make that organizational shift,” Pozniak said.

Looking back, Agblor described the CDC’s fifth decade as a time of accelerating, exponential and unparalleled growth in research activities. In the 2019-20 fiscal year, for example, the CDC carried out 116 research programs and projects worth $30.1 million - compared to the operational budget of $19.8 million just five years earlier.

The challenge was to marshal the resources to keep pace. “What kept me awake at night was, how do you maintain that growth?” Agblor said.

To raise awareness of the CDC’s value and attract greater support, the organization commissioned independent consultants to prepare an economic impact report, which was released in 2016. Some key figures underscore the CDC’s enormous contribution in the prairie provinces. From 1991 to 2015, the crop varieties it developed and released increased producer profitability by $3.8 billion. For every dollar invested in CDC plant breeding, producers saw a seven-fold return. The authors also estimated that CDC plant breeding added an average of $29 million annually to the prairie economy and created an average of 258 new full-time jobs each year.

The impact on production and markets continues. Among other research highlights of the past decade: Dr. Tom Warkentin (PhD) worked with a Canadian Light Source team, using the synchrotron to assess the nutritional value of pea varieties he developed. A team comprised of Warkentin, along with Dr. Bert Vandenberg (PhD), Dr. Kirstin Bett (PhD) Dr. Bunyamin Tar'an (PhD) and Dr. Sabine Banniza (PhD) set a goal to provide at least two pulse crop options for every farm in Saskatchewan, and to increase pulse production from 12 to 20 per cent of total seeded acres in the Prairies.

Dr. Aaron Beattie (PhD) developed a malting barley, CDC Bow, which became the feature ingredient in a contest exemplifying

A sampling of crop kinds produced by the CDC.

farm-to-table production. Locally grown Bow was small-batch malted at Maker's Malt in Rosthern SK. It was then distributed to 14 Saskatchewan craft breweries who were challenged to brew a unique beer with it.

Dr. Randy Kutcher (PhD) and Dr. Lipu Wang (PhD) developed a fast and accurate process to aid researchers in testing for the mycotoxin DON produced by fusarium head blight. Dr. Bill Biligetu (PhD), the CDC's forage breeder, is working on salt tolerant forage grasses, important to farmers dealing with high soil salinity resulting from weather extremes. And the list goes on.

Digital phenotyping using drones is an emerging technology in crop research.

An essential task in sustaining the CDC's operations is the maintenance and expansion of the infrastructure vital to this work. One of the major projects of the decade was a revamp of the Controlled Environment Facility, also known as the phytotron. Located in the Agriculture Building, the phytotron features 183 growth chambers - an array of reach-in cabinets and walk-in rooms that can be programmed to produce various environmental conditions, such as qualities and intensities of light, ranges of temperature and humidity. They are crucial to plant-breeding work.

But as the CDC approached its fifth decade, the phytotron's refrigeration system was gradually failing, and the facility's operation fell to about 60 per cent capacity. Bringing the phytotron back up to full operation was the largest project undertaken since it was built in 1990.

"It was quite a bit of a juggling act," said general manager Adam Harrison, who oversaw the project. The challenge was to

get it done as quickly as possible so usage of the facility could be ramped up again, but to also proceed in such a way that crop research could continue.

To that end, the revamp was done in three phases. Work began in the summer of 2010 with replacement of the lighting, starting with the 40 per cent of the chambers that were unoccupied. All of them were serviced and cleaned prior to the lighting retrofits. "It was time consuming but we needed to do it in a manner that we didn't shut down completely," Harrison said.

Wheat Congress in Saskatoon. Chaired by Pozniak, it attracted more than 800 delegates to the city.

Pozniak agrees the past decade has been one of building and expanding on the CDC's original vision. Faculty have become recognized not only as leaders in crop breeding and releasing varieties to western Canadian producers, but are also "recognized internationally as world-leading scientists that are creating knowledge, all with the aim to facilitate development of improved varieties."

Plants in the Controlled Environment Facility.

The new efficient lighting cut energy consumption by half, a cost saving that helped pay for the retrofit. It also reduced the heat load, creating more redundancy for the chillers (refrigeration equipment) in case any had to be taken down for repairs.

The next two phases, replacement of controllers and chillers, were completed by the end of 2013. The total cost of around $11.3 million was covered through contributions from the university, along with government and private sources.

In addition to the phytotron revamp, an irrigation system to promote disease development and to protect breeding materials during periods of extended drought was expanded in the fall of 2018, with the purchase of a linear system for the Campus field located south of 108th Street. Equipped with the latest technology including GPS tracking and remote operation, the new system was used extensively during the extremely dry spring of 2019.

A major international event that drew world attention to the CDC was held in July 2019. Canada hosted the 1st International

The challenge is more exacting than ever – in this era of population growth, climate change, and evolving markets and technology. Not only must varieties yield more and be easier to harvest. They must also offer improved nutrition and safety, and suit new processing methods and industrial uses.

Loading a sequencing library on to a GridION flow cell.

Today's research is tomorrow's food.

Seed of the Year West

Seed of the Year-West is a program that recognizes both a western Canadian publicly developed seed variety and the plant breeder that created it. The title may be misleading as the selected variety is celebrated for its total lifetime achievement and the significant contributions it has made to agriculture. Through the program's application process, nominated varieties are evaluated on innovation, presence throughout the value chain, sustainability, marketability, and overall impact on the Canadian agri-food industry. Five varieties released by the Crop Development Centre have received Seed of the Year-West recognition.

Harrington Barley

2009 Seed of the Year West

Harrington barley is a 2-Row malt barley that was released in 1981 by Drs Bryan Harvey and Brian Rossnagel. It was the first high enzyme rapid modification 2-Row malting barley bred in Canada.

Harrington was derived from the cross Klages/3/Gazellel/Betzes/Centennial. The initial cross was made in 1972 and subsequent generations were handled by a modified pedigree system. Breeder Seed was derived from an F_5 line, later designated S76333. Emphasis in selection was good dryland performance and a high enzyme malting profile. This variety revolutionized malting quality in 2-Row barley. It modified 20% faster, could be malted as soon as harvested and had a very similar enzyme profile to the best 6-Rows of the time. It soon replaced the latter as the dominant variety used in Canada and also suited the traditional export markets for 2-Row.

Harrington dominated the malt barley market for over 25 years being grown on over 60 million acres and having an estimated value of over $15 Billion. In 1991, 10 years after being released, the barley variety recorded its highest single year production numbers at 4.7 million acres. Its consistency to produce a quality malt even in times when the malting conditions were changed played a huge role in why growers were not eager to risk growing newer varieties. The guaranteed performance of Harrington challenged plant breeders to develop new varieties that would assure producers similar or stronger performance from the improved varieties.

Harrington Barley was named in honor of Dr. J.B. Harrington who was a member of the Plant Sciences Department from 1923 – 1956, and Head of the Department from 1951 – 1956. During his time with the University, Dr. Harrington had released many cereal varieties that were adapted to Saskatchewan agriculture.

CDC Bethune Flax

2012 Seed of the Year West

CDC Bethune was released by Dr. Gordon Rowland in 1998. The marketing rights were awarded to SeCan and Plant Breeders Rights were granted to the variety in 2001.

The brown-seeded flax variety was derived from a cross between NorMan (an Agriculture and Agri-Food Canada 1984 release) and FP857 (a sister line in 1985 of the CDC variety Somme).

The line was first selected in 1990 and coded as F91109. It was grown in replicated trials from 1991-1997 where it consistently performed as the top yielding variety with excellent straw strength, good oil content and resistance to North American races of rust caused by *Melampsora lini* and moderately resistant to wilt caused by *Fusarium oxysporum* f. sp. lini. The line was supported for registration by the Prairie Registration Recommending Committee on Grain (PRRCG) in 1998.

Upon introduction into the western Canadian seed market, CDC Bethune became the yield standard for brown-seeded oilseed flax. Its consistently high seed yield provided greater economic returns for the producer but its increased straw strength over variety Vimy made it more suitable across a wider growing region. During its peak years of 2006-2010, its estimated that CDC Bethune was grown on 60% of the available flax acres in western Canada with an economic return to farmers of $178 million.

The variety name CDC Bethune continued the theme of naming CDC flax varieties after significant Canadian World War 1 locations. Bethune is a town in northern France where Canadian troops were often sent for rest when they were pulled out of the front lines.

Laird Lentil

2013 Seed of the Year West

Laird lentil was released by Dr. Al Slinkard 1978. It was granted a license as the first lentil cultivar in Canada on November 14, 1978.

Efforts to adapt lentil varieties to Saskatchewan began in 1972 with the acquisition of about 500 lentil accessions from the United States Plant Introduction Station in Pullman Washington. Over the next 5 years, the 10 most promising accessions were grown in field trials and hand harvested until 1978 when the Crop Development Centre released the first lentil variety.

Prior to 1978, pulse crops were almost unknown in the province, with only small acreages of peas being grown. Acceptance of the new lentil crop did not come easily. After Laird's release, Dr. Slinkard would spend the next 10 years testing and providing farmers with information on agronomic practices for the crop. He answered thousands of phone calls, attended hundreds of meetings and gave hundreds of phone, television and magazine interviews educating Canadian farmers and the Canadian public on the potential of the new crop for Western Canadian agriculture.

By 1987 Laird lentil became an international standard of quality and was grown on over 200,000 ha in western Canada, making it the most widely grown lentil cultivar in the world. The CDC also released the variety Eston in 1980 and together with Laird, lentil production in Canada went from 0 ha in 1969 to over 240,000 ha in 1987. Canada had become the third largest lentil producer in the world after India and Turkey. By, 1991 Canada had become the largest exporter of green seed lentils and in 1994 Canada became the largest lentil producer in the world.

The variety was named after Mr Tom Laird, a farmer in the Rosetown SK area who generously bequeathed money to the Crop Science Department to be used for research and the development of new crop varieties in and for the area commonly known as the Rosetown wheat belt.

CDC Teal Wheat

2015 Seed of the Year West

CDC Teal wheat was released by Drs Geoff Hughes and Pierre Hucl in 1991. It was an early-maturing hard red spring wheat that combined early maturity with good yield potential and resistance to both leaf and stem rust. The marketing rights were awarded to local farmer owned Value Added Seeds.

The line was selected from a three way cross made in 1977 between BW514/Benito/BW38. Both BW514 and BW38 contain parentage tracing to CIMMYT lines, providing new genetic diversity to the premium Canada Western Red Spring class of wheat. The resulting population was advanced to the F5 generation by a modified single-plant bulk method of selection. Later single-plant selections for plant height, maturity, straw strength and rust resistance were done. The line was entered in the Western Bread Wheat 'B' Test in 1986 as W84315, and then as BW616 in the Western Bread Wheat Cooperative Test from 1987 to 1989, and in the Central Bread Wheat Cooperative Test from 1988 to 1990.

In the late 1990s, CDC Teal accounted for more than 20 percent of the wheat acres in Western Canada. It was released for its improved yield and disease resistance, but its popularity grew when Warburton's, a family-owned bakery in England, noted its superior dough strength and chose to use the variety as a key ingredient in its flour blend. CDC Teal was a popular wheat variety in Western Canadian wheat markets until newer more improved varieties became available.

The variety was named because of Hughes's interest in northern Saskatchewan lakes and the birds he observed there. The teal is a small duck that is usually found in dense flocks and has a habitat range that spans the six major continents and many islands.

CDC Copeland Malt Barley

2019 Seed of the Year

CDC Copeland is a 2-Row malt barley that was released in 1999 by Drs. Bryan Harvey, Eric Lefol and Brian Rossnagel. Marketing rights of the variety were rewarded to SeCan and the variety received Plant Breeder's Rights in December 2001.

The line was selected from a cross between WM861-5/TR118 and coded as SM94516. TR118 was a line selected in 1991 for resistance to pre-harvest sprouting by the CDC malt barley program and is derived from the variety Harrington. The objectives in selecting CDC Copeland were to achieve excellent field performance in the central Saskatchewan and to provide an alternate quality profile to the high enzyme varieties. It not only filled the niche for all-malt craft beers but also performed well for the higher adjunct big industry players as well.

When CDC Copeland was released in 1999, it yielded 16% to as much as 26% higher in some regions of western Canada than the popular Harrington variety. It had greater straw strength, plumper kernels and better disease resistance. It had excellent malting quality and the same ability to be produce malt on a consistent basis. Its versatility to create beer for large brewers or smaller craft brewers was not immediately recognized. It would take more than 15 years for it to become one of the most widely grown malt barley varieties in western Canada. In 2016 CDC Copeland was grown on 44.7% of the available malt barley acres in western Canada, and in 2020, the variety remained as popular at 44% of seeded acres.

The variety was named after William Copeland, a farmer in the Elrose area of Saskatchewan in recognition of his support of the Crop Development Centre's barley breeding program.

The far reaching impact of the CDC

BY KATHY FITZPATRICK

More than 500 registered crop varieties in 50 years. That alone is an admirable record for USask's Crop Development Centre (CDC). But by far, it's not all the CDC has to show for a half-century of service.

Also count in the expertise passed on: grad students trained; scientific papers and books published; farmers and other agriculture and food industry players educated through extension activities. Among faculty honoured for this knowledge transfer is cereal and flax pathologist Dr. Randy Kutcher (PhD), recipient of an Award of Merit from the North American Colleges and Teachers of Agriculture in 2020.

For some trainees, their experience evolved into a lasting professional association with the CDC. "It's been twenty-five years of me having the great opportunity to work with that organization," said alumnus Bill Greuel.

To date, nearly 300 students have pursued graduate degrees in connection with the CDC. Many have landed leading roles in government, industry and academia.

In fact, the CDC has produced a multi-generational chain of wheat breeders. Dr Bob Baker (PhD), who arrived in the late 1970's, trained Dr. Pierre Hucl (PhD) (who recently served as interim CDC Director). Hucl in turn mentored Dr. Curtis Pozniak (PhD), current CDC Director.

Other current faculty who came up through graduate student ranks include Dr. Randy Kutcher (PhD) (cereal and flax pathologist), Dr. Tom Warkentin (PhD) (field pea and soybean breeder), and Dr, Aaron Beattie (PhD) (feed and malt barley and oat breeder). Dr. Bert Vandenberg (PhD), a lentil and faba bean breeder was trained by the legendary pulse breeder Dr. Al Slinkard (PhD).

And Kirk Blomquist, field superintendent since 1994, landed the job while working on his MSc under the supervision of feed barley and oat breeder Dr. Brian Rossnagel (PhD). Both men grew up on prairie farms (Rossnagel in Manitoba, Blomquist near Perdue, SK), and became life-long friends.

"Even today Brian and I are in frequent contact," said Blomquist, who still occasionally seeks Rossnagel's advice.

Another of Baker's students, Stanford Blade (MSc Crop Science '87) became Dean of Agricultural, Life and Environmental Sciences at the University of Alberta. The University of Manitoba's Plant Science faculty includes two former students of now-retired winter wheat breeder Dr. D. Brian Fowler (PhD), Dr. Anita Brule-Babel (PhD) and Dr. Martin Entz (PhD).

Entz's work focuses on natural systems agriculture. He said he gained the confidence to step into an area which he describes as "not well supported" after seeing the "can-do" attitude within the CDC, in particular Fowler's risk-taking work on cold hardiness in winter wheat.

"I think the fact that I was working in a field that was emerging and had many, many problems but we kept trying and we didn't give up, that was a very important lesson. And that has inspired me," Entz said. To him, Fowler was "a very patient but very wise mentor" whose determination has continued to guide him.

The appeal of working with Fowler - and the quality of the people at the CDC in general - drew Entz to pursue his PhD there. It was a sharp turn in his career path. Having obtained a Master's degree in horticulture, Entz had been working as an agronomist in the sugar beet industry. He had considered doing his PhD on sugar beet weed control at Colorado State University. However, he then thought that if he was going to work in Canada, he should know something about wheat. His eyes turned to the University of Saskatchewan.

Entz was impressed by the work he saw, "on practical problems that meant something to society, to farmers, to the environment." It mirrored his own ambitions, to work in a field that had some practical application "but was applying the best possible science to that."

Entz also believes his time at the CDC made him more versatile because "we weren't just focusing on the breeding program." He speaks with admiration for not only Fowler, but also Fowler's close collaborator Dr. Larry Gusta (PhD), "a world-class cold acclimation physiologist." Entz's PhD work focused on drought stress physiology.

In the years he was there (1984-88), Entz considered the CDC unique in Canada by virtue of its size. Being so well-resourced "gave it the critical mass that made it really special."

Not that the facilities were quite so impressive back then. Although he and his colleagues worked out of Atco trailers,

Teaching, extension and long-lasting relationships

Entz said he loved being there because what mattered were the people, their spirit and "the questions we were addressing."

The CDC attracted numerous graduate students from across Canada with whom Entz created lasting relationships. They are now all over the world, Entz said, creating a valuable network for him that he otherwise would not have had.

Greuel earned his MSc at USask under the supervision of former CDC Director Dr. Bryan Harvey (PhD), himself a world renowned malt barley breeder who brought early success to the organization.

"My career has intersected with the Crop Development Centre ever since," Greuel said.

After first working in the private sector, Greuel progressed through a series of roles in the Saskatchewan Ministry of Agriculture, culminating with Assistant Deputy Minister, Regulatory and Innovation. In that time, Greuel had a direct hand in administering core funding for the CDC.

He also spent time at the agricultural giant BASF, where he managed the commercial arrangement with the CDC for the development of herbicide-tolerant lentil and wheat.

Greuel now leads the development of Canada's plant protein sector, as CEO of Protein Industries Canada, an industry-led, not-for-profit organization based in Regina. There, too, he finds connection with the CDC, where research into the production and use of plant protein figures prominently.

Greuel's arrival at the CDC illustrates its particular strength in collaborating with the private sector. Just finishing his undergraduate degree in agricultural biology, Greuel seized a sudden and unexpected opportunity he heard about. His brother, who was pursuing his Master's in agricultural economics, had attended a seminar in the College of Agriculture given by Tom Schuler of Plant Genetic Systems. At the time it was a small start-up company based in Belgium that went on to start the hybrid canola industry in Canada. Schuler commented on the need for more private sector investment in plant breeding, and said he had money to support a graduate student if he could find the right person.

The next day Bill Greuel called Schuler. They put together a project concept and pitched it to the Department of Plant Sciences. It led to what Greuel describes as a very unique arrangement at the time: working for a private sector company but doing his research under the guidance of professors in the department.

"Here comes this kid just finishing off his undergraduate degree, with an Industry partner and they were completely open to that arrangement."

Here comes this kid just finishing off his undergraduate degree, with an Industry partner and they were completely open to that arrangement.

Greuel's graduate work was in hybrid canola seed production. Although no one at the CDC was working in canola, Harvey had done some of his own undergraduate and graduate work in that area. Hence, he was able to guide Greuel's research with a depth of knowledge and understanding of both the plant genetics and the industry.

Greuel also counts among his mentors Dr. Graham Scoles (PhD) in Plant Sciences, and Baker. Greuel said Baker in particular taught him how to craft research design, and also the importance of correlating lab and field results to understand what is happening in the production environment.

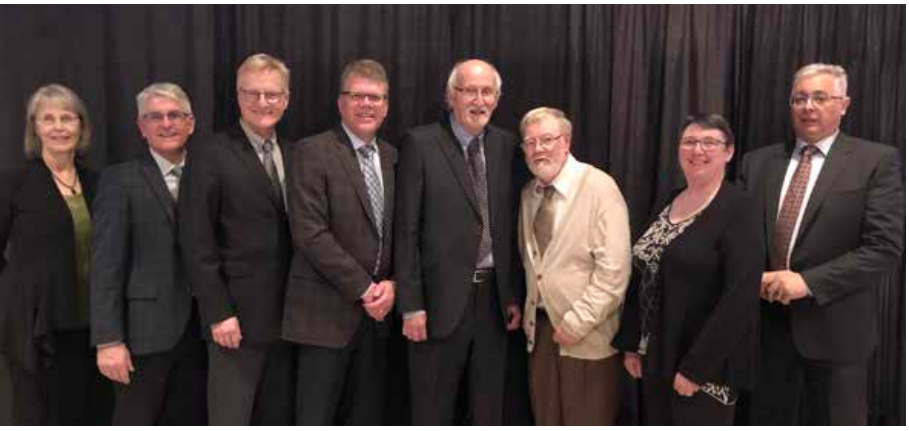
The many other accomplished and influential CDC alumni include several at Agriculture and Agri-Food Canada (AAFC). Dr. Rob Graf (PhD), who earned his PhD in Plant Breeding and Agronomy under the supervision of Dr. Gordon Rowland (PhD), is Principal Research Scientist in winter wheat breeding at AAFC's Research and Development Centre in Lethbridge, AB.

At the same facility, Dr. Parthiba Balasubramanian (PhD) is a research scientist in dry bean breeding. Earlier, he arrived from India with a BSc in Agriculture and obtained both his MSc and PhD in Plant Breeding at USask. Meanwhile, at the parallel facility in Brandon, MB Dr. Kirby Nilsen (PhD) heads the oat breeding program.

A strong rapport between Nilsen and his supervisor at the CDC launched him on the path to his current position. Nilsen completed both his Master's and PhD degrees in Plant Sciences at USask under the supervision of Pozniak before going on to work as an assistant plant breeder at the CDC.

Nilsen had always been interested in plant breeding, he said, having earlier worked in a couple of plant breeding programs in private industry. But his career choice was firmly set while, pursuing his BSc in Agricultural Biology, he took a fourth year course in plant breeding with Pozniak. The two hit it off, engaging in discussions during and after class. "I recognized the passion that he has for what he does as a plant breeder, and I think some of that probably rubbed off on me," Nilsen said.

Originally from Saskatoon, Nilsen said USask will always be home to him and the decision to move to AAFC in Brandon was a



Dr. Brian Fowler and past graduate students attending the SK Hall of Fame induction ceremony in 2018.

Bill Greuel

Dr. Asheesh (Danny) Singh

difficult one. A major factor is that his wife is from Manitoba, and farms there with her family.

He initially obtained a position in wheat phenomics. Phenomics uses technologies such as robotics and aerial drone imaging to collect data in the field. The information is used to assist in making selections for plant breeding. When the oat-breeding position opened up, Nilsen went for it.

CDC alumni can also be found beyond Canada's borders. For example, Dr. Asheesh (Danny) Singh (PhD) is now a Professor of Agronomy at Iowa State University. After first earning his Bachelor's degree in Agriculture and Animal Husbandry in India, Singh obtained his Master's degree at USask under Rossnagel's supervision, before completing his PhD at the University of Guelph and then spending six years as a wheat breeder at AAFC.

In Indiana, Dr. Lasantha Ubayasena (PhD) has recently joined the plant breeding technology company Inari Agriculture as a Senior Research Scientist. There, he is leading the establishment of Molecular Breeding and Genotyping activities to support the company's growing precision breeding programs with their proprietary gene editing technologies.

Previously at Corteva Agriscience in Johnston, Iowa, Lasantha Ubayasena led the development and implementation of next generation genotyping technologies to support genomic breeding and trait introgression programs.

Back in early 2000, a mix of risk-taking and good fortune landed Ubayasena at the CDC. Nothing had been arranged in advance of his arrival in Saskatoon from his home country, Sri Lanka, with family in tow. He had simply heard about the local scene from friends who studied in the Department of Plant Sciences.

Keenly interested and knowledgeable in the use of molecular markers in plant breeding, "I came with that mission" he said. He arrived at a time when the technology was gaining momentum at the CDC.

Ubayasena had already earned his undergraduate degree in agriculture. That was followed by eight years as a research officer in genetics and plant breeding at Sri Lanka's Sugarcane Research Institute, where his work included the initiation of molecular marker development to support the conventional breeding program.

It took him only a few days after landing in Saskatoon to find a job as research assistant to Scoles and Dr. Branka Barl (PhD) in their Crop Molecular Genetics Laboratory. He then got funding to do his Master's degree under their supervision. Following work at AAFC, Ubayasena returned to Scoles' lab to work on a project funded by Genome Prairie.

He then seized an opportunity to do his PhD under the supervision of Warkentin, whom he calls "one of the best" pulse crop breeders. Ubayasena said it was then that he put together plant breeding and molecular technologies.

While writing his thesis, he went to work for Dow AgroSciences in Saskatoon, where he contributed to molecular marker development, process improvement and high throughput marker analysis in canola.

Ubayasena's work with molecular markers continued at Dow's head office in Indianapolis. Corteva, where he subsequently worked, is a standalone spinoff of DowDuPont, itself the product of a corporate merger.

His studies with Warkentin stood him in good stead at Corteva. Describing himself as a "lab rat" for his long hours spent in that setting, Ubayasena's time at the CDC gave him the chance to learn about evaluating cultivars in the field. At Corteva, he had to work closely with both plant breeders and lab staff. "I have a really good understanding of both sides," he said.

Ubayasena also praises CDC faculty and staff for the personal support they gave him and his family after coming to Saskatoon. "We were struggling from every angle" as they established themselves in a new country, he explained.

"In reaching out to farmers, the tradition goes back to Slinkard's early days when he crisscrossed Saskatchewan explaining why they should include pulses in their rotations.

Alfalfa is being bred to increase production and used as a forage in Canada.

Purple wheat is used to make vodka and is a popular noodle colour in some parts of the world.

In reaching out to farmers, the tradition goes back to Slinkard's early days when he crisscrossed Saskatchewan explaining why they should include pulses in their rotations. "We still see that today with breeders and pathologists at USask speaking at grower and SPG-hosted events," said Carl Potts, Executive Director of Saskatchewan Pulse Growers. The pulse industry appreciates not only the work done to develop new varieties, but also the knowledge imparted on how to best produce them.

Of course, producers of the full range of crops developed by the CDC - along with students and other agricultural scientists across the globe – receive the benefit of knowledge acquired. In 2019-20 alone, faculty engaged in more than 150 outreach and extension activities such as meetings and conferences, presentations, lectures and seminars, field and program tours, and media interviews.

Meanwhile, knowledge shared in written form is just as prolific: 97 conference publications and 65 peer-reviewed papers in that same year.

Now, as the CDC enters its sixth decade, the work of developing the crops of the future continues. Among the highlights:

Pozniak, together with Dr. Sylvie Cloutier (PhD) at AAFC, are leading the $11.2 million 4DWheat project, named for its application of cutting-edge genomics to harness diversity, advance domestication, enable discovery and expedite delivery of new sources of genetic variation.

As lead funder Genome Canada notes, wheat supplies the most calories and proteins to the world's people, but current yield gains will not meet the needs of a growing global population. One possible reason that yield increases are starting to plateau, Pozniak explained, is that genetic diversity has narrowed – wheat breeders are using similar germplasm over and over again.

The 4DWheat team hopes to tap into some of the diversity that has either been lost or gone unused in breeding, stored in a treasure trove of about half a million different accessions of wheat relatives in gene banks around the world. The challenge is, separating the highly valued traits from the undesirable (such as shattering seeds, tall growth or very late maturity). Genomics will be used to efficiently identify desired traits to be bred into new, higher yielding and more disease-resistant wheat varieties.

Meanwhile, pulse breeders Dr. Kirstin Bett (PhD) and Bert Vandenberg are using genomics to accelerate the development of new lentil varieties that will be highly competitive in the global market. Bett and Vandenberg earlier co-led a project to identify which varieties will best perform in new growing areas – vital intelligence in the effort to boost production world-wide.

Now they co-lead the $7.4 million project called EVOLVES (Enhancing the Value of Lentil Variation for Ecosystem Survival). The aim is to tailor-make lentil varieties with quality traits such as size and colour that meet the demand of specialty processors such as the pasta industry - varieties more likely to command a premium price.

Disease resistance is a recurring theme in the work of CDC pulse breeders, often in collaboration with their plant pathologist colleagues. For instance, Dr. Bunyamin Tar'an (PhD) is working on high yielding chickpea cultivars with such traits as improved resistance to ascochyta blight. He is conducting disease screening in collaboration with pulse pathologist Dr. Sabine Banniza (PhD).

Similarly, through resistance screening of germplasm – including wild relatives of cultivated lentil in particular – Banniza's team has identified resistance to root rot in lentil. Together with Dr. Tom Warkentin (PhD), the pea breeder at CDC, she recently developed a marker-assisted platform to breed resistance to *Aphanomyces euteiches* (a water mould which causes root rot) into high-yielding pea varieties. She hopes to do the same in lentil.

In fact, Banniza has shifted focus from earlier work on diseases affecting the leaves of pulse crops to root rot pathogens. In recent years, her team has contributed to research led by colleagues at AAFC to identify ways to control Aphanomyces root rot on the prairies which, as she wrote, "has developed into the most threatening disease at present." Further, along with provincial collaborators, her team is currently surveying pathogens on chickpea roots from commercial fields in Saskatchewan "as root rots are becoming an emerging issue in this crop too."

Still, work continues on an important pathogen causing fungal lesions on lentil leaves, *Colletotrichum lentis*. Banniza's team has sequenced its genome, and is estimating the risk that new races may develop. She hopes to "gain more detailed insight into the genes that are activated when this pathogen infects lentil, which could then be targeted through breeding in a very specific way to improve resistance."

The cereal crop diseases Fusarium head blight (FHB) and wheat stripe rust remain high priorities for Kutcher. A genome-wide association study will identify markers linked to FHB resistance in wheat. Kutcher is also studying the benefits of integrated pest

management on FHB, such as inclusion of non-host crops (such as pulses, oilseeds and corn) in rotations, and determining the most effective fungicide management strategies for FHB mitigation in wheat and pasmo in flax.

Meanwhile, work to identify stripe rust resistance genes will aid in the development of new wheat cultivars, potentially minimizing the use of fungicides and saving millions of dollars for western Canadian growers. As well, new diseases, such as bacterial leaf streak of wheat and barley require attention to minimize their establishment across the prairies and determine appropriate management practices should they become established.

For Warkentin, resistance to powdery mildew, the ascochyta blight complex, root rot and lodging remain preoccupations as he develops high yielding pea cultivars. He is also engaged in collaborative research to breed enhanced resistance to environmental stresses, particularly heat and drought. And, he is working on lines with improved nitrogen fixation, an important process in plant growth.

In soybeans, Warkentin is working on high-yield cultivars with acceptable disease and insect resistance for western Canadian conditions, along with acceptable protein and oil composition.

Nutrition is also the focus of two of Warkentin's current projects. One aims to boost the bioavailability (active effect after ingestion) of iron in field peas. The other involves the study of pea varieties for indicators of glycemic index, a measure of how quickly or slowly a food releases glucose into the bloodstream, important for people with diabetes in particular. Molecular markers associated with low glycemic index may be developed, which will facilitate breeding for this trait. He is also collaborating with Tar'an in a five-year project to improve yellow pea protein concentration and quality.

Tar'an's other work on chickpeas focuses on resistance to herbicides, as well as improved adaptation and yield in suboptimal environments. The latter involves the introgression of traits from wild chickpea.

Meanwhile, Beattie is working on molecular markers linked to oat crown rust. In his barley breeding program, he's working on new two-row malting barleys with improved agronomic, disease and quality attributes to meet the needs of producers and the malting and brewing industries, including the expanding craft segment. His focus on improved agronomic and disease attributes carries through to two-row feed barley and hulless food and malting varieties. A new area is coloured food types. For the beef and dairy sectors as well, Beattie is working on improved quality in forage barley and oat such as higher protein, starch, digestibility and dry matter yield.

Forage breeder Dr. Bill Biligetu (PhD) is working as well on improved yield, nutritional profile and adaptation. In genomics, he is testing to see genomic selection can significantly improve genetic gain in alfalfa breeding, part of the effort to increase production and use of this forage plant in Canada, including in high saline soil areas. And, working with Dr. Andrew Sharpe (PhD) (Director of Genomics and Bioinformatics at USask's Global Institute for Food Security), Biligetu is building a catalogue of genetic information for bromegrass species. Other projects include development of: meadow brome and cicer milkvetch varieties for stockpiled grazing in western Canada; hybrid wheatgrass for salt tolerance; and wheatgrass varieties for improved drought tolerance, and resilience.

Meanwhile, Hucl is leading the development of forage wheat, an effort Biligetu has collaborated in for the past seven years. "This forage wheat breeding effort is the first of its kind in Canada," Biligetu noted.

Currently, Hucl is also working to enhance wheat breeding capacity at the CDC. He is also developing herbicide-tolerant spring wheat, and he is collaborating in a project to improve yield, yield stability and grade protection in western Canadian spring wheat cultivars. As well, he is developing triticale lines with wheat-like baking quality. In canary seed, in addition to breeding, Hucl is evaluating germplasm for response to wild oat herbicides and Fusarium head blight.

The importance of all of this work to the provincial economy cannot be overstated. Saskatchewan's Minister of Agriculture, David Marit, called research and innovation "the foundation of growth in the agriculture industry," and the CDC's role "key" in supporting producers, ensuring the province is able to provide the world with sustainably grown agri-food products. Marit noted the CDC's research will support efforts to meet the Saskatchewan Growth Plan objectives of increasing crop production to 45 million tonnes, agriculture exports to $20 billion, and value-added revenue to $10 billion by 2030.

"The work done at the CDC will continue to elevate Saskatchewan's reputation as an internationally recognized leader in research and bioscience," Marit wrote.

Pozniak wants to spread the word of the CDC's remarkable impact farther and wider, expanding its social media presence to keep stakeholders and the public abreast of its current work. Plans also include a new logo, and a revamped website to better communicate the CDC's mission and vision and how it will achieve them.

Meanwhile, the CDC's success in attracting new funding and expanding its programs has once again led to the need for expansion in both facilities and land base, Pozniak noted. He is making land purchase a top priority, looking to roughly double current capacity, with an eye to locate beyond the pressures of the city.

"We want to be far enough away that we're not doing this again in ten or twenty years. We're looking at a fifty- to eighty-year horizon in terms of what we would need."

And so begins the confident launch into the next half-century of innovation in the service of Saskatchewan and beyond.

"The CDC is pretty unique in the world. They're embedded within the university, so they can do research, but also have economic relationships where they can release seeds/varieties to the market. They have a constant delivery of new varieties to the industry. They have a different value proposition from other university organizations."

– Shawn Gibson, SK Ministry of Agriculture

BY ASHLEIGH MATTERN

BREEDING PEAS THAT PACK A NUTRITIONAL PUNCH

The visual quality of pea and soybean seeds — like the size, shape and colour — is one of the aspects Professor Tom Warkentin breeds for.

"It has to be attractive for consumers because pulses are historically purchased based on a raw product that consumers see almost as it is off the combine," Warkentin said.

Warkentin is a field pea and soybean breeder, specializing in breeding pea cultivars for western Canada and the northern tier states, and soybean breeding for the short season regions of western Canada.

Protein concentration in peas is important as well because pea is being used more and more in the plant-based protein world, including in plant-based burgers, plant-based beverages and sports nutrition.

"Pea has kind of gained an interesting fit into those markets," he said.

From a plant breeding point of view, his goal is to develop varieties that have more protein in the seeds to make it more efficient to extract protein from them. Those industries are growing in Canada, the U.S., Europe, and China, extracting protein from peas and selling them to high value markets, he said.

In 2019, the Saskatchewan Ministry of Agriculture supported a five-year project led by Warkentin and Dr. Bunyamin Tar'an (PhD) to increase protein concentration and quality in pea. The program is called P-POD, which stands for Pea Protein Omic Determination. There are about 30 local, national and international collaborators on that project.

IMPROVING MICRONUTRIENTS

There has also been some work done to improve minerals and micronutrients in peas, like boosting iron, zinc and selenium.

With iron, they're not only increasing the concentration, but also how available it is to the human or animal eating the food. Peas, like other grains, have a molecule called phytate that latches on to the iron and makes it unavailable, but Warkentin's team has developed a low-phytate pea.

In a recently published study, when the low phytate pea was fed to chickens there was improvement to blood hemoglobin levels when compared to a regular pea or a non-pea diet.

The low-phytate peas are also currently being tested in an eight-week study with female athletes, in collaboration with researchers in kinesiology, nutrition, and food science.

"Basically, we are comparing the hemoglobin level of the athletes at the beginning of that study and the end of the study … to see if there's some change based on the diet," Warkentin said.

The study will also look at exercise performance. They're working with women because there is a higher tendency for women athletes to be low in iron.

"My daughter's an athlete, too, so it hits home for me," Warkentin said.

DR. TOM WARKENTIN (PhD)

Warkentin grew up on a farm near Winnipeg, MB, and he still enjoys being in the field.

"I like the summer season — to see the plots, to be in the field, to make observations, to collect data, to see the province," he said.

Warkentin earned his bachelor's and Masters degree through the University of Manitoba-Faculty of Agricultural and Food Sciences, and completed his Ph.D at the University of Saskatchewan.

He was attracted to the work because he likes tackling problems with practical outcomes. And the results of his work certainly have had a real-world impact: His program's pea varieties are occupying 80 per cent of the production area in the Canadian prairies, he said.

'BUILDING FOR THE FUTURE'

Breeding for root rot resistance will be a major focus of his work for the next five years or more, Warkentin said.

"We have a significant issue with root rot," he said. "There's several fungi that are contributing to this complex of root rot so we are putting a major emphasis on trying to address that."

He works closely with CDC plant pathologist Dr. Sabine Banniza (PhD), who is looking at the problem from the pathology side, while he is looking at it from the side of breeding for resistance.

The soybean program at the CDC is younger than the pea program, but also has potential in the future of agriculture in Saskatchewan.

"We think about it as ... building for the future," he said. "We're trying to provide another option for farmers."

MAJOR AWARDS

RECEIVED BY CDC RESEACHERS

25-year award, National Sciences and Engineering Research Council of Canada (NSERC)
- Dr. D. Brian Fowler, 2004
- Dr. Lawrence V. Gusta, 2004

Agriculture Excellence Award, Saskatchewan Institute of Agrologists
- Crop Development Centre, 2005

Award of Merit, Saskatchewan Soil Conservation Association
- Dr. D. Brian Fowler, 2009

Canadian Agricultural Hall of Fame
- Dr. Alfred E. Slinkard, 2003
- Dr. Bryan L. Harvey, 2020

Certificate of Excellence, Saskatchewan Herb, and Spice Industry
- Crop Development Centre, 2004

Clark-Newman-Clayton Award, Canadian Seed Growers' Association
- Dr. Alfred E. Slinkard, 2002
- Dr. Bryan L. Harvey, 2005
- Dr. Brian G. Rossnagel, 2016

Dean's Award for Excellence in Outreach and Engagement, College of Agriculture and Bioresources
- Dr. Brian G. Rossnagel, 2004
- Dr. Aaron D. Beattie, 2020

Dean's Award for Research Excellence, College of Agriculture and Bioresources
- Dr. Curtis J. Pozniak, 2014
- Dr. Thomas D. (Tom) Warkentin, 2016
- Dr. Pierre J. Hucl, 2017
- Dr. Kirstin E. Bett, 2020

Dean's New Researcher Award of Excellence, College of Agriculture and Bioresources
- Dr. Curtis J. Pozniak, 2010
- Dr. Bill Biligetu, 2018

Dean's Award for Excellence in Teaching, College of Agriculture and Bioresources
- Dr. Aaron D. Beattie, 2016

Distinguished Achievement Award, Bean Improvement Cooperative
- Dr. Albert (Bert) Vandenberg, 2005

Distinguished Agrologist, Saskatchewan Institute of Agrologists
- Dr. Alfred E. Slinkard, 1990
- Professor Frederick A. (Rick) Holm, 1995
- Dr. Gordon G. Rowland, 2002
- Dr. Brian G. Rossnagel, 2004
- Dr. Bryan L. Harvey, 2006
- Mr. Ken L. Sapsford, 2008

Distinguished Agronomist, Canadian Society of Agronomy
- Dr. Gordon G/ Rowland, 2010

Early Career Agronomist, Canadian Society of Agronomy
- Dr. Brian G. Rossnagel, 1993
- Dr. Curtis J. Pozniak, 2010
- Dr. Bill Biligetu, 2020

Excellence in Weed Science Award for western Canada
- Professor Frederick A. (Rick) Holm, 1995

Fellow, Agri-Food Innovation Council
- Dr. Douglas R. Knott,
- Dr. Alfred E. Slinkard, 1987
- Dr. Bryan L. Harvey, 1990
- Professor Frederick A. (Rick) Holm, 2000
- Dr. Brian G. Rossnagel, 2002

Fellow, American Association of Cereal Chemists
- Dr. Rattan (Ron) Bhatty, 1992

Fellow, American Society of Agronomy
- Dr. Bryan L. Harvey, 1990
- Dr. Alfred E. Slinkard, 1991
- Dr. D. Brian Fowler, 2001

Fellow, Canadian Society of Agronomy
- Dr. D. Brian Fowler, 1994
- Professor Frederick A. (Rick) Holm, 2007
- Dr. Brian G. Rossnagel, 2007
- Dr. Pierre J. Hucl, 2012

Fellow, Canadian Weed Science Society
- Professor Frederick A. (Rick) Holm, 2009

Fellow, Crop Science Society of America
- Dr. Bryan L. Harvey, 1990

Gold Harvest Award, Agriculture and Agri-Food Canada
- Dr. Pierre J. Hucl, 2013

Honorable Doctor of Science, University of Saskatchewan
- Dr. Bryan L. Harvey, 2021

Honorary Life Membership, Alberta Seed Growers Association
- Dr. Bryan L. Harvey, 2005
- Dr. Brian G. Rossnagel, 2013

Honorary Life Membership, Canadian Seed Growers Association
- Dr. Herman M. Austenson, 1987
- Dr. Douglas R. Knott, 1987
- Dr. Alfred E. Slinkard, 1991
- Dr. Bryan L. Harvey, 1994
- Dr. Brian G. Rossnagel, 2000
- Dr. Gordon G. Rowland, 2003
- Professor Frederick A. (Rick) Holm, 2007
- Dr. Pierre J. Hucl, 2009

Honorary Life Membership, Canadian Seed Trade Association
- Dr. Kofi Agblor, 2020

Honorary Life Membership, Saskatchewan Pulse Crop Growers Association
- Dr. Alfred E. Slinkard, 1983

Honorary Life Membership, Saskatchewan Seed Growers Association
- Dr. Brian G. Rossnagel, 1991
- Dr. Bryan L. Harvey, 1992
- Dr. Gordon G. Rowland, 1999
- Professor Frederick A. (Rick) Holm, 2003
- Dr. Pierre J. Hucl, 2005
- Dr. Geoff R. Hughes, 2006
- Ms. Dorothy Murrell, 2007
- Mr. Dave Benallack, 2008

Innovation Award, Saskatchewan Forage Industry
- Dr. Bill Biligetu, 2018

Merit of Service Award, Canadian Weed Science Society
- Professor Frederick A. (Rick) Holm, 2010

Merit of Service Award, North American Pulse Improvement Association
- Dr. Kirstin E. Bett, 2019

Order of Canada, The Governor General of Canada
- Dr. Douglas R. Knott, 1999
- Dr. Bryan L. Harvey, 2007
- Dr. Alfred E. Slinkard, 2020

Outstanding Achievement Award, North American Pulse Improvement
- Dr. Thomas D. Warkentin, 2013

Outstanding Contributions to western Canadian winter wheat Industry, Alberta Winter Wheat Producers Commission
- Dr. D. Brian Fowler, 2011

Outstanding Research Award, Canadian Society of Agronomy
- Dr. Alfred Slinkard, 1985

Outstanding Service Award, American Oat Workers
- Dr. Brian G. Rossnagel, 2010

Outstanding Service Award, Canadian Seed Trade Association
- Dr. Bryan L. Harvey, 1997
- Dr. Alfred E. Slinkard, 1997

Plant Breeding and Genetics Award, Canadian Seed Trade Association
- Dr. Gordon G. Rowland, 2011
- Dr. Pierre J. Hucl, 2019

Presidential Award, Crop Science Society of America
- Dr. Bryan L. Harvey, 2007

Provost College Award for Outstanding Teaching, University of Saskatchewan
- Dr. H. Randy Kutcher, 2020

Pulse Legacy Award, Saskatchewan Pulse Growers
- Dr. Alfred E. Slinkard, 2013

Pulse Promoter of the Year Award, Saskatchewan Pulse Growers
- Dr. Alfred E. Slinkard, 1999
- Dr. Albert (Bert) Vandenberg, 2005
- Professor Frederick A. (Rick) Holm, 2007
- Dr. Thomas D. (Tom) Warkentin, 2014

Queen Elizabeth II Diamond Jubilee Medal
- Dr. Bryan L. Harvey, 2012

Queen Elizabeth II Golden Jubilee Medal
- Dr. Douglas R. Knott, 2002

SABEX Innovation Award, Greater Saskatoon Chamber of Commerce
- Dr. Pierre J. Hucl, 2014
- Dr. Curtis J. Pozniak, 2014

Saskatchewan Agricultural Hall of Fame
- Dr. Douglas R. Knott, 1995
- Dr. Herman M. Austenson, 1999
- Dr. Alfred E. Slinkard, 2000
- Dr. Bryan L. Harvey, 2006
- Dr. Brian G. Rossnagel. 2010
- Dr. Gordon G. Rowland, 2013
- Dr. D. Brian Fowler, 2018

Saskatchewan Centennial Medal, Government of Saskatchewan
- Dr. Bryan Harvey, 2005

Saskatchewan Order of Merit, Government of Canada
- Dr. Bryan L. Harvey, 2005
- Dr. Brian G. Rossnagel. 2012

Teaching Award of Merit, North American Colleges and Teachers of Agriculture (NACTA)
- Dr. H. Randy Kutcher, 2020

GRADUATES

1971-2021

MSc

KUMAR, Jagdish
SARWAR, Ghulam
REYNOLDS, John Robert
LIMIN, A.E
MELLISH, Dwane Robert
WRIGHT, Alexander Timothy
DRIBNENKI, P.C.
LEGGE, W.G.
MUGALA, Martin Siganda Chitente
TYLER, N.J.
BERNARD, C.M.
HINDAGALA, C.B.
PANCHUK, K.M.
YE, J.M.
MORRISON, Malcolm
MUDEREWICH, R.P.
ARIYARATNE, H.P.
BRANDLE, James Edward
VAILLANCOURT, Rene
YADAV, Bakheru
YAMAMOTO, Sharon
GEHL, David T.
KNOX, Ronald E.
OFORI, I.
REANEY, M.J.T.
WEERASENA, Liyana
YANG, Rong-Cai
GILLILAND, David J.
WELLER, Janet A.
AIDUN, Vahid L.
BLADE, Stanford F.
KING, William
SARIAH, Mellanie
HONG, Ma
JOHNSTON, Adrian
McGregor, Linda. J.
GROSS, Kenneth John
MUGALA Mary Vyapenye
PEDERSON, Eric
SONNTAG, Calvin
TAY, Juan
HULTGREN, Gordon
ZHANG, Hongtao
COLLINS, Brent
DIETZ, Leslie Walter
GLATT, Kathleen
MUNOZ, Alejandro Matus
CHOWDHURY, Mahboob
CHURCHILL, Grant
FERRIE, James R.
LIU, Jianxin
MORDEN, Lillie
BHATTACHARJEE, Arindam
CLARKE, Fran R.
NTIAMOAH, Charles
ZYLA, Lloyd
ANDRAHENNADI, Chandra
DOUGLAS, Dale Wilson
HUEL, Denis
NAIR, Harikumar
MASSIE, Garth
TAVAKKOL AFSHARI, Reza
AZAM PARSA, Mohammad Reza
BLOMQUIST, Leslie Kirk
MATUS, Maria Alejandra
RECKSIEDLER, Blaine
DEMMON, Goewin R.
BALASUBRAMANIAN, Parthiba
de SILVA, N.K. Devini
DUNFIELD, Kari E.
MAKBUL, Kisman
MUNASINGHE, Gnanaseeli
WANG, Ting-Fu
WIJAYANTO, Teguh
GREUEL, William
VAKULABHARANAM, Venkata
ZATORSKI, Tom
HANSON, Keith
MAU, Yosep
MOONEY, Brent A. G.
HORN, Dale
JOHNSON, Eric
SINGH, Asheesh Kumar
DYCK, James A.
GRADIN, Barbara Leanne
MITTAPALLI, Omprakash
RUAN, YueFeng
WALLACE, Trevor
FENG, Jie (Jerry)
SCHREIBER, Karl
TRISCHUK, Russell
CHANT, Shannon
GRAHAM, Gavin
HANLAN, Tyler Graham
ZHANG, Chunzhen
JUNK, Donna
VAIL, Sally L.
FIALA, Jane V.
HOFFMAN, Travis
KUCHURAN, Mark
MWAKUTUYA, Edmore
BURTON, Alison
CHADIRASEKARAN, Rajamohan
DAVEY, Blaine
DENESIK, Tyrel
GEISEL, Bryce G.L.
KUMAR, Pramod
BANDLA, Narashima Rao
BRUCE, Jesse
CAMM, Giselle A.
REIMER, Sherisse O.
CHATFIELD, Paula
WANG, Jinghe
DHANDA, Rohit K.
MARTINEZ ROJO, Jocepascual
MATLOCK, Erin
RAMACHANDRAN, Adithya
ELSADR, Hanny
WIEBE, Krystalee D.
ANDERSON, Jay F.
DELGERJAV, Oyuntamir (Tamira)
LIN, Yang
LIU, Yong
PODDER, Rajib
CHEN, Ting
FEDORUK, Michael
LIU, Yining
LOKURUGE, Prabhath
MALO, Lisa
NILSEN, Kirby
THOMPSON, Courtney
WONG, Gabriel
ZHANG, Tao
JEFFERIES, Laura
LIU, Xiaofei (Sophie)
BRAR, Gurcharn
LIN, Xue (Snow)
LINDENBACK, Kayla
SUN, Jia
WARALE, Rushikesh
BANGAR, Parminderjit
CAUDILLO RUTZ, Kiela
EDIRISINGHE,Priyangi
GRIFFITH, Lindsay
KUNDU, Shudhangshu
MCLEAN, Dustin
MEIER, Kendra
SOOMRO, Wali
THOMAS, Tina
ANTON, Travis
BHATTARAI, Surendra
CHOLONGO MARTINEZ, Paulina
FIELD, Jennara
PENG, Xinhui
SIVACHANDRAKUMAR, Nimllash
BAMRAH, Ramandeep
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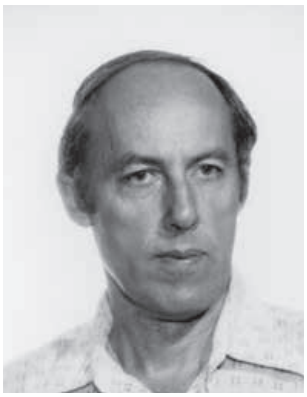
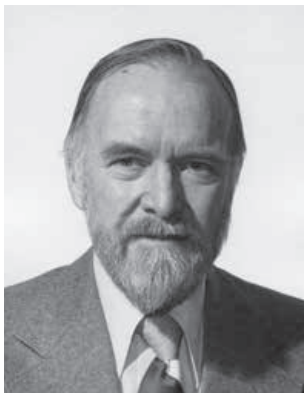


1971-1974
Dr. Graham Simpson (PhD)
First Director of the CDC



1975-1983
Dr. Herman Austenson (PhD)
Head of the Department of Plant Sciences and Director of the CDC

1983-1994
Dr. Bryan Harvey (PhD)
Head of the Department of Plant Sciences and Director of the CDC

1995-1999
Dr. Gordon Rowland (PhD)
Director of the CDC

1999-2006
Rick Holm
Director of the CDC

2007-2011
Dorothy Murrell
Managing Director of the CDC

2012-2019
Dr. Kofi Agblor (PhD)
Managing Director of the CDC

2019
Dr. Pierre Hucl (PhD)
Interim Managing Director of the CDC

2020-present
Dr. Curtis Pozniak (PhD)
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