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Spotlight on AWC-funded

Research

Alberta Wheat COMMISSION

DR. LAUREN COMIN
ALBERTA WHEAT AND BARLEY COMMISSION

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Stories written by Geoff Geddes | The Word Warrior
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A message from the director of research

Research is Alberta Wheat Commission's largest investment for a reason. Development of new, improved wheat genetics and best management practices will be key to helping producers adapt to changing environments, government policies and both domestic and international market demands, all while maximizing their profit.

This edition of the Spotlight on Research is all about finding new solutions to "pesty" production challenges. The development of herbicide resistance in weed populations has been a growing issue across the world. Luckily, there are two new projects that provide farmers with support for this issue. There is a new group on the block looking to take action on resistant wild oats. Meanwhile, a project will begin which seeks to develop a decision support tool to help farmers make herbicide decisions to manage herbicide resistance and prevent future instances. To continue the theme of prevention of pest issues, a new program at the University of British Columbia will start work to attempt to stay ahead of evolving cereal pathogens through genetics. Instead of keeping bad things out of the field, we pivot to keeping good things in. A team from Lethbridge is continuing their work to determine the value of beneficial insects and determine how aware farmers are of these tiny helpers. Finally, grain that isn't dry at harvest is certainly considered a pest by many and a new research program is working on optimizing grain drying for quality and efficiency.

For more information on research projects and extension opportunities, visit **albertawheatbarley.com**.

DR. BREANNE TIDEMANN

Tools to use when it's time to choose

Growers face daunting dilemmas in the course of their day: green or red combine; water or wait; Coke or Pepsi. Some of the most impactful decisions relate to managing herbicide resistant weeds as the choices made in this area can greatly affect production and profitability. Many farmers would welcome assistance in making those critical choices, and, luckily, help is on the way with the project "Developing decision support tools for effective herbicide use in the face of herbicide resistance."

"Herbicide resistant weeds continue to make weed management more challenging in Western Canada," said Dr. Breanne Tidemann, research scientist, Science and Technology Branch, Agriculture and Agri-Food Canada (AAFC).

MULTIPLE CHOICES

A key strategy in both managing and delaying the evolution of herbicide resistant weeds is the use of multiple effective modes of action (MEMOA) during herbicide applications. While this is a simple concept in theory, there are many complicating factors that make determination of whether MEMOA are being used on different weed species more difficult.

To aid in sorting out these factors, the project is working on two separate tools for producers.

"The first tool came about from a presentation I gave at an Agronomy Update in 2020," said Tidemann. "I was talking about using MEMOA for management of wheat.

Research made possible through collaborative industry funding: SaskWheat Development Commission RDAR Results Driven Agriculture Research

Sometimes marketing can be misleading; just because you have multiple modes of action in a product, it doesn't mean that the modes of action are all effective on your target weed species. Also, there are factors that growers might not consider in terms of rates and resistance profiles to determine if they have two effective products in their tank mix."

Tidemann then had an exchange with someone from the audience:

"Is there a tool available for producers to help them with these issues?"
"No."
"Why not?"
"I don't know."

Apart from being refreshingly honest, Tidemann's response got her pondering how this could be done and the project sprouted from there.

CALCULATED RISK

Shortly afterwards, she attended a Weed Science Society of America joint meeting with the Western Society of Weed Science. At the meeting, she learned about a calculator being developed by the University of Wyoming for Nebraska and Wyoming farmers that allowed them to input their four year rotation, the weed they were concerned about and the herbicide to be applied in each crop rotation. In return, the tool would provide them with a herbicide resistance risk calculation, so that if they were putting a lot of selection pressure on a particular herbicide product or group, they could look at revamping their approach.

While the herbicide resistance risk calculator has been developed for Wyoming and Nebraska, there is no equivalent tool available for western Canadian producers. In addition, there are no accessible tools to help simplify the use of MEMOA for those producers, a strategy that can be easily confused by marketing.

"Based on my experiences at the two meetings, this project aims to develop decision support tools to aid producers in determining what products would constitute MEMOA for target weeds in their field. A second tool will also be created to help identify the potential risk of herbicide resistance evolving based on a four year crop rotation and the resulting herbicide choices."

FILLING AN APP GAP

The tool will take the form of an app, likely web browser based, in which producers are able to select a weed, known resistance, a four year rotation of crops and the herbicides they will use in each of those crop rotation phases. Based on this input, the app will provide information on herbicide cost, herbicide efficacy and herbicide resistance risk.

Just as the approach to the project is multi-pronged, so too should be the results.

"I am hoping we will see more implementation of MEMOA and more consideration of the long-term implications of herbicides being applied within a system or rotation. We want to lower selection pressure for additional herbicide resistance cases and keep our herbicides a viable tool for as long as we can. While science is always looking for other weed management methods that don't rely on herbicides, these chemicals are easy, effective and relatively economical in comparison to some other solutions. Given that we are having trouble moving people away from herbicides, we can at least ensure that they are using them in the best way possible. If we can slow some of our resistance evolution issues at the same time, that's even better."

Though it is hardly her first foray into research, this project stands out for Tidemann.

"This is the first time I have participated in a project that is not strictly research based, as we know that multiple modes of action are an effective approach. It is a chance to dip my toe into trying to really transfer that research to growers in a format and tool they can easily use and apply on their farm. I have talked about integrated weed management for five years now, and Neil [Dr. Neil Harker] discussed it for 30 years before that. We talk about these things, but they are not always easy to do, so it's great to be helping farmers put them to use and hopefully have a real impact on their operation."

DR. BREANNE TIDEMANN

Dr. Tidemann is a research scientist with Agriculture and Agri-Food Canada (AAFC) in Lacombe. She completed all of her degrees at the University of Alberta, and holds a B.Sc. in Biological Sciences, and an M.Sc. and a Ph.D. in Plant Sciences, with projects focused on weed science and weed management. Tidemann started with AAFC in 2016 as a weed scientist/field agronomist. Her research program in Lacombe focuses on management of herbicide resistant weeds, integrated weed management strategies, weed biology and harvest weed seed control.

Did you know?

- *It's currently estimated that 59 per cent of field area in the Prairies is affected by herbicide resistant weeds, with a perceived cost of weed resistance to growers of $33 per hectare.*
- *Using multiple effective modes of action in a herbicide mixture is a frequently recommended best management practice for management and prevention of herbicide resistant weeds.*
- *Using multiple effective modes of action is not easy. To achieve the best results you need to understand which active ingredients are effective on which weed species, resistance profiles of the weed and rate structures of active ingredients.*

Inefficient drying can lead to grain spoilage, quality degradation and excessive energy consumption, resulting in increased drying cost and high shrink due to over-drying."

DR. CHANDRA SINGH

Dry it so they'll buy it

A "dry" topic may be dull or boring, but proper grain drying has exciting potential when it comes to storing, saving and selling your crop. Of course, the key word is "proper", as the right approach can make all the difference to your balance sheet.

With that as their starting point, researchers embarked on the project "Developing on-farm grain drying strategies for optimum quality and energy efficiency". This three-year study is led by Dr. Chandra Singh, Applied Research Chair - Agricultural Engineering and Technology at Lethbridge College. It is jointly funded by Alberta Wheat Commission (AWC), Results Driven Agriculture Research (RDAR), Alberta Innovates (AI) and Saskatchewan Wheat Development Commission (SWDC).

"With crop market receipts of $6.9 billion, Alberta produced nearly 31 per cent of Canadian wheat, 29 per cent of canola, 48 per cent of barley, and 20 per cent of oats in 2018," said Singh. "Yet despite such strong crop numbers, Alberta grain producers have suffered significant production and economic losses due to adverse weather conditions during recent harvests. For 2019, the estimated total value of unharvested acres was $778 million."

SOME CHALLENGES IN STORE

Those farmers who managed to get their crops harvested in 2019 experienced storage challenges due to higher grain moisture, and producers selling grains above maximum allowable moisture limits (above straight grade moisture) are discounted by grain elevators. Consequently, the harvested crops needed to be dried to minimize spoilage and avoid discount. Farmers with drying capacity can start harvesting the crop as soon as it reaches physiological maturity, allowing for an extended harvest season that also mitigates the risks of adverse harvest conditions.

"Inefficient drying can lead to grain spoilage, quality degradation and excessive energy consumption, resulting in increased drying cost and high shrink due to over-drying," said Singh. "Therefore, growers should be provided with tools to make informed decisions and select appropriate drying strategies."

When he joined Lethbridge College, Singh found there was no critical data or studies that he could reference for his work on grain drying. Though he didn't find major grain moisture issues in the Lethbridge area, he knew that some growers further north in Alberta had problems with grain drying and delayed harvests.

"We felt that growers needed one reliable science-based source of information where they could get most of their answers around grain drying and specific recommendations based on their location in the province."

To that end, this project will investigate in-bin natural air drying (with optional low temperature heat), high temperature drying and combination drying (using high temperature drying followed by in-bin natural air drying). Based on their findings, researchers plan to develop wheat storage and handling guidelines for Alberta climatic conditions. These guidelines will also be useful in postharvest preservation of other major cereal grains, oil seeds and pulses in Alberta and Western Canada.

Research made possible through collaborative industry funding: SaskWheat Development Commission, RDAR Results Driven Agriculture Research, Alberta Innovates

SUCCESS IS IN THE AIR

"The success of drying depends on several critical factors such as aeration system design and airflow rate, grain type, initial and target moisture content, grain drying start date, ambient air conditions with drying potential (temperature above 5ºC), and geographic location. These parameters will be investigated and optimized for drying."

At present, scientists are just starting their project planning for the coming growing season. On-farm grain drying trials will be conducted in the South, Central, North East, North West, and Peace regions of Alberta to incorporate regional variability in postharvest climatic conditions and develop region based grain storage and handling guidelines. To facilitate this work, Lethbridge College is looking for participation from growers with on-farm grain drying and storage capacity (20,000-50,000 bushel bins are preferred) for in-bin natural air drying, in-bin drying with heater, and high temperature drying. The goal is to engage growers from the outset to understand what they do and where there are information gaps that can be filled to improve their results.

DRIED OR DISCOUNTED

"One of those improvements relates to energy efficiency. We want to demonstrate to growers how they can make their drying operation more efficient and technology driven: 'If you do things a bit differently, this will be your savings in terms of drying cost'. We also want to compare different approaches to grain drying, as farms have a variety of infrastructure capacities. They can look at the outcomes of this study and say, 'based on my capacity, this is the best approach for how I can harvest earlier and manage my crop to maximize energy savings and quality, while minimizing spoilage'."

Another benefit of effective drying and storing is that it keeps growers from being market dependent. In bumper crop years, elevators delay or refuse grain deliveries as railway companies struggle to ship huge grain volumes. This creates a major logistical issue for the grain supply chain, so storing on farm makes more sense. If farmers can't dry and store properly, they are compelled to take their crop to the elevator immediately, meaning they may miss out on premium prices while being discounted for the cost of drying.

"If you see there is a risk to your crop, you might be forced to sell it too soon, but if you can safely store the grain for a longer period, you may getter a better price as a result. I was talking to a farmer in Northern Alberta recently who just sold his canola, only to see the price rise $20 per bushel."

Depending on your perspective, you might call research on grain drying interesting, vital, valuable or informative; just don't call it boring.

CHANDRA SINGH

Dr. Singh, a professional engineer registered in Alberta, completed his undergraduate degree in Agricultural Engineering from the G.B. Pant University of Agriculture and Technology, and his Masters in Postharvest Engineering from the Indian Institute of Technology (IIT), both in India. He then moved to Canada and obtained his Ph.D. in Biosystems Engineering from the University of Manitoba.

His doctoral research was focused on detection of insect and fungal damage and incidence of sprouting in stored wheat using near-infrared (NIR) hyperspectral and digital colour imaging. He conducted postdoctoral research at the Canadian Wheat Board Centre for Grain Storage Research in Winnipeg. As part of this research, Singh used synchrotron sourced infrared imaging to detect damage in wheat and canola caused by molds.

Prior to assuming the role of applied research chair at Lethbridge College, Singh was an associate professor at the University of South Australia. He worked in the industry for nearly five years as a grain management expert and principal engineer with an international grain management technology company based in Calgary.

Did you know?

- *Hundreds of millions of tonnes of wheat, corn, soybean, rice and other grains such as sorghum, sunflower seeds, rapeseed/canola, barley and oats are dried in grain dryers.*
- *The more oil the grain has, the lower its storage moisture content will be.*
- *Though drying is a requisite for safe storage to inhibit microbial growth, low temperatures in storage are also highly recommended to avoid degradative reactions and, especially, the growth of insects and mites.*

Armed with this data, science can better target farmer outreach activities to increase the use of beneficial insects to manage common field crop pests where feasible."

DR. EMMA STEPHENS

Badly needed knowledge of **good insects**

At a first glance, "beneficial insects" seem akin to "stress-free farming"; a contradiction in terms. In fact, some insects do play a major role in controlling crop pests and minimizing their impact on growers. However, to realize their benefits farmers must be aware of what they are and what they do. To get a sense of current understanding around these interesting insects, researchers established the project "Quantifying farmer awareness and knowledge of beneficial insects in Alberta crop fields."

"Insect pests remain a major challenge in Canadian prairie crop production," said Dr. Emma Stephens, research scientist and bio-economist with Agriculture and Agri-Food Canada (AAFC) at the Lethbridge Research and Development Centre. "Every crop field is an ecosystem with pest, neutral, and beneficial insects. Beneficial insects provide economic value through consuming large numbers of crop pests."

The seeds for this project were first sown in July 2019 when Stephens joined AAFC in Lethbridge as a bio-economist. She began working with scientists at the center on socio-economic questions around their research projects. One of those scientists was Dr. Haley Catton, a specialist in cereal crop entomology.

TWO BRIGHT HEADS ARE BETTER THAN ONE

"Dr. Catton does a lot of work on beneficial insects, how they operate in the field and whether farmers consider them in their insect management decision making. Given that focus, and my work with farmer survey data regarding on-farm practices, we decided to collaborate and help fill a void for growers."

Overall, researchers suspect that producers are currently more aware of pests than of beneficial insects. Reported farmer use of any kind of biopesticide in Alberta, including beneficial insects, is less than one per cent. Scientists believe this is due to a combination of lack of information for producers about beneficial insects, and the perceived low economic and risk management value of these insects compared to insecticides. Unfortunately, it is not possible at present to examine these factors in more detail, as in-depth data about farmer awareness of beneficial insects simply does not exist.

"Our project can help address some of these issues by creating a detailed baseline assessment of farmer knowledge of beneficial insects, as well as their preferred insect pest management practices. The survey will also capture other important correlates of pest management decisions such as access to information, pest costs and risks."

Armed with this data, science can better target farmer outreach activities to increase the use of beneficial insects to manage common field crop pests where feasible. It will do so by cataloging producer information levels and identifying possible reasons for differing levels of knowledge and awareness of the value of beneficial insects across producers.

ENEMIES AND ALLIES

"Our concern is that current pest management practices, including the application of insecticides, do not distinguish between pests and beneficial insects. Part of our research is trying to optimize spray timing in a way that still responds to the pest management needs of growers. When might it be okay to allow beneficial insects to do the same job as insecticides, without having to pay for, and apply, chemicals to your field?"

As well, farmers cannot make use of beneficial insects if they don't know which ones they have in their field. Lady beetles (the scientifically correct common name for the ladybug), for example, are considered "stone cold killers of pests", as they eat a variety of insects that might

harm your crops, whereas other beneficial insects pair best with a specific pest threat.

"If you can back off on your spraying when you know you have a sufficient population of the 'twin' to your pest of concern, apart from saving money, you can also minimize the environmental impact of chemical applications you don't need."

Although a grower's own field is obviously their primary concern, researchers hope they will think more broadly as well since habitats for beneficial insects spread across farms and must be preserved for the benefit of all.

ADVICE YOU CAN BANK ON

While Catton examines the ecology of beneficial insects and Stephens works on the economic angle, they are trying to home in on a critical aspect for growers in a tight margin business: "Show me the money".

"We want to calculate just how much could be saved in terms of input costs by identifying the beneficial insects on your farm and taking better advantage of them," said Stephens. "Our hope is that this will lead to more analysis of how farmers can benefit economically when they have the proper information on these insects."

For many farmers, beneficial insects are still a hidden resource or a tool that can greatly enhance their bottom line if used correctly and to maximum advantage.

"A lot of farmers don't take beneficial insects into account or have a concept of how best to use them. What are the appropriate thresholds? How fast do these insects eat? If you see one in your field, does that indicate the presence of many more or just a small group that won't adequately address your pest problem?"

Moving into uncharted territory and closing a knowledge gap for both producers and scientists is a large part of the project's appeal for Stephens.

"Right now, growers are operating with incomplete information on what they are doing in terms of pest management. I like finding a way to share previously untapped resources with them, and there doesn't seem to be any other means of gathering this knowledge through existing data."

At the same time, polling producers is a two-way street. While growers can benefit from the project results, potential benefits also flow back to the ones sending out the surveys.

"The responses through this project can help us on the science side as well. Farmer reports on what they see in the field can add to our understanding of insect ecology in Alberta as we can't scout every field every day, and beneficial insects are too small to be detected by satellites."

Clearly, the concept of beneficial insects is not an oxymoron, but a resource whose time has come. As for stress-free farming, that's still a work in progress.

DR. EMMA STEPHENS

Dr. Stephens is a bio-economist working out of Agriculture and Agri-Food Canada's (AAFC) Lethbridge Research and Development Centre. She obtained her Ph.D. in economics from Cornell University in 2007. In addition to capturing baseline information about current levels of farmer awareness of beneficial insects, she is also collaborating with scientists across AAFC on several projects. These include estimating economic barriers and incentives to using cover crops, examining synergies in carbon capture and water saving practices in fruit orchards, and surveying farmers about barriers to accessing livestock feed testing services and modeling linkages between agricultural production and food security outcomes in Canada.

Prior to joining AAFC, she held a tenured position as Professor of Economics at Pitzer College in Southern California.

Did you know?

- *Some beneficial insects are only a couple of millimeters long. It is very easy for the untrained eye to miss them.*
- *The wheat midge parasitoid Macroglenes penetrans was calculated to save $248.3 million in insecticide costs in Saskatchewan in the 1990s by reducing the pests to below thresholds. This parasitoid also controls an average of 31.5 per cent of the wheat midge across Saskatchewan.*
- *Beneficial insects can also be helpful for backyard growers. Lady beetles aid gardeners by eating the unwanted pests that gnaw on plants. Female lady beetles can eat up to 75 aphids in one day.*

Wild oats are related to the cultivated oat and are most commonly found as a weed of other cereal plants."

ERIC JOHNSON

Teaming up to clamp down on wild oats

When your name includes "wild", it's likely you need to be tamed, and that's clearly the case with resistant wild oats. Field surveys on the Canadian Prairies have reported that 69 per cent of fields contain wild oats with some level of herbicide resistance.

Wild oats are related to the cultivated oat and are most commonly found as a weed of other cereal plants. In response to a public request, the Canadian Weed Science Society recently formed a Resistant Wild Oat Action Committee (RWOAC). The committee consists of 12 members representing a cross-section of the agricultural industry, including producers, research scientists, government, the agrichemical industry and retail agronomists.

"We first started dealing with wild oat resistance in the 1990s, and surveys have shown that the level of resistance in farmers' fields has climbed steadily over the years," said Eric Johnson, chair of the RWOAC. He is also a research officer in the Department of Plant Sciences, College of Agriculture and Bioresources at the University of Saskatchewan.

Today, costs associated with resistant wild oats are extremely high in terms of weed competition if they can't be controlled, and additional expenses are incurred for multiple applications of different herbicides.

"The financial impact on growers can be huge, so the goal of this project is to create producer engagement and community discussion around the growing issue of resistant wild oats," said Johnson.

THE ROOTS OF RESISTANCE

This effort traces back to another committee formed in the 1970s that conducted research on wild oat biology and ecology. As time went on, a number of effective wild oat herbicides were introduced and the committee began winding down in anticipation of unlimited access to these herbicides for growers. When that did not occur, talk began on reinventing the committee to deal with reemerging resistance issues.

"In 2018, a request came from Ken Eshpeter, a producer from Daysland, Alberta, and Dr. Neil Harker, a retired weed scientist, to the Canadian Weed Science Society. They proposed the formation of a Herbicide Resistance Task Force or Wild Oat Action Committee to engage scientists, producers and the agriculture industry. The overarching goal was to advance the technology and management available to producers to address herbicide resistant weeds on their farms."

In response to that proposal, a group of farmers met in early 2019, and, by November of that year, the Canadian Weed Science Society endorsed the creation of the RWOAC.

"From there, we formed an ad hoc committee of 13, representing cross sections of the agriculture industry in the Prairies, with members coming from Alberta, Saskatchewan and Manitoba."

Armed with a two-year funding commitment from members of the Alberta Funding Consortium, including the Alberta Wheat Commission, the committee began work on one of its main goals: engaging farmers to devise methods for managing resistant wild oats.

"A lot of our focus is on farmers interacting with other farmers, researchers, industry partners and extension people in forging solutions. With that in mind, we will establish and support a pilot community-based group in central Alberta."

Community based approaches to managing herbicide resistance can be effective, as demonstrated by the Harrison County Pest Resistance Management Project in Iowa (**www.ipm.iastate.edu/harrison-county-pest-resistance-management-project-overview**). As well, producer involvement in the Australian WeedSmart initiative led to Australian farmers being recognized

Research made possible through collaborative industry funding: Sask Wheat Development Commission, Manitoba Crop Alliance, SFSDC

globally in the fight against herbicide resistant rye grass. In the process, they created the renowned Harrington Seed Destructor, which mechanically destroys weed seeds in the chaff to help control weed populations.

Until now, programs like WeedSmart and community-based approaches to managing herbicide resistance have been lacking in Western Canada, but Johnson and his colleagues hope to change all that.

LET'S BE PRACTICAL

"It's important that our efforts produce practical, on-farm solutions, as research is only valuable if it's adopted and applied. While some of our efforts might involve researchers communicating with growers, we really want to create a two-way dialogue and share ideas. Somebody might be having success with fall-seeded crops, and another doing well with silaging. Our role is to provide a vehicle for the exchange of information."

Though the pandemic is limiting interaction these days, the committee is receiving good feedback thus far from its community group, where members are well aware of the resistance problem and keen to address it.

"We have certainly received a lot more press on this than we expected, and we're just getting started. The committee has also established a social media presence on Twitter and developed some infographics which have gone over very well."

The committee recently hired a project manager and will be going in a few directions this year, though focusing largely on central Alberta and tillage ideas to stimulate wild oat seed production, or where needed, reduce emergence.

"We have some applied research and demonstration projects lined up based on things that farmers have expressed an interest in and will conduct some field tours if COVID-19 restrictions allow it."

THE SURVEY SAYS...

They are also developing a survey to gain a better understanding of growers' knowledge and understanding of wild oat resistance and the issues they currently face. In addition, committee members plan to collect wild oat seeds from ten different farms and test them for resistance to all herbicide families where resistance concerns exist, beginning with groups 1 and 2.

While the initial activities are slated for Alberta, there is hope that the committee can expand its scope to Saskatchewan and Manitoba down the road. It would be a natural progression, as growers in all three provinces are feeling the effects of wild oat resistance on their pocketbooks.

"Grain producers are experiencing increased costs related to wild oat populations that are resistant to herbicide action. The cost of resistant weeds was estimated at $17 per acre in 2017 to Alberta producers, $11 per acre in 2016 to Manitoba producers, and $12 per acre in 2014-2015 for growers in Saskatchewan."

If this average cost is extrapolated to the field area affected by weed resistance, the total cost is estimated at $196 million annually in Alberta (2017), $74 million annually in Manitoba (2016) and $258 million annually in Saskatchewan (2014-2015).

The stakes are high, but the RWOAC is committed to working with the global research and extension community and Canadian producers to find new methodologies for controlling resistant wild oats and reducing losses associated with the herbicide resistance challenge.

"This is a work in progress, and it's a bit like a research project in that you don't know how it will turn out or the impact it will have. Hopefully, though, this is just the beginning of a much larger initiative that will make a real difference to growers and industry."

ERIC JOHNSON

Eric Johnson is a research officer for the Agronomy and Crop Imaging Laboratory in the Department of Plant Sciences at the University of Saskatchewan. He has over 38 years of research and extension experience. Johnson began his extension career with Saskatchewan Agriculture before moving into his research career as a Weed Biologist and Officer-In-Charge with Agriculture and Agri-Food Canada at the Scott Research Farm. Johnson was also the site manager for the Pesticide Minor Use Program at Scott. He joined the University of Saskatchewan in 2015.

Did you know?

- *Wild oat resistance to herbicides has been identified in nearly 70 per cent of fields surveyed in the Canadian Prairies. Group 1 resistance is most common; however, the incidence of Group 2 and multiple herbicide (resistance to both Group 1 and 2) resistance is also increasing.*
- *The Resistant Wild Oat Action Committee is an ad-hoc committee of 13 members representing a cross-section of the agricultural industry. Its mission is to develop herbicide resistant wild oat management solutions through producer engagement, knowledge transfer and research.*
- *A two-year project funded by the Alberta Funding Consortium will support the formation of a community-based organization in central Alberta that will focus on forging solutions for resistant wild oat.*

DR. GURCHARN BRAR

The science of **saving cereals**

While the "cereal killer" pun has been done to death, research on cereal pathogens is alive and well. That is good news for growers, as these pathogens can be devastating to their crops and finances. To counter those effects using cutting-edge technology, scientists launched the project "Staying ahead of ever evolving cereal pathogens: management by early detection and genetic host resistance".

"In human and plant disease epidemics, one of the most important management steps is timely and accurate detection of the associated pathogens," said Dr. Gurcharn Singh Brar, assistant professor, Plant Science, Faculty of Land and Food Systems at the University of British Columbia. "Among wheat pathogens, rusts quickly spread long distances on air currents and stripe rust, in particular, is an increasing concern in Canada."

Additionally, rusts have the ability to rapidly mutate and gain virulence over varietal resistance in a short time. Leaf spotting pathogens, most importantly tan spot of wheat and net blotch of barley, can also cause significant yield loss in disease favorable years. To date, cereal pathologists have relied on traditional methods of pathogen detection and characterization that include eyeball assessments, collection of field samples, and greenhouse and laboratory tests.

Unfortunately, these approaches are time-consuming and slow, so by the time a race is identified, typically during the winter season, new ones may appear the following season. As well, these methods require the skills to identify and assess the disease.

The process of addressing those barriers began where successful science often starts: with other scientists.

GREAT GAINS IN GREAT BRITAIN

"In the U.K., they developed a technique called 'field-pathogenomics' for wheat stripe rust, where they can quickly identify pathogen strains or lineages. The process normally takes one-to-three years, but with their system, they collect the samples directly from the field, bring them to the lab and sequence them, all in about six months. We replicated that method in Canada last year as part of a pilot experiment, and in the meantime, that same group from the U.K. published another approach (named MARPLE) that was even faster."

The new method can identify pathogen lineages within days or even hours, so Brar decided to adopt the approach in Canada and expand it from wheat stripe rust to include wheat tan spot and barley net blotch. The sequencers are smaller than a smart-phone, portable, and only require a powerful laptop to operate, making this approach highly feasible.

"Our project is focused on management of leaf diseases by two means: early, rapid detection and characterization, typically within two-to-three days, using modern sequencing technology, and identification of new resistance sources against newly emerging races from diverse germplasm. That germplasm will then be made available to breeders for resistance breeding."

Using data from the Plant Gene Resources of Canada (PGRC) gene bank, researchers plan to thoroughly characterize the genetic population structures of the predominant pathogens. They will also have the capacity to characterize any pathogen that might be more important in a given crop year in a given region.

SUMMER SESSION

Though this project officially began March 1, 2021, the real excitement comes in July when the surveys and sampling get underway. Graduate and summer students

Research made possible through collaborative industry funding: SaskWheat Development Commission SaskBarley Development Commission

will conduct surveys for wheat and barley diseases across Alberta, Saskatchewan and parts of B.C. and Manitoba, aiming to cover all major wheat and barley growing regions of the Prairies. The goal will be to study 100-120 samples per pathogen per crop over the course of the project. As multiple pathogen races or genotypes can infect the same leaf in commercial crops, they will target isolated single lesions/spots on the leaves for sequencing.

As is the case in so many areas of life, technological advances play a major role in ensuring success with the study.

"The greatest advantage we have is that over the last 10 years or so, there has been a revolution in sequencing technologies; however, not all of these technologies are being applied in the context of plant or crop pathology in Western Canada. Eventually, we hope to extend these portable sequencing platforms for use directly in the field, where DNA or RNA would be extracted from a sample right on the spot and sequenced. This approach would provide the pathogen's lineage in four-to-five hours."

By studying the pathogens in this way, scientists can guide future research on resistance breeding or varietal development and support the efforts of breeders going forward.

"We will be able to tell breeders that 'this is what we know about the pathogen, and this is how it is changing'. As they work to develop a variety over the next 10 years, this knowledge will help them strengthen the immune system of wheat and barley in the long-run."

LET THE BATTLE BEGIN

In many ways, pathogen research is like going to war, so it's best to be well armed if you hope to defeat the enemy.

"These pathogens are very smart, and sometimes I think they are even smarter than humans. This project will give us the tools to combat the pathogens as we track the speed of their evolution and how they change over time. If there is a new strain emerging in a given year, we want to detect it in the same year or even month and observe how it gives rise to other strains. 20 years ago, pathologists didn't have access to these tools, so we need to take advantage of the weapons we possess."

DR. GURCHARN BRAR

Dr. Brar grew up in northwestern India in the state of Punjab, often known as the bread-basket of India, where he came across stripe rust for the first time in his own family farm. After finishing his Bachelor of Science in Agriculture (honors in Crop Protection) from the renowned Punjab Agricultural University (India), he relocated to the University of Saskatchewan in fall 2012 for his grad school years.

He was trained by Drs. Randy Kutcher, Pierre Hucl and Curtis Pozniak in wheat breeding, genetics and pathology, and their successful mentorship helped him earn a tenure-track faculty position at The University of British Columbia (UBC) in Vancouver following his Ph.D. in 2019. Brar won several national and international awards and scholarships for his outstanding grad school research on stripe rust and Fusarium head blight (FHB) in wheat.

Brar's research interests encompass pre-breeding wheat and barley for disease resistance (mainly rusts and FHB), abiotic stress tolerance, and other traits of economic importance. He is currently running a 'Crop Genetics and Pathology' lab at UBC. With his lab, he has the capacity to do both field and lab research while benefitting from his ongoing national and international collaborations in Canada, U.S., UK, Australia, and Mexico.

Did you know?

- *There is a phase in a plant pathogen's disease cycle called "latent infection", when infection is not visible for a number of days.*
- *Modern sequencers are capable of detecting latent infection.*
- *Stripe rust pathogen has nearly 15,000 genes and wheat has approximately 100,000 genes.*
- *Red smudge on durum wheat kernels is a result of tan spot pathogen infection.*
- *Six-row barley is usually more resistant to net blotch than two-row barley.*

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