

Expand Your Scouting Toolkit with Laboratory Diagnostics

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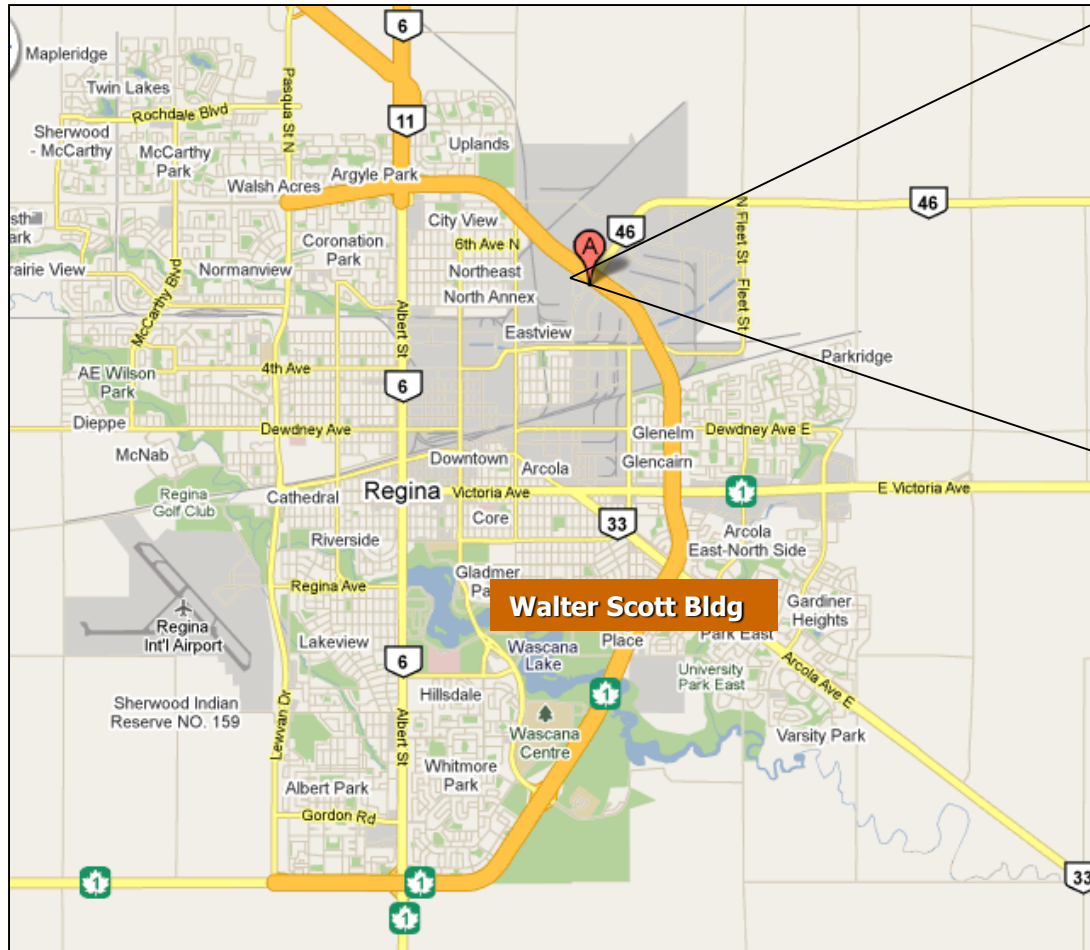
Saskatchewan Ministry of Agriculture

Provincial Diagnostic Laboratories Across the Prairies



- **Alberta Plant Health Lab**
Pest Surveillance Branch
Alberta Agriculture and Forestry
Edmonton, AB
- **Saskatchewan Crop Protection Lab**
Crops and Irrigation Branch
Saskatchewan Ministry of Agriculture
Regina, SK
- **Manitoba Crop Diagnostic Centre**
Manitoba Agriculture
Winnipeg, MB

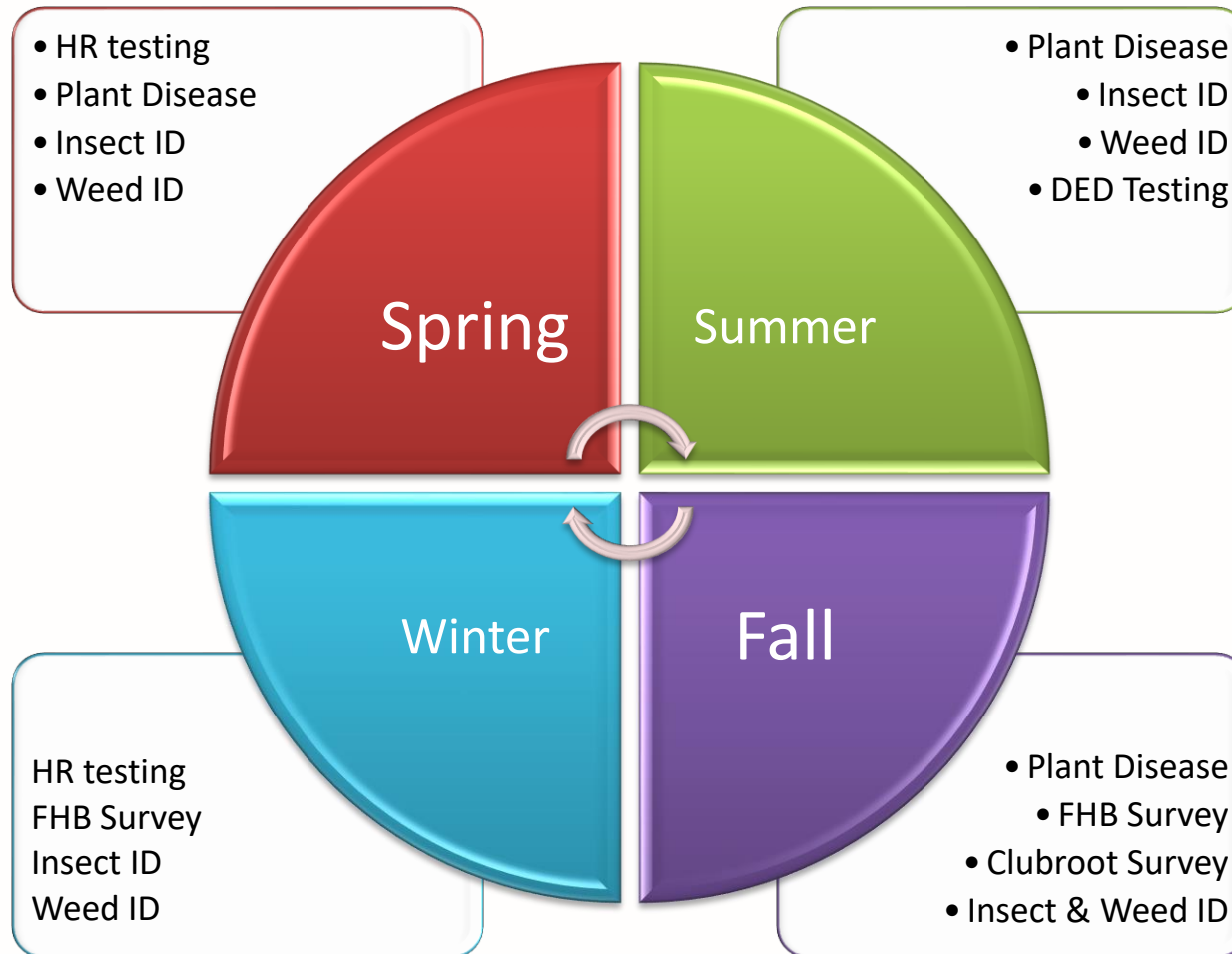
Saskatchewan Crop Protection Lab



Crop Protection Lab
346 McDonald Street
Regina, SK S4N 6P6

Hours (M-F)
8:00AM-12:00PM
1:00PM-5:00PM

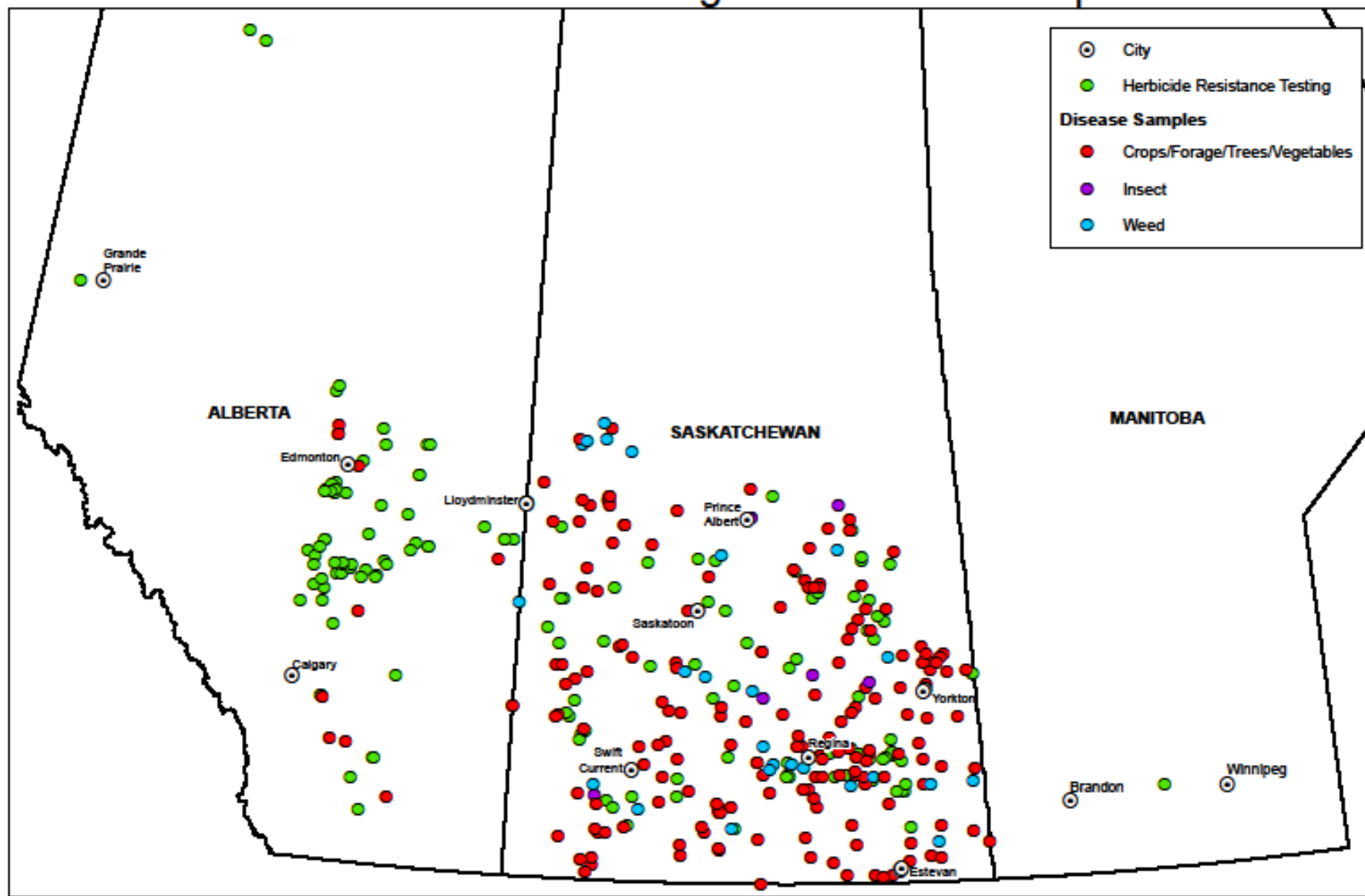
Saskatchewan Crop Protection Lab



Samples Submitted to CPL in 2016

Type of Testing	Total Testing 2016
Ministry of Agriculture Staff Samples	27
Saskatchewan Crop Insurance Corporation Samples	8
Plant Disease Diagnosis - non-SK	10
Plant Disease Diagnosis - SK	222
Weed Identification - non-SK	1
Weed Identification - SK	26
Insect Identification – SK	10
HR Testing – fops & dims to be tested at CPL Regina	121
HR Testing – other to be tested at AAFC Saskatoon	143
Dutch Elm Disease Testing	213
Clubroot Survey – no positives detected through qPCR in 2016	127
FHB Survey – disease in 82% of survey samples in 2016 (1753 isolates)	192
Total Number of 2016 Growing Season Tests/Surveys as of Mar 1, 2017	1100

2016 Herbicide Resistance Testing and Disease Sample Locations



Diagnostic Tools Used in the Lab

- Visual Assessment
- Microscope
- Culturing
- ELISA - enzyme-linked immunosorbent assay
- DNA based detection



We couldn't afford one of those cool PCR robots, so we just got a summer student and a cardboard box.

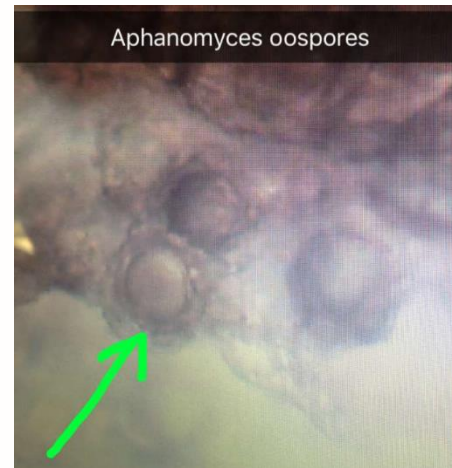
Visual Assessment – eg. Symptoms Consistent with Herbicide Damage

Suspected herbicide damage in 2016	65
Barley	3
Canaryseed	1
Canola	13
Chickpea	10
Durum	2
Fababean	1
Field Pea	8
Flax	6
Horseradish	1
Lentil	13
Sweet Clover	1
Various	1
Wheat	4
White Spruce	1



Visual Assessment / Microscopy / Plating eg. Wet Feet / Root Rot Complex

Root Rot Complex in 2016	63
Barley	1
Chickpea	3
Field Pea	33
Lentil	26
Root, Crown, and Foot Rot	3
Canaryseed	1
Durum	2
Seedling blight	3
Barley	1
Wheat	2

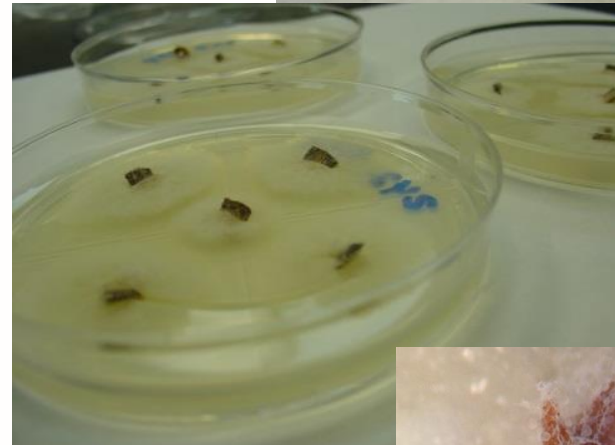


Including Fusarium spp.	26
Field Pea	11
Lentil	11
Including Fusarium spp. and oomycete(s)	17
Field Pea	12
Lentil	5
Including oomycete(s)	20
Field Pea	10
Lentil	10

	<i>Pythium irregulare</i>	<i>Pythium ultimum</i>
<i>Aphanomyces</i>	30	8
		3

Plating / Microscopy eg. Dutch Elm Disease

- Between June-September, Ministry of Environment, City staff, and homeowners can submit small pieces of elm tree branches for DED testing



Elm Samples 2016	Causal Agent(s)	Number of Samples
Dothiorella wilt	<i>Dothiorella ulmi</i>	17
Dutch elm disease (DED)	<i>Ophiostoma ulmi</i>	55
Negative for disease	No pathogens detected	127

Visual Assessment / ELISA

eg. Wheat Streak Mosaic Virus

Wheat Streak Mosaic Virus Samples in 2016	9
Durum	6
Wheat	3



DNA Based Detection Methods

eg. Clubroot Survey

Timeline of Clubroot in Saskatchewan

Year	Activities
2008	Canola Disease Survey - 130 fields surveyed - soil samples collected from 30 fields – One positive field (no symptoms, positive PCR test, positive bioassay)
2009	Declared a pest under The Pest Control Act (PCA)
2009	Ministry formed the SK Clubroot Initiative (SCI)
2009	Canola Disease Survey - 158 fields surveyed - soil samples from 60 fields – No positives
2010	Canola Disease Survey - 265 fields surveyed - soil samples from 76 fields – No positives
2011	Canola Disease Survey - 241 fields surveyed - soil samples from 99 fields – No positives
2011	Two fields confirmed positive outside of the Canola Disease Survey
2012	Canola Disease Survey - 253 fields surveyed - soil samples from 91 fields – One positive field (no symptoms, positive PCR test, positive bioassay)
2013	Canola Disease Survey - 268 fields surveyed - soil sampled from 122 fields – No positives including 12 fields in the surrounding area from the positive field in 2012
2014	Canola Disease Survey - 271 fields surveyed - soil samples from 98 fields – No positives
2015	Canola Disease Survey - 253 fields surveyed - soil samples from 134 fields -No positives
2016	Canola Disease Survey – 224 fields surveyed – soil samples collected from 127 fields – No positives

Herbicide Resistance Testing

Wild Oat Herbicides		Number Resistant	Total Tested	%
Group 1	Clodinafop	62	68	91%
	Clethodim	55	77	71%
	Sethoxydim	46	62	74%
	Penoxaden	87	100	87%
Group 2	Imazamox & Imazethypyr	24	40	60%
	Sulam / TZP	30	37	81%
	SACT	36	48	75%
Group 4	Fluroxypyr	0	1	0
Group 8	Triallate	2	17	12%
Group 9	Glyphosate	1	3	33%

- 132 out of 585 (23%) requested herbicide resistance tests for wild oats could not be performed in 2015 due to immature seeds or insufficient germination
- 343 out of 453 (75%) of the remaining wild oat tests showed at least some herbicide resistance

Herbicide Resistance Testing



- Collect only mature, healthy seed from the suspect plants that have appeared to have survived the herbicide application
- **A minimum of two thousand seeds per herbicide subgroup is required.**
- Do not submit seed that has been treated with a pre-harvest herbicide.
- Seed should be clean with as little stems and foreign material as possible.

Herbicide Resistance Testing

- Seeds **MUST** be dry before shipping.
- Ensure all sections of the Herbicide Resistance Testing Request Form are complete and submitted along with the sample.



Improved Diagnostics

Most Important Piece – information

 Crop Protection Laboratory Ministry of Agriculture – Crops and Irrigation Branch	Plant Disease Lab #:	Cost: \$50 + GST (SK Residents) \$125 + GST (non-SK Residents)
		Payment Options: Credit Card – call (306) 787-4998 <input type="checkbox"/> In-person via Credit Card/Debit – 346 McDonald St. <input type="checkbox"/> Cash or Cheque – invoice me <input type="checkbox"/>
send samples and forms to: 346 McDonald Street Regina SK S4N 6P6	Lab Phone: 306-787-8130 Billing Inquiries: 306-787-4998 croplab@gov.sk.ca	The status of your sample will be acknowledged within 15 working days.

 Crop Protection Laboratory Ministry of Agriculture – Crops and Irrigation Branch	Insect ID Lab #:	Cost: \$30 + GST (SK Residents) \$50 + GST (non-SK Residents)
		Payment Options: Credit Card – call (306) 787-4998 <input type="checkbox"/> In-person via Credit Card/Debit – 346 McDonald St. <input type="checkbox"/> Cash or Cheque – invoice me <input type="checkbox"/>
send samples and forms to: 346 McDonald Street Regina SK S4N 6P6	Lab Phone: 306-787-8130 Billing Inquiries: 306-787-4998 croplab@gov.sk.ca	The status of your sample will be acknowledged within 15 working days.

Contact Information for Payment (required*) – Do NOT send payment with the sample and do NOT email credit card number

Company	Name of contact for payment*
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Contact Information for Payment (required*) – Do NOT send payment with the sample and do NOT email credit card number

Company	Name of contact for payment*		
Address*	Town/City*	Province*	Postal Code*

Address* _____ Town/City* _____

Email* _____

 Crop Protection Laboratory Ministry of Agriculture – Crops and Irrigation Branch	LAB USE ONLY \$125 + GST (per subgroup) (SK Residents) <input type="checkbox"/> \$200 + GST (per subgroup) (non-SK Residents) <input type="checkbox"/>	Herbicide Resistance
SUBMISSION DEADLINE: MARCH 1, 2018		

Email* _____

Contact Information for Submitter/Agronomist/Grower (if different)

Name of contact for sample info	Email
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 Crop Protection Laboratory Ministry of Agriculture – Crops and Irrigation Branch	Weed ID Lab #:	Cost: \$30 + GST (SK Residents) \$50 + GST (non-SK Residents)
		Payment Options: Credit Card – call (306) 787-4998 <input type="checkbox"/> In-person via Credit Card/Debit – 346 McDonald St. <input type="checkbox"/> Cash or Cheque – invoice me <input type="checkbox"/>
send samples and forms to: 346 McDonald Street Regina SK S4N 6P6	Lab Phone: 306-787-8130 Billing Inquiries: 306-787-4998 croplab@gov.sk.ca	The status of your sample will be acknowledged within 15 working days.

* Land Location or GPS	Quarter	Section	Township	Range	Meridian	Latitude
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If you suspect resistance, do NOT wait for confirmation to initiate corrective measures. Testing is conducted between January and June - we CANNOT guarantee test results will be available prior to seeding. Method used for testing is intended to determine resistance to a herbicide GROUP with a common mode of action, NOT

* Land Location or GPS	Quarter	Section	Township	Range	Meridian	Latitude
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Contact Information for Payment (required*) – Do NOT send payment with the sample and do NOT email credit card number

Company	Name of contact for payment*		
Address*	Town/City*	Province*	Postal Code*

Planting and Crop Information

Planting Date _____ **Main symptom** of concern? _____ Area Affected _____

Crop Rotation and Disease History (add additional sheet if needed)

Contact Information for Payment (required*)

Company	Name of contact for payment*		
Address*			
Town/City*	Province*	Postal Code	Email

If insect was found on a plant, please fill in:

Plant: _____ Cultivar: _____

Seeding Date: _____ Date: _____

Weather conditions prior to damage observation: _____

Contact Information for Submitter/Agronomist/Grower (if different from above)

Name of contact for sample info	Email
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Symptoms	Part of Plant Affected (mark all)			
	Roots	Stem	Leaves	Head/Florets
Wilting	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Stunting	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Discolouration	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Mallformation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Physical Damage	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Mould Growth	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Lesions/Spots	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Rotting/Dead	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Contact Information for Submitter/Agronomist/Grower (if different from above)

Name of contact for sample info	Email
Location (Town & Province)	Phone
Field ID (eg. Mom's field):	

Parts of Plant Affected (mark all that apply)

Roots Stunting Spots Tunelling Abnormal Growth/Distortion Chewed Other _____

Type of Damage Caused (mark all that apply)

Wilting Stunting Spots Tunelling Abnormal Growth/Distortion Chewed Other _____

****Please add any other relevant information on**

Contact Information for Submitter/Agronomist/Grower (if different from above)

Name of contact for sample info	Email
Location (Town/Province)	Phone

Severity of the main symptom of concern (check one below)

Slight Severe Moderate Variable

What do you think **main symptom** of? _____ Did you take photo? _____

***Weed Type (choose one):**

Wild Oats Green Foxtail (Wild Millet) Kochia Wild Mustard Shepherd's Pursue Other _____

LAB USE ONLY

Identification Complete

Common Name: _____ Scientific Name: _____

Results are confidential except where Ministry is required to report the results (quarantine or regulatory significance). CPL reserves the right to refuse submission due to improper sample, incomplete form or if your prior payment is outstanding.

Sample Identifiers

Field ID (eg. Mom's field): _____ Are you a Weed Inspector? Yes No

* Land Location or GPS	Quarter	Section	Township	Range	Meridian	Latitude	Longitude
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IMPORTANT PLEASE READ:

Each sample **must** contain:

- at least 2000 DRY, MATURE seeds FOR EACH SUBGROUP
- NO STEMMS
- NO glyphosate applied
- completed form (do NOT include payment)

**** In case of insufficient seed, we will choose which subgroup is tested unless you specify priority. ****

Sample Type	Soil Type	Growth Habit	Habitat			
<input type="checkbox"/> Commercial Agriculture	<input type="checkbox"/> Clay <input type="checkbox"/> Loam <input type="checkbox"/> Sand	<input type="checkbox"/> Herb <input type="checkbox"/> Tree <input type="checkbox"/> Shrub <input type="checkbox"/> Roots in water <input type="checkbox"/> Other _____	<input type="checkbox"/> Low, wet areas <input type="checkbox"/> Stough edge <input type="checkbox"/> Forest/Tree area <input type="checkbox"/> Industrial Ballast <input type="checkbox"/> Forage/Hay <input type="checkbox"/> Slopes/Hilltops <input type="checkbox"/> No Till Field			
Plant Habit	Plant Height	Leaf Type	Fruit Size	Fruit Type	Plant Colour	Quantity
<input type="checkbox"/> Upright <input type="checkbox"/> Creeping	<input type="checkbox"/> < 30 cm <input type="checkbox"/> 10 - 30 cm <input type="checkbox"/> 30 cm <input type="checkbox"/> > 100 cm	<input type="checkbox"/> Broad <input type="checkbox"/> Grassy	<input type="checkbox"/> < 1 cm <input type="checkbox"/> 1 - 2 cm <input type="checkbox"/> > 2 cm	<input type="checkbox"/> Aggregate (ex. strawberry) <input type="checkbox"/> Berry <input type="checkbox"/> Grain	<input type="checkbox"/> Red <input type="checkbox"/> Green <input type="checkbox"/> Brown	<input type="checkbox"/> 1 plant <input type="checkbox"/> Few <input type="checkbox"/> Many
Nature of Growth	Root Type	Fruit Colour	Flower Colour	Flower Odour		
<input type="checkbox"/> Annual <input type="checkbox"/> Biennial <input type="checkbox"/> Perennial	<input type="checkbox"/> Fibrous <input type="checkbox"/> Tap	<input type="checkbox"/> Nut <input type="checkbox"/> Pod <input type="checkbox"/> Silique (ex. garbanzo)				

Herbicide(s) used on plants: _____

****Please add any other relevant information on an additional sheet if necessary****

Herbicide Group 1	Lab Use Only:	Herbicide Group 2	Lab Use Only:	Other Herbicide Groups	Lab Use Only:
<input type="checkbox"/> fops <input type="checkbox"/> dims <input type="checkbox"/> dens <input type="checkbox"/> clethodim	<input type="checkbox"/> imi <input type="checkbox"/> TPS (formerly T2P or sulam) <input type="checkbox"/> SACT <input type="checkbox"/> SU	<input type="checkbox"/> 3 <input type="checkbox"/> 8 <input type="checkbox"/> 9 / glyphosate <input type="checkbox"/> Other _____			

Lab Use Only: repeat requested yes no

LAB USE ONLY

Identification Complete

Common Name: _____ Scientific Name: _____

Results are confidential except where Ministry is required to report the results (quarantine or regulatory significance). CPL reserves the right to refuse submission due to improper sample, incomplete form or if your prior payment is outstanding.

Ten Outcomes of a CPL Diagnosis

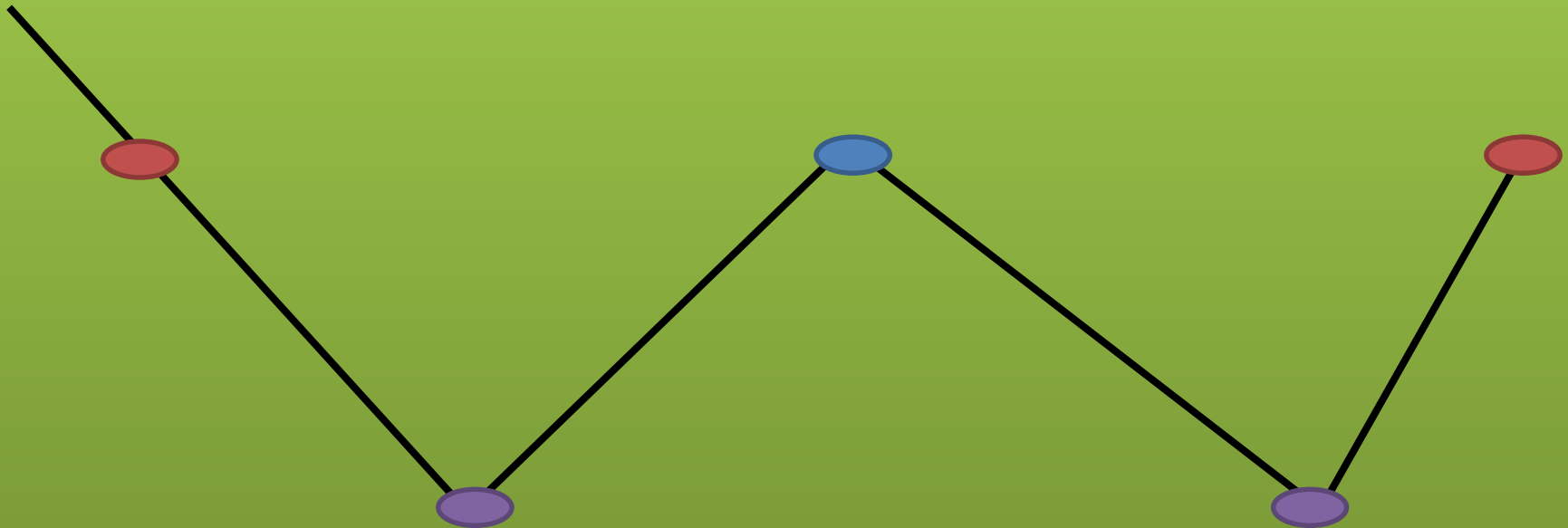
1. Determine immediate action
2. Management decisions
3. Information for record keeping
4. Guide for additional testing
5. Data generation for extension
6. Directing research needs
7. Evidence for investigations
8. Regulatory response
9. Ag awareness
10. Fee for service - we now take credit card

Service	Fee Sask. residents	Fee Non-residents
Sample Identification		
Plant/Weed identification	\$30	\$50
Insect identification	\$30	\$50
Plant Disease/Disorder Testing		
Plant disease diagnosis ² or damage caused by herbicides ³ , fertilizers or environmental conditions	\$50	\$125
Dutch Elm Disease test	No charge	Not offered
Herbicide Resistance Testing of Weed Seeds		
Wild Oats		
Group 1 - subgroups include: • "Fops" • "Dims" • "Dens" • Clethodim ⁴	\$125 per subgroup tested	\$200 per subgroup tested
Group 2 - subgroups include: • Imidazolinones • Triazolopyrimidines • Sulfonylaminocarbonyltriazolinones	\$125 per subgroup tested	\$200 per subgroup tested
Group 8	\$125 per test	\$200 per test
Green Foxtail		
Group 1	\$125 per group tested	\$200 per group tested
Group 3		
Any other herbicide resistance testing	\$125 per test requested	\$200 per test requested

Scouting and Diagnostics

Purpose of Scouting

- Identify disease & assess severity
- Determine effectiveness of control measures



- 5-10 sites per 100 acres

Sampling

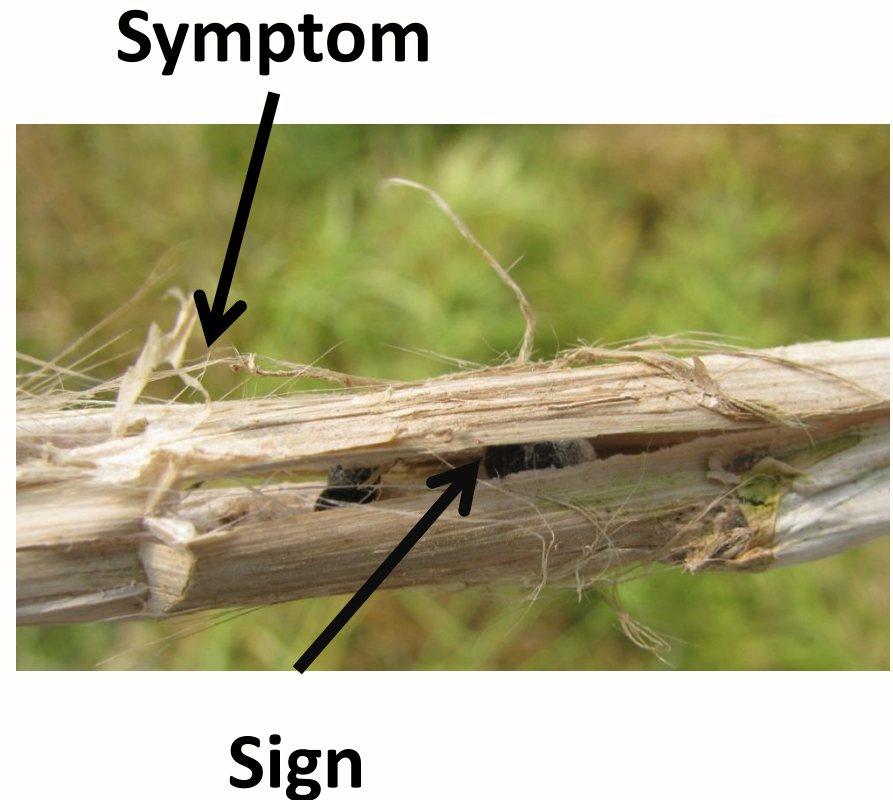
- Choose specimens showing various stages of disease symptoms.
- Include some healthy specimens for comparison.
- If possible whole plants including roots should be submitted.
- Record the plant parts affected, symptoms observed, distribution within the plant population, and cropping history.
- Complete and include the online Plant Disease Diagnosis Request Form.

Packaging Samples

- Wrap specimens in dry paper towel.
- If the sample includes the root system with soil attached, put this portion into a plastic bag and tie it off at the base of the stem.
- Submit the sample in a rigid container, loosely packed in dry packing material such as newspaper.

Diagnosing “Plant Disease”

1. Recognizing and identifying **symptoms**
2. Look for **signs** of the pathogen
3. Diagnose



What is disease?

- Ultimately affect crop quality & yield:
 - Reduce photosynthesis
 - Result in flower and head infections



What is disease?

- Ultimately affect crop quality & yield:
 - Reduce root growth/uptake
 - Restrict stem flow

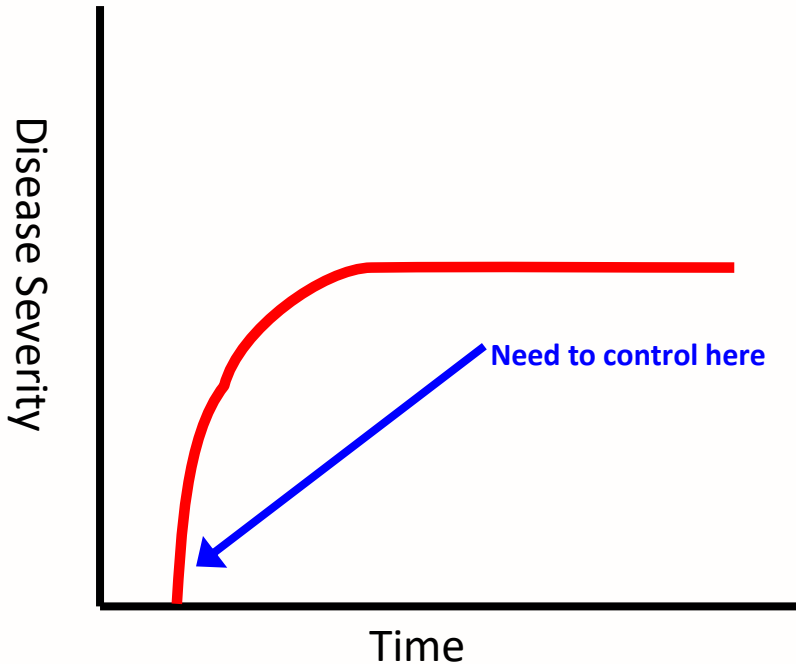


Wheat Take All



S. Chant, SMA

How pathogens are spread...



- Mono-cyclic diseases are those that have **only 1 infection cycle per season**
 - One main release of spores
 - Host is susceptible one time
- Need to control at start of infection cycle
 - Symptoms = too late
- Diagnosing later can help plan/prepare for next time

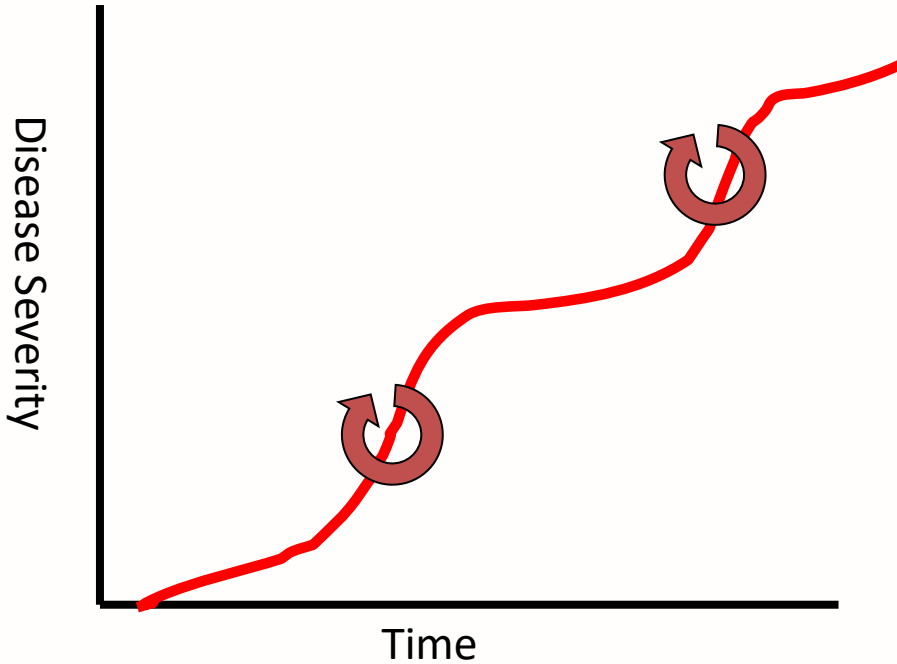
Take-home message:

Instead of scouting for symptoms to determine risk ... you need to scout for the conditions that favour disease.

Mono-cyclic Diseases



How pathogens are spread...

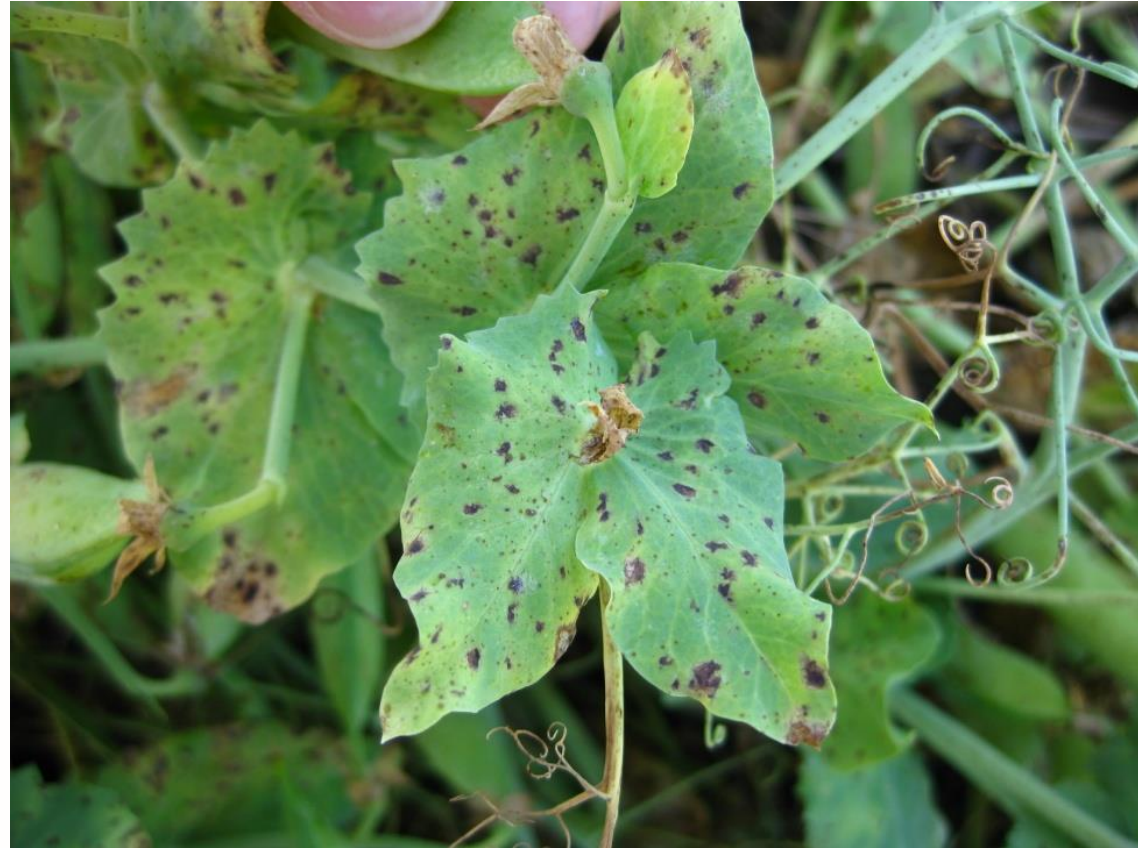


- Poly-cyclic diseases are those that have **>1 infection cycle per season**
 - Multiple spore releases
 - Plant is susceptible over a longer period of time
- Scout for early symptoms, then provide control to stop additional infection cycles
- Diagnosing can help with decision-making

Take-home message:

Greater chance of success for control measures, but need to act before too many cycles have occurred.

Poly-cyclic Diseases



Accurate Diagnosis

- Environmental Stresses:
 - Dry soils, waterlogged soils, high temperatures, frost, hail and strong winds (sandblasting)
- Chemical damage
- Insect damage
- Nutrient deficiencies
- Off-types or physiological spots

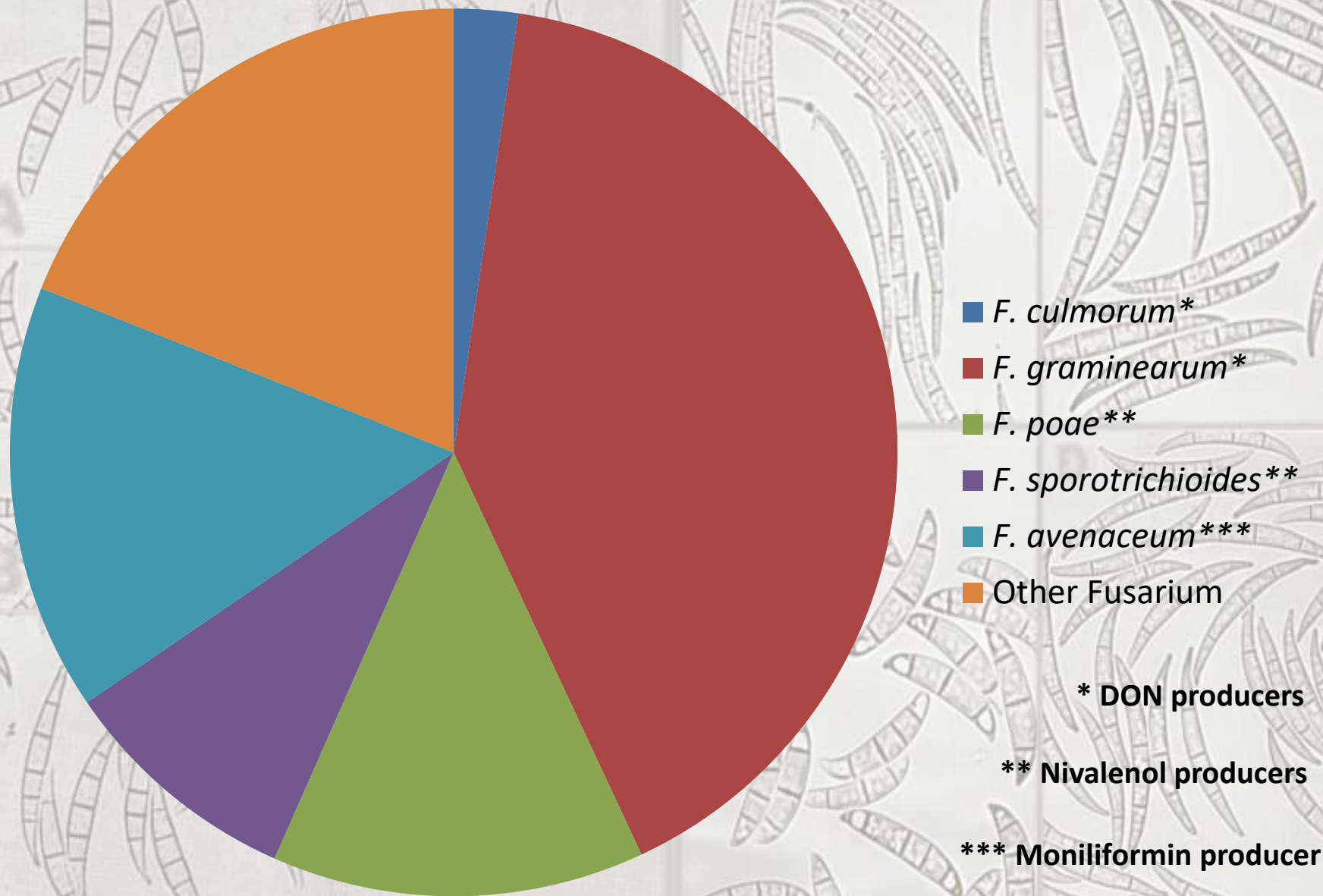




Fusarium Head Blight

- CPL does visual/plating for samples from the annual FHB survey of ~210 wheat and barley fields in SK
 - 82% of the fields surveyed in 2016 had at least trace levels of FHB
 - *F. graminearum* was detected in 57% of the fields surveyed in 2016
- Damaged kernels aren't necessarily FHB damage (FDK)
 - 68% of the suspected damaged kernels in the 2016 survey were confirmed to be infected with *Fusarium*
- But in-tact kernels aren't necessarily *Fusarium*-free either
 - Saprophytic *Fusarium* can grow on dead/ripe material
 - *Fusarium*-infected seed can result in...
 - Reduced germination
 - Seedling blights
 - Mycotoxin production
 - Have seed intended for seeding tested at a private lab!

Fusarium Species Isolated in 2016 FHB Survey



<i>F. culmorum</i> *	<i>F. graminearum</i> *	<i>F. poae</i> **	<i>F. sporotrichioides</i> **	<i>F. avenaceum</i> ***	Other Fusarium	Total
41	717	239	156	274	334	1761

Integrated Pest Management Toolbox

- Crop rotation & disease tolerant cultivars
- Prevention & sanitation measures
- Seedling health & seed treatments
- Crop scouting & foliar fungicides
- Laboratory diagnostics
- Good record keeping & planning



Other Ministry Diagnostic Contacts

- Barb Ziesman, Provincial Specialist, **Plant Disease**- (306) 787-4671
- Clark Brenzil, Provincial Specialist, **Weed Control**- (306) 787-4673
- Scott Hartley, Provincial Specialist, **Insect Management**- (306) 787-4669
- Ken Panchuk, Provincial Specialist, **Soils**- (306) 787-0556
- Danielle Stephens, **IPM Agrologist**- (306)787-4670

Regional Offices:

Prince Albert- (306) 953-2363

Outlook- (306) 867-5575

North Battleford- (306) 446-7962

Tisdale- (306) 878-8842

Yorkton- (306) 786-1531

Weyburn- (306) 848-2857

Watrous- (306) 946-3220

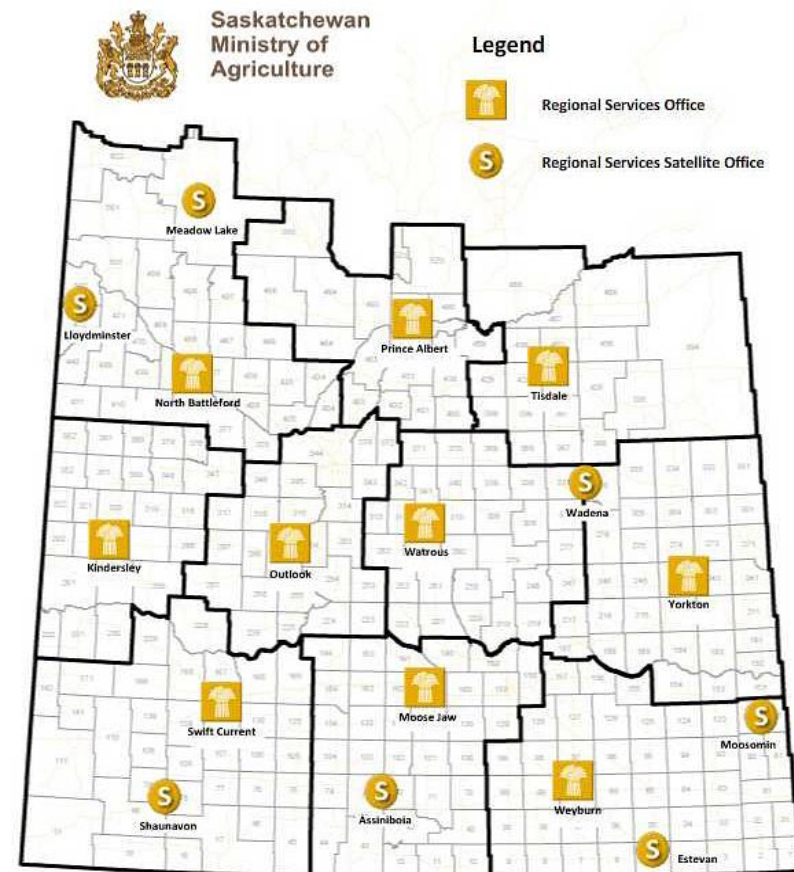
Kindersley- (306) 463-5513

Swift Current- (306) 778-8285

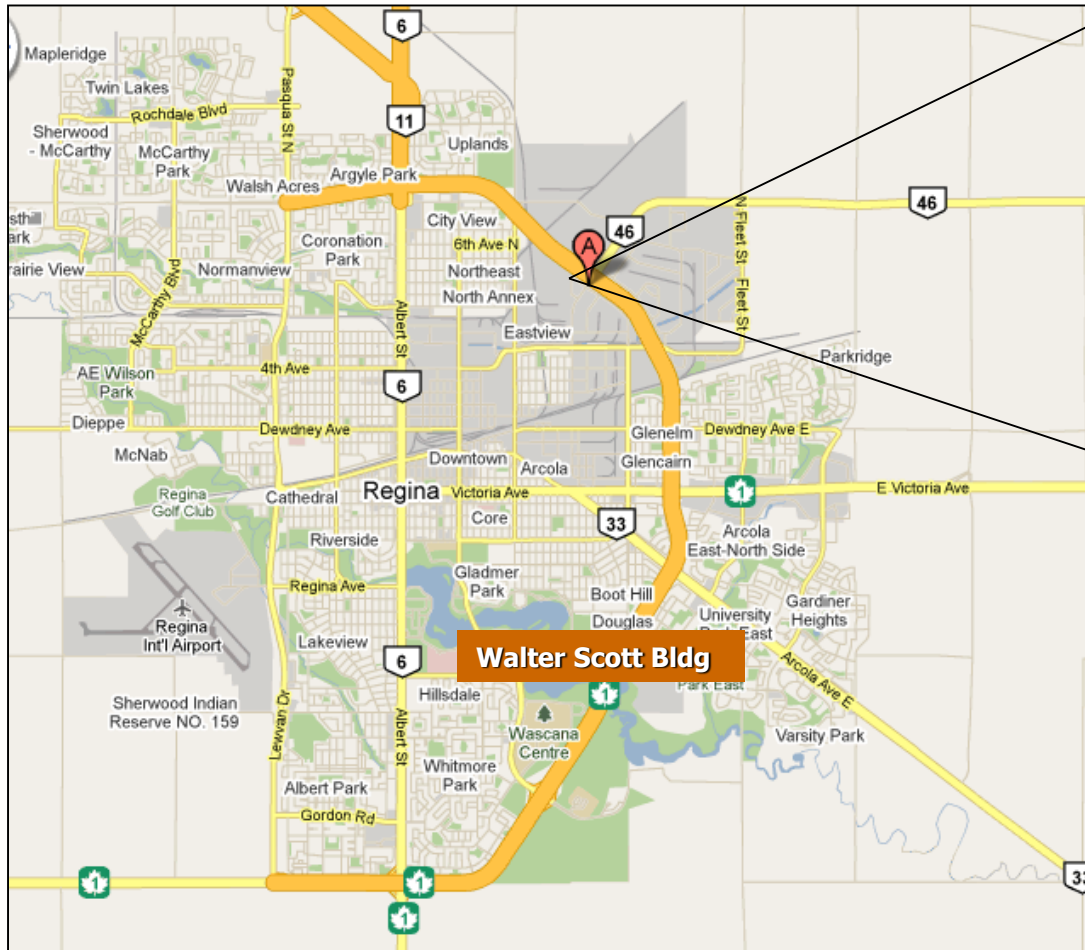
Moose Jaw- 1-866-457-2377

- **Agriculture Knowledge Centre**: 1-866-457-2377

Regional Offices Locations



Crop Protection Laboratory



**346 McDonald Street
Regina, SK S4N 6P6**

**Hours (M-F)
8:00AM-12:00PM
1:00PM-5:00PM**

306-787-8130

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faye.bouchard@gov.sk.ca

306-798-0100 (office)

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saskatchewan.ca