

Provincial Pest Monitoring Program

- **We need your help!** Please sign up to allow us access to your land to continue this work and provide you with valuable and timely information on pests
- Please scan the QR code on the right to sign up or contact the Ag Knowledge Center at 1-866-457-2377 or aginfo@gov.sk.ca



2023 Saskatchewan Canola Diseases and Updates

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and surveyors from

Meadow Lake Co-op, Bayer Crop Science Inc., Nutrien, and Canola Council of Canada

2023 GENERAL CANOLA DISEASE SURVEY

- 217 canola crops were surveyed
 - Prevalence
 - Incidence of disease
 - Severity for some diseases
- Fields are surveyed with producer permission



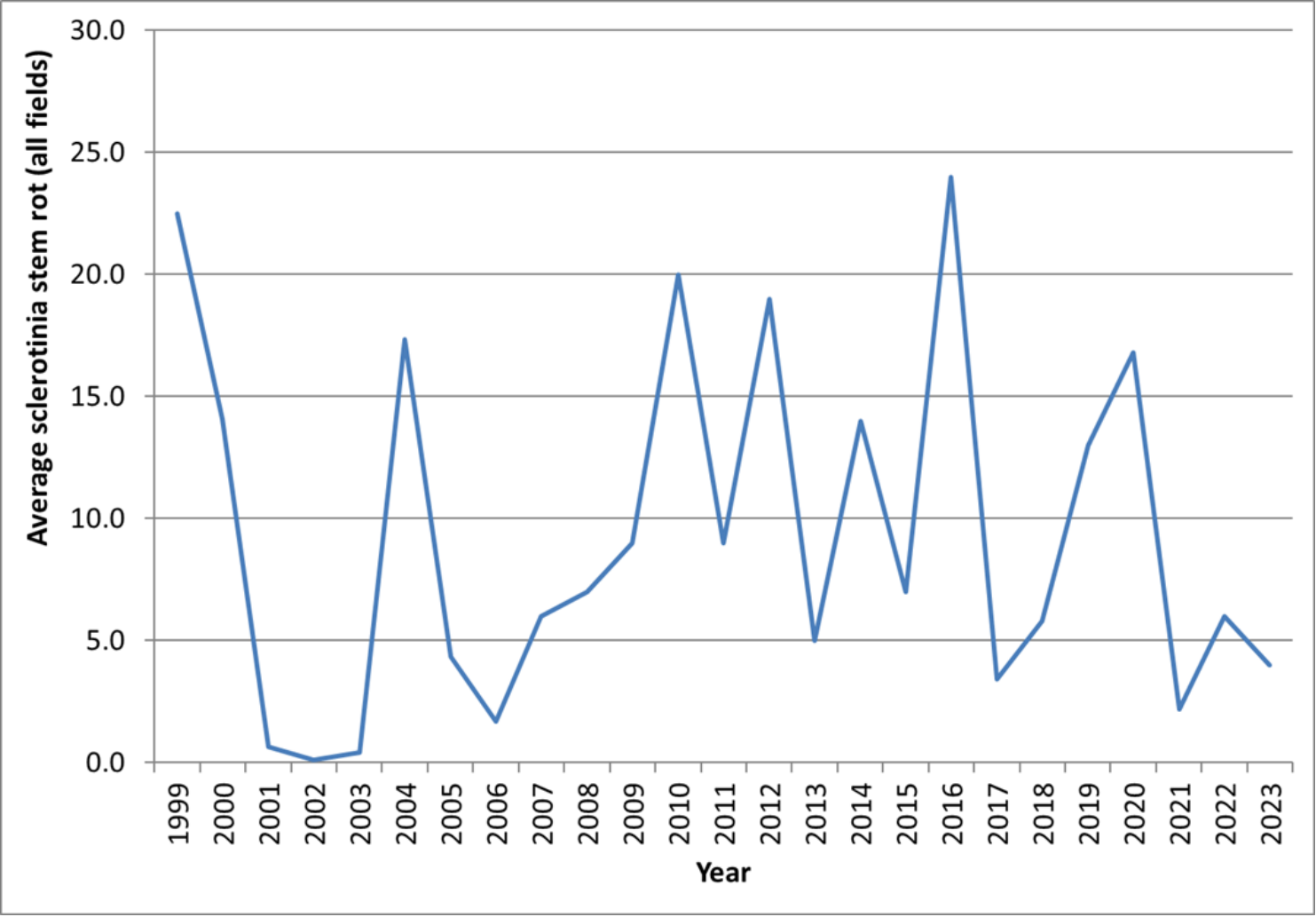
SCLEROTINIA STEM ROT

- **Prevalence:**
 - 30% of crops surveyed in SK in 2023 had at least trace levels of sclerotinia stem rot
- **Incidence:**
 - 4% across all surveyed fields
 - 12% in infected fields
- **Severity:**
 - 0.1 across all surveyed fields
 - 0.4 in infected fields

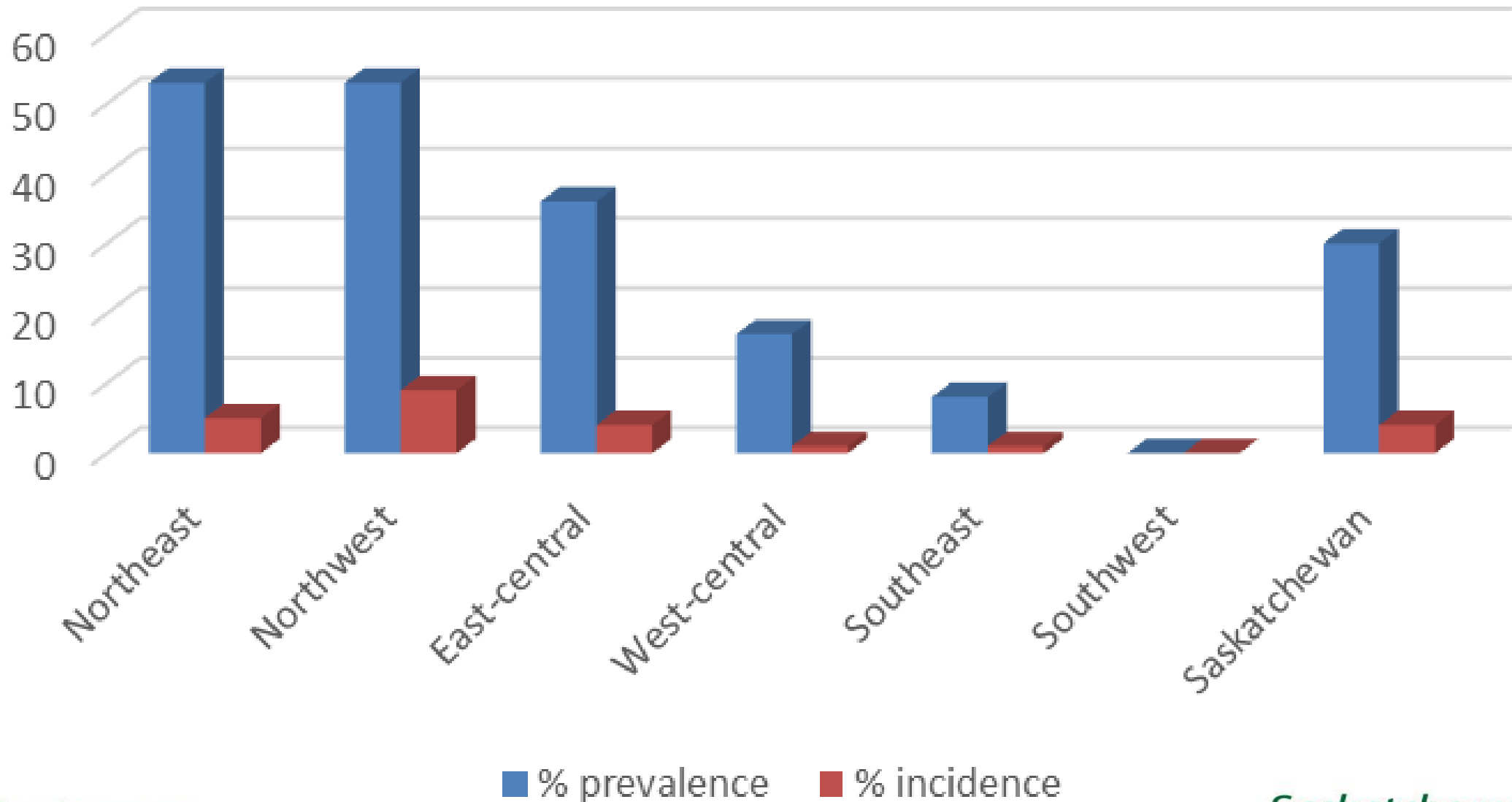


1	Pod		Infection of pods only
2			<p>Lesion situated on main stem or branch(es) with potential to affect up to $\frac{1}{4}$ of seed formation and filling on plant</p>
3			<p>Lesion situated on main stem or on a number of branches with potential to affect up to $\frac{1}{2}$ of seed formation and filling on plant</p>
4			<p>Lesion situated on main stem or on a number of branches with potential to affect up to $\frac{3}{4}$ of seed formation and filling on plant</p>
5	Lower		<p>Main stem lesion with potential effects on seed formation and filling of entire plant</p>

Sclerotinia Incidence in Saskatchewan (1999-2023)



Sclerotinia prevalence and incidence in 2023



Sclerotinia stem rot







	Prevalence	Incidence (all fields surveyed)	Severity
Alberta	21%	1%	Not Collected
Saskatchewan	30%	4%	0.1
Manitoba	13%	1%	0.2

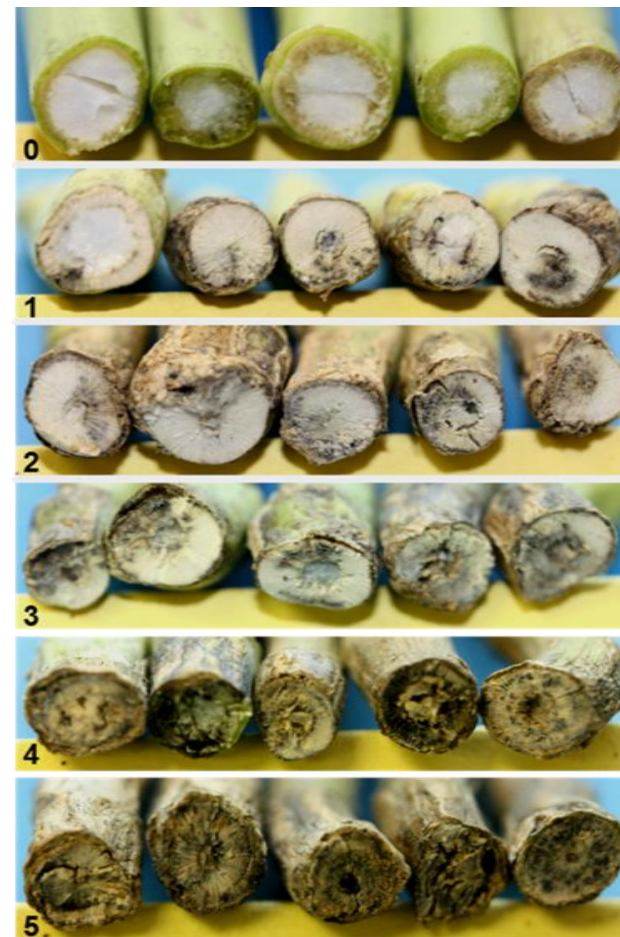
BLACKLEG

- **Prevalence:**
 - **72%** of the crops surveyed in 2023 had at least trace levels of blackleg
- **Incidence:**
 - **12%** across all surveyed fields
 - **16%** in infected fields
- **Severity:**
 - **0.2** across all surveyed fields
 - **0.3** in infected fields



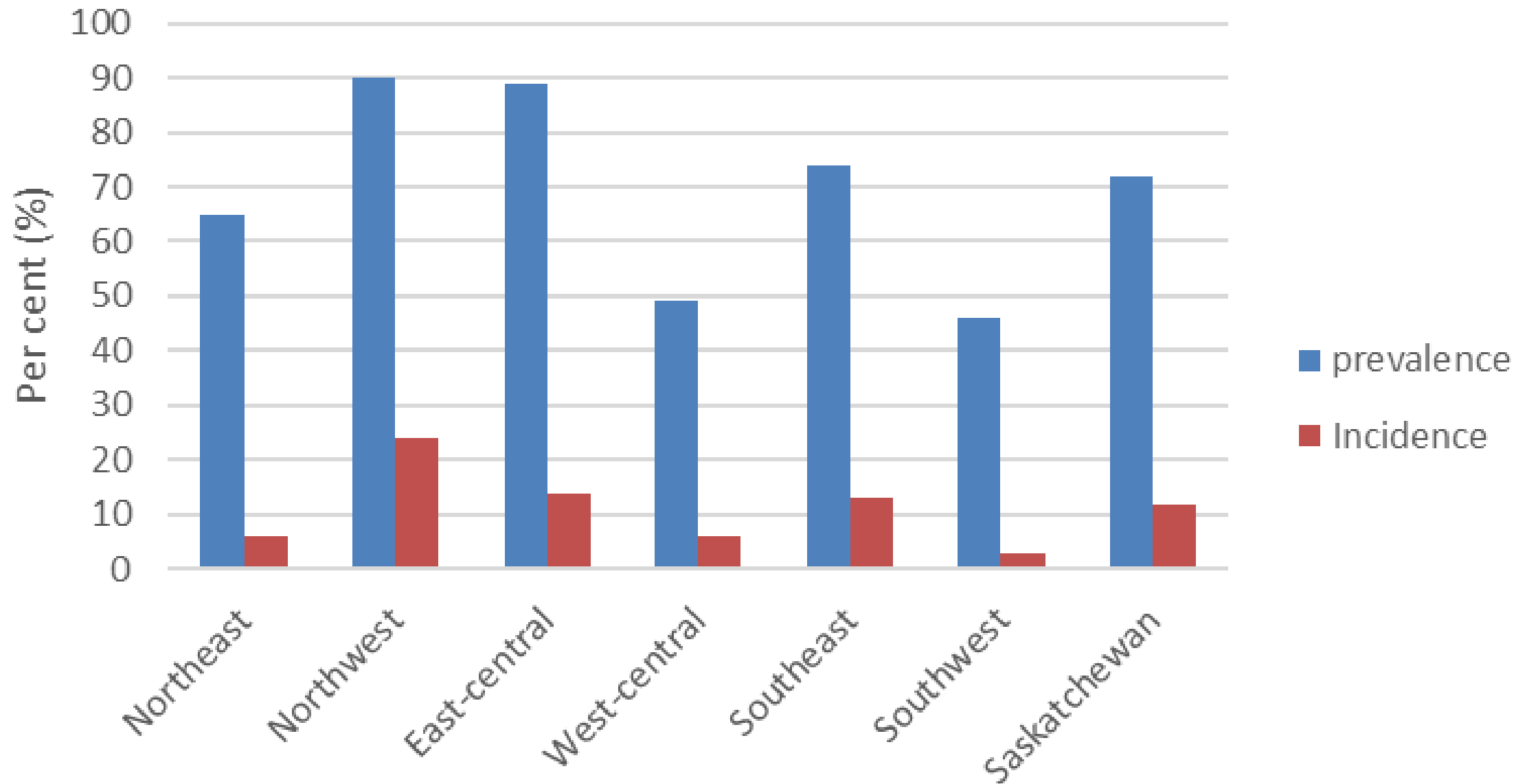
BLACKLEG FIELD RATING SCALE

Image	Disease Score	Description
	0	No diseased tissue visible in the cross section
	1	Diseased tissue occupies 25% or less of cross section
	2	Diseased tissue occupies 26-50% of cross section
	3	Diseased tissue occupies 51-75% of cross section
	4	Diseased tissue occupies >75% of cross section with little or no constriction of affected tissues
	5	Diseased tissue occupies 100% of cross section with significant constriction of affected tissues; tissue dry and brittle, plant dead

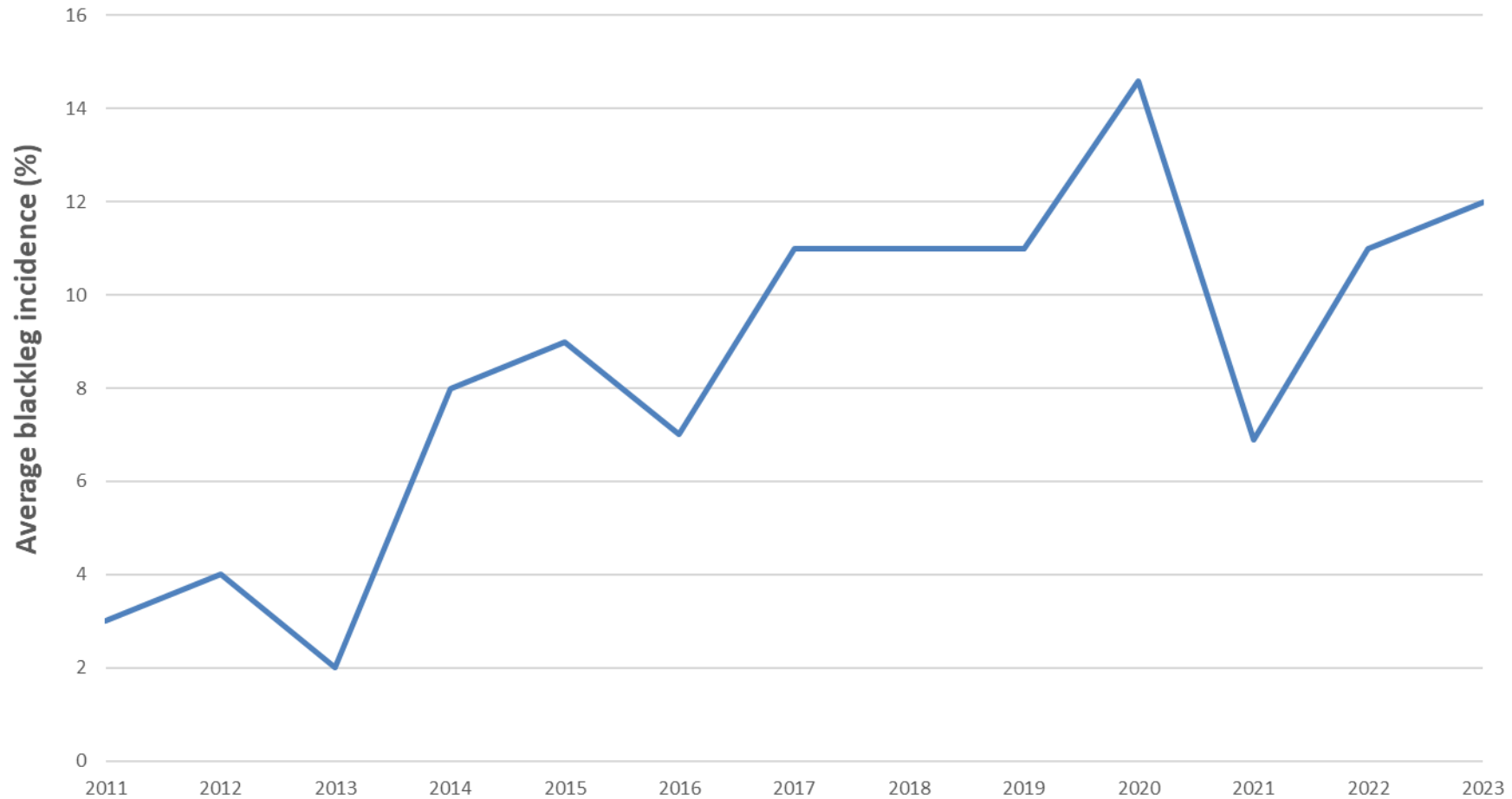


Gary Peng, AAFC Saskatoon

Blackleg prevalence and incidence in 2023



Blackleg Incidence in Saskatchewan (2011-2023)



Blackleg

	Prevalence	Incidence (all fields surveyed)	Severity
Alberta	92%	26%	0.5
Saskatchewan	72%	12%	0.2
Manitoba	78%	10%	1.1

Aster yellows

- **Prevalence:**
 - 33% (if only considering 100 plants addressed)
 - 65% of fields (if seen in field anywhere)



- **Incidence:**
 - 5% in diseased fields



	Aster Yellows
Saskatchewan	33% (5% incidence in diseased fields)
Manitoba	21% (4% incidence in diseased fields)

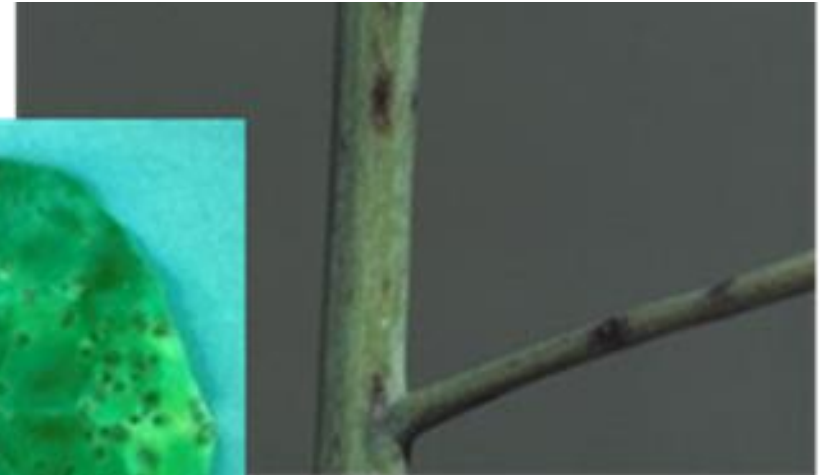
Prevalence of Aster yellows



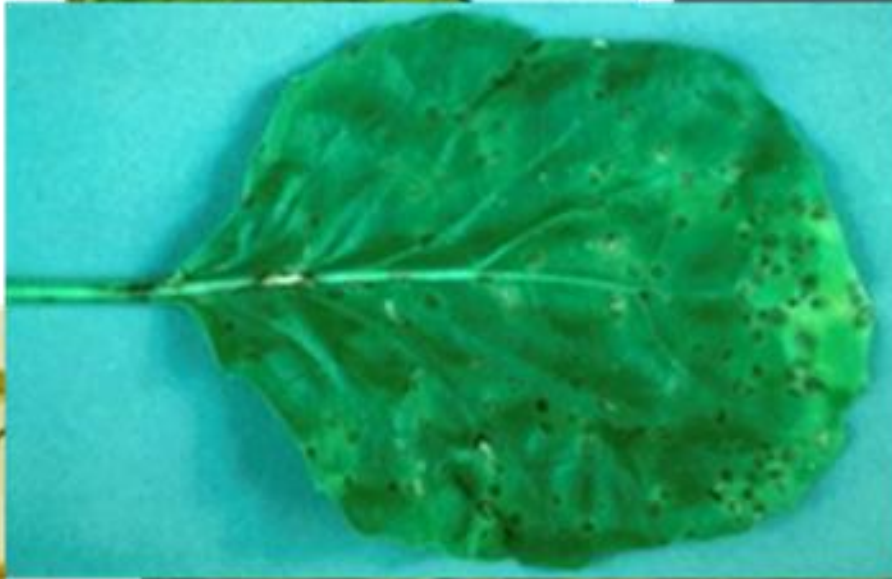
Powdery Mildew

Symptoms of powdery mildew were seen in 13 of the surveyed fields (6% prevalence)

Alternaria black spot: Prevalence: 48%



Beth Hoar

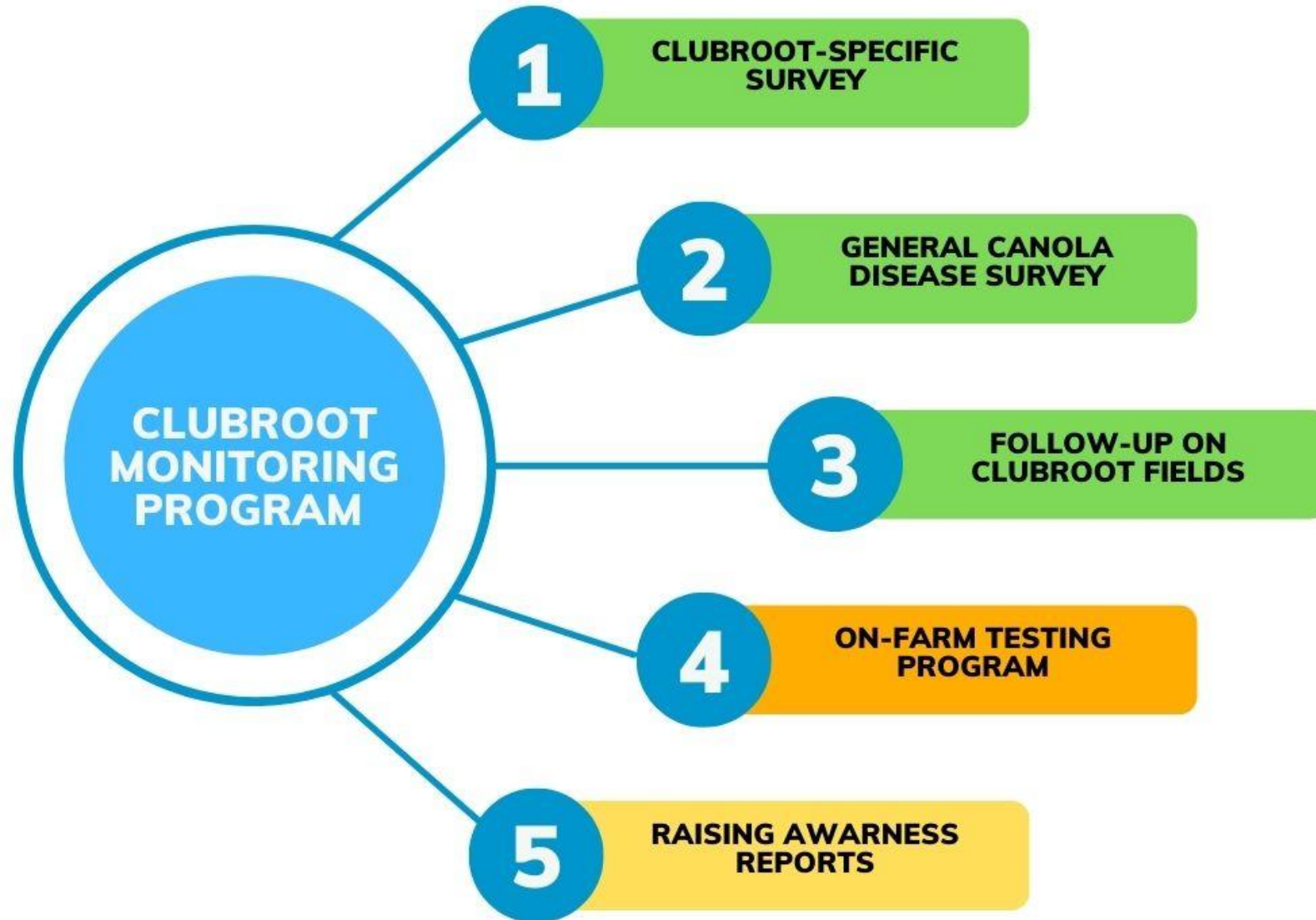


2023 SK Clubroot Monitoring Program

2023 Clubroot monitoring program

- The Saskatchewan clubroot monitoring program is a collaboration among the Ministry with SARM Plant Health Technical Advisors (PHTAs), Saskatchewan Crop Insurance Corp and SaskCanola
- **100 percent permission based**





Pillars

Clubroot risk-based survey in high-risk areas

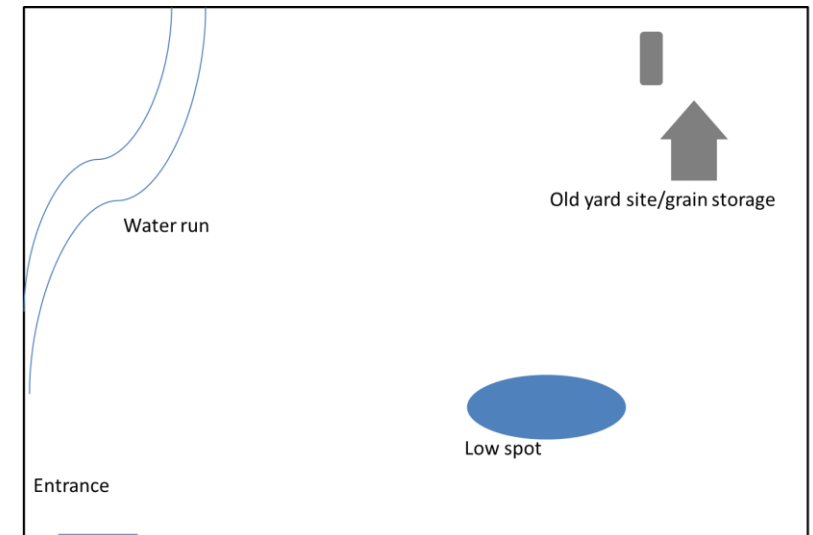
Continue monitoring for clubroot through the general canola disease survey

Follow-up on fields identified as positives through previous surveys

- Fields surveyed by Plant Health Technical Advisors with support from ministry.
- Located in high-risk areas.
- Will include fields with continuous canola identified through SCIC's Farm Practice Survey.
- Will monitor the spread and severity in these regions.
- **Permission-based survey.**

- Fields were surveyed by ministry staff, SARM Plant Health Technical Advisors and industry agronomists
- Plants in each field will be examined for visible symptoms.
- Soil samples will be collected when permission is granted and tested at the Crop Protection Laboratory.
- **Permission-based survey.**

- Follow-up on fields identified as positives through previous surveys by Plant Health Technical Advisors
- Will help producers in management of clubroot
- **Permission-based survey.**



Pillars

Raising awareness to increase external reporting

- Increase communication to industry agronomists to increase external reporting.
- Communicate ethical responsibility.
- **Enable reporting at only a general location level.**
- **Offer soil testing and pathotyping to provide value.**
- Ministry, SaskCanola and SARM Plant Health Technical Advisors.

Encourage on farm testing through the soil testing program

- **Soil testing bags available at the Ministry regional offices, SaskCanola, interested RM offices and through Plant Health Technical Advisors.**
- Producers can also sign-up online to receive a soil testing bag in the mail.
- Continued through a partnership with **SaskCanola**.
- Need producer involvement/permission.

Saskatchewan
SaskCanola

→ Remove crop residue from the soil surface. Collect approx. 1/3 cup of soil, 5-10 cm deep, from 5 high risk clubroot areas: field entrance, water ways, & at least 20 m from field edge.
Questions? 1-877-241-7044
↓ Fill to this line ↓

2020 Clubroot Soil Test

Name: _____
Farm Name: _____
Town: _____
Phone: _____
Email: _____
R.M.: _____
Land Location: _____
Date Collected: _____

→ Please complete all information above.
→ Personal information will be kept confidential. Specific land locations will only be shared with the R.M. if a clubroot bylaw is enacted, but the Ministry will contact you first.
→ Drop sample at a Ministry Regional Office or Discovery Seed Labs before October 30, 2020 #ST0045

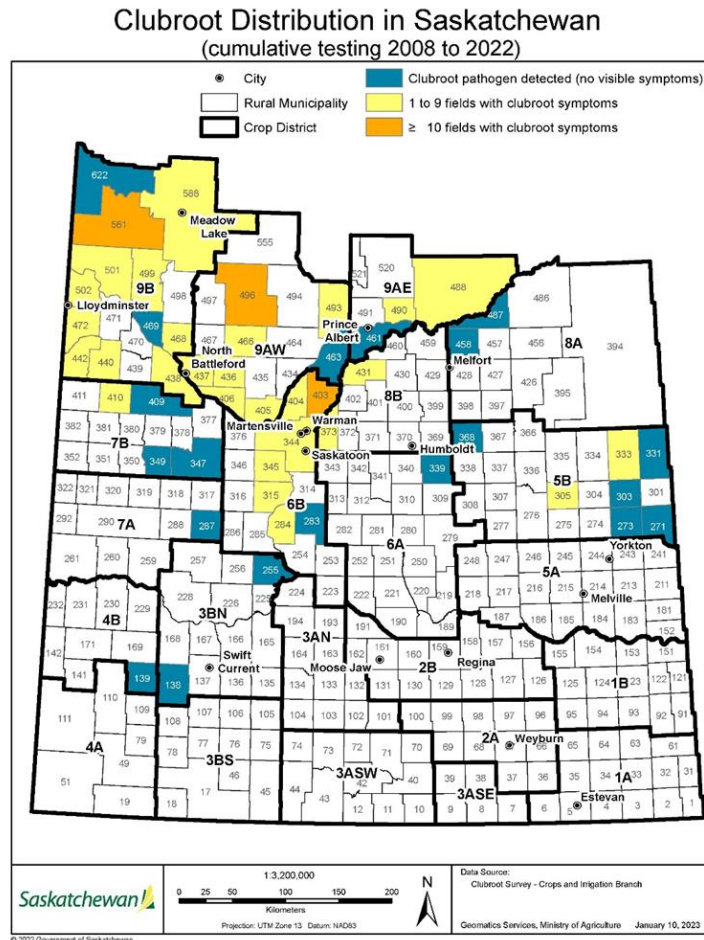


2023 clubroot monitoring program

534 fields Examined in 205 Rural Municipalities (RMs)

1. 217 fields throughout the province (182 soil samples from these fields) – **General canola Disease Survey**
2. 188 fields located in areas of the province where clubroot and/or the clubroot pathogen were known to occur or where a tight rotation is in practice- **clubroot specific (risk-based) survey**
3. 92 soil samples submitted from producers/agrologists through on-farm monitoring (**clubroot DNA soil testing program, aka SaskCanola clubroot soil testing program**)
4. 37 Positive fields (**Follow-up**)

Saskatchewan Clubroot Distribution Map



- The general locations of all clubroot-infested fields to date were used to update the Saskatchewan Clubroot Distribution Map
- This map is a guide to indicate which areas have the highest clubroot risk
- Since clubroot is a soil-borne disease, the pathogen is likely also present in other fields or RMs near regions where clubroot has been confirmed

In 2023, 205 RMs were inspected for clubroot symptoms and the clubroot pathogen DNA

Visible symptoms - **0** fields in 2023

DNA-based testing - general canola disease survey - **1** field **NEW** RM of McLeod (185)

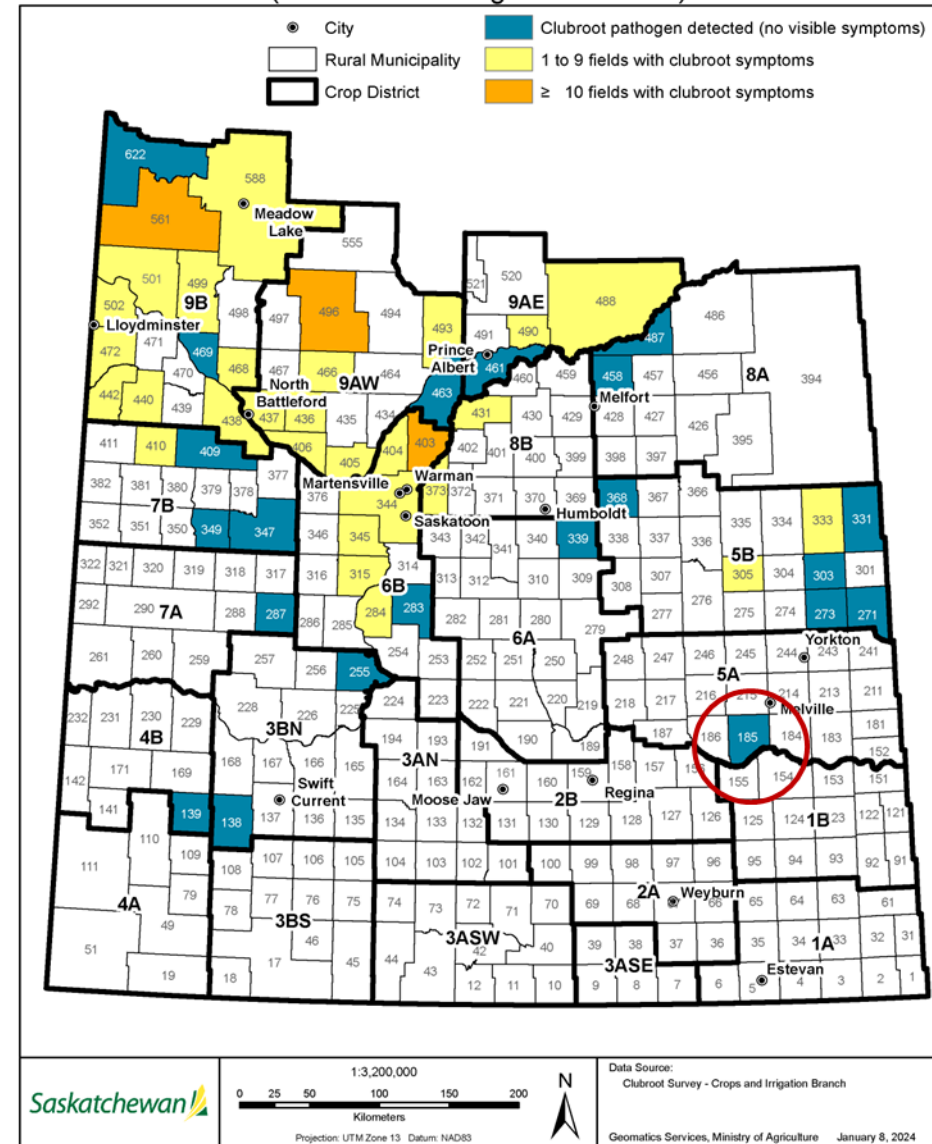
DNA-based testing - on-farm soil testing program - **1** field – **not new**

DNA-based testing - clubroot risk-based survey - **0** fields in 2023

Positive fields (Follow-up) - **6** fields – **not new**

External report - **0** fields

Clubroot Distribution in Saskatchewan
(cumulative testing 2008 to 2023)



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2023 clubroot findings

Visible Symptoms

- **0** new fields confirmed to have visible symptoms (was 2 and 5 new in 2022 and 2021)
- **82** fields with clubroot symptoms have been confirmed in Saskatchewan since 2017 (was the same 82 in 2022, no increase)



2022 clubroot findings pathogen DNA only (no visible symptoms)

- Clubroot pathogen DNA was detected in **1** additional (new) field that did not have clubroot symptoms (was 4 and 9 in 2022 and 2021)
- RM of McLeod with positive clubroot DNA had no documented clubroot history before 2023
- Number of commercial fields identified to have the clubroot pathogen through DNA testing rises from 42 to **43**



Numbers in Saskatchewan

Survey	With visible symptoms in commercial fields	DNA test without visible symptoms in commercial fields
2023	82 (0 new)	43 (1 new)
2022	82 (2 new)	42 (4 new)
2021	80 (5 new)	38 (9 new)
2020	75 (18 new)	29 (18 new)
2019	57 (14 new)	11 (5 new)
2018	43 (40 new)	6 (3 new)
2017	3 (3 new)	3 (1 new)
Before 2017	0 (only two in research sites in 2011)	2 (2012 and 2008, one field each year)

Pathotyping

- 2023 Pathotyping samples (none)
- 2022 Pathotyping samples (**2**) : 5I (1), 5? (1)
- 2021 Pathotyping samples (**5**) : 3H (3), 8N (2)
- 2020 Pathotyping samples (**12**) : 3H (7), 8N (3), 5L (1), 8A (1)
- None appeared to overcome first generation resistance in CR canola

Clubroot

Alberta

Prevalence	Incidence	Severity
(%)	(%)	(0-3)
6	0.6	0.5

- 380 fields were surveyed for clubroot in Alberta.

Manitoba:

- One new symptomatic cases of clubroot in 129 canola fields surveyed.
- Three new symptomatic case outside of the survey.
- Soil samples from 40 fields have been collected and are currently being processed for clubroot DNA.



Resources:

Clubroot Management Plan

Developed by the Saskatchewan Clubroot Initiative
Revised June 2021

Clubroot Overview

What is clubroot?

Clubroot is a soil-borne disease caused by a microbe, *Plasmodiophora brassicae* (*P. brassicae*). Clubroot affects the roots of host plants, which include cruciferous field crops such as canola, mustard, camelina, oilseed radish and taramira and cruciferous vegetables such as arugula, broccoli, Brussels sprouts, cabbage, cauliflower, Chinese cabbage, kale, kohlrabi, radish, rutabaga and turnip. Cruciferous weeds (e.g. stinkweed, shepherd's purse, wild mustard) can also serve as hosts for the clubroot pathogen.



Clubroot infected canola root with intact clubroot galls

What are the symptoms of clubroot?

Clubroot infection is easily identified by plant roots with a swollen or club-like appearance (clubroot galls). These swollen and deformed roots have a reduced ability to absorb water and nutrients, leading to stunting, wilting, yellowing, premature ripening and shriveling of seeds. The cause of these above-ground symptoms can be confirmed by digging up suspect plants to check roots for gall formation. Clubroot affects the yield and quality of several crops, described above, to a similar degree as other diseases affecting water and nutrient uptake and its impact depends on soil conditions and the growth stage of the crop when infection occurs. Early infection of seedlings tends to result in greater yield losses. Infection by the clubroot pathogen and disease development are favoured by warm soils, high soil moisture and low soil pH.

How does clubroot spread?

Infected roots will eventually disintegrate, releasing resting spores into the soil, which may then be transported by wind, water erosion, animals/manure, shoes/clothing, vehicles/tires, or field equipment. The clubroot pathogen, in the form of resting spores in the soil, can be moved any way that soil can be moved. Activities that move large volumes of soil (such as on agricultural or industrial field equipment) between areas or regions are considered to have the highest risk.



Decomposing clubroot gall

The pathogen population (spore numbers) in the soil will decline over time when non-host crops are grown, but a small proportion can survive in soil for up to 20 years.

Clubroot is primarily a soil-borne disease; it does not infect the seed but it may be found in soil attached to the seed (including seed potatoes) or other plant parts. If you are growing potatoes, source your seed potatoes from regions where clubroot has not been confirmed or suspected. Clubroot does not present any legal phytosanitary issues for trade.

saskatchewan.ca/crops

Saskatchewan!

clubroot.ca

Your comprehensive source for clubroot information.



WHAT'S NEW

- Pre- and Post-Swath Disease Scouting Videos
- Latest news releases
- Clubroot resistance Q&A

[// READ MORE](#)

CLUBROOT QUESTIONS?

- Ask your CCC agronomy specialist today
- Industry links to more information on clubroot

[// READ MORE](#)

ABOUT CLUBROOT

Learn more about clubroot basics

- Clubroot overview
- Disease cycle
- Environmental factors

[// READ MORE](#)

IDENTIFY CLUBROOT

Look here for information on clubroot identification

- Videos on scouting
- Identification in canola
- Testing

[// READ MORE](#)

CONTROL CLUBROOT

Bookmark this page for up-to-date information on preventing and managing clubroot.

- Prevent clubroot
- Manage clubroot
- Stewardship

[// READ MORE](#)

AFFECTED REGIONS

Clubroot is a disease that affects crucifers worldwide. In Canada, clubroot is primarily established in the vegetable growing regions of British Columbia, Quebec, Ontario, and the Atlantic provinces.



[// READ MORE](#)

Verticillium Stripe

What is it?

- Verticillium Stripe of rapeseed is a very important disease in Europe
 - Identified in Canada on canola for the first time in 2014
- Verticillium Stripe is caused by the fungus
 1. *Verticillium longisporium*
 - Hosts: *Brassica* crops (canola a major host)
 2. *Verticillium dahliae*
 - similar to verticillium wilt on alfalfa, potatoes, sunflower, etc.
- Develops in the similar way and has similar symptoms as fusarium wilt

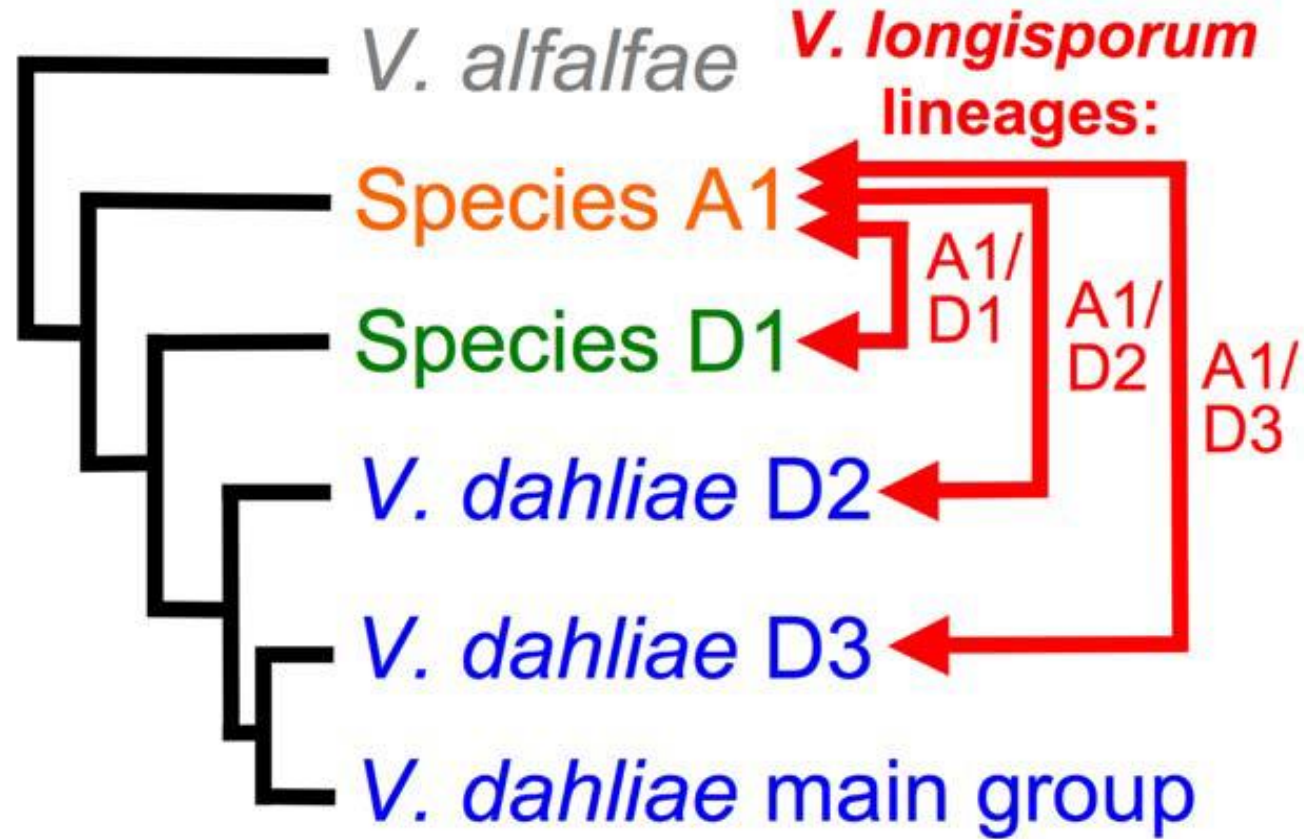


Verticillium Stripe in Canola

- First discovered in Manitoba in 2014
- Led to follow up soil surveys by the Canadian Food Inspection Agency in 2015, finding *Verticillium longisporum* DNA in Alberta, British Columbia, Manitoba, Ontario, Quebec and Saskatchewan
- Never officially confirmed by Saskatchewan with visible signs before 2021
- Poses a new threat to brassica crops, grown on more than 11 million acres across all of Saskatchewan

Verticillium Stripe in Canola

- Like clubroot, verticillium is a soil-borne pathogen
- Still much to learn about the disease incidence, severity, impact and management
- In Europe, yield losses are reported to be 10 - 50% with an earlier infection causing more yield loss



Evolutionary history

The three lineages/groups of VL evolved independently by hybridization involving two unknown species A1 and D1, and two lineages of *V. dahliae* (D2 and D3).

Inderbitzin et al. 2011 & 2013

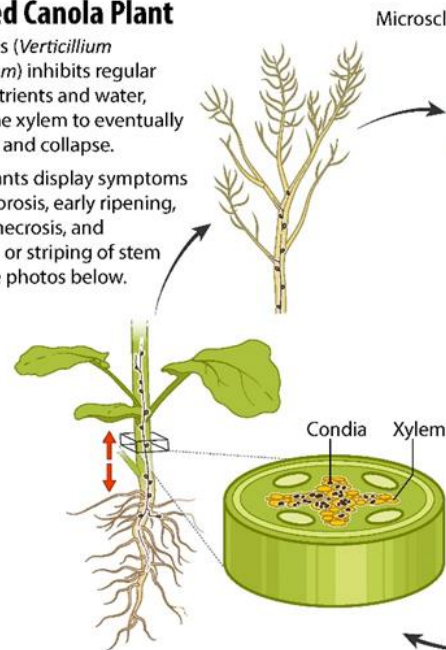
Verticillium Stripe Disease Cycle

(Caused by the fungus *Verticillium longisporum*)

4 Diseased Canola Plant

The fungus (*Verticillium longisporum*) inhibits regular flow of nutrients and water, causing the xylem to eventually turn black and collapse.

Canola plants display symptoms of leaf chlorosis, early ripening, stunting, necrosis, and shredding or striping of stem tissue. See photos below.

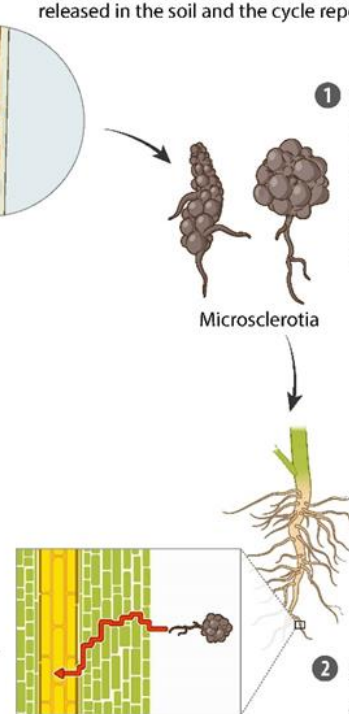


3 Distribution of Disease

Hyphae and single cell spores called conidia are produced locally in the xylem and move up the vascular system.

5 Release of Microsclerotia

The pathogen moves into non-vascular tissue where multicellular microsclerotia are formed. The stem tissue is fragile, allowing for it to easily shred. The stem epidermis peels back to expose the microsclerotia. The microsclerotia are released in the soil and the cycle repeats.

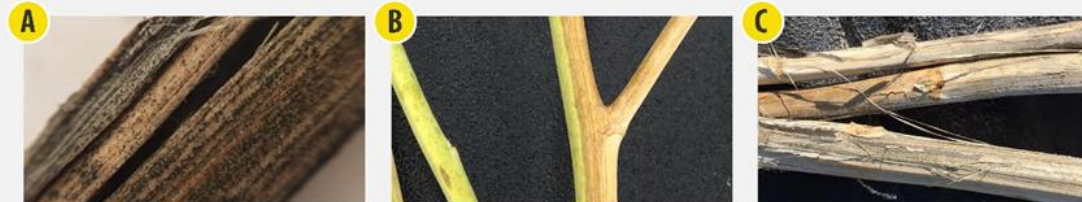


1 Germination of Fungal Propagules

Fungal propagules called microsclerotia are present in soil or dead plant tissue. Root exudates stimulate microsclerotial development.

2 Systemic Invasion and Multiplication

Microsclerotia enter the plant vascular system through fungal hyphae and multiply.

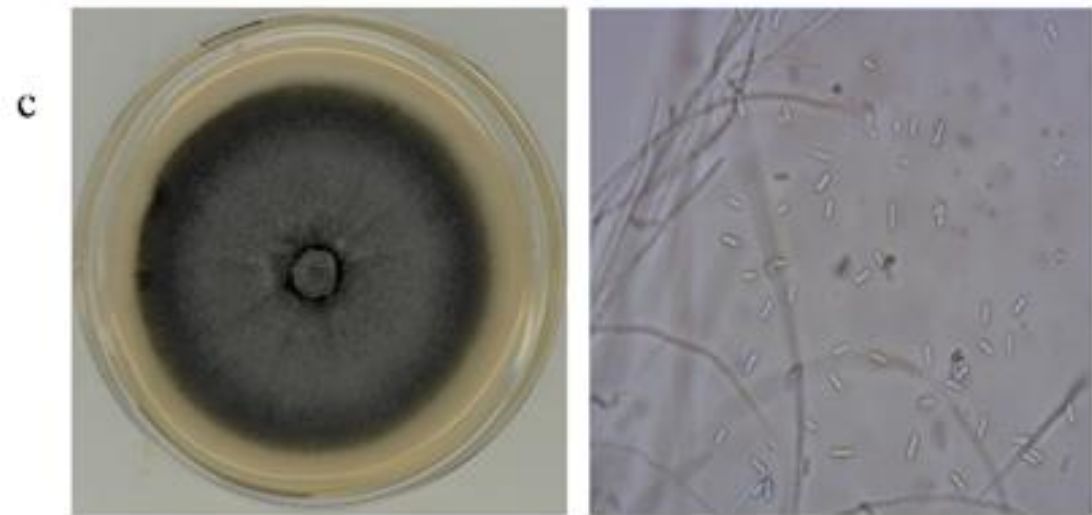


Symptoms of verticillium stripe disease spotted in canola plants: (A) microsclerotia, (B) half stem senescence (unilateral streaking), and (C) striping of the stem tissue.

Verticillium Stripe Symptoms

- Chlorosis of lateral branches and leaves
- Early senescence and stunting of plants
- Vertical yellow or brown stripe up one side of the stem







Stem Senescing

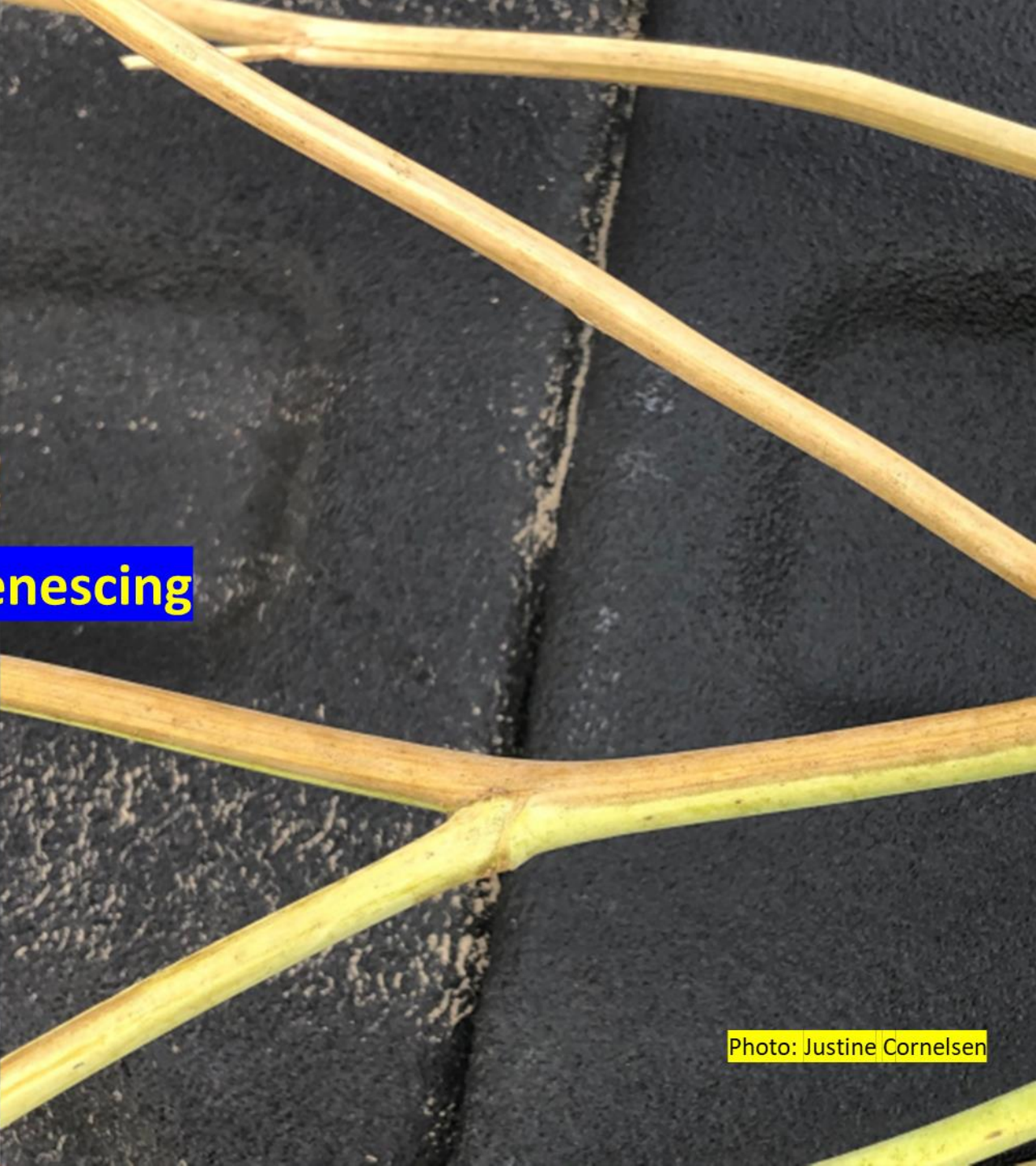


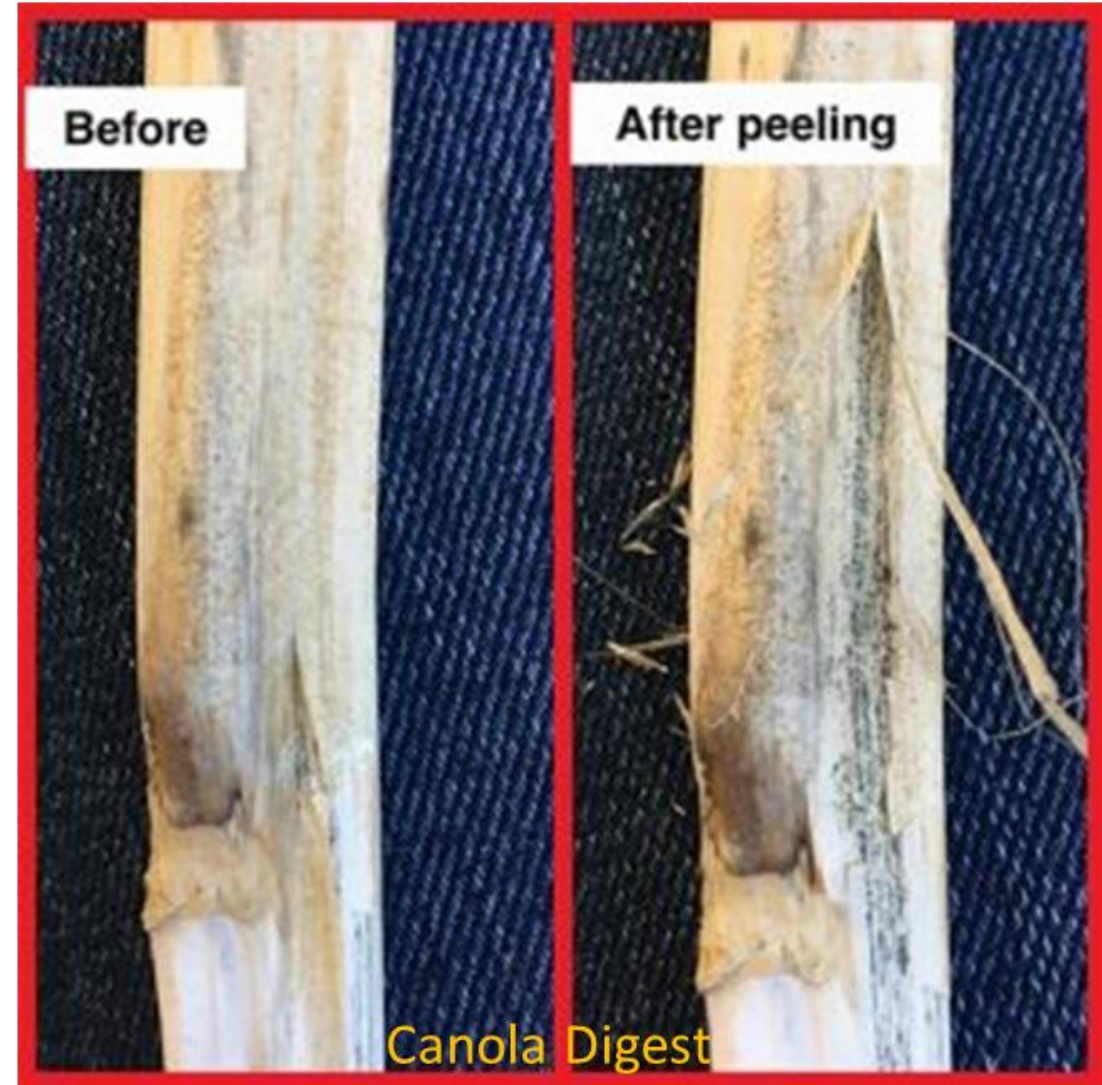
Photo: Justine Cornelsen

Most indicative symptom/sign

At the end of the season there will be peeling back of the epidermis to reveal tiny black microsclerotia



Can be used to distinguish from fusarium wilt



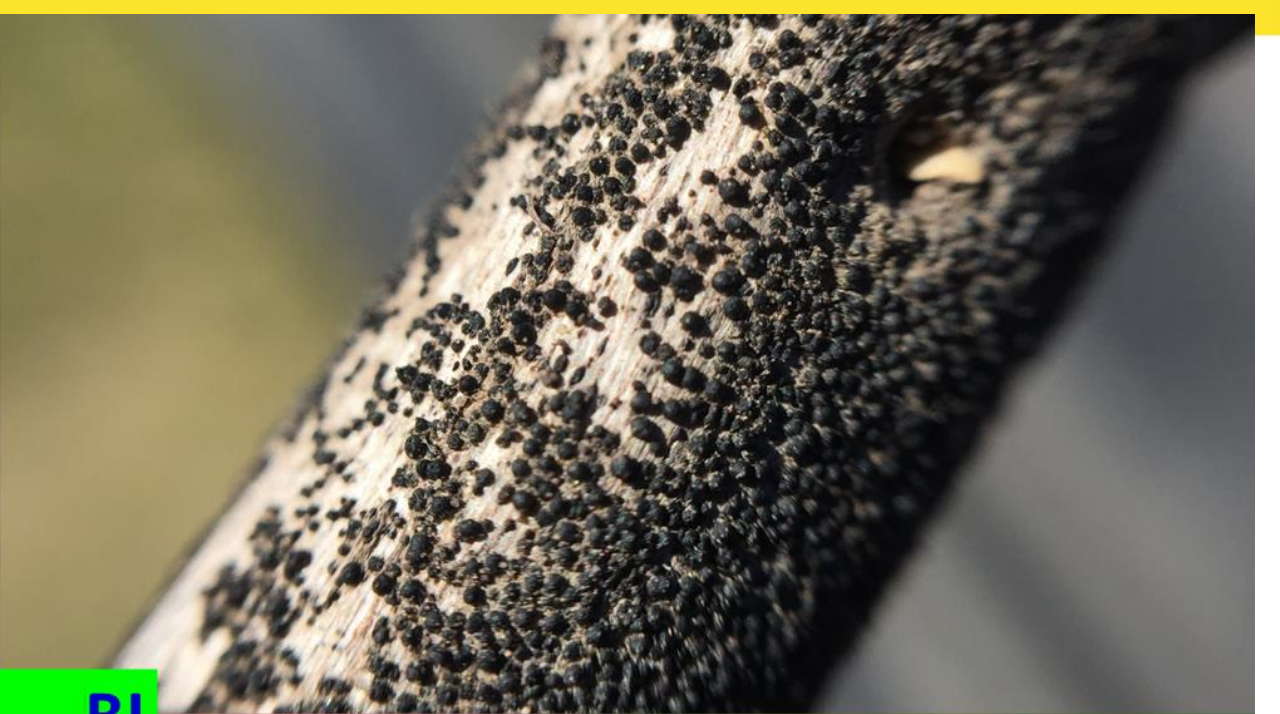


Sclerotinia stem rot

- No microsclerotia



Blackleg



VS

BL



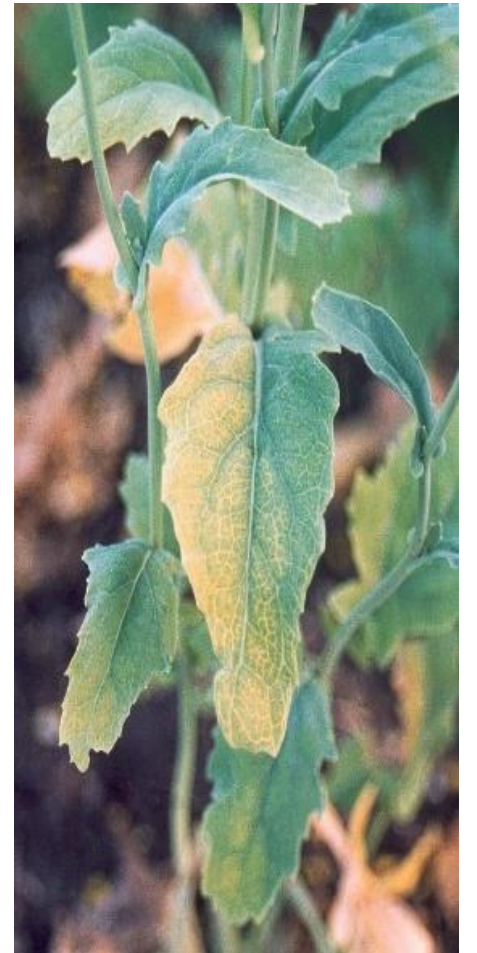
Photo: Justine Cornelsen

***Verticillium
&
Blackleg
on the same plant***



Photo: Justine Cornelsen

Fusarium Wilt



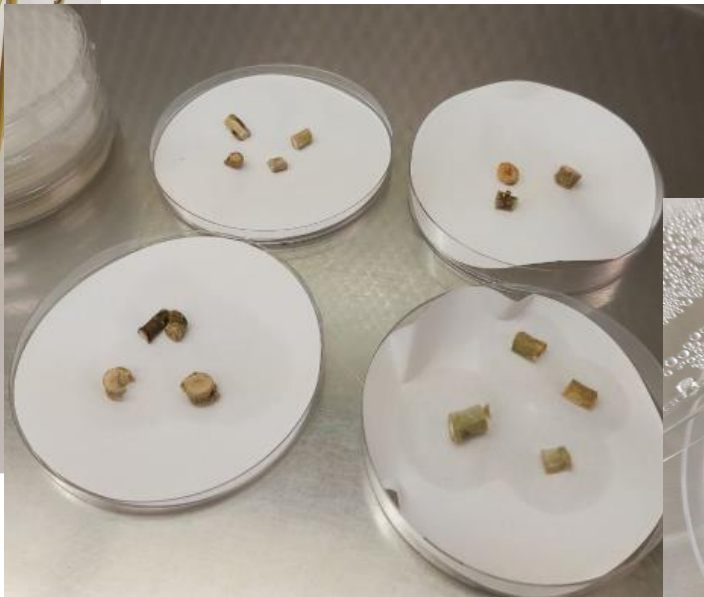
Verticillium Stripe



Isolation



Canola stem samples



Surface-sterilized stem sections



Stem section placed onto PDA



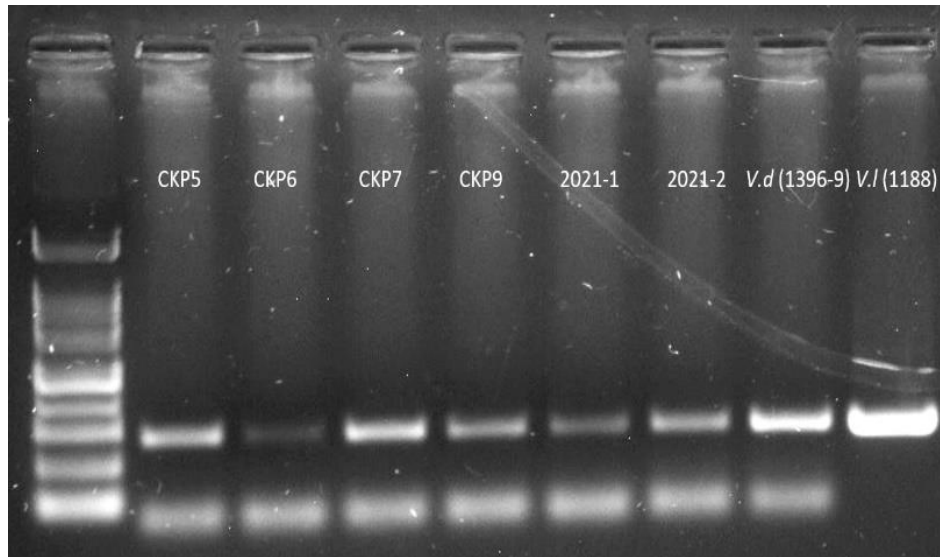
Fungus colony





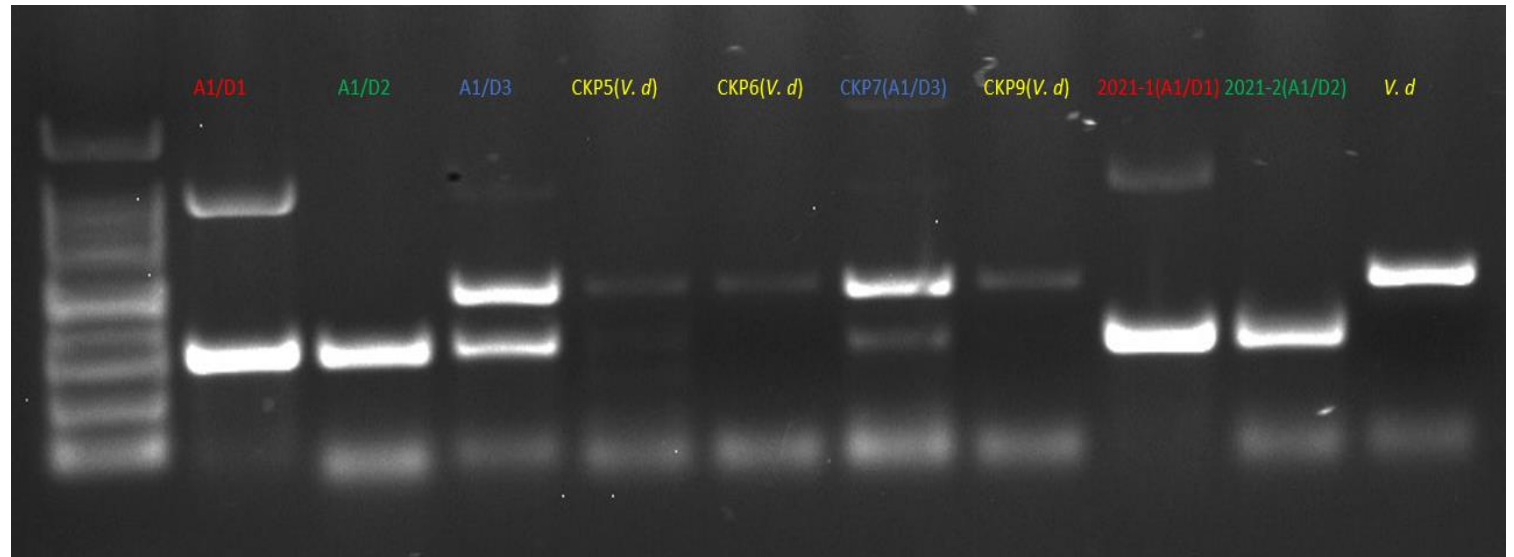
Conidia size difference in *V. dahliae* (left, average 5.5 μm) and *V. longisporum* (right, average 10.7 μm) ($\times 40$)

Saskatchewan: 6 samples 2021



PCR using VlsplF1/VlsplR4 primers

Lane 1: DNA ladder (100bp)
Lane 2-7 Samples
Lane 8: *V. dahliae* (1396-9) control
Lane 9: *V. longisporum* (1188) control



Multiplex PCR using Df/Dr_D1F/AlfD1r_A1f/A1r primers

Lane 1: DNA ladder (100bp)
Lanes 2-4: *V. longisporum* isolates A1/D1 (1188), A1/D2 (1196), and A1/D3 (1197) controls
Lane 5-10: Samples
Lane 11: *V. dahliae* (1396-9) control



“Our journey” Verticillium Stripe in Saskatchewan 2021

Four suspicious samples (no visible signs) during the 2021 survey from East-central Saskatchewan (near the Manitoba border and further west)

- Three samples were confirmed as *Verticillium dahlia*
- and one as *V. longisporum*, lineage **A1/D3** (U of M)



Verticillium Stripe in Saskatchewan 2021

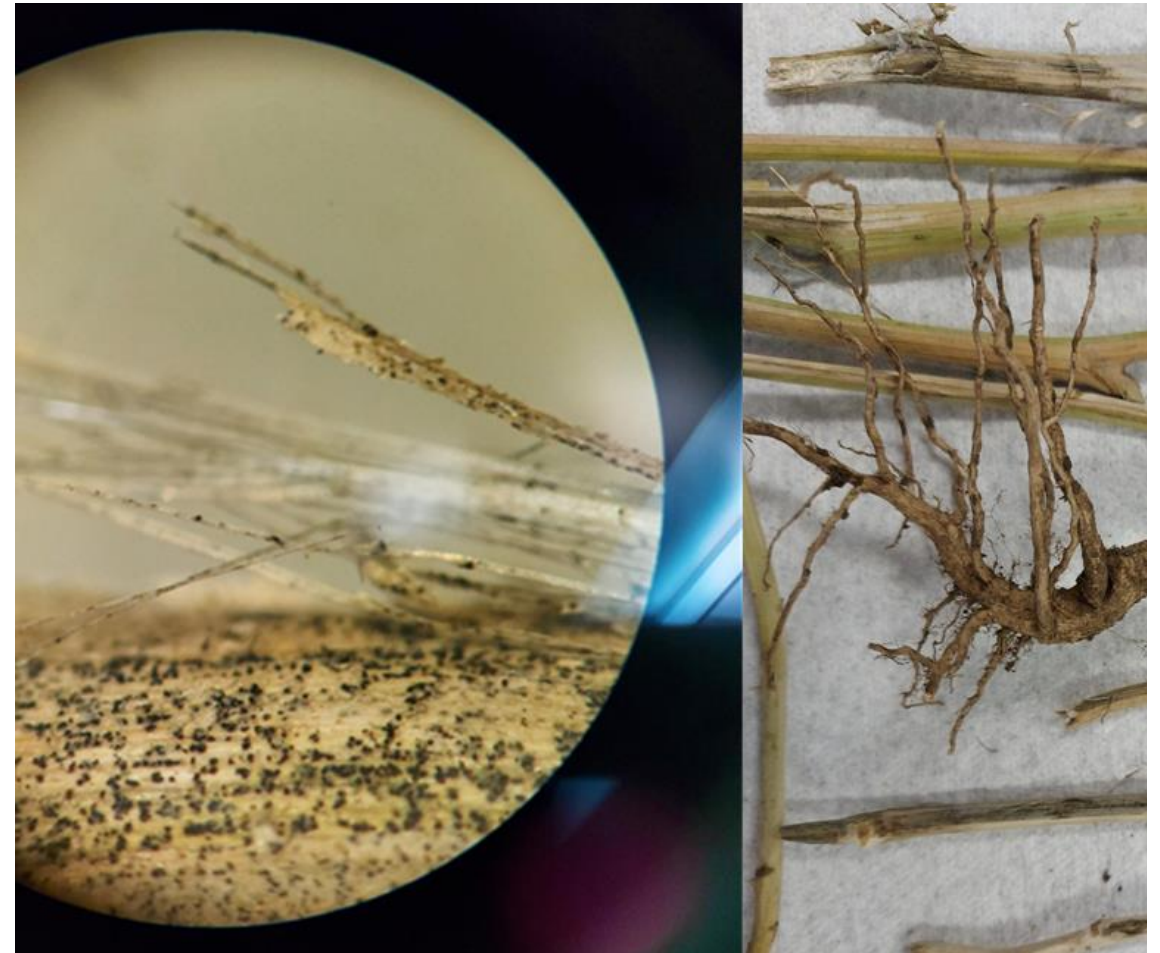
Two additional samples were found with typical symptoms and **pathogen signs** of verticillium stripe, once at swathing and once shortly after

Samples were confirmed to be caused by) *V. longisporum* one each of lineage **A1/D1** and lineage **A1/D2** (U of M



Verticillium Stripe in Saskatchewan 2021

- First confirmed report from Saskatchewan for the occurrence of verticillium stripe with typical symptoms and pathogen signs
- First report of *V. longisporum* A1/D2 and A1/D3 lineages from Canada




Our journey 2022

Is verticillium stripe a rare disease in Saskatchewan?

- **Suspect sample of verticillium stripe was found and confirmed only in one field during the general canola disease survey out of 205 surveyed fields assessed.**
- The Saskatchewan Ministry of Agriculture initiated a small-scale **verticillium-specific survey** in **2022**.
- **Targeting areas in eastern Saskatchewan** to assess the prevalence and incidence of the disease and help evaluate the risk this disease poses to canola production in Saskatchewan.
- This small-scale survey was an “**after-swath**” specific survey in addition to the general canola disease survey.

2022 Verticillium Stripe Survey Data Sheet

Field Code:	Surveyor name:
Date:	Grower name (if known):
RM:	Nearest town:
GPS latitude:	GPS longitude:
Legal land description:	
Growth stage:	Canola variety (if known):
Field history (if known) – e.g., crop rotation, fungicide treatment, etc....	
Evidence of Verticillium Stripe? <ul style="list-style-type: none">• stem cross-section greyish hue discolouration Yes No• bleaching of the stem (on one side or all around the stem) Yes No• shredding of the stem tissue. Yes No• peeling epidermis (the outer skin of the stem) with signs of microsclerotia Yes No	
• Plant samples collected and sent? Yes No	
• Photographs of symptomatic plants sent? Yes No	
saskatchewan.ca	

Disease assessment

Site number	# of Plants With Verticillium suspect symptoms (out of 20)	Comments on Severity of Symptoms	Picture Taken	
1			Yes	No
2			Yes	No
3			Yes	No
4			Yes	No
5			Yes	No



Like General Canola Disease Survey



A big multi-diseases patch including verticillium stripe disease in a canola field in Saskatchewan in 2022.

After-Harvest Verticillium Stripe Specific Survey 2022

(Targeted survey, we were there to find it!)

Fields Surveyed (Eastern Saskatchewan)	25
Fields with suspect samples	15
Prevalence of fields with <u>suspect samples</u> (visual)	60%
Average Incidence of <u>suspect samples</u> (visual)	9.7%
<u>Prevalence of fields with confirmed samples (lab testing)</u>	<u>28% (7/25)</u>

2022

	Prevalence	Incidence
Alberta (348)	2%	0.004%
Saskatchewan (205) General Canola Disease Survey	1/205 confirmed	-
Saskatchewan (25) After-Swath Verticillium Specific Targeted Survey in eastern Saskatchewan	Visual: 60% ¹ (15/25) Lab confirmed: 28% (7/25)	10% ²
Manitoba (115)	38%	9%

2023 Survey Plan for Saskatchewan

- **2021:** Verticillium Stripe with typical signs and symptoms was discovered for the very first time in Saskatchewan
- **2022:**
 - only one confirmed cases of verticillium stripe - general canola disease survey
 - 28% of fields through the verticillium stripe specific survey in canola after harvest
- **2023:**
 - General canola disease survey**
 - Verticillium stripe specific survey**
 - Expanded the survey to cover all the canola growing areas of the province. Target Crop Districts were like that of the general canola disease survey.
 - Hundred fields in 2023 across the province were included in the verticillium stripe specific survey in canola after harvest.
 - These fields were selected from those already surveyed for the general canola disease survey.
 - This provides an opportunity to compare the disease symptoms observed in the two different survey timings. The survey will take place right after harvest.

Verticillium stripe-specific survey in 2023

- Contributes to understanding the risk this disease poses to canola production in Saskatchewan
- The in-field portion of the verticillium specific survey has been completed but lab analysis of the collected samples is still underway

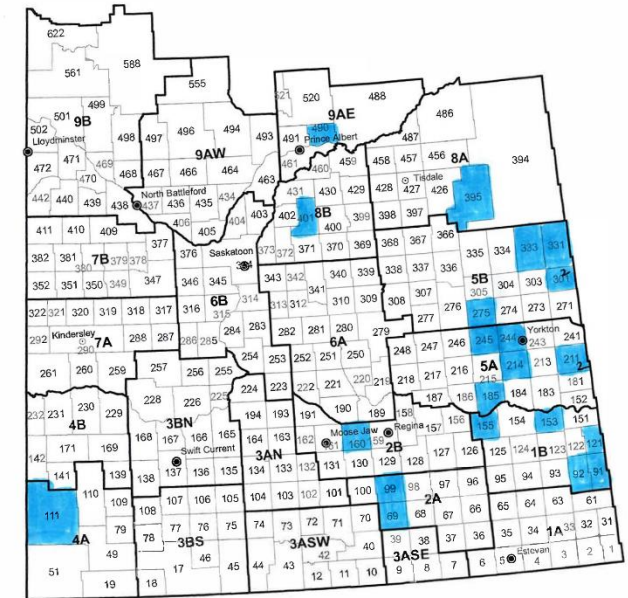
Verticillium Stripe in Saskatchewan 2023

➤ General Canola Disease Survey

- Verticillium Stripe were confirmed in **23 fields in 2024** (11% of the fields)

➤ Verticillium stripe-specific survey

- **Results pending**- DNA analysis in progress



	Prevalence	Incidence	Severity
Alberta	15% suspect symptoms	-	n.d.
Saskatchewan	General Canola Disease Survey: 11%	-	n.d.
	After-Swath/Harvest Verticillium Specific Survey	Data not available currently	n.d.
Manitoba	29%	3%	n.d.

Verticillium Stripe

2023 SaskCanola Disease Testing Program



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Disease Testing Program

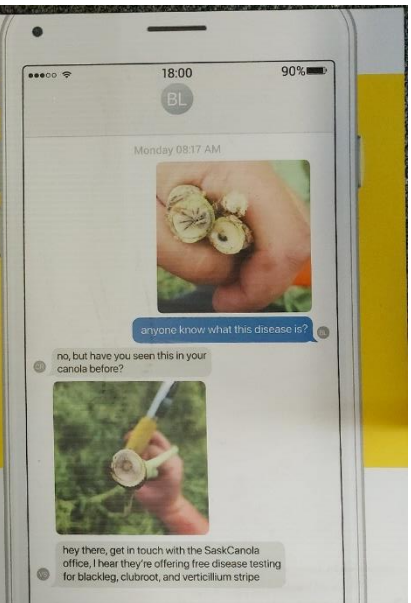
SaskCanola, in partnership with the [Saskatchewan Ministry of Agriculture](#), is ensuring growers have the tools they need to detect the most devastating canola diseases on their farm. The current disease monitoring program now includes verticillium testing in addition to clubroot and blackleg testing. Details below provide information about how to participate.

Farmers can't manage the unknown...

SaskCanola's disease testing program helps identify pests so farmers can manage the spread and maximize yields



Call (306) 975-0262 or visit [saskcanola.com](https://www.saskcanola.com) for more info on our FREE canola disease testing program



Management

Currently

- no fungicides registered to control verticillium stripe yet
- no registered resistant varieties yet (work in progress)
- prevention is the best form of management
 - Same practices to reduce the spread of clubroot may also reduce the risk of spreading verticillium stripe
 - Sanitizing and removing soil from equipment and minimizing the overall amount of soil movement
 - Longer crop rotations (three-year break between canola crops)
 - Resistant cultivars?



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