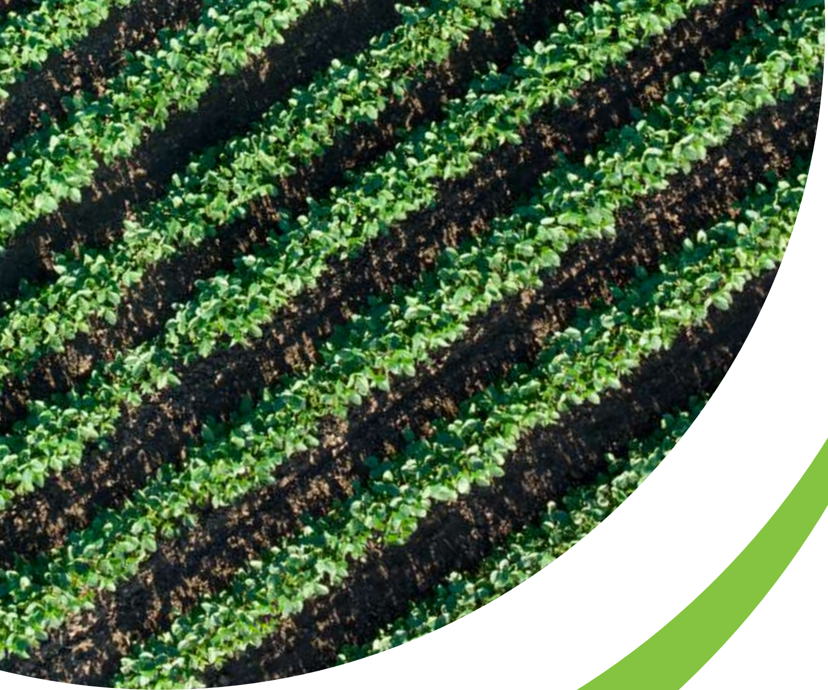
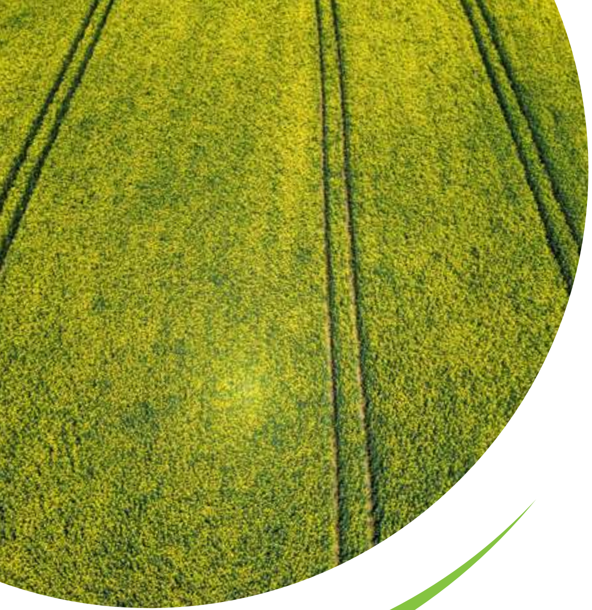


Integrated Crop Agronomy Cluster

SUMMARY

2018-2023

WGRF



A whole-farm approach to agronomic research

Canadian farmers face agronomic challenges that cut across multiple crops. The Integrated Crop Agronomy Cluster addresses gaps in multi-crop and systems approaches to agronomic research.

$9M invested from 2018-2023

$6.3M from Agriculture and Agri-Food Canada, under the Canadian Agricultural Partnership

$1.6M from Western Grains Research Foundation

$1.1M from industry partners

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Research Success Stories

Collaborating research organizations include:

Agriculture and Agri-Food Canada (AAFC), Alberta Agriculture and Forestry, Agri-Metrix, Brandon University, Farming Smarter, InnoTech Alberta, Prairie Agricultural Machinery Institute (PAMI), Smoky Applied Research and Demonstration Association (SARDA), University of Alberta, University of Manitoba, University of Saskatchewan, and Western Applied Research Corporation (WARC).

Integrated Crop
Agronomy Cluster Summary

The Integrated Crop Agronomy Cluster (ICAC) represents a first in agricultural research – a multi-crop approach that will provide farmers with practical insight as they tackle widespread agronomic challenges.

The cluster is led by Western Grains Research Foundation (WGRF), a farmer-funded non-profit organization. WGRF invests in agricultural research that benefits western Canadian producers; it has given producers a voice in agricultural research funding decisions since 1981.

The Integrated Crop Agronomy Cluster addresses the gap in multi-crop and systems approaches to agronomic research. This report showcases the results of this valuable research and enables producers and agronomists to respond in a timely way to agronomic challenges.

The eight research activities outlined in this report range from soil health to herbicide resistance and climate change adaptation. Other activities include coordination of crop insects and disease monitoring, assessing and managing spray drift, developing a risk model for mitigating Fusarium head blight, development and management of productive, resilient and sustainable cropping. By taking the "whole-farm approach," the research completed by ICAC will provide farmers with valuable insight as they tackle widespread agronomic challenges.

ICAC has been funded by WGRF, Agriculture and Agri-Food Canada, under the Canadian Agricultural Partnership, a five-year federal-provincial-territorial initiative, along with industry partners. In total, $9 million dollars in research has been secured over the past five years for a strategic investment in science and cutting-edge research.

Coordination and collaboration were really important in helping make the ICAC cluster so successful. We would like to acknowledge all the funders of this cluster: Alberta Pulse Growers, Alberta Wheat Commission, Brewing and Malting Barley Research Institute, Manitoba Canola Growers Association, Manitoba Crop Alliance, Manitoba Pulse and Soybean Growers, Prairie Oat Growers Association, Saskatchewan Canola Development Commission, Saskatchewan Pulse Growers, and Saskatchewan Wheat Development Commission.

Researcher Profiles

Meet the Researchers

More than 78 researchers participated in Integrated Crop Agronomy Cluster work. Here is a closer look at eight of them.

DR. CHARLES GEDDES

Research Scientist – Weed Ecology and Cropping Systems
Lethbridge Research and Development Centre, AAFC

You could say that herbicide-resistant weeds found Charles Geddes – presenting "themselves" as something in need of his attention. While studying agroecology at the University of Manitoba – and farming with his parents near Pilot Mound, MB – they took over some rented land with very little field history. "As it turned out, there were some pretty big issues with herbicide-resistant weeds and that really solidified for me that this was an area where I could make a difference," says Geddes.

Geddes joined AAFC in 2017 after completing his PhD at the University of Manitoba, and focuses much of his work on the discovery, monitoring and management of the herbicide-resistant weeds farmers are dealing with across the prairies. "One of the core projects I lead is the Prairie Herbicide Resistant Weed Surveys," says Geddes.

Much of his motivation is driven by the need for a changing mindset to address this increasing issue. "Herbicide-resistant weeds have gone beyond being a nuisance, and thankfully we are seeing more and more adoption of integrated weed management practices."

PROJECT: Glyphosate-Resistant Kochia

The project was focused on managing glyphosate-resistant kochia with:

- Crop rotation
- Seeding rates and row width
- Harvest timing

Herbicide-resistant weeds have gone beyond being a nuisance, and thankfully we are seeing more and more adoption of integrated weed management practices.

Geddes comes by his holistic approach to weed management honestly. His parents and grandparents instilled the benefits of taking a larger view to the farm business, considering economics as well as environmental and social aspects.

And he has kept the home farm close at hand in other parts of his life. A self-taught musician, he now makes some of his own instruments, with plans to craft the next guitar body out of wood from the farm. He is also a brewer, conducts hops varietal experiments in his backyard, and has brewed beer with hops that grow naturally near Pilot Mound.

IAN PAULSON

Technical Services Lead – Mechanical Engineering and Simulation
Prairie Agricultural Machinery Institute, Humboldt

As a farm kid, Ian Paulson watched in awe as his parents and grandparents operated, repaired and improved the equipment on the family grain operation north of Foam Lake, SK. Being around equipment from an early age – and taking a lead from his parents' inquisitive minds – it is little wonder he has grown into a career in modelling and simulation.

After completing his BSc in mechanical engineering, Paulson worked in the automotive industry simulating and testing vehicle performance. He returned to the University of Saskatchewan for his MSc, focusing on modeling and measurement of the dynamic performance of seeding equipment at increased speeds that ultimately led him to PAMI in 2017.

"Given the speed and size of modern spraying equipment, investigating the impact of how spray droplets behave, using simulation, was a natural interest for me," says Paulson.

One of the aspects of his work that he appreciates most is the crossover between simulation-generated information and field data. "Field data is gold when it comes to validating what we see in simulation tests," he says. "The opportunity to collaborate with others during this research has been just as rewarding."

PROJECT: Spray Drift Management

The project was focused on:

- Air flow around sprayers
- Drift risk
- Travel speed

> **Field data is gold when it comes to validating what we see in simulation tests.**

Working in this area gives Paulson the opportunity to help inform practices around the intersection of farm productivity, environmental stewardship and equipment operation. "These are the real challenges producers face every day." And even though his family is no longer farming, a career in this aspect of agriculture has offered him a meaningful opportunity to support the agriculture industry.

Paulson and his family live in Saskatoon and he continues to work in custom machinery simulation and development.

Photo credit: Farm & Food Care Saskatchewan

DR. KELLY TURKINGTON

Research Scientist – Plant Pathology
Lacombe Research and Development Centre, AAFC

Throughout his career, it is the people that have made the big difference for Kelly Turkington. From advisors and mentors in graduate school, to family, fellow scientists, farmers, industry and extension staff, his inspiration and drive is fueled by the people around him.

It was in high school while working on his parent's small grain farm at Daylesford, SK, that Turkington pondered career options and decided to enrol in agriculture at the University of Saskatchewan. It was not a common choice among his friends who wondered aloud "are you going into agriculture to learn to drive a tractor?" Then during his third year of university, a course in plant pathology by Dr. Robin Morrall sparked his interest. And work as a summer student gave him exposure to agricultural research and small plot research.

Turkington joined AAFC in 1996. "It was an exciting time for a young scientist with much of the work focused on cropping systems research – the risks and benefits of moving to conservation tillage, and direct seeding as it related to crop productivity and pest management," says Turkington.

PROJECT: Crop Disease Monitoring Network

The project was focused on:

- Forecasting disease
- Monitoring change
- Identifying risk

> **I am most interested in research that develops practical, integrated solutions for crop health and disease management.**

His research focuses on developing strategies to mitigate the impact of a range of cereal and canola diseases. "We work closely with other pathologists, agronomists and weed scientists to improve cropping and pest management strategies while also reducing inputs and promoting sustainable production," he says. "I am most interested in research that develops practical, integrated solutions for crop health and disease management that helps farmers and the industry deal with crop and pest management issues."

DR. KUI LIU

Research Scientist

Swift Current Research and Development Centre, AAFC

Some of Kui Liu's earliest contributions to improving agricultural production were on his parent's small farm where they grew a variety of crops including wheat, rice, corn, soybeans, canola and peanuts. It was during his third year of university that he helped them choose corn cultivars based on what he had learned in class. His input saw his parent's crop yield much better than the neighbour's, and his agricultural career was set.

After earning his PhD at Dalhousie University with an emphasis on organic cropping systems management, Liu completed post doctoral work on crop nutrients and their environmental impacts. In 2020, he joined AAFC with a focus on crop management across the Canadian Prairies.

"I work on a variety of crops including pulses, cereals and oilseeds, with an overall goal to understand their impact on productivity, resource use efficiency and environmental quality," says Liu.

He is very keen on a systems approach to crop management – collaborating with breeders, soil scientists, economists and agricultural specialists to optimize the performance of cropping systems as a whole.

> I like to talk with producers and understand the challenges they are facing and explore possible solutions.

"I like to talk with producers and understand the challenges they are facing and explore possible solutions," he says. "I see a need for research that will help us understand how crops respond to stresses, so we can develop best management practices to build greater resilience in our cropping systems and help farmers adopt new agricultural practices for a more sustainable industry."

When he is not focused on cropping systems, Liu can be found playing sports and enjoying backyard gardening.

PROJECT: Systems Productivity, Resilience and Sustainability

The project was focused on:

- Crop rotations
- Biodiversity
- Yield and resilience

DR. MEGHAN VANKOSKY

Research Scientist – Field Crop Entomology
Saskatoon Research and Development Centre, AAFC

When Dr. Meghan Vankosky decided not to pursue a career in medicine, she stumbled into entomology despite a lifelong fear of spiders.

She credits Dr. Lloyd Dosdall, one of her university professors and MSc co-supervisors, with opening her eyes to the possibilities of integrated pest management. "Lloyd had a passion for insects and managing agricultural pests, and my enthusiasm for focusing my career in Integrated Pest Management (IPM) definitely grew out of his enthusiasm," says Vankosky. "And entomological research has a rich history in Western Canada and that appeals to the historian in me."

After completing her MSc at the University of Alberta, PhD at the University of Windsor, and a post-doctoral fellowship at the University of California, she joined AAFC in Saskatoon in 2016 where her research focuses on insect ecology and population dynamics, as well as integrated pest management of insects.

"We do a lot of work developing models to predict the distribution and risk associated with insect pests in field crops, and I co-chair the Prairie Pest Monitoring Network," she says. "I really enjoy teaching people about how interesting six-legged creatures are."

PROJECT: Insect Pest Monitoring

The project was focused on:

- Pest tracking
- Timely information sharing
- Tracking trends

> **I hope the research we conduct on insects, and managing them, makes crops easier and more efficient to grow.**

Vankosky's research looks to reduce the threat of insects to crop yields which has benefits for farmers, the environment and society. "I hope the research we conduct on insects and managing them in agriculture makes crops easier and more efficient to grow, while reducing potentially negative impacts of agriculture on the environment."

Vankosky grew up in a farming community west of Edmonton on a cattle and forage crop operation and calls Saskatoon her home today.

Photo Credit: Wheat stem sawfly (AAFC)

DR. PAUL BULLOCK

Senior Scholar, Agrometeorology
University of Manitoba

A strong and steady connection back to his farming roots in rural Saskatchewan plays into much of the research Paul Bullock focuses on as an agrometeorologist – studying the impact of weather on agriculture. "Whenever I look at research results, I ask myself if my dad and brother could use this to improve things on the farm," says Bullock, who joined the University of Manitoba in 2000.

His interest in research was first piqued while working at the University of Saskatchewan, leading him to complete a MSc there, and then a PhD at the Australian National University in Canberra, Australia. His post-graduate job was doing weather and crop surveillance for the Canadian Wheat Board. "I was doing a job that was contributing to the success of not only my family farm but to Canadian agriculture more broadly," he says.

In the Department of Soil Science at the University of Manitoba, Bullock's research focuses on monitoring and modelling soil moisture, critical weather factors that affect crop production, modelling the impact of weather on crop pests, yield and quality for wheat and canola, and remote sensing techniques for crop monitoring.

PROJECT: Fusarium Head Blight Risk Models

The project was focused on:

- Crop rotations
- Predicting risk
- User-friendly mapping

> **Whenever I look at research results, I ask myself if my dad and brother could use this to improve things on the farm.**

Bullock's research has always had an applied focus and he considers how his work can help people at the farm level. He does not have to look far for the applicability check in. "My dad is one of the best agronomists I know and I talk to him every week about the practical challenges of running a grain farm in Western Canada." Bullock's father is actively farming in his 80s, along with Bullock's brother.

DR. RAMONA MOHR

Research Scientist – Agronomy
Brandon Research and Development Centre, AAFC

Growing up on a family farm in the Interlake region of Manitoba, Ramona Mohr always had an interest in agriculture and science. Perhaps that experience was an early sign that her professional career would keep her close to her roots as a research scientist focused on agronomy.

Mohr completed her BSA and MSc at the University of Manitoba. Shortly after completing her PhD – jointly at the University of Manitoba and AAFC in Lethbridge – she joined AAFC in Brandon as a biologist, before her current role as research scientist.

"The research we do and the information it generates for the agriculture community really comes down to the people we work with," says Mohr.

She is responsible for the Agronomy Research Program at Brandon, and her research focuses on developing crop management strategies to support the economic and environmental viability of farms in Western Canada for crops including cereals, oilseeds, pulses and corn.

PROJECT: Western Canadian Crop Rotations

The project was focused on:

- Multi-year rotations
- Corn and soybeans in rotations
- Long-term impacts

> **The research we do and the information it generates for the agricultural community really comes down to the people we work with.**

"In all our agronomic research, we are fortunate to have support and input from producer groups, and to collaborate with other scientists, technical and field staff from various organizations who are willing to share their knowledge and expertise," she says.

One of her current research projects is on crop rotations, and she is looking to gain a better understanding of how corn and soybeans could perform in Western Canada and offer new options for producers. "We hope to provide producers with the information and management tools to reduce the risks of growing these crops in non-traditional regions."

Researcher Profile

DR. RANDY KUTCHER

Professor – Cereal and Flax Pathology
Crop Development Centre, University of Saskatchewan

PROJECT: Fusarium Head Blight Risk Models

The project was focused on:

- Crop rotations
- Predicting risk
- User-friendly mapping

For Randy Kutcher, it is the small things – like microorganisms and how you manage them – that can make a big difference in crop protection on the prairies. As a plant pathologist, he studies diseases in field crops focusing on Fusarium head blight in wheat, as well as diseases in flax.

But his career did not start in agricultural research. Kutcher grew up in rural Manitoba and after completing a BSc at the University of Manitoba he began working as an agronomist for a private agricultural company. "When I realized I was really not a very good grain buyer, I decided to go back to school," says Kutcher.

He completed an MSc at the University of Manitoba and PhD at the University of Saskatchewan in plant pathology, and a post doctoral fellowship with AAFC on biological control of weeds. He took a position at AAFC in Melfort, SK as a research scientist for the next 15 years where his research focused on mitigating diseases in oilseed crops through integrated pest management.

In 2011, Kutcher joined the University of Saskatchewan where he continues to use integrated pest management solutions to diseases in wheat, barley, oats and flax.

> **Throughout my career, it is the people that have made the difference.**

"Throughout my career, it is the people that have made the difference – my parents, extended family, teachers, professors and the farmers I have had the pleasure to know," says Kutcher. And he is passing it on, as his work includes teaching field crop pathology and supervising undergraduate research thesis projects.

"It feels good to be involved in research and providing information about managing diseases that will improve crop production for Saskatchewan growers, for the industry and for Canadians."

Research Summary

Research Success Stories

The Integrated Crop Agronomy Cluster researched many topics across Western Canada. Here is a look at the projects and their results.

Prairiepest.ca

Online hub home to Prairie-wide surveillance resources

More than 20 years of local insect surveillance powers the Prairie Pest Monitoring Network (PPMN) – a collective hub that tracks the population and distribution of seven key insect pests across Manitoba, Saskatchewan, Alberta and the Peace River region in British Columbia.

The information captured and communicated by the network is as critical as ever for helping provide a better understanding of insect populations from a pest management standpoint. The delivery methods continue to evolve – what began as a blog has grown into a robust website and e-newsletter – to ensure farmers, agronomists, industry stakeholders and provincial specialists have access to timely, accurate information to be able to make the best possible in-season decisions.

"The big thing we do every year is monitor pests in fields across the Prairies to develop population distribution maps that highlight where risk might occur in the current year and to help forecast the risks for the following year," says Dr. Meghan Vankosky, PPMN co-chair and field crop entomologist with Agriculture and Agri-Food Canada (AAFC) at the Saskatoon Research and Development Centre. "We are also raising awareness of beneficial insects as we monitor their populations."

Centralized insect information

The network's website prairiepest.ca forms the central hub for information. "The website means we can provide very timely information throughout the growing season, as well as a host of other resources," says Vankosky, who shares co-chair responsibility for the network with Jennifer Otani who works at the AAFC research farm at Beaverlodge, AB.

With about 1,000 subscribers, the weekly email updates continue to be a cornerstone of the network's outreach, providing 16 to 20 weeks of insights during the growing season based on field monitoring findings and model-based predictions.

Our overall goal with the network is to provide as much timely information as we can about insects to the people who need it to make insect management decisions.

"Our overall goal with the network is to provide as much timely information as we can about insects to the people who need it to make insect management decisions," says Vankosky.

Additional information on the site includes the popular "insect of the week" feature, field guides, insect distribution maps and monitoring protocols. The online resources are designed for farmers to use to help decide when to scout their fields for insect pests; information from scouting helps to make effective insect management decisions.

The network has also created standardized monitoring protocols that they encourage farmers and agronomists to use when making decisions about insect risks in any particular field.

The power of the network

With so many boots on the ground, the network aims to cover as much area as possible every year to monitor insect populations. "There are a lot of people who volunteer and let us on their fields to collect information and feed the process," says Vankosky. "We have a team of collaborators, but our entire team is huge and we are very grateful to them all."

Every year, they gather 5,000-6,000 data points (a piece of information about an insect at a specific location) on the seven insects monitored – bertha armyworm, cabbage seedpod weevil, diamondback moth, grasshoppers, pea leaf weevil, wheat midge and wheat stem sawfly.

Tracking trends

Being in field, every year, across such a wide swath of the Prairies also allows the network to track trends.

"We have definitely seen a shift of some insect populations to different areas of the Prairies that seem to be driven by soil moisture levels," says Vankosky. "Pea leaf weevils have traditionally been an important pest in southern Saskatchewan and Alberta, and we are now finding the highest populations have moved towards moisture in more northern areas."

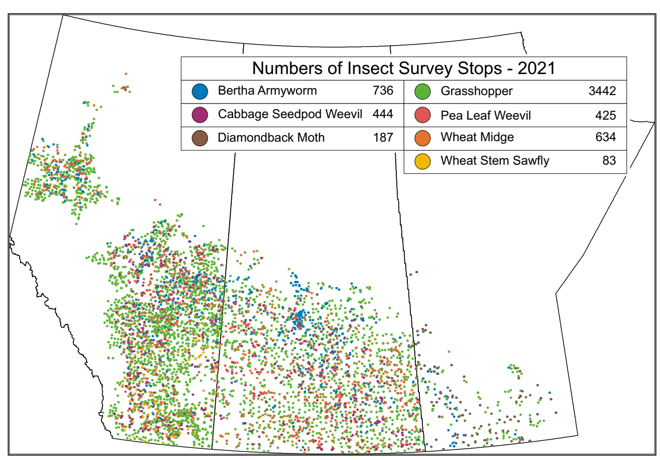
Bertha armyworm is another insect they have been watching for – having expected an outbreak over the last few years – but it has not happened.

"One of the amazing things about this long-term monitoring project is that we really get a good look at how things have changed over the last 20 or so years."

For more information, or to subscribe to the PPMN weekly updates, visit:

prairiepest.ca

All Stops Map 2021



Funded by:

Why monitoring matters

Collaborators monitor and manage field crop disease through new Prairie-wide network

When disease strikes a nearby field crop, information is key. What disease is it, and what crops does it affect? How fast does it travel, and what should growers watch for? What category of fungicide will it respond to? Access to fast, coordinated information can make all the difference in stopping a yield-robber in its tracks – and it requires a coordinated approach.

That is the idea behind the Prairie Crop Disease Monitoring Network (PCDMN), established to foster a more cohesive, collaborative approach to field crop disease monitoring for Alberta, Saskatchewan and Manitoba. It is a five-year Canadian Agricultural Partnership funded project as part of the Integrated Crop Agronomy Cluster.

"The Prairie region has a long history of working together on insect monitoring in the Prairie Pest Management Network, so we had an excellent example on which we could base our network," says Kelly Turkington, Research Scientist at Agriculture and Agri-Food Canada, based at the Lacombe Research and Development Centre, AB.

The value of monitoring

Turkington points to the development of cereal rust risk forecasts for the Prairies as one key function of the network. Leaf rust, stripe rust and stem rust can produce spores that are long lived, and are resistant to UV radiation, wetting and drying. Spores can be carried by parcels of wind over hundreds or thousands of kilometres.

"As a network, we consider whether we have a source of rust in the U.S., and whether we have wind trajectories that will carry those rust spores into the Prairie region," says Turkington. "Then we look at Prairie weather conditions and crop development, and we are able to identify specific at-risk regions where producers and consultants need to be on the lookout for emerging rust issues and the need for timely fungicide application."

Beware of shifts in virulence

While it is important to forecast how a disease travels or where it may appear, Turkington says it is just as important to monitor its changes over time. Over the last several decades of monitoring rust pathogens in cereals, researchers have a better understanding of the breadth and virulence that is out there.

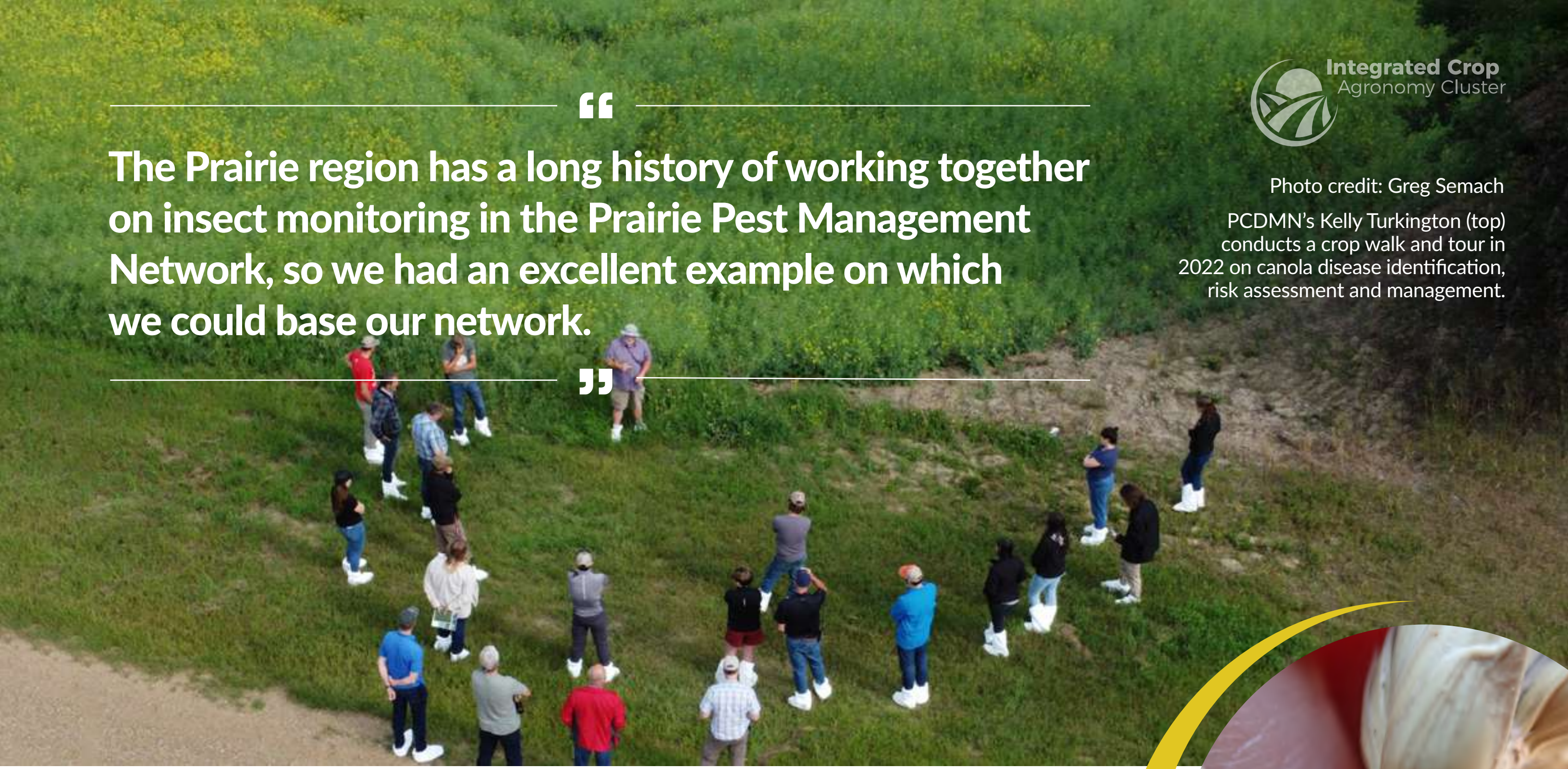
"When we look at cereal rusts, or the pathogens that cause blackleg in canola, or barley leaf spot diseases, we see shifts in virulence over the last 20 years," says Turkington. "As an industry we need to monitor these shifts so we know the most effective sources of resistance that can be bred into new varieties, and we also need to be aware of shifts in fungicide sensitivity."

Knowledge transfer tools

The network uses a blog, Twitter and factsheets to share information. In 2021, they launched the PCDMN quick disease reporter tool, accessed as an app or website form. The tool allows users to choose the crop, disease issue and upload a picture. Data is only collated based on municipality, and once reports are reviewed to flag potential misidentifications, the network generates maps that identify risk based on the number of disease reports by region.

"We are then able to communicate with producers and consultants that regionally they need to be on the lookout

Integrated Crop Agronomy Cluster



> **The Prairie region has a long history of working together on insect monitoring in the Prairie Pest Management Network, so we had an excellent example on which we could base our network.**

Photo credit: Greg Semach

PCDMN's Kelly Turkington (top) conducts a crop walk and tour in 2022 on canola disease identification, risk assessment and management.

for a specific disease, and how to identify it, provide key management information, and give information about assessing risk and determining the need for fungicide," says Turkington.

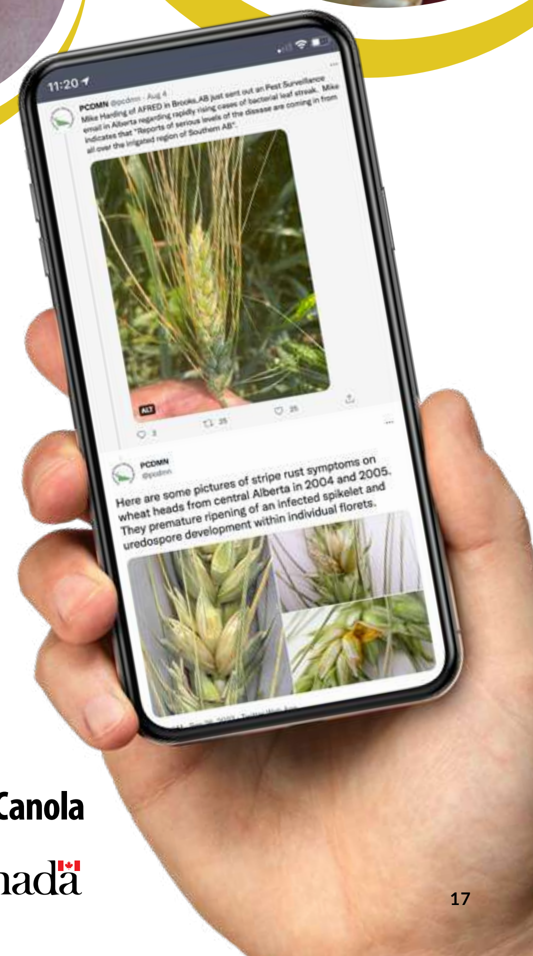
Plans to grow the network

The PCDMN's initial five-year project is coming to an end, but Turkington says proof of concept is there. He hopes to facilitate further expansion of the network in the coming years, including the number of pathologists and other collaborators, the range of diseases and number of crops.

As pandemic restrictions continue to ease, he also hopes to build a broader range of avenues to share information, including in-person events such as field days, crop walks and training sessions.

"As an industry, we need to understand what crop diseases are out there so we can develop appropriate management strategies, or initiate research that will lead us to new or better tools for disease management," says Turkington. "That information needs to run from the farm to policy makers in government, so we know where to put our resources."

Prairie Crop Disease Monitoring Network



Sign up for free email updates at **prairiecropdisease.blogspot.com** and follow on Twitter **@pcdmn.**

Funded by:

Canadian Agricultural Partnership · WGRF · Alberta Pulse Growers · Manitoba Crop Alliance · SaskCanola · Sask Wheat Development Commission · Saskatchewan Pulse Growers · Alberta Wheat Commission · Manitoba Pulse & Soybean Growers · Canada

Research Summary

Paul Bullock checks portable weather stations that collects local data to power FHB risk models.

Finding new FHB solutions

Research looks at crop rotation and a new risk assessment tool

Fusarium head blight (FHB) continues to rank as one of the most severe crop diseases in Canada. Researchers in Western Canada are looking at ways for producers to manage FHB from two different angles – using crop rotation strategies and building local models to better predict the risk. Dr. Randy Kutcher and MSc student Alejandra Oviedo-Ludena at the University of Saskatchewan, and Paul Bullock at the University of Manitoba were part of a five-year research project that tackled two different angles at mitigating FHB risk.

Does diversification reduce FHB risk?

Under the supervision of Kutcher, Oviedo-Ludena, who is now a research assistant at the University of Saskatchewan, conducted her MSc research project on the effect of crop rotation on FHB and leaf spots using three-year crop rotations of cereals and non-cereal crops – durum, barley, pea, canola and corn.

Rotations research sites were in Lethbridge, Saskatoon, Indian Head, Melfort and Brandon, growing the five core crops, and adding other crops based on location including drybean, canary seed, oats, flax, lentils, soybeans, quinoa and hemp.

"What we found was that diversifying a crop rotation brings many benefits to cereal crops," says Oviedo-Ludena. "The yields of durum, wheat and barley were higher when preceded by a non-host crop like peas, soybeans or canola."

As for the impact on FHB, adding a non-host crop provided a positive response. "We can improve yield and quality by adding a more diverse selection of crops, such as flax to a rotation," she says.

In this study, corn did not rank well in the rotations, reducing the yield of durum and barley, and although it was not detected, it is likely to increase the FHB risk. "If corn becomes popular in Western Canada, we must consider the FHB risk if adding into a crop rotation."

There were some surprises from adding legumes such as pea into a cereal rotation that Oviedo-Ludena did not expect. Despite improving yield and quality, adding a pea crop in rotation did not reduce FHB. "Pea improved yield, but in terms of FHB, we need more research on its effectiveness as a break crop in a long-term cereal rotation," says Oviedo-Ludena.

The research occurred under generally dry conditions and low FHB epidemic risk years (2018-2022). "If we have a high epidemic FHB year, producers should consider diversifying with non-host FHB crops like canola, drybean, flax, quinoa or even hemp," says Oviedo-Ludena.

Building a better predictor

Paul Bullock's part of the bigger Fusarium puzzle focused on developing a reliable FHB risk prediction tool to fuel farm-level decisions about the need for a fungicide application.

"We set out to create a homegrown, Prairie-wide risk assessment tool that would predict when a severe FHB outbreak is expected or when it is not," says Bullock, an agrometeorologist. "There are benefits for producers both ways as they make agronomic and economic decisions for their farm."

Fusarium head blight risk models involved three parts:

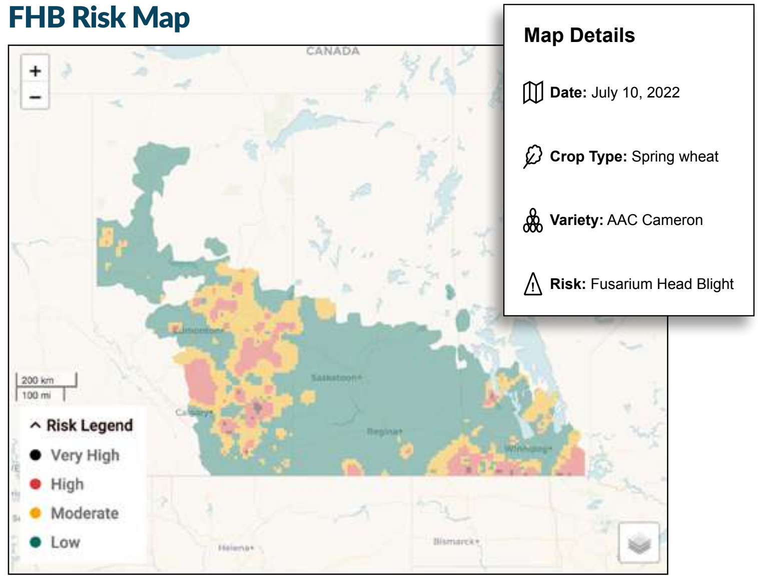
- Develop a good local data set to power risk assessment models for FHB index (FHBi), Fusarium damaged kernels (FDK) and deoxynivalenol (DON)
- Test the models in field conditions
- Build a user-friendly, online risk mapping tool

To build the data base, spring wheat, winter wheat, barley and durum cultivars were grown at 15 plots sites across the Prairies for three years in a row. Portable weather stations were set up at each plot location to track detailed weather conditions that provided 80 different weather variables for model development. Every plot was assessed in the field for FHBi, harvested grain was graded for FDK percentage and also tested for DON.

"This was the nuts and bolts of the project," says Bullock. "We paired the FHBi, FDK and DON from each plot with the weather variables, and ultimately developed algorithms that would turn weather conditions into risk levels by crop type."

To test the new models in field conditions, they collaborated with the agriculture departments in each province to identify more than 300 producer fields where

FHB Risk Map



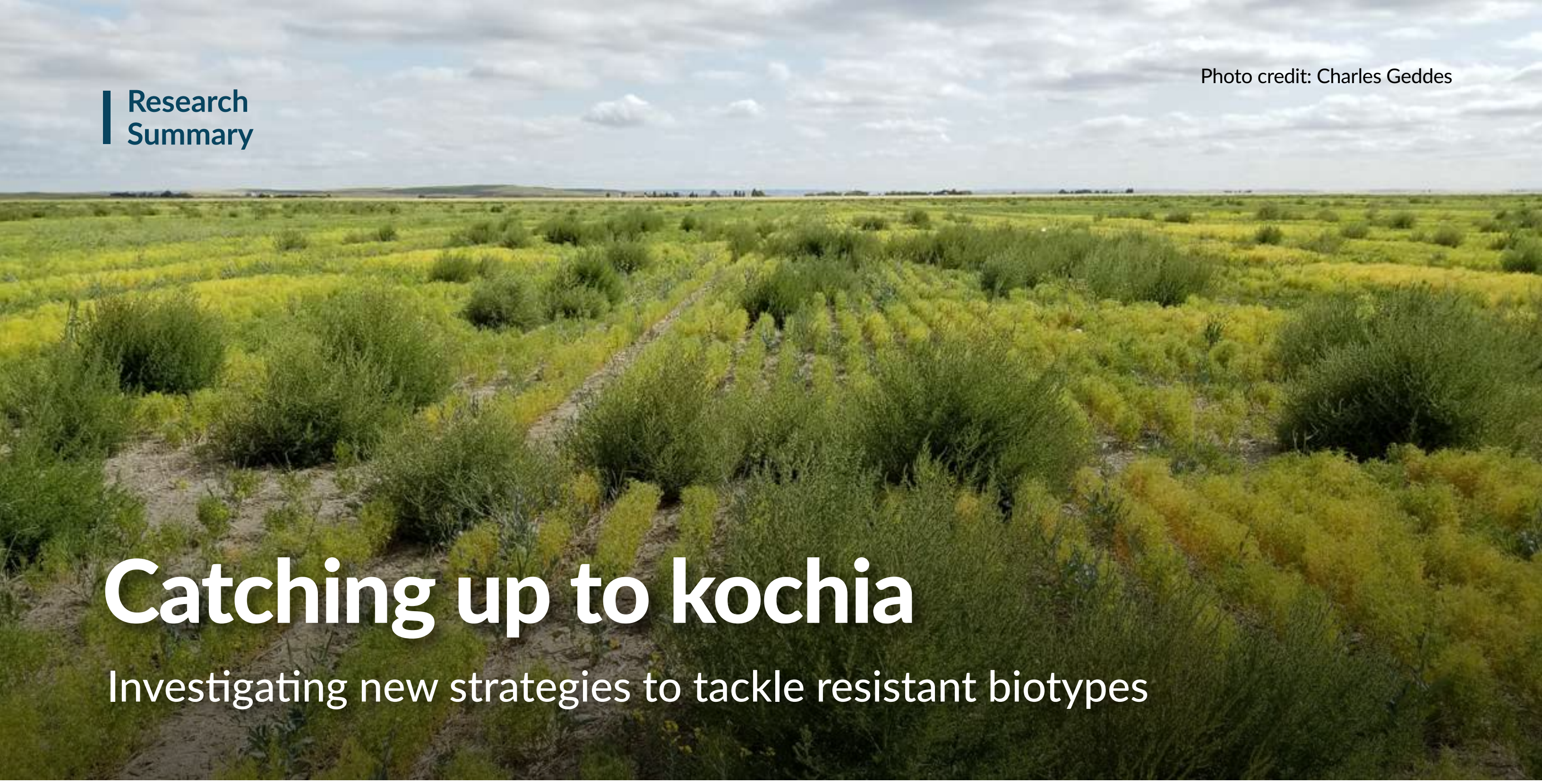
an unsprayed check area was established, regardless of whether producers planned to use a fungicide. "For each of these check areas, we assessed FHBi, FDK and DON, and used weather from the nearest local station to model the risk for the farmers' fields," says Bullock. "This let us compare what our models predicted to what happened in the field."

Bullock then developed a risk mapping tool. "Real-time data from 500+ weather stations on the Prairies feed the models we created, and the tool provides the farmer-facing piece to deliver the modeled FHB risk levels mapped out across the Prairies."

Once the final revisions are complete before the 2023 growing season, the new FHB risk mapping tool will be rolled out to the public and accessible from the University of Manitoba website. Users will choose the crop, specific variety and FHB risk to be measured, and a map will be generated with colour-coded risk levels from very high to low, showing an entire region or zooming in to a specific area.

The dry conditions across much of Western Canada in the years that both projects were conducted provided some additional challenges – highlighting the unpredictability of FHB and the key role weather has on its severity. Researchers hope to continue work on both projects to build more robust information to help producers manage this widespread disease.

Funded by: Canadian Agricultural Partnership, WGRF, Brewing and Malting Barley Research Institute, Alberta Wheat Commission, Manitoba Crop Alliance, Sask Wheat Development Commission, POGA Prairie Oat Growers Association, Canada



Research Summary

Photo credit: Charles Geddes

Catching up to kochia

Investigating new strategies to tackle resistant biotypes

When it comes to herbicide-resistant kochia, Charles Geddes does not mince words. He is clear and concise about the tremendous challenges Prairie farmers face with kochia populations, and about promising new research that is offering new tools and approaches to combat kochia.

A Research Scientist with Agriculture and Agri-Food Canada at Lethbridge, AB, Geddes is leading a Prairie-wide, five-year collaborative and practical research project to look at various cultural practices to help growers get ahead of kochia. The project is funded through the Integrated Crop Agronomy Cluster.

"If you just use chemicals to manage herbicide-resistant kochia, it is not going to work well," says Geddes. "It is safe to assume that all kochia in Western Canada is resistant to Group 2 herbicides, the majority is now glyphosate resistant (Group 9), and a portion are also showing resistance to Group 4."

The compounded trouble with kochia

Geddes knows we are long past simple herbicide solutions for kochia. The trouble lies largely in the very biology of the weed – almost as if it was designed by nature to spread. "It is a tumbleweed that is very efficient at dispersing its seeds among multiple fields and multiple farms within the same year," he says. "And as a long season plant, kochia continues to grow throughout the season as long as conditions are favourable."

Group 2 resistant kochia was first identified in Western Canada in the late 1980s. In 2011, the first glyphosate-resistant kochia was identified in southern Alberta. In the last 10+ years, glyphosate resistance has reached more than 50% of the kochia populations tested across the Prairies. "And there is no silver bullet solution," says Geddes.

That is why he is leading a team of collaborators in Alberta, Saskatchewan and Manitoba in a series of research projects over the last four years – they are searching for new approaches to manage glyphosate-resistant kochia in a range of environments across the Prairies.

Crop rotation disrupts kochia life cycle

The first part looked at diversifying the crops in a rotation to disrupt kochia's foothold. They added winter wheat in two of the four years of several rotations, and added an alfalfa crop for hay production into another rotation.

> **We know that once weeds are resistant to multiple modes of action, we have to look at the biology of the plant to find control options. It makes weed management more complex than just spraying herbicides, and it is where integrated weed management truly is necessary.**

The strategy with winter wheat is that it is well established in the spring when kochia is trying to emerge, so the crop is more competitive from the start. "Plus, winter wheat is harvested before kochia has begun producing viable seeds so we have reduced the opportunity for kochia seeds to be released at harvest and go back in the seed bank."

Adding a forage produced a similar result because again, harvest happened before kochia was producing seeds. Both approaches are showing promise.

"Changing spring wheat for winter wheat resulted in a decrease in kochia biomass by 64% and density by 74% in year three of the study," says Geddes. "Adding in a forage decreased kochia biomass by 89% and density by 99% in year three."

Cultural tools create more competitive crops

They also looked at altering cultural practices to improve a crop's competitiveness against kochia including using narrow or wide row spacing, and recommended seed rates or doubled rates. Doubling seeding rates in two of the four years of the rotation saw kochia biomass decreased by 64%. And narrower rows brought a benefit in all four years with a 56% reduction in kochia biomass.

"When we combined both factors – higher seeding rates in narrow rows – we saw an overall 80% decrease in kochia biomass. That is the same as the threshold of control required by herbicide regulators to designate that a herbicide controls kochia," says Geddes.

So, optimizing the plant spatial arrangement in a field – to boost the competitiveness of crops against kochia – brings a level of control similar to adding a new herbicide mode of action against kochia.

Harvest timing helps weed management

The final part of the project looked at how harvest dates could impact kochia seed production. "Understanding the biology of kochia, we wanted to see if it makes sense to use a pre- or post-harvest herbicide, and if harvest date has an impact on that," says Geddes.

Kochia starts producing seeds in mid- to late-August. If you cut off kochia during crop harvest when plants are still vegetative (before flowering), the plants tend to regrow.

"If you harvest before kochia is producing seed (August or earlier), a post-harvest herbicide makes sense to prevent kochia from regrowing. But if you are harvesting in September or later, you do not need post-harvest control because when you cut down kochia that is producing seed, it tends to die off and not regrow," he says.

Practical recommendations

The project is wrapping up, and Geddes has identified some clear recommendations for growers.

- Kochia responds to competitive crops by reducing its biomass and seed production, so anything you can do to promote a competitive crop is a good option, including narrow rows and higher seeding rates.
- Harvest timing is important for kochia management. Earlier harvest can decapitate kochia before it produces viable seeds, but it is important to consider a post-harvest herbicide to control regrowth.

Funded by: Canadian Agricultural Partnership; Manitoba Pulse Soybean Growers; Manitoba Crop Alliance; WGRF; Canada

> We know there is a wake behind the sprayer and there are measurable effects on spray drift.

The winds of change

Studying the role of sprayers in creating spray drift

While "low and slow" may be the best practice for applying crop protection products, the reality of ever-increasing sprayer size and sprayer speeds has triggered the need for a better understanding of the role machinery may play in the spray drift equation.

Photo credit: Farm & Food Care Saskatchewan

"There is a lot of research that looks at droplet size and sprayer nozzle design, but there was a gap in knowledge about how the sprayer itself might affect the potential for spray drift," says Ian Paulson, a mechanical engineer at the Prairie Agricultural Machinery Institute (PAMI) and lead researcher on a project looking at the potential for machine-induced spray drift.

Paulson led a multi-year project designed to inform best spray practices based on a wider understanding of spray drift. Working closely with spray expert Dr. Tom Wolf of AgriMetrix Research and Training, Paulson and team scaled up small test plots to field-sized machinery and environment to track air flow movement. To dig a little deeper, an air flow simulation model was developed for the project by PAMI and the University of Saskatchewan.

In the wake

One major goal was to characterize the wake created by high clearance sprayers. They measured air flow around the sprayer in field conditions – looking at air speed behind the tires, immediately behind the boom, and behind the blockage that the tractor cab and spray tank creates.

"You might assume a sprayer does not disrupt the air like a car or a semi truck might, especially since the sprayer is going quite slow, comparatively," says Paulson. "We knew there was a disruption of air flow behind the sprayer, and with our simulation work we were able to characterize the wake and look at where the air flow is disrupted."

They simulated a real sprayer giving them a unique opportunity to look at sprayer speed, droplet size and wind, as well as the impact of machinery blockage. "We were able to introduce droplets into the model to gain a much better understanding of how droplets are influenced in the sprayer wake, and this could ultimately help lead to opportunities for better sprayer design."

Tracking turbulence

What they found was not surprising to the team, but will hopefully support more of the low and slow approach. Using the sprayer simulation, they identified distinct areas behind the sprayer where the wake caused air to flow up for enough time to represent a potential drift risk.

There were three main areas where more turbulence was seen in the wake of the sprayer – behind the sprayer body/tank, behind the rear tires, and downstream of larger boom-mounted components. "Spray drops that enter these areas are more likely to mix with the air and that creates a greater potential for spray drift," says Paulson.

The sprayer equation

The biggest takeaway from all the air flow measurement testing – in the field and with the simulation model – was the influence of machinery on spray drift. "There is definitely a machine impact and a wake created by the sprayer," says Paulson. "And there are implications of the resulting wake that are detrimental to spray performance."

Most sprayers are characterized by big tires and a big tank, and those are the parts that are creating issues in the field. Paulson says there are some manufacturers paying more attention to design to keep obstructions out of the way. Nearly all the detrimental patterns noted were more severe with higher airspeed, highlighting the benefit of reduced travel speeds and how the ambient wind can influence the size of the sprayer wake.

Care and caution

Paulson knows spray drift can be a tough topic. "There is always the balance of logistics and agronomy when it comes to spraying," he says. This research has helped demonstrate the influences and the impact when products drift away from the location where they are intended to work, and the care and caution that is needed with sprayer application.

"The best tool is to slow down and lower the spray boom," says Paulson. "It is not a new concept – it is simple and logical – and helps reduce the potential for a drift event."

Start with the outside rounds at a minimum. As part of this research, Paulson and team found that reducing travel speed and lowering boom height can reduce spray drift by up to 50 percent at 40 to 80 metres downwind of the spray swath.

"We know there is a wake behind the sprayer and there are measurable effects on spray drift."

Funded by: Canadian Agricultural Partnership, Manitoba Pulse Soybean Growers, Alberta Pulse Growers, Saskatchewan Pulse Growers, Manitoba Crop Alliance, WGRF, Canada

From simple to systems

Building a regional road map for better crop rotations

Wheat and canola form the backbone of crop rotations on the Prairies. It is a simple rotation that has worked for decades, but more and more research points to the benefits of diversifying crop rotations for long-term sustainability whether you measure it by yield, soil health or resilience to biotic and abiotic stresses.

In an ideal world, producers would farm in four-year crop rotation cycles as an effective way to balance the varied needs of the crop and soil, manage pest pressures and maintain vital biodiversity.

While it is a lofty goal, a group of researchers across Western Canada are working on ways to bring biodiversity back into crop rotations. They are part of Resilient Rotations, a project of the Integrated Crop Agronomy Cluster that is evaluating practical options for more productive, sustainable and resilient cropping systems. By comparing different crop rotations – measuring drawbacks and benefits – the goal is to ultimately help farmers make decisions that are the best fit for their operation.

Dr. Kui Liu, Research Scientist with Agriculture and Agri-Food Canada, is leading the five-year project with a team as diverse as the crop rotation options they are evaluating for western Canadian farmers. There are agronomists, weed scientists, pathologists, economists, meteorologists and soil health experts – a testament to the diversity of factors that impact an effective, sustainable and productive approach to crop rotation.

"We are approaching crop rotation using a systems approach – all the elements that impact crop rotation from yield, soil health and economics to local growing conditions," says Liu. It is a more holistic way to look at crop rotation and one they hope will provide new insights and options for farmers in a more customized, prescriptive type of approach.

A slow switch

The team is evaluating six different crop rotations at eight field sites across the Prairies to provide relevant recommendations based on local growing conditions. There are three sites in Alberta, three in Saskatchewan and one in Manitoba. Data from the four-year rotations are being evaluated by region based on yield, resource use efficiency, soil health, pest pressure, economics, carbon footprint and resilience.

They are under no illusion that there is a single solution, but rather a slow switch from a simplified two-crop rotation to a rotation that takes a systems approach – considering all the factors that impact the performance of cropping systems. "We do not want producers making one year rotation decisions," says Dr. Sheri Strydhorst, Principal with Sheri's Ag Consulting, and part of the Resilient Rotations team. "It should be a long-term process that considers the local field and farm conditions, and the many factors that impact crop performance and farm economics."

Spreading the news

"We are producing factsheets with regional results on how each of the six rotations performed based on the evaluation criteria," says Strydhorst, who also leads extension for the Resilient Rotations project. "Rainfall and yield are key issues on producers' minds and the first two factsheets will provide timely and relevant information to help with 2023 planning decisions." Other factsheets will follow on nutrient use efficiency and economic returns.

Regional recommendations

One thing is clear from the four years of field data under their belt. "There is no single cropping system that is suitable for a large region like Western Canada," says Liu. "We need site specific cropping systems based on local conditions."

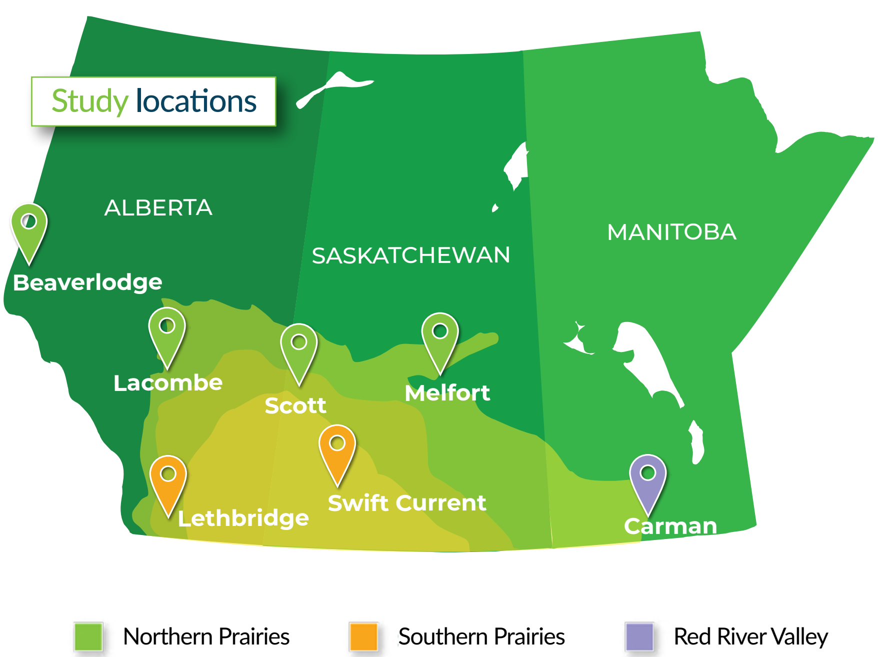
It is too early for even regional recommendations. But the research team expects to provide a road map or decision tree of information for producers to consider for future crop rotation decisions. "A geographic decision tree could be the ultimate tool for producers from this work," says Strydhorst. "Producers would start by their region, and identify their top concern – nutrient use efficiency, weed control, economics, etc. – and look to that "branch" for recommendations for their farm."

As the current five-year project wraps up, Liu has applied for continued funding through the next Integrated Crop Agronomy Cluster. "We really need two to three cycles of studying various crop rotation data to be able to make solid recommendations to producers," he says. "And it is important for producers to realize that the benefits of a diversified cropping system may not be realized in the first four years, but gradually, and sustainably, over time."

More information is available at:

wgrf.ca/resilient-rotations-factsheet

The Resilient Rotations Project



The Resilient Rotations project is evaluating six crop rotations across the Prairies:

Control: historically recommended, four-year crop rotation

Intensified: oilseed intensified in the northern Prairies or pulse crop intensified in the southern Prairies

Diversified: multiple crop types, diversified rotations

Market driven: crop types selected based on annual commodity prices

High risk: introduce new crop types that may not be adapted for the geographic region

Soil health: include green manures and intercrops to improve soil health

Funded by: Canadian Agricultural Partnership, WGRF, Sask Wheat Development Commission, SaskCanola, Alberta Wheat Commission, Alberta Pulse Growers, Manitoba Crop Alliance, Canada

Funded by: CANADIAN AGRICULTURAL PARTNERSHIP WGRF MANITOBA CROP ALLIANCE MANITOBA Pulse Soybean GROWERS Canada

Crop options

Is there a place for corn and soybeans in western rotations?

As cropping systems across Western Canada continue to change, there is an ongoing need for local research to evaluate the agronomic, economic and environmental aspects of adding new crops into a rotation. Dr. Ramona Mohr is taking a closer look at the possibilities for introducing corn and soybeans into typical cereal and oilseed rotations.

"Growing corn and soybeans on the Prairies is not a new idea, but with better adapted cultivars and the prospect of a warming climate, there may be some new opportunities for expanding production in the west," says Mohr, research scientist with AAFC at its Brandon Research and Development Centre.

Manitoba in particular has seen significant changes in rotations over time. In an area once dominated by cereals and oilseeds, Manitoba is second only to Ontario for soybean production, growing about 1.1 million acres in 2022.

Multi-year rotations

Mohr led a study looking at various crop rotations at three AAFC sites – Brandon, Indian Head and Lethbridge – and one site at the University of Saskatchewan in Saskatoon. The following rotations were done in small plots at all locations.

- **Two-year rotations:** wheat/canola and soybean/corn
- **Three-year rotations:** soybean/wheat/canola, corn/wheat/canola, corn/soybean/wheat, and corn/soybean/canola
- **Four-year rotations:** corn/soy/wheat/canola

"Our goal with this type of research is to provide producers with good information and management tools – the more information you have before taking on a new crop the better chance of successful adoption and diversification," says Mohr. "Corn and soybeans are attractive options because they have an established market to help reduce the economic risk for producers."

"We took a very wholistic approach to evaluating these rotations to understand the whole cropping system looking at crop yield and quality, disease incidence, as well as nutrient dynamics and soil quality factors," says Mohr.

The team also included an agricultural economist and meteorologist to round out the full evaluation of the rotations. "We are trying to understand all the factors that drive crop performance in different rotations."

Long-term endeavour

While the full analysis of the five-year study is not complete, Mohr has some observations from the project, beginning with the long look needed for crop rotation work.

"Crop rotation is inherently a long-term investment," says Mohr. "To really understand how rotations will perform we need to look at them in the long term as effects accrue over time and changes in factors like soil health occur slowly."

Adding any new crop calls for producers to consider a range of factors. "What are the economics, how do the new crops fit into the overall operation, what about equipment and marketing opportunities, and individual risk tolerance," she says. Then there is the basic agronomic information needed related to seeding, fertilizer, harvest and pest management.

Mohr knows it is going to take some time to understand how the rotations they tested may provide a new opportunity for producers. "We need a solid set of information for producers as they consider these crops in rotation," says Mohr. "The first five years is a great start, and our goal is to repeat these rotations to continue to build our bank of knowledge and experience on growing corn and soybeans, that is specific to the Prairies."

Multi-year rotations

Mohr led a study looking at various crop rotations at three AAFC sites – Brandon, Indian Head and Lethbridge – and one site at the University of Saskatchewan in Saskatoon.

Brandon

Indian Head

Lethbridge

Saskatoon

The following rotations were done in small plots at all locations.

2 YR ROTATIONS

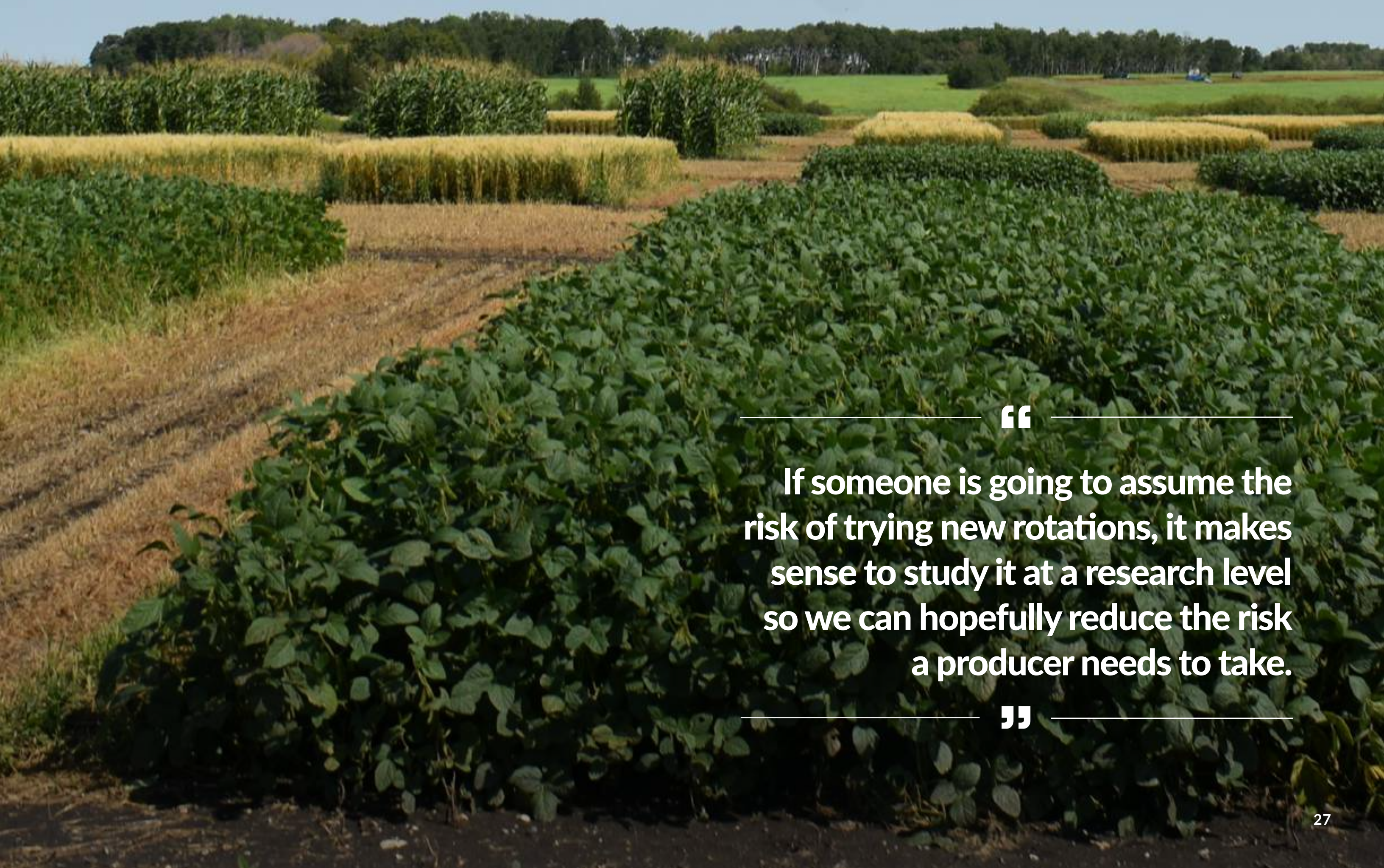
- wheat / canola
- soybean / corn

3 YR ROTATIONS

- soybean / wheat / canola
- corn / wheat / canola
- corn / soybean / wheat
- corn / soybean / canola

4 YR ROTATIONS

- corn / soy / wheat / canola



"If someone is going to assume the risk of trying new rotations, it makes sense to study it at a research level so we can hopefully reduce the risk a producer needs to take."

Integrated Crop Agronomy Cluster

SUMMARY

2018-2023

WGRF