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CANOLA DIGEST

Science Edition

Harmeet Singh Chawla (right) and Mohamed Youssef lead one of many new projects on verticillium stripe. This flask contains *Verticillium longisporum* spores.
P. 25

Inside

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Your provincial research leads

BRITTANY VISSCHER
Research director
Alberta Canola

As the research director at Alberta Canola, I am committed to ensuring your levy dollars are put toward research projects that cover timely challenges and opportunities affecting your farm and canola production. Alberta Canola's research portfolio continues to grow in exciting ways. However, research costs continue to increase, which puts a strain on tight budgets, yet it is still critical to ensure that canola growers' needs continue to be met.

In April of 2024, the research committee at Alberta Canola expanded on its research priorities and identified the top eight research funding targets. The committee used grower feedback received from the first two Research Symposiums (Lethbridge 2023 and Grande Prairie 2024). Alberta Canola recognizes the diverse growing landscape across the province and understands research needs can reflect this. That is why it's important to the research committee that the Research Symposium moves each year to reach as many canola growers across the province as possible. Our 2025 symposium will be in Red Deer where we hope to identify the needs of central Alberta canola growers.

Alberta Canola is excited to continue engaging with growers and learning how to best meet your needs. We strive for a well rounded, applicable and leveraged research portfolio to find better ways to grow canola, investigate new uses and health benefits of canola oil, and promote the use of canola meal in livestock feed rations.

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AMY DELAQUIS
Research manager
Manitoba Canola Growers

As the research manager with Manitoba Canola Growers Association, I'm responsible for prioritizing farmer-identified research needs, managing funding, exploring new research collaborations and growing our applied research programs. I have been immersed in agriculture my entire life through farming, industry jobs and post-secondary education. My love for the agricultural community paired with curiosity has driven my research career and continues to push me to ensure that the MCGA research program is aligned with the priorities of Manitoba farmers. I also ensure that results produced from our programs are available to farmers in a format they can use on their farms.

In 2024, we launched our Manitoba Canola Variety Evaluation Program with trials at six locations across the province. We are very excited to see this program come to the field after there was no independent variety testing on the Prairies in 2023. As this program grows and evolves, we continue to work with industry members to ensure we are best representing canola performance on a field level and that we can include a wide range of varieties across the market. This program is paired with our On-Farm Research Program to provide Manitoba farmers with applied research results from across the province to help farmers make informed management decisions on their farms.

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DOUG HEATH
Research manager
SaskOilseeds

SaskOilseeds continues to invest in important new research to help farmers. This year, two new projects deal with management of herbicide resistant kochia. We funded several projects to continue building our knowledge on the four major diseases of canola. These include screening sources of resistance to verticillium stripe and how it interacts with the blackleg pathogen, looking at natural viruses that could control sclerotinia, and attempting to culture the clubroot pathogen outside of plants and developing methods to isolate single spores so that pure lines can be used in research. As for insect pests, we are funding projects for monitoring swede midge, tracking the spread of different flea beetle populations, and using volatiles to attract and kill flea beetles.

Other projects include further optimizing canola's oil profile, continued development of breeding tools to allow wider genomic variation to be brought into canola more easily, and evaluating co-extrusion of canola meal with pea starch to lead to better balanced nutrition rations for livestock.

Our on-farm field scale program expanded to four protocols this year. Co-operators could choose a protocol and use it to perform valid research trials on their farm. We have many ways for you to take advantage of our extension activities to learn more about these projects, our free disease testing programs, and to find out how you can participate in on-farm research!

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Features

Provincial Bulletins

ALBERTA CANOLA

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Each grower dollar Alberta Canola contributed to research for 2024 was matched by an additional $4.50 from research partners and programs. To help identify research priorities, attend the Alberta Canola Conference and Research Symposium, January 22-23 in Red Deer.

SaskCanola

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SaskOilseeds is recruiting farmers to participate in its on-farm research trials program in 2025. Each year, SaskOilseeds awards two-year scholarships to graduate students conducting research related to canola or flax. Recipients for this year are Cresilda Alinapon and Kate Sauser.

Manitoba Canola Growers

6

Manitoba Canola Growers invests research dollars in two major programs – on-farm research and canola variety evaluation trials. On-farm trials for 2024 included seeding rate, nitrogen rate, seed-placed fertilizer toxicity, phosphorus sources, and cover crops to manage flea beetles.

Completed Projects

Plant establishment

Nutrient management

Integrated pest management — DISEASE

13 **Blackleg seed treatment helps in some scenarios**
Key result: Seed treatment could reduce early blackleg infection, depending on canola variety resistance.

14 **Advances in verticillium stripe ID and assessment**
Key result: Verticillium stripe can affect seedling establishment and crop growth before affecting tissues in the stem. Assessing disease at seedling and adult stages will be necessary for determining host resistance.

15 **Crop rotation reduces clubroot risk**
Key result: The treatments (liming, grassing, gypsum) did not consistently have a measurable effect on spore concentrations relative to the bare soil control. The best clubroot management practices remain rotation and resistant cultivars.

16 **Over-fertilization may increase clubroot**
Key result: While recommended fertilizer rates are required to improve overall plant growth and yield, over-fertilization may contribute to increased *P. brassicae inoculum* loads and greater clubroot pressure over the long term.

Integrated pest management — WEEDS

17 **Chaff lining not an effective herbicide alternative**
Key result: Chaff lining concentrates chaff (including harvested weed seeds) into a narrow line behind the combine, with the goal to smother weed seeds in chaff.

Integrated pest management — INSECTS

20 **Beneficial nematodes feed on cutworms, root maggots**
Key result: Native entomopathogenic nematodes (EPNs) have potential for biocontrol of cutworms and canola root maggots, performing fairly well when compared to introduced commercial species.

20 **Striped and crucifer flea beetles do not compete**
Key result: In most cases (but not all), striped flea beetles will emerge about one to two weeks before crucifer flea beetles. Their early arrival does not seem to have any negative effect on crucifer flea beetle activity.

Genetics

18 **Lower auxin response decreased clubroot severity**
Key result: The clubroot pathogen uses the plant's hormone auxin to help make galls. Canola plants with less auxin response have lower clubroot severity.

18 **Progress on drought-tolerant canola**
Key result: When researchers use gene-editing and RNAi to suppress the Kanghan gene family in canola, the crop seems to have higher drought tolerance.

18 **Clearing a path for capturing diversity**
Key result: Researchers identified a gene in canola responsible for protecting genetic purity. Controlling this gene could make it easier to "diversify" the canola genome, and introduce more yield-resilient canola cultivars.

19 **Second-generation clubroot resistance wildly inconsistent**
Key result: Growers cannot assume second generation clubroot resistance is "enhanced" resistance.

19 **Key advances in blackleg breeding**
Key result: An indoor quantitative trait loci (QTL) test will reduce the time required to identify and incorporate adult plant resistance genes into commercial canola varieties.

19 **Faster blackleg and clubroot tests**
Key result: Researchers developed a faster and more accurate way to scan plant and soil samples for blackleg pathogen races and clubroot pathotypes.

New Projects

21 **Sustainable Canadian Agricultural Partnership projects**
The Sustainable Canadian Agricultural Partnership canola research projects are funded in part by the Government of Canada with contributions from Alberta Canola, SaskOilseeds, Manitoba Canola Growers, the Ontario Canola Growers Association and industry, including the Canola Council of Canada.

23 **13 new Canola Agronomic Research Program projects**
Canola Agronomic Research Program (CARP) projects that commenced in 2024 will investigate management solutions related to blackleg, clubroot, flea beetle, midge, sclerotinia stem rot, verticillium stripe and other biotic and abiotic threats. Alberta Canola, SaskOilseeds and Manitoba Canola Growers and Western Grains Research Foundation provided funding.

Ongoing projects

26 The significant number of plant establishment, nutrient management, integrated pest management, and genetics projects still in progress cover topics from nitrogen-fixing bacteria, to verticillium stripe, to the development of climate ready canola. Canola growers contribute to these projects through their levy payments to SaskOilseeds, Alberta Canola and Manitoba Canola Growers.

New Research Projects for 2024

Alberta Canola is committed to funding research projects that help farmers succeed, whether it's finding better ways to grow canola, investigating new uses and health benefits of canola oil, or promoting the use of canola meal in livestock feed rations. Each grower dollar Alberta Canola contributed to research for 2024 was matched by an additional $4.50 in investment from collaborative research partners and programs. Additionally, the overall leverage of Alberta Canola's research portfolio since 2012 rose to 7.36 thanks to the Sustainable Canadian Agricultural Partnership Canola Cluster having a leverage of 14.02. Alberta Canola is grateful for the aligned priorities of funding partners, which allow continued investment in a wide range of canola research, extending the reach of farmers' dollars.

After two successful Research Symposiums held in conjunction with the Alberta Canola Conference, the research committee was able to update and clearly identify the research priorities and targets of Alberta Canola growers. Gathering such feedback is critical as it identifies timely and impactful issues Alberta farmers are facing – and where research may be lacking for the continued long-term production of canola. For more information on these newly defined research priorities and funding targets for 2024-25, visit **albertacanola.com/research-priorities**. See below to view the list of Alberta Canola's new research projects for 2024.

Researcher	Project Title	Years	Alberta Canola Funding	Total Project Cost	Partners
Stephen Strelkov University of Alberta	Methods to isolate and maintain clubroot for improved resistance screening and labeling	3	$56,925	$341,550	MCGA, SaskOilseeds, WGRF
Mary Ruth McDonald University of Guelph	In vitro culture of *Plasmodiophora brassicae*	2	$24,955	$99,820	SaskOilseeds, WGRF
Boyd Mori University of Alberta	Population dynamics and monitoring programs for midges attacking canola	3	$27,610	$110,440	SaskOilseeds, WGRF
Boyd Mori University of Alberta	Tracking the movement of flea beetles across the Canadian Prairies	2	$70,871	$212,614	MCGA, SaskOilseeds
Maya Evenden University of Alberta	Volatile-based trapping and management of flea beetles	3	$104,506	$209,012	SaskOilseeds
Stephen Strelkov University of Alberta	Clubroot Pathotype Evaluation and Monitoring	3	$90,562	$362,250	SaskOilseeds, WGRF
Sheau-Fang Hwang University of Alberta	Investigating the conditions favoring Verticillium stripe development and yield losses in canola	4	$100,000	$823,400	MCGA, SaskOilseeds, WGRF
Hossein Borhan AAFC Saskatoon	Impact of synergistic interactions between *V. longisporum* and *L. maculans* on canola yield	5	$118,965	$475,860	SaskOilseeds, WGRF
Boyd Mori University of Alberta	Enhancing flea beetle monitoring and management through production of pheromones in yeast	3	$49,986	$299,272	RDAR, WGRF
		2024 TOTAL	**$644,380**	**$2,934,218**	

MCGA = Manitoba Canola Growers Association, **RDAR** = Results Driven Agriculture Research, **WGRF** = Western Grains Research Foundation

Saskatchewan Farmers Needed for Research Trials

SaskOilseeds on-farm research trials program aims to address challenges and answer questions to help Saskatchewan farmers. We recruit cooperators each year prior to seeding.

What differentiates these trials from other trials?
These trials differ from regular strip trials as they are both replicated and randomized to account for any field variability. This makes the trials quite large, however having adequate data to properly analyze after harvest is crucial to being able to provide the cooperator and other farmers with results they can be confident in.

What are the perks of becoming a cooperator?
You get to trial a practice on your farm, using your equipment, and you'll have access to a research specialist the entire time. This means that the analyzed data will be specific to your farm – not a farm or research station miles away.

You'll join a network of like-minded farmers who are interested in on-farm, field-scale research. We partner with the other crop commissions to host a field tour during the summer, and a winter wrap up banquet. At this banquet, you will get the first access to all of the trial results. This means you'll not only see your trial results and the combined results of the protocol, but you'll also see the results from all other crop trials. These results will also be packaged in a booklet for you to take home.

To review trial results from the programs' first two years, for a more in-depth list of frequently asked questions about the program, to suggest a protocol, or to sign up as a new cooperator, visit **saskcanola.com/on-farm-research-trials**.

SaskOilseeds Awards 2024 Graduate Scholarships to Next Generation of Researchers

Every year, SaskOilseeds proudly awards two, two-year scholarships to graduate students conducting research related to canola or flax. In doing so, our goal is to build research capacity by investing in the future of the oilseeds industry. Congratulations to this year's recipients Cresilda Alinapon and Kate Sauser!

Cresilda is studying the molecular function of Plasmodiophora brassicae effector proteins to understand and combat clubroot disease in canola. The aim is to develop clubroot-resistant canola cultivars.

Kate is researching the impact of herbicide-tolerant canola and no-till practices on agricultural greenhouse gas emissions, carbon sequestration and sustainability in Saskatchewan, with the goal of informing policy to enhance sustainable practices and recognize farmers' contributions to climate change mitigation.

We would also like to recognize Nirpesh Dhakal and Hansanee Fernando who were awarded graduate scholarships in 2023 and continue their studies at the University of Saskatchewan.

Cresilda Alinapon
Biology

Hansanee Fernando
Plant Science

Kate Sauser
Agriculture & Resource Economics

Nirpesh Dhakal
Chemical Engineering

Applied Research Program – On-Farm Research

Manitoba Canola Grower Association's Canola On-Farm Research program hit the fields again in 2024 for its third season. The table describes the five different trial types. MCGA partnered with agronomists across the province to work with farmers to establish trials, collect in-season data and harvest trials. Trials provide farmers with valuable applied data on how new products and best management practices perform on a wide range of farm operations across the province.

Scan the QR code to learn more about on-farm research!

Trial Type	Year	Research Questions	Treatments	Number of locations, 2024
Nitrogen (N) rate	3	Are N rates being applied across Manitoba sufficient for optimizing yield and return on investment?	Normal rate (100%), 75% and 125% Farmers choice of N source	5
Seeding rate	3	How are seeding rates influencing emergence and yield of canola across Manitoba?	Normal rate (100%), 75%, and 125%	6
Seed-placed fertilizer (SPF) toxicity	2	Are SPF applications being used across Manitoba safe for canola plant establishment and what are the major factors influencing seed safety?	No SPF, 100% SPF rate, 150% SPF rate Farmers choice SPF source	19
Phosphorus (P) source	1	How does P source influence canola yield and P uptake?	Standard P source vs. Competitor P source of farmers choice P sources tested in 2024 include: Alpine G22, MST, TopPhos, Crystal Green Synchro	4
Cover crops for flea beetle management (in partnership with University of Manitoba)	1	How does the incorporation of cover crops influence flea beetle pressure in canola?	No cover crop vs. cover crop (fall rye or oat)	4

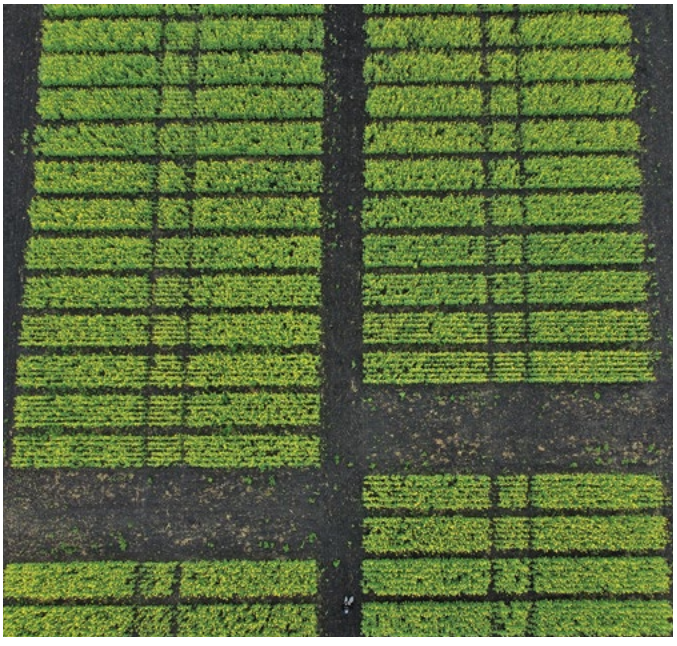
Visit our website at **canolagrowers.com** for 2022 and 2023 trial results, and stay tuned for 2024 data, which will be available in early December.

Applied Research Program - Canola Variety Evaluation Trials

MCGA strongly supports the independent evaluation of commercial canola varieties marketed to farmers across the province. This season MCGA launched a provincial Canola Variety Evaluation Trial (CVET) program to replace the prairie-wide program, Canola Performance Trials (CPT), that ended in 2022.

During the winter of 2023-24, MCGA worked to gain support from the canola seed industry and develop a protocol that would accurately represent canola varietal performance in fields across Manitoba for the 2024 pilot season. Trials showcased 18 varieties at six locations across the province – Swan River, Hamiota, Melita, Carman, Holland and Rosser. Unfortunately the Swan River location was cancelled due to early-season conditions. Growers can get results from the remaining five locations through MCGA and Seed Manitoba publications as well as winter extension events such as AgDays.

As MCGA continues to build this program, the organization aims to highlight the value of independent variety testing for farmers across the province. It hopes that all seed companies will participate in the future to provide a well-rounded evaluation of the canola seed market.



↑ Research Trial in Rosser, Manitoba
MCGA started its new Canola Variety Evaluation Trial (CVET) program at six sites – Swan River, Hamiota, Melita, Carman, Holland and Rosser.

15 years of oil and meal research

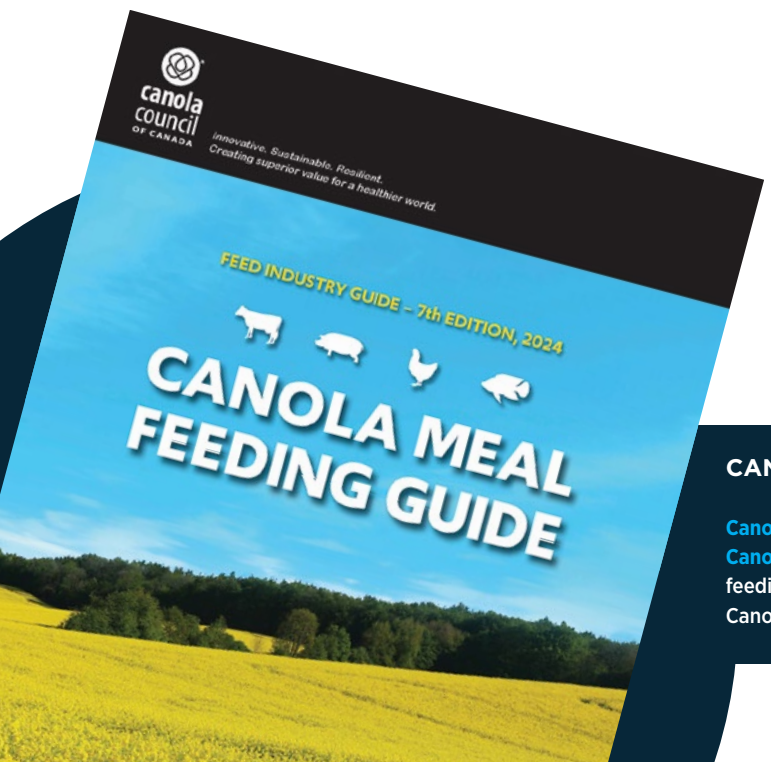
Canola Digest Science has focused on canola agronomy advancements since its first issue in 2013. Here is a quick review of canola oil and meal utilization research funded through the federal government's cluster programs.

Probably the most influential canola oil study from the past 15 years, says Shaunda Durance-Tod, was the "Canola oil multi-centre intervention trial (COMIT)." Durance-Tod is CanolaInfo manager for the Canola Council of Canada (CCC). The COMIT randomized controlled trial study evaluated human subjects at three sites – University of Manitoba in Winnipeg, Laval University in Quebec City and Penn State University in Pennsylvania.

The study, funded through the Government of Canada's Growing Forward 1 (2009-13) cluster program, examined how the composition of different dietary oils affects metabolic responses important in the development of cardiovascular diseases. Namely, the relationship between dietary oil consumption and arterial function, blood fat content and blood markers of cardiovascular disease risk. The study also examined how the body converts fat from dietary oils into other specific fat compounds with known health benefits. The COMIT study led to 10 published reports in medical journals, and provided more evidence of canola oil's health benefits. To find the 10 published reports, go to canolacouncil.org/research/oil/ and click on the COMIT study name.

Durance-Tod highlights another notable study, "Effect of canola oil as part of a low glycemic load diet on glucose control and coronary heart disease risk factors in type 2 diabetes." Conducted at the University of Toronto, the Growing Forward 1 study established canola oil as an effective means to lower the glycemic load of the healthy dietary component for people with type 2 diabetes and added to evidence of its health benefits.

> ***"This guide includes decades of research and is regularly revised to keep it up to date."***
>
> –Essi Evans



To see more on these studies and the other five canola oil and human health studies conducted over the past 15 years, go to canolacouncil.org/research/oil/. Several publications from these studies also influenced content at canolainfo.org, a consumer-facing website to describe canola oil's health benefits.

Canola meal in livestock diets

The most important Canola Council of Canada resource for canola meal customers is the Canola Meal Feeding Guide. Many researchers funded through the Government of Canada clusters over the past 15 years provided the published reports cited in the feeding guide, which has sections for dairy, hog, poultry and fish rations.

"Our goal has always been to ensure anyone formulating rations has the most accurate information possible," says Essi Evans, livestock nutrition specialist who advises the CCC and runs E&E Technical Advisory Services in Bowmanville, Ontario. "This guide includes decades of research and is regularly revised to keep it up to date."

Evans says the Growing Forward 1 study, "Maximize use of canola meal in high value dairy feeds," conducted in California, Wisconsin, South Dakota, Quebec and Saskatchewan, provided key information about canola meal amino acid utilization by dairy cows. Evans says the California experiments laid the groundwork for some additional studies that involved large numbers of cows. California dairies represent the biggest market for Canadian canola meal.

The Growing Forward 2 (2013-18) study, "Maximizing use of canola meal in dairy diets," also included U.S. dairy studies and Evans says results further supported the use of canola meal to boost milk production.

Researchers from University of California – Davis conducted the Canadian Agricultural Partnership (2018-23) study, "Evaluation of canola meal as compared to soybean meal in practical California rations: effects upon long term lactational performance, reproductive performance and metabolic disease," at Cloverdale Dairy, a large California farm.

The Canola Council of Canada, through these federal government funding partnerships, also supported research to evaluate and improve meal quality, and test canola meal in rations for pigs and chickens. Two new studies, funded in part through the Government of Canada under the Sustainable Canadian Agricultural Partnership, are looking at canola meal in fish diets.

Learn more about canola meal and download a free copy of the Canola Meal Feeding Guide, visit **canolamazing.com**.

CANOLA OIL AND MEAL RESOURCES

CanolaInfo.org is for consumers who want more health information on canola oil. Canolamazing.com is for livestock nutritionists who want more information about feeding canola meal to cattle, hogs, poultry and fish. That site also has the new Canola Meal Feeding Guide in PDF format.

Reaching out to Indigenous farmers

Breanna Miller and Jay Whetter, two Canola Council of Canada employees, spent the day on a National Circle for Indigenous Agriculture and Food (NCIAF) tour in August. They made a short presentation about canola and spent the rest of the day connecting with Indigenous farmers and National Circle staff.

BY JAY WHETTER

One of my favourite moments on the National Circle for Indigenous Agriculture and Food's "first annual" bus tour in August was watching Justice Acoose and Tianna Peepeetch take a moment together, away from the rest of the tour, to share their awe of Prairie crops. "I just love plants," Peepeetch said during a stop at the Indian Head Agricultural Research Foundation. I had shown them canola, mustard and lentil plants, and Peepeetch made this comment later while looking at a field of canaryseed, "People don't realize the opportunities in agriculture."

Acoose is the communications specialist with the National Circle for Indigenous Agriculture and Food (NCIAF) in Regina, Saskatchewan. Peepeetch is taking business administration at First Nations University of Canada, and was a summer intern for NCIAF, working with Acoose.

The National Circle is a new organization based in Regina and serving all of the Prairies, with the purpose to show Indigenous

Terry Lerat takes Jay Whetter and the bus tour to one of his canola fields (above and right). Lerat is an agriculture advisor for the National Circle for Indigenous Agriculture and Food, and runs 4C Farms at Cowessess First Nation, north of Broadview, Saskatchewan.

people the opportunities in agriculture. As it says on the website (nciaf.ca), the Indigenous-led, non-profit organization is dedicated to the advancement of reconciliation in the agriculture industry and the creation of a national dialogue for Indigenous agriculture.

In some cases, Indigenous agriculture will be more traditional, including bison ranching, collection and cultivation of native plants, and traditional Indigenous practices, such as intercropping and silviculture. However, one theme from the bus tour was a strong desire to also work within mainstream agriculture on the Prairies.

> ***"This proved to me, and to our chief and council, that we can do this ourselves."***
>
> — Terry Lerat

Terry Lerat is reconciliAG advisor for NCIAF and runs 4C Farms at Cowessess First Nation, north of Broadview, Saskatchewan. Lerat was on the bus tour and the tour stopped at his farm site and a few of his fields.

4C Farms started with 25 cows and a quarter section of land. In 2021, Lerat went to the Cowessess chief and council and asked, "would you let us farm our best land?". The goal, he says, "is to utilize our land to improve on the quality of life for our First Nations."

Cowessess has 17,000 acres under cultivation on its main reserve and another 85,000 or so in other blocks. Lerat would like 4C Farms to ultimately farm the whole 17,000 acres on the main reserve. The farm cropped 6,000 acres in 2024. This was also the first year 4C Farms did all the work with Indigenous management and labour. "This proved to me, and to our chief and council, that we can do this ourselves," he says.

Lerat head-hunted skilled workers to run the farm's modern fleet of equipment, which now includes two X9 John Deere combines. "I know those two combines are too much for 6,000 acres, but they're probably the right capacity for 10,000," he says. He expects the farm will grow quickly.

Lerat has high praise for the help and support he gets from local businesses, including the John Deere dealership in Yorkton, Viterra in Grenfell, Stone X in Brandon, and Hometown Co-op, which provides ag inputs and agronomy service.

As the farm grows, Lerat plans to bring younger people from Cowessess into the business. "The problem," he says, "is that most First Nation people are three generations removed from farming." That makes it a challenge to get young people interested. "We need to bring agriculture back into the classroom," he says. "The opportunities are so great, it's crazy."

Peepeetch says her "mission is to get our youth excited about agriculture." Acoose's LinkedIn profile says: "Passionate supporter of reigniting Indigenous peoples and communities' involvement in agriculture, agribusiness and food sovereignty." One of Acoose's goals is to promote programs for youth and education.

NCIAF aims to build Indigenous capacity for agriculture through awareness of opportunities, knowledge exchange, education, and skills development. For example, NCIAF assisted with Ochapowace Nation's community garden. "The garden has a youth representative who is currently studying at the First Nations University of Canada," Acoose says. "And the lead gardener and a member of Ochapowace is particularly passionate about engaging the youth with the garden."

Sonia Gardypie is lands manager at Mosquito, Grizzly Bear's Head and Lean Man First Nations in western Saskatchewan. She was on the tour along with her lands administrator Jamie Lewis. Lewis is taking lands manager training in Saskatoon.

Gardypie has a lot of energy and enthusiasm, and is guiding her First Nations in many new projects. For example, Mosquito First Nation will soon receive delivery of a herd of huge Yellowstone Bison. Gardypie wants to see First Nation farming succeed in community with the whole Prairies agriculture ecosystem. "We're all part of this together," she says.

The CCC has a goal to increase knowledge transfer to indigenous researchers and farmers. This work is funded in part through the Canola AgriScience Cluster, a five-year research program funded through Agriculture and Agri-Food Canada's Sustainable Canadian Agricultural Partnership. Attending the NCIAF tour allowed CCC staff to make initial connections that will help deliver canola research results to indigenous farmers.

–Jay Whetter is the editor of Canola Digest.

Study supports early seeding

KEY RESULT:

This study tested five seeding dates and clearly demonstrated that early seeding (May versus June) is a recommended practice to maximize canola yield potential and quality.

PROJECT NAME, PRINCIPAL INVESTIGATOR:
"Demonstrating benefits of seeding date and rate on canola yield and quality." Robin Lokken, Conservation Learning Centre; Gursahib Singh, Irrigation Crop Diversification Corporation; Brianne McInnes, Northeast Agriculture Research Foundation; Amber Wall, Wheatland Conservation Area.

FUNDING: SaskOilseeds

This study aimed to demonstrate how different seeding dates and rates can improve canola yield and quality. Researchers tested five seeding dates – starting with early May and then seeding plots every 10-14 days, ending with a late June planting. Each seeding date also included low and high seeding rates. Low seeding rate at the three dryland sites was 80 seeds per square metre and the high rate was 160 seeds per square metre.

Wheatland Conservation Area (WCA) in Swift Current, Northeast Agriculture Research Foundation (NARF) in Melfort, Irrigation Crop Diversification Corporation (ICDC) in Outlook, and Conservation Learning Centre (CLC) in Prince Albert each hosted these trials in 2023.

Results

Overall, yields decreased when canola was seeded late in June. Yield losses for these very late seeding trials were up to 48 per cent in Prince Albert, 50 per cent in Melfort, 87 per cent in Outlook, and 91 per cent in Swift Current. Late-seeded canola also had lower oil content. These yield and quality issues were related to issues with uniform dry down and harvest delayed to as late as October 25.

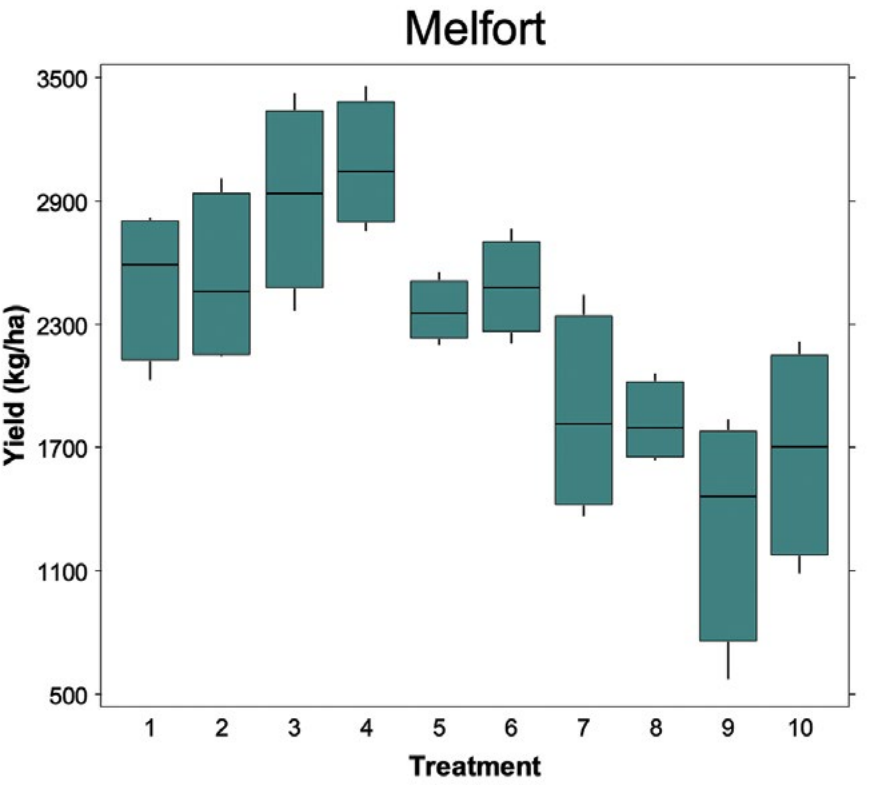
Seeding rates were included in this study to demonstrate how the practice can compensate for high seedling mortality during unfavourable growing conditions, especially for early seeded canola. In 2023, conditions were dry compared to long term averages, but anticipated risks such as high flea beetle pressure, cool soils and frost damage did not occur.

High seeding rates are still recommended to target minimum plant stands, as seed mortality was often 50 per cent or greater in these trials.

This study clearly demonstrated that, when spring conditions are favourable, early seeding is a recommended practice to maximize yield potential.

While difficult to predict the likelihood of flea beetle pressure in an upcoming growing season, it would be valuable to repeat this demonstration with higher flea beetle populations. Selecting an earlier seeding date could help showcase how less desirable growing conditions can affect canola yields and how seeding rates can help compensate and reduce yield losses. This trial was done again this year (2024) at NARF, ICDC, WCA and WARC. Seeding rates stayed the same, but seeding dates were earlier.

The full report, available at saskcanola.com/research-results, has specific seeding dates and agronomy information for each site, as well as yield and quality results for reach seeding date and rate.



Here are the yield results for Melfort. Only Melfort experienced flea beetle pressure on earlier seeded canola; populations did not meet economic thresholds and no yield differences were detected for low or high seeding rates. Odd-numbered bars are results for the low seeding rate of 80 seeds per square metres, even-numbered bars are the high rate of 160 seeds. Two bars per seeding date, starting with bars one and two seeded May 12 and ending with bars nine and 10 seeded June 19. While researchers believe slightly later seeding dates may be more appropriate than early seeding dates for striped flea beetles, pressure was not great enough in 2023 to capture this. →

The root microbiome changes based on nutrient need

KEY RESULT:

As researchers added phosphorus to the soil, microorganism diversity in the canola root microbiome went down. The roots didn't need to "recruit" as many microorganisms.

PROJECT NAME, PRINCIPAL INVESTIGATOR:
"Understanding canola root morphology and microbiomes in response to soil phosphorus fertility" Bobbi Helgason and associate Alex (Mengying) Liu, University of Saskatchewan; Leon Kochian, Global Institute for Food Security; David Schneider, U of S; Isobel Parkin, Agriculture and Agri-Food Canada Saskatoon

FUNDING: SaskOilseeds, Global Institute for Food Security

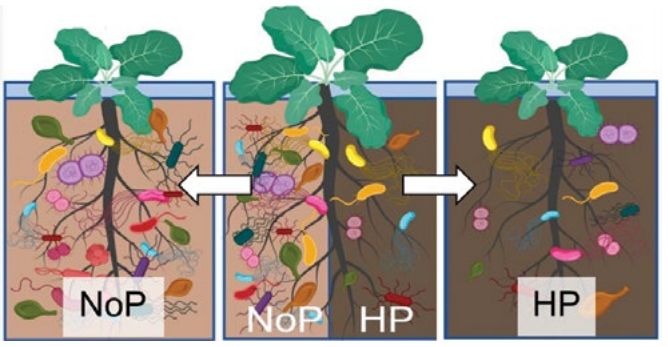
Canola plant roots assemble or recruit a community of microorganisms to help with nutrient uptake, and that community – the root-associated microbiome – changes depending on what the plant needs.

This study looked at the root-associated microbiome in soils with low and high levels of phosphorus (P). Researchers ran field studies at the Agriculture and Agri-Food Canada research farm at Scott, Saskatchewan and at the Conservation Learning Centre at Prince Albert, Saskatchewan. They also ran growth room experiments using Scott soil as a medium. Canola growing in narrow clear "rhizoboxes" allowed them to observe root growth patterns in the soil. Background levels of soil available P were considered minimally sufficient (with around 25 ppm of P).

Results

In general, as researchers added P to canola growing in controlled-condition rhizoboxes, microorganism diversity in the microbiome went down. Because sufficient P is there, plant roots perhaps don't recruit as much variety in the bacteria and fungi they associate with.

Interestingly, rhizobox studies showed that early canola growth was higher in plants where half of the root system was exposed to fertilized soil and the other half to unfertilized soil. Each half of the root system had a distinct root microbiome indicating that the root-microbiome system may confer the best advantage in soil where P availability is variable – as would be found in most field soils. This also supports the common practice of putting starter P in the seed row to give the crop an early jump and then letting lateral roots gather P from the soil.



↑ This graphic portrays the difference in plant microbiome response in rhizoboxes with added phosphorus (HP) and no added phosphorus (NoP), and canola growing in split rhizoboxes that provide both at once. Canola root shoot mass was highest in the split NoP, high P rhizobox.

Credit: Alex (Mengying) Liu

Researchers also observed that the abundance of fungal pathogens that cause blackleg and sclerotinia were correlated with the no-P application. The no-P application appeared to make plants more susceptible to these pathogens, although disease symptoms were not assessed.

Overall, the plant microbiome response to P was inconsistent in the field, reflecting the complex factors contributing to soil P availability and canola uptake. Higher baseline levels of P may have been a factor. Expected associations may not occur when P is not the most limiting factor in plant growth and the root-associated microbiome.

Humic acid study inconclusive

KEY RESULT:

This one-year study, conducted in 2023, observed no noticeable plant density and yield improvements by treating mono-ammonium phosphate (MAP) fertilizer with humic acid. Humic acid is an organic substance formed during plant decomposition. It is often promoted as a nutrient enhancer, but Saskatchewan has limited research. Unfortunately, drought and heat stress affected all trial locations in this one-year study. Researchers also note that the bulked nature of tissue samples impedes the ability to draw precise conclusions. They recommend further research with a more targeted approach.

STUDY NAME, PRINCIPAL INVESTIGATOR:
"Response of canola and flax to humic-acid-coated phosphorus fertilizer (MAP) rates" Gursahib Singh, Irrigation Crop Diversification Corporation; Robin Lokken, Conservation Learning Centre; Chris Holzapfel, Indian Head Agricultural Research Foundation; Mike Hall, East Central Research Foundation

FUNDING: SaskOilseeds

Try the soil health assessment tool

KEY RESULT:

To use the new soil health scoring tool, enter soil test results for key biological indicators and select the soil zone. The tool provides a soil health ranking and description of the relative soil health status for that sample.

PROJECT NAME, PRINCIPAL INVESTIGATOR:
"Enhancing the Saskatchewan Soil Health Assessment Protocol – Phase 2" Kate Congreves, Rich Farrell, Melissa Arcand, Athena Wu, University of Saskatchewan

FUNDING: SaskOilseeds, SaskWheat

This study evaluated biological indicators of soil health. These indicators include organic and total carbon, total nitrogen, mineralized carbon, extracellular enzyme activity, and phospholipid fatty acid (PLFA) analysis for microbial biomass and adaptation response ratio.

Researchers collected 153 soil samples from different fields in the Black, Dark Brown and Brown soil zones in Saskatchewan. They found that biological indicators of soil health generally improved with more regenerative crop production practices such as cover cropping.

Researchers used these results to develop a soil health scoring tool. Users input a soil test result for key biological indicators (i.e., soil organic carbon, total nitrogen, carbon dioxide mineralization, and PLFA microbial biomass) and select their soil zone. The tool provides a soil health ranking and description of the relative soil health status for their sample.

A test version of the tool is available at Kate Congreves' website: **researchers.usask.ca/kate-congreves/index.php**. Look under the Research tab.

Use SKSIS Mapper to make predictive field maps

KEY RESULT:

Saskatchewan farmers and agronomists can tap into Saskatchewan soil records online at mapper.sksis.ca to create predictive field maps and pinpoint soil test locations.

PROJECT NAME, PRINCIPAL INVESTIGATOR:
"SKSIS-3: Synergies and Sustainability for the Saskatchewan Soil Information System" Angela Bedard-Haughn, University of Saskatchewan

FUNDING: SaskOilseeds, SaskWheat, Saskatchewan's Agriculture Development Fund, Western Grains Research Foundation

Saskatchewan farmers can access detailed soil mapping through SKSIS Mapper at mapper.sksis.ca.

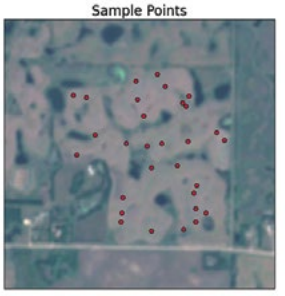
The Saskatchewan Soil Information System Working Group launched the platform, which allows users to understand how the soil varies across a field and use that to generate detailed predictive soil maps and identify soil sampling locations.

The platform also helps support the Saskatchewan Soil Information System (SKSIS) by creating a means to collect soil and environmental data that would not otherwise be accessible. It also generates funding to keep the project operational.

Through focus group interactions with agronomists and farmers, the SKSIS working group learned that farmers are willing to share their soil and environmental data so long as that data was not publicly available, and the purpose of that data collection was made clear. In working with the University of Saskatchewan Legal Counsel, the SKSIS working group defined a Terms of Service agreement that reflects those requirements.

SKSIS Mapper is currently free to use, but will transition to a paid service in 2025. A price of $0.10 per acre enables agronomy firms to offer predictive soil mapping through use of SKSIS Mapper, while keeping their fees affordable. The main map at **sksis.ca** will always remain free to use.

The SKSIS Offline desktop application further enhances the usefulness of SKSIS for informing field work in Saskatchewan. It does so by allowing users to download the soil survey information for a specified region so that it can be accessed and utilized in the field even when they are in regions of the province without network access.



↑ The tool to generate sampling locations provides coordinates as well as a simple map (shown) of the point locations across the site. The algorithm breaks the site down into terrain-derived slope position zones then uses a statistical method called the conditioned Latin hypercube sampling method to determine where to place the sample points within each slope position based on remote-sensing data.

Blackleg seed treatment helps in some scenarios

KEY RESULT:

Seed treatment could reduce early blackleg infection, depending on canola variety resistance.

PROJECT TITLE, PRINCIPAL INVESTIGATOR:
"Investigating interactions of ascospores and pycnidiospores with blackleg resistance in canola and efficacy of seed-applied fungicides in these specific interactions in Western Canada" Dilantha Fernando and Shuanglong Huang, University of Manitoba; Gary Peng, Agriculture and Agri-Food Canada Saskatoon

FUNDING: SaskOilseeds

This study suggests that genetic resistance is the most promising strategy to deal with blackleg disease. The study also shows that the infection caused by a mixture of ascospores and pycnidiospores led to the greatest blackleg aggressiveness.

Objectives of this study were to (1) develop a protocol to efficiently produce ascospore and pycnidiospore inoculum with defined virulence (Avr) profile for inoculation of canola seedlings in research and resistance screening by industry; (2) assess potential interactions of inoculum types (ascospores and pycnidiospores) with the variety resistance; and (3) evaluate the efficacy of seed-applied fungicides against the infection.

First, a quick refresher on the blackleg cycle. The *L. maculans* fungus overwinters on infected canola residue. In the spring, the fungus produces fruiting bodies, called pseudothecia and pycnidia (Figure 1), on infected canola residue. Pseudothecia may continue to be produced on infected residue for several years until the infected residue breaks down. Pseudothecia release small microscopic sexual spores, called ascospores (Figure 2A), resulting in long distance dispersal of the disease to newly planted canola crops. Ascospores are considered the primary inoculum. During the growing season, the pathogen also produces another type of fruiting body called pycnidia that appear as pepper-like spots within lesions. From the pycnidia ooze masses of tiny spores called pycnidiospores (Figure 2B). These spores spread short distances by rain splash and wind, and cause secondary infection within a crop. Infected stubble can continue to produce pycnidiospores for three to five years.

Results

Objective 1. Researchers developed protocols to produce ascospores and pycnidiospores in the lab, and used these lab-reared spores to test canola materials for blackleg resistance in both controlled environment and field conditions.

Objective 2. Researchers inoculated a panel of 17 commercial canola lines with ascospores, pycnidiospores and a combination of the two and assessed for seedling and quantitative resistance. Field experiments carried out in Carman, Manitoba and Melfort, Saskatchewan in 2022 and 2023 indicated that the mixture of ascospores and pycnidiospores exhibited the greatest aggressiveness level. Ascospores were the next most aggressive. Indoor experiments came to the same conclusion. With infected stubble likely to produce both types of spores, longer breaks between canola crops – allowing stubble to decompose – remains an effective management practice.

Objective 3. When researchers applied ascospores and pycnidiospores directly into canola plants through fresh wounds, fluopyram seed treatment reduced blackleg, relative to non-treated control. However, the treatment made little difference on resistant varieties where the disease levels were low. This is likely because this infection came later after the fungicide effect waned. In short, seed treatment could improve canola plants from blackleg spores that enter early through wounds on cotyledons. Insect feeding is a common cause for these wounds.

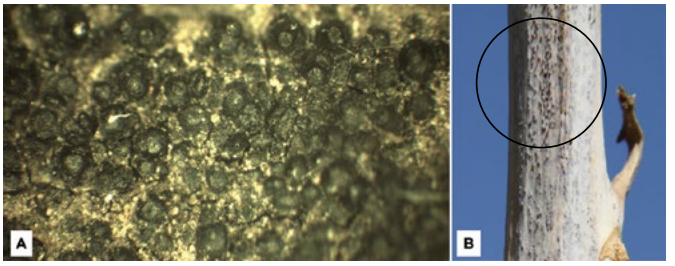


Figure 1

↑ The blackleg fungus produces dark-coloured fruiting bodies, called pseudothecia (A) and pycnidia (B) on canola stubble.

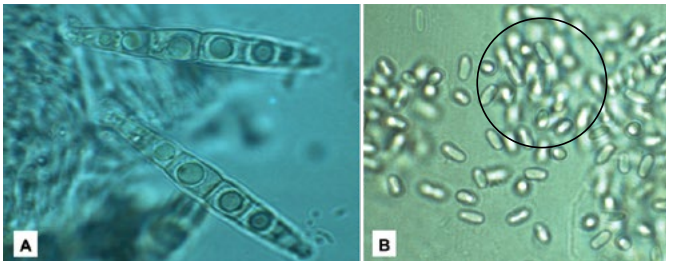


Figure 2

↑ Ascospores (A) and pycnidiospores (B) released respectively from pseudothecia and pycnidia produced by the blackleg fungus on canola stubble.

Advances in verticillium stripe identification and assessment

KEY RESULT:

Verticillium stripe can affect seedling establishment and crop growth before affecting tissues in the stem to reduce yield. Seedling and adult stage disease look different and new disease assessment scales were developed for both. This will be necessary for evaluating host resistance. Extra measures to control blackleg may be needed where verticillium stripe is present.

PROJECT TITLE, PRINCIPAL INVESTIGATOR:
"Verticillium Stripe – The Disease Management" Sheau-Fang Hwang and Stephen Strelkov, University of Alberta

FUNDING: SaskOilseeds

One goal of this five-year project was to help farmers and industry predict the impact of verticillium stripe. Other objectives were to facilitate more efficient research into verticillium stripe going forward and to screen genetic material for resistance to the pathogen more effectively. To accomplish all of this, the research team investigated verticillium stripe disease development, evaluated canola genotypes for resistance and examined its interactions with blackleg.

Within this study, researchers measured yield losses in two ways: on a per-plant basis by growing plants in micro-plots inoculated at different densities, and by growing plants in six by 1.5 metre field plots harvested by a small plot combine. They used greenhouse experiments to determine interactions between blackleg and verticillium stripe.


A field scouting guide for canola producers

Is it verticillium stripe or blackleg?

Blackleg and **verticillium stripe** can both cause stunting, leaf chlorosis, lodging, dieback and premature ripening symptoms. Use this guide to differentiate between these two diseases when scouting your canola crops.

STEP 1: Check external symptoms

Blackleg is a stubble-borne disease caused by a fungus that favours wet/warm conditions. Though infection happens in spring, these symptoms are easier to identify later in the growing season:

- Cankering at the base of the stem where it becomes woody. Basal stem lesions may be blackened at the base, with stem tissue constricted or pinched at the soil surface **(A)**.
- Lesions on cotyledons, leaves and stems, usually at the base or points of leaf attachment **(B)**.
- Under moist weather conditions, a viscous pink liquid carrying the pycnidiospores ooze from pycnidia **(C)**.
- Dotting of numerous small, black round pycnidia **(D)**.

A B C D

Verticillium stripe is a soil-borne disease caused by a fungus that favours infection in stressed canola plants under dry/hot conditions. It is easiest to identify just prior to swath timing or immediately after harvest (prior to decomposition) by:

- Partial stem senescence on one side (half) of the stem **(A)**.
- Peeling back of the outer stem (epidermis) and faint black vertical striping on stems which darkens with maturity **(B)**.
- Shredding and breakdown of the vascular system or inner stem (without sclerotinia-causing sclerotia) **(C)**.
- Late in the season, tiny black ("peppery" looking) microsclerotia (smaller than blackleg pycnidia) occur on stems **(D)**.

A B C D

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← Some of the results and photos from this research contributed to this verticillium stripe field scouting guide which is available on the Canola Council website at:

Results

Verticillium stripe infecting canola in the early stages inhibited canola establishment and growth. Later infection led to deterioration of the stem and vascular tissues. Infection at both stages affected yield and yield loss increased as the infections became more severe. Yield loss occurred without obvious symptoms under low moisture.

A 0-6 assessment scale was proposed to evaluate disease severity in canola seedlings, and a 0-4 scale was developed for this evaluation in mature plants. The capacity to assess disease at different growth stages is important for distinguishing between different types of resistance (such as quantitative vs. qualitative) that may be active at different times, and provides a measure of disease progression. Canola breeders could use the scale to evaluate the disease in canola breeding lines.

Researchers also improved methods for inoculating canola with the verticillium stripe-causing fungus, *Verticillium longisporum*. This is important for screening canola germplasm and more accurately evaluating resistance in canola.

Blackleg or verticillium stripe?

Greenhouse experiments conducted as part of this research found that canola infected with both blackleg and verticillium stripe showed increased blackleg severity, but blackleg didn't increase the severity of verticillium stripe.

Verticillium stripe symptoms were observed and recorded, including ways to differentiate it from blackleg. This includes:

- Microsclerotia of *V. longisporum* (the pathogen that leads to verticillium stripe) were much smaller and greyer than the pycnidia produced by *L. maculans* (the pathogen that leads to blackleg).
- While verticillium stripe and blackleg both cause vascular discolouration, the cross-sections at the base of the stem of plants with blackleg were darker (black) and more discrete than the grey, more diffuse verticillium stripe-infected stems.
- In blackleg-infected plants, the vascular discolouration was restricted to the lower stem, affecting the cortex and epidermis. In contrast, plants infected by verticillium stripe had symptoms extending up the stem, with a hollow, darker centre. When plants were infected by both diseases, longitudinal sections revealed a hollow and darker centre together with black discolouration of the cortex and epidermis.

Crop rotation reduces clubroot risk

KEY RESULT:

The treatments (liming, grassing, gypsum) did not consistently have a measurable effect on spore concentrations relative to the bare soil control. The best clubroot management practices remain rotation breaks between host canola crops and the use of resistant cultivars.

PROJECT TITLE, PRINCIPAL INVESTIGATOR:
"Managing small patches of clubroot infestation in canola fields" Bruce D. Gossen, Tim Dumonceaux, Agriculture and Agri-Food Canada Saskatoon; Mary Ruth McDonald, University of Guelph

FUNDING: SaskOilseeds, Manitoba Canola Growers, DL Seeds, Manitoba Agriculture, Graymont

Genetic resistance is effective against clubroot but can break down quickly. Plant breeders are also falling behind in developing cultivars resistant to the many newer clubroot pathotypes. As a result, farmers need effective ways to manage clubroot in situations where genetic resistance is not yet available or where high spore numbers increase the risk of a breakdown in resistance.

Researchers conducted this study to provide farmers with practical approaches to minimize the risk of clubroot spreading from small patches in newly infested fields. Their results are also applicable to managing hot spots of new pathotypes in fields where the pathogen is already established.

One of the first outputs of the study was an improved method to quantify the numbers of resting spores in soil using a molecular approach known as digital drop PCR (ddPCR). This approach was less expensive, more accurate and more robust than previous methods, so it was used throughout the study.

The study examined the effect of liming and grass cover crops on survival of resting spores of *P. brassicae* in short-term studies under controlled conditions and in commercial fields over several years.

Researchers conducted field-site experiments on a wide range of soil types (clay, loam, sand) with a range of soil pH (5.5-7.0) at sites in Alberta, Saskatchewan and Manitoba.

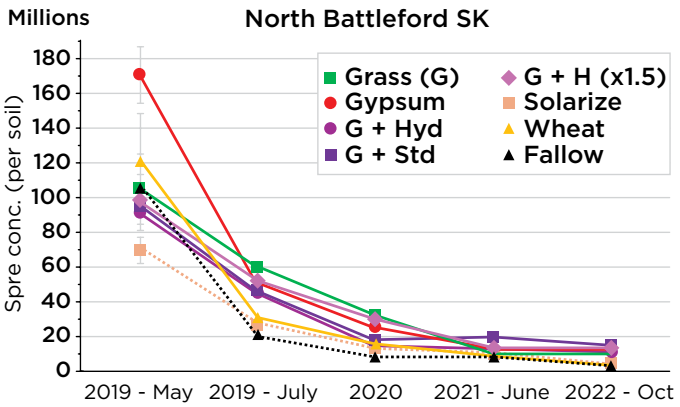
Results

In short, the treatments (liming, grassing, gypsum) did not consistently have a measurable effect on spore concentrations relative to the bare soil control.

- Short-term dense planting of grass and cereal crops produced a small reduction in resting spore concentration in infested soil. However, this effect was not detectable at field sites, regardless of soil type or pH.
- Application of lime did not reduce spore numbers relative to the untreated control. The target pH for liming treatments was 7.5, but it was difficult to maintain that pH at sites with highly acidic soil.
- Long-term perennial grass cover crop on clubroot patches did not, on its own, reduce spores but did hold soil in place. This minimizes movement of infested soil by wind and water erosion as well as the risk of contaminating farm machinery and other vehicles driven across the infested patch.

In closing, this study strongly supports the recommendation that growers extend crop rotations in clubroot-infested fields to at least two to three years (longer is better) between susceptible crops. This allows the spore concentration in infested areas to fall, which reduces the risk of spreading spores and breakdown of resistance.

The study also confirmed that growers should always select resistant cultivars for use in infested fields, because high numbers of clubroot spores were almost always still present after five years of non-host crops.



↑ Here are results from field trials at North Battleford. Interestingly, all of the sites had quite variable starting clubroot spore levels for each treatment. This is not a treatment effect. Gossen says this points to large differences in spore numbers within small areas. The key message is that years out of canola (time) is more important to reduce spores than any individual treatment. Grass mix only (G), grass and gypsum (Gypsum), grass and standard lime (G + Std), grass and hydrated lime (G + Hyd), grass and 1.5X hydrated lime (G + Hx1.5), wheat, solarization (which included two weeks under impermeable film), bare soil control (Fallow).

Over-fertilization may increase clubroot

KEY RESULT:

While recommended fertilizer rates are required to improve overall plant growth and yield, over-fertilization may contribute to increased *P. brassicae* inoculum loads and greater clubroot pressure over the long term.

PROJECT TITLE, PRINCIPAL INVESTIGATOR:
"Study of the effects of Brassica root architecture and fertilizer application on clubroot disease severity and yield" Stephen Strelkov, University of Alberta, with Rudolph Fredua-Agyeman, Sheau-Fang Hwang, Linda Gorim and Jocelyn Ozga

FUNDING: Alberta Canola, Western Grains Research Foundation, Results Driven Agriculture Research

Clubroot targets canola roots, but not many studies in clubroot have focused on root traits or how nutrients may influence infected roots.

This project examined the role of root architecture and nutrient supply on both the severity of clubroot disease (caused by *Plasmodiophora brassicae*) and root traits to determine if root-type is an important trait to consider for clubroot resistance, understand the effects of nitrogen levels on clubroot resistance, and create a foundation for understanding genetic control of root morphology.

Researchers assessed 379 brassica lines for differences in root size, and selected 96 for this study. Only some were *Brassica napus*, the primary canola species. They grew these lines in greenhouse tubs using a soilless mix inoculated with *P. brassicae* pathotypes 3A and 3H. They also compared results for three fertilizer treatments – a nitrogen, phosphorus and potassium (20:20:20) mix at regular, high (4x) and no fertilizer rates.

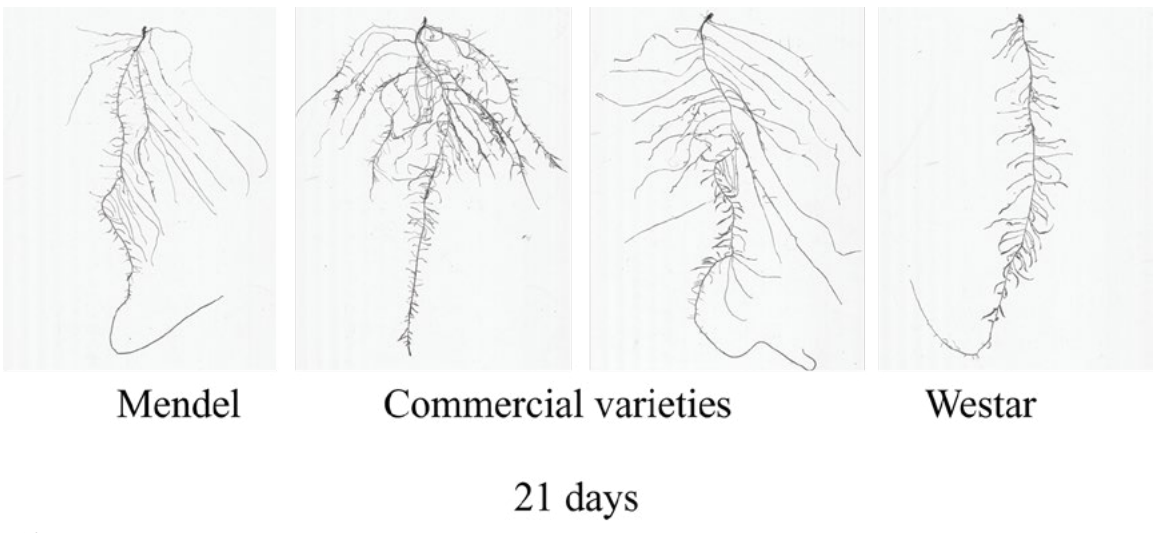
Eight weeks after inoculation, researchers uprooted and washed the plants and assessed their clubroot severity.

Results

Root architecture and clubroot. The lines tested produced wildly different root lengths. *B. napus* and *B. oleracea* possessed the largest and most complex root systems. This degree of variability with the Brassica family, significantly influenced by genotype and species, indicates strong potential to breed for root architecture suitable to different growing conditions – dry, compacted, saline soils on one hand or highly productive soils on the other. In this study, the brassica species with the smallest root system – *B. nigra* – appears to show the greatest resistance to clubroot. This resistance may simply result from the smaller root system actually escaping (not reaching) clubroot spores.

Nutrient rates and clubroot. Clubroot symptoms developed five to 10 days earlier in plants fertilized with nitrogen, phosphorus and potassium at recommended and higher rates compared to unfertilized plants. However, after eight weeks, no significant differences in clubroot severity were observed. Conversely, fresh and dry gall weights significantly increased in the two treatments with fertilizer compared to the unfertilized treatment. Plant height, number of branches, and silique count were also significantly higher in fertilized treatments. Therefore, while fertilizer accelerated the onset of clubroot and promoted larger galls, fertilizer also significantly enhanced yield parameters.

While recommended fertilizer rates are required to improve overall plant growth and yield, over-fertilization may contribute to increased *P. brassicae* inoculum loads and greater disease pressure over the long term.



← These images compare root systems for Westar, the European oilseed rape Mendel and two modern Canadian canola cultivars after 21 days of growth in semi-hydroponic system.
Credit: Chunxiao Rai Yang

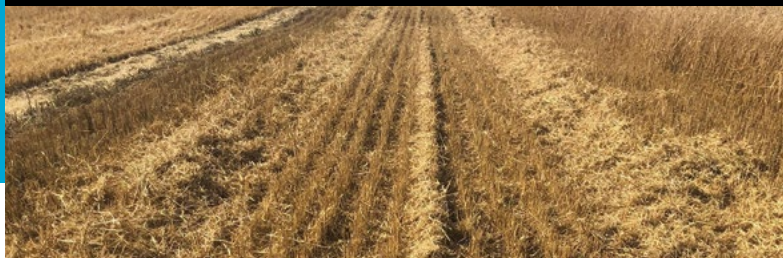
Chaff lining not an effective herbicide alternative

KEY RESULT:

Chaff lining concentrates chaff (including harvested weed seeds) into a narrow line behind the combine, with the goal to smother weed seeds in chaff. In this study, chaff lining did reduce weed emergence, but did not actually reduce the weed seed bank. Weed seed viability was not reduced after overwintering under the chaff line, and in most cases increased compared to overwintering on bare ground. Where canola seeding rows intersected chaff lines, canola emergence dropped by about 50 plants per square metre, on average.

PROJECT TITLE, PRINCIPAL INVESTIGATOR:
"Suitability and efficacy of chaff lining for weed control in Western Canada" Breanne Tidemann, Agriculture and Agri-Food Canada, Lacombe

FUNDING: Alberta Canola



↑ The narrows strips are chaff lines. Credit: Ryan Malmgren.

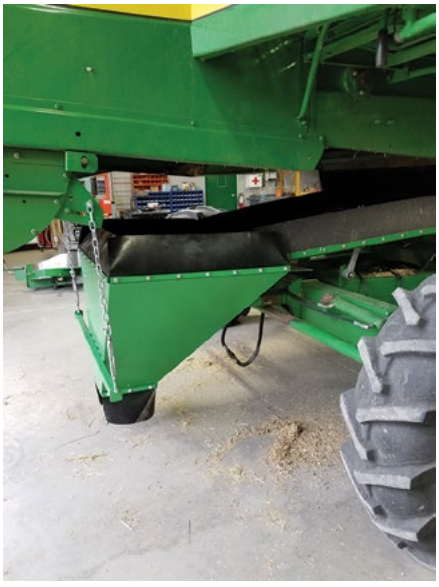
Chaff lining is one way to limit the spread of seeds from herbicide-resistant weeds out the back of the combine. But does chaff lining work, and what do these lines mean for soil fertility and crop emergence?

Researchers took on this study because Western Canadian farmers need easily implemented and effective non-chemical weed control methods to support herbicides, and reduce the economic cost of herbicide-resistant weeds.

Harvest weed seed control is a group of non-chemical weed control techniques. They include narrow windrow burning, chaff lining, chaff collection, bale direct systems and physical impact mill systems. Expert opinion expects physical impact mills – the combine-mounted weed seed destroyers – to be the most likely harvest weed seed control technique to be adopted on a large scale in Western Canada. These mills have high levels of efficacy and reduced requirements for additional management. The principal investigator has previously studied physical impact mills.

This project is about chaff lining, which concentrates the chaff into a narrow line behind the combine. The goal is to block weed seed emergence by smothering seeds in chaff. A chaff lining chute costs about $5,000 and cheaper versions could be made in the shop. Chaff lining allows straw to be spread as normal, and requires no post-harvest management. The project compared three different combines, three locations and four crops – canola, peas, wheat and barley or rye.

Objectives are to investigate seed viability of wild oat, cleavers, volunteer canola, kochia, green foxtail and wild buckwheat after an overwintering period under and beside chaff lines. Researchers also investigated weed seed movement and capture in chaff lines, crop and weed emergence after chaff lining, and the impact of chaff lines on soil fertility and plant nutrient status.



↑ AAFC had this chaff lining chute built specifically for this project. It cost about $5,000. Credit: Louis Molnar

Results

Chaff lining did not perform well in this study.

- Weed seed viability was not reduced after overwintering under the chaff line, and in most cases increased compared to overwintering on bare ground. The only exception was kochia seeds under the pea chaff line. (33 per cent of kochia seeds were viable after overwintering outside the chaff line, and 15 per cent in the pea chaff line.)
- While weed emergence was reduced in chaff lines and the researchers successfully collected a number of weeds in the chaff line, crop emergence where crop seeding rows intersected the chaff lines was also reduced. Chaff lines reduced canola emergence by about 50 plants per square metre, on average.
- Nutrients can be concentrated under the chaff lines, but it was highly inconsistent between sites and requires further investigation.
- Chaff lining may be more effective on small-seeded broadleaf weeds. It is less effective on larger-seeded weeds.

This study demonstrated that while chaff lining can reduce weed emergence, it does not reduce weed seed viability, can impact crop emergence, and efficacy is dependent on the amount of chaff produced.

Lower auxin response decreased clubroot severity

KEY RESULT:

The clubroot pathogen uses the plant's hormone auxin to help make galls. Canola plants with less auxin response have lower clubroot severity.

PROJECT NAME, PRINCIPAL INVESTIGATOR: "Increasing abiotic (drought) and biotic (clubroot) resistance in Brassica species (Arabidopsis and Canola) by modifying auxin response" Jocelyn Ozga, Stephen Strelkov, Guanqun Chen, Sheau-Fang Hwang, University of Alberta

FUNDING: SaskOilseeds, Alberta Canola, Natural Sciences and Engineering Research Council of Canada

Auxin is a natural plant-growth hormone in all plants. The clubroot pathogen may actually use that auxin to develop galls. If brassica plants have lower auxin response, would clubroot disease severity drop?

To test that question, researchers started with the canola relative arabidopsis. They used transgenics to insert a pea auxin receptor gene into arabidopsis, and it reduced the arabidopsis auxin response and decreased clubroot severity. They then inserted this pea gene into canola. Canola transgenic lines expressing the pea auxin receptor also showed reduced clubroot disease symptoms. Reducing auxin response is a potential mechanism to partially suppress clubroot progression in future canola cultivars.

Progress on drought-tolerant canola

KEY RESULT:

When researchers use gene-editing and RNAi to suppress the Kanghan gene family in canola, the crop seems to have higher drought tolerance.

PROJECT NAME, PRINCIPAL INVESTIGATOR: "Drought tolerance in canola through modulating the Kanghan (KH) gene family" Jitao Zou, Wenyun Shen, Hui Yang, National Research Council

FUNDING: SaskOilseeds, Manitoba Canola Growers, Western Grains Research Federation

Researchers tested transgenic introduction of single genes for drought tolerance with limited success. However, canola lines with the Kanghan (KH) family of genes suppressed, or turned off, could produce higher yields under drought conditions.

Growth chamber assessment demonstrated that RNA interference (RNAi) of the KH gene family in canola leads to drastically improved drought tolerance. Researchers then moved to confined field trials in the Okanagan Valley of British Columbia to assess water-limited yield potential under field conditions. This project also conducted CRISPR gene editing of the KH genes in canola to generate stable knockout lines with improved drought tolerance.

The Okanagan trial seasons were excessively dry and hot, and there was noticeable unevenness of soil quality at different sections of the trial site. Even so, some of RNAi lines performed better than the control. Also, during the 2023 growing season, the RNAi lines with better yield displayed consistent yield advantage across a majority of trial subsections.

Clearing a path for capturing diversity

KEY RESULT:

Researchers identified a gene in canola responsible for protecting genetic purity. Controlling this gene could make it easier to "diversify" the canola genome, and introduce more yield-resilient canola cultivars.

PROJECT NAME, PRINCIPAL INVESTIGATOR: "Manipulating recombination in crop polyploids" Isobel Parkin, AAFC Saskatoon

FUNDING: SaskOilseeds, SaskWheat, Agriculture and Agri-Food Canada, National Research Council

Canola and wheat are complex polyploid species – species with multiple sets of chromosomes – with mechanisms within their DNA to strongly protect genetic purity. These mechanisms can make it difficult to introduce new diversity, especially from wild relatives, which often carry useful resistance to common stresses. By manipulating these mechanisms it is possible to encourage exchange of genetic material within and between species and to potentially speed up the process of plant breeding. This project aimed to identify key genes involved in this mechanism, and use that knowledge to pave a pathway to more readily manipulate the genome of complex crops.

Genetic analyses of canola identified three quantitative trait loci (QTL) – bits of genetic material – involved in this mechanism. One, called the Brassica Ph1 gene, is particularly strong. Controlling that gene has applications for both increasing stability in canola, which ensures yield performance, and disrupting recombination in order to introduce new genetic variation. This could allow breeders to improve complex traits that lead to more yield-resilient canola cultivars.

Second-generation clubroot resistance wildly inconsistent

KEY RESULT:

Growers cannot assume second generation clubroot resistance is "enhanced" resistance.

PROJECT NAME, PRINCIPAL INVESTIGATOR:
"New clubroot pathotypes and second generation resistance" Stephen Strelkov, Sheau-Fang Hwang, Rudolph Fredua-Agyeman, Keisha Hollman, Emilee Storfie, Victor Manolii, University of Alberta

FUNDING: SaskOilseeds, Alberta Canola, Western Grains Research Foundation

The first generation of canola resistance introduced to Canadian canola cultivars all came from the same source, a European cultivar called Mendel. Second generation resistance comes from various sources, and results from this study show a great deal of inconsistency in their reactions to clubroot.

Prairie soils have a growing number of clubroot pathotypes, which can change in response to the host grown in the field. This presents a challenge for genetic resistance, a critical tool for clubroot management. Second-generation resistance offers promise against pathotypes that can overcome first-generation resistance.

Researchers conducted annual surveys to assess the occurrence of clubroot on canola with second-generation resistance. They extracted resting spores from symptomatic canola roots, with the spores obtained from one plant regarded as one field isolate. And they evaluated isolates for pathotype classification on the Canadian Clubroot Differential set and for virulence on seven canola cultivars with second-generation resistance and three control host varieties.

Some second-generation cultivars evaluated in this study exhibited significantly improved resistance to pathogen isolates that were virulent on first-generation resistance. Other second-generation cultivars had resistance profiles that were either similar or notably inferior to first-generation resistance.

Key advances in blackleg breeding

KEY RESULT:

An indoor quantitative trait loci (QTL) test will reduce the time required to identify and incorporate adult plant resistance genes into commercial canola varieties.

PROJECT NAME, PRINCIPAL INVESTIGATOR:
"Towards better understanding of genetics in *Leptosphaeria-Brassica* interactions via international collaborations to standardize the nomenclature of blackleg resistance genes" Hossein Borhan, Gary Peng, Agriculture and Agri-Food Canada Saskatoon; Dilantha Fernando, University of Manitoba

FUNDING: SaskOilseeds, Alberta Canola, Manitoba Canola Growers

This project validated an indoor quantitative trait loci (QTL) test that will reduce the time required to identify and incorporate adult plant resistance genes into commercial canola varieties. A round of indoor screening using this new method takes 10 to 12 weeks. Field-based screening provides one round per growing season. The indoor test also eliminates environmental variations that impact the field results.

This project also developed five new *Brassica napus* (canola) lines with single resistance (R) genes. Researchers provided these lines to canola breeders to generate canola varieties with highly effective R genes against blackleg. They also developed and validated additional markers to determine blackleg pathogen races and the R gene profile of canola cultivars.

Through a collaboration among Canadian research labs and researchers in Australia and France, these investigators developed a common set of blackleg pathogen races, *Brassica napus* lines with single R genes, tools such as markers for genotyping pathogen and plant, and protocols for adult plant resistant gene screening. They also developed tools to identify the specific virulence gene AvrLms-Lep2.

Faster blackleg and clubroot tests

KEY RESULT:

Researchers developed a faster and more accurate way to scan plant and soil samples for blackleg pathogen races and clubroot pathotypes.

PROJECT NAME, PRINCIPAL INVESTIGATOR:
"From field to the genome – application of third generation sequencing to direct genotyping of canola pathogens" Hossein Borhan, Tim Dumonceaux, Agriculture and Agri-Food Canada Saskatoon; Stephen Strelkov, University of Alberta

FUNDING: SaskOilseeds, Alberta Canola

This project developed a high-throughput and accurate pathogen genotyping method to determine the blackleg pathogen races present in canola stems and clubroot pathotypes present in root galls and soil samples. The method is much faster and precise than the PCR-based system, and can also identify several other fungal pathogens on the same samples.

Knowledge of pathogen races is essential for the successful prevention of crop pathogens. Plant pathogen virulence genes, also known as effectors, can mutate rapidly and generate new pathogen races/pathotypes that overcome disease-resistant varieties. Detecting and tracking changes in the effector genes of pathogens is important for crop disease management.

Unlike PCR markers, targeted sequencing not only identifies known mutations in the genes of interest but also detects new mutations. Commercial labs would need sequencing capability and training to use these tests.

Beneficial nematodes feed on cutworms, root maggots

KEY RESULT:

Native entomopathogenic nematodes (EPNs) have potential for biocontrol of cutworms and canola root maggots, performing fairly well when compared to introduced commercial species.

PROJECT TITLE, PRINCIPAL INVESTIGATOR:

"Exploring further possibilities and advancements of using bio-control entomopathogenic nematodes (EPNs) for the management of insect pests in Alberta" Shabeg Briar, Olds College of Agriculture & Technology

FUNDING: Alberta Canola, Results Driven Agriculture Research

Cabbage root maggot and cutworms can cause developmental delay, lodging and yield losses in canola. Canola growers could benefit from alternative sustainable methods to manage below ground pest populations effectively.

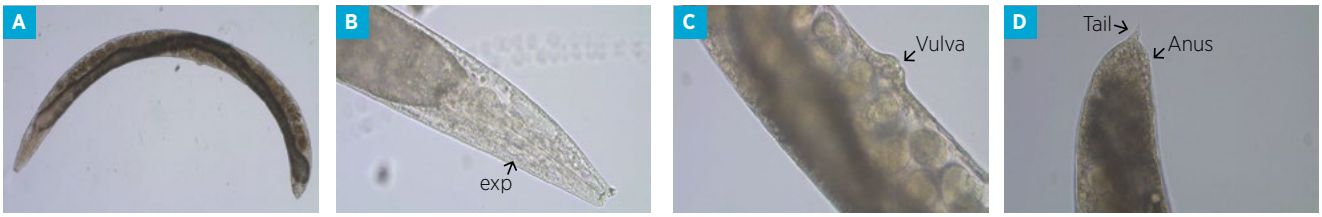
Entomopathogenic nematodes (EPNs) are known predatory nematodes of many insects. This project will assess the management of cabbage root maggots and cutworms using commercially available (*Steinernema feltiae* and *Steinernema kraussei*) EPN species and native EPN (s213) strains in both the lab and greenhouse to determine the persistence of EPNs in Prairie soils.

Results

S213 showed comparable efficacy to commercial strains against cutworms – equally effective as *S. feltiae* and *S. kraussei*. Moreover, s213 and *S. feltiae* significantly outperformed *S. kraussei* in controlling maggots. Regarding persistence, *S. feltiae* demonstrated superior long-term efficacy, although all strains showed consistent persistence in soil.

This study highlights the potential of native EPNs as viable biocontrol agents. It stresses the importance of considering factors like dose, persistence and impact on plant health in EPN-based pest management strategies.

For growers, the use of EPNs can contribute to integrative pest management through limiting the use of insecticides while protecting canola crops. This can save on chemical costs and contribute to maximum yield potential.



Steinernema feltiae- s213- gravid female; A: Entire body of gravid female; B: Head region; C: Vulval region, D: Tail regions; Scale bars: B-D = 100 µm. exp= secretory excretory pore

Striped and crucifer flea beetles do not compete

KEY RESULT:

In most cases (but not all), striped flea beetles will emerge about one to two weeks before crucifer flea beetles. Their early arrival does not seem to have any negative effect on crucifer flea beetle activity.

PROJECT TITLE, PRINCIPAL INVESTIGATOR:

"Incorporation of abiotic and biotic factors for development of stage-structured predictive models of flea beetles on canola in Alberta" Maya Evenden and associate Sharavari Kulkarni, University of Alberta

FUNDING: Alberta Canola, Results Driven Agriculture Research

Both striped and crucifer flea beetles pose significant damage to canola, but how do they interact? And does this interaction affect crop damage? This project developed a weather-dependent, stage-structured developmental model for striped and crucifer flea beetles. The goal is to determine temperature-driven development of flea beetles and interspecific competition under different biotic and abiotic conditions.

Results

Striped flea beetle development in the spring begins at 8°C, and adult emergence in Alberta can peak between 150 and 200 degree days using this 8°C base. (This is the same calculation used for growing degree days.) Crucifer flea beetle development in the spring begins at 11°C, and activity will likely peak between 125 and 200 degree days using the 11°C base. Canola growers and agronomists can use this to predict peak flea beetle activity in an area.

In practical terms, striped flea beetles will usually emerge one to two weeks before crucifer flea beetles. There can be some site-year specific variation.

Results showed no effect from early-arriving striped flea beetle activity on the feeding or egg-laying of crucifer flea beetles. In other words, the two species seem to perform their activities together, not in competition. The presence of striped does not seem to deter crucifer flea beetles in any way.

↑ Sharavari Kulkarni, research associate investigator for this study.

The Canola AgriScience Cluster focuses on priority areas of research to support sustainable growth of the canola industry. This includes climate change and environment, economic growth and development, improving canola's resilience in response to climatic stressors and pest pressures as well as knowledge and technology transfer and impact assessment aspects. The Sustainable Canadian Agricultural Partnership canola research projects are funded in part by the Government of Canada with contributions from Alberta Canola, SaskOilseeds, Manitoba Canola Growers, the Ontario Canola Growers Association and industry, including the Canola Council of Canada. These projects, which span up to five years, began in 2023.

Sustainable Canadian Agricultural Partnership Projects

Nutrient management

Project: Getting more from less – enhancing NUE and carbon sequestration in canola
Principal investigator: Sally Vail, Agriculture and Agri-Food Canada Saskatoon
Funding: Government of Canada under the Sustainable Canadian Agricultural Partnership, Alberta Canola, Canola Council of Canada, Manitoba Canola Growers, SaskOilseeds
Purpose: To develop and identify canola germplasm and traits that improve nitrogen utilization efficiency, plant architecture and rooting characteristics for increased yield and carbon sequestration.

Project: Precision 4R management: Improving nitrogen use efficiency, greenhouse gas emissions and productive economics of canola
Principal investigator: Mario Tenuta, University of Manitoba
Funding: Government of Canada under the Sustainable Canadian Agricultural Partnership, Alberta Canola, Canola Council of Canada, Manitoba Canola Growers, SaskOilseeds
Purpose: To investigate the use of variable rate mapping to selectively apply enhanced efficiency fertilizers in high-risk zones to increase profitability and reduce emissions.

Project: Improving nitrogen management in winter canola
Principal investigator: Eric Page, Agriculture and Agri-Food Canada Harrow
Funding: Government of Canada under the Sustainable Canadian Agricultural Partnership, Ontario Canola Growers Association
Purpose: To address the knowledge gap on fertility recommendations in winter canola and to develop better winter canola nutrient management practices.

Integrated pest management

Project: Clubroot pillar 2: Development and deployment of novel resistance genes to improve clubroot management on canola
Principal investigator: Gary Peng, Agriculture and Agri-Food Canada Saskatoon
Funding: Government of Canada under the Sustainable Canadian Agricultural Partnership, Alberta Canola, Canola Council of Canada, Manitoba Canola Growers, SaskOilseeds
Purpose: To identify novel clubroot resistance genes, characterize resistance develop markers, and incorporate into germplasm for breeding. It also investigates stacking and rotation of genes to develop better clubroot resistance strategies.

Project: Protecting canola against blackleg by introducing novel genes and developing R gene specific markers
Principal investigator: Hossein Borhan, Agriculture and Agri-Food Canada Saskatoon
Funding: Government of Canada under the Sustainable Canadian Agricultural Partnership, Alberta Canola, Canola Council of Canada, Manitoba Canola Growers, SaskOilseeds
Purpose: To introduce novel sources of blackleg disease resistance genes and to develop gene-specific markers that will be used as tools for precision breeding of resistant cultivars.

Project: Assessing fungicide sensitivity in *S. sclerotiorum*
Principal investigator: Dwayne Hegedus and Lone Buchwaldt, Agriculture and Agri-Food Canada, Saskatoon
Funding: Government of Canada under the Sustainable Canadian Agricultural Partnership, Alberta Canola, Canola Council of Canada, Manitoba Canola Growers, SaskOilseeds
Purpose: To compare the sensitivity of sclerotinia isolates from 2010 to present collections to common fungicides and develop markers to identify mechanisms of resistance to aid in future monitoring programs.

Project: Flea beetle resistance in canola
Principal investigator: Dwayne Hegedus, Agriculture and Agri-Food Canada Saskatoon
Funding: Government of Canada under the Sustainable Canadian Agricultural Partnership, Alberta Canola, Canola Council of Canada, Manitoba Canola Growers, SaskOilseeds
Purpose: To identify the genomic regions controlling hair (trichome) production in Brassica species, develop markers to introgress traits into breeding lines, and test the impact of hair density on flea beetle feeding.

Genetics

Project: Evaluation of gene-edited canola with improved yield and abiotic stress tolerance
Principal investigator: Michael Emes, University of Guelph
Funding: Government of Canada under the Sustainable Canadian Agricultural Partnership, Alberta Canola, Canola Council of Canada, Manitoba Canola Growers, SaskOilseeds
Purpose: Using CRISPR, starch enzymes will be replaced with maize homologues to increase stem thickness and improve resistance to drought and high temperature. The main goal is a massive increase in yield. Results will be validated in growth chambers and field trials.

Project: Establishment and applications of Brassica TILLING resources for development of resilient canola
Principal investigator: Raju Datla, Global Institute for Food Security
Funding: Government of Canada under the Sustainable Canadian Agricultural Partnership, Alberta Canola, Canola Council of Canada, Manitoba Canola Growers, SaskOilseeds
Purpose: To establish the TILLING breeding resource in breeding germplasm to improve water use efficiency/drought tolerance, photosynthetic efficiency and other climate-resilient traits.

Project: Towards a full understanding of canola germination and seedling performance
Principal investigator: Sally Vail, Agriculture and Agri-Food Canada, Saskatoon
Funding: Government of Canada under the Sustainable Canadian Agricultural Partnership, Alberta Canola, Canola Council of Canada, Manitoba Canola Growers, SaskOilseeds
Purpose: To investigate seed and seedling vigour screening on the NAM breeding population under controlled and field conditions, to study the environmental impact on canola seed carbohydrates/proteins, and to develop a database to curate germination, vigor and other seed characteristics to accelerate breeding.

Canola meal utilization

Project: Assessing/Understanding synergies between canola-meal and other mitigation strategies in reducing dairy-associated methane emissions
Principal investigator: Chaouki Benchaar, Agriculture and Agri-Food Canada Sherbrooke
Funding: Government of Canada under the Sustainable Canadian Agricultural Partnership, Alberta Canola, Canola Council of Canada, Manitoba Canola Growers, SaskOilseeds
Purpose: To identify the inclusion of canola meal in dairy diets that reduce methane production and perform a life cycle analysis of milk production from canola meal-based diets to determine carbon footprint.

Project: Impact of canola meal and forage quality in sustainable dairy cow diets
Principal investigator: Kenneth Kalscheur, USDA-ARS Wisconsin
Funding: Government of Canada under the Sustainable Canadian Agricultural Partnership, Alberta Canola, Canola Council of Canada, Manitoba Canola Growers, SaskOilseeds
Purpose: To determine canola meal/fiber digestibility in dairy cows, assess lactation performance, assess methane emissions reductions and collaborate on life cycle analysis under American dairy cow production systems.

Project: Canola protein and performance, health, and life cycle assessment of Atlantic salmon
Principal investigator: Ivan Tankovski, Onda
Funding: Government of Canada under the Sustainable Canadian Agricultural Partnership, Alberta Canola, Canola Council of Canada, Manitoba Canola Growers, SaskOilseeds
Purpose: To assess the effect of canola meal on nutrient digestibility, performance and health of Atlantic salmon, determine the bioactive molecules in canola meal to improve immunity in salmon, and conduct a life cycle analysis between normal feed rations and canola meal-containing ones.

Project: Nutrient allocation using canola supplemented fish feed in aquaponics
Principal investigator: Nick Savidov, Lethbridge Polytechnic
Funding: Government of Canada under the Sustainable Canadian Agricultural Partnership, Alberta Canola, Canola Council of Canada, Manitoba Canola Growers, SaskOilseeds
Purpose: To determine the impact on performance and production of plants and fish in aquaponic systems with the inclusion of canola meal, compare phosphorus and nitrogen cycling in canola meal-fed trout and tilapia, and assess the economic value of canola meal-based diets in aquaponics systems.

↓ Ivan Tankovski, researcher at Onda in PEI, and his associates are assessing the effect of canola meal on nutrient digestibility, performance and health of Atlantic salmon.

Canola Agronomic Research Program (CARP) projects that commenced in 2024 will investigate management solutions related to blackleg, clubroot, flea beetles, midges, sclerotinia, verticillium stripe and other biotic and abiotic threats. These projects are funded by Alberta Canola, SaskOilseeds and Manitoba Canola Growers, as well as the Western Grains Research Foundation (WGRF).

13 new Canola Agronomic Research Program Projects

Integrated pest management: DISEASES

Project: Biocontrol of blackleg using carnivorous bacteria (part 2)
Principal investigator: Paul Holloway, University of Winnipeg
Funding: Manitoba Canola Growers, Western Grains Research Foundation
Purpose: To identify strains and species of bacteria from Manitoban soils that inhibit/kill blackleg, challenge bacteria-inoculated seedlings with blackleg and identify if the same bacteria are effective against verticillium stripe.

Project: Methods to isolate and maintain clubroot for improved resistance screening and labelling
Principal investigator: Stephen Strelkov, University of Alberta
Funding: Alberta Canola, Manitoba Canola Growers, SaskOilseeds, Western Grains Research Foundation
Purpose: To develop best practices to maintain clubroot isolates on plants, optimize micro-lasers to isolate single spores and work with the Clubroot Steering Committee to introduce clubroot labelling on major pathotypes.

Project: In vitro culture of *Plasmodiophora brassicae*
Principal investigator: Mary Ruth McDonald, University of Guelph
Funding: Alberta Canola, SaskOilseeds, Western Grains Research Foundation
Purpose: To develop a method for in vitro culturing of clubroot and produce single-spore cultures of clubroot for sequencing.

Project: Clubroot pathotype evaluation and monitoring
Principal investigator: Stephen Strelkov, University of Alberta
Funding: Alberta Canola, SaskOilseeds, Western Grains Research Foundation
Purpose: Tracking clubroot occurrence, severity and spread, generating isolates from collected root samples, and monitoring pathotype composition, virulence shifts and potential resistance breaking pathotypes.

Project: Expanding BnVQs (Valene-Glutamine) gene family against *Sclerotinia sclerotiorum* in canola
Principal investigator: Zhongwei Zou, Wilfred Laurier University
Funding: SaskOilseeds, Western Grains Research Foundation
Purpose: To evaluate sclerotinia resistance of canola varieties (spring canola, winter canola, blackleg resistance lines) and characterize BnVQ gene expression patterns. Produce transgenic lines overexpressing critical BnVQ genes and identify novel genes that can improve resistance.

Project: Investigating the conditions favouring verticillium stripe development and yield losses in canola
Principal investigator: Sheau-Fang Hwang, University of Alberta and Fouad Daayf, University of Manitoba
Funding: Alberta Canola, Manitoba Canola Growers, SaskOilseeds, Western Grains Research Foundation
Purpose: To examine interactions between verticillium stripe and blackleg in soil and in lab, evaluate the impact of pH on verticillium stripe, investigate how canola defenses react to verticillium stripe and determine the lineage/specificity of collected isolates while also looking at the verticillium stripe seed infection rate.

Mary Ruth McDonald, University of Guelph, leads a new project to develop a method for in vitro culturing of clubroot and produce single-spore cultures of clubroot for sequencing. →

↑ Ahmed Abdelmagid with Agriculture and Agri-Food Canada in Morden, Manitoba is developing a verticillium stripe disease nursery. The nursery will help researchers select for cultivars with disease resistance.

Project: Comparative analysis of *Verticillium longisporum* lineages in the Canadian Prairies: Safeguarding canola production
Principal investigator: Zhongwei Zou, Wilfred Laurier University and Harmeet Singh Chawla, University of Manitoba
Funding: SaskOilseeds, Western Grains Research Foundation
Purpose: Collect and characterize different *V. longisporum* isolates prevalent in the Prairies to provide critical genetics and genomics knowledge on verticillium stripe and the disease progression in canola plants.

Project: A comprehensive survey of verticillium stripe and establishment of a disease nursery in Morden, Manitoba
Principal investigator: Ahmed Abdelmagid, Agriculture and Agri-Food Canada Morden
Funding: Manitoba Canola Growers, SaskOilseeds, Western Grains Research Foundation
Purpose: To conduct a survey across Manitoba to build a collection of isolates to develop a disease breeding nursery in Morden, and to characterize the lineages of collected isolates.

Project: Impact of synergistic interaction between *Verticillium longisporum* and *Leptosphaeria maculans* on canola yield
Principal investigator: Hossein Borhan, Agriculture and Agri-Food Canada Saskatoon
Funding: Alberta Canola, SaskOilseeds, Western Grains Research Foundation
Purpose: To investigate the compound impact of verticillium stripe and blackleg on susceptible canola, identify sources of resistance to verticillium stripe, test durability of multiple gene blackleg resistance lines and develop susceptible/resistance check lines to test verticillium stripe resistance.

Integrated pest management: INSECTS

Project: Population dynamics and monitoring programs for midges attacking canola
Principal investigator: Meghan Vankosky, Agriculture and Agri-Food Canada, Saskatoon
Funding: Alberta Canola, SaskOilseeds, Western Grains Research Foundation
Purpose: The utilization of pheromone traps to monitor swede midge and canola flower midge for early detection of invasion and monitor population density/geographic range. Also to determine growing season population dynamics of flower midge and its potential impact on yields.

Project: Tracking the movement of flea beetles across the Canadian Prairies
Principal investigator: Boyd Mori, University of Alberta
Funding: Alberta Canola, Manitoba Canola Growers, SaskOilseeds
Purpose: To survey flea beetle populations across the Prairies to determine species composition and movement of beetles and to conduct a field level study to determine if flea beetles with non-crop hosts contribute to populations in nearby canola crops.

Project: Volatile-based trapping and management of flea beetles
Principal investigator: Maya Evenden, University of Alberta
Funding: Alberta Canola and SaskOilseeds
Purpose: To compare commercial flea beetle attractants and traps in spring and fall, and identify best practices for implementing lures/traps to develop a attract-and-kill formulation.

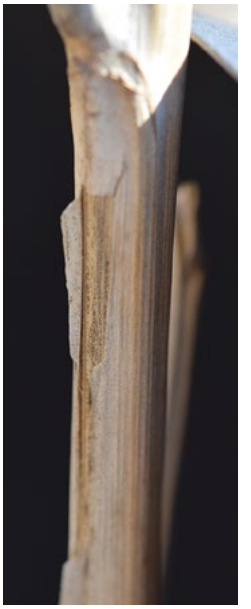
Genetics

Project: New pre-breeding tools for canola – facilitating canola improvement by accessing diploid variation
Principal investigator: Steve Robinson, Agriculture and Agri-Food Canada, Saskatoon
Funding: SaskOilseeds, Western Grains Research Foundation
Purpose: To access new genetic variation from diploid Brassica species by marker-assisted introduction of alleles, remove reproductive barriers between *B. rapa* and *B. oleracea* and generate synthetic *B. napus* lines for canola breeding. The genetic resources developed during this project can be made available to the canola industry supporting additional efforts to introduce necessary variation required by canola breeders.

Much needed verticillium stripe research

BY JAY WHETTER

Canola growers need proven methods to manage verticillium stripe in canola. Four new grower-funded studies will help.



"My main concern is that verticillium stripe may be secretly robbing more yield than people know," says Breanna Miller, agronomy specialist with the Canola Council of Canada.

Canola growers understand the rising concern that is verticillium stripe. Unofficial disease scouting reports suggest the disease took another step toward blackleg and sclerotinia stem rot status in 2024. Sensing the need for better understanding of the disease and management options, canola growers funded four new verticillium stripe research projects in their 2024 Canola Agronomic Research Program (CARP). CARP is funded by the three provincial canola grower organizations – Alberta Canola, SaskOilseeds and the Manitoba Canola Growers – and administered by the Canola Council of Canada. Western Grains Research Foundation (WGRF) also contributed.

Verticillium is common in rapeseed in Europe, but our knowledge of its activity in Canadian canola plants and the Prairies environment are limited. "If we are to increase canola production on the Prairies, we need to manage the diseases that can steal yield away from us," says Chris Manchur, Canola Council of Canada agronomy specialist. "Current verticillium stripe research will help us identify these solutions and set our industry on the right path towards sustainable production."

Miller adds that best practices, especially the option to use resistant cultivars in fields with virulent verticillium isolates, will be a big help. "The industry is working on finding those resistant genes in new and current cultivars," she says.

These four new projects will help.

Harmeet Singh Chawla with the University of Manitoba is a lead investigator for "Comparative analysis of *Verticillium longisporum* lineages in the Canadian Prairies: Safeguarding canola production," one of the four studies.

Chawla was a graduate student in Germany before coming to Canada. While in Germany, he worked on verticillium research in partnership with big German rapeseed breeding companies. He used bioinformatics to sequence the DNA of *V. longisporum*, the pathogen. He confirmed that the *V. Longisporum* group A1/D1 was really the only virulent group, and that within that group were many different isolates, or races.

↑ As verticillium infection advances, microsclerotia will form underneath the peeling outer layer of stem skin.
Credit: Breanna Miller, CCC

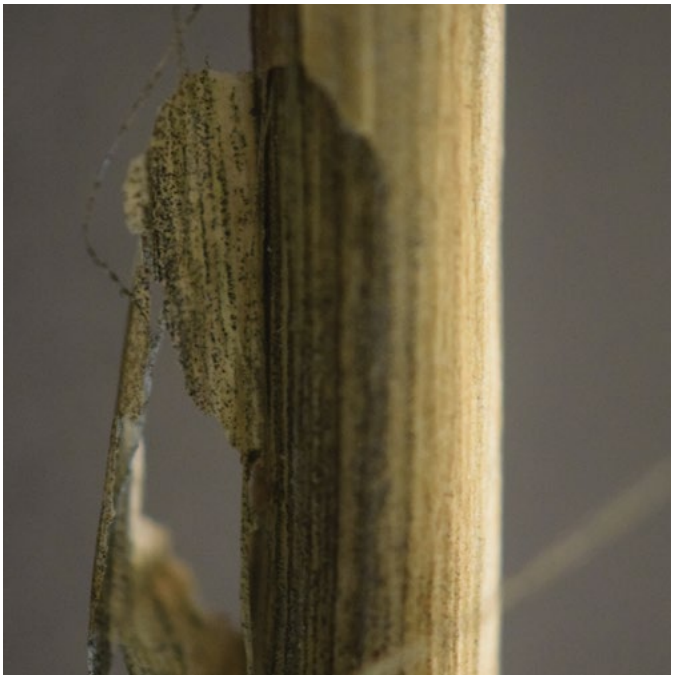
← Harmeet Singh Chawla (right) and research associate Mohamed Youssef with the University of Manitoba investigate *Verticillium longisporum* lineages on the Canadian Prairies. The flask contains spores.

A1/D1 also dominates in Canada. Part of Chawla's project is to identify the more aggressive isolates within that group. The project will then create markers for those isolates, which test labs can use to qualify the virulence level of races found in a field. Canola breeders could also use that information to select for cultivars with resistance to these most virulent isolates.

The other three studies

- "A comprehensive survey of verticillium stripe and establishment of a disease nursery in Morden, Manitoba" Ahmed Abdelmagid, principal investigator with Agriculture and Agri-Food Canada.
- "Investigating the conditions favoring verticillium stripe development and yield losses in canola" Co-investigators Sheau-Fang Hwang from the University of Alberta and Fouad Daayf from the University of Manitoba.
- "Impact of synergistic interaction between *V. Longisporum* and *L. maculans* on canola yield" Hossein Borhan, principal investigator with Agriculture and Agri-Food Canada Saskatoon. For more on these studies, see pages 23-24.

–Jay Whetter is the editor of Canola Digest.



ONGOING PROJECTS

The significant number of plant establishment, nutrient management, integrated pest management and genetics projects that are still in progress cover topics ranging from nitrogen-fixing bacteria, to verticillium stripe, to the development of climate ready canola. Canola growers contribute to these projects through their levy payments to SaskOilseeds, Alberta Canola and Manitoba Canola Growers. Many projects also have funding from other commodity groups, provincial sources (such as Saskatchewan's Agriculture Development Fund) and other Prairie-wide funders, including Western Grains Research Foundation and Alberta's Results Driven Agriculture Research.

Ongoing Projects

Project title	Principal investigator, Affiliation	Funders
Plant establishment		
Beneficial practices for soil and water quality, excess water management and drought resiliency in an undulating soil landscape in southwestern Manitoba	David Whetter, AgriEarth Consulting	Manitoba Canola Growers
Climate change resilience of Prairie oilseed crops and their below-ground microbiota under drought stress in controlled and field environments	Tim Dumonceaux, Agriculture and Agri-Food Canada Saskatoon	SaskOilseeds
Using modulated on-farm response surface experiments (MORSE) to develop evidence based, agronomic recommendations	Steve Shirtliffe, University of Saskatchewan	SaskOilseeds, Sask Wheat, Western Grains Research Foundation
Optimizing crop rotations to enhance agronomic, economic and environmental performance	Ramona Mohr, Agriculture and Agri-Food Canada Brandon	Manitoba Canola Growers

Project title	Principal investigator, Affiliation	Funders
Nutrient management		
Do we need deep banding of phosphorus in no-till systems in the Canadian Prairies?	Maryse Bourgault, University of Saskatchewan	SaskOilseeds, Western Grains Research Foundation
Strategies to build sustainable P levels and optimize water use efficiencies on low P soil	Gursahib Singh, Irrigation Crop Diversification Corporation	SaskOilseeds, Sask Wheat
Using a 4Rs Plus approach to improve growth and sustainability of annual cropping systems in Saskatchewan	Blake Weiseth, Discovery Farm	SaskOilseeds, Sask Wheat
Collecting the carbon data needed for climate-smart agriculture in Saskatchewan	Kate Congreves, University of Saskatchewan	SaskOilseeds, Sask Wheat, SaskOats, Saskatchewan's Agriculture Development Fund
Climate-smart canola: quantifying soil- and fertilizer-derived nitrogen sources and greenhouse gas emissions under canola hybrids	Melissa Arcand, University of Saskatchewan	SaskOilseeds, Alberta Canola, Manitoba Canola Growers, Western Grains Research Foundation
How does fall-applied nitrogen fertilizer influence soil-emitted nitrous oxide emissions during the over-winter and spring thaw period in the semi-arid Prairies?	Reynald Lemke, Agriculture and Agri-Food Canada Saskatoon	Alberta Canola
Discovering the optimal rate of a dual-inhibitor nitrogen fertilizer for maximum N2O emissions reduction	Reynald Lemke, Agriculture and Agri-Food Canada Saskatoon	SaskOilseeds, Saskatchewan's Agriculture Development Fund, Western Grains Research Foundation, Sask Wheat
Evaluation of variable rate applied enhanced efficiency N fertilizers on wheat and canola – field scale management zones comparison	Haben Tedla, Agriculture and Agri-Food Canada Saskatoon	SaskOilseeds, Sask Wheat
Biological nitrogen fixation in canola	Alicja Ziemienowicz, Agriculture and Agri-Food Canada Lethbridge	Alberta Canola, Alberta Innovates, Western Grains Research Foundation, Alberta's Results Driven Agriculture Research
Tracing carbon and nitrogen during crop residue decomposition to optimize C sequestration and predict N transfer credit	Bobbi Helgason, University of Saskatchewan	SaskOilseeds, Sask Wheat, SaskBarley
Impact of phosphorus fertilizer forms on nutrition of wheat, pea and canola, soil fate and losses in run-off water	Jeff Schoenau, University of Saskatchewan	SaskOilseeds, Sask Wheat, SaskPulse, Western Grains Research Foundation
Shining a light on digital agriculture: Linking soil NIR measurements, fertility and crop yields	Derek Peak, University of Saskatchewan	SaskOilseeds, Sask Wheat, Saskatchewan's Agriculture Development Fund
Integrated pest management		
The Prairie Crop Disease Monitoring Network: Fostering further network development	Kelly Turkington, Agriculture and Agri-Food Canada Lacombe	SaskOilseeds, Alberta Canola, Manitoba Canola Growers and others
Monitoring changes in *Leptosphaeria maculans* races and blackleg impact on canola after the introduction of the new *R* genes *Rlm2, Rlm4* and *Rlm7*	Gary Peng, Agriculture and Agri-Food Canada Saskatoon	SaskOilseeds, Alberta Canola, Western Grains Research Foundation
Understanding the role of the clubroot pathogen kinases in disease progress and resistance	Edel Pérez-López, Université Laval	Alberta Canola, SaskOilseeds, Manitoba Canola Growers
Evaluation of the root-associated fungus *Olpidium brassicae* and its interactions with *Plasmodiophora brassicae*	Jennifer Town, Agriculture and Agri-Food Canada Saskatoon	SaskOilseeds, Saskatchewan's Agriculture Development Fund, Western Grains Research Foundation
Cover crops for flea beetle management	Yvonne Lawley, University of Manitoba	Manitoba Canola Growers, Western Grains Research Foundation
Insect response to climate change and ag-inputs across the Prairies	Meghan Vankosky, Agriculture and Agri-Food Canada Saskatoon	SaskOilseeds, Alberta Canola, Manitoba Canola Growers and others
Balancing economic, action, and seed production thresholds for glyphosate-resistant kochia in canola	Charles Geddes, Agriculture and Agri-Food Canada Lethbridge	SaskOilseeds, Western Grains Research Foundation
Digging out the unknown: Finding the resistance against verticillium stripe in canola	Dilantha Fernando, University of Manitoba	Alberta Canola, SaskOilseeds, Manitoba Canola Growers, Western Grains Research Foundation
The role of insect feeding and plant defense responses in aster yellows disease epidemiology	Sean Prager, University of Saskatchewan	Alberta Canola, Manitoba Canola Growers
Biocontrol of blackleg using carnivorous bacteria (part 1)	Paul Holloway, University of Winnipeg	Manitoba Canola Growers, Western Grains Research Foundation
Influence of pH on the clubroot pathogen: are there pH-insensitive strains?	Stephen Strelkov, University of Alberta	Alberta Canola, SaskOilseeds, Manitoba Canola Growers, Western Grains Research Foundation
Clubroot inoculum management for sustainable canola production	Stephen Strelkov, University of Alberta	Alberta Canola, Alberta Agriculture, Forestry and Rural Economic Development
A rapid molecular assay to identify *Plasmodiophora brassicae* pathotypes from plant and soil samples	Stephen Strelkov, University of Alberta	Alberta Canola, Alberta Agriculture, Forestry and Rural Economic Development

Project title	Principal investigator, Affiliation	Funders
Application of hyperspectral imaging for detection and mapping of small patch clubroot infestations in commercial canola fields	David Halstead, Saskatchewan Polytechnic	SaskOilseeds, Saskatchewan's Agriculture Development Fund
Understanding fusarium wilt and root rot of hybrid canola occurrence, host range, disease development, resistance and yield	Sheau-Fang Hwang, University of Alberta	Alberta Canola, Alberta's Results Driven Agriculture Research
Biopesticides as a novel management strategy for sclerotinia in canola	Tim Dumonceaux and Susan Boyetchko, Agriculture and Agri-Food Canada Saskatoon	SaskOilseeds, Manitoba Canola Growers
Identifying key predators and their role in canola insect pest suppression	Boyd Mori, University of Alberta	Alberta Canola, Manitoba Canola Growers, Western Grains Research Foundation
Insecticide susceptibility and resistance monitoring of flea beetles in canola	Boyd Mori, University of Alberta	Alberta Canola, Western Grains Research Foundation, Alberta's Results Driven Agriculture Research
Continuing to watch the winds: the origin and arrival of migrant aster leafhoppers and diamondback moths	Tyler Wist, Agriculture and Agri-Food Canada Saskatoon	SaskOilseeds, Western Grains Research Foundation
Biological control of lygus plant bugs in established and emerging crops	Hector Carcamo, Agriculture and Agri-Food Canada Lethbridge	Alberta Canola
Comprehensive investigation of pesticides in honey, pollen, bees and soil collected from canola fields	Elemir Simko, University of Saskatchewan	SaskOilseeds, Saskatchewan's Agriculture Development Fund
Develop and assess different strategies to reduce the impact of pollen beetle *Brassicogethes viridescens (Coleoptera: Nitidulidae)*, a new invasive insect pest on canola	Christine Noronha, Agriculture and Agri-Food Canada Charlottetown	Alberta Canola, Manitoba Canola Growers, Alberta's Results Driven Agriculture Research, Western Grains Research Foundation
Effects of heat and drought on canola – pollinator interactions and crop yield	Shelley Hoover, University of Lethbridge	Alberta Canola, Alberta's Results Driven Agriculture Research
Enhance understanding of cleavers populations in western Canada	Breanne Tidemann, Agriculture and Agri-Food Canada Lacombe	SaskOilseeds, Alberta Canola, Western Grains Research Foundation
Screening false cleavers from the Prairie Herbicide Resistance Surveys for quinclorac and glyphosate resistance	Breanne Tidemann, Agriculture and Agri-Food Canada Lacombe	Alberta Canola, Western Grains Research Foundation
Updating the critical weed free period in canola	Rob Gulden, University of Manitoba	SaskOilseeds, Alberta Canola, Manitoba Canola Growers, Alberta's Results Driven Agriculture Research
The Prairie Weed Monitoring Network: Building a strong biovigilance foundation	Charles Geddes, Agriculture and Agri-Food Canada Lethbridge	Alberta Canola, Agriculture and Agri-Food Canada, Alberta Grains, Manitoba Crop Alliance, Manitoba Canola Growers, Manitoba Pulse & Soybeans, Prairie Oat Growers, SaskOilseeds, SaskPulse, Sask Wheat
Manipulating weed seed production through phenology-based weed control	Charles Geddes, Agriculture and Agri-Food Canada Lethbridge	Alberta Canola, Alberta Wheat Commission, Sask Wheat, Western Grains Research Foundation
Prairie weed surveys	Julia Leeson, Agriculture and Agri-Food Canada Saskatoon	Western Grains Research Foundation, SaskOilseeds and other commodity groups
Promotion of wetland stewardship best management practices through a targeted water monitoring project	Tony Ciarla, Millenium EMS Solutions	Alberta Canola and various other public and private funders
NSERC Industrial Research Chair in Agricultural Entomology	Boyd Mori, University of Alberta	Alberta Canola, Alberta Barley Commission, Alberta Pulse Growers, Alberta Wheat Commission and Natural Sciences and Engineering Research Council of Canada (NSERC)

Genetics

Identifying novel genetic factors contributing to durable disease resistance in canola	Isobel Parkin, Agriculture and Agri-Food Canada Saskatoon	SaskOilseeds, Saskatchewan's Agriculture Development Fund, Western Grains Research Foundation
Functional use of core pathogenicity genes to develop mitigation strategies against blackleg of canola and FHB of wheat	Hossein Borhan, Agriculture and Agri-Food Canada Saskatoon	SaskOilseeds, Saskatchewan's Agriculture Development Fund, Western Grains Research Foundation, Manitoba Crop Alliance
Exploiting susceptibility genes in canola to improve blackleg resistance	Gary Peng, Agriculture and Agri-Food Canada Saskatoon	Alberta Canola, SaskOilseeds, Manitoba Canola Growers, Western Grains Research Foundation
Capturing ancestral diversity for developing climate ready canola	Isobel Parkin, Agriculture and Agri-Food Canada Saskatoon	Alberta Canola, SaskOilseeds, Western Grains Research Foundation
Clubroot resistance gene function based on whole genome sequences, genome editing and resistance phenotypes	Stephen Strelkov, University of Alberta	SaskOilseeds, Alberta Canola, Alberta's Results Driven Agriculture Research
Virus-induced gene silencing in hairy roots to test root pathogen resistance	Chris Todd, University of Saskatchewan	SaskOilseeds
Evaluation of the A-genome genes for resistance to *Plasmodiophora brassicae* pathotypes, and their combined effect with the C-genome resistance	Habibur Rahman, University of Alberta	Alberta Canola, Alberta's Results Driven Agriculture Research
Dissecting the genetics of *B. napus* resistance to clubroot	Hossein Borhan, Agriculture and Agri-Food Canada Saskatoon	Alberta Canola, Alberta's Results Driven Agriculture Research, Western Grains Research Foundation

Project title	Principal investigator, Affiliation	Funders
Enhancing clubroot resistance in canola through regulating a transcription factor AIL7	Gavin Chen, University of Alberta	Alberta Canola, Alberta's Results Driven Agriculture Research, Western Grains Research Foundation
Elevating canola yield and oil and protein content by altering cellular carbon partitioning	Gavin Chen, University of Alberta	Alberta Canola, Alberta's Results Driven Agriculture Research, Alberta Innovates
Developing allele specific molecular markers for the *B. napus* blackleg resistance *(Rlm)* genes	Hossein Borhan, Agriculture and Agri-Food Canada Saskatoon	SaskOilseeds, Western Grains Research Foundation
Identification of genetic mapping of novel genes for resistance to blackleg in Chinese and Canadian *Brassica napus*	Dilantha Fernando, University of Manitoba	SaskOilseeds
Building bridges to success - Accessing brassica diploid variation for canola improvement	Steve Robinson, Agriculture and Agri-Food Canada Saskatoon	Alberta Canola, Manitoba Canola Growers, SaskOilseeds
Modification of surface waxes for improved water retention in canola	Mark Smith, Agriculture and Agri-Food Canada Saskatoon	SaskOilseeds, Saskatchewan's Agriculture Development Fund, Western Grains Research Foundation
Modified lipid metabolism to deliver improved low temperature tolerance in *Brassica napus*	Mark Smith, Agriculture and Agri-Food Canada Saskatoon	SaskOilseeds, Saskatchewan's Agriculture Development Fund
Improving heat and drought resistance in canola through regulating diacylglycerol acyltransferase activity	Gavin Chen, University of Alberta	SaskOilseeds, Western Grains Research Foundation
Using avirulence markers to predict the phenotypes of clubroot pathotypes	Edel Pérez-López, Université Laval	Alberta Canola, Manitoba Canola Growers, Western Grains Research Foundation
Efficient identification of *Plasmodiophora brassicae* pathotypes by metabarcoding	Stephen Strelkov, University of Alberta	Alberta Canola, Alberta's Results Driven Agriculture Research, Western Grains Research Foundation
Understanding the molecular basis of NLR-mediated clubroot resistance in *Brassica napus*	Edel Pérez-López, Université Laval	SaskOilseeds, Alberta Canola, Western Grains Research Foundation
A proteomics-based approach towards identifying host and pathogen proteins critical to clubroot establishment in canola	Christopher Todd, University of Saskatchewan	SaskOilseeds, Western Grains Research Foundation
Developing single-spore isolates of pathotypes of *Plasmodiophora brassicae*	Mary Ruth MacDonald, University of Guelph	SaskOilseeds
Purifying genotypes of *P. brassicae* and developing markers linked to races of *P. brassicae* collected in Western Canada	Fengqun Yu, Agriculture and Agri-Food Canada Saskatoon	SaskOilseeds, Manitoba Canola Growers, Western Grains Research Foundation
Cloning clubroot resistance genes from *B. nigra* and transferring the genes into canola through a CRISPR/Cas9 based technology	Fengqun Yu, Agriculture and Agri-Food Canada Saskatoon	SaskOilseeds, Saskatchewan's Agriculture Development Fund, Western Grains Research Foundation
Deploying calcium-dependent protein kinases to fight canola pathogens	Jacqueline Monaghan, Queen's University	SaskOilseeds, Alberta Canola, Manitoba Canola Growers, Western Grains Research Foundation
Identification and exploitation of genome structural variants for trait improvement in Prairie crops	Andrew Sharpe, Global Institute for Food Security	SaskOilseeds, Sask Wheat, Alberta Grains, Western Grains Research Foundation
Identifying the optimal root system architecture for Brassica crops	Isobel Parkin, Agriculture and Agri-Food Canada Saskatoon	SaskOilseeds, Saskatchewan's Agriculture Development Fund
Evaluating canola germplasm for photosynthetic efficiency	Linda Gorim, University of Alberta	Alberta Canola, Alberta's Results Driven Agriculture Research
Pre-breeding lines combining canola quality with sclerotinia resistance, good agronomy and genomic diversity from PAK93	Sally Vail, Agriculture and Agri-Food Canada Saskatoon	Alberta Canola, Manitoba Canola Growers, SaskOilseeds, Western Grains Research Foundation
Determine the contribution of specific defense genes to *Sclerotinia sclerotiorum* resistance in canola *(Brassica napus)*	Lone Buchwaldt, Agriculture and Agri-Food Canada Saskatoon	SaskOilseeds, Saskatchewan's Agriculture Development Fund
Addressing yield stability drivers of canola in a changing climate using high throughput phenotyping	Sally Vail, Agriculture and Agri-Food Canada Saskatoon	Manitoba Canola Growers, SaskOilseeds, Western Grains Research Foundation

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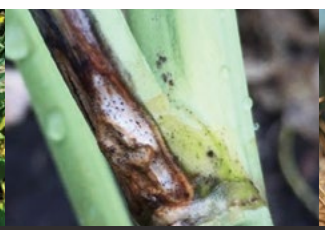
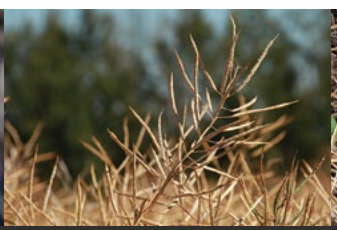

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