The Society recognizes the continuing need to publish plant disease surveys to document plant pathology in Canada and to benefit federal, provincial and other agencies in planning research and development on disease control.

La Société estime qu’il est nécessaire de publier régulièrement les résultats d’études sur l’état des maladies au Canada afin qu’ils soient disponibles aux phytopathologistes et qu’ils aident les organismes fédéraux, provinciaux et privés à planifier la recherche et le développement en lutte contre les maladies.

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The Canadian Plant Disease Survey is a periodical of information and record on the occurrence and severity of plant diseases in Canada and the estimated losses from diseases.

Authors who wish to publish articles and notes on other aspects of plant pathology are encouraged to submit this material to the scientific journal of their choice, such as the Canadian Journal of Plant Pathology or Phytoprotection.

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L’inventaire des maladies des plantes au Canada est un périodique d’information sur la fréquence des maladies des plantes au Canada, leur gravité et les pertes qu’elles occasionnent.

Les auteurs qui veulent publier des articles et des notes sur d’autres aspects de la phytopathologie sont invités à soumettre leurs textes à la revue scientifique de leur choix, par exemple à la Revue canadienne de phytopathologie.

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<th>EDITORS AND ADDRESSES</th>
</tr>
</thead>
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INDEX – TITLES AND AUTHORS / TITRES ET AUTEURS

DIAGNOSTIC LABORATORIES / LABORATOIRES DIAGNOSTIQUES .................................................. 6

V. Joshi. Diseases/symptoms diagnosed on commercial crop samples submitted to the British Columbia Ministry of Agriculture (BCAGRI) Plant Health Laboratory in 2018 .................................................. 6

J.F. Elmirsth. Diseases diagnosed on ornamental nursery and landscape crops in British Columbia, 2018 .................................................................................................................. 16


C. Brenzil, S. Hartley, T. Sliva, G. Sweetman & B. Ziesman. Diseases diagnosed on crop samples submitted to the Saskatchewan Ministry of Agriculture Crop Protection Laboratory in 2017 .................................................................................................................. 31

M.P. Pradhan, V. Bisht, P. Bajracharya & H. Derksen. 2018 Manitoba Agriculture Crop Diagnostic Centre Laboratory submissions .................................................................................................................. 34

M. Melzer & X. Shan. Diseases diagnosed on plant samples submitted to the Plant Disease Clinic, University of Guelph, in 2018 .................................................................................................................. 41

Z. Telfer, M.R. McDonald. Diseases diagnosed on plant samples submitted to the Muck Crops Research Station Diagnostic Laboratory in 2018 .................................................................................................................. 53


M.T. Tesfaendrias. Diseases diagnosed on plant samples submitted to the NBDAAF Plant Disease Diagnostic Laboratory in 2018 .................................................................................................................. 75

M.M. Clark & A. MacLeod. Diseases diagnosed on commercial crop samples submitted to the Prince Edward Island Plant Disease Diagnostic Service (PDDS) in 2018 .................................................................................................................. 78

CEREALS / CÉRÉALES .......................................................................................................................... 81


M. Banik, M. Beyene & X. Wang. Fusarium head blight of barley in Manitoba – 2018 .................................................................................................................. 83

P. Cholango-Martinez & H.R. Kutzer. Leaf spot diseases in barley in Saskatchewan in 2018 .................................................................................................................. 85

N.E. Rauhala & T.K. Turkington. 2018 barley disease survey in Central Alberta .................................................................................................................. 87

S. Waterman, K. Kumar & K. Xi. Wheat and barley disease survey in Central Alberta, 2018 .................................................................................................................. 89

A.G. Xue & Y. Chen. Diseases of barley in central and eastern Ontario in 2018 .................................................................................................................. 91

P. Cholango-Martinez, P. Hucl & H.R. Kutzer. Leaf mottle and Fusarium spp. in canary seed in Saskatchewan in 2018 .................................................................................................................. 94

M. Banik, M. Beyene & X. Wang. Fusarium head blight of oat in Manitoba – 2018 .................................................................................................................. 96


A.G. Xue & Y. Chen. Diseases of oat in Central and Eastern Ontario in 2018 .................................................................................................................. 103

M. Beyene M. Banik & X. Wang. Barley and oat leaf spot diseases in Manitoba - 2018 .................................................................................................................. 105


S. Rioux. Observations des maladies des céréales au Québec en 2018 .................................................................................................................. 109
M.A. Henriquez, H. Derksen, J. Doherty, D. Miranda & O. Gruenke. Fusarium head blight of spring wheat in Manitoba in 2018 .......................................................... 111
M.A. Henriquez, H. Derksen, J. Doherty, D. Miranda & O. Gruenke. Fusarium head blight of winter wheat in Manitoba in 2018 .......................................................... 113
M.A. Henriquez, H. Derksen, J. Doherty, D. Miranda & O. Gruenke. Leaf spot diseases of winter wheat in Manitoba in 2018 .......................................................... 115
M.A. Henriquez, H. Derksen, J. Doherty, D. Miranda & O. Gruenke. Leaf spot diseases of spring wheat in Manitoba in 2018 .......................................................... 117
T. Fetch & T. Zegeye. Stem rusts of cereals in western Canada in 2018 .......................................................... 120
K.F. Chang, R. Nyandoro, K. Xi, K. Kumar, S. Strelkov & F. Capettini. The occurrence of cereal crop diseases in northeast Alberta in 2018 .......................................................... 131
R. Aboukhaddour, K. Ghanbarnia, K. Xi, K. Kumar, M. Harding & H. Klein-Gibbinck. Stripe (yellow) rust of cereals in Alberta .......................................................... 135
A.G. Zue & Y. Chen. Diseases of spring wheat in central and eastern Ontario in 2018 .......................................................... 140

OILSEEDS, PULSES, FORAGES AND SPECIAL CROPS / OLÉAGINEUX, PROTÉAGINEUX, PLANTES FOURRAGÈRES ET CULTURES SPÉCIALES .......................................................... 151
J.D. Reich, T. Tetzlaff, M.W. Harding & S. Chatterton. White mold of dry bean in southern Alberta in 2018 .......................................................... 164
M.W. Harding, S. Chatterton, R. Bowness, D.A. Burke, C. Vicurevich, T. Dubitz & G.C. Daniels. A province-wide survey for diseases of field pea in Alberta in 2018 .......................................................... 166
M.W. Harding. A survey for soybean diseases in Alberta in 2018 .......................................................... 174
B.D. Olson, S. Banniza, T. Blois, B. Ernst, S. Junek, S. Phelps & B. Ziesman. Seed-borne pathogens of pulse crops in Saskatchewan in 2015 .......................................................... 177
B.D. Olson, S. Banniza, T. Blois, B. Ernst, S. Junek, S. Phelps & B. Ziesman. Seed-borne pathogens of pulse crops in Saskatchewan in 2016 .......................................................... 182


2019 AUTHOR INDEX (ALPHABETICAL) / INDEX D’AUTEURS (ALPHABÉTIQUE) – 2019

LIST OF FIGURES / LISTE DE FIGURES
Diagnostic Laboratories /Laboratoires Diagnostiques

CROP: Diagnostic Laboratory Report - Commercial Crops
LOCATION: British Columbia

NAME AND AGENCY:
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Plant Health Laboratory, Plant and Animal Health Branch, BC Ministry of Agriculture, Abbotsford Agriculture Centre, 1767 Angus Campbell Road, Abbotsford, BC V3G 2M3
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Web page: https://www2.gov.bc.ca/gov/content/industry/agriculture-seafood/animals-and-crops/plant-health/plant-health-laboratory

TITLE: DISEASES/SYMPTOMS DIAGNOSED ON COMMERCIAL CROP SAMPLES SUBMITTED TO THE BRITISH COLUMBIA MINISTRY OF AGRICULTURE (BCAGRI), PLANT HEALTH LABORATORY IN 2018

ABSTRACT: The British Columbia Ministry of Agriculture (BCAGRI) Plant Health Laboratory provides diagnoses of diseases caused by fungi, bacteria, viruses, plant parasitic nematodes and insect pests of agricultural crops grown in British Columbia. Between January 1 and November 30, 2018, the laboratory received 921 samples including Christmas trees, field crops, greenhouse vegetable and floriculture crops, forest nursery seedlings, herbaceous and woody ornamentals, small fruits, tree fruits, nuts and specialty crops for diagnosis. No significantly new or unusually high level of any disease was detected in the samples.

METHODS: The BCAGRI Plant Health Laboratory provides diagnoses for diseases caused by fungi, bacteria, viruses, plant parasitic nematodes, and insect pests of agricultural crops grown in British Columbia. Samples were submitted to the laboratory by ministry staff, growers, agri-businesses, municipalities and Master Gardeners. Diagnoses were accomplished by visual and microscopic examination, culturing onto artificial media, biochemical identification of bacteria using BIOLOG®, serological testing of viruses, fungi and bacteria with micro-well and membrane-based enzyme-linked immunosorbent assay (ELISA). Molecular techniques (polymerase chain reaction (PCR) (conventional and/or real time) were used for some species-specific diagnoses. Electron microscopic examination was performed on samples with unknown virus-like symptoms. Some specimens were referred to other laboratories for identification or confirmation of the diagnosis.

RESULTS AND COMMENTS: Overall in 2018, British Columbia had a wet spring followed by a long dry summer. The wet weather in the spring supported bacterial blights on woody ornamentals, tree fruits and berry crops. Fire blight incidence was higher in tree fruit and woody ornamental crops. Fruit rots and postharvest rots were much lower than normal due to dry weather in late summer. Diseases and their causal agents diagnosed on crop samples submitted to the laboratory are presented in the following tables (1 to 11) organized by crop category. Diagnoses not listed include: abiotic symptoms such as nutritional stress, pH imbalance, water stress, drought stress, physiological response to adverse growing conditions, genetic abnormalities, environmental and chemical stresses including herbicide damage, fruit abortion due to lack of pollination, insect-related injury and damage where no conclusive causal factor was identified.
Table 1. Diseases/disorders detected in field crop samples submitted to the BCAGRI Plant Health Laboratory between January 1 and November 30, 2018.

<table>
<thead>
<tr>
<th>CROP</th>
<th>DISEASE / SYMPTOM</th>
<th>CAUSAL / ASSOCIATED ORGANISM</th>
<th>NO. OF SAMPLES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corn</td>
<td>Downy mildew</td>
<td>Peronosclerospora sp.</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Fusarium stalk rot</td>
<td>Fusarium verticillioides</td>
<td>1</td>
</tr>
<tr>
<td>Sorghum/sudangrass</td>
<td>Leaf spot</td>
<td>Cladosporium sp. and Alternaria sp.</td>
<td>1</td>
</tr>
</tbody>
</table>

Table 2. Diseases/disorders detected in floriculture samples submitted to the BCAGRI Plant Health Laboratory between January 1 and November 30, 2018.

<table>
<thead>
<tr>
<th>CROP</th>
<th>DISEASE / SYMPTOM</th>
<th>CAUSAL / ASSOCIATED ORGANISM</th>
<th>NO. OF SAMPLES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dahlia</td>
<td>Dahlia mosaic virus</td>
<td>Dahlia mosaic virus</td>
<td>1</td>
</tr>
<tr>
<td>Dianthus</td>
<td>Stem and root rot</td>
<td>Fusarium spp.</td>
<td>1</td>
</tr>
<tr>
<td>Echeveria</td>
<td>Leaf spot</td>
<td>Impatiens necrotic spot virus</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Stem/crown rot</td>
<td>Fusarium sp.</td>
<td>1</td>
</tr>
<tr>
<td>Echeveria nodulosa</td>
<td>Leaf spot</td>
<td>Tomato spotted wilt virus</td>
<td>1</td>
</tr>
<tr>
<td>Eragrostis</td>
<td>Phyllosticta leaf blight</td>
<td>Phyllosticta sp.</td>
<td>1</td>
</tr>
<tr>
<td>Hakonechloa</td>
<td>Leaf spot</td>
<td>Bipolaris sp.</td>
<td>1</td>
</tr>
<tr>
<td>Helianthus</td>
<td>Botrytis head rot</td>
<td>Botrytis cinerea</td>
<td>1</td>
</tr>
<tr>
<td>Helleborus</td>
<td>Botrytis blight</td>
<td>Botrytis cinerea</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Leaf spot</td>
<td>Colletotrichum sp.</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Leaf spot</td>
<td>Phyllosticta sp.</td>
<td>2</td>
</tr>
<tr>
<td>Iris</td>
<td>Leaf spot</td>
<td>Heterosporium iridis</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Leaf spot</td>
<td>Phyllosticta sp.</td>
<td>1</td>
</tr>
<tr>
<td>Kalanchoe</td>
<td>Leaf spot</td>
<td>Botrytis cinerea</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Powdery mildew</td>
<td>Sphaerotheca fuliginea</td>
<td>1</td>
</tr>
<tr>
<td>Kalanchoe blossfeldiana</td>
<td>Powdery mildew</td>
<td>Erysiphe sp.</td>
<td>1</td>
</tr>
<tr>
<td>Kalanchoe tomentosa</td>
<td>Necrotic spots</td>
<td>Impatiens necrotic spot virus</td>
<td>1</td>
</tr>
<tr>
<td>Lavandula</td>
<td>Botrytis blight</td>
<td>Botrytis cinerea</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Root rot</td>
<td>Pythium sp.</td>
<td>1</td>
</tr>
<tr>
<td>Pachysandra terminalis</td>
<td>Leaf spot</td>
<td>Phyllosticta sp.</td>
<td>1</td>
</tr>
<tr>
<td>Paeonia</td>
<td>Botrytis blight</td>
<td>Botrytis cinerea</td>
<td>1</td>
</tr>
<tr>
<td>Phormium</td>
<td>Anthracnose</td>
<td>Colletotrichum sp.</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Pythium root rot</td>
<td>Pythium sp.</td>
<td>1</td>
</tr>
<tr>
<td>Tagetes</td>
<td>Gray mold</td>
<td>Botrytis cinerea</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Stem canker</td>
<td>Paraconiothyrium sp.</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Stem canker</td>
<td>Phomopsis sp.</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>White mold</td>
<td>Sclerotinia sclerotiorum</td>
<td>1</td>
</tr>
</tbody>
</table>
Table 3. Diseases/disorders detected in forest nursery samples submitted to the BCAGRI Plant Health Laboratory between January 1 and November 30, 2018.

<table>
<thead>
<tr>
<th>CROP</th>
<th>DISEASE/SYMPTOM</th>
<th>CAUSAL/ASSOCIATED ORGANISM</th>
<th>NO. OF SAMPLES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abies balsamea</td>
<td>Botrytis blight</td>
<td>Botrytis cinerea</td>
<td>1</td>
</tr>
<tr>
<td>Abies procera</td>
<td>Fusarium root rot</td>
<td>Fusarium sp.</td>
<td>1</td>
</tr>
<tr>
<td>Alnus rubra</td>
<td>Botrytis blight</td>
<td>Botrytis cinerea</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Phoma blight</td>
<td>Phoma sp.</td>
<td>1</td>
</tr>
<tr>
<td>Larix occidentalis</td>
<td>Phoma blight</td>
<td>Phoma sp.</td>
<td>1</td>
</tr>
<tr>
<td>Picea engelmannii x glauca</td>
<td>Cylindrocarpon root rot</td>
<td>Cylindrocarpon sp.</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Fusarium root rot</td>
<td>Fusarium sp.</td>
<td>1</td>
</tr>
<tr>
<td>Picea mariana</td>
<td>Botrytis blight</td>
<td>Botrytis cinerea</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Fusarium root rot</td>
<td>Fusarium sp.</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Phoma blight</td>
<td>Phoma sp.</td>
<td>1</td>
</tr>
<tr>
<td>Pinus banksiana</td>
<td>Botrytis blight</td>
<td>Botrytis cinerea</td>
<td>1</td>
</tr>
<tr>
<td>Pinus contorta</td>
<td>Botrytis blight</td>
<td>Botrytis cinerea</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Phoma blight</td>
<td>Phoma sp.</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Root rot</td>
<td>Fusarium sp. and Pythium sp.</td>
<td>1</td>
</tr>
<tr>
<td>Pinus resinosa</td>
<td>Botrytis blight</td>
<td>Botrytis cinerea</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Cylindrocarpon root rot</td>
<td>Cylindrocarpon sp.</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Fusarium root rot</td>
<td>Fusarium sp.</td>
<td>1</td>
</tr>
<tr>
<td>Pseudotsuga menziesii</td>
<td>Cylindrocarpon root rot</td>
<td>Cylindrocarpon sp.</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Fusarium root rot</td>
<td>Fusarium sp.</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Needle blight</td>
<td>Rhizosphaera pini</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Phoma blight</td>
<td>Phoma sp.</td>
<td>2</td>
</tr>
<tr>
<td>Pseudotsuga menziesii var. glauca</td>
<td>Alternaria blight</td>
<td>Alternaria sp.</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Botrytis blight</td>
<td>Botrytis cinerea</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Cylindrocarpon root rot</td>
<td>Cylindrocarpon sp.</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Fusarium root rot</td>
<td>Fusarium sp.</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Phoma blight</td>
<td>Phoma sp.</td>
<td>3</td>
</tr>
<tr>
<td>Thuja plicata</td>
<td>Foliar infection</td>
<td>Botrytis cinerea, Penicillium sp. and Phoma sp.</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Fusarium root rot</td>
<td>Fusarium sp.</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Rhizoctonia root rot</td>
<td>Rhizoctonia sp.</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Saprophytic fungus</td>
<td>Sporothrix or Geomyces sp.</td>
<td>1</td>
</tr>
<tr>
<td>Tsuga heterophylla</td>
<td>Botrytis blight</td>
<td>Botrytis cinerea</td>
<td>1</td>
</tr>
<tr>
<td>Tsuga mertensiana</td>
<td>Botrytis blight</td>
<td>Botrytis cinerea</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Foliar blight</td>
<td>Alternaria sp.</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Needle blight</td>
<td>Sclerophoma sp.</td>
<td>1</td>
</tr>
</tbody>
</table>
Table 4. Diseases/disorders detected in **greenhouse vegetable** samples submitted to the BCAGRI Plant Health Laboratory between January 1 and November 30, 2018.

<table>
<thead>
<tr>
<th>CROP</th>
<th>DISEASE / SYMPTOM</th>
<th>CAUSAL / ASSOCIATED ORGANISM</th>
<th>NO. OF SAMPLES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cucumber</td>
<td>Anthracnose</td>
<td>Colletotrichum sp.</td>
<td>1</td>
</tr>
<tr>
<td>Pepper</td>
<td>Blotching on fruit</td>
<td>Impatiens necrotic spot virus</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Damping off</td>
<td>Fusarium sp.</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Root rot</td>
<td>Fusarium sp., Pythium sp. and Rhizoctonia sp.</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Pythium sp.</td>
<td>1</td>
</tr>
</tbody>
</table>

Table 5. Diseases/disorders detected in **herbaceous perennial** plant samples submitted to the BCAGRI Plant Health Laboratory between January 1 and November 30, 2018.

<table>
<thead>
<tr>
<th>CROP</th>
<th>DISEASE / SYMPTOM</th>
<th>CAUSAL / ASSOCIATED ORGANISM</th>
<th>NO. OF SAMPLES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ajuga</td>
<td>Crown / stem canker</td>
<td>Phoma sp.</td>
<td>1</td>
</tr>
<tr>
<td>Anemonella thalictroides rosea</td>
<td>Anthracnose</td>
<td>Colletotrichum sp.</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Leaf spot</td>
<td>Pseudomonas syringae</td>
<td>1</td>
</tr>
<tr>
<td>Arctostaphylos uva-ursi</td>
<td>Phytophthora root rot</td>
<td>Phytophthora sp.</td>
<td>4</td>
</tr>
<tr>
<td>Buxus</td>
<td>Foliar blight</td>
<td>Clonostachys sp.</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Leaf spot</td>
<td>Macrohoma sp.</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Leaf spot</td>
<td>Phyllosticta sp.</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Phytophthora root rot</td>
<td>Phytophthora sp.</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Tip die-back</td>
<td>Phomopsis sp.</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Volutella blight</td>
<td>Volutella buxi</td>
<td>9</td>
</tr>
<tr>
<td>Echinacea</td>
<td>Alternaria leaf spot</td>
<td>Alternaria sp.</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Leaf spot</td>
<td>Colletotrichum sp.</td>
<td>1</td>
</tr>
<tr>
<td>Epimedium</td>
<td>Leaf spot</td>
<td>Phyllosticta sp.</td>
<td>1</td>
</tr>
<tr>
<td>Gaillardia</td>
<td>Botrytis blight</td>
<td>Botrytis cinerea</td>
<td>1</td>
</tr>
<tr>
<td>Hepatica</td>
<td>Leaf spot</td>
<td>Pseudomonas syringae</td>
<td>1</td>
</tr>
<tr>
<td>Hosta</td>
<td>Leaf spot</td>
<td>Pseudomonas syringae</td>
<td>1</td>
</tr>
<tr>
<td>Lupinus</td>
<td>Leaf spot</td>
<td>Cladosporium sp.</td>
<td>1</td>
</tr>
<tr>
<td>Polystichum munitum</td>
<td>Leaf spot</td>
<td>Phyllosticta sp.</td>
<td>1</td>
</tr>
</tbody>
</table>
Table 6. Diseases/disorders detected in small fruit (berry) samples submitted to the BCAGRI Plant Health Laboratory between January 1 and November 30, 2018.

<table>
<thead>
<tr>
<th>CROP</th>
<th>DISEASE / SYMPTOM</th>
<th>CAUSAL / ASSOCIATED ORGANISM</th>
<th>NO. OF SAMPLES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blackberry</td>
<td>Downy mildew</td>
<td>Peronospora sparsa</td>
<td>1</td>
</tr>
<tr>
<td>Blueberry</td>
<td>Bacterial blight</td>
<td>Pseudomonas syringae</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Blossom blight</td>
<td>Phomopsis sp.</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Blueberry Mosaic Virus</td>
<td>Blueberry mosaic virus</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Blueberry Scorch Virus</td>
<td>Blueberry scorch virus</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>Blueberry Shock Virus</td>
<td>Blueberry shock virus</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td>Botrytis blight</td>
<td>Botrytis cinerea</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Crown gall</td>
<td>Agrobacterium tumefaciens</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Galls on canes</td>
<td>Rhizobium rhizogenes</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Godronia canker</td>
<td>Fusarium putrefaciens</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Leaf spot</td>
<td>Gloeosporium sp.</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Nematode contribution</td>
<td>Paratrichodorus sp.</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Nematode damage</td>
<td>Pratylenchus crenatus</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Fruit damage</td>
<td>Aureobasidium sp., Alternaria sp. and Cladosporium sp.</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Phomopsis blight/canker</td>
<td>Phomopsis sp.</td>
<td>13</td>
</tr>
<tr>
<td></td>
<td>Phytophthora root rot</td>
<td>Phytophthora cinnamoni and other Phytophthora spp.</td>
<td>17</td>
</tr>
<tr>
<td>Cranberry</td>
<td>Stem canker</td>
<td>Phomopsis sp. and Coniothyrium sp.</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Twig blight</td>
<td>Sporocadus sp.</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Bitter rot</td>
<td>Colletotrichum sp.</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Black rot</td>
<td>Allantophomopsis sp. and Strasseria sp.</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Black rot</td>
<td>Allantophomopsis cytisporea</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Blotch rot</td>
<td>Physalospora vaccinii</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>End rot</td>
<td>Fusarium sp.</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Fruit rot</td>
<td>Coleophoma sp. and/or Allantophomopsis sp.</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Leaf spot</td>
<td>Allantophomopsis sp. and/or Strasseria sp.</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Leaf spot</td>
<td>Coleophoma sp.</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Leaf spot</td>
<td>Colletotrichum sp. and Phyllosticta sp.</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Scarring on fruit</td>
<td>Blueberry shock virus</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Stem dieback</td>
<td>Cytopsora sp.</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Upright dieback</td>
<td>Diapothoe sp.</td>
<td>3</td>
</tr>
<tr>
<td>Raspberry</td>
<td>Anthracnose</td>
<td>Phyctema vagabunda</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Bacterial blight</td>
<td>Pseudomonas syringae pv. syringae</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Cane blight</td>
<td>Seimatosporium sp. and Paraconiothyrium sp.</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Cane blight</td>
<td>Xenoidymella planata</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Canker</td>
<td>Coniothyrium sp.</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Chlorotic leaves</td>
<td>Raspberry bushy dwarf virus</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Nematode contribution</td>
<td>Pratylenchus sp. and/or Xiphinema sp.</td>
<td>13</td>
</tr>
<tr>
<td></td>
<td>Phytophthora root rot</td>
<td>Phytophthora sp.</td>
<td>7</td>
</tr>
<tr>
<td>Strawberry</td>
<td>Black root root complex</td>
<td>Rhizoctonia sp. and Fusarium sp.</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Botrytis blight</td>
<td>Botrytis cinerea</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Crown / root rot</td>
<td>Fusarium sp., Cylindrocarpon sp., and Rhizoctonia sp.</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Fruit rot</td>
<td>Botrytis cinerea</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Mycosphaerella leaf spot</td>
<td>Mycosphaerella fragariae</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Nematode contribution</td>
<td>Pratylenchus sp.</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Phytophthora root rot</td>
<td>Phytophthora sp.</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Verticillium wilt</td>
<td>Verticillium sp.</td>
<td>2</td>
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</tbody>
</table>
Table 7. Diseases/disorders detected in **specialty crop** samples submitted to the BCAGRI Plant Health Laboratory between January 1 and November 30, 2018.

<table>
<thead>
<tr>
<th>CROP</th>
<th>DISEASE / SYMPTOM</th>
<th>CAUSAL / ASSOCIATED ORGANISM</th>
<th>NO. OF SAMPLES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basil</td>
<td>Leaf spot</td>
<td><em>Botrytis cinerea</em></td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Leaf spot</td>
<td><em>Botrytis cinerea</em> and <em>Alternaria</em> sp.</td>
<td>1</td>
</tr>
<tr>
<td>Ginseng</td>
<td>Crown and root rot</td>
<td><em>Phytophthora</em> sp.</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Root rot</td>
<td><em>Fusarium</em> sp.</td>
<td>1</td>
</tr>
<tr>
<td>Hops</td>
<td>Apple mosaic virus</td>
<td>Apple mosaic virus</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Hop latent viroid</td>
<td>Hop latent viroid</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Powdery mildew</td>
<td><em>Podosphaera macularis</em></td>
<td>1</td>
</tr>
<tr>
<td>Parsley</td>
<td>Alternaria leaf blight</td>
<td><em>Alternaria</em> sp.</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Fusarium root rot</td>
<td><em>Fusarium</em> sp.</td>
<td>1</td>
</tr>
<tr>
<td>Soil / Hops</td>
<td>Nematode contribution</td>
<td><em>Meloidogyne</em> sp., <em>Pratylenchus</em> sp. and <em>Xiphinema</em> sp.</td>
<td>2</td>
</tr>
</tbody>
</table>

Table 8. Diseases/disorders detected in **tree fruit and grape** samples submitted to the BCAGRI Plant Health Laboratory between January 1 and November 30, 2018.

<table>
<thead>
<tr>
<th>CROP</th>
<th>DISEASE / SYMPTOM</th>
<th>CAUSAL / ASSOCIATED ORGANISM</th>
<th>NO. OF SAMPLES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apple</td>
<td>Anthracnose</td>
<td><em>Neofabraea malicortis</em></td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Anthracnose</td>
<td><em>Phlyctema vagabunda</em></td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Bacterial canker/ blight</td>
<td><em>Pseudomonas syringae</em></td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Botryosphaera canker</td>
<td><em>Botryosphaeria</em> sp.</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Diaporthe canker</td>
<td><em>Phomopsis</em> sp.</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Leucostoma canker</td>
<td><em>Leucostoma cincta</em> or <em>Cytospora</em> sp.</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Nectria canker</td>
<td><em>Neonectria galligena</em></td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Nectria twig blight</td>
<td><em>Nectria cinnabarina</em></td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Root damage</td>
<td><em>Pratylenchus</em> sp.</td>
<td>1</td>
</tr>
<tr>
<td>Cherry</td>
<td>Cytospora canker</td>
<td><em>Cytospora</em> sp.</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Root rot</td>
<td><em>Phytophthora cinnamomi</em></td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Root rot</td>
<td><em>Oomycete</em> and <em>Thielaviopsis basicola</em></td>
<td>1</td>
</tr>
<tr>
<td>Grape</td>
<td>Botrys bunch rot</td>
<td><em>Botrytis cinerea</em></td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Leaf spot</td>
<td><em>Botrytis cinerea</em> and <em>Cladosporium</em> sp.</td>
<td>1</td>
</tr>
<tr>
<td>Olive</td>
<td>Leaf spot</td>
<td><em>Uncinula necator</em></td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Powdery mildew</td>
<td><em>Phyllosticta</em> sp.</td>
<td>1</td>
</tr>
</tbody>
</table>

Table 9. Diseases/disorders detected in **turf grass** samples submitted to the BCAGRI Plant Health Laboratory between January 1 and November 30, 2018.

<table>
<thead>
<tr>
<th>LOCATION</th>
<th>DISEASE / SYMPTOM</th>
<th>CAUSAL / ASSOCIATED ORGANISM</th>
<th>NO. OF SAMPLES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Green</td>
<td>Brown patch</td>
<td><em>Rhizoctonia solani</em></td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Fairy ring</td>
<td><em>Marasmius</em> sp.</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Nematode contribution</td>
<td>Multiple parasitic nematodes</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>Pythium root rot</td>
<td><em>Pythium</em> sp.</td>
<td>3</td>
</tr>
<tr>
<td>Lawn</td>
<td>Anthracnose</td>
<td><em>Colletotrichum graminicola</em></td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Rapid blight</td>
<td><em>Labyrinthula terrestris</em></td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Root rot</td>
<td><em>Pythium</em> sp.</td>
<td>1</td>
</tr>
</tbody>
</table>
Table 10. Diseases/disorders detected in field vegetable samples submitted to the BCAGRI Plant Health Laboratory between January 1 and November 30, 2018.

<table>
<thead>
<tr>
<th>LOCATION</th>
<th>DISEASE/ SYMPTOM</th>
<th>CAUSAL / ASSOCIATED ORGANISM</th>
<th>NO. OF SAMPLES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bean</td>
<td>Leaf Mosaic</td>
<td>Cucumber mosaic virus</td>
<td>1</td>
</tr>
<tr>
<td>Beet</td>
<td>Ramularia leaf spot</td>
<td>Ramularia sp.</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Root rot</td>
<td>Fusarium sp.</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Phoma betae</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Pythium sp.</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Fusarium sp. and Rhizoctonia solani</td>
<td>1</td>
</tr>
<tr>
<td>Cabbage</td>
<td>Botrytis rot</td>
<td>Botrytis cinerea</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Club root</td>
<td>Plasmodiophora brassicae</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Leaf rot</td>
<td>Cladosporium sp. and Botrytis cinerea</td>
<td>2</td>
</tr>
<tr>
<td>Carrot</td>
<td>Crown gall</td>
<td>Rhizobium radiobacter</td>
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</tr>
<tr>
<td></td>
<td>Root rot</td>
<td>Cylindrocarpon sp. and Fusarium sp.</td>
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</tr>
<tr>
<td></td>
<td>Root rot</td>
<td>Pythium sp.</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Southern blight</td>
<td>Sclerotinia rolfsii</td>
<td>1</td>
</tr>
<tr>
<td>Celeriac</td>
<td>Root rot complex</td>
<td>Fusarium sp., Rhizoctonia sp. and Pythium sp.</td>
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</tr>
<tr>
<td>Corn</td>
<td>Fusarium root rot</td>
<td>Fusarium sp.</td>
<td>1</td>
</tr>
<tr>
<td>Cucumber</td>
<td>Alternaria leaf spot</td>
<td>Alternaria alternata</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Fusarium wilt</td>
<td>Fusarium oxysporum</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Gummy stem blight</td>
<td>Stagonosporopsis sp.</td>
<td>1</td>
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<tr>
<td></td>
<td>Pythium root rot</td>
<td>Pythium ultimum var. ultimum</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Scab</td>
<td>Cladosporium cucumerinum</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Stem rot</td>
<td>Fusarium oxysporum</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Ulocladium leaf spot</td>
<td>Ulocladium sp.</td>
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</tr>
<tr>
<td>Eggplant</td>
<td>Early blight</td>
<td>Alternaria sp.</td>
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<tr>
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<td>Gray mold</td>
<td>Botrytis cinerea</td>
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</tr>
<tr>
<td>Garlic</td>
<td>Basal rot</td>
<td>Fusarium culmorum</td>
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<tr>
<td></td>
<td>Blue mold</td>
<td>Penicillium sp.</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>Botrytis bulb rot</td>
<td>Botrytis porri</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>Bulb infection</td>
<td>Cladosporium sp., Rhizopus sp. and Epicoccum sp.</td>
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</tr>
<tr>
<td></td>
<td>Bulb infection</td>
<td>Embellisia allii and Fusarium sp.</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>Bulb infection</td>
<td>Embellisia allii and Penicillium sp.</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Bulb infection</td>
<td>Embellisia allii and Rhizoctonia solani</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Bulb infection</td>
<td>Embellisia allii, Fusarium sp. and Penicillium sp.</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Bulb infection</td>
<td>Fusarium proliferatum</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Bulb infection</td>
<td>Fusarium sp.</td>
<td>42</td>
</tr>
<tr>
<td></td>
<td>Bulb infection</td>
<td>Fusarium sp., Penicillium sp.</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Bulb infection</td>
<td>Penicillium sp., Rhizopus sp. and Fusarium sp.</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Bulb infection</td>
<td>Penicillium sp. and Rhizoctonia solani</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Bulb rot</td>
<td>Botrytis porri</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Bulb rot</td>
<td>Penicillium sp.</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>Embellisia skin blotch</td>
<td>Embellisia allii</td>
<td>67</td>
</tr>
<tr>
<td></td>
<td>Leaf blight</td>
<td>Stemphyllium sp.</td>
<td>1</td>
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<tr>
<td></td>
<td>Leaf blotch</td>
<td>Cladosporium sp.</td>
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<tr>
<td></td>
<td>Leaf streak / yellowing</td>
<td>Potyvirus</td>
<td>111</td>
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<td></td>
<td>Nematode contribution</td>
<td>Ditylenchus sp., Aphelenchoides sp., Pratylenchus sp. and/or Helicotylenchus sp.</td>
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<tr>
<td></td>
<td>Outer scale infection</td>
<td>Fusarium proliferatum</td>
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continued
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<thead>
<tr>
<th>LOCATION</th>
<th>DISEASE / SYMPTOM</th>
<th>CAUSAL / ASSOCIATED ORGANISM</th>
<th>NO. OF SAMPLES</th>
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<td>Garlic (con’t.)</td>
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<td>Puccinia allii</td>
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<td>Sclerotinia rot</td>
<td>Sclerotinia sclerotiorum</td>
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<td></td>
<td>Soft rot</td>
<td>Pseudomonas marginalis</td>
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<td>White rot</td>
<td>Sclerotium cepivorum</td>
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<td>Leek</td>
<td>Damping off</td>
<td>Rhizoctonia sp.</td>
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<td>Lettuce</td>
<td>Root lesions</td>
<td>Pratylenchus sp.</td>
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<tr>
<td>Parsnip</td>
<td>Phoma rot</td>
<td>Phoma complanata</td>
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<td>Root rot</td>
<td>Cylindrocarpon sp.</td>
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<td>Pea</td>
<td>Aphanomyces root rot</td>
<td>Aphanomyces euteiches</td>
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<td>Fusarium root rot</td>
<td>Fusarium solani</td>
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<tr>
<td></td>
<td>Pythium foliar blight</td>
<td>Pythium sp.</td>
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<tr>
<td></td>
<td>Rhizoctonia root rot</td>
<td>Rhizoctonia solani</td>
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<td>Potato</td>
<td>Black leg</td>
<td>Pectobacterium atrosepticum</td>
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<td>Common scab</td>
<td>Streptomyces scabies</td>
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<td>Fusarium sp.</td>
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<td>Fusarium wilt</td>
<td>Fusarium oxysporum</td>
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<td>Pink rot</td>
<td>Phytophthora erythroseptica</td>
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<td>Potato virus Y</td>
<td>Potato virus Y</td>
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<td>Pythium leak</td>
<td>Pythium ultimum var. ultimum.</td>
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<td>Rhubarb</td>
<td>Anthracnose</td>
<td>Colletotrichum dematium</td>
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<tr>
<td></td>
<td>Crown and root rot</td>
<td>Cylindrocarpon sp.</td>
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<td>Crown infection</td>
<td>Verticillium sp.</td>
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<td>Leaf blight</td>
<td>Botrytis cinerea</td>
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<tr>
<td></td>
<td>Leaf mottling</td>
<td>Turnip mosaic virus</td>
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<tr>
<td>Rhubarb</td>
<td>Leaf spot</td>
<td>Ascochyta rhei</td>
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<td>Leaf spot</td>
<td>Ramularia sp.</td>
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<tr>
<td></td>
<td>Leaf spot/blight</td>
<td>Botrytis cinerea</td>
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<tr>
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<td>Root damage</td>
<td>Pratylenchus sp. and/or Paratylenchus sp.</td>
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<tr>
<td></td>
<td>Root rot</td>
<td>Rhizoctonia solani</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Soft rot</td>
<td>Pectobacterium chrysanthemi</td>
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<tr>
<td>Squash</td>
<td>Black root rot</td>
<td>Thielaviopsis basicola</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Black rot</td>
<td>Stagonosporopsis cucurbitacearum</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Crown and root rot</td>
<td>Fusarium solani</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Fusarium fruit rot</td>
<td>Fusarium sp.</td>
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<tr>
<td>Swiss chard</td>
<td>Alternaria leaf spot</td>
<td>Alternaria sp.</td>
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<tr>
<td>Tomato</td>
<td>Alternaria rot</td>
<td>Alternaria alternata</td>
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</tr>
<tr>
<td></td>
<td>Fruit and leaf mosaic</td>
<td>Tobacco mosaic virus</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Fusarium crown rot</td>
<td>Fusarium oxysporum f.sp. radicis-lycopersici</td>
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<tr>
<td></td>
<td>Gray leaf spot</td>
<td>Stemphylium sp.</td>
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</tr>
<tr>
<td></td>
<td>Leaf mold</td>
<td>Passalora fulva</td>
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<tr>
<td></td>
<td>Leaf mosaic</td>
<td>Cucumber mosaic virus</td>
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<td></td>
<td>Leaf mosaic</td>
<td>Tomato spotted wilt virus</td>
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<tr>
<td></td>
<td>Leaf mottle</td>
<td>Tomato/tobacco mosaic virus</td>
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</tr>
<tr>
<td></td>
<td>Leaf spot</td>
<td>Phoma sp.</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Mosaic on fruit</td>
<td>Tobacco mosaic virus</td>
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<tr>
<td></td>
<td>Root damage</td>
<td>Pratylenchus sp.</td>
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<td>Yellow shoulder</td>
<td>Physiological stress</td>
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<td>Turnip</td>
<td>Fusarium wilt / yellows</td>
<td>Fusarium oxysporum</td>
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</tbody>
</table>
Table 11. Diseases/disorders detected in woody ornamental samples submitted to the BCAGRI Plant Health Laboratory between January 1 and November 30, 2018.

<table>
<thead>
<tr>
<th>LOCATION</th>
<th>DISEASE / SYMPTOM</th>
<th>CAUSAL / ASSOCIATED ORGANISM</th>
<th>NO. OF SAMPLES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acer</td>
<td>Anthracnose</td>
<td>Discula sp.</td>
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<tr>
<td>Acer macrophyllum</td>
<td>Botryosphaeria canker</td>
<td>Botryodiopodia sp.</td>
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<tr>
<td>Acer palmatum</td>
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<td>Aureobasidium apocryptum/Discula sp.</td>
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<td>Alnus rubra</td>
<td>Phytophthora canker</td>
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<tr>
<td>Amelanchier</td>
<td>Fire blight</td>
<td>Erwinia amylovora</td>
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</tr>
<tr>
<td></td>
<td>Nectria canker</td>
<td>Nectria sp.</td>
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</tr>
<tr>
<td>Chamaecyparis nootkatensis</td>
<td>Botryosphaeria canker</td>
<td>Botryosphaeria sp.</td>
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<tr>
<td>Cotoneaster</td>
<td>Fire blight</td>
<td>Erwinia amylovora</td>
<td>1</td>
</tr>
<tr>
<td>Crataegus</td>
<td>Bacterial canker</td>
<td>Pseudomonas syringae</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Fire blight</td>
<td>Erwinia amylovora</td>
<td>1</td>
</tr>
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<td>Cupressus</td>
<td>Foliar blight</td>
<td>Stigmina sp.</td>
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<td>Fraxinus</td>
<td>Valsa canker</td>
<td>Valsa sordida</td>
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<td>Ilex</td>
<td>Phytophthora blight</td>
<td>Phytophthora ilicis</td>
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<td></td>
<td>Stem canker</td>
<td>Botryodiopodia sp., Leptosphaeria sp. and Phoma sp.</td>
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<tr>
<td>Juniperus</td>
<td>Stem decay</td>
<td>Fusarium sp.</td>
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<tr>
<td>Magnolia</td>
<td>Botryosphaeria canker</td>
<td>Botryosphaeria sp.</td>
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<td>Phomopsis canker</td>
<td>Diaporthe sp.</td>
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<td>Phytophthora root rot</td>
<td>Phytophthora sp.</td>
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<td>Malus</td>
<td>Bacterial canker</td>
<td>Pseudomonas syringae pv. syringae</td>
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<td>Cytospora canker</td>
<td>Cytospora sp.</td>
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<tr>
<td></td>
<td>Fire blight</td>
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<td></td>
<td>Nectria canker</td>
<td>Neonectria galligena</td>
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<td></td>
<td>Root rot</td>
<td>Cylindocarpon sp. and Fusarium sp.</td>
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<tr>
<td>Picea glauca</td>
<td>Foliar blight</td>
<td>Phoma sp. and Sclerophoma sp.</td>
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<tr>
<td>Picea omorika</td>
<td>Phomopsis canker</td>
<td>Phomopsis occulta</td>
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<td>Picea pungens</td>
<td>Foliar blight</td>
<td>Phoma sp. and Alternaria sp.</td>
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<tr>
<td></td>
<td>Root rot</td>
<td>Cylindocarpon sp.</td>
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<td>Sudden needle drop</td>
<td>Setomelanomoma holmii</td>
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<td>Pinus cembra</td>
<td>Root rot</td>
<td>Fusarium proliferatum</td>
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<td>Pinus contorta</td>
<td>Needle blight</td>
<td>Hendersonia pinicola</td>
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<td>Pinus mugo</td>
<td>Needle cast</td>
<td>Cyclaneusma sp.</td>
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<td>Prunus</td>
<td>Anthracnose</td>
<td>Colletotrichum sp.</td>
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<tr>
<td>Prunus persica</td>
<td>Anthracnose</td>
<td>Colletotrichum sp.</td>
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<tr>
<td>Pseudotsuga menziesii</td>
<td>Needle blight</td>
<td>Rhizosphaera kalkhoffii</td>
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<tr>
<td>Pyrus</td>
<td>Fire blight</td>
<td>Erwinia amylovora</td>
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<tr>
<td>Rhododendron</td>
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<td>Phytophthora sp.</td>
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<td></td>
<td>Stem canker</td>
<td>Coniothyrium sp.</td>
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<tr>
<td>Rosa</td>
<td>Phytophthora root rot</td>
<td>Phytophthora sp.</td>
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<td></td>
<td>Stem canker</td>
<td>Phomopsis sp.</td>
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<td>Sarcococca</td>
<td>Pythium root rot</td>
<td>Pythium sp.</td>
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<td>Twig dieback</td>
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<td>Sequoiadendron giganteum</td>
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<td>Phomopsis sp.</td>
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continued
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<th>LOCATION</th>
<th>DISEASE / SYMPTOM</th>
<th>CAUSAL / ASSOCIATED ORGANISM</th>
<th>NO. OF SAMPLES</th>
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<tbody>
<tr>
<td>Sorbus aucuparia</td>
<td>Nectria Canker</td>
<td>Nectria cinnabarina</td>
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<td></td>
<td>Ascochyta leaf spot</td>
<td>Ascochyta syringae</td>
<td>1</td>
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<tr>
<td></td>
<td>Bacterial canker</td>
<td>Pseudomonas syringae pv. syringae</td>
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<td>Thuja</td>
<td>Armillaria root rot</td>
<td>Armillaria ostoyae</td>
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<td></td>
<td>Charcoal root rot</td>
<td>Macrophomina sp.</td>
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<td></td>
<td>Coryneum blight</td>
<td>Seiridium cardinale</td>
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<tr>
<td></td>
<td>Crown and root rot</td>
<td>Phytophthora sp.</td>
<td>3</td>
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<tr>
<td></td>
<td>Pestalotiosis blight</td>
<td>Pestalotiosis funerea</td>
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<tr>
<td></td>
<td>Phomopsis blight</td>
<td>Phomopsis sp.</td>
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<tr>
<td>Thuja plicata</td>
<td>Foliar blight</td>
<td>Pestalotiosis sp.</td>
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<tr>
<td></td>
<td>Seiridium blight</td>
<td>Seiridium cardinale</td>
<td>1</td>
</tr>
</tbody>
</table>
CROP: Diagnostic Laboratory Report - Ornamental Nursery and Landscape Crops
LOCATION: British Columbia

NAME AND AGENCY:
Janice F. Elmhirst
Elmhirst Diagnostics & Research, 5727 Riverside Street, Abbotsford, BC V4X1T6
Telephone: 604-820-4075; Email: janice.elmhirst@shaw.ca

TITLE: DISEASES DIAGNOSED ON ORNAMENTAL NURSERY AND LANDSCAPE CROPS IN BRITISH COLUMBIA, 2018.

ABSTRACT: Diseases of commercial nursery and landscape ornamental crops and causal agents identified by Elmhirst Diagnostics & Research in south coastal British Columbia in 2018 are listed.

METHODS: Elmhirst Diagnostics & Research (EDR) provides diagnosis of diseases of commercial horticultural crops in British Columbia caused by fungi, bacteria, viruses, plant parasitic nematodes, arthropod and mite pests and abiotic factors. Laboratory diagnostic services are provided in conjunction with on-site diagnostic consultations. Diagnosis is performed primarily by association of known symptoms with the presence of a pathogen known to cause these symptoms, identified by microscopic examination. If the diagnosis is uncertain or further identification or confirmation is needed, fungal and bacterial pathogens are isolated in pure culture for further examination of morphological characteristics, or plant tissue or cultured specimens are sent to other laboratories for identification by ELISA, PCR or DNA sequencing.

RESULTS AND COMMENTS: A summary of diseases and causal agents diagnosed on ornamental crops is presented in Table 1. Problems caused by abiotic factors, i.e., nutrient or pH imbalance, water stress, physiological response to growing conditions, genetic abnormalities and environmental and chemical stresses including herbicide damage, are not included. The spring of 2018 was cool and wet resulting in a high level of downy mildew on rose and other crops.

In August 2017, a Calonectria species was isolated in culture (PDA) from Cornus alba leaves affected by septoria leaf spot. DNA was extracted in 2018 and submitted for sequencing by Lisa Wegener, Institute for Sustainable Horticulture (ISH) Laboratory, Kwantlen Polytechnic University, Langley BC. BLAST comparison to published sequences in GenBank® showed the highest level of homology (99%) to Calonectria morganii Crous, Alfenas & M.J. Wingf. 1993 (anamorph Cylindrocladium scoparium Morgan 1892). Calonectria are primarily warm-temperature species. To my knowledge, this is the first report of Calonectria morganii (Cylindrocladium scoparium) in British Columbia. Koch’s postulates have not been completed.
Table 1. Diseases diagnosed in 2018 on ornamental nursery and landscape crops in British Columbia by Elmhirst Diagnostics & Research.

<table>
<thead>
<tr>
<th>CROP</th>
<th>SYMPTOM / DISEASE</th>
<th>CAUSAL AGENT</th>
<th>NO. OF SAMPLES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acer rubrum ‘Prairie Rouge’</td>
<td>Root Rot</td>
<td>Pythium sp / Phytophthora sp.</td>
<td>1</td>
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<tr>
<td>Buxus microphylla koreana x sempervirens ‘Green Mountain’, ‘Green Velvet’</td>
<td>Black stem canker</td>
<td>Pseudomonas syringae</td>
<td>2</td>
</tr>
<tr>
<td>Cornus alba ‘Cream Cracker’</td>
<td>Leaf spot (associated)</td>
<td>Calonectria morganii (Cylindrocladium scoparium)</td>
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<tr>
<td>Dahlia x hybrida ‘Hypnotica Pink Bi-color’</td>
<td>Powdery mildew</td>
<td>Golovinomyces sp.</td>
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</tr>
<tr>
<td>Dianthus x hybrida ‘Shooting Star’</td>
<td>Anthracnose</td>
<td>Colletotrichium sp.</td>
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</tr>
<tr>
<td>Echeveria agavoides ‘Lemaire’</td>
<td>Root and crown rot</td>
<td>Pythium sp. / Phytophthora sp.</td>
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</tr>
<tr>
<td>Gasteria ‘Royal Wolfgang’</td>
<td>Bacterial soft rot</td>
<td>Unidentified</td>
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<tr>
<td>Gasteria ‘Royal Wolfgang’</td>
<td>Root rot</td>
<td>Pythium sp.</td>
<td>1</td>
</tr>
<tr>
<td>Hydrangea arborescens ‘Incrediball Blush’</td>
<td>Ascochya blight</td>
<td>Ascochya hydrangeae (Boeremia exigua)</td>
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</tr>
<tr>
<td>Abelia x grandiflora ‘Kaleidoscope’</td>
<td>Basal stem rot</td>
<td>Rhizoctonia sp., Botrytis sp., Fusarium sp.</td>
<td>1</td>
</tr>
<tr>
<td>Lavandula angustifolia</td>
<td>Root rot</td>
<td>Pythium sp. / Phytophthora sp.</td>
<td>1</td>
</tr>
<tr>
<td>Lupinus x hybrida ‘Tequila Flame’</td>
<td>Anthracnose</td>
<td>Colletotrichium sp.</td>
<td>1</td>
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<tr>
<td>Monarda didyma ‘Balmy Purple’</td>
<td>Downy mildew</td>
<td>Peronospora lamii</td>
<td>1</td>
</tr>
<tr>
<td>Myosotis sylvatica ‘Rosylva’</td>
<td>Botrytis blight and stem canker</td>
<td>Botrytis cinerea</td>
<td>1</td>
</tr>
<tr>
<td>Rosa x hybrida ‘White Licorice’ and other cultivars</td>
<td>Downy mildew</td>
<td>Peronospora sparsa</td>
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</tr>
<tr>
<td>Sedum (Hylotelephium) x hybrida ‘Thunderhead’</td>
<td>Powdery mildew</td>
<td>Erysiphe sedi</td>
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<tr>
<td>Spiraea japonica ‘Rouge’</td>
<td>Powdery mildew</td>
<td>Podosphaera sp.</td>
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<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td><strong>27</strong></td>
</tr>
</tbody>
</table>

CROP: Fruits, vegetables and woody ornamentals  
LOCATION: Alberta

NAME AND AGENCY:  
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TITLE: SURVEY OF PLANT-PARASITIC NEMATODES IN HORTICULTURAL CROPS IN ALBERTA, 2014 AND 2015

ABSTRACT: Plant-parasitic nematode populations were analyzed in a total of 152 soil samples from horticultural crops in Alberta in 2014 and 2015. Major genus-level groups of plant-parasitic nematodes found in the survey were, in order of frequency of occurrence: pin, stunt, spiral, lesion, dagger, stubby root, ring, and stem and bulb nematodes. Lesion nematodes, which have significant potential to affect horticultural crops grown in temperate regions, were present in a relatively low percentage of fields, usually at relatively low population densities. Stubby root nematodes were similarly present at relatively low population densities in a low percentage of fields. No root-knot nematodes were found in this survey.

INTRODUCTION: Production of horticultural crops, including new crops such as rhodiola, is rapidly increasing in Alberta. Soils used for horticultural crop production in cool temperate regions often become infested with specific populations of plant-parasitic nematodes that can have significant negative impacts on crop productivity. Nematode groups of primary concern for cool temperate horticultural crops are lesion nematodes (Pratylenchus species), particularly P. penetrans; root-knot nematodes, primarily the northern root-knot nematode, Meloidogyne hapla; stem and bulb nematode, Ditylenchus dipsaci; and stubby root nematodes, Paratrichodorus species (Potter & Olthoff 1993; Johnson 1998). On woody perennial crops, dagger nematodes (Xiphinema spp.) also can be a significant threat to crop productivity (Nyczepir & Halbrendt 1993). Little is known of the presence of plant-parasitic nematodes in soils used for production of horticultural crops in Alberta. Accordingly, the objective of this survey was to assess the presence of plant-parasitic nematodes in soils used for horticultural crop production in Alberta.

METHODS: A total of 152 soil samples were taken from a wide range of horticultural crops in Alberta, in late summer of 2014 (81 samples) and 2015 (71 samples) (Table 1). At each site, 20 to 30 soil cores were taken to a depth of 30 cm when possible and combined into one composite sample. The samples were kept refrigerated and shipped in batches to the Summerland Research and Development Centre, Agriculture and Agri-Food Canada for nematode analyses. A wet sieving-sucrose centrifugation procedure was used to extract all nematodes from a 100 ml subsample from each composite sample (Forge & Kimpinski 2007). Plant-parasitic nematodes in each sample extract were identified to genus and their populations were counted using an inverted microscope with a gridded counting dish.

RESULTS AND DISCUSSION: For summarization, crops for which there were not more than three sites were combined into crop groups (Table 1). For each combination of crop group and nematode group, the frequency of occurrence (Table 1) and mean and maximum population densities of plant-parasitic nematodes were tabulated (Table 2). Overall frequency of occurrence of the nematode groups was in the order of pin, stunt, spiral, lesion, dagger, stubby root, ring, stem-and-bulb (Table 1). Results are discussed below based on the potential impacts of these nematodes on crops.

Lesion nematodes: Owing to their wide host range and migratory endo-parasitic mode of feeding, these nematodes, particularly P. penetrans, are considered to be the most cosmopolitan and overall economically important nematode pests of temperate fruit and vegetable crops (Potter & Olthoff 1993; Johnson 1998). The relatively low frequency of occurrence of lesion nematodes suggests that they are not currently having a significant impact on Alberta horticulture. Among temperate species, P. penetrans is generally considered to be more frequently associated with, and damaging to, horticultural crops than other Pratylenchus species (Castillo & Vovlas 2007). None of the lesion nematodes observed in this survey was identified to species. Of
all *Pratylenchus* species found in temperate regions, *P. penetrans* is the only amphimictic species, with all others being parthenogenic (Castillo & Vovlas 2007). Thus, the presence of males can provide a crude indication of the presence of *P. penetrans*, but no males were found in any of the samples in this survey. *Pratylenchus neglectus* has been found to be widespread on other crops in Alberta, including in irrigated potato (Forge et al. 2015), and mixed rotations and cereals (Forge, personal observation). We speculate that most of the *Pratylenchus* populations recovered in this survey could be *P. neglectus*. While *P. neglectus* is well known as a parasite of canola, cereals, pulses and various grasses (Castillo & Vovlas 2007), its potential impact on most of the crops considered in this survey is not known.

**Root-knot nematodes:** This nematode was not found in any of the samples in 2014 or 2015. In areas with low to moderate infestations, it is possible to fail to detect *M. hapla* in soil samples in mid-summer as most of the second-stage larvae (L2), the only stage found freely in soil, have already entered roots. Typically, L2 start to appear in soil again after the new generation of eggs have matured and begun to hatch, usually in late fall and/or spring before planting (East et al. 2019). Future sampling for soil-dwelling nematodes on crops known to be good hosts for *M. hapla* should target fall or late spring season (e.g. at planting).

**Stubby root nematodes:** These are ectoparasitic nematodes in the genera *Paratrichodorus* and *Trichodorus*. These nematodes can be directly pathogenic to vegetable crops, particularly in sandy soils (Johnson 1998). They are also important for their role as vectors of tobaviruses, particularly tobacco rattle virus (TRV), which causes corky ringspot of potato (Johnson 1998). These nematodes were neither found frequently (Table 1) nor at high population densities (Table 2), therefore do not appear to be a significant concern for Alberta horticulture. Extended monoculture cropping in sandy soils could, however, result in the development of problematic populations.

**Stem and bulb nematodes: *Ditylenchus* nematodes that were morphologically similar to *D. dipsaci* were found in soils from the root zone of crabapple (Table 1). This species, which is composed of multiple host-races (EPPO 2017), was previously reported on irrigated alfalfa in Alberta (Hahn 1973) and the nearby southern interior of British Columbia (Vrain 1983). In recent years, an outbreak of *D. dipsaci* on garlic in Ontario has caused significant economic losses and raised broader concerns about the presence of the garlic race of this nematode in other parts of Canada. More detailed analyses of the identity and host-range of the population that we observed under crabapple was outside the scope of this survey. Because the garlic race of *D. dipsaci* has the potential to spread rapidly via infested planting material and can have significant impacts on production of garlic and onion, additional research on the presence of *D. dipsaci* in Alberta and other parts of western Canada is warranted.

**Dagger nematodes:** These are ectoparasitic nematodes in the genus *Xiphinema*. Based on research conducted on major commercial woody perennial (e.g. apple, cherry, grape), dagger nematodes are generally damaging at very high populations (e.g. in excess of ~100 per 100 ml soil). With the exception of one currant site (Table 2), the majority of the fields sampled in this survey had population densities well below the critical threshold.

**Pin nematodes:** These nematodes are in the genus *Paratylenchus*. Pin nematodes were found in all mixed vegetable (primarily rhubarb) and rhodiola sites, and were present at very high population densities (Table 2). These ectoparasites generally have a wide host range but are most often associated with perennials, especially grasses and forbs (Potter & Olthoff 1993; Johnson 1998). They are relatively common and occasionally found at seemingly high population densities (e.g. in excess of 500 per 100 ml sample). However, they are generally not very damaging, even at such high population densities (Potter & Olthoff 1993; Johnson 1998). The high population densities of *Paratylenchus* found in the rhodiola and rhubarb fields, however, strongly suggests that those crops are very favourable hosts for the nematodes. Controlled-inoculation experiments to verify host status and assess potential damage to rhodiola and rhubarb by pin nematodes have not previously been conducted and would be informative.

**Ring nematodes:** These are ectoparasitic nematodes primarily in the genus *Mesocriconema*. The most widespread species associated with commercial crops is *M. xenoplax*, but a few other species are occasionally associated with woody perennials in North America. Ring nematodes are almost exclusively associated with woody perennial crops and they are proven components of severe disease complexes of *Prunus* species and grapevines in southern growing regions such as the southeastern US and California (Brown et al. 1993; Nyczepir & Becker 1998; Nyczepir & Halbrendt 1993). This nematode was only found in seven samples, six of which were from woody perennials (Table 1). Samples from apple and cherry soils had average population densities in excess of 300 per 100 ml soil (Table 2).

**Spiral nematodes:** These are ectoparasitic nematodes in the genera *Helicotylenchus* and *Rotylenchus*. *Helicotylenchus* is most often associated with grasses, and known to cause measurable dieback and patchy decline of turfgrasses (Bernard et al. 1998). Most of the spiral nematodes found in the 2014 samples...
appeared to be *Helicotylenchus*. We speculate that these nematodes are probably not of significance to the horticultural crops and are being maintained in these production systems due to feeding on alleyway or rotational cover crops.

**Stunt nematodes:** Nematodes in the genus *Tylenchorhynchus* are the primary representative of this group, but it includes other closely-related genera in the family Dolichodoridae including *Merlinius* and *Amphimerlinius*. The ecology of these nematodes is very similar to that of *Helicotylenchus*; they are ectoparasites most often associated with grasses, capable of causing patchy decline of turfgrasses (Bernard et al. 1998). No species in this group is recognized to be pathogenic to any horticultural crops.

**CONCLUSIONS:** The relatively low frequency of occurrence and low population densities of lesion and root-knot nematodes suggests that as a whole, horticultural production in Alberta is not being significantly impacted by parasitic root nematodes. Nonetheless, additional research to verify the presence of *P. penetrans* relative to other *Pratylenchus* species in horticultural crops would provide a better understanding of anticipated future impacts. While stubby root nematode populations do not currently appear to be at problematic levels, the potential for their population increase in irrigated sandy soils and its association with tobacco rattle virus should be monitored. Although *D. dipsaci* was only detected in soils from the root zone of crabapple at one site, its presence in Alberta, particularly the presence of the garlic race on *Allium* crops, warrants further investigation.

**ACKNOWLEDGEMENTS:** We thank the Alberta Funding Consortium for funding and the market gardens and farms in Alberta that allowed access to their crops.

**REFERENCES:**


Table 1. Number of sites in each crop group, sampled in 2014 and 2015, positive for the presence of each group of nematodes.$^{a,b}$

<table>
<thead>
<tr>
<th>Crop Group</th>
<th>PIN</th>
<th>STUNT</th>
<th>SPIRAL</th>
<th>LESION</th>
<th>DAGGER</th>
<th>STUBBY ROOT</th>
<th>RING</th>
<th>STEM &amp; BULB</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apple$^c$ (n=9)</td>
<td>6 (67)</td>
<td>7 (78)</td>
<td>6 (67)</td>
<td>2 (22)</td>
<td>0</td>
<td>0</td>
<td>2 (22)</td>
<td>1 (11)</td>
</tr>
<tr>
<td>Brassica (n=17)</td>
<td>6 (35)</td>
<td>5 (29)</td>
<td>7 (41)</td>
<td>5 (29)</td>
<td>2 (12)</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Cherry$^d$ (n=25)</td>
<td>20 (80)</td>
<td>6 (24)</td>
<td>7 (28)</td>
<td>3 (12)</td>
<td>3 (12)</td>
<td>0</td>
<td>1 (4)</td>
<td>0</td>
</tr>
<tr>
<td>Currant (n=10)</td>
<td>9 (90)</td>
<td>3 (30)</td>
<td>0</td>
<td>0</td>
<td>1 (10)</td>
<td>0</td>
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<tr>
<td>Haskap (n=4)</td>
<td>3 (75)</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1 (25)</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Lily (n=5)</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Mixed Berry$^e$ (n=9)</td>
<td>5 (100)</td>
<td>4 (80)</td>
<td>3 (60)</td>
<td>4 (80)</td>
<td>0</td>
<td>1 (20)</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Mixed Veg$^f$ (n=13)</td>
<td>9 (69)</td>
<td>5 (38)</td>
<td>3 (23)</td>
<td>2 (15)</td>
<td>2 (15)</td>
<td>3 (23)</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Perennial Veg$^g$ (n=3)</td>
<td>3 (100)</td>
<td>0</td>
<td>1 (33)</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Raspberry (n=18)</td>
<td>11 (61)</td>
<td>7 (39)</td>
<td>3 (17)</td>
<td>3 (17)</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Rhodiola (n=15)</td>
<td>15 (100)</td>
<td>0</td>
<td>3 (20)</td>
<td>0</td>
<td>10 (67)</td>
<td>4 (27)</td>
<td>1 (7)</td>
<td>0</td>
</tr>
<tr>
<td>Saskatoon (n=12)</td>
<td>5 (42)</td>
<td>4 (33)</td>
<td>1 (8)</td>
<td>1 (8)</td>
<td>1 (8)</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Strawberry (n=8)</td>
<td>3 (38)</td>
<td>4 (50)</td>
<td>2 (25)</td>
<td>1 (13)</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Woody Ornamental$^h$ (n=4)</td>
<td>3 (75)</td>
<td>1 (25)</td>
<td>3 (75)</td>
<td>0</td>
<td>1 (25)</td>
<td>2 (50)</td>
<td>3 (75)</td>
<td>0</td>
</tr>
<tr>
<td>Total (n=152)</td>
<td>98 (64)</td>
<td>48 (32)</td>
<td>39 (26)</td>
<td>21 (14)</td>
<td>20 (13)</td>
<td>11 (7)</td>
<td>7 (5)</td>
<td>1 (1)</td>
</tr>
</tbody>
</table>

$^a$ For each crop group, n = number of sites sampled.
$^b$ Values in parentheses are the percentage of sites positive for each combination of nematode group and crop group.
$^c$ crabapple
$^d$ chokecherry, sour cherry
$^e$ buffaloberry, highbush cranberry, elderberry, gojiberry, honeyberry, honeysuckle, jostaberry, sea buckthorn
$^f$ pumpkin, squash, watermelon, bean, corn, lettuce, pea, peppers, potato, tomato
$^g$ mint, rhubarb
$^h$ mountain ash, hawthorn, dogwood
Table 2. Average and maximum (in parentheses) population densities (nematodes/100 ml soil sample) of the main groups of plant-parasitic nematodes found in the 2014 and 2015 survey, by crop group.\(^{a,b}\)

<table>
<thead>
<tr>
<th>Crop Group</th>
<th>PIN</th>
<th>STUNT</th>
<th>SPIRAL</th>
<th>LESION</th>
<th>DAGGER</th>
<th>STUBBY ROOT</th>
<th>ROOT</th>
<th>RING</th>
<th>STEM &amp; BULB</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apple(^c) (n=9)</td>
<td>144 (528)</td>
<td>53 (313)</td>
<td>99 (444)</td>
<td>4 (4)</td>
<td>0</td>
<td>0</td>
<td>619 (1236)</td>
<td>13 (13)</td>
<td></td>
</tr>
<tr>
<td>Brassica (n=17)</td>
<td>34 (103)</td>
<td>5 (12)</td>
<td>51 (246)</td>
<td>4 (11)</td>
<td>4 (7)</td>
<td>0</td>
<td>0</td>
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<td>0</td>
</tr>
<tr>
<td>Cherry(^d) (n=25)</td>
<td>271 (2124)</td>
<td>18 (58)</td>
<td>34 (174)</td>
<td>7 (14)</td>
<td>8 (19)</td>
<td>0</td>
<td>312 (312)</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Currant (n=10)</td>
<td>1001 (4152)</td>
<td>1 (2)</td>
<td>0</td>
<td>0</td>
<td>112 (112)</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Haskap (n=4)</td>
<td>89 (226)</td>
<td>5 (6)</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>13 (13)</td>
<td>0</td>
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</tr>
<tr>
<td>Lily (n=5)</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
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</tr>
<tr>
<td>Mixed Berry(^e)  (n=9)</td>
<td>102 (456)</td>
<td>41 (130)</td>
<td>249 (744)</td>
<td>16 (44)</td>
<td>0</td>
<td>5 (5)</td>
<td>0</td>
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</tr>
<tr>
<td>Mixed Veg(^f) (n=13)</td>
<td>84 (288)</td>
<td>34 (74)</td>
<td>141 (264)</td>
<td>4 (6)</td>
<td>2 (2)</td>
<td>3 (4)</td>
<td>0</td>
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</tr>
<tr>
<td>Perennial Veg(^g) (n=3)</td>
<td>2057 (4797)</td>
<td>0</td>
<td>112 (112)</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Raspberry (n=18)</td>
<td>266 (1032)</td>
<td>8 (26)</td>
<td>55 (158)</td>
<td>6 (15)</td>
<td>0</td>
<td>0</td>
<td>0</td>
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</tr>
<tr>
<td>Rhodiola (n=15)</td>
<td>1528 (2928)</td>
<td>0</td>
<td>7 (17)</td>
<td>0</td>
<td>8 (20)</td>
<td>4 (9)</td>
<td>1 (1)</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Saskatoon (n=12)</td>
<td>446 (2028)</td>
<td>23 (69)</td>
<td>1 (1)</td>
<td>4 (4)</td>
<td>108 (108)</td>
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<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Strawberry (n=8)</td>
<td>105 (300)</td>
<td>35 (85)</td>
<td>2 (3)</td>
<td>2 (2)</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Woody Ornamental(^h) (n=4)</td>
<td>94 (256)</td>
<td>4 (4)</td>
<td>24 (62)</td>
<td>0</td>
<td>7 (7)</td>
<td>20 (36)</td>
<td>10 (17)</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

\(^{a}\) Values are means from sites that were positive for the nematode group.

\(^{b}\) For each crop group, n = number of sites sampled.

\(^{c}\) crabapple

\(^{d}\) chokecherry, sour cherry

\(^{e}\) buffaloberry, highbush cranberry, elderberry, goji berry, honeyberry, honeysuckle, jostaberry, sea buckthorn

\(^{f}\) pumpkin, squash, watermelon, bean, corn, lettuce, pea, peppers, potato, tomato

\(^{g}\) mint, rhubarb

\(^{h}\) mountain ash, hawthorn, dogwood
CROP: Diagnostic Laboratory Report - All Crops
LOCATION: Alberta

NAME AND AGENCY:
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Telephone: 780-644-3436; E-mail: Jie.Feng@gov.ab.ca

TITLE: DISEASES DIAGNOSED ON SAMPLES SUBMITTED TO THE ALBERTA PLANT HEALTH LAB IN 2018

ABSTRACT: The Alberta Plant Health Lab (APHL) provides plant pest diagnosis and expertise to Alberta's agricultural industry. The lab accepts samples exclusively from agricultural fieldmen, academic institutions, applied research associations and municipal pest management departments, at no cost. A total of 369 samples were processed for diagnosis in the 2018 crop year. Dutch elm disease was not identified in any of the 30 suspect elm samples received and there was a substantial increase in conifer samples diagnosed with needle cast pathogens in 2018.

METHODS: Samples are submitted to the Alberta Plant Health Lab (APHL) by agricultural fieldmen, academic institutions, applied research associations and municipal pest management departments. Diagnoses are based on a combination of visual examination of symptoms, microscopic observation, culturing on artificial media, PCR/qPCR, DNA barcoding and commercial diagnostic kits. Specifically, fungal barcoding was performed using the PCR primer pair ITS1/ITS4 (White et al. 1990) and/or EF1-1018F/EF1-1620R (Stielow et al. 2015). Bacteria are usually identified based on DNA sequencing. PCR identification of Fusarium graminearum from submitted cultures was performed following Zuzak et al. (2018). For identification of Fusarium species from plant tissues, protocols described by Demeke et al. (2005) were used. Phytoplasmas were detected by PCR using the primer pairs P1/Tint and R16MF2n/R16MR2n (Smart et al. 1996). Confirmation of late blight on potato and tomato was made using the Agdia ImmunoStrip® kit for Phytophthora species (http://www.agdia.com). For diagnosis of all other diseases, when PCR techniques were used, quantitative PCR (qPCR) preceded conventional PCR and probe-based qPCR preceded SYBR® Green based qPCR. The primers and protocols were chosen from the most recent literature and verified by APHL using positive and negative controls.

RESULTS: A total of 369 disease diagnoses were completed between January 2 and November 30, 2018. Categories of samples received for diagnosis included cereals (10%), canola (13%), potato (12%), corn (26%), legume (7%), tree and fruit (26%), vegetable (2%) and other (4%). The category ‘other’ covers samples such as timothy, hops, quinoa and flax. Fungal, oomycete, protist, bacterial and viral pathogens were identified in these samples as the causal agents of disease. In most samples, one or more causal agents were identified. Summaries of symptoms / diseases and associated pathogens diagnosed on the submitted samples are provided in Tables 1 to 8 by crop category. The diagnoses reported may not necessarily reflect the major problems encountered during the season in the field, but rather those most prevalent within the samples submitted for testing.

Thirty elm samples were submitted for Dutch elm disease diagnosis and none of them tested positive. However, in twenty-one of the samples, Dothiorella ulmi was present. There were also cases of phoma canker and elm leaf spot in the samples submitted.

Sydowia polyspora (Sclerophoma pithyophila) was identified as the causal agent of needle cast and blight in 27 spruce, 6 pine, 4 fir and 1 mugo pine sample submitted to the APHL in 2018. This pathogen is associated with tip dieback as well as needle cast of conifers.

REFERENCES:


Table 1: Diseases diagnosed on cereal crops submitted to the Alberta Plant Health Lab in 2018.

<table>
<thead>
<tr>
<th>CROP</th>
<th>SYMPTOM/ DISEASE</th>
<th>CAUSAL AGENT(S)</th>
<th>NO. OF SAMPLES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barley</td>
<td>Net blotch</td>
<td>Pyrenophora teres</td>
<td>19</td>
</tr>
<tr>
<td></td>
<td>Leaf spot</td>
<td>Epicoccum sp.</td>
<td>8</td>
</tr>
<tr>
<td>Durum wheat</td>
<td>Leaf chlorosis</td>
<td>Fusarium spp.</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Spot blotch</td>
<td>Bipolaris sp.</td>
<td>1</td>
</tr>
<tr>
<td>Wheat</td>
<td>Take-all</td>
<td>Gaeumannomyces tritici</td>
<td>2</td>
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<td></td>
<td>Leaf chlorosis</td>
<td>Negative for phytoplasma*</td>
<td>1</td>
</tr>
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<td></td>
<td>White blotch</td>
<td>Bacillus megaterium</td>
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<tr>
<td></td>
<td>Early senescence</td>
<td>Fusarium spp.</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Isolated culture</td>
<td>Microdochium bolleyi</td>
<td></td>
</tr>
<tr>
<td>Winter wheat</td>
<td>Leaf chlorosis</td>
<td>Sordariomycetes sp.</td>
<td>1</td>
</tr>
<tr>
<td>Sorghum</td>
<td>Seedling blight</td>
<td>Microdochium nivale</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Epicoccum sp.</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td><strong>37</strong></td>
</tr>
</tbody>
</table>

*These samples were submitted specifically for phytoplasma testing.

Table 2: Diseases diagnosed on canola samples submitted to the Alberta Plant Health Lab in 2018.

<table>
<thead>
<tr>
<th>CROP</th>
<th>SYMPTOM/ DISEASE</th>
<th>CAUSAL AGENT(S)</th>
<th>NO. OF SAMPLES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Canola</td>
<td>Stem cankers</td>
<td>Leptosphaeria maculans</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Root galling</td>
<td>Plasmodiophora brassicae</td>
<td>45</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td><strong>48</strong></td>
</tr>
</tbody>
</table>
Table 3: Diseases diagnosed on potato samples submitted to the Alberta Plant Health Lab in 2018.

<table>
<thead>
<tr>
<th>CROP</th>
<th>SYMPTOM/ DISEASE</th>
<th>CAUSAL AGENT(S)</th>
<th>NO. OF SAMPLES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Potato</td>
<td>Suspect late blight</td>
<td>Negative for Phytophthora spp.(^a)</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td>Isolated cultures</td>
<td>Fusarium sambucinum or Fusarium tumidum</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>Isolated cultures</td>
<td>Fusarium sambucinum</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Blackleg</td>
<td>Pectobacterium atrosepticum</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Dry rot</td>
<td>Fusarium oxysporum</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Black scurf</td>
<td>Rhizoctonia solani</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Leaf lesions</td>
<td>Alternaria sp.</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Blackleg</td>
<td>Dickeya dianthicola(^b)</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Blackleg</td>
<td>Negative for Dickeya dianthicola(^b)</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Grey mold</td>
<td>Botrytis sp.</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Blight</td>
<td>Verticillum spp.</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Tuber discoloration/ darkening</td>
<td>Phytophthora spp.</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Powdery scab</td>
<td>Spongospora subterranea</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Wilt</td>
<td>Plectosphaerella cucumerina</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>White mold</td>
<td>Sclerotinia sp.</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Stem malformation/ Suspect Beet</td>
<td>Negative for BCTV</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Curly Top Virus (BCTV)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Suspect zebra chip</td>
<td>Negative for the zebra chip bacterium (Candidatus Liberibacter solanacearum)</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td><strong>44</strong></td>
</tr>
</tbody>
</table>

\(^a\)These samples were submitted specifically for Phytophthora testing.
\(^b\)These samples were submitted specifically for Dickeya dianthicola testing.

Table 4: Diseases diagnosed on corn samples and corn stalk-derived fungal cultures submitted to the Alberta Plant Health Lab in 2018.

<table>
<thead>
<tr>
<th>CROP</th>
<th>SYMPTOM/ DISEASE</th>
<th>CAUSAL AGENT(S)</th>
<th>NO. OF SAMPLES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corn</td>
<td>Isolated cultures</td>
<td>Fusarium graminearum</td>
<td>94</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td><strong>94</strong></td>
</tr>
</tbody>
</table>

Table 5: Diseases diagnosed on legumes submitted to the Alberta Plant Health Lab in 2018.

<table>
<thead>
<tr>
<th>CROP</th>
<th>SYMPTOM/ DISEASE</th>
<th>CAUSAL AGENT(S)</th>
<th>NO. OF SAMPLES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mung bean</td>
<td>Isolated cultures</td>
<td>Fusarium agglomerans</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>Isolated cultures</td>
<td>Pseudomonas savastanoi</td>
<td>6</td>
</tr>
<tr>
<td>Chickpea</td>
<td>Wilt</td>
<td>Fusarium redolens</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Root rot</td>
<td>Fusarium spp.</td>
<td>1</td>
</tr>
<tr>
<td>Field pea</td>
<td>Root rot</td>
<td>Fusarium spp.</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Wilt</td>
<td>Fusarium spp.</td>
<td>1</td>
</tr>
<tr>
<td>Bean</td>
<td>Root rot and seedling blight</td>
<td>Fusarium spp.</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Leaf spot</td>
<td>Botrytis sp.</td>
<td>1</td>
</tr>
<tr>
<td>Soybean</td>
<td>Root rot</td>
<td>Fusarium spp.</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Root rot</td>
<td>Rhizoctonia solani</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Leaf deformation</td>
<td>Suspect Bean Common Mosaic</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td><strong>26</strong></td>
</tr>
</tbody>
</table>
Table 6: Diseases diagnosed on trees submitted to the Alberta Plant Health Lab in 2018.

<table>
<thead>
<tr>
<th>CROP</th>
<th>SYMPTOM/ DISEASE</th>
<th>CAUSAL AGENT(S)</th>
<th>NO. OF SAMPLES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elm</td>
<td>Wilt</td>
<td>Negative for <em>Ophiostoma ulmi</em></td>
<td>30</td>
</tr>
<tr>
<td></td>
<td>Wilt</td>
<td><em>Dothiorella ulmi</em></td>
<td>21</td>
</tr>
<tr>
<td></td>
<td>Phoma canker</td>
<td><em>Phoma glomerata</em></td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Elm leaf spot</td>
<td><em>Alternaria</em> sp.</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Wilt</td>
<td><em>Verticillium</em> sp.</td>
<td>1</td>
</tr>
<tr>
<td>Spruce</td>
<td>Needle cast</td>
<td><em>Sydowia polyspora</em></td>
<td>27</td>
</tr>
<tr>
<td></td>
<td>(Sclerophoma pithyophila)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Needle cast</td>
<td><em>Phoma</em> sp.</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td>Needle cast</td>
<td><em>Lophodermium piceae</em></td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Needle blight</td>
<td><em>Botrytis cinerea</em></td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Needle cast</td>
<td><em>Aureobasidium</em> sp.</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Needle blight and dieback</td>
<td><em>Darkera parca</em></td>
<td>1</td>
</tr>
<tr>
<td>Pine</td>
<td>Needle cast/ blight</td>
<td><em>Sydowia polyspora</em></td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>(Sclerophoma pithyophila)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Needle necrosis</td>
<td><em>Sordaria</em> sp.</td>
<td>1</td>
</tr>
<tr>
<td>Fir</td>
<td>Needle cast</td>
<td><em>Sydowia polyspora</em></td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Canker</td>
<td>(Sclerophoma pithyophila)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td><em>Phoma</em> sp.</td>
<td>1</td>
</tr>
<tr>
<td>Caragana</td>
<td>Leaf spot</td>
<td><em>Ascochyta</em> sp. (Didymella sp.)</td>
<td>2</td>
</tr>
<tr>
<td>Mugo pine</td>
<td>Needle cast</td>
<td><em>Sydowia polyspora</em></td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(Sclerophoma pithyophila)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td><em>Phoma</em> sp.</td>
<td></td>
</tr>
<tr>
<td>Poplar</td>
<td>Sooty mold</td>
<td><em>Aureobasidium</em> sp.</td>
<td>1</td>
</tr>
<tr>
<td>Cedar (soil)</td>
<td>Root rot</td>
<td><em>Pythium</em> sp. and <em>Fusarium</em> sp.</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td><strong>97</strong></td>
</tr>
</tbody>
</table>

*aThese samples were submitted specifically for Dutch elm disease (*Ophiostoma ulmi*) testing. Of 30 samples submitted, all were negative for Dutch elm disease, but 25 samples were diagnosed with other diseases.

Table 7: Diseases diagnosed on vegetable crops submitted to the Alberta Plant Health Lab in 2018.

<table>
<thead>
<tr>
<th>CROP</th>
<th>SYMPTOM/ DISEASE</th>
<th>CAUSAL AGENT(S)</th>
<th>NO. OF SAMPLES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Garlic</td>
<td>Phytoplasma testing</td>
<td>Positive for phytoplasma</td>
<td>4</td>
</tr>
<tr>
<td>Carrot</td>
<td>Bacterial lesions/ storage rot</td>
<td><em>Pseudomonas</em> sp.</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Bacterial lesions/ storage rot</td>
<td><em>Agrobacterium tumefaciens</em></td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Storage rot</td>
<td><em>Plectosphaerella cucumerina</em></td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Root rot</td>
<td><em>Fusarium</em> sp.</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td><strong>9</strong></td>
</tr>
</tbody>
</table>

*aThese samples were submitted specifically for phytoplasma testing.*
Table 8. Diseases diagnosed on other crops submitted to the Alberta Plant Health Lab in 2018.

<table>
<thead>
<tr>
<th>CROP</th>
<th>SYMPTOM/ DISEASE</th>
<th>CAUSAL AGENT(S)</th>
<th>NO. OF SAMPLES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rosea</td>
<td>Suspect Fireblight</td>
<td>Negative for Fireblight ((Erwinia amylovora))</td>
<td>3</td>
</tr>
<tr>
<td>Hydrangeab</td>
<td>Leaf chlorosis</td>
<td>Negative for Impatiens Necrotic Spot Virus (INSV)</td>
<td>2</td>
</tr>
<tr>
<td>Geranium</td>
<td>Leaf necrosis</td>
<td>Botrytis sp.</td>
<td>2</td>
</tr>
<tr>
<td>Geranium</td>
<td>Leaf chlorosis</td>
<td>Positive for phytoplasma</td>
<td>1</td>
</tr>
<tr>
<td>Alfalfa</td>
<td>Leaf spot</td>
<td>Ascochyta medicaginicola var. medicaginicola</td>
<td>1</td>
</tr>
<tr>
<td>Timothy</td>
<td>Leaf streak</td>
<td>Pyrenophora grahamii</td>
<td>1</td>
</tr>
<tr>
<td>Timothy</td>
<td>Stem rust</td>
<td>Puccinia sp.</td>
<td>1</td>
</tr>
<tr>
<td>Hops</td>
<td>Downy mildew</td>
<td>Pseudoperonospora humuli</td>
<td>1</td>
</tr>
<tr>
<td>Flax</td>
<td>Stem blight</td>
<td>Alternaria linicola</td>
<td>1</td>
</tr>
<tr>
<td>Quinoa</td>
<td>Wilt and leaf chlorosis</td>
<td>Fusarium sp.</td>
<td>1</td>
</tr>
<tr>
<td>Salvia</td>
<td>Delayed growth</td>
<td>Pseudomonas sp.</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td><strong>14</strong></td>
</tr>
</tbody>
</table>

aThese samples were submitted specifically for fireblight testing.

bThese samples were submitted specifically for Impatiens Necrotic Spot Virus testing.
CROP: Diagnostic Laboratory Report
LOCATION: Saskatchewan

NAMES AND AGENCIES:
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Saskatchewan Ministry of Agriculture, Crop Protection Laboratory, 346 McDonald St., Regina, SK S4N 6P6
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TITLE: DISEASES DIAGNOSED ON CROP SAMPLES SUBMITTED TO THE SASKATCHEWAN MINISTRY OF AGRICULTURE CROP PROTECTION LABORATORY IN 2018

ABSTRACT: In 2018, 438 samples were submitted for diagnosis to the Crop Protection Laboratory in Saskatchewan, including 220 crop samples and 218 elm tree samples for Dutch Elm Disease testing. Similar to the previous year, fungal diseases were diagnosed on many of the samples submitted in 2018, however many of the samples exhibited symptoms of environmental injury and a large number exhibited symptoms consistent with herbicide damage.

METHODS: The Saskatchewan Ministry of Agriculture’s Crop Protection Laboratory (CPL) provides fee-for-service diagnostic services to the agricultural industry on all crop health issues. Fee-for-service samples are usually submitted by growers and agronomists, Saskatchewan Ministry of Agriculture and Saskatchewan Crop Insurance Corporation staff, or market/home gardeners. Services include disease diagnostics, insect and weed identification, as well as testing of weed seeds for herbicide resistance. The CPL also provides a Dutch elm disease (DED) testing service to the general public, under which American elm (Ulmus americana) and Siberian elm (U. pumila) samples are tested for DED and dothiorella wilt. These samples are submitted by the Saskatchewan Ministry of Environment, cities/towns including the City of Regina and City of Saskatoon, or homeowners. Diagnosis of fungal plant diseases is performed primarily through visual assessment of plant symptoms, microscopic examination and isolation of fungal organisms on artificial media. Diagnosis of injuries suspected to be due to herbicide damage and/or nutrient deficiencies is based on visual observation. Viral and bacterial diagnoses are also based on visible symptoms. Enzyme-linked immunosorbent assay (ELISA) testing is used to identify wheat streak mosaic virus (WSMV). Diagnostics are aided by the receipt of representative samples in good condition and adequately detailed background information.

RESULTS AND COMMENTS: In 2018, 220 samples of field crops (including cereals, forages, oilseeds, pulses and special crops), ornamentals and trees were submitted to the Crop Protection Laboratory for diagnosis, of which 157 were diagnosed with diseases or abiotic disorders (Tables 1-6). The remainder had insect damage or the causal agent was undetermined due to the poor condition of the sample or other factors. An additional 218 elm tree samples were submitted for DED testing in 2018 (Table 6).

Temperatures were higher in the spring of 2018 as compared to 2017 and dry conditions persisted during the 2018 growing season. Higher precipitation in the fall and early snow slowed or stopped harvest in some regions of the Province. As a result, symptoms of environmental stress were observed on many of the samples received in 2018 and symptoms of herbicide injury, resulting from herbicide carryover, due to the dry conditions and slow chemical breakdown, were observed in many sample submissions.
Table 1. Diseases and disorders diagnosed on cereal crop samples submitted to the Saskatchewan Crop Protection Laboratory in 2018.

<table>
<thead>
<tr>
<th>CROP</th>
<th>DISEASE/INJURY</th>
<th>CAUSAL AGENT</th>
<th>NO. OF SAMPLES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barley</td>
<td>Root rot / crown rot</td>
<td><em>Fusarium</em> spp.</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Environmental stress</td>
<td>Various stresses</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>Herbicide damage</td>
<td>Suspect Group 2 and Group 9 herbicides</td>
<td>4</td>
</tr>
<tr>
<td>Durum</td>
<td>Environmental stress</td>
<td>Various stresses</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>Herbicide damage</td>
<td>Suspect Group 2 herbicides</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Root rot / crown rot</td>
<td><em>Fusarium</em> spp. and <em>Rhizoctonia</em> spp.</td>
<td>7</td>
</tr>
<tr>
<td>Oats</td>
<td>Environmental stress</td>
<td>Various stresses</td>
<td>4</td>
</tr>
<tr>
<td>Wheat</td>
<td>Environmental stress</td>
<td>Various stresses</td>
<td>13</td>
</tr>
<tr>
<td></td>
<td>Fusarium head blight / root rot</td>
<td><em>Fusarium</em> spp.</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Seedling blight</td>
<td><em>Cochliobolus sativus</em></td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Herbicide damage</td>
<td>Suspect various herbicides</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Take-all</td>
<td><em>Gaeumannomyces graminis var. tritici</em></td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Wheat Streak Mosaic Virus</td>
<td>Wheat Streak Mosaic Virus</td>
<td>1</td>
</tr>
</tbody>
</table>

Table 2. Diseases and disorders diagnosed on forage crop samples submitted to the Saskatchewan Crop Protection Laboratory in 2018.

<table>
<thead>
<tr>
<th>CROP</th>
<th>DISEASE/INJURY</th>
<th>CAUSAL AGENT</th>
<th>NO. OF SAMPLES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alfalfa</td>
<td>Environmental stress</td>
<td>Winter kill</td>
<td>1</td>
</tr>
</tbody>
</table>

Table 3. Diseases and disorders diagnosed on oilseed crop samples submitted to the Saskatchewan Crop Protection Laboratory in 2018.

<table>
<thead>
<tr>
<th>CROP</th>
<th>DISEASE/INJURY</th>
<th>CAUSAL AGENT</th>
<th>NO. OF SAMPLES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Canola</td>
<td>Clubroot and fusarium root rot</td>
<td><em>Plasmodiophora brassicae</em> and <em>Fusarium</em> spp.</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Environmental stress</td>
<td>Various stresses</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Herbicide damage</td>
<td>Suspect various herbicides</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>Fertilizer burn</td>
<td>Undetermined</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Seedling blight</td>
<td><em>Rhizoctonia</em> spp.</td>
<td>1</td>
</tr>
</tbody>
</table>

Table 4. Diseases and disorders diagnosed on ornamental crop samples submitted to the Saskatchewan Crop Protection Laboratory in 2018.

<table>
<thead>
<tr>
<th>CROP</th>
<th>DISEASE/INJURY</th>
<th>CAUSAL AGENT</th>
<th>NO. OF SAMPLES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dogwood</td>
<td>Environmental stress</td>
<td>Severe winter conditions</td>
<td>1</td>
</tr>
<tr>
<td>Cotoneaster</td>
<td>Fire blight</td>
<td><em>Erwinia amylovora</em></td>
<td>1</td>
</tr>
</tbody>
</table>
Table 5. Diseases and disorders diagnosed on pulse crop samples submitted to the Saskatchewan Crop Protection Laboratory in 2018.

<table>
<thead>
<tr>
<th>CROP</th>
<th>DISEASE / INJURY</th>
<th>CAUSAL AGENT</th>
<th>NO. OF SAMPLES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chickpea</td>
<td>Fusarium root rot / fusarium wilt</td>
<td><em>Fusarium</em> spp.</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Oomycete(s)</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Suspect herbicide damage</td>
<td>Suspect Group 2 and 4 herbicides</td>
<td>9</td>
</tr>
<tr>
<td>Fababean</td>
<td>Chocolate spot and foot rot</td>
<td><em>Botrytis</em> spp. and <em>Fusarium</em> spp.</td>
<td>1</td>
</tr>
<tr>
<td>Field Pea</td>
<td>Root rot complex</td>
<td><em>Fusarium</em> spp.</td>
<td>14</td>
</tr>
<tr>
<td></td>
<td>Herbicide damage</td>
<td><em>Fusarium</em> spp. and oomycete(s)</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Suspect various herbicide groups</td>
<td>3</td>
</tr>
<tr>
<td>Lentil</td>
<td>Anthracnose</td>
<td><em>Colletotrichum truncatum</em></td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Environmental stress</td>
<td>Various stresses</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Root rot complex</td>
<td><em>Fusarium</em> spp.</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Oomycete(s)</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>Suspect herbicide damage</td>
<td>Suspect Group 2 herbicide injury</td>
<td>1</td>
</tr>
</tbody>
</table>

Table 6. Diseases and disorders diagnosed on tree samples submitted to the Saskatchewan Crop Protection Laboratory in 2018.

<table>
<thead>
<tr>
<th>CROP</th>
<th>DISEASE / INJURY</th>
<th>CAUSAL AGENT</th>
<th>NO. OF SAMPLES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Evergreen (pine and spruce)</td>
<td>Environmental stress</td>
<td>Various stresses</td>
<td>6</td>
</tr>
<tr>
<td>Poplar</td>
<td>Septoria leaf spot</td>
<td><em>Septoria</em> spp.</td>
<td>1</td>
</tr>
<tr>
<td>Elm</td>
<td>Dothiorella wilt</td>
<td><em>Dothiorella ulmi</em></td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>Dutch elm disease (DED)</td>
<td>Confirmed <em>Ophiostoma ulmi</em></td>
<td>94</td>
</tr>
<tr>
<td></td>
<td>Samples testing negative for disease</td>
<td>None isolated</td>
<td>115</td>
</tr>
</tbody>
</table>
ABSTRACT: In 2017, 421 samples were received for diagnosis by the Crop Protection Laboratory in Saskatchewan, including 123 crop samples and 259 elm samples for Dutch Elm Disease testing. Plant diseases were confirmed on many samples however, environmental and herbicide injury were diagnosed on a large number of samples, also, as a result of the dry conditions during the 2017 growing season.

RESULTS AND COMMENTS: In 2017, 123 samples of field crops (including cereals, forages, oilseeds, pulses and special crops), ornamentals and trees were submitted to the Saskatchewan Crop Protection Lab for disease diagnosis. Eighty samples were diagnosed with disease, environmental injury or suspected herbicide damage (Tables 1-6). The remaining samples had insect damage or the causal agent could not be determined due to the poor condition of the sample or other factors. An additional 259 elm tree samples were tested for DED in 2017 (Table 6).

Symptoms of environmental stress resulting from the dry conditions during the 2017 growing season were reflected in many samples received. Injury due to herbicide carryover was diagnosed on many samples. This was primarily related to the dry conditions that resulted in slow breakdown of the chemicals.
### Table 1. Diseases and disorders diagnosed on cereal crop samples submitted to the Saskatchewan Crop Protection Laboratory in 2017.

<table>
<thead>
<tr>
<th>CROP</th>
<th>DISEASE / INJURY</th>
<th>CAUSAL AGENT</th>
<th>NO. OF SAMPLES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barley</td>
<td>Saprophytic mold, Fusarium Environmental stress</td>
<td><em>Alternaria</em> sp., <em>Fusarium avenaceum</em></td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Various stresses</td>
<td>Various stresses</td>
<td>4</td>
</tr>
<tr>
<td>Durum</td>
<td>Environmental stress</td>
<td>Various stresses including wind and dry conditions</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Herbicide damage</td>
<td>Suspect Group 2</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Wheat Streak Mosaic Virus</td>
<td>Wheat Streak Mosaic Virus</td>
<td>1</td>
</tr>
<tr>
<td>Wheat</td>
<td>Environmental stress</td>
<td>Cool temperatures, dryness, soil salinity</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Herbicide damage</td>
<td>Various groups suspected</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Wheat Streak Mosaic Virus</td>
<td>Wheat Streak Mosaic Virus</td>
<td>1</td>
</tr>
<tr>
<td>Winter Wheat</td>
<td>Environmental stress</td>
<td>Frost damage, dry conditions</td>
<td>4</td>
</tr>
</tbody>
</table>

### Table 2. Diseases and disorders diagnosed on forage crop samples submitted to the Saskatchewan Crop Protection Laboratory in 2017.

<table>
<thead>
<tr>
<th>CROP</th>
<th>DISEASE / INJURY</th>
<th>CAUSAL AGENT</th>
<th>NO. OF SAMPLES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alfalfa</td>
<td>Environmental stress</td>
<td>Winter kill</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Spring black stem</td>
<td><em>Phoma medicaginis</em></td>
<td>1</td>
</tr>
</tbody>
</table>

### Table 3. Diseases and disorders diagnosed on oilseed crop samples submitted to the Saskatchewan Crop Protection Laboratory in 2017.

<table>
<thead>
<tr>
<th>CROP</th>
<th>DISEASE / INJURY</th>
<th>CAUSAL AGENT</th>
<th>NO. OF SAMPLES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Canola</td>
<td>Blackleg and gray stem</td>
<td><em>Leptosphaeria maculans</em> and <em>Pseudocercosporella capsellae</em></td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Environmental stress</td>
<td>Various stresses</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Herbicide damage</td>
<td>Various herbicide groups suspected</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>Nutrient deficiency</td>
<td>Undetermined</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Brown girdling root rot</td>
<td><em>Rhizoctonia</em> spp.</td>
<td>1</td>
</tr>
<tr>
<td>Flax</td>
<td>Seedling blight</td>
<td>Various including <em>Alternaria</em> spp. and other pathogens</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Environmental stress</td>
<td>Various stresses</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Herbicide damage</td>
<td>Suspect Group 2</td>
<td>1</td>
</tr>
</tbody>
</table>
### Table 4. Diseases and disorders diagnosed on ornamental crop samples submitted to the Saskatchewan Crop Protection Laboratory in 2017.

<table>
<thead>
<tr>
<th>CROP</th>
<th>DISEASE/INJURY</th>
<th>CAUSAL AGENT</th>
<th>NO. OF SAMPLES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lilac</td>
<td>Environmental stress</td>
<td>High temperatures, dry conditions</td>
<td>1</td>
</tr>
<tr>
<td>Rose</td>
<td>Environmental stress</td>
<td>Various stresses (high temperatures and salinity)</td>
<td>2</td>
</tr>
<tr>
<td>Ornamental grass</td>
<td>Environmental stress</td>
<td>Dry conditions</td>
<td>1</td>
</tr>
</tbody>
</table>

### Table 5. Diseases and disorders diagnosed on pulse crop samples submitted to the Saskatchewan Crop Protection Laboratory in 2017.

<table>
<thead>
<tr>
<th>CROP</th>
<th>DISEASE/INJURY</th>
<th>CAUSAL AGENT</th>
<th>NO. OF SAMPLES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chickpea</td>
<td>Ascochyta blight</td>
<td>Ascochyta rabiei</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Fusarium wilt</td>
<td>Suspect Fusarium oxysporum</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Herbicide damage</td>
<td>Suspected herbicide groups 2 and 4</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Seedling blight</td>
<td>Botrytis sp.</td>
<td>1</td>
</tr>
<tr>
<td>Fababean</td>
<td>Chocolate spot and foot rot</td>
<td>Botrytis spp. and Fusarium spp.</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Foot rot</td>
<td>Botrytis spp.</td>
<td>1</td>
</tr>
<tr>
<td>Field Pea</td>
<td>Foot rot</td>
<td>Ascochyta spp.</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Root rot complex</td>
<td>Fusarium spp. and oomycete(s)</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Herbicide damage</td>
<td>Suspect herbicide Groups 2 and 9</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Mycosphaerella blight / ascochyta foot rot</td>
<td>Various stresses (including frost damage and nutrient deficiency)</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Environmental stress</td>
<td>Ascochyta spp.</td>
<td>1</td>
</tr>
<tr>
<td>Lentil</td>
<td>Environmental stress</td>
<td>Various (including frost, dry conditions, salinity)</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Root rot</td>
<td>Fusarium spp. and other pathogens</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Herbicide damage</td>
<td>Oomycete(s)</td>
<td>1</td>
</tr>
</tbody>
</table>

### Table 6. Diseases and disorders diagnosed on tree samples submitted to the Saskatchewan Crop Protection Laboratory in 2017.

<table>
<thead>
<tr>
<th>CROP</th>
<th>DISEASE/INJURY</th>
<th>CAUSAL AGENT</th>
<th>NO. OF SAMPLES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Swedish aspen</td>
<td>Brown spot</td>
<td>Suspect Notophoma quercina</td>
<td>1</td>
</tr>
<tr>
<td>Evergreen</td>
<td>Environmental stress</td>
<td>Winter tip burn, frost injury, dry conditions</td>
<td>3</td>
</tr>
<tr>
<td>Maple</td>
<td>Herbicide damage</td>
<td>Various herbicides suspected</td>
<td>1</td>
</tr>
<tr>
<td>Elm</td>
<td>Dothiorella wilt</td>
<td>Dothiorella ulmi</td>
<td>25</td>
</tr>
<tr>
<td></td>
<td>Dutch elm disease (DED)</td>
<td>Confirmed Ophiostoma ulmi</td>
<td>87</td>
</tr>
<tr>
<td></td>
<td>Negative for Disease</td>
<td>None isolated</td>
<td>147</td>
</tr>
</tbody>
</table>
CROP: Diagnostic Laboratory Report – All Crops
LOCATION: Manitoba

NAMES AND AGENCIES:
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²Manitoba Agriculture, Crops Industry Branch, Box 1149, Carman, MB R0G 0J0

TITLE: 2018 MANITOBA AGRICULTURE CROP DIAGNOSTIC CENTRE LABORATORY SUBMISSIONS

ABSTRACT: This report summarizes the diseases and disorders diagnosed on plant samples submitted to and analyzed by the Manitoba Agriculture Crop Diagnostic Centre in 2018. Samples received by the laboratory covered most crops grown in Manitoba and also included ornamentals, grasses and trees.

METHODS: The Manitoba Agriculture, Crop Diagnostic Centre provides diagnoses and control recommendations for disease problems of agricultural crops, including field and horticultural crops. Plant samples for diagnoses are received from Manitoba Agriculture Crop Industry Branch Specialists, extension and other departmental personnel, farmers, agri-business representatives and the public. Diagnostic methods used include visual examination for symptoms, microscopy, moist chamber incubation, culturing onto artificial media (general and pathogen specific), Agdia ImmunoStrips® and ELISA testing.

RESULTS: Summaries of diseases diagnosed on plants in different crop categories are presented in Tables 1 to 9 and cover the period from January 1 to December 20, 2018.

Table 1. Diseases diagnosed on herbaceous ornamental plant samples submitted to the Manitoba Agriculture Crop Diagnostic Centre in 2018.

<table>
<thead>
<tr>
<th>CROP</th>
<th>DISEASE / INJURY</th>
<th>CAUSAL AGENT</th>
<th>NO. OF SAMPLES</th>
</tr>
</thead>
<tbody>
<tr>
<td>African violet (Saintpaulia sp.)</td>
<td>Root rot</td>
<td>Pythium sp.</td>
<td>1</td>
</tr>
</tbody>
</table>

Table 2. Diseases diagnosed on cereal crop samples submitted to the Manitoba Agriculture Crop Diagnostic Centre in 2018.

<table>
<thead>
<tr>
<th>CROP</th>
<th>DISEASE / INJURY</th>
<th>CAUSAL AGENT</th>
<th>NO. OF SAMPLES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wheat</td>
<td>Bacterial leaf blight</td>
<td>Pseudomonas syringae pv. syringae</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Bacterial leaf streak</td>
<td>Xanthomonas sp.</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Black head molds</td>
<td>Epicoccum nigrum, Alternaria sp.</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Common root rot</td>
<td>Cochliobolus sativus</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Fusarium head blight</td>
<td>Fusarium sp.</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Leaf spot</td>
<td>Septoria sp.</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Powdery mildew</td>
<td>Blumeria graminis</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>Root rot</td>
<td>Fusarium sp., Pythium sp., Rhizoctonia solani</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Tan spot</td>
<td>Pyrenophora tritici-repentis</td>
<td>3</td>
</tr>
<tr>
<td>Wheat Streak Mosaic</td>
<td>Wheat Streak Mosaic Virus</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>Environmental injury</td>
<td></td>
<td></td>
<td>29</td>
</tr>
<tr>
<td>Physiological leaf spot</td>
<td></td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>Herbicide injury</td>
<td></td>
<td></td>
<td>13</td>
</tr>
<tr>
<td>Nutrient deficiency</td>
<td>Chloride deficiency</td>
<td></td>
<td>5</td>
</tr>
</tbody>
</table>

continued
<table>
<thead>
<tr>
<th>CROP</th>
<th>DISEASE/INJURY</th>
<th>CAUSAL AGENT</th>
<th>NO. OF SAMPLES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barley</td>
<td>Bacterial leaf blight</td>
<td><em>Pseudomonas syringae pv. syringae</em></td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Common root rot</td>
<td><em>Cochliobolus sativus</em></td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Net blotch</td>
<td><em>Drechslera teres</em></td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Root rot</td>
<td><em>Fusarium sp.</em></td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Herbicide injury</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Environmental injury</td>
<td></td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Nutrient deficiency</td>
<td>Undetermined</td>
<td>2</td>
</tr>
<tr>
<td>Oat</td>
<td>Bacterial blight</td>
<td><em>Pseudomonas syringae</em></td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>Fusarium head blight</td>
<td><em>Fusarium graminearum; F. avenaceum</em></td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Powdery mildew</td>
<td><em>Blumeria graminis</em></td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Root rot</td>
<td><em>Fusarium sp.</em></td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Herbicide injury</td>
<td></td>
<td>1</td>
</tr>
</tbody>
</table>

**Table 3.** Diseases diagnosed on vegetable crop samples submitted to the Manitoba Agriculture Crop Diagnostic Centre in 2018.

<table>
<thead>
<tr>
<th>CROP</th>
<th>DISEASE/INJURY</th>
<th>CAUSAL AGENT</th>
<th>NO. OF SAMPLES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beet</td>
<td>Scab</td>
<td><em>Streptomyces scabies</em></td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Root rot</td>
<td><em>Rhizoctonia solani</em></td>
<td>1</td>
</tr>
<tr>
<td>Carrot</td>
<td>Itersonilia canker</td>
<td><em>Itersonilia sp.</em></td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Root rot</td>
<td><em>Fusarium oxysporum</em></td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td><em>Pythium spp.</em></td>
<td>2</td>
</tr>
<tr>
<td>Chili Pepper</td>
<td>Fruit rot / black mold</td>
<td><em>Alternaria sp., Cladosporium sp., Fusarium sp.</em></td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>General stress</td>
<td>Environmental stress</td>
<td>1</td>
</tr>
<tr>
<td>Cucumber</td>
<td>Alternaria leaf spot</td>
<td><em>Alternaria cucumerina</em></td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>General stress</td>
<td>Environmental stress</td>
<td>1</td>
</tr>
<tr>
<td>Garlic</td>
<td>Fusarium basal plate rot</td>
<td><em>Fusarium culmorum</em></td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Blue mold</td>
<td><em>Penicillium spp.</em></td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Virus</td>
<td>Unidentified</td>
<td>1</td>
</tr>
<tr>
<td>Leek</td>
<td>Fusarium basal plate rot</td>
<td><em>Fusarium sp.</em></td>
<td>1</td>
</tr>
<tr>
<td>Onion</td>
<td>Leaf bacterial blight</td>
<td><em>Xanthomonas sp.</em></td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Fusarium basal plate rot</td>
<td><em>Fusarium sp.</em></td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Blue mold</td>
<td><em>Penicillium sp.</em></td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Bulb neck rot</td>
<td><em>Botrytis sp.</em></td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Transplant shock</td>
<td>Environmental stress</td>
<td>1</td>
</tr>
<tr>
<td>Parsnip</td>
<td>Root canker</td>
<td><em>Itersonilia sp.</em></td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Root rot</td>
<td><em>Fusarium sp.</em></td>
<td>1</td>
</tr>
<tr>
<td>Pumpkin</td>
<td>Alternaria leaf spot</td>
<td><em>Alternaria cucumerina</em></td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Fruit rot</td>
<td><em>Fusarium sp.</em></td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>General stress</td>
<td>Environmental stress</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Herbicide injury</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Squash</td>
<td>Alternaria leaf spot</td>
<td><em>Alternaria cucumerina</em></td>
<td>1</td>
</tr>
<tr>
<td>Butternut</td>
<td>Fruit rot</td>
<td><em>Sclerotinia sp.</em></td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Root rot seedling</td>
<td><em>Fusarium oxysporum</em></td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>General stress</td>
<td>Environmental stress</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Nutrient deficiency</td>
<td>Undetermined</td>
<td>1</td>
</tr>
</tbody>
</table>

*continued*
<table>
<thead>
<tr>
<th>CROP</th>
<th>DISEASE / INJURY</th>
<th>CAUSAL AGENT</th>
<th>NO. OF SAMPLES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tomato</td>
<td>Abiotic leaf flaking</td>
<td>Environmental stress</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Cercospora leaf mold</td>
<td><em>Pseudocercospora fuligena</em></td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Early blight</td>
<td><em>Alternaria solani</em></td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>General stress</td>
<td>Environmental injury</td>
<td>2</td>
</tr>
</tbody>
</table>

Table 4. Diseases diagnosed on **potato crop samples** submitted to the Manitoba Agriculture Crop Diagnostic Centre in 2018.

<table>
<thead>
<tr>
<th>SYMPTOM / DISEASE</th>
<th>CAUSAL AGENT</th>
<th>NO. OF SAMPLES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bacterial soft rot</td>
<td><em>Pectobacterium carotovorum subsp. carotovorum</em></td>
<td>3</td>
</tr>
<tr>
<td>Black dot on tuber/stem</td>
<td><em>Colletotrichum coccodes</em></td>
<td>16</td>
</tr>
<tr>
<td>Blackleg</td>
<td><em>Pectobacterium carotovorum subsp. atrosepticum</em></td>
<td>2</td>
</tr>
<tr>
<td>Black scurf (tuber)</td>
<td><em>Rhizoctonia solani</em></td>
<td>2</td>
</tr>
<tr>
<td>Fusarium dry rot</td>
<td><em>Fusarium sambucinum</em></td>
<td>2</td>
</tr>
<tr>
<td>Leak</td>
<td><em>Pythium sp.</em></td>
<td>3</td>
</tr>
<tr>
<td>Pink rot</td>
<td><em>Phytophthora erythroseptica</em></td>
<td>2</td>
</tr>
<tr>
<td>Potato Mop Top</td>
<td>Furovirus</td>
<td>1</td>
</tr>
<tr>
<td>Root rot</td>
<td><em>Rhizoctonia solani, Fusarium spp.</em></td>
<td>2</td>
</tr>
<tr>
<td>Scab, common</td>
<td><em>Streptomyces spp.</em></td>
<td>1</td>
</tr>
<tr>
<td>Silver scurf</td>
<td><em>Helminthosporium solani</em></td>
<td>5</td>
</tr>
<tr>
<td>Verticillium Wilt</td>
<td><em>Verticillium sp.</em></td>
<td>2</td>
</tr>
</tbody>
</table>
Table 5. Diseases diagnosed on shelterbelt trees and woody ornamental plants submitted to the Manitoba Agriculture Crop Diagnostic Centre in 2018.

<table>
<thead>
<tr>
<th>CROP</th>
<th>DISEASE/INJURY</th>
<th>CAUSAL AGENT</th>
<th>NO. OF SAMPLES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ash (Fraxinus sp.)</td>
<td>Anthracnose</td>
<td>Gloeosporium aridum</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Environmental injury</td>
<td></td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Herbicide injury</td>
<td></td>
<td>6</td>
</tr>
<tr>
<td>Aspen, trembling</td>
<td>Anthracnose</td>
<td>Gloeosporium sp.</td>
<td>1</td>
</tr>
<tr>
<td>(Populus tremuloides)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Apple, crab (Malus sp.)</td>
<td>Canker</td>
<td>Cytospora sp.</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Frogeye leaf spot</td>
<td>Botryosphaeria obtusa</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Environmental injury</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Herbicide injury</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>Basswood (Tilia americana)</td>
<td>Anthracnose</td>
<td>Apiognomonia tiliae</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Herbicide injury</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Environmental injury</td>
<td></td>
<td>5</td>
</tr>
<tr>
<td>Buckthorn (Rhamnus sp.)</td>
<td>Herbicide injury</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Environmental injury</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Cedar (Thuja sp.)</td>
<td>Canker</td>
<td>Phoma sp.</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Needle blight</td>
<td>Phomopsis sp.</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Environmental injury</td>
<td></td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Herbicide injury</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>Cotoneaster (Cotoneaster sp.)</td>
<td>Nutrient deficiency</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Elm, American (Ulmus americana)</td>
<td>Anthracnose</td>
<td>Gnomonia ulmea</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>Botryosphaeria canker</td>
<td>Botryosphaeria sp.</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Coniothyrium canker</td>
<td>Coniothyrium sp.</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Cytospora canker</td>
<td>Cytospora sp.</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Canker</td>
<td>Unidentified</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>Dutch elm disease</td>
<td>Ophiostoma ulmi</td>
<td>29</td>
</tr>
<tr>
<td></td>
<td>Verticillium wilt</td>
<td>Verticillium sp.</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>Environmental injury</td>
<td></td>
<td>13</td>
</tr>
<tr>
<td>Lilac (Syringa vulgaris)</td>
<td>Herbicide injury</td>
<td></td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Nutrient deficiency</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>Maple Manitoba (Acer negundo)</td>
<td>Anthracnose</td>
<td>Gloeosporium sp.</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Canker</td>
<td>Sphaeropsis sp.</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Environmental injury</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Herbicide injury</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Oak (Quercus macrocarpa)</td>
<td>Anthracnose</td>
<td>Discula sp.</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Canker</td>
<td>Phoma sp.</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Herbicide injury</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Environmental injury</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Pear (Pyrus sp.)</td>
<td>Frogeye leaf spot</td>
<td>Botryosphaeria sp.</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Nutrient deficiency</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>Pine, Scots (Pinus sylvestris)</td>
<td>Needle cast</td>
<td>Lophodermium sp.</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Winter injury</td>
<td>Environmental stress</td>
<td></td>
</tr>
</tbody>
</table>

continued
<table>
<thead>
<tr>
<th>CROP</th>
<th>DISEASE / INJURY</th>
<th>CAUSAL AGENT</th>
<th>NO. OF SAMPLES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spruce (Picea sp.)</td>
<td>Canker</td>
<td>Undetermined</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Canker</td>
<td>Cytospora sp.</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Needle blight</td>
<td>Lirula sp.</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Needle cast</td>
<td>Lophodermium spp.</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Rhizosphaera kalkhoffii</td>
<td>23</td>
</tr>
<tr>
<td></td>
<td>Twig canker</td>
<td>Stigmina lautii</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>Environmental injury</td>
<td>Phoma sp.</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Nutrient deficiency</td>
<td></td>
<td>24</td>
</tr>
<tr>
<td>Willow (Salix alba)</td>
<td>Environmental injury</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Herbicide injury</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Nutrient deficiency</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2</td>
</tr>
</tbody>
</table>

Table 6. Diseases diagnosed on oilseed crop samples submitted to the Manitoba Agriculture Crop Diagnostic Centre in 2018.

<table>
<thead>
<tr>
<th>CROP</th>
<th>DISEASE / INJURY</th>
<th>CAUSAL AGENT</th>
<th>NO. OF SAMPLES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Canola</td>
<td>Anthracnose</td>
<td>Colletotrichum sp.</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Alternaria black spot</td>
<td>Alternaria sp.</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>Blackleg</td>
<td>Leptosphaeria maculans</td>
<td>17</td>
</tr>
<tr>
<td></td>
<td>Clubroot</td>
<td>Plasmodiophora brassicae</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Fusarium wilt</td>
<td>Fusarium oxysporum</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Gray stem</td>
<td>Pseudocercosporella capsellae</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Root rot</td>
<td>Fusarium sp., Pythium sp., and</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Rhizoctonia solani</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Stem rot</td>
<td>Sclerotinia sclerotiorum</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Verticillium stem stripe</td>
<td>Verticillium sp.</td>
<td>31</td>
</tr>
<tr>
<td></td>
<td>Nutrient deficiency</td>
<td>Possible sulphur/phosphorus deficiency</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>Nutrient deficiency</td>
<td>Possible nitrogen deficiency</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Nutrient deficiency</td>
<td>Undetermined</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td>Physiological disorder</td>
<td>Undetermined</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Environmental injury</td>
<td></td>
<td>24</td>
</tr>
<tr>
<td></td>
<td>Herbicide injury</td>
<td></td>
<td>26</td>
</tr>
<tr>
<td>Flax</td>
<td>Fusarium wilt</td>
<td>Fusarium oxysporum</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Root rot</td>
<td>Pythium sp., Rhizoctonia spp.</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Environmental injury</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Herbicide injury</td>
<td></td>
<td>7</td>
</tr>
<tr>
<td>Sunflower</td>
<td>Leaf spot</td>
<td>Alternaria sp.</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Root rot</td>
<td>Fusarium sp.</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Environmental injury</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Herbicide injury</td>
<td></td>
<td>3</td>
</tr>
</tbody>
</table>
Table 7. Diseases diagnosed on fruit crop samples submitted to the Manitoba Agriculture Crop Diagnostic Centre in 2018.

<table>
<thead>
<tr>
<th>CROP</th>
<th>DISEASE/INJURY</th>
<th>CAUSAL AGENT</th>
<th>NO. OF SAMPLES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apple</td>
<td>Canker</td>
<td>Botryosphaeria sp.</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Canker</td>
<td>Cytospora sp.</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Canker</td>
<td>Diplodia sp.</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Canker</td>
<td>Phomopsis sp.</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Canker</td>
<td>Undetermined</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Fireblight</td>
<td>Erwinia amylovora</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Twig canker</td>
<td>Nectria cinnabarina</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>General stress</td>
<td>Environmental injury</td>
<td>2</td>
</tr>
<tr>
<td>Grape</td>
<td>Downy mildew</td>
<td>Plasmopara sp.</td>
<td>1</td>
</tr>
<tr>
<td>Raspberry</td>
<td>Cane blight</td>
<td>Coniothyrium fuckelii</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Spur blight</td>
<td>Phoma sp.</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>General stress</td>
<td>Environmental stress</td>
<td>1</td>
</tr>
<tr>
<td>Strawberry</td>
<td>Black root rot</td>
<td>Fusarium spp., Cylindrocarpon sp.</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Anthracnose crown rot</td>
<td>Colletotrichum fragariae</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>Leaf scorch</td>
<td>Diplocarpon earlianum</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Leaf spot</td>
<td>Mycosphaerella fragariae</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Fusarium wilt</td>
<td>Fusarium oxysporum</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Root rot</td>
<td>Rhizoctonia sp., Phytophthora sp.</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>Verticillium wilt</td>
<td>Verticillium sp.</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Nutrient deficiency</td>
<td>Undetermined</td>
<td>3</td>
</tr>
</tbody>
</table>

Table 8. Diseases diagnosed on specialty crop samples submitted to the Manitoba Agriculture Crop Diagnostic Centre in 2018.

<table>
<thead>
<tr>
<th>CROP</th>
<th>DISEASE/INJURY</th>
<th>CAUSAL AGENT</th>
<th>NO. OF SAMPLES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Buckwheat</td>
<td>Environmental injury</td>
<td>Clavibacter michiganensis subsp. nebraskensis</td>
<td>1</td>
</tr>
<tr>
<td>Corn</td>
<td>Goss’s wilt</td>
<td>Exserohilum turcicum</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Northern leaf blight</td>
<td>Exserohilum turcicum</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Root rot</td>
<td>Fusarium sp.</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Environmental injury</td>
<td></td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>Nutrient deficiency</td>
<td></td>
<td>5</td>
</tr>
<tr>
<td>Hemp</td>
<td>Flower blight</td>
<td>Fusarium graminearum, F. sporotrichioides</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Root and stem rot</td>
<td>Fusarium oxysporum</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Herbicide injury</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>Quinoa</td>
<td>Leaf and stem spot</td>
<td>Ascochyta sp.</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Stem canker</td>
<td>Phoma sp.</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Root and stem rot</td>
<td>Fusarium oxysporum</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Environmental injury</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>CROP</td>
<td>DISEASE/INJURY</td>
<td>CAUSAL AGENT</td>
<td>NO. OF SAMPLES</td>
</tr>
<tr>
<td>--------------</td>
<td>-------------------</td>
<td>--------------------------------------------------</td>
<td>---------------</td>
</tr>
<tr>
<td>Dry bean</td>
<td>Common blight</td>
<td><em>Xanthomonas axonopodis pv. phaseoli</em></td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Root rot</td>
<td><em>Fusarium oxysporum, Fusarium spp.</em></td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>General stress</td>
<td>Environmental stress</td>
<td>1</td>
</tr>
<tr>
<td>Fababean</td>
<td>Alternaria leaf spot</td>
<td><em>Alternaria alternata</em></td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Anthracnose</td>
<td><em>Colletotrichum sp.</em></td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Chocolate spot</td>
<td><em>Botrytis sp.</em></td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Root rot</td>
<td><em>Fusarium sp.</em></td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>General stress</td>
<td>Environmental stress</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Herbicide injury</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Field pea</td>
<td>Alternaria leaf spot</td>
<td><em>Alternaria sp.</em></td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Root rot</td>
<td><em>Aphanomyces spp.</em></td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Root rot</td>
<td><em>Fusarium sp.</em></td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>Root rot complex</td>
<td><em>Fusarium sp., Rhizoctonia sp., Pythium sp.</em></td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>General stress</td>
<td>Environmental stress</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Nutrient deficiency</td>
<td>Undetermined</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Herbicide injury</td>
<td></td>
<td>6</td>
</tr>
<tr>
<td>Lentil</td>
<td>Herbicide injury</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Soybean</td>
<td>Alternaria leaf spot</td>
<td><em>Alternaria sp.</em></td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>Anthracnose</td>
<td><em>Colletotrichum sp.</em></td>
<td>6</td>
</tr>
<tr>
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<td>Brown spot</td>
<td><em>Septoria glycines</em></td>
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<td><em>Fusarium sp., Pythium sp., Rhizoctonia solani</em></td>
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<td><em>Phytophthora sp.</em></td>
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<td>Herbicide injury</td>
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CROP: Diagnostic Laboratory Report - Commercial Crops
LOCATION: Ontario

NAME AND AGENCY:
M. Melzer and X. Shan
Plant Disease Clinic, Laboratory Services Division, University of Guelph, 95 Stone Road W, Guelph, ON N1H 8J7
Telephone: (519) 823-1268; Facsimile: (519) 767-6240; Email: xshan@uoguelph.ca
Web page: www.guelphlabservices.com

TITLE: DISEASES DIAGNOSED ON PLANT SAMPLES SUBMITTED TO THE PLANT DISEASE CLINIC, UNIVERSITY OF GUELPH IN 2018

ABSTRACT: Diseases and their causal agents diagnosed on plant samples received by the Plant Disease Clinic, University of Guelph in 2018 are summarized in this report. Samples included greenhouse vegetables, annual and perennial ornamental plants, field crops, berry crops, tree fruits, turfgrass and trees.

METHODS: The Plant Disease Clinic of the University of Guelph provides plant pest diagnostic services to growers, agri-businesses, provincial and federal governments and the general public across Canada. Services include plant disease diagnosis, plant parasitic nematode identification and enumeration, pathogen detection from soil and water, and insect identification. The following data are for samples received by the laboratory for disease diagnosis in 2018. Diagnoses were accomplished using microscopic examination, culturing on artificial media, biochemical identification of bacteria using BIOLOG®, enzyme-linked immunosorbent assay (ELISA), polymerase chain reaction (PCR) based techniques including DNA Multiscan®, PCR and RT-PCR and DNA sequencing.

RESULTS AND COMMENTS: In 2018, from January 1 to December 31, the Plant Disease Clinic received samples representing approximately 85 plant genera for disease diagnosis. Results are presented in Tables 1 to 6. For various reasons, the frequency of diseases diagnosed on samples submitted to the laboratory does not reflect the prevalence of diseases of various crops in the field. Problems caused by plant parasitic nematodes, insects and abiotic factors are not listed. Most diseases identified in 2018 are commonly diagnosed on the respective plant hosts.

Table 1. Diseases diagnosed on vegetable samples (including greenhouse vegetables) submitted to the University of Guelph Plant Disease Clinic in 2018.

<table>
<thead>
<tr>
<th>CROP</th>
<th>DISEASE</th>
<th>CAUSAL AGENT</th>
<th>NO. OF SAMPLES</th>
</tr>
</thead>
<tbody>
<tr>
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<td>Rhizomania (Beet Necrotic Yellow Vein Virus (BNYVV))</td>
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<td>Fusarium oxysporum</td>
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<tr>
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<tr>
<td></td>
<td>Root rot</td>
<td>Pythium irregular</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Root rot</td>
<td>Pythium ultimum</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Root rot</td>
<td>Rhizoctonia solani</td>
<td>2</td>
</tr>
<tr>
<td>Broccoli (Brassica oleracea var. botrytis)</td>
<td>Bacterial leaf spot</td>
<td>Xanthomonas campestris</td>
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<tr>
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<td>Black spot</td>
<td>Alternaria sp.</td>
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<tr>
<td>Cabbage (Brassica oleracea var. capitata)</td>
<td>Black rot</td>
<td>Xanthomonas campestris</td>
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<tr>
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<tr>
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<td>Wire stem</td>
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<td>White mold</td>
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continued
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<td>Rhizoctonia solani</td>
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<td>Mosaic Virus</td>
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<th>NO. OF SAMPLES</th>
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<td>Pythium sp.</td>
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<tr>
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<td>Pythium ultimum</td>
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<td>Crown and root rot</td>
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<td>Fulvia fulva</td>
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<th>CAUSAL AGENT</th>
<th>NO. OF SAMPLES</th>
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<td><em>Pythium dissolocum</em></td>
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<td>Root rot</td>
<td><em>Pythium ultimum</em></td>
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<td>Root rot</td>
<td><em>Rhizoctonia solani</em></td>
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<td>Root rot</td>
<td><em>Thielaviopsis basicola</em></td>
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<td>Stem rot</td>
<td><em>Pectobacterium carotovorum</em></td>
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<td></td>
<td>Tomato bacterial canker</td>
<td><em>Clavibacter michiganensis</em></td>
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<td></td>
<td>White mold</td>
<td><em>Sclerotinia sclerotiorum</em></td>
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<td></td>
<td></td>
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<td></td>
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<td>Zucchini (Cucurbita pepo)</td>
<td>Bacterial soft rot</td>
<td><em>Pectobacterium carotovorum</em></td>
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<td>Foot rot</td>
<td><em>Fusarium oxysporum</em></td>
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<td>Root rot</td>
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Table 2. Diseases diagnosed on fruit samples submitted to the University of Guelph Plant Disease Clinic in 2018.

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<tr>
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<th>CAUSAL AGENT</th>
<th>NO. OF SAMPLES</th>
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</thead>
<tbody>
<tr>
<td>Apple (Malus sp.)</td>
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<td><em>Botryosphaeria obtusa</em></td>
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<tr>
<td></td>
<td>Canker</td>
<td><em>Botryosphaeria</em> sp.</td>
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<tr>
<td></td>
<td>Canker</td>
<td><em>Fusarium</em> sp.</td>
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</tr>
<tr>
<td></td>
<td>Canker</td>
<td><em>Nectria galligena</em></td>
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<tr>
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<td>Canker</td>
<td><em>Phomopsis</em> sp.</td>
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<tr>
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<td>Crown gall</td>
<td><em>Agrobacterium</em> sp.</td>
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<td><em>Rhizoctonia solani</em></td>
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<td><em>Erwinia amylovora</em></td>
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<td>Fruit rot</td>
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<td><em>Fusarium</em> sp.</td>
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<td>Luteovirus</td>
<td><em>Lutoeovirus</em></td>
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<td><em>Cylindrocarpon</em> sp.</td>
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<tr>
<td></td>
<td>Root rot</td>
<td><em>Fusarium</em> sp.</td>
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<tr>
<td></td>
<td>Root rot</td>
<td><em>Phytophthora</em> sp.</td>
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<tr>
<td></td>
<td>Twig blight</td>
<td><em>Nectria cinnabarina</em></td>
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<td></td>
<td>Wood decay</td>
<td><em>Schizophyllum commune</em></td>
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<tr>
<td>Blueberry (Vaccinium sp.)</td>
<td>Leaf spot</td>
<td><em>Phomopsis</em> sp.</td>
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<tr>
<td></td>
<td>Root rot</td>
<td><em>Fusarium</em> sp.</td>
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<tr>
<td></td>
<td>Root rot</td>
<td><em>Pythium</em> sp.</td>
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<tr>
<td>Cantaloupe (Cucumis melo)</td>
<td>Angular leaf spot</td>
<td><em>Pseudomonas syringae</em></td>
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<tr>
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<td>Bacterial leaf spot</td>
<td><em>Xanthomonas campestris</em></td>
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<td>Bacterial blight</td>
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<td>Root rot</td>
<td><em>Fusarium</em> sp.</td>
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<tr>
<td></td>
<td>Root rot</td>
<td><em>Pythium ultimum</em></td>
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continued
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<th>CAUSAL AGENT</th>
<th>NO. OF SAMPLES</th>
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<tbody>
<tr>
<td>Grape (Vitis sp.)</td>
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<td>Root rot</td>
<td>Rhizoctonia solani</td>
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<td>Pear (Pyrus sp.)</td>
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<td>Pythium sp.</td>
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<td>Strawberry Vein Banding Virus (SVBV)</td>
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<td>Root rot</td>
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<td>Root rot</td>
<td>Pythium ultimum</td>
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<td>Verticillium wilt</td>
<td>Verticillium dahliae</td>
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continued
Table 3. Diseases diagnosed on herbaceous ornamental samples submitted to the University of Guelph Plant Disease Clinic in 2018.

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<th>CAUSAL AGENT</th>
<th>NO. OF SAMPLES</th>
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<td>Watermelon</td>
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<td>Root rot</td>
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<td>Wilt</td>
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<td>Pythium sp.</td>
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<td>(Ajuga sp.)</td>
<td>Potyvirus</td>
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<td>Canna lily</td>
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<td>Christmas cactus</td>
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<td>Fusarium sp.</td>
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<td>Tomato Spotted Wilt Virus (TSWV)</td>
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<td>Columbine</td>
<td>Gray mold</td>
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<td>(Aquilegia sp.)</td>
<td>Root rot</td>
<td>Pythium sp.</td>
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<td>Pythium dissotocum</td>
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<td>Fusarium solani</td>
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<td>Root rot</td>
<td>Pythium ultimum</td>
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<tr>
<td></td>
<td>Root rot</td>
<td>Rhizoctonia solani</td>
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continued
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<thead>
<tr>
<th>CROP</th>
<th>DISEASE</th>
<th>CAUSAL AGENT</th>
<th>NO. OF SAMPLES</th>
</tr>
</thead>
<tbody>
<tr>
<td>European wild ginger</td>
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<td>(Asarum europaeum)</td>
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<td>Stem canker</td>
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<th>NO. OF SAMPLES</th>
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<td>Root rot</td>
<td>Pythium ultimum</td>
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<td>Peace lily</td>
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<td>Poinsettia</td>
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Table 4. Diseases diagnosed on woody ornamental samples submitted to the University of Guelph Plant Disease Clinic in 2018.

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<th>DISEASE</th>
<th>CAUSAL AGENT</th>
<th>NO. OF SAMPLES</th>
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</thead>
<tbody>
<tr>
<td>Austrian pine (Pinus nigra)</td>
<td>Brown spot needle blight</td>
<td>Lecanosticta acicola</td>
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<tr>
<td>Balsam fir (Abies balsamea)</td>
<td>Root rot</td>
<td>Fusarium oxysporum</td>
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<tr>
<td>Boxwood (Buxus sp.)</td>
<td>Canker</td>
<td>Volutella buxi</td>
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<td></td>
<td>Leaf blight</td>
<td>Volutella buxi</td>
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<td></td>
<td>Leaf spot</td>
<td>Macrophoma sp.</td>
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<td>Colorado blue spruce (Picea pungens)</td>
<td>Needlecast</td>
<td>Rhizosphaera kalkhoffii</td>
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<td>Setomelanomma holmii</td>
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<td>Needlecast</td>
<td>Stigmina sp.</td>
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<td>Root rot</td>
<td>Cylindrocarpon destructans</td>
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<td>Douglas fir (Pseudotsuga menziesii)</td>
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<td>Cylindrocarpon destructans</td>
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<td>Eastern white cedar (Thuja occidentalis)</td>
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<td>Pestalotiopsis sp.</td>
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<td>Crown and root rot</td>
<td>Pythium ultimum</td>
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<tr>
<td>Fragrant sumac (Rhus aromatica)</td>
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<td>Pythium sylvaticum</td>
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<td>Root rot</td>
<td>Pythium ultimum</td>
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<td>Fraser fir (Abies fraseri)</td>
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<td>Pythium ultimum</td>
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<td>Crown and root rot</td>
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<td>Armillaria ostoyae</td>
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<td>Cylindrocarpon sp.</td>
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<td>Gray dogwood (Cornus racemosa)</td>
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<td>Root rot</td>
<td>Rhizoctonia solani</td>
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<td>Juniper (Juniperus sp.)</td>
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<td>Botryosphaeria sp.</td>
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continued
### Table 5. Diseases diagnosed on field crop samples submitted to the University of Guelph Plant Disease Clinic in 2018.

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<th>DISEASE</th>
<th>CAUSAL AGENT</th>
<th>NO. OF SAMPLES</th>
</tr>
</thead>
</table>
| Adzuki bean  
(\textit{Vigna angularis}) | Alfalfa Mosaic Virus | Alfalfa Mosaic Virus (AMV) | 1 |
| Barley  
(\textit{Hordeum vulgare}) | Root rot | Bipolaris sp. | 1 |
| Canola  
(\textit{Brassica napa}) | Downy mildew | 
| | Powdery mildew | Erysiphe cruciferarum | 1 |
| Bean  
(\textit{Phaseolus vulgaris}) | Anthracnose | Colletotrichum lindemuthianum | 3 |
| | Cucumber mosaic virus | Cucumber mosaic virus (CMV) | 1 |
| | Root rot | Fusarium sp. | 2 |
| | Tobacco Streak Virus | Tobacco Streak Virus (TSV) | 1 |
| Canola  
(\textit{Brassica napa}) | Downy mildew | Peronospora parasitica | 2 |
| | Powdery mildew | Erysiphe cruciferarum | 1 |

\textit{continued}
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<th>NO. OF SAMPLES</th>
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<td>Pythium sp.</td>
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<tr>
<td></td>
<td>Rust</td>
<td>Puccinia sp.</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Snow mold</td>
<td>Microdochium nivale</td>
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</tr>
</tbody>
</table>

Table 6. Diseases diagnosed on herb and specialty crop samples submitted to the University of Guelph Plant Disease Clinic in 2018.

<table>
<thead>
<tr>
<th>CROP</th>
<th>DISEASE</th>
<th>CAUSAL AGENT</th>
<th>NO. OF SAMPLES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ginseng (Panax sp.)</td>
<td>Blight</td>
<td>Botrytis sp.</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Root rot</td>
<td>Cylindrocarpon destructans</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Root rot</td>
<td>Fusarium solani</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Root rot</td>
<td>Pythium sp.</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Root rot</td>
<td>Pythium irregulare</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Root rot</td>
<td>Pythium ultimum</td>
<td>1</td>
</tr>
<tr>
<td>Hop (Humulus lupulus)</td>
<td>Apple Mosaic Virus</td>
<td>Apple Mosaic Virus (ApMV)</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Hop Latent Virus</td>
<td>Hop Latent Virus (HpLV)</td>
<td>3</td>
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<tr>
<td></td>
<td>Hop Mosaic Virus</td>
<td>Hop Mosaic Virus (HpMV)</td>
<td>2</td>
</tr>
<tr>
<td>Spearmint (Mentha sp.)</td>
<td>Root rot</td>
<td>Fusarium sp.</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Root rot</td>
<td>Pythium dissotocum</td>
<td>1</td>
</tr>
</tbody>
</table>
CROP: Diagnostic Laboratory Report
LOCATION: Bradford / Holland Marsh, Ontario

NAME AND AGENCY:
Z. Telfer & M.R. McDonald
Muck Crops Research Station, University of Guelph, 1125 Woodchoppers Lane, King, ON L7B 0E9
Telephone: (905) 775-3783; E-mail: ztelfer@uoguelph.ca; www.uoguelph.ca/muckcrop/

TITLE: DISEASES DIAGNOSED ON PLANT SAMPLES SUBMITTED TO THE MUCK CROPS RESEARCH STATION DIAGNOSTIC LABORATORY IN 2018

ABSTRACT: As part of the Integrated Pest Management (IPM) program provided by the Muck Crops Research Station (MCRS), a diagnostic service is provided to vegetable growers around Holland Marsh / Bradford, Ontario. In 2018, 85 samples were submitted to the diagnostic laboratory for identification and possible control recommendations. Samples included plants with infectious disease, physiological disorders, insect feeding damage and weeds.

INTRODUCTION AND METHODS: As part of the Integrated Pest Management (IPM) program, the plant disease diagnostic laboratory of the Muck Crops Research Station (MCRS) provides diagnosis and control recommendations for diseases, insect pests and weed problems of vegetable crops to growers in the Bradford / Holland Marsh and surrounding area of Ontario in addition to supporting grower implementation of IPM by scouting growers’ fields. Samples are submitted to the MCRS diagnostic laboratory by IPM scouts, growers, agribusiness representatives and crop insurance agents. Disease diagnoses are based on a combination of visual examination of symptoms, microscopic observations and culturing onto growth media.

RESULTS AND COMMENTS: Overall, weather conditions in 2018 were generally favourable for disease development. Compared to the previous 10-year average, air temperatures in 2018 were above average for May (15.8°C), August (21.9°C) and September (17.5°C), average for June (18.4°C) and July (22.0°C) and below average for October (8.3°C). Monthly rainfall was above the 10-year average for August (109 mm), average for May (82 mm), July (104 mm) and October (69 mm) and below average for June (59 mm) and September (20 mm). From May 15 to October 24, 2018, the diagnostic laboratory received 90 samples for diagnosis. Of these, 75% were diseases (64 samples), 16% physiological disorders (14 samples), and 8% insect problems (7 samples). These samples were associated with the following crops: onion (52%), carrot (28%), celery (12%), and other crops (8.2%). Major insect pests identified included carrot weevil and onion thrips. Insect issues are included here as they are a deviation from the norm: carrot weevil caused carrot mortality and damage in celery while cabbage maggot damage occurred in an insecticide-treated field. Sclerotinia white mold in carrot was found in the upper canopy of carrot plants for the second time in two years. Typically, it only occurs in the bottom of an enclosed canopy after carrot leaves start to die. Aster yellows phytoplasma occurred in onions and celery in 2018, and was detected before the disease was detected in carrots. Similar to 2017, no botrytis leaf blight in onion was seen in the Holland Marsh. Despite conditions favourable for disease, there was no outbreak of downy mildew with only one sample positively identified. A summary of diseases and damage and causal agents diagnosed on crop samples submitted to the MCRS diagnostic laboratory in 2018 is presented in Table 1.

ACKNOWLEDGEMENTS: Funding was provided in part by the Bradford Cooperative Storage Ltd., agrochemical companies and growers participating in the Muck Crops Research Station IPM program.
<table>
<thead>
<tr>
<th>CROP</th>
<th>DISEASE</th>
<th>CAUSAL AGENT</th>
<th>NO. OF SAMPLES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beet</td>
<td>Tarnished plant bug (leaf damage)</td>
<td><em>Lygus lineolaris</em></td>
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<tr>
<td>Carrot</td>
<td>Aster yellows</td>
<td>Phytoplasma</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Plant mortality (carrot weevil)</td>
<td><em>Listronotus oregonensis</em></td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Chemical damage</td>
<td>Herbicide injury</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Fusarium dry rot</td>
<td><em>Fusarium</em> spp.</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Leaf blight</td>
<td><em>Alternaria dauci and Cercospora carotae</em></td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>Nematode forking</td>
<td><em>Meloidogyne hapla</em></td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Pythium root dieback</td>
<td><em>Pythium</em> spp.</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Sclerotinia white mold</td>
<td><em>Sclerotinia sclerotiorum</em></td>
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<tr>
<td></td>
<td>Violet root rot</td>
<td><em>Rhizoctonia crocorum</em></td>
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</tr>
<tr>
<td>Celery</td>
<td>Aster yellows</td>
<td>Phytoplasma</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Bacterial rot</td>
<td><em>Pectobacterium carotovorum</em></td>
<td>1</td>
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<tr>
<td></td>
<td>Blackheart</td>
<td>Calcium deficiency</td>
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</tr>
<tr>
<td></td>
<td>Stalk damage (Carrot weevil)</td>
<td><em>Listronotus oregonensis</em></td>
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<tr>
<td></td>
<td>Celery leaf curl</td>
<td><em>Colletotrichum</em> spp.</td>
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<td></td>
<td>Chemical injury</td>
<td>Herbicide damage</td>
<td>3</td>
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<tr>
<td>Onion</td>
<td>Aster yellows</td>
<td>Phytoplasma</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Bacterial rot/soft rot</td>
<td><em>Pectobacterium carotovorum</em></td>
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<td></td>
<td>Chemical injury</td>
<td>Herbicide damage</td>
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<td></td>
<td>Downy mildew</td>
<td><em>Peprobacterium destructor</em></td>
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<td>Pink root</td>
<td><em>Phoma terrestris</em></td>
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<td>Purple blotch</td>
<td><em>Alternaria porri</em></td>
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<td></td>
<td>Smut</td>
<td><em>Urocystis cepalae</em></td>
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<td></td>
<td>Stemphylium leaf blight</td>
<td><em>Stemphylium vesicarium</em></td>
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<td></td>
<td>White rot</td>
<td><em>Sclerotium cepivorum</em></td>
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<td>Pepper</td>
<td>Xanthomas leaf spot</td>
<td><em>Xanthomonas campestris pv. vesicatoria</em></td>
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<td>Potato</td>
<td>Powdery scab</td>
<td><em>Spongospora subterranean</em></td>
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<td>Radish</td>
<td>Root damage (cabbage maggot)</td>
<td><em>Delia radicum</em></td>
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<tr>
<td>Spinach</td>
<td>Tipburn</td>
<td>Calcium deficiency</td>
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<td>Tomato</td>
<td>Early blight</td>
<td><em>Alternaria solani, A. alternata</em></td>
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<td></td>
<td>Late blight</td>
<td><em>Phytophthora infestans</em></td>
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<td><strong>DISEASED SAMPLES</strong></td>
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<tr>
<td><strong>ABIOTIC AND OTHER DISORDERS</strong></td>
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<td><strong>TOTAL SUBMISSIONS</strong></td>
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</table>
CULTURES: Échantillons reçus en 2018 au Laboratoire d'expertise et de diagnostic en phytoprotection
RÉGION: Québec

NOMS ET ORGANISMES:
A.-M. Breton, A. Dionne, D. Hamel, N. Shallow & J. Vivancos
Laboratoire d’expertise et de diagnostic en phytoprotection, ministère de l’Agriculture, des Pêcheries et de l’Alimentation du Québec (MAPAQ), Complexe scientifique, 2700, rue Einstein - D.1.200h, Québec, QC G1P 3W8 Téléphone: 418 643-5027; Télécopieur: 418 646-6806;
Courriel: Ann-Marie.Breton@mapaq.gouv.qc.ca, Phytolab@mapaq.gouv.qc.ca
Sites Internet:
http://www.mapaq.gouv.qc.ca/fr/Productions/Protectiondescultures/diagnostic/Pages/diagnostic.aspx
http://www.agrireseau.qc.ca/lab/

TITRE: MALADIES ET PROBLÈMES ABIOTIQUES DIAGNOSTIQUÉS SUR LES ÉCHANTILLONS DE PLANTES REÇUS EN 2018 AU LABORATOIRE D’EXPERTISE ET DE DIAGNOSTIC EN PHYTOPROTECTION DU MAPAQ

RÉSUMÉ: Du 1er janvier au 13 décembre 2018, 1933 échantillons ont été traités par la section phytopathologie du laboratoire. Les échantillons reçus comprennent les plantes maraîchères (serres et champs), les petits fruits, les grandes cultures, les plantes à usage industriel, les plantes fourragères, les arbres et arbustes fruitiers, les graminées à gazon, les plantes herbacées, les arbres et les arbustes ornementaux (serres et pépinières) ainsi que les plantes aromatiques et médicinales.


Voici les principaux tests utilisés afin d’appuyer le diagnostic: les nématodes vermiformes sont extraits du sol et des tissus végétaux par entonnoir de Baermann tandis que les nématodes à kystes sont extraits du sol à l’aide d’un appareil de Fenwick. Les genres, et lorsque possible les espèces, sont identifiés par microscopie et par des techniques de biologie moléculaire. Les champignons sont isolés sur des milieux de culture gélosés, identifiés selon leurs caractéristiques morphologiques ou par des techniques de biologie moléculaire (PCR, qPCR et/ou séquençage d’ADN). Les bactéries sont isolées sur des milieux de culture gélosés puis identifiées par des tests biochimiques Biolog® et de techniques de biologie moléculaire ((PCR, qPCR et/ou séquençage d’ADN). Les phytoplasmes sont détectés par des techniques de biologie moléculaire (PCR nichée et séquençage d’ADN). Les virus sont, quant à eux, détectés par des tests sérologiques ELISA, par RT-qPCR ou qPCR.

RÉSULTATS ET DISCUSSIONS: Le nombre de maladies rapportées ne correspond pas au nombre d’échantillons réellement reçus et traités puisque plus d’une maladie peut être identifiée sur un échantillon. De plus, les diagnostics dont les causes sont indéterminées ou incertaines pour lesquels les résultats de détection sont négatifs n’ont pas été inclus dans ce rapport.

Il est à noter que les problèmes abiotiques diagnostiqués sur les échantillons sont de nature hypothétique. Il peut s’agir de stress culturaux regroupant, entre autres, les désordres minéraux, les pH et les conductivités électriques de sols et de solutions nutritives inadéquates, les structures de sols inadaptées, une irrigation inappropriée, les blessures mécaniques, etc. Les stress climatiques pour leur part concernent les insolations, le gel, le froid, l’excès de chaleur, les polluants atmosphériques, l’intumescence, l’asphyxie racinaire, les orages violents, les vents forts et la grêle blessant les feuilles. Ces diagnostics sont établis en fonction d’observation de symptômes caractéristiques, de résultats de tests et/ou de discussions avec le client.
**REMERCIEMENTS**: Les auteurs remercient François Bélanger, Marion Berrouard, Annie Guérin, Kariane Pouliot, Michel Lemieux, Chantal Malenfant, Carolle Fortin et Annie-Pier Hachey pour leur support technique ainsi que les étudiants Alexandra Gélinas, Dominic Lafleur et Ève Tremblay-Morel.

**Tableau 1.** Sommaire des maladies diagnostiquées parmi les *plantes maraîchères* reçus au Laboratoire d’expertise et de diagnostic en phytoprotection du MAPAQ en 2018.

<table>
<thead>
<tr>
<th>CULTURE</th>
<th>AGENT PATHOGÈNE / CAUSE</th>
<th>MALADIE / SYMPTOM</th>
<th>NOMBRE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ail</td>
<td><em>Botrytis cinerea</em></td>
<td>Pourriture du col / dépérissement</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td><em>Botrytis porri</em></td>
<td>Pourriture du col / dépérissement</td>
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<tr>
<td></td>
<td><em>Botrytis sp.</em></td>
<td>Pourriture du col / dépérissement</td>
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<tr>
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<td><em>Burkholderia gladioli</em></td>
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<tr>
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<td><em>Cladosporium sp.</em></td>
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<tr>
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<td><em>Colletotrichum sp.</em></td>
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<tr>
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<td>Désordre génétique</td>
<td>Malformation</td>
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<tr>
<td></td>
<td><em>Ditylenchus sp.</em></td>
<td>Nématoide des tiges et des bulbes</td>
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<tr>
<td></td>
<td><em>Embellisia sp.</em></td>
<td>bulbes</td>
<td>22</td>
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<tr>
<td></td>
<td><em>Enterobacter cloacae</em></td>
<td>Suie des bulbes</td>
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<td></td>
<td><em>Fusarium acuminatum</em></td>
<td>Pourriture du bulbe</td>
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<tr>
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<td><em>Fusarium commune</em></td>
<td>Pourriture fusarienne du bulbe</td>
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<td></td>
<td><em>Fusarium oxysporum</em></td>
<td>Pourriture fusarienne du bulbe</td>
<td>29</td>
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<tr>
<td></td>
<td><em>Fusarium solani</em></td>
<td>Pourriture fusarienne du bulbe</td>
<td>3</td>
</tr>
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<td><em>Fusarium sp.</em></td>
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<td>Pourriture fusarienne du bulbe</td>
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<td><em>Penicillum sp.</em></td>
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<td>Pourriture</td>
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<td><em>Rhizoctonia sp.</em></td>
<td>Pourriture des feuilles</td>
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<tr>
<td></td>
<td>Virus commun latent de l’ail (GCLV)</td>
<td>Rhizoctone</td>
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<tr>
<td></td>
<td>Virus de la bigarrure de l’oignon (OYDV)</td>
<td>Asymptomatique</td>
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<td></td>
<td>Virus de la striure du poireau (LYSV)</td>
<td>Malformation / mosaïque foliaire</td>
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<td>Asperge</td>
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<td>Pourriture fusarienne</td>
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<td><em>Alternaria sp.</em></td>
<td>Tache alternarienne</td>
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<tr>
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<td>Carence minérale</td>
<td>Anomalie de coloration</td>
<td>1</td>
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<tr>
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<td>Froid</td>
<td>Anomalie de coloration</td>
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<td><em>Aphanomyces sp.</em></td>
<td>Pied noir</td>
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<td></td>
<td><em>Cercospora sp.</em></td>
<td>Tache foliaire</td>
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<tr>
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<td><em>Rhizoctonia sp.</em></td>
<td>Rhizoctone</td>
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*à suivre*
<table>
<thead>
<tr>
<th>CULTURE</th>
<th>AGENT PATHOGÈNE / CAUSE</th>
<th>MALADIE / SYMPTOM</th>
<th>NOMBRE</th>
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<td>Brocoli</td>
<td><em>Alternaria brassicicola</em></td>
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<td>Carence en potassium</td>
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</tr>
<tr>
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<td>Conductivité électrique faible</td>
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<tr>
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<td><em>Pectobacterium carotovorum subsp. brasiliensis</em></td>
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<td>pH élevé</td>
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<td><em>Plasmodiophora brassicaceae</em></td>
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<sup>a</sup>Complexe fongique comprenant une combinaison des champignons *Fusarium* sp., *Rhizoctonia* sp., *Cylindrocarpon* sp. et / ou des oomycètes *Phytophthora* sp. et *Pythium* sp.
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<tr>
<td></td>
<td><em>Phomopsis</em> viticola</td>
<td>Excoriose</td>
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<td>Excoriose</td>
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à suivre
### Tableau 3. Sommaire des maladies diagnostiquées parmi les grandes cultures et cultures industrielles reçues au Laboratoire d’expertise et de diagnostic en phytoprotection du MAPAQ en 2018

<table>
<thead>
<tr>
<th>CULTURE</th>
<th>AGENT PATHOGÈNE / CAUSE</th>
<th>MALADIE / SYMPTÔM</th>
<th>NOMBRE</th>
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<tbody>
<tr>
<td>Vigne</td>
<td><em>Pied noir</em></td>
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<td><em>Plasmopara viticola</em></td>
<td>Mildiou</td>
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<td></td>
<td><em>Pseudopezicula</em></td>
<td>Rougeot parasitaire</td>
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<tr>
<td></td>
<td><em>Uncinula (Erysiphe) necator</em></td>
<td>Blanc</td>
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</tr>
<tr>
<td></td>
<td>Virus des taches en anneau de la tomate (ToRSV)</td>
<td>Grappe naine</td>
<td>8</td>
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<tr>
<td></td>
<td>Virus de l’enroulement des feuilles de la cigne (GLRaV3)</td>
<td>Anomalie de coloration</td>
<td>2</td>
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<tr>
<td></td>
<td><em>Xiphinema sp.</em></td>
<td>Nématode à dague</td>
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<td><em>Colletotrichum sp.</em></td>
<td>Anthracnose</td>
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<td><em>Fusarium lateritium</em></td>
<td>Pourriture fusarienne</td>
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<td><em>Alternaria sp.</em></td>
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<td><em>Fusarium sp.</em></td>
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<td><em>Helminthosporium sp.</em></td>
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<td><em>Cladosporium sp.</em></td>
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<td><em>Fusarium sp.</em></td>
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<td><em>Microdochium sp.</em></td>
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<td><em>Pythium sylvaticum</em></td>
<td>Pourriture pythienne</td>
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<td><em>Albugo candida</em></td>
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<td><em>Peronospora parasitica</em></td>
<td>Mildiou</td>
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<td><em>Alternaria alternata</em></td>
<td>Tache alternarienne</td>
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<td><em>Fusarium oxysporum</em></td>
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<td>Chanvre</td>
<td><em>Microdochium sp.</em></td>
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<td><em>Pseudomonas syringae</em></td>
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<td><em>Rhizoctonia solani</em></td>
<td>Rhizoctone</td>
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<td><em>Rhizoctonia sp.</em></td>
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<td>Virus de la mosaïque du pommier (ApMV)</td>
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*À suivre*
### Tableau 4. Sommaire des maladies diagnostiquées parmi les plantes fourragères reçues au Laboratoire d’expertise et de diagnostic en phytoprotection du MAPAQ en 2018

<table>
<thead>
<tr>
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<th>AGENT PATHOGÈNE / CAUSE</th>
<th>MALADIE / SYMPTÔM</th>
<th>NOMBRE</th>
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<tr>
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<td><em>Pythium arrhenomanes</em></td>
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<td>Piétin brun</td>
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<tr>
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<td><em>Rhizoctonia sp.</em></td>
<td>Rhizoctone</td>
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<td><em>Usilago sp.</em></td>
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<td>Quinoa</td>
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<td>Virus du flétrissement de la fève (BBV)</td>
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<td>Panic érigé</td>
<td><em>Tilletia maclaganii</em></td>
<td>Charbon</td>
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<td>Seigle d’automne</td>
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<td>Moisissure nivéale</td>
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<td><em>Alternaria sp.</em></td>
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<td></td>
<td>Chaleur</td>
<td>Dépérissement</td>
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<td><em>Pythium sp.</em></td>
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<td>Rhizoctone</td>
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<td><em>Septoria sp.</em></td>
<td>Tache septorienne</td>
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**Tableau 5.** Sommaire des maladies diagnostiquées parmi les arbres et arbustes ornementaux reçus au Laboratoire d’expertise et de diagnostic en phytoprotection du MAPAQ en 2018

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<thead>
<tr>
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<th>AGENT PATHOGÈNE / CAUSE</th>
<th>MALADIE / SYMPTÔM</th>
<th>NOMBRE</th>
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<td>Anthracnose</td>
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<td>Gel</td>
<td>Dépérissement</td>
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<td><em>Peniophora</em> sp.</td>
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<td><em>Peniophora</em> sp.</td>
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<td>Gel</td>
<td>Dépérissement</td>
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<td><em>Septoria</em> sp.</td>
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<th>NOMBRE</th>
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<td>Puccinia allii</td>
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<td>Fusarium sp.</td>
<td>Pourriture fusarienne</td>
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<td>Rhizoctonia sp.</td>
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<td>Fusarium oxysporum</td>
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<td></td>
<td>Pythium irregularre</td>
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<tr>
<td></td>
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<td></td>
<td>Virus des taches nécrotique de l'impatiens (INSV)</td>
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<tr>
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<tr>
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<td>Pythium sp.</td>
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<tr>
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<td>Potyvirus</td>
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<td>Dahlia</td>
<td>Podosphaera xanthii</td>
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<tr>
<td>Écheveria</td>
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<td>Échinacée</td>
<td>Agrobacterium sp.</td>
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<tr>
<td></td>
<td>Botrytis sp.</td>
<td>Moisissure grise</td>
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à suivre
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<th>CULTURE</th>
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<th>MALADIE/SYMPTÔM</th>
<th>NOMBRE</th>
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<td><em>Colletotrichum</em> sp.</td>
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<td><em>Curvularia</em> sp.</td>
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<td>Nématode spiralé</td>
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<td></td>
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<td></td>
<td><em>Magnaporthe</em> sp.</td>
<td>Pourriture des racines</td>
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</tr>
<tr>
<td></td>
<td><em>Microdochium</em> sp.</td>
<td>Pourriture rose</td>
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<td></td>
<td><em>Microdochium bolleyi</em></td>
<td>Anthracnose</td>
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<tr>
<td></td>
<td><em>Pythium</em> sp.</td>
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<td>3</td>
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<tr>
<td></td>
<td><em>Pythium torulosum</em></td>
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</tr>
<tr>
<td></td>
<td><em>Pythium vanterpoolii</em></td>
<td>Pourriture pythienne</td>
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</tr>
<tr>
<td>Géranium / Pelargonium</td>
<td><em>Pythium</em> irregulare</td>
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<tr>
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<td>Virus pelargonium (PFBV)</td>
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<tr>
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<td></td>
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<td>Rhizoctone</td>
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<td></td>
<td>Virus des taches en anneaux du tabac (TRSV)</td>
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<tr>
<td>Hibiscus</td>
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<td>Moissure grise</td>
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<tr>
<td>Immortelle à bractées</td>
<td>Virus de la mosaïque de l'alternanthère / Virus de la mosaïque du papayer (AltMV / PapMV)</td>
<td>Anomalie de coloration</td>
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</tr>
<tr>
<td>Iris des jardins</td>
<td><em>Fusarium</em> sp.</td>
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<td></td>
<td>Potyvirus</td>
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<tr>
<td></td>
<td>Virus des taches en anneaux du tabac (TRSV)</td>
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<td>Lavande</td>
<td><em>Botrytis cinerea</em></td>
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<tr>
<td>Lin de Nouvelle-Zélande</td>
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<tr>
<td>Lys</td>
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<td></td>
<td><em>Rhizoctonia</em> sp.</td>
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<td>Marguerite</td>
<td><em>Rhodococcus</em> fascians</td>
<td>Malformation</td>
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<td>Muguet</td>
<td><em>Aureobasidium</em> sp.</td>
<td>Tache foliaire</td>
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<tr>
<td>Némésie</td>
<td>Virus de la maladie bronzee de la tomate (TSWV)</td>
<td>Anomalie de coloration</td>
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<tr>
<td>Ôeillet</td>
<td><em>Fusarium</em> proliferatum</td>
<td>Fusariose</td>
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à suivre
<table>
<thead>
<tr>
<th>CULTURE</th>
<th>AGENT PATHOGÈNE/CAUSE</th>
<th>MALADIE/SYMPTÔM</th>
<th>NOMBRE</th>
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<td>Pâturin annuel</td>
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<td></td>
<td><em>Curvularia</em> sp.</td>
<td>Brûlure de la feuille estivale</td>
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<td></td>
<td><em>Drechslera poae</em></td>
<td>Helminthosporiose</td>
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<td></td>
<td><em>Microdochium bolleyi</em></td>
<td>Pourriture rose</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td><em>Microdochium</em> sp.</td>
<td>Anthracnose</td>
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<tr>
<td></td>
<td><em>Pythium oligandrum</em></td>
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<td></td>
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<td>Pourriture pythienne</td>
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<td></td>
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<tr>
<td></td>
<td><em>Fusarium</em> sp.</td>
<td>Pourriture</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td><em>Phytophthora</em> sp.</td>
<td>Pourriture</td>
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<td></td>
<td><em>Pythium sylvaticum</em></td>
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<tr>
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<td>Sédum / orpin</td>
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<td>Blanc</td>
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<td>Stipe</td>
<td><em>Microdochium nivale</em></td>
<td>Moisissure nivale</td>
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<tr>
<td>Tabac</td>
<td><em>Penicillium</em> sp.</td>
<td>Pourriture</td>
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<tr>
<td>Victoria d'Amazonie</td>
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<td>Pourriture pythienne</td>
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Tableau 7. Sommaire des maladies diagnostiquées parmi les **plantes aromatiques et médicinales** reçues au Laboratoire d’expertise et de diagnostic en phytoprotection du MAPAQ en 2018.

<table>
<thead>
<tr>
<th>CULTURE</th>
<th>AGENT PATHOGENE / CAUSE</th>
<th>MALADIE / SYMPTÔM</th>
<th>NOMBRE</th>
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<tr>
<td></td>
<td><em>Fusarium</em> sp.</td>
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<tr>
<td>Ciboulette</td>
<td><em>Stemphylium</em> sp.</td>
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<td>Coriandre</td>
<td><em>Alternaria alternata</em></td>
<td>Tache alternarienne</td>
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<td></td>
<td><em>Alternaria dauci</em></td>
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<tr>
<td></td>
<td><em>Alternaria</em> sp.</td>
<td>Tache alternarienne</td>
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<td>Carence minérale</td>
<td>Anomalie de coloration</td>
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</tr>
<tr>
<td></td>
<td><em>Pseudomonas syringae</em></td>
<td>Tache foliaire</td>
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<tr>
<td></td>
<td><em>Pseudomonas viridiflava</em></td>
<td>Brûlure</td>
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<td></td>
<td><em>Pythium</em> sp.</td>
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<tr>
<td>Coriandre</td>
<td><em>Phoma</em> sp.</td>
<td>Tache foliaire</td>
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<td>Vietnamienne</td>
<td><em>Stemphylium</em> sp.</td>
<td>Brûlure stemphylienne</td>
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<tr>
<td>Menthe verte</td>
<td><em>Oidium</em> sp.</td>
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<td></td>
<td><em>Alternaria</em> sp.</td>
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<tr>
<td></td>
<td><em>Fusarium</em> sp.</td>
<td>Pourriture fusarienne</td>
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<tr>
<td></td>
<td>pH bas</td>
<td>Anomalie de coloration</td>
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<td>Persil</td>
<td><em>Pythium</em> sp.</td>
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<td>Safran</td>
<td><em>Cylindrocarpon</em> sp.</td>
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<td></td>
<td><em>Fusarium</em> sp.</td>
<td>Pourriture fusarienne</td>
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<td><em>Fusarium oxysporum</em></td>
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<td><em>Gele</em></td>
<td>Dépérissement</td>
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<td><em>Meloidogyne</em> sp.</td>
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<td><em>Penicillium</em> sp.</td>
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<td><em>Pseudomonas marginalis</em></td>
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<td></td>
<td><em>Pythium</em> sp.</td>
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<tr>
<td></td>
<td><em>Rhizoctonia</em> sp.</td>
<td>Rhizoctone</td>
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<td></td>
<td><em>Xiphinema</em> sp.</td>
<td>Nématode à dague</td>
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<tr>
<td>Thym</td>
<td><em>Pythium irregular</em></td>
<td>Pourriture pythienne</td>
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</table>
CROP: Diagnostic Laboratory Report
LOCATION: New Brunswick

NAME AND AGENCY:
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New Brunswick Department of Agriculture, Aquaculture and Fisheries (NBDAAF), 1350 Regent Street, Fredericton, NB E3C 2G6
Telephone: (506) 453-3478; Facsimile: (506) 453-7978; E-mail: michael.tesfaendrias@gnb.ca

TITLE: DISEASES DIAGNOSED ON PLANT SAMPLES SUBMITTED TO THE NBDAAF PLANT DISEASE DIAGNOSTIC LABORATORY IN 2018

ABSTRACT: The New Brunswick Department of Agriculture, Aquaculture and Fisheries (NBDAAF) Plant Disease Diagnostic Laboratory provides diagnostic services and disease management recommendations to growers and the agricultural industry in New Brunswick. In 2018, a total of 116 plant tissue samples were submitted to the diagnostic laboratory for problem identification and possible control recommendations. Samples included infectious diseases and abiotic disorders.

INTRODUCTION AND METHODS: The NBDAAF Plant Disease Diagnostic Laboratory located in Fredericton, NB, provides diagnostic services and control recommendations for diseases of various crops to growers and the agricultural industry in New Brunswick as part of an integrated pest management (IPM) service. Samples are submitted to the diagnostic laboratory by IPM scouts, growers, agribusiness representatives, crop insurance agents and NBDAAF crop specialists and extension officers. Disease diagnoses are based on a combination of visual examination of symptoms, microscopic observations and culturing onto growth media.

RESULTS AND COMMENTS: From March 1 to November 30, 2018, the Plant Disease Diagnostic Laboratory received 116 diseased plant samples for diagnosis. Of these, 79% were infectious diseases (92 in total) and 21% physiological disorders (24 in total). Samples submitted to the diagnostic laboratory which were associated with insect damage are not included in this report. Also, samples diagnosed during scouting (surveys) and field visits are not included in this report. Summaries of diseases and causal agents diagnosed on plant tissue samples submitted to the NBDAAF Plant Disease Diagnostic Laboratory in 2018 are presented in Tables 1 to 5 by crop category.

Table 1. Diseases diagnosed on fruit tree crops submitted to the NBDAAF Plant Disease Diagnostic Laboratory in 2018.

<table>
<thead>
<tr>
<th>CROP</th>
<th>DISEASE</th>
<th>CAUSAL AGENT</th>
<th>NO. OF SAMPLES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apple</td>
<td>Apple scab</td>
<td>Venturia inaequalis</td>
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<tr>
<td></td>
<td>Black rot</td>
<td>Botryosphaeria obtusa</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Cedar apple rust</td>
<td>Gymnosporangium juniperi-virginianae</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>European canker</td>
<td>Neonectria ditissima</td>
<td>2</td>
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<tr>
<td></td>
<td>Powdery mildew</td>
<td>Podosphaera leucotricha</td>
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<tr>
<td></td>
<td>Phytophthora root and crown rot</td>
<td>Phytophthora spp.</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Burr knot</td>
<td>Physiological disorder</td>
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<tr>
<td></td>
<td>Chemical injury</td>
<td>Pesticide damage</td>
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</tr>
<tr>
<td></td>
<td>Wilting</td>
<td>Drought stress</td>
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<tr>
<td>Cherry</td>
<td>Leaf spot</td>
<td>Alternaria sp.</td>
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</table>

DISEASED SAMPLES  16
ABIOTIC DISORDERS  4
TOTAL SUBMISSIONS  20
Table 2. Diseases diagnosed on berry crops submitted to the NBDAAF Plant Disease Diagnostic Laboratory in 2018.

<table>
<thead>
<tr>
<th>CROP</th>
<th>DISEASE</th>
<th>CAUSAL AGENT</th>
<th>NO. OF SAMPLES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Black currant</td>
<td>White pine blister rust</td>
<td><em>Cronartium ribicola</em></td>
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<tr>
<td>Blueberry (lowbush)</td>
<td>Botrytis blight</td>
<td><em>Botrytis cinerea</em></td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Septoria leaf spot</td>
<td><em>Septoria</em> spp.</td>
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</tr>
<tr>
<td></td>
<td>Exobasidium fruit and leaf spot</td>
<td><em>Exobasidium maculosum</em></td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Phomopsis canker</td>
<td><em>Phomopsis vaccinii</em></td>
<td>2</td>
</tr>
<tr>
<td>Blueberry (highbush)</td>
<td>Protoventuria leaf spot</td>
<td><em>Protoventuria</em> spp.</td>
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<tr>
<td>Cranberry</td>
<td>Fruit rot</td>
<td><em>Botrytis</em> sp.</td>
<td>2</td>
</tr>
<tr>
<td>Elderberry</td>
<td>Root rot</td>
<td><em>Phytophthora</em> sp.</td>
<td>1</td>
</tr>
<tr>
<td>Grape</td>
<td>Environmental injury</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Haskap</td>
<td>Anthracnose</td>
<td><em>Colletotrichium</em> spp.</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Powdery mildew</td>
<td><em>Sphaerotheca</em> spp.</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Root rot</td>
<td><em>Rhizoctonia</em> spp. and <em>Pythium</em> spp.</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Root rot</td>
<td><em>Phytophthora</em> spp.</td>
<td>1</td>
</tr>
<tr>
<td>Raspberry</td>
<td>Phytophthora root rot</td>
<td><em>Phytophthora fragariae var. rubi</em></td>
<td>1</td>
</tr>
<tr>
<td>Red currant</td>
<td>Bacterial blight</td>
<td><em>Pseudomonas syringae</em></td>
<td>1</td>
</tr>
<tr>
<td>Strawberry</td>
<td>Black root rot</td>
<td><em>Fusarium</em> spp., <em>Pythium</em> sp., <em>Rhizoctonia</em> spp.</td>
<td>17</td>
</tr>
<tr>
<td></td>
<td>Crown rot</td>
<td><em>Phytophthora cactorum</em></td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Gray mold</td>
<td><em>Botrytis cinerea</em></td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Powdery mildew</td>
<td><em>Sphaerotheca macularis</em> f.sp.</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Tip burn</td>
<td>Nutrient (Ca) deficiency</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Vivipary</td>
<td>Physiological disorder</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Environmental injury</td>
<td>Frost damage</td>
<td>6</td>
</tr>
<tr>
<td>Sea buckthorn</td>
<td>Verticillium wilt</td>
<td><em>Verticillium</em> spp.</td>
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</tbody>
</table>

**DISEASED SAMPLES** 46
**ABIOTIC DISORDERS** 12
**TOTAL SUBMISSIONS** 58

Table 3. Diseases diagnosed on vegetable (field and greenhouse) crops submitted to the NBDAAF Plant Disease Diagnostic Laboratory in 2018.

<table>
<thead>
<tr>
<th>CROP</th>
<th>DISEASE</th>
<th>CAUSAL AGENT</th>
<th>NO. OF SAMPLES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bean</td>
<td>Environmental injury</td>
<td>Wind damage</td>
<td>1</td>
</tr>
<tr>
<td>Cucumber</td>
<td>Alternaria leaf blight</td>
<td><em>Alternaria cucumerina</em></td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Scab</td>
<td><em>Cladosporium cucumerinum</em></td>
<td>1</td>
</tr>
<tr>
<td>Garlic</td>
<td>Fusarium basal plate rot</td>
<td><em>Fusarium oxysporum</em> f. sp. <em>cepa</em></td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Purple blotch</td>
<td><em>Alternaria porri</em></td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Stem and bulb nematode</td>
<td><em>Ditylenchus dipsaci</em></td>
<td>1</td>
</tr>
<tr>
<td>Kale</td>
<td>Gray mold</td>
<td><em>Botrytis cinerea</em></td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Soft rot</td>
<td><em>Pectobacterium carotovorum</em></td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Environmental injury</td>
<td>Heat stress</td>
<td>1</td>
</tr>
<tr>
<td>Leek</td>
<td>Purple blotch</td>
<td><em>Alternaria porri</em></td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Stemphylium leaf blight</td>
<td><em>Stemphylium</em> sp.</td>
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</table>

*continued*
<table>
<thead>
<tr>
<th>CROP</th>
<th>DISEASE</th>
<th>CAUSAL AGENT</th>
<th>NO. OF SAMPLES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lettuce</td>
<td>Lettuce drop</td>
<td>Sclerotinia sclerotiorum</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Rust</td>
<td>Puccinia doloicae</td>
<td>1</td>
</tr>
<tr>
<td>Onion</td>
<td>Purple blotch</td>
<td>Alternaria porri</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Sour skin</td>
<td>Burkholderia cepacia</td>
<td>2</td>
</tr>
<tr>
<td>Pumpkin</td>
<td>Anthracnose</td>
<td>Colletotrichum orbiculare</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Bacterial leaf spot</td>
<td>Xanthomonas cucurbitae</td>
<td>1</td>
</tr>
<tr>
<td>Tomato</td>
<td>Septoria leaf spot</td>
<td>Septoria lycopersici</td>
<td>1</td>
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<tr>
<td></td>
<td>Leaf mold</td>
<td>Passalora fulva</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Blossom end rot</td>
<td>Calcium deficiency</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Leaf roll</td>
<td>Environmental injury</td>
<td>1</td>
</tr>
<tr>
<td>Turnip</td>
<td>Internal cracking of the root</td>
<td>Boron deficiency</td>
<td>1</td>
</tr>
</tbody>
</table>

**Table 4.** Diseases diagnosed on field crops (cereal, legume and mustard) submitted to the NBDAAF Plant Disease Diagnostic Laboratory in 2018.

<table>
<thead>
<tr>
<th>CROP</th>
<th>DISEASE</th>
<th>CAUSAL AGENT</th>
<th>NO. OF SAMPLES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barley</td>
<td>Root rot</td>
<td>Rhizoctonia sp., Pythium sp.</td>
<td>1</td>
</tr>
<tr>
<td>Corn</td>
<td>Nutrient deficiency</td>
<td>Potassium deficiency</td>
<td>1</td>
</tr>
<tr>
<td>Soybean</td>
<td>Alternaria leaf spot</td>
<td>Alternaria spp.</td>
<td>1</td>
</tr>
<tr>
<td>Wheat</td>
<td>Tip burn</td>
<td>Heat stress</td>
<td>1</td>
</tr>
</tbody>
</table>

**DISEASED SAMPLES** 2  
**ABIOTIC DISORDERS** 2  
**TOTAL SUBMISSIONS** 4

<table>
<thead>
<tr>
<th>CROP</th>
<th>DISEASE</th>
<th>CAUSAL AGENT</th>
<th>NO. OF SAMPLES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hops</td>
<td>Environmental injury</td>
<td>Wind damage</td>
<td>1</td>
</tr>
<tr>
<td>Red maple</td>
<td>Nectria canker</td>
<td>Nectria galligena</td>
<td>1</td>
</tr>
<tr>
<td>Saffron</td>
<td>Corm rot</td>
<td>Rhizoctonia sp., Pythium sp.</td>
<td>1</td>
</tr>
<tr>
<td>Sorrel</td>
<td>Root rot</td>
<td>Pythium sp.</td>
<td>1</td>
</tr>
<tr>
<td>Turf</td>
<td>Pythium blight</td>
<td>Pythium spp.</td>
<td>4</td>
</tr>
</tbody>
</table>

**DISEASED SAMPLES** 7  
**ABIOTIC DISORDERS** 1  
**TOTAL SUBMISSIONS** 8

**Table 5.** Diseases diagnosed on trees, herbal and ornamental plants submitted to the NBDAAF Plant Disease Diagnostic Laboratory in 2018.
CROP: Diagnostic Laboratory Report - All Crops
LOCATION: Prince Edward Island

NAME AND AGENCY:
M. M. Clark¹ & A. MacLeod²
¹PEI Department of Agriculture and Fisheries, PEI Analytical Laboratories Plant Disease Diagnostic Service, 23 Innovation Way, Charlottetown, PE C1E 0B7
Telephone: (902) 368-5261; Facsimile: (902) 368-6299; Email: mmclark@gov.pe.ca
²PEI Department of Communities, Land and Environment, PEI Analytical Laboratories, 23 Innovation Way, Charlottetown, PE C1E 0B7

TITLE: DISEASES DIAGNOSED ON COMMERCIAL CROP SAMPLES SUBMITTED TO THE PEI ANALYTICAL LABORATORIES PLANT DISEASE DIAGNOSTIC SERVICE (PDDS) IN 2018

ABSTRACT: The Prince Edward Island Department of Agriculture and Fisheries Plant Disease Diagnostic Service (PDDS) section of PEI Analytical Laboratories provides diagnosis of disease problems of commercial crops produced on PEI. A total of 164 samples were processed for the 2018 crop year.

METHODS: Plant samples for disease diagnosis are submitted to the PDDS laboratory by agriculture extension staff, growers, agri-business representatives, crop insurance agents and the general public. Diagnoses are based on a combination of investigative work, visual examination of symptoms, microscopic observation and culturing onto artificial media. In most samples processed in 2018, one or more causal agents were identified.

RESULTS: A total of 164 samples with 247 disease diagnoses, were processed between June 1st and November 5th, 2018. Categories of samples received were: potatoes (74.5%), cereal crops (8.1%), vegetable and fruit crops (15.0%), and other crops (2.0%). There was one confirmed case of Dutch elm disease (Ophiostoma novo-ulmi) found in Victoria, PEI. There were no potato late blight foliar infections this season due to the low level of inoculum and extremely dry growing conditions. One Phytophthora erythroseptica isolate was confirmed as metalaxyl-sensitive. Potato blackleg infections were identified in potato varieties: 'Russet Burbank', 'Dakota Russet' and 'Dakota Pearl'. The bacteria causing the blackleg symptoms were confirmed to be Pectobacterium spp. A new orchard crop, Asian pear, is being grown on PEI and phomopsis canker (Phomopsis oblonga) was identified for the first time in this crop. Two crops that are increasing in acreage on PEI are apples and highbush blueberry. This season, a leaf disorder with characteristic symptoms of a variegated light and dark green was identified in "Honeycrisp" apples. This discoloration was due to an excessive build-up of carbohydrates in the leaves due to a light crop. This phenomenon is common in ‘Honeycrisp’ apples and relates back to poor growing conditions. In ‘Honeycrisp’ apples, Diaporthe eker was also isolated from the bark of several trees.

A summary of diseases diagnosed on crop samples is provided in Table 1 by crop category. The diagnoses reported may not necessarily reflect the major disease problems encountered during the season in the field but rather those most prevalent within the samples submitted.
### Table 1. Diseases diagnosed on commercial crop samples submitted to the PEI Analytical Laboratories, Plant Disease Diagnostic Service, Prince Edward Island Department of Agriculture in 2018.

<table>
<thead>
<tr>
<th>CROP</th>
<th>DISEASE</th>
<th>CAusal AGENT/PLANT PATHOGEN</th>
<th>FREQUENCY OF IDENTIFICATION</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>VEGETABLE</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Brussels Sprouts</td>
<td>Physiological disorder</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Carrot</td>
<td>Crater rot</td>
<td><em>Rhizoctonia</em> sp.</td>
<td>1</td>
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<tr>
<td>Cauliflower</td>
<td>Alternaria leaf spot</td>
<td><em>Alternaria</em> sp.</td>
<td>1</td>
</tr>
<tr>
<td>Corn</td>
<td>Bacterial leaf streak</td>
<td><em>Xanthomonas</em> sp.</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Northern leaf blight</td>
<td><em>Cladosporium</em> sp.</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Stalk rot</td>
<td><em>Diplodia</em> sp.</td>
<td>3</td>
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<tr>
<td></td>
<td></td>
<td><em>Fusarium</em> sp.</td>
<td>3</td>
</tr>
<tr>
<td>Potato</td>
<td>Bacterial soft rot</td>
<td><em>Clostridium</em> sp.</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td></td>
<td><em>Pectobacterium</em> sp.</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td></td>
<td><em>Pseudomonas</em> sp.</td>
<td>17</td>
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<tr>
<td></td>
<td></td>
<td><em>Xanthomonas</em> sp.</td>
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<tr>
<td>Black dot</td>
<td></td>
<td><em>Colletotrichum coccodes</em></td>
<td>18</td>
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<tr>
<td>Black scurf</td>
<td></td>
<td><em>Rhizoctonia solani</em></td>
<td>5</td>
</tr>
<tr>
<td>Blackleg</td>
<td></td>
<td><em>Pectobacterium</em> sp.</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td></td>
<td><em>Pectobacterium wasabiae</em></td>
<td>3</td>
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<tr>
<td>Botrytis gray mold</td>
<td></td>
<td><em>Botrytis cinerea</em></td>
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<tr>
<td>Brown spot</td>
<td></td>
<td><em>Alternaria alternata</em></td>
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<tr>
<td>Common scab</td>
<td></td>
<td><em>Streptomyces scabies</em></td>
<td>1</td>
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<tr>
<td>Fusarium dry rot</td>
<td></td>
<td><em>Fusarium oxysporum</em></td>
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<tr>
<td>Fusarium wilt</td>
<td></td>
<td><em>Fusarium avenaceum</em></td>
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<tr>
<td></td>
<td></td>
<td><em>Fusarium oxysporum</em></td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td><em>Fusarium solani</em></td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td><em>Fusarium sp.</em></td>
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</tr>
<tr>
<td>Leak</td>
<td></td>
<td><em>Pythium</em> sp.</td>
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<tr>
<td>Physiological disorders</td>
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<td><em>Black heart</em></td>
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<td></td>
<td><em>Greening</em></td>
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<td><em>Hail damage</em></td>
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<td><em>Herbicide damage</em></td>
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<td><em>Off-type</em></td>
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<tr>
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<td><em>Vascular discolouration</em></td>
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<tr>
<td>Pink rot</td>
<td></td>
<td><em>Phytophthora erythroseptica</em></td>
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<tr>
<td>Pinkeye</td>
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<td>Unknown cause</td>
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<tr>
<td>Rhizoctonia stem</td>
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<td><em>Rhizoctonia</em> sp.</td>
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<td>girdling</td>
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<td><em>Clostridium</em> sp.</td>
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<td>Seed piece decay</td>
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<td><em>Geotrichum</em> sp.</td>
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<td></td>
<td></td>
<td><em>Pythium</em> sp.</td>
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<td></td>
<td></td>
<td><em>Rhizopus</em> sp.</td>
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<td></td>
<td></td>
<td><em>Pectobacterium</em> sp.</td>
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<td></td>
<td><em>Rhizopus</em> sp.</td>
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<td>Soft rot</td>
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<td><em>Verticillium dahliae</em></td>
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<td>Verticillium wilt</td>
<td></td>
<td><em>Verticillium spp.</em></td>
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<tr>
<td>Virus</td>
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<td><em>Mosaic</em></td>
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<tr>
<td>White mold</td>
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<td><em>Sclerotinia sclerotiorum</em></td>
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</table>

*continued*
<table>
<thead>
<tr>
<th>CROP</th>
<th>DISEASE</th>
<th>CAUSAL AGENT / PLANT PATHOGEN</th>
<th>FREQUENCY OF IDENTIFICATION</th>
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<tbody>
<tr>
<td>Tomato</td>
<td>Septoria leaf spot</td>
<td><em>Septoria</em> sp.</td>
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<tr>
<td></td>
<td>Virus</td>
<td>Mosaic</td>
<td>1</td>
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<tr>
<td>Rutabaga</td>
<td>Alternaria leaf spot</td>
<td><em>Alternaria</em> sp.</td>
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<tr>
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<td>Bacterial soft rot</td>
<td><em>Pectobacterium</em> sp.</td>
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<td></td>
<td><em>Pseudomonas</em> sp.</td>
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<td>Physiological disorder</td>
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<td>CEREAL / OILSEED CROP:</td>
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<tr>
<td>Barley</td>
<td>Black point</td>
<td><em>Bipolaris</em> sp.</td>
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<tr>
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<td>Net blotch</td>
<td><em>Pyrenophora teres</em></td>
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<td></td>
<td>Seedling blight</td>
<td><em>Bipolaris</em> sp.</td>
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<tr>
<td></td>
<td>Smut</td>
<td><em>Ustilago</em> sp.</td>
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<tr>
<td></td>
<td>Spot blotch</td>
<td><em>Bipolaris</em> sp.</td>
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</tr>
<tr>
<td>Mixed grain</td>
<td>Leaf rust</td>
<td><em>Puccinia</em> sp.</td>
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<td>Sooty mold</td>
<td><em>Alternaria</em> sp.</td>
<td>1</td>
</tr>
<tr>
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<td></td>
<td><em>Aspergillus</em> sp.</td>
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<td><em>Stemphylium</em> sp.</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Spot blotch</td>
<td><em>Bipolaris</em> sp.</td>
<td>1</td>
</tr>
<tr>
<td>Oats</td>
<td>Rust</td>
<td><em>Puccinia</em> sp.</td>
<td>1</td>
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<tr>
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<td>Smut</td>
<td><em>Ustilago</em> sp.</td>
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</tr>
<tr>
<td>Wheat</td>
<td>Bunt</td>
<td><em>Tilletia</em> sp.</td>
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<td>Powdery mildew</td>
<td><em>Blumeria graminis</em></td>
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<tr>
<td></td>
<td>Sooty mold</td>
<td><em>Alternaria</em> sp.</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td><em>Cladosporium</em> sp.</td>
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<tr>
<td>FRUIT:</td>
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<td>Apple</td>
<td>Phomopsis canker</td>
<td><em>Diaporthe eres</em></td>
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<tr>
<td></td>
<td>Physiological disorder</td>
<td>Leaf disorder</td>
<td>1</td>
</tr>
<tr>
<td>Blueberry</td>
<td>Phomopsis canker</td>
<td><em>Phomopsis</em> sp.</td>
<td>1</td>
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<tr>
<td>Pear</td>
<td>Phomopsis canker</td>
<td><em>Phomopsis oblonga</em></td>
<td>3</td>
</tr>
<tr>
<td>Plumcot</td>
<td>Bacterial spot</td>
<td><em>Xanthomonas</em> sp.</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Brown rot</td>
<td><em>Monilinia</em> sp.</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Scab</td>
<td><em>Cladosporium</em> sp.</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td><em>Venturia inaequalis</em></td>
<td>1</td>
</tr>
<tr>
<td>Raspberry</td>
<td>Spur blight</td>
<td><em>Didymella</em> sp.</td>
<td>2</td>
</tr>
<tr>
<td>Strawberry</td>
<td>Crown rot</td>
<td><em>Phytophthora</em> sp.</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td><em>Rhizoctonia</em> sp.</td>
<td>1</td>
</tr>
<tr>
<td>OTHER CROPS:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tree</td>
<td>Dutch elm disease</td>
<td><em>Ophiostoma novo-ulmi</em></td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>4</td>
</tr>
<tr>
<td>TOTAL:</td>
<td></td>
<td></td>
<td>247</td>
</tr>
</tbody>
</table>

---

*a* *Pectobacterium wasabiae* identification was confirmed by Dr. Sean Li and Dr. Jingbai Nie (CFIA), Charlottetown, PE.

*b* *Phytophthora erythroseptica* isolate sensitivity screening was provided by Dr. Rick Peters and staff at Agriculture and Agri-Food Canada (AAFC), Charlottetown, PE.

*c* Confirmation of the *Diaporthe eres* was completed by Dr. Rafik Assabgui and staff at National Fungal Identification Service (NFIS), Ottawa, ON.

*d* *Phomopsis oblonga* identification was confirmed by Dr. Abbasi Pervaiz at Agriculture and Agri-Food Canada (AAFC), Charlottetown, PE.
CEREALS / CÉRÉALES

CROP: Barley
LOCATION: Saskatchewan

NAMES AND AGENCIES:
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TITLE: FUSARIAUM HEAD BLIGHT IN BARLEY IN SASKATCHEWAN IN 2018

ABSTRACT: In 2018, fusarium head blight (FHB) incidence and severity were assessed in 31 barley crops (mainly 2-row) in Saskatchewan. FHB occurred in 55% of the surveyed barley crops at a mean provincial severity (FHB Index) of 0.27%. The most prevalent Fusarium species was F. poae which was detected in 94% of barley crops with FHB symptoms.

INTRODUCTION AND METHODS: Fusarium head blight (FHB) incidence and severity in Saskatchewan were assessed in 31 barley crops (28 two-row; 3 six-row) in 2018. Field location and results were grouped according to soil zone (Zone 1 = Brown; Zone 2 = Dark Brown; Zone 3 = Black/Grey). The data will be presented for all barley crops (two-row and six-row) combined for each year.

Crop adjustors with the Saskatchewan Crop Insurance Corporation randomly collected 50 spikes from barley crops at late milk to early dough stages (Lancashire et al. 1991). A subsample of 30 spikes was analyzed for visual FHB symptoms at the Crop Protection Laboratory in Regina. The number of infected spikes per crop and the number of infected spikelets in each spike, as a proportion of the total, were recorded. An FHB disease severity rating, also referred to as the FHB Index, was determined for each crop surveyed: FHB severity (%) = [% of spikes affected x mean proportion (%) of kernels infected] / 100. Mean FHB severity values were calculated for each soil zone and for the whole province. Glumes or kernels with visible FHB symptoms were surface sterilized in 0.6% NaOCl solution for 1 min and cultured on modified potato dextrose agar to confirm presence of Fusarium species on infected kernels. A maximum of 20 symptomatic kernels per sample were selected to represent infected samples to confirm FHB and the Fusarium spp. involved.

RESULTS AND COMMENTS: Approximately 1.1 million ha (2.7 million ac) of barley were seeded in Saskatchewan in 2018 with an average yield of 3.7 metric tonnes per ha (62.7 bu/ac). Barley yields in 2018 were slightly down from 2016 (3.8 metric tonnes per acre; 69.8 bu/ac) and 2017 (3.6 metric tonnes per ha; 66.4 bu/ac) (Statistics Canada, 2018).

FHB occurred in 55% of the barley crops surveyed in 2018 with a provincial mean severity of 0.27%. The severity of FHB in 2018 was higher than in both 2016 and 2017 (Ziesman et al. 2018). In 2018, the highest FHB severity occurred in soil zone 3, while the severity of FHB was the same in soil zones 1 and 2 (0.09%).

In 2018, a total of 129 isolations were made to confirm the presence of Fusarium species and to identify the pathogen to the species level (Table 2). The most frequently isolated causal pathogen, F. poae, occurred in 94% of barley crops with FHB symptoms and accounted for 83% of all the Fusarium isolations. Fusarium graminearum was detected in 29% of the barley crops from which survey samples were collected, which was less than in 2016, but more than in 2017 (Ziesman et al. 2018). F. sporotrichioides, F. culmorum, and F. avenaceum were also detected and were present in 29%, 18% and 6% of barley fields with FHB symptoms, respectively.
ACKNOWLEDGEMENTS: We gratefully acknowledge the assistance of Saskatchewan Crop Insurance Corporation staff agrologists with the collection of cereal samples for this survey.

REFERENCES:

Table 1. Prevalence and severity of fusarium head blight (FHB) in barley crops grouped by soil zone in Saskatchewan in 2018.

<table>
<thead>
<tr>
<th>Soil zones</th>
<th>Prevalence(a) (no. of crops affected)</th>
<th>Mean FHB severity(b) (range)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zone 1 Brown</td>
<td>25</td>
<td>0.09 (0 – 0.27)</td>
</tr>
<tr>
<td>Zone 2 Dark Brown</td>
<td>38</td>
<td>0.09 (0 – 0.30)</td>
</tr>
<tr>
<td>Zone 4 Black/Grey</td>
<td>79</td>
<td>0.40 (0 – 3.19)</td>
</tr>
<tr>
<td>Overall Total/ Mean</td>
<td>55</td>
<td>0.27 (0 – 3.19)</td>
</tr>
</tbody>
</table>

\(a\) Prevalence (%) = number of crops affected / total crops surveyed.

\(b\) FHB severity (FHB Index) = [\% of spikes affected x mean proportion (\%) of kernels infected] / 100.

Table 2. Prevalence of Fusarium species on kernels or glumes of barley crops displaying visual FHB symptoms in Saskatchewan in 2018.

<table>
<thead>
<tr>
<th></th>
<th>(F. avenaceum)</th>
<th>(F. culmorum)</th>
<th>(F. graminearum)</th>
<th>(F. poae)</th>
<th>(F. sporotrichioides)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2018</td>
<td>6%</td>
<td>18%</td>
<td>29%</td>
<td>94%</td>
<td>29%</td>
</tr>
</tbody>
</table>
CROP: Barley
LOCATION: Manitoba

NAMES AND AGENCIES:
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TITLE: FUSARIAUM HEAD BLIGHT OF BARLEY IN MANITOBA – 2018

ABSTRACT: Forty-seven barley fields in Manitoba were surveyed for Fusarium head blight (FHB) in 2018 to assess disease severity and the Fusarium species causing FHB on barley. The mean FHB index in 2018 was 0.88 which is below the 10-year average of 0.98% (2008-2017). F. poae was the predominant Fusarium species found in commercial fields, followed by F. graminearum, F. sporotrichioides, F. avenaceum, and F. equiseti.

INTRODUCTION AND METHODS: A total of 47 barley (45 two-row, 2 six-row) fields in Manitoba were surveyed for FHB from July 18-August 5 when crops were at the early- to soft-dough (ZGS 79-82, Zadoks et al. 1974) stages of growth. Fields were selected at regular intervals approximately 20-25 km along survey routes, depending on crop availability and accessibility. The areas sampled were bounded by highway numbers 67, 16 to the north, 12 to the east, 3 to the south, 8 to the north and 83 to the west. FHB incidence (the percentage of spikes showing typical FHB symptoms) was assessed in each field by sampling 95-110 spikes at three locations and averaging the scores. The mean spike proportion infected (SPI) was estimated for each field. Forty to sixty affected spikes were collected at each survey site and stored in paper envelopes.

Subsequently, one gram of infected kernels removed from 15 randomly selected spikes from each field was frozen in liquid nitrogen and ground to a powder using Spex SamplePrep 2010 Geno/Grinder®. DNA was extracted from the ground grain sample from each field using the QIAGEN DNeasy® Mini Kit (QIAGEN). Polymerase chain reaction (PCR) analysis was performed on extracted DNA samples using species-specific oligonucleotide primers for various Fusarium species frequently found in cereal grains in western Canada (Demeke et al. 2005).

RESULTS AND COMMENTS: The mean FHB incidence in 2-row barley was 9.3% (range from 1.0% – 32.3%) and the mean SPI was 12.1 % (range from 1.0% – 20.0%). In six-row barley, the incidence was 5.7% (range from 2.3 – 8%) and the mean SPI was 2.0%. The resulting mean Fusarium Head Blight Index (FHB-I) [%incidence X %SPI / 100] for two-row barley was 0.92 (range from 0.01- 6.2), and that for six-row barley was 0.1 (range from 0.04 to 0.16). The mean FHB index in 2018 was 0.88 which is below the 10-year average of 0.98% (2008-2017).

DNA of individual Fusarium species was amplified from infected kernels using conventional PCR (Table 1). F. poae was the most common Fusarium species which was detected in 61.7% of the fields. F. graminearum and F. sporotrichioides were found in 40.6% and 19.2% of fields, respectively. F. avenaceum and F. equiseti were also detected but only at much lower levels (Table 1).

Real-time qPCR was performed on field samples with primers specific to F. poae, F. graminearum and F. sporotrichioides. On average, DNA of F. poae was found at the level of 2.87 pg per ng of the total genomic DNA which is twice as much as the amount of F. graminearum DNA present in barley grains (1.11 pg per ng of the total genomic DNA). DNA of F. sporotrichioides was detected at a much lower level with an average of 0.3 pg per ng of the total genomic DNA. F. poae has been the most common Fusarium species found in barley and oat in recent years (Tekauz et al. 2013; Beyene et al. 2014, 2015, 2016).
REFERENCES:

Table 1. PCR detection of *Fusarium* spp. in grain samples from 47 barley fields in Manitoba in 2018.

<table>
<thead>
<tr>
<th><em>Fusarium</em> spp.</th>
<th>Percent of fields</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>F. avenaceum</em></td>
<td>4.3</td>
</tr>
<tr>
<td><em>F. equiseti</em></td>
<td>10.6</td>
</tr>
<tr>
<td><em>F. graminearum</em></td>
<td>40.4</td>
</tr>
<tr>
<td><em>F. poae</em></td>
<td>61.7</td>
</tr>
<tr>
<td><em>F. sporotrichioides</em></td>
<td>8.51</td>
</tr>
</tbody>
</table>

Table 2. Real-time qPCR analysis for *F. poae*, *F. graminearum* and *F. sporotrichioides* DNA in barley grains collected in 2018.

<table>
<thead>
<tr>
<th><em>Fusarium</em> spp.</th>
<th>Range (pg of fungal DNA/ng of total genomic DNA)</th>
<th>Mean (pg of fungal DNA/ng of total genomic DNA)</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>F. poae</em></td>
<td>1.42-68.8</td>
<td>2.87</td>
</tr>
<tr>
<td><em>F. graminearum</em></td>
<td>0.1333-6.17</td>
<td>1.1123</td>
</tr>
<tr>
<td><em>F. sporotrichioides</em></td>
<td>0.1-0.7</td>
<td>0.3</td>
</tr>
</tbody>
</table>
CROP: Barley
LOCATION: Saskatchewan

NAMES AND AGENCY:
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TITLE: LEAF SPOT DISEASES OF BARLEY IN SASKATCHEWAN IN 2018

ABSTRACT: Fifty-two barley crops were surveyed to assess disease severity in commercial fields. Disease severity was lower in 2018 than in 2017. Prevalence and incidence of *Pyrenophora teres* was higher than *Cochliobolus sativus*, while *Septoria passerinii* was the least prevalent and had the lowest incidence of the three pathogens.

INTRODUCTION AND METHODS: In 2018, a barley disease survey was conducted from July 25th to August 27th throughout Saskatchewan. The fifty-two commercial crops surveyed included fields in crop districts (2A, 2B, 5A, 5B, 6A, 6B, 7A, 7B, 8A, 8B, 9AE and 9B). Disease severity on 10 leaves from each crop was visually assessed for leaf spot diseases of barley. The average severity was categorized as: none (no visible symptoms); trace (<1%); very slight (1-5%); slight (6-15%); moderate (16-40%); and severe (41-100%).

Ten different leaves were collected from each field. One piece from each leaf was randomly selected and surface sterilized with a 5% bleach (NaOCl) solution for 1 minute and then rinsed 3 times in sterile distilled water, dried and placed on water agar. After 7 days, the leaf pieces were observed for the presence of net blotch (*Pyrenophora teres* Drechsler), spot blotch (*Cochliobolus sativus* Ito & Kuribayashi Drechs ex Dast.) and Septoria leaf spot (*Septoria passerinii* Sacc.). Identification of the pathogens was based on the characteristics of the colonies and the morphology of the spores (Zillinsky 1983).

RESULTS AND CONCLUSIONS: Weather conditions in 2018 were hot and dry throughout the growing season. The lack of rainfall across the province during June and July and high temperatures beginning mid-July affected the establishment and development of diseases across Saskatchewan (Saskatchewan Ministry of Agriculture 2018). Among the 52 barley fields, 10% of the crops had no disease, 15% trace, 21% very slight, 35% slight, 17% moderate and 2% were rated as severe. In this year’s survey, there were fewer fields (46%) with 0-5% disease severity than in 2017 when 65% were rated with 0-5% disease severity. Among the 320 leaf pieces chosen from 32 out of the 52 barley crops with levels of disease severity of ≥5%, the most prevalent pathogen was *P. teres* (84% of the crops), and the incidence (number of leaf pieces affected of those plated) was 52%, which was higher than in 2016 (34%) or 2017 (43%). Prevalence of *C. sativus* was 28% and incidence was 22%; the incidence was lower than in the last two years which was 55% in 2016 and 25% in 2017 (Cholango-Martinez & Kutcher 2017, 2018). The prevalence of *S. passerinii* was 19% and incidence was 6%; incidence was higher than in 2017 (2%) (Cholango-Martinez & Kutcher 2018).

ACKNOWLEDGEMENTS: We thank the Saskatchewan Crop Insurance Corporation and the Cereal and Flax Pathology group of the University of Saskatchewan for sample collection during the growing season.

REFERENCES:
http://www.publications.gov.sk.ca/deplist.cfm?d=20&c=6366
Table 1. Leaf spot disease severity in 52 barley crops surveyed in Saskatchewan in 2018.

<table>
<thead>
<tr>
<th>Severity (%)</th>
<th>No. of fields</th>
<th>Frequency (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>5</td>
<td>10</td>
</tr>
<tr>
<td>Trace &lt;1%</td>
<td>8</td>
<td>15</td>
</tr>
<tr>
<td>Very slight 1-5%</td>
<td>11</td>
<td>21</td>
</tr>
<tr>
<td>Slight 6-15%</td>
<td>18</td>
<td>35</td>
</tr>
<tr>
<td>Moderate 16-40%</td>
<td>9</td>
<td>17</td>
</tr>
<tr>
<td>Severe 41-100%</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>52</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>

*aFrequency: number of fields affected / total of surveyed fields.

Table 2. Prevalence and incidence of barley leaf spot diseases from fields samples in Saskatchewan in 2018.

<table>
<thead>
<tr>
<th>Pathogen</th>
<th>Prevalence (%)</th>
<th>Incidence (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Cochliobolus sativus</em></td>
<td>28</td>
<td>22</td>
</tr>
<tr>
<td><em>Pyrenophora teres</em></td>
<td>84</td>
<td>52</td>
</tr>
<tr>
<td><em>Septoria passerinii</em></td>
<td>19</td>
<td>6</td>
</tr>
</tbody>
</table>

*aPrevalence: % of barley crops from which the pathogen was isolated.
*bIncidence: % of 320 leaf pieces infected by each pathogen.
CROP: Barley
LOCATION: Central Alberta

NAMES AND AGENCY:
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TITLE: 2018 BARLEY DISEASE SURVEY IN CENTRAL ALBERTA

ABSTRACT: In 2018, 20 random commercial barley crops were surveyed for disease levels in central Alberta. Leaf disease and common root rot levels were similar to those in previous years.

INTRODUCTION AND METHODS: A survey to document diseases of barley was conducted in 20 fields in Central Alberta from July 30 - August 7, 2018. Growers were contacted for permission to access their land, with evaluations being done at the late milk to soft dough stage. The fields were traversed in a diamond pattern starting at least 25 m in from the field edge, with visual assessment of 10 penultimate leaves at each of 5 locations that were at least 25 m apart. Leaf diseases were rated for percentage leaf area diseased (LAD) for scald, netted net blotch and other leaf spots. Common root rot (CRR) was assessed on 5 sub-crown internodes at each of 5 sites using a 0-4 scale where 0=none, 1=trace and 4=severe. Other diseases, if present, were rated as a percent of the plants affected. Following the survey, a representative tissue sub-sample of diseased plant parts collected at each location was cultured in the laboratory for pathogen isolation and identification.

RESULTS AND COMMENTS: Survey results are presented in Table 1. Growing conditions in Central Alberta were variable throughout the region being dependent on rain showers for the moisture received. Generally, May, June, July and August had lower precipitation and higher temperatures than average. Disease development was similar to the previous year throughout the surveyed region (Rauhala & Turkington 2018). Scald (Rhynchosporium secalis) was found in 10 of the 20 surveyed fields with a severity range from 0.1 to 5 % in eight fields while one field had 9% and another had 22%. Netted net blotch (Pyrenophora teres f. teres) was found at trace levels in two of the 20 surveyed fields with one field having a level of 31%. Spot blotch (Cochliobolus sativus) was isolated from 20% of the other leaf symptoms while spotted net blotch (Pyrenophora teres f. maculata) was isolated from 80% of the other leaf spot symptoms. Other leaf spot severity ranged from 0.1 to 5% in 13 fields while five fields had 6 to 10% and two fields had 18 to 25% LAD. Alternaria spp. were also isolated from sub-samples of leaf tissues exhibiting other leaf spot symptoms.

Common root rot of barley (Cochliobolus sativus and Fusarium spp.) occurred in all of the surveyed fields, at similar levels to those in previous years (Rauhala & Turkington 2018).

No stripe rust (Puccinia striiformis) was found in any of the 20 commercial barley fields surveyed.

REFERENCES:
Table 1. Disease incidence and severity in 20 commercial barley fields in Central Alberta, 2018.

<table>
<thead>
<tr>
<th>Disease (severity rating scale)</th>
<th>% of fields affected</th>
<th>Overall average severity (% LAD)(^a)</th>
<th>Range in average severity per field</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scald</td>
<td>50</td>
<td>2</td>
<td>0 – 22</td>
</tr>
<tr>
<td>Netted net blotch</td>
<td>15</td>
<td>2</td>
<td>0 – 31</td>
</tr>
<tr>
<td>Other leaf spots</td>
<td>100</td>
<td>6</td>
<td>1 – 25</td>
</tr>
<tr>
<td>Total leaf area diseased (LAD)</td>
<td>100</td>
<td>10</td>
<td>1 – 56</td>
</tr>
<tr>
<td>Common root rot (0-4)</td>
<td>100</td>
<td>2</td>
<td>1 – 3</td>
</tr>
</tbody>
</table>

\(^a\)Percentage leaf area diseased.
CROP: Wheat, Barley
LOCATION: Central Alberta

NAMES AND AGENCY:
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Field Crop Development Centre, Alberta Agriculture and Forestry, 6000 C and E Trail, Lacombe, AB T4L 1W1
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TITLE: WHEAT AND BARLEY DISEASE SURVEY IN CENTRAL ALBERTA, 2018

ABSTRACT: From October 2017 to October of 2018, 10 barley, 18 spring wheat fields, and 19 winter wheat fields in central Alberta were randomly surveyed primarily for foliar diseases. For 19 winter wheat fields, disease assessments were done multiple times for stripe rust over the growing season. Leaf disease levels on barley and wheat were lower than in previous years. Breeding sites for the Field Crop Development Centre (FCDC) in central Alberta also showed lower levels of leaf diseases on barley and wheat than in the previous year.

INTRODUCTION AND METHODS: Leaf diseases were surveyed in 10 barley and 18 spring wheat fields at the late milk to soft dough stage from July 31 to August 2, 2018. Stripe rust development in 19 winter wheat fields was monitored from the two-leaf stage in October 2017, to the soft dough and hard dough stage in July to August 2018. Commercial fields surveyed for stripe rust were located near Camrose, Lacombe, Stettler, Stony Plain, Wetaskiwin, and Red Deer, Alberta. Monitoring of stripe rust was also conducted at Alberta Agriculture and Food (AAF) Field Crop Development Centre (FCDC) breeding nurseries at Lacombe, Olds, Morrin, and Trochu from October 2017 to October 2018.

RESULTS AND COMMENTS: Conditions during May were drier than the average accumulated precipitation reported in 2017 (http://agriculture.alberta.ca/acis/alberta-weather-data-viewer.jsp). June, July and August were also hotter and drier than in previous years. These hot, dry conditions had a major impact on the development and spread of cereal leaf diseases in the region for 2018. Results of the barley and spring and winter wheat disease surveys are presented in Tables 1 and 2, respectively.

Two-row barley was grown in all 10 commercial barley fields surveyed. Leaf diseases included scald and netted net blotch and were light in severity in the majority of fields surveyed. Only one field out of 10 surveyed showed severe netted net blotch, while low levels of loose smut were observed in one field (Table 1). In spring wheat, the leaf spotting complex involving tan spot and stagonospora/septoria leaf blight was observed in the majority of fields and only at light disease severities (Table 2), although an intermediate level of tan spot was observed in one field and a light level of loose smut in another field. Stripe rust was present at low severities in three of the 18 spring wheat fields (data not presented). The stripe rust information is published in another survey report (Aboukhaddour et al. 2019).

FCDC barley breeding plots in central Alberta showed light levels of scald, and light to intermediate levels of other leaf spots (data not presented). However, in the laboratory, only Alternaria and Cladosporium spp. were isolated from these other leaf spots, and thus symptoms may have been due to physiological
leaf spotting. Light levels of stripe rust were found on barley differentials in the field. For wheat, low to intermediate levels of the leaf spot complex were found at most breeding sites (data not presented). Stripe rust was also low to intermediate in severity on wheat differentials at the breeding sites. In the fall of 2018, no stripe rust pustules were observed in the five winter wheat fields surveyed (data not presented).

REFERENCES:

Table 1: Disease severity and incidence in 10 barley fields surveyed in central Alberta in the 2018 growing season. a

<table>
<thead>
<tr>
<th>Disease</th>
<th>Light</th>
<th>Intermediate</th>
<th>Severe</th>
<th>% of fields affected</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scald <em>(Rhynchosporium secalis)</em></td>
<td>6</td>
<td>0</td>
<td>0</td>
<td>60.0</td>
</tr>
<tr>
<td>Netted net blotch <em>(Pyrenophora teres f. teres)</em></td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>20.0</td>
</tr>
<tr>
<td>Loose smut <em>(Ustilago nuda)</em></td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>10.0</td>
</tr>
</tbody>
</table>

aFor the 0-9 disease severity scale, light = 0.1-3.9; intermediate = 4-5.9; and severe = 6-9.

Table 2: Disease severity and incidence in 18 spring wheat fields surveyed in central Alberta in the 2018 growing season.

<table>
<thead>
<tr>
<th>Disease</th>
<th>Light</th>
<th>Intermediate</th>
<th>Severe</th>
<th>% of fields affected</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leaf spot complex on spring wheat <em>(Pyrenophora tritici-repentis, Stagonospora and Septoria spp.)</em> a</td>
<td>13</td>
<td>0</td>
<td>0</td>
<td>72.2</td>
</tr>
<tr>
<td>Tan spot <em>(P. tritici-repentis)</em> b</td>
<td>6</td>
<td>1</td>
<td>0</td>
<td>38.9</td>
</tr>
<tr>
<td>Septoria <em>(Septoria spp.)</em> b</td>
<td>8</td>
<td>0</td>
<td>0</td>
<td>44.4</td>
</tr>
<tr>
<td>Loose smut <em>(Ustilago tritic)</em> b</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>5.6</td>
</tr>
</tbody>
</table>

aFor the 0-9 disease severity scale, light = 0.1-3.9; intermediate = 4-5.9; and severe = 6-9.

bFor the percentage severity scale, light = 0.01-10.9%; intermediate = 11-29.9%; severe = ≥30%.
CROP: Barley
LOCATION: Central and Eastern Ontario

NAMES AND AGENCY:
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TITLE: DISEASES OF BARLEY IN CENTRAL AND EASTERN ONTARIO IN 2018

ABSTRACT: Forty-one barley fields in Central and Eastern Ontario were surveyed for diseases in 2018. Of 14 the diseases observed, spot blotch, take-all and loose smut were the most prevalent, having moderate to severe levels of infection in 13, 5, and 3 fields, respectively. Fusarium head blight (FHB) was observed in 40 fields with low severities. Fusarium poae was the predominant species isolated from the FHB infected kernels.

INTRODUCTION AND METHODS: A survey for barley diseases was made in Central and Eastern Ontario, in areas where spring barley is grown, in the third week of July 2018. Forty-one fields were sampled when plants were at the soft-dough stage of growth. Foliar disease severity was determined on 10 flag and penultimate leaves sampled at each of three random sites per field, using a rating scale of 0 (no disease) to 9 (severely diseased). Diagnosis was based on visual symptoms. Average severity scores of <1, <3, <6, and ≥6 were considered as trace, slight, moderate, and severe disease levels, respectively. The severity of covered smut, ergot, leaf stripe, loose smut, and tassel blight were observed in 15, 2, 19, 31, and 6 fields at mean severities of 1.4, 1.0, 1.3, 1.2, and 1.2, respectively (Table 1). Other foliar diseases observed included leaf stripe (Pyrenophora teres) and barley yellow dwarf (BYDV) were the most common foliar diseases, and were found in 41, 38, and 38 fields at average severities of 3.1, 1.7, and 1.3 respectively. Moderate to severe levels of infection from these diseases were estimated to have averaged <5% in affected fields. Other foliar diseases observed included leaf rust (Puccinia hordei), powdery mildew (Blumeria graminis f.sp. hordei), scald (Rhynchosporium secalis), septoria complex including speckled leaf blotch (Septoria tritici) and leaf blotch (Stagonospora nodorum), and stem rust (Puccinia graminis f. sp. tritici or f. sp. secalis). These diseases were observed in 15, 2, 19, 31, and 6 fields at mean severities of 1.4, 1.0, 1.3, 1.2, and 1.2, respectively, and occurred at trace to slight levels. None would have resulted in substantive damage to the crop.

RESULTS AND COMMENTS: The survey included 18 two-row and 23 six-row barley fields. A total of 14 diseases or disease complexes were observed (Table 1). Spot blotch (Cochliobolus sativus), net blotch (Pyrenophora teres) and barley yellow dwarf (BYDV) were the most common foliar diseases, and were found in 41, 38, and 38 fields at average severities of 3.1, 1.7, and 1.3 respectively. Moderate to severe levels of infection from these diseases were observed in 13, 2, and 1 fields, respectively. Yield reductions due to these diseases were estimated to have averaged <5% in affected fields. Other foliar diseases observed included leaf rust (Puccinia hordei), powdery mildew (Blumeria graminis f.sp. hordei), scald (Rhynchosporium secalis), septoria complex including speckled leaf blotch (Septoria tritici) and leaf blotch (Stagonospora nodorum), and stem rust (Puccinia graminis f. sp. tritici or f. sp. secalis). These diseases were observed in 15, 2, 19, 31, and 6 fields at mean severities of 1.4, 1.0, 1.3, 1.2, and 1.2, respectively, and occurred at trace to slight levels. None would have resulted in substantive damage to the crop.

The root disease take-all (Gaemumannomyces graminis), loose smut (Ustilago nuda), covered smut (Ustilago Hordei), ergot (Claviceps purpurea), and leaf stripe (Pyrenophora graminea) were observed in all fields at mean incidences of 1.7, 1.5, 0.5, 0.5 and 0.5%, respectively (Table 1). Severe infections from these diseases were not observed, but moderate levels of take-all and loose smut were found in five and three fields, respectively. Yield reductions due to take-all and loose smut were estimated at <5% in affected fields.
FHB was observed in 40 fields at a mean FHB index of 0.3% (range 0.01% to 4.0%) (Table 1). Moderate to severe FHB infection was observed in one field only. Yield and quality reductions due to FHB were estimated at >5%. Seven *Fusarium* species were isolated from putatively infected kernels (Table 2). *Fusarium poae* predominated and occurred in 93% of surveyed fields and on 22.6% of infected kernels, respectively. *Fusarium equiseti* and *F. sporotrichioides* were less common, occurring in 56-66% of fields and 3.0-5.9% of kernels. *Fusarium acuminatum, F. avenaceum, F. graminearum,* and *F. verticillioides* were least common, occurring in 3-17% of fields and 0.1-0.6% of kernels.

The 14 diseases observed on barley in Ontario in 2018 were the same as those recorded in 2017 except for powdery mildew, which was not found in 2017 (Xue et al. 2018). Overall, the incidence and severity of these diseases were generally lower in 2018 than in 2017. Less frequent rain events in June and July in 2018 compared with 2017 in Central and Eastern Ontario were likely responsible for the decreased disease severities observed.

**REFERENCES:**

**Table 1.** Prevalence and severity of barley diseases in Central and Eastern Ontario in 2018.

<table>
<thead>
<tr>
<th>Disease</th>
<th>No. of fields affected (n=41)</th>
<th>Disease severity in affected fields&lt;sup&gt;a&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Mean</td>
</tr>
<tr>
<td>Barley yellow dwarf</td>
<td>38</td>
<td>1.3</td>
</tr>
<tr>
<td>Leaf rust</td>
<td>15</td>
<td>1.4</td>
</tr>
<tr>
<td>Net blotch</td>
<td>38</td>
<td>1.7</td>
</tr>
<tr>
<td>Powdery mildew</td>
<td>2</td>
<td>1.0</td>
</tr>
<tr>
<td>Scald</td>
<td>19</td>
<td>1.3</td>
</tr>
<tr>
<td>Septoria complex</td>
<td>31</td>
<td>1.2</td>
</tr>
<tr>
<td>Spot blotch</td>
<td>41</td>
<td>3.1</td>
</tr>
<tr>
<td>Stem rust</td>
<td>6</td>
<td>1.2</td>
</tr>
<tr>
<td>Cover smut (%)</td>
<td>41</td>
<td>0.5</td>
</tr>
<tr>
<td>Ergot (%)</td>
<td>41</td>
<td>0.5</td>
</tr>
<tr>
<td>Leaf stripe (%)</td>
<td>41</td>
<td>0.5</td>
</tr>
<tr>
<td>Loose smut (%)</td>
<td>41</td>
<td>1.5</td>
</tr>
<tr>
<td>Take-all (%)</td>
<td>41</td>
<td>1.7</td>
</tr>
<tr>
<td>Fusarium head blight&lt;sup&gt;b&lt;/sup&gt;</td>
<td>40</td>
<td>5.3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5.4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.3</td>
</tr>
</tbody>
</table>

<sup>a</sup>Foliar disease severity was rated on a scale of 0 (no disease) to 9 (severely diseased); covered smut, ergot, leaf stripe, loose smut, and take-all severity was based on % plants infected.

<sup>b</sup>FHB Index = (% incidence x % severity)/100.
Table 2. Prevalence of *Fusarium* species isolated from fusarium-damaged barley kernels in Central and Eastern Ontario in 2018.

<table>
<thead>
<tr>
<th>Fusarium spp.</th>
<th>% affected fields</th>
<th>% affected kernels</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total <em>Fusarium</em></td>
<td>97.6</td>
<td>32.9</td>
</tr>
<tr>
<td><em>F. acuminatum</em></td>
<td>9.8</td>
<td>0.2</td>
</tr>
<tr>
<td><em>F. avenaceum</em></td>
<td>12.2</td>
<td>0.6</td>
</tr>
<tr>
<td><em>F. equiseti</em></td>
<td>65.9</td>
<td>5.9</td>
</tr>
<tr>
<td><em>F. graminearum</em></td>
<td>17.1</td>
<td>0.6</td>
</tr>
<tr>
<td><em>F. poae</em></td>
<td>92.7</td>
<td>22.6</td>
</tr>
<tr>
<td><em>F. sporotrichioides</em></td>
<td>56.1</td>
<td>3.0</td>
</tr>
<tr>
<td><em>F. verticillioides</em></td>
<td>2.4</td>
<td>0.1</td>
</tr>
</tbody>
</table>
CROP: Canary seed
LOCATION: Saskatchewan

NAMES AND AGENCY:
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TITLE: LEAF MOTTLE AND FUSARIUM SPP. IN CANARY SEED IN SASKATCHEWAN IN 2018

ABSTRACT: Leaf mottle caused by Septoria triseti Speg. was absent in most of the commercial fields surveyed; only a few fields had trace to slight leaf mottle in 2018. Fusarium graminearum was the only Fusarium species identified on canary seed, but only in one field and its incidence was very low (0.1%).

INTRODUCTION AND METHODS: Between July 25th and August 15th a canary seed survey was conducted in Saskatchewan. Fifteen commercial crops in the province were randomly selected: seven fields from west-central SK (6B and 7A), four from east-central SK (5A, 5B and 6A), two from the southwestern (3BN), and two from the southeast (2B). Surveyed fields were between BBCH 65 and 89 (full flower – fully ripe) (Lancashire et al. 1991); two crops were at full flower, one at the end of flowering, one watery ripe, two at medium milk, two at late milk, one at early dough, three at soft dough, two at hard dough, and one fully ripe. An average of ten penultimate and flag-2 leaves (leaf below the penultimate leaf) from each crop were assessed for leaf mottle severity and categorized as follows: none (no visible symptoms), trace (<1% of leaf tissue affected), very slight (1-5%), slight (6-15%), moderate (16-40%), or severe (41-100%).

Four of the 15 fields surveyed were chosen for plating of leaves, based on the presence of necrotic or chlorotic symptoms to assess the presence of S. triseti. Ten random leaves from each field were cut into pieces, surface sterilized with a 5% bleach (NaOCl) solution for 1 min, rinsed three times in sterile water, and then the leaf pieces plated on water agar. After seven days, samples were observed and the presence of S. triseti recorded.

To determine the presence of Fusarium spp. on seed, 100 seeds of eight crops, between BBCH 83 and 89, were surface sterilized in 5% bleach (NaOCl) solution for 1 min and rinsed three times in sterile water. Seeds were placed on filter paper to dry, then plated on PDA, and placed under a 12-hour light/dark regime at room temperature (23°C) for five days (Warham et al. 1995). Fusarium spp. were identified morphologically from examination of spores and mycelial growth (Gerlach & Nirenberg 1982).

The prevalence of S. triseti and Fusarium spp. were determined by counting the proportion of crops affected, and incidence by counting the number of leaves affected (from the 10 leaves plated), or the number of seeds affected by each Fusarium spp. of the 100 plated for each canary seed crop.

RESULTS AND CONCLUSIONS: Among the 15 samples, 11 fields did not have any symptoms of leaf mottle, one was assessed as trace for leaf mottle (<1% of leaf area affected), two samples were assessed as very slight (1-5%) and one was categorized as slight (6-15%) (Table 1). Prevalence of leaf mottle was 27% (4 of 15 crops). Absence of severe leaf mottle disease may be attributed to the high temperatures and dry conditions across the province and low inoculum levels from previous years. Septoria triseti was not identified among the 40 leaves plated. In the last five years, prevalence of S. triseti has declined from 81% (2013) to 42% (2017) to 0 in 2018 (Vera et al. 2014; Cholango-Martinez et al. 2018). Also, the number of canary seed fields surveyed this year were low: Kindersley and Indian Head used to be areas where most canary seed crops were surveyed in previous years; however, this year, flax and soybean crops were relatively common, but not canary seed. High temperatures and lack of moisture around the province during the field season in 2018 (Saskatchewan Ministry of Agriculture, 2018) were likely responsible for the low incidence and severity of leaf mottle observed in surveyed fields.
One field, located in Crop District 5B, had Fusarium seed infection. The only *Fusarium* spp. identified was *Fusarium graminearum*. The incidence (# of seed infected/total of plated seeds) of *F. graminearum* was 0.1%. Incidence of *F. graminearum* in canary seed has decreased since 2014 (12%), 2015 (3%), 2016 (0.5%) and 2017 (0%) (Cholango-Martinez et al. 2015, 2016, 2017, 2018). Warm temperatures, lack of moisture, and low levels of inoculum from previous years may be responsible for the low incidence of *F. graminearum* in 2018.

**ACKNOWLEDGEMENTS:** Thank you to the summer and co-op students and technicians from the Cereal and Flax Pathology group of the University of Saskatchewan for organizing and collecting samples for the survey.

**REFERENCES:**

**Table 1.** Canary seed leaf mottle disease severity and prevalence in 15 fields in Saskatchewan in 2018.

<table>
<thead>
<tr>
<th>Severity (%)</th>
<th>No. of crops</th>
<th>Prevalence (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>11</td>
<td>0</td>
</tr>
<tr>
<td>Trace &lt;1%</td>
<td>1</td>
<td>7</td>
</tr>
<tr>
<td>Very slight 1-5%</td>
<td>2</td>
<td>13</td>
</tr>
<tr>
<td>Slight 6-15%</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Moderate 16-40%</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Severe 41-100%</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

*aNumber of fields with presence of leaf symptoms/total surveyed fields.
CROP: Oat  
LOCATION: Manitoba  

NAMES AND AGENCY:  
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TITLE: FUSARIAUM HEAD BLIGHT OF OAT IN MANITOBA – 2018  

ABSTRACT: Sixty-four oat fields in Manitoba were surveyed for Fusarium head blight (FHB) to assess severity and the causal Fusarium species. FHB-like symptoms were found in 10 out of 64 fields. F. poae was the predominant species detected in the commercial fields, followed by F. graminearum.  

INTRODUCTION AND METHODS: Sixty-four oat fields in Manitoba were surveyed for FHB from July 18 to August 5 when crops were at the early to soft-dough (ZGS 79-83, Zadoks et al. 1974) stages of growth. Fields were selected at regular intervals approximately 20-25 km along the survey routes, depending on crop frequency. The area sampled was bounded by Highways numbers 67, 16 to the north, 12 to the east, 3 to the south, 8 to the north and 83 to the west.  

FHB incidence (the percentage of oat panicles showing typical FHB symptoms) was assessed by sampling 95-110 panicles at three locations and averaging the scores. Subsequently, 1 gm of infected kernels was removed from 15 randomly selected panicles from each field. The infected kernels were then frozen in liquid nitrogen and ground to a powder using Spex SamplePrep 2010 Geno/Grinder®. DNA was extracted from the ground grain sample from each field using the QIAGEN DNeasy® Plant Mini Kit (QIAGEN). Molecular techniques such as conventional polymerase chain reaction (PCR) or quantitative real-time qPCR were performed using Fusarium species-specific oligonucleotide primers commonly detected in cereal crops (Demeket al. 2005; Nicolaisen et al. 2009). Real time qPCR was executed with the CFX96™ Real Time PCR detection system (BioRad) using 2X SsoFast EvaGreen® supermixes (BioRad) and a 37-cycle threshold (Ct) cut-off detection limit was used to detect and quantify Fusarium species.  

RESULTS AND COMMENTS: FHB-like symptoms were found in 10 out of 64 fields and the incidence of FHB ranged from 0 to 13%.  

Using conventional PCR, F. poae DNA was detected in 44 out of 64 fields and F. graminearum DNA was detected in 33 out 64 fields. Real-time qPCR was performed with primers specific to F. poae and F. graminearum. On average, DNA of F. poae was detected at the level of 8.34 pg per ng of the total genomic DNA, which is much higher than the amount of F. graminearum DNA present in oat kernels (0.68 pg per ng the total genomic DNA). F. poae was the most common Fusarium species found in oat in 2018. F. poae has been the predominant Fusarium species found in commercial oat fields since 2010 (Tekauz et al. 2012; Beyene et al. 2016a, 2016b).  

REFERENCES:  

**Table 1.** PCR detection of *Fusarium* spp. in samples from 64 oat fields in Manitoba in 2018.

<table>
<thead>
<tr>
<th><em>Fusarium</em> spp.</th>
<th>Percentage of positive fields</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>F. graminearum</em></td>
<td>51.6</td>
</tr>
<tr>
<td><em>F. poae</em></td>
<td>68.7</td>
</tr>
</tbody>
</table>

**Table 2.** Real-time qPCR analysis for *F. poae* and *F. graminearum* DNA in oat samples collected in 2018.

<table>
<thead>
<tr>
<th><em>Fusarium</em> spp.</th>
<th>Range (pg of fungal DNA/ng of total genomic DNA)</th>
<th>Mean (pg of fungal DNA/ng of total genomic DNA)</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>F. poae</em></td>
<td>0.1-40.6</td>
<td>8.34</td>
</tr>
<tr>
<td><em>F. graminearum</em></td>
<td>0.1-3.26</td>
<td>0.68</td>
</tr>
</tbody>
</table>
CROP: Oat
LOCATION: Manitoba and eastern Saskatchewan (eastern prairie region), Ontario and Quebec

NAMES AND AGENCIES:
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3Crop Production Research Farm, La Coop fédérée, Saint-Hyacinthe, QC J2T 5J4

TITLE: CROWN RUST OF OAT IN MANITOBA, SASKATCHEWAN, ONTARIO AND QUEBEC IN 2017

ABSTRACT: In 2017, 74 fields with wild oats and 21 fields of common oats were surveyed for the incidence and severity of crown rust (Puccinia coronata Cda f. sp. avenae Erikss.) in Manitoba and eastern Saskatchewan. Crown rust infected plants were found in 50% and 29% of all wild and common oat fields at mean incidences of 11% and 2%, respectively, and mean severities of 1 MR and 1 MR. No virulence was detected to resistance genes Pc94, Pc97, Pc98, and Pc101 in 84 crown rust collections from Manitoba and Saskatchewan. Twenty crown rust isolates were collected from Ontario and Quebec, and no virulence was detected to the resistance genes Pc59, PC97, Pc98, PC101, and Pc103-1 in those collections.

INTRODUCTION AND METHODS: Surveys for the incidence and severity of oat crown rust, caused by Puccinia coronata Cda f. sp. avenae Erikss., were conducted in Manitoba and Saskatchewan from August 8 to August 14, 2017. The areas surveyed were in crop districts 1, 2, 3, 7, 8, 9, and 11 in Manitoba and crop districts 1, 2, and 5 in Saskatchewan. Incidence was considered to be the percentage of leaves infected with rust in a given field, and the severity was the mean percentage leaf area with pustules. Crown rust collections were obtained from wild oat (Avena fatua L.) and common oat (A. sativa L.) in the surveyed fields, and susceptible and resistant oat lines and cultivars grown in uniform rust nurseries. The nurseries were located at Emerson and Thornhill, MB, and Indian Head, SK. One crown rust isolate on a commercial oat line was also submitted from Lacombe, Alberta. Samples from fields in Ontario and Quebec were collected in July. For virulence studies, single-pustule isolates (spi) were established from the rust collections. Races were identified using 16 standard oat crown rust differentials (Table 1) as described by Chong et al. (2000). In addition, single Pc-gene lines with Pc91, Pc94, Pc96, temp_pc97, temp_PC98, Pc101, Pc103-1, and Pc104 were used as supplemental differentials.

RESULTS AND COMMENTS: Seventy-four fields with wild oats and 21 fields of common oat lines were surveyed in Manitoba and Saskatchewan. Wild oat plants infected with P. coronata f. sp. avenae were found in 37 (50%) of the fields, and infected common oat plants were found in 6 (29%) of the fields.

Crown rust incidence on wild oats ranged from 0 to 100%, with a mean incidence of 11%. The severity of crown rust on wild oats ranged from 0 to 3S with a mean severity of 1 MR. The incidence and severity of crown rust infection on wild oats was higher in southwestern Manitoba and southeastern Saskatchewan.

Crown rust incidence on common oats ranged from 0 to 30%, with a mean incidence of 2%. The severity of crown rust on common oats ranged from 0 to 3MS with a mean severity of 1 MR. The incidence and severity of crown rust infection on common oats was generally higher in Manitoba crop district 8 and Saskatchewan crop district 5.

Sixty-three spi were made from wild oat collections from Manitoba and eastern Saskatchewan, and 46 races were identified. Thirty-eight (60%) races were each represented by only one spi, with the most common race (JTQG) represented by five spi. No virulence was reported to genes Pc94, Pc97, Pc98 and Pc101 in the spi from wild oat (Table 1) and virulence was observed at 5% or less for Pc50, Pc54, Pc58, Pc62, Pc64, Pc96 and Pc103-1. Virulence was observed in 60% or more of the spi from wild oat for Pc38, Pc39, Pc51 and Pc56.
Ten spi were made from common oat collections from Manitoba and Saskatchewan, with nine races identified. Virulence to 10 of the Pc genes was not observed in these isolates, and virulence to Pc38, Pc39 and Pc56 was common (>70%) (Table 1). A spi made from the sample provided off of commercial oats in Alberta was virulent to Pc38, Pc39, Pc40, Pc45, Pc46, Pc48, Pc51, Pc52, Pc56 and Pc68.

Eleven spi were made from collections from the Uniform Rust Nursery and 10 races identified. Virulence to nine of the Pc genes was not observed with these spi (Table 1) and 80% or more of the spi possessed virulence to Pc38, Pc39, Pc51, Pc52 and Pc56.

Overall, in Manitoba and eastern Saskatchewan, virulence was not observed to Pc94, Pc97, Pc98 and Pc101 and in addition, less than 5% of the spi possessed virulence to Pc38, Pc39, Pc48, Pc56 and Pc68.

Twenty spi were made from the eastern Canada collections, and 19 races identified. Virulence to Pc38, Pc39, Pc48, Pc56 and Pc68 was observed in 90% or more of the spi (Table 1). None of the spi possessed virulence to Pc59, Pc97, Pc98, Pc101 and Pc103-1.

Greater than 50% of all Canadian spi from the 2017 collections possessed virulence to resistance genes Pc38, Pc39, Pc48, Pc51, Pc52 and Pc56, while virulence was not observed to Pc97, PpC98 and PpC101 (Table 1). The high levels of virulence to Pc38, and Pc39 likely reflect the deployment of Pc38 and Pc39 in combination in the eastern prairies, as well as North Dakota and Minnesota since the 1980s.

REFERENCES:
Table 1. Frequencies (%) of virulence of *Puccinia coronata* f. sp. *avenae* isolates from the eastern Canadian Prairie region and eastern Canada on 16 standard and eight supplemental crown rust differential oat lines in 2017.

<table>
<thead>
<tr>
<th>Oat lines and <em>Pc</em> gene present</th>
<th>Wild oat</th>
<th>Commercial oat field</th>
<th>Uniform rust nursery</th>
<th>Eastern Canada</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No. isolates</td>
<td>Percent</td>
<td>No. isolates</td>
<td>Percent</td>
</tr>
<tr>
<td><strong>Standard</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Pc38</em></td>
<td>47</td>
<td>75</td>
<td>8</td>
<td>80</td>
</tr>
<tr>
<td><em>Pc39</em></td>
<td>52</td>
<td>83</td>
<td>8</td>
<td>80</td>
</tr>
<tr>
<td><em>Pc40</em></td>
<td>12</td>
<td>19</td>
<td>1</td>
<td>10</td>
</tr>
<tr>
<td><em>Pc45</em></td>
<td>30</td>
<td>48</td>
<td>4</td>
<td>40</td>
</tr>
<tr>
<td><em>Pc46</em></td>
<td>19</td>
<td>30</td>
<td>4</td>
<td>40</td>
</tr>
<tr>
<td><em>Pc48</em></td>
<td>32</td>
<td>51</td>
<td>5</td>
<td>50</td>
</tr>
<tr>
<td><em>Pc50</em></td>
<td>3</td>
<td>5</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><em>Pc51</em></td>
<td>38</td>
<td>60</td>
<td>5</td>
<td>50</td>
</tr>
<tr>
<td><em>Pc52</em></td>
<td>30</td>
<td>48</td>
<td>4</td>
<td>40</td>
</tr>
<tr>
<td><em>Pc54</em></td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>10</td>
</tr>
<tr>
<td><em>Pc56</em></td>
<td>43</td>
<td>68</td>
<td>7</td>
<td>70</td>
</tr>
<tr>
<td><em>Pc58a</em></td>
<td>2</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><em>Pc59a</em></td>
<td>7</td>
<td>11</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><em>Pc62</em></td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>10</td>
</tr>
<tr>
<td><em>Pc64</em></td>
<td>3</td>
<td>5</td>
<td>1</td>
<td>10</td>
</tr>
<tr>
<td><em>Pc68</em></td>
<td>27</td>
<td>43</td>
<td>5</td>
<td>50</td>
</tr>
<tr>
<td><strong>Supplemental</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Pc91</em></td>
<td>31</td>
<td>49</td>
<td>3</td>
<td>30</td>
</tr>
<tr>
<td><em>Pc94</em></td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><em>Pc96</em></td>
<td>1</td>
<td>2</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Temp_Pc97</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Temp_Pc98</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><em>Pc101</em></td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><em>Pc103-1</em></td>
<td>3</td>
<td>5</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><em>Pc104</em></td>
<td>10</td>
<td>16</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>63</strong></td>
<td><strong>10</strong></td>
<td><strong>11</strong></td>
<td><strong>20</strong></td>
</tr>
</tbody>
</table>

*The *Pc58*-differential was shown to carry three linked genes, and the *Pc59*-differential three unlinked genes (Chong et al. 2008).*
ABSTRACT: *Fusarium* species present on seed samples of 45 oat crops that were collected across Saskatchewan in 2018 were identified based on macrospore morphology. Prevalence and incidence were calculated for each species identified. Three species were identified: *F. poae*, *F. graminearum* and *F. nivale*. *Fusarium poae* was the most prevalent and had the highest incidence of the three species.

INTRODUCTION AND METHODS: In 2018, 45 oat crops in nine crop districts across Saskatchewan were surveyed between July 20 and August 30. Approximately 15 panicles were collected from each crop. After collection, the samples were dried, stored in paper bags, and hand-threshed. The seeds were then surfaced sterilized in 5% bleach for three minutes, rinsed in sterile water for three minutes and air-dried. Thirty seeds from each sample were placed on potato dextrose agar and incubated for six days under 12-hour light/dark periods. The *Fusarium* spp. present in each sample were identified based on macrospore morphology (Zillinsky 1983; Gerlach & Nirenburg 1982). Prevalence (number of crops in which each *Fusarium* spp. was detected from the 45 crops) and incidence (number of seeds from which each *Fusarium* spp. was isolated of the 1350 seeds plated) were calculated.

RESULTS AND COMMENTS: *Fusarium* spp. were detected in 27 of the 45 crops (60%) surveyed (Table 1). Three species were identified: *F. poae*, *F. graminearum*, and *F. nivale*. *Fusarium poae* was prevalent and detected in 51% of the crops surveyed, while *F. nivale* was least prevalent at 4% (Table 2). The prevalence of *F. graminearum* was 20%. *Fusarium poae* also had the highest incidence at 4.9%, and *F. nivale* the lowest at 0.1%, while the incidence of *F. graminearum* was 1.2%.

The overall prevalence of *Fusarium* spp. identified on oat (60%) was lower than in 2015 (70%), and similar to 2016 and 2017 (Table 1). Prevalence of *F. graminearum* was up from 3% in 2017 to 20% in 2018.

Most of the province received low precipitation in 2018, which may explain the similar prevalence of *Fusarium* spp. to 2017, as it was also a dry year (Government of Saskatchewan 2018; Dyck et al. 2018). The eastern edge of the province and northern crop districts received closer to average precipitation and these were the districts where *F. graminearum* was found (Table 3). This would explain the higher prevalence of *F. graminearum* in these regions as it requires humid conditions (Zillinsky 1983).

ACKNOWLEDGEMENTS: We thank the Saskatchewan Crop Insurance Corporation for collecting samples and the Saskatchewan Oat Development Commission for financial support.

REFERENCES:
Table 1. Prevalence (%) of *Fusarium* spp. in oat crops surveyed from 2015-2018.

<table>
<thead>
<tr>
<th>Year</th>
<th>Prevalence (%) of crops</th>
<th>Total <em>Fusarium</em> species</th>
<th><em>Fusarium graminearum</em></th>
</tr>
</thead>
<tbody>
<tr>
<td>2015</td>
<td>70</td>
<td>32</td>
<td></td>
</tr>
<tr>
<td>2016</td>
<td>60</td>
<td>23</td>
<td></td>
</tr>
<tr>
<td>2017</td>
<td>57</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>2018</td>
<td>60</td>
<td>20</td>
<td></td>
</tr>
</tbody>
</table>

Table 2. Prevalence and incidence (isolation frequency on oat seed) of *Fusarium* spp. in Saskatchewan in 2018.

<table>
<thead>
<tr>
<th>Pathogen</th>
<th>Prevalence (%) of crops</th>
<th>Incidence(^a) (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Fusarium poae</em></td>
<td>51</td>
<td>4.9</td>
</tr>
<tr>
<td><em>Fusarium graminearum</em></td>
<td>20</td>
<td>1.2</td>
</tr>
<tr>
<td><em>Fusarium nivale</em></td>
<td>4</td>
<td>0.1</td>
</tr>
</tbody>
</table>

\(^a\)Incidence = percentage of seeds from which each pathogen was isolated.

Table 3. *Fusarium* spp. found in crop districts of Saskatchewan 2018.

<table>
<thead>
<tr>
<th>Crop District</th>
<th>Number of infected kernels</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><em>Fusarium poae</em></td>
</tr>
<tr>
<td>2A</td>
<td>1</td>
</tr>
<tr>
<td>2B</td>
<td>0</td>
</tr>
<tr>
<td>5A</td>
<td>10</td>
</tr>
<tr>
<td>5B</td>
<td>19</td>
</tr>
<tr>
<td>6A</td>
<td>0</td>
</tr>
<tr>
<td>8A</td>
<td>1</td>
</tr>
<tr>
<td>8B</td>
<td>23</td>
</tr>
<tr>
<td>9A</td>
<td>6</td>
</tr>
<tr>
<td>9B</td>
<td>10</td>
</tr>
</tbody>
</table>
CROP: Oat
LOCATION: Central and Eastern Ontario

NAMES AND AGENCY:
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Agriculture and Agri-Food Canada, Ottawa Research and Development Centre, K.W. Neatby Building, 960 Carling Avenue, Ottawa, ON K1A 0C6
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TITLE: DISEASES OF OAT IN CENTRAL AND EASTERN ONTARIO IN 2018

ABSTRACT: Thirty-three oat crops in Central and Eastern Ontario were surveyed for diseases in 2018. Of the 11 diseases observed, barley yellow dwarf, crown rust, take-all, and stagonospora leaf blotch were most prevalent, having moderate to severe levels of infection in 8, 6, 6, and 5 fields, respectively. Fusarium head blight (FHB) was observed in 32 fields with low severities. *Fusarium poae* was the predominant species isolated from the FHB infected kernels.

INTRODUCTION AND METHODS: A survey to document diseases in Central and Eastern Ontario oat crops was conducted during the third week of July 2018 when plants were at the soft dough stage of development. Twenty-nine fields were chosen at random in regions where most oat crops were grown. Foliar disease severity was determined on 10 flag and penultimate leaves sampled at each of three random sites per field, using a rating scale of 0 (no disease) to 9 (severely diseased). Disease diagnosis was based on visual symptoms. Average severity scores of <1, <3, <6, and ≥6 were considered as trace, slight, moderate, and severe disease levels, respectively. The severity of ergot, loose smut, and take-all was based on the percentage of plants infected at each of the three random sites per field. FHB was rated for incidence (% infected panicles) and severity (% infected spikelets in the affected panicles) based on approximately 200 panicles at each of the three sites per field. An FHB index [(% incidence x % severity)/100] was determined for each field. The percentage of infected plants or FHB index values of <5, <10, <20, and ≥20% were considered as slight, moderate, severe, and very severe disease levels, respectively.

Determination of the causal species of FHB was based on 50 infected panicles (heads) collected from each field. The panicles were air-dried at room temperature and subsequently threshed. Fifty discolored kernels per sample were chosen at random, surface sterilized in 1% NaOCl for 60 seconds and plated in 9-cm diameter petri dishes on modified potato dextrose agar (10 g dextrose per liter amended with 50 ppm of streptomycin sulphate). The plates were incubated for 10-14 days at 22-25ºC and a 14-hour photoperiod using fluorescent and long wavelength ultraviolet tubes. The *Fusarium* species isolated were identified by microscopic examination using standard taxonomic keys.

RESULTS AND COMMENTS: Eleven diseases were identified (Table 1). Barley yellow dwarf (BYDV), crown rust (*Puccinia coronata* f. sp. *avenae*) and stagonospora leaf blotch (*Stagonospora avenae* f. sp. *avenaria*) were the most prevalent foliar diseases and were found in 33, 16, and 28 fields at average severities of 2.4, 3.1, and 2.3, respectively. Moderate to severe levels of infection from these diseases were observed in 8, 6, and 5 fields, respectively. Yield reductions due to these diseases were estimated to be <10% in affected fields. Other foliar diseases observed were halo blight (*Pseudomonas syringae* pv. *coronafaciens*), pyrenophora leaf blotch (*Pyrenophora avenae*), spot blotch (*Cochliobolus sativus*), and stem rust (*Puccinia graminis* f. sp. *tritici*); they were observed in 30, 31, 29, and 2 fields at mean severities of 1.8, 1.6, 1.3, and 1.0, respectively. Severe levels of these diseases were not found and none would have resulted in measurable damage to the crop.

Ergot (*Claviceps purpurea*), loose smut (*Ustilago nuda*) and take-all root rot (*Gaumannomyces graminis* var. *avenae*) were observed in 31, 33, and 33 fields at incidence levels of 0.5, 0.6, and 1.8%, respectively (Table 1). Moderate to severe levels of infection from ergot and loose smut were not observed, while moderate to severe levels of take-all were found in 6 fields. Yield reductions due to take-all were estimated at <5% in affected fields.
Fusarium head blight occurred in 32 fields at a mean FHB index of 0.8% (range 0.01-4.0%) (Table 1). Severe FHB infection was not found in the affected crops. Six *Fusarium* species were isolated from discolored kernels (Table 2). *Fusarium poae* predominated and occurred in 91% of fields and on 16.7% of kernels. *Fusarium equiseti* and *F. sporotrichioides* were less common and found in 43-52% of fields and on 2.7-6.3% of kernels. *Fusarium acuminatum, F. avenaceum,* and *F. graminearum* were least common, occurring in 3-9% of fields and on 0.1-0.4% of kernels.

The 11 diseases observed on oat in Ontario in 2018 were the same as those recorded in 2017 (Xue et al. 2018). Overall, the incidence and severity of these diseases were generally lower in 2018 than in 2017. Less frequent rain events in June and July in 2018 compared with 2017 in Central and Eastern Ontario were likely responsible for the decreased disease severities observed.

**REFERENCE:**

**Table 1.** Prevalence and severity of oat diseases in central and eastern Ontario in 2018.

<table>
<thead>
<tr>
<th>Disease</th>
<th>No. of fields affected (n=33)</th>
<th>Disease severity in affected fields&lt;sup&gt;a&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Mean</td>
</tr>
<tr>
<td>Barley yellow dwarf</td>
<td>33</td>
<td>2.4</td>
</tr>
<tr>
<td>Crown rust</td>
<td>16</td>
<td>3.1</td>
</tr>
<tr>
<td>Halo blight</td>
<td>30</td>
<td>1.8</td>
</tr>
<tr>
<td>Pyrenophora leaf blotch</td>
<td>31</td>
<td>1.6</td>
</tr>
<tr>
<td>Spot blotch</td>
<td>29</td>
<td>1.3</td>
</tr>
<tr>
<td>Stagonospora leaf blotch</td>
<td>28</td>
<td>2.3</td>
</tr>
<tr>
<td>Stem rust</td>
<td>2</td>
<td>1.0</td>
</tr>
<tr>
<td>Ergot (%)</td>
<td>31</td>
<td>0.5</td>
</tr>
<tr>
<td>Loose smut (%)</td>
<td>33</td>
<td>0.6</td>
</tr>
<tr>
<td>Take-all (%)</td>
<td>33</td>
<td>1.8</td>
</tr>
<tr>
<td>Fusarium head blight&lt;sup&gt;b&lt;/sup&gt;</td>
<td>32</td>
<td>7.2</td>
</tr>
<tr>
<td>Incidence (%)</td>
<td></td>
<td>7.3</td>
</tr>
<tr>
<td>Severity (%)</td>
<td></td>
<td>0.8</td>
</tr>
<tr>
<td>Index (%)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<sup>a</sup> Foliar disease severity was rated on a scale of 0 (no disease) to 9 (severely diseased); ergot, loose smut, and take-all severity was based on % plants infected.

<sup>b</sup>%FHB Index = (% incidence x % severity)/100.

**Table 2.** Prevalence of *Fusarium* species isolated from putatively infected kernels of oat in Central and Eastern Ontario in 2018.

<table>
<thead>
<tr>
<th>Fusarium spp.</th>
<th>% affected fields</th>
<th>% affected kernels</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total <em>Fusarium</em></td>
<td>97.0</td>
<td>26.3</td>
</tr>
<tr>
<td><em>F. acuminatum</em></td>
<td>6.1</td>
<td>0.1</td>
</tr>
<tr>
<td><em>F. avenaceum</em></td>
<td>9.1</td>
<td>0.4</td>
</tr>
<tr>
<td><em>F. equiseti</em></td>
<td>51.5</td>
<td>6.3</td>
</tr>
<tr>
<td><em>F. graminearum</em></td>
<td>3.0</td>
<td>0.1</td>
</tr>
<tr>
<td><em>F. poae</em></td>
<td>90.9</td>
<td>16.7</td>
</tr>
<tr>
<td><em>F. sporotrichioides</em></td>
<td>42.4</td>
<td>2.7</td>
</tr>
</tbody>
</table>
ABSTRACT: In 2018, 47 barley fields and 64 oat fields were assessed for leaf spot diseases in Manitoba. In Manitoba, the severity of leaf spot diseases in barley and oat was low in 2018, partially due to dry weather conditions during the growing season which were not very conducive for the development of leaf spot pathogens. *Cochliobolus sativus* (spot blotch) and *Pyrenophora teres* (net blotch) were the principal pathogens found in barley whereas *Pyrenophora avenae* was the predominant pathogen isolated from commercial oat fields.

INTRODUCTION AND METHODS: In 2018, barley and oat leaf spot diseases in Manitoba were assessed by surveying 111 farm fields (47 barley and 64 oat fields) from July 18-August 5, when most crops were at the early- to soft-dough stages of growth (ZGS 79-82, Zadoks et al. 1974). Fields were sampled at regular intervals approximately 20-25 km along survey routes, depending on crop availability. The areas sampled were bounded by Highways #s 67, 16 to the north, 12 to the east, 3 to the south, 8 to the north and 83 to the west. Disease incidence and severity were recorded by averaging disease incidence on 10-20 plants along a diamond-shaped transect of about 50 m per side, beginning near the field edge. Disease ratings were taken on both the upper (flag and penultimate leaves) and lower leaf canopies, using a six-category scale: 0 (no visible symptoms); trace (<1% leaf area affected); very slight (1-5%); slight (6-15%); moderate (16-40%); and severe (41-100%). Infected leaves with typical symptoms were collected at each site, dried, and stored in paper envelopes. Subsequently, 10 surface-sterilized pieces of putatively infected leaf tissue were incubated on filter paper in moist chambers for 3-5 days to promote sporulation to identify the causal agent(s) and disease(s).

RESULTS AND COMMENTS:

Barley - In lower leaf canopies, disease severity was trace to slight in 67%, moderate in 8% and severe in 25% of the fields. In upper leaf canopies, disease severity was trace to slight in 94%, moderate in 4% and severe in 2% of the fields.

The disease level in 2018 was lower than previous years (Tekauz et al. 2013; Wang et al. 2015; Banik et al. 2014, 2016), mostly due to dry weather conditions during the growing season, which were not very favourable for the development leaf spot diseases.

*Cochliobolus sativus* (causal agent of spot blotch) and *Pyrenophora teres* (net blotch) were the principal pathogens isolated from infected leaf tissues and caused the most damage in the fields surveyed. *C. sativus* was isolated from 30 fields and *P. teres* was found in 26 fields (Table 1). *S. passerinii* (speckled leaf blotch) was isolated from 7 fields. This pathogen was not detected at all in the 2014 and 2015 Manitoba disease surveys (Wang et al. 2015; Banik et al. 2016).

Oat - In upper leaf canopies, leaves from 15% of the fields showed moderate to severe disease. In lower canopies, 44% of the fields showed moderate to severe leaf spot disease.

*Pyrenophora avenae*, causal agent of pyrenophora leaf blotch, was the most prevalent leaf pathogen in oat (Table 2). This pathogen was isolated from 48% of fields which was at levels similar to those reported in 2011, 2012 and 2016 (Tekauz et al. 2012, 2013; Banik et al. 2017). *C. sativus* and *S. avenae* (stagonospora leaf blotch) were both isolated from five commercial fields (Table 2).
REFERENCES:

Table 1. Incidence and isolation frequency of leaf spot pathogens of barley in Manitoba in 2018.

<table>
<thead>
<tr>
<th>Pathogen</th>
<th>Incidence (% of fields)</th>
<th>Frequency (% of isolations)</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Cochliobolus sativus</em></td>
<td>43.19</td>
<td>72.5</td>
</tr>
<tr>
<td><em>Pyrenophora teres</em></td>
<td>13.64</td>
<td>11.25</td>
</tr>
<tr>
<td><em>Septoria passerinii</em></td>
<td>13.64</td>
<td>7.5</td>
</tr>
</tbody>
</table>

Table 2. Incidence and isolation frequency of leaf spot pathogens of oat in Manitoba in 2018.

<table>
<thead>
<tr>
<th>Pathogen</th>
<th>Incidence (% of fields)</th>
<th>Frequency (% of isolation)</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Pyrenophora avenae</em></td>
<td>52.46</td>
<td>63.1</td>
</tr>
<tr>
<td><em>Stagonospora avenae</em></td>
<td>45.9</td>
<td>40.2</td>
</tr>
</tbody>
</table>
CROP: Oat
LOCATION: Saskatchewan

NAMES AND AGENCY:
P. Cholango-Martinez & H. R. Kutcher
Crop Development Centre, University of Saskatchewan, 51 Campus Drive, Saskatoon, SK S7N 5A8
Telephone: (306) 966-8161; Facsimile: (306) 966-5015; E-mail: randy.kutcher@usask.ca

TITLE: LEAF SPOT DISEASES OF OAT IN SASKATCHEWAN IN 2018

ABSTRACT: Leaf spot disease severity of oat and identification of the causal pathogens were assessed in 44 commercial fields. *Pyrenophora avenae* Ito & Kuribayashi (pyrenophora leaf blotch) and *Stagonospora avenae* (Frank) Bisset f. sp. *avenaria* (stagonospora leaf blotch) were the pathogens isolated from diseased oat leaves.

INTRODUCTION AND METHODS: In 2018, an oat survey was conducted between July 30th and August 25th. Forty-four commercial fields were surveyed from nine Crop Districts (2A, 2B, 3BN, 5A, 5B, 6A, 8A, 8B, 9A and 9B) in Saskatchewan. Leaf samples were collected from fields at growth stages varying between BBCH 59 (end of heading) and 89 (fully ripe) (Lancashire et al. 1991). Field ratings were based on disease severity (percent diseased leaf area) on the upper (flag and penultimate) leaves as follows: 0 (no visible symptoms); trace (<1% leaf area affected); very slight (1-5%); slight (6-15%); moderate (16-40%); and severe (41-100%). Approximately 50 leaves from each field were collected and placed in paper bags, and air-dried at room temperature. Ten leaves were randomly chosen from the 50 collected from each field, and a small piece from each leaf was surface-sterilized in 5% bleach (NaOCl) for 1 minute, rinsed 3 times with water to remove residual NaOCl and air dried. These leaf pieces were plated on water agar. After 7 days the leaf pieces were observed for pathogen identification by assessing morphological characteristics: spore size, shape and color, and colony characteristics.

RESULTS AND COMMENTS: Leaf disease severity varied from 0 to 50% among the 44 fields surveyed. Six fields were rated as trace (<1% leaf area affected), twenty-four as very slight (1-5%), five as slight (6-15%), five as moderate (16-40%), one as severe (41-100%), and three had no visible symptoms. Most of the fields surveyed had ≤5% leaf spot disease severity, and just one field was rated as severe. From plating 220 leaves, chosen from 22 of the 44 oat crops, two pathogens were identified: *Pyrenophora avenae* and *Stagonospora avenae* f. sp. *avenaria*. The prevalence of *P. avenae* was 32% and incidence among the 220 leaf pieces plated was 28% (Table 1). Prevalence of *S. avenae* was 9% and incidence 5%. *Pyrenophora avenae* has been the most prevalent pathogen during the past five years at 81% (Taylor et al. 2014), 70% (Taylor et al. 2015), 65% (Grewal et al. 2016), 33% (Woitas et al. 2017) and 59% (Woitas et al. 2018), although prevalence in 2018 was lower than in the past five years. Incidence of *P. avenae* was >91% during 2012 to 2014 and lower than 23% in the last two years (2016 and 2017). *Cochliobolus sativus* was not detected on leaf samples this year. Warm conditions and lack of moisture in much of Saskatchewan were likely responsible for the low levels and limited detection of these oat diseases this year.

ACKNOWLEDGMENTS: We thank the Cereal and Flax Pathology Lab at the Crop Development Centre and the Saskatchewan Crop Insurance Corporation for assistance with sample collection.

REFERENCES:
Table 1. Prevalence and incidence of leaf spot pathogens of oat in Saskatchewan in 2018.

<table>
<thead>
<tr>
<th>Pathogen</th>
<th>Prevalence (%)&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Incidence (%)&lt;sup&gt;b&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pyrenophora avenae</td>
<td>32</td>
<td>28</td>
</tr>
<tr>
<td>Stagonospora avenae</td>
<td>9</td>
<td>5</td>
</tr>
</tbody>
</table>

<sup>a</sup> Prevalence: % of the barley crops from which the pathogen was isolated.

<sup>b</sup> Incidence: % of leaf pieces infected by each pathogen.
CULTURES: Avoine (Avena sativa), Orge (Hordeum vulgare), Blé (Triticum aestivum)
RÉGION: Québec

NOMS ET ORGANISMES:
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Centre de recherche sur les grains inc. (CÉROM), 2700, rue Einstein, Québec, QU G1P 3W8
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TITRE: OBSERVATIONS DES MALADIES DES CÉRÉALES AU QUÉBEC EN 2018

RÉSUMÉ: Malgré le temps chaud et sec qui a caractérisé l’été 2018 au Québec, les taches foliaires se sont manifestées aussi fortement que par les années passées, alors que les rouilles et l’oïdium ont été moins répandus et la jaunisse nanisante absente. La rouille de l’avoine n’est apparue que dans le sud de la province, alors que la rouille jaune du blé était présente dans les régions du sud, du centre et de l’est, et aussi intensément chez le blé d’hiver que chez le blé de printemps. La rouille brune a touché le blé de printemps des régions du sud seulement et n’a pas été observée chez l’orge. L’oïdium était présent dans les régions du centre sur les deux types de blé ainsi que sur l’orge. Finalement, tout comme en 2017, la fusariose de l’épi n’a pas été un problème en 2018.

ABSTRACT: Despite the warm and dry conditions that characterized the 2018 summer in Quebec, leaf spots were as severe as they were in the previous years, while rusts and powdery mildew were less common, and yellow dwarf absent. Crown rust of oats appeared only in the southern part of the province, while yellow stripe rust of wheat was present in the southern, central and eastern regions, and was as severe in winter wheat as in spring wheat. Brown leaf rust affected spring wheat and only in the southern regions, and was not observed on barley. Powdery mildew was present in the central regions on both types of wheat as well as on barley. Finally, as in 2017, Fusarium head blight was not a problem in 2018.

MÉTHODES: En 2018, des essais d’enregistrement et de performance de céréales ont été visités une fois entre le stade laitex moyenn et pâteux moyen de la céréale afin d’y dépister les maladies du feuillage. Les quatre essais de blé d’hiver et les sept à neuf essais de céréales de printemps visités étaient répartis dans différentes régions du Québec (RGCQ 2018). Les maladies ont été identifiées sur la base d’observations visuelles des symptômes et leur intensité a été évaluée selon une échelle de notation de 0 à 9 (0 correspondant à aucun symptôme et 9 à des symptômes sur plus de 50 % de la surface de la feuille étendard). Une intensité faible correspond à des valeurs de 0 à 4, une intensité moyenne à des valeurs de 4 à 7 et une intensité élevée à des valeurs de 7 à 9. Le nom des agents pathogènes normalement associés à ces maladies est mentionné dans le texte à titre indicatif. Quant aux résultats sur la fusariose de l’épi du blé et de l’orge, ils proviennent de La Financière agricole du Québec (FADQ) (Michel Malo, FADQ, communication personnelle) qui fournit le nombre d’avis de dommages aux cultures principalement causés par la fusariose.

RÉSULTATS et COMMENTAIRES: Le couvert de neige de l’hiver 2018 a permis une bonne survie du blé d’hiver dans la majorité des régions (FADQ 2018a). Les semis ont été quelque peu retardés à cause d’un début de printemps froid et pluvieux, mais grâce aux bonnes conditions qui ont suivi, ils ont pu être réalisés dans les temps habituels (FADQ 2018b). La période estivale a été marquée par des températures supérieures et des précipitations inférieures à la normale sur presque tout le territoire, causant même des conditions de sécheresse dans les régions plus à l’est et plus au nord (FADQ 2018c, 2018d, 2018e). Ces conditions climatiques ont permis une récolte plus hâtive qu’à l’habitude dans la plupart des régions (FADQ 2018e).

La tache ovoïde (Stagonospora avenae) de l’avoine était présente et d’intensité moyenne dans tous les essais visités. La rouille couronnée (Puccinia coronata), cependant, était quasi absente. Elle n’a même pas été observée à La Pocatière (Bas-Saint-Laurent) où elle se manifeste habituellement. Elle a été notable seulement à Saint-Hyacinthe (région de Montréal) où les symptômes étaient de faible intensité. Quant au virus de la jaunisse nanisante de l’orge, aucun symptôme n’a été observé chez l’avoine.
En 2018, la rouille jaune du blé (*Puccinia striiformis*) s’est manifestée sur le blé d’hiver dans les régions du sud, du centre et de l’est de la province. Les essais de La Pocatière et de Princeville (Centre-du-Québec) ont été les plus touchés avec une intensité de symptômes variant de moyenne à élevée pour les lignées/cultivars les plus sensibles, alors qu’à Saint-Augustin-de-Desmaures (région de Québec), l’intensité des symptômes pour ces mêmes lignées/cultivars était faible. Dans le cas du blé de printemps, la présence de la rouille jaune ainsi que de la rouille brune s’est limitée en 2018 à deux stations, soit Saint-Hugues (région de Montréal) et Princeville pour la rouille jaune, et Saint-Mathieu-de-Beloeil (région de Montréal) et Princeville pour la rouille brune. L’intensité des symptômes était moyenne à Saint-Mathieu-de-Beloeil pour les lignées/cultivars sensibles et faible à moyenne aux autres sites. Quant à l’intensité des symptômes d’oïdium (*Blumeria graminis* f.sp. *tritici*, syn. *Erysiphe graminis*), observés à Saint-Augustin-de-Desmaures et Princeville sur les deux types de blé, elle variait beaucoup d’un cultivar/lignée à l’autre, de nulle à élevée. Tous les essais de blé présentaient des symptômes de taches foliaires (*Drechslera tritici-repentis*, *Stagonospora nodorum* et *Cochliobolus sativus*) dont l’intensité variait de moyenne à élevée dépendamment du cultivar/lignée. Finalement la fusariose de l’épi n’a pas été un problème en 2018; seulement 0,6 % des producteurs de blé assurés (8 sur 1412) ont rapporté des dommages dus à la maladie.

Chez l’orge, les taches foliaires (*Drechslera teres*, *Rhynchosporium secalis* et *Cochliobolus sativus*) ont, elles aussi, été observées dans tous les essais visités. L’intensité des symptômes était plutôt faible à moyenne à La Pocatière, Hébertville (Lac-Saint-Jean) et Normandin (Lac-Saint-Jean), et moyenne à élevée à Saint-Hugues, Saint-Hyacinthe, Princeville, Saint-Augustin-de-Desmaures et Causapscal (Gaspésie). L’oïdium (*Blumeria graminis* f.sp. *hordei*, syn. *Erysiphe graminis*) a été noté seulement à Princeville et, tout comme pour l’oïdium chez le blé, les symptômes montraient une grande variabilité entre les cultivars/lignées en termes d’intensité, allant de 0 à 7. La rouille des feuilles de l’orge (*Puccinia hordei*), quant à elle, ne s’est pas manifestée en 2018. La fusariose de l’épi de l’orge, tout comme pour le blé, n’a pas été un problème en 2017 alors que seulement 0,4 % des producteurs d’orge assurés (2 sur 533) à la FADQ ont signalé des dommages à leur culture attribuables à cette maladie.

**RÉFÉRENCES:**
CROP: Spring Wheat
LOCATION: Manitoba

NAMES AND AGENCIES: M.A. Henriquez¹, H. Derksen², J. Doherty¹, D. Miranda¹ & O. Gruenke¹
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TITLE: FUSARIUM HEAD BLIGHT OF SPRING WHEAT IN MANITOBA IN 2018

ABSTRACT: In 2018, fusarium head blight incidence and severity were assessed in 155 spring wheat fields in Manitoba. The disease occurred in 34.8% of the wheat fields surveyed at a provincial mean FHB severity (FHB Index) of 0.5%. The most prevalent Fusarium species was F. graminearum, followed by F. poae.

INTRODUCTION AND METHODS: Spring wheat in Manitoba was surveyed for fusarium head blight (FHB) at 155 field locations. The survey for FHB was conducted from early July to early August when most of the crops were at growth stage ZGS 73 – 85 (Zadoks et al. 1974). In contrast to other disease surveys conducted in Manitoba, the fields were not surveyed at random. Instead, information on their location was obtained from producers. The proportion of infected spikes per field (incidence) and the proportion of infected spikelets in each spike (severity) were recorded from 5 heads (main stems) at 10 sites along a W pattern in the field, while avoiding sampling tillers. An FHB index (overall severity) was determined for each field surveyed: [Average % incidence X Average % severity] / 100.

Fifty spikes were processed from 145 fields for pathogen isolation and identification in the laboratory. Ten kernels from each field surveyed were surface-sterilized in a laminar flow bench and then placed on potato dextrose agar (PDA) (25% strength) + streptomycin media. Identification of Fusarium species involved microscopic examination and morphological characterization using the criteria of Leslie & Summerell (2006).

RESULTS AND COMMENTS: According to the Manitoba Agricultural Services Corporation’s Variety Market Share Report (MASC 2018), there were approximately 2,515,440 million acres of spring wheat seeded in Manitoba in 2018. The top five cultivars, based on seed acreage, were ‘AAC Brandon’ (65.1%), ‘AAC Elle’ (8.6%), ‘Cardale’ (7.2%), ‘AAC Viewfield’ (3.6%), and ‘Carberry’ (2.1%). ‘AAC Brandon’ was the predominant spring wheat cultivar grown in the fields sampled in this survey.

Fusarium head blight prevalence was 34.8% (Table 1). The provincial mean FHB severity (FHB Index) was 0.5%. Prevalence of FHB in spring wheat most prevalent in the Northwest (43%). The highest FHB Index was identified in the Eastern/Interlake region (0.8%). Disease levels were higher than the levels observed in 2017 (0.28%) (Henriquez et al. 2018).

The results from kernels plated on PDA (25% strength) + streptomycin media showed that Fusarium graminearum was the most frequently isolated pathogen species, accounting for 72.6% of isolations (Table 2). It was detected in 29.7% of surveyed fields. Fusarium poae was detected in 11%, accounting for 22.2% of isolations.

ACKNOWLEDGEMENTS: We gratefully acknowledge the participation of Manitoba Agriculture Farm Production Extension Specialists for the collection of a portion of the cereal samples for this survey and the respective incidence and severity ratings, as well as Dr. Henriquez’s summer students Amber Bezte, Jordan Blatz, Ryland McCallum, Alisha Suderman, Gwendolyn Friesen, Jasmine Street, and Michael Pahl.
REFERENCES:

Table 1. Fusarium head blight incidence and severity (FHB index) in spring wheat fields in Manitoba in 2018.

<table>
<thead>
<tr>
<th>Region</th>
<th>No. fields surveyed</th>
<th>Prevalence(^a) %</th>
<th>Average incidence(^b) %</th>
<th>Average severity(^c) %</th>
<th>Average FHB index(^d) %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Central</td>
<td>50</td>
<td>28%</td>
<td>1.9%</td>
<td>5.1%</td>
<td>0.5%</td>
</tr>
<tr>
<td>Eastern/Interlake</td>
<td>20</td>
<td>40%</td>
<td>2.7%</td>
<td>8.1%</td>
<td>0.8%</td>
</tr>
<tr>
<td>Northwest</td>
<td>21</td>
<td>43%</td>
<td>1.7%</td>
<td>8.2%</td>
<td>0.3%</td>
</tr>
<tr>
<td>Southwest</td>
<td>64</td>
<td>36%</td>
<td>2.1%</td>
<td>6.3%</td>
<td>0.4%</td>
</tr>
<tr>
<td>MANITOBA</td>
<td>155</td>
<td>34.8%</td>
<td>2%</td>
<td>6.4%</td>
<td>0.5%</td>
</tr>
</tbody>
</table>

\(^a\) Prevalence (%) = Number of fields affected / total fields surveyed.
\(^b\) Incidence: The proportion of infected spikes per field.
\(^c\) Severity: The proportion of infected spikelets in each spike.
\(^d\) Mean FHB Index: \([\text{Average \% incidence} \times \text{Average \% severity}] / 100\).

Table 2. *Fusarium* species isolated from kernels in FHB-affected spring wheat fields in Manitoba in 2018.

<table>
<thead>
<tr>
<th>Pathogen</th>
<th>Prevalence(^a) %</th>
<th>Frequency(^b) %</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>F. graminearum</em></td>
<td>29.7</td>
<td>72.6</td>
</tr>
<tr>
<td><em>F. poae</em></td>
<td>11.0</td>
<td>22.2</td>
</tr>
<tr>
<td><em>F. sporotrichioides</em></td>
<td>2.1</td>
<td>2.6</td>
</tr>
</tbody>
</table>

\(^a\) Prevalence = % of spring wheat fields from which the pathogen was isolated.
\(^b\) Frequency = % of *Fusarium* species (as the % of the total *Fusarium* isolations).
CROP: Winter Wheat
LOCATION: Manitoba

NAMES AND AGENCIES:
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TITLE: FUSARIUM HEAD BLIGHT OF WINTER WHEAT IN MANITOBA IN 2018

ABSTRACT: In 2018, fusarium head blight (FHB) incidence and severity were assessed in 24 winter wheat fields in Manitoba. FHB occurred in 29.2% of the surveyed winter wheat fields. The provincial mean FHB severity (FHB Index) was 0.1%. The most prevalent pathogen species was Fusarium graminearum.

INTRODUCTION AND METHODS: Winter wheat in Manitoba was surveyed for fusarium head blight (FHB) incidence and severity at 24 field locations. The survey was conducted in July when most of the fields were at growth stage ZGS 73 – 85 (Zadoks et al. 1974). In contrast to other disease surveys conducted in Manitoba, the fields were not surveyed at random. Instead, information on their location was obtained from producers. The proportion of infected spikes per field (incidence) and the proportion of infected spikelets in each spike (severity) were recorded for 5 heads (main stems) at 10 sites along a W pattern in the field, while avoiding sampling tillers. An FHB index (overall severity) was determined for each field surveyed: [Average % incidence X Average % severity] / 100.

Fifty spikes were processed from 23 fields for pathogen isolation and identification in the laboratory. Ten kernels from each field surveyed were surface-sterilized in a laminar flow bench and then placed on potato dextrose agar (PDA) (25% strength) + streptomycin media. Identification of Fusarium species involved microscopic examination and morphological characterization using the criteria of Leslie & Summerell (2006).

RESULTS AND COMMENTS: According to the Manitoba Agricultural Services Corporation’s Variety Market Share Report (MASC 2018), there were approximately 66,039 acres of commercial winter wheat seeded in Manitoba for 2018. The top five cultivars, based on their seed acreage, were ‘Emerson’ (49.1%), ‘AAC Gateway’ (33.3%), ‘CDC Falcon’ (8.3%), ‘AAC Elevate’ (2.3%) and ‘CDC Buteo’ (2.1%). ‘AAC Emerson’ was the predominant winter wheat cultivar grown in the fields sampled in this survey.

FHB occurred in 29.2% of the surveyed winter wheat fields in Manitoba (Table 1). The provincial mean FHB severity (FHB Index) was 0.1%. Prevalence and severity of FHB in winter wheat was lower in the Northwest region (0.0%) and most prevalent in the Southwest region (80%). The highest FHB Index was identified in the Southwest region (0.3%). Based on the survey results, FHB caused minimal damage in Manitoba winter wheat fields in 2018.

The results from kernels plated on PDA (25% strength) + streptomycin showed that Fusarium graminearum was the most frequently isolated pathogen species, accounting for 100% of isolations. This species was detected in 8.7% of surveyed fields.

ACKNOWLEDGEMENTS: We gratefully acknowledge the participation of Manitoba Agriculture Farm Production Extension Specialists for the collection of a portion of the cereal samples for this survey and the respective incidence and severity ratings, as well as Dr. Henriquez’s summer students Amber Bezte, Jordan Blatz, Ryland McCallum, Alisha Suderman, Gwendolyn Friesen, Jasmine Street, and Michael Pahl.
REFERENCES:

Table 1. Fusarium head blight (FHB) index in winter wheat fields in Manitoba in 2018.

<table>
<thead>
<tr>
<th>Region</th>
<th>No. fields surveyed</th>
<th>Prevalencea %</th>
<th>Average incidenceb</th>
<th>Average severityc</th>
<th>Average FHB indexd</th>
</tr>
</thead>
<tbody>
<tr>
<td>Central</td>
<td>10</td>
<td>20%</td>
<td>1.6%</td>
<td>1.5%</td>
<td>0.1%</td>
</tr>
<tr>
<td>Eastern/Interlake</td>
<td>8</td>
<td>12.5%</td>
<td>1.1%</td>
<td>1.5%</td>
<td>0.1%</td>
</tr>
<tr>
<td>Northwest</td>
<td>1</td>
<td>0%</td>
<td>0.0%</td>
<td>0.0%</td>
<td>0.0%</td>
</tr>
<tr>
<td>Southwest</td>
<td>5</td>
<td>80%</td>
<td>2.4%</td>
<td>7.8%</td>
<td>0.3%</td>
</tr>
<tr>
<td>MANITOBA</td>
<td>24</td>
<td>29.2%</td>
<td>1.3%</td>
<td>2.7%</td>
<td>0.1%</td>
</tr>
</tbody>
</table>

a Prevalence (%) = Number of fields affected / total fields surveyed.
b Incidence: The proportion of infected spikes per field.
c Severity: The proportion of infected spikelets in each spike.
d Mean FHB Index: [Average % incidence X Average % severity] / 100.
CROP: Winter Wheat
LOCATION: Manitoba

NAMES AND AGENCIES:
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TITLE: LEAF SPOT DISEASES OF WINTER WHEAT IN MANITOBA IN 2018

ABSTRACT: In 2018, leaf spot diseases were assessed in 24 winter wheat fields in Manitoba. Prevalence and isolation frequency of leaf spot pathogens showed that Pyrenophora tritici-repentis was the most prevalent pathogen.

INTRODUCTION AND METHODS: A survey for leaf spot (LS) diseases of winter wheat was conducted between the milk and dough growth stages in 2016 (ZGS 73 – 85, Zadoks et al. 1974). A total of 24 winter wheat fields were sampled. In contrast to other disease surveys conducted in Manitoba, the fields were not surveyed at random. Instead, information on their location was obtained from producers. In each field, 50 flag leaves were collected at random and percentage of leaf area affected by LS (severity) was recorded using a scale from 1 (slightly affected) to 50 (leaves dead) (Fernandez 1998).

From each field, 1 cm² surface-disinfested leaf pieces were plated on V8 juice agar media amended with 0.02% streptomycin sulfate to promote pathogen sporulation for disease identification. Identification of LS pathogens involved microscopic examination and morphological characterization.

RESULTS AND COMMENTS: According to the Manitoba Agricultural Services Corporation’s Variety Market Share Report (MASC 2018), there were approximately 66,039 acres of commercial winter wheat seeded in Manitoba for 2018. The top five cultivars, based on their seed acreage, were ‘Emerson’ (49.1%), ‘AAC Gateway’ (33.3%), ‘CDC Falcon’ (8.3%), ‘AAC Elevate’ (2.3%) and ‘CDC Buteo’ (2.1%). ‘AAC Emerson’ was the predominant winter wheat cultivar grown in the fields sampled in this survey.

Leaf spot diseases were observed in all fields surveyed. The provincial mean LS severity was 13%. This severity was higher than in 2015 (9.5%), 2016 (5.9%) and 2017 (10.2%) (Henriquez et al. 2015, 2016, 2017). As reported for previous years (Henriquez et al. 2016, 2017, 2018) Pyrenophora tritici-repentis (tan spot) was the most prevalent and widespread LS pathogen in Manitoba, accounting for 67.7% of isolations. This species was detected in 83.3% of surveyed fields (Table 1).

ACKNOWLEDGEMENTS: We gratefully acknowledge the participation of Manitoba Agriculture Farm Production Extension Specialists for the collection of a portion of the cereal samples for this survey and the respective incidence and severity ratings, as well as Dr. Henriquez’s summer students Amber Bezte, Jordan Blatz, Ryland McCallum, Alisha Suderman, Gwendolyn Friesen, Jasmine Street, and Michael Pahl.
REFERENCES:
Fernandez MR. 1998. Percentage leaf spot infection. Laboratory protocols. Semi-Arid Prairie Agricultural Research Centre. AAFC, Swift Current, SK.

Table 1. Prevalence and isolation frequency of leaf spot pathogens in winter wheat fields in Manitoba in 2018.

<table>
<thead>
<tr>
<th>Pathogen</th>
<th>Prevalence %a</th>
<th>Frequency %b</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Pyrenophora tritici-repentis</em></td>
<td>83.3</td>
<td>67.7</td>
</tr>
<tr>
<td><em>Cochliobolus sativus</em></td>
<td>4.2</td>
<td>1.5</td>
</tr>
<tr>
<td><em>Stagonospora nodorum</em></td>
<td>58.3</td>
<td>30.8</td>
</tr>
</tbody>
</table>

*a* Prevalence = % of winter wheat fields from which the pathogen was isolated.

*b* Frequency = % of leaf spot pathogens isolated as a % of the total pathogen isolations.
CROP:  Spring Wheat  
LOCATION:  Manitoba  

NAMES AND AGENCIES:  
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Telephone 204-822-7551; Facsimile 204-822-7507; E-mail: MariaAntonia.Henriquez@canada.ca  
²Manitoba Agriculture, 65-3rd Avenue NE, Carman, MB R0G 0J0  

TITLE: LEAF SPOT DISEASES OF SPRING WHEAT IN MANITOBA IN 2018  

ABSTRACT: In 2018, leaf spot diseases were assessed in 145 spring wheat fields in Manitoba. Prevalence and isolation frequency of leaf spot pathogens showed that Pyrenophora tritici-repentis was the most prevalent and widespread pathogen, followed by Stagonospora nodorum.  

INTRODUCTION AND METHODS: A survey for leaf spot (LS) diseases of spring wheat was conducted between the milk and dough growth stages in 2018 (ZGS 73 – 85, Zadoks et al. 1974). A total of 145 spring wheat fields were sampled. In contrast to other disease surveys conducted in Manitoba, the fields were not surveyed at random. Instead, information on their location was obtained from producers. In each field, 50 flag leaves were collected at random and percentage of leaf area affected by LS (severity) was recorded using a scale from 1 (slightly affected) to 50 (leaves dead) (Fernandez 1998).  

From each field, 1 cm² surface-disinfested leaf pieces were plated on V8 juice agar media amended with 0.02% streptomycin sulfate to promote pathogen sporulation for disease identification. Identification of LS pathogens involved microscopic examination and morphological characterization.  

RESULTS AND COMMENTS: According to the Manitoba Agricultural Services Corporation’s Variety Market Share Report (MASC 2018), there were approximately 2,515,440 million acres of spring wheat seeded in Manitoba in 2018. The top five cultivars, based on seed acreage, were ‘AAC Brandon’ (65.1%), ‘AAC Elie’ (8.6%), ‘Cardale’ (7.2%), ‘AAC Viewfield’ (3.6%), and ‘Carberry’ (2.1%). ‘AAC Brandon’ was the predominant spring wheat cultivar grown in the fields sampled in this survey.  

Leaf spot diseases were observed in all of the fields surveyed. The provincial mean LS severity as 10.1%. As reported for previous years (Henriquez et al. 2015, 2016, 2017), Pyrenophora tritici-repentis (tan spot) was the most prevalent and widespread LS pathogen in Manitoba, accounting for 81.2% of isolations. This species was detected in 81% of surveyed fields. This was followed by Stagonospora nodorum (18.3%) detected in 28.6% of surveyed fields (Table 1).  

ACKNOWLEDGEMENTS: We gratefully acknowledge the participation of Manitoba Agriculture Farm Production Extension Specialists for the collection of a portion of the cereal samples for this survey and the respective incidence and severity ratings, as well as Dr. Henriquez’s summer students Amber Bezete, Jordan Blatz, Ryland McCallum, Alisha Suderman, Gwendolyn Friesen, Jasmine Street and Michael Pahl.
REFERENCES:
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Table 1. Prevalence and isolation frequency of leaf spot pathogens in spring wheat fields in Manitoba in 2018.

<table>
<thead>
<tr>
<th>Pathogen</th>
<th>Prevalence %a</th>
<th>Frequency %b</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pyrenophora tritici-repentis</td>
<td>81.0</td>
<td>81.2</td>
</tr>
<tr>
<td>Cochliobolus sativus</td>
<td>0.7</td>
<td>0.2</td>
</tr>
<tr>
<td>Stagonospora nodorum</td>
<td>28.6</td>
<td>18.3</td>
</tr>
<tr>
<td>Septoria tritici</td>
<td>0.7</td>
<td>0.2</td>
</tr>
</tbody>
</table>

a Prevalence = % of spring wheat fields from which the pathogen was isolated.
b Frequency = % of leaf spot pathogens isolated as a % of the total pathogen isolations.
CROP: Spring and Winter Wheat
LOCATION: Manitoba and eastern Saskatchewan

NAMES AND AGENCY:
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TITLE: LEAF RUST AND STRIPE RUST OF WHEAT IN MANITOBA AND EASTERN SASKATCHEWAN IN 2018

ABSTRACT: Field surveys for leaf and stripe rust were conducted during July and August 2018 in Manitoba and eastern Saskatchewan on winter and spring wheat. Wheat leaf rust was first reported in June in Manitoba and developed throughout the growing season.

INTRODUCTION AND METHODS: Trap nurseries and commercial fields of spring wheat in Manitoba and eastern Saskatchewan were surveyed for the incidence and severity of leaf rust (Puccinia triticina Erikss.) and stripe rust (Puccinia striiformis var. tritici Westend.) during July and August 2018. Winter wheat trials were examined for rust at trap nurseries in Manitoba in July.

RESULTS AND COMMENTS: Wheat leaf rust was found in nearly all surveyed locations but at low levels of severity, due to low precipitation throughout the growing season. Somewhat higher levels were observed in eastern Saskatchewan where rainfall was higher. Three winter wheat Manitoba Crop Variety Evaluation (MCVET) trials were surveyed in mid-July (the low number was due to winter kill on the remaining MCVET trials), and leaf rust severity was low on most varieties, with a high of 15% disease severity on susceptible varieties. Eleven spring wheat nurseries were surveyed in late-July to mid-August (seven MCVET trials, two Saskatchewan provincial trial locations and two Uniform Rust Nursery [URN] trials). At the MCVET locations, leaf rust was often at trace levels with up to 35% disease severity at the Arbog location in the Interlake region of Manitoba. At one Saskatchewan provincial location one variety was found to have 60% disease incidence. At the URN trials, highly susceptible varieties such as Morocco and Little Club had over 90% disease severity. Trace levels of leaf rust were found in four production fields, but was not found in the other fields surveyed. The average level of leaf rust severity in Manitoba was 3.5% and in eastern Saskatchewan it was 13.1% on susceptible varieties, compared to long term averages of 11.8% for Manitoba and 4.9% for Saskatchewan.

Stripe rust was rarely observed in this region in 2018 and when found it was at trace levels of severity.
ABSTRACT: Field surveys for stem rust were conducted from July to September 2018 in Manitoba and eastern Saskatchewan. No stem rust was observed in wheat and was at trace levels in barley and oat fields. For wheat/barley stem rust, races GFCSC (80%) and QFCSC (20%) were detected. For oat stem rust, race TJS was dominant (53%), followed by race TGN (29%). Five other races of oat stem rust were detected at low (2-5%) frequency in 2018. One new race (TGS) was found in six samples from wild oat in Manitoba in 2018 and threatens oat production in Canada.

RESULTS AND COMMENTS: Mean temperature was normal (-2 to +2°C) over the growing season, but mean precipitation was much below average (<40 to 85%) in July and August when rust infection normally occurs. Stem rust infection was absent in wheat fields and at trace levels in barley and oat fields. This was mainly attributed to the lack of inoculum blowing up from the United States, as very light levels of leaf, stripe, and stem rust were found in 2018 in the USA.

Similar as to what occurred in 2017 (Fetch & Zegeye 2018), stem rust pustules were hard to find in stands of wild barley (*Hordeum jubatum*) in 2018. Two races [GFCSC (80%) and QFCSC (29%)] were detected in 2018. Race GFCSC may have evolved from QFCSC, as the only difference is avirulence on gene *Sr5*.

Stem rust in cultivated and wild oat stands also was at trace levels in western Canada in 2018. Race TJS was dominant (53%) and attacks all commonly grown oat cultivars in Canada and the United States. The next prevalent race was TGN at 29%, and is not virulent on gene *Pg13*, which is in resistant Canadian oat cultivars. Five other races (SGB, SGD, TGD, TJJ, and TGS) were detected at low frequency. Race TGS is novel and was found in six samples of wild oat stands in Manitoba. Race TGS is a new threat to Canadian oat production, as it is virulent on the *Pg2*+*Pg13* combination and to *Pg*-a that are deployed in resistant oat cultivars.

REFERENCES:
CROP: Wheat
LOCATION: Saskatchewan

NAMES AND AGENCIES:
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TITLE: FUSARIUM HEAD BLIGHT IN COMMON AND DURUM WHEAT IN SASKATCHEWAN IN 2018

ABSTRACT: In 2018, Fusarium head blight (FHB) incidence and severity were assessed in 147 wheat crops (100 common wheat and 47 durum) in Saskatchewan. FHB occurred in 26% and 53% of the surveyed common and durum wheat crops respectively. The provincial mean FHB severities for common wheat and durum wheat were 0.07% and 1.31% respectively. FHB severity was assessed based on the presence of visual symptoms. Symptomatic kernels were further processed to determine the Fusarium species present. In both common and durum wheat Fusarium poae was the most prevalent species (61% and 71% respectively) with F. graminearum only present in 15% of common wheat and 40% of durum wheat fields with FHB symptoms in 2018.

INTRODUCTION AND METHODS: Fusarium head blight (FHB) incidence and severity were assessed in 147 wheat crops in Saskatchewan in 2018: 100 common wheat (Canada Western Red Spring and Canada Prairie Spring classes) and 47 durum wheat (Canada Western Amber Durum class). Fields and results were grouped according to soil zone (Zone 1 = Brown; Zone 2 = Dark Brown; Zone 3 = Black/Grey). In 2018, crop adjustors with the Saskatchewan Crop Insurance Corporation randomly collected 50 spikes from each wheat crop at the late milk to early dough stages (Lancashire et al. 1991). A subsample of 30 spikes per field was analyzed for visual FHB symptoms at the Crop Protection Laboratory in Regina. The number of infected spikes per crop and the number of infected spikelets in each spike were recorded. An FHB disease severity rating, also known as the FHB index, was determined for each wheat crop surveyed: FHB severity (%) = [% of spikes affected x mean proportion (%) of kernels infected] / 100. Mean FHB severity values were calculated for each soil/irrigation zone and for the whole province. Glumes or kernels with visible FHB symptoms were surface sterilized in 0.6% NaOCl solution for 1 min and cultured on modified potato dextrose agar to confirm presence of Fusarium spp. on infected kernels. A maximum of 20 symptomatic kernels per sample were selected to represent infected samples for confirmation and Fusarium spp. identification.

RESULTS AND COMMENTS: In 2018, approximately 3.2 million ha (7.8 million ac) of common spring wheat and 2.0 million ha (5.0 million ac) of durum wheat were seeded in Saskatchewan. The average yields in 2018 were 3.4 metric tonnes per ha (45.7 bu/ac) for common spring wheat and 3.4 metric tonnes per ha (34.6 bu/ac) for durum wheat (Statistics Canada 2018).

In 2018, FHB occurred in 26% and 53% of the surveyed common and durum wheat crops, respectively (Table 1). Prevalence and severity of FHB in common wheat was generally low across all three soil zones. Compared to 2017, the FHB prevalence and severity were slightly higher in soil zone 2 (8% prevalence, <0.01% severity in 2017 and 26% prevalence and 0.07% severity in 2018); while the prevalence was lower with a higher severity in soil zone 3 (37% prevalence, 0.7% severity in 2017 and 27% prevalence and 1.31% severity in 2018). Both the prevalence and severity of FHB were higher in durum wheat compared to common wheat in 2018 with an average prevalence of 53% and average severity of 1.31 in the province. The highest prevalence (62%) and severity (2.2%) occurred in the brown soil zone. Unlike in common wheat the prevalence and severity of durum wheat was higher in 2018 compared to 2017 (9%...
prevalence and <0.01% severity). Though dry conditions were experienced throughout a large part of the province in 2018, higher levels of FHB in durum in 2018 may be in part due to timely rains when the crop was susceptible to FHB infection and a higher level of genetic susceptibility in durum compared to some common wheat varieties.

In 2018, a total of 247 isolations were made from symptomatic kernels. The most frequently isolated causal pathogen was *F. poae*. This species was detected 67% of all wheat fields with FHB symptoms (6% of common wheat and 72% of durum wheat) and accounted for 52% of all isolations. This is consistent with the findings from 2017 and is likely driven by the environmental conditions during the growing season (Ziesman et al. 2018). *F. culmorum* was the second most prevalent species and was detected in 31% of symptomatic wheat fields (19% common wheat and 44% durum) and accounted for 13% of isolations. *F. graminearum*, the most aggressive FHB pathogen, was present in 27% of all wheat crops and was more prevalent in durum (40%) than in common wheat (19%). *Fusarium graminearum* accounted for 20% of the isolation which means that, though it was present in a fewer number of fields compared to *F. culmorum* it represented a higher proportion of the *Fusarium* isolates collected from symptomatic kernels. *F. sporotrichioides* was detected in 21% of wheat fields and accounted for 7% of all isolations, while *F. avenaceum* was only present in 10% of all wheat fields and accounted for 4% of all isolations. Of the total *Fusarium* isolations in 2018, 4% were classified as other *Fusarium* species and were present in 12% of wheat fields with FHB symptoms (Table 2).

ACKNOWLEDGEMENTS: We gratefully acknowledge the assistance of Saskatchewan Crop Insurance Corporation staff with the collection of cereal samples for this survey.

REFERENCES:
Statistics Canada. 2018. Table 32-10-0359-01- Estimated areas, yield, production, average farm price and total farm value of principal field crops, in metric units, annual, CANSIM database. [accessed: January 24, 2019]

Table 1. Prevalence and severity of fusarium head blight (FHB) in common wheat and durum wheat crops grouped by soil zone in Saskatchewan in 2018.

<table>
<thead>
<tr>
<th>Soil Zones</th>
<th>Common wheat</th>
<th>Durum</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Prevalence (no. of crops surveyed)</td>
<td>Mean FHB severity (range)</td>
</tr>
<tr>
<td>Zone 1</td>
<td>0% (4)</td>
<td>0% (0 – 1.51)</td>
</tr>
<tr>
<td>Zone 2</td>
<td>26% (27)</td>
<td>0.09% (0 – 1.46%)</td>
</tr>
<tr>
<td>Zone 3</td>
<td>27% (69)</td>
<td>0.06% (0 – 1.29%)</td>
</tr>
<tr>
<td>Overall</td>
<td>26% (100)</td>
<td>0.07% (0 – 1.46%)</td>
</tr>
<tr>
<td>Total/Mean</td>
<td>26% (100)</td>
<td>0.07% (0 – 1.46%)</td>
</tr>
</tbody>
</table>

*Prevalence = Number of crops affected / total crops surveyed.
Percent FHB severity = [% of spikes affected x mean proportion (%) of kernels infected] / 100.
N/a = not applicable. No durum crops were surveyed in soil zone 3 in 2018.*
Table 2. Prevalence of fields with *Fusarium* species detected in durum and common wheat crops with FHB symptoms in 2018.

<table>
<thead>
<tr>
<th>Crop</th>
<th><em>F. avenaceum</em></th>
<th><em>F. culmorum</em></th>
<th><em>F. graminearum</em></th>
<th><em>F. poae sporotrichioides</em></th>
<th>Other <em>Fusarium</em></th>
</tr>
</thead>
<tbody>
<tr>
<td>Durum</td>
<td>4</td>
<td>19</td>
<td>15</td>
<td>61</td>
<td>19</td>
</tr>
<tr>
<td>Common</td>
<td>16</td>
<td>44</td>
<td>40</td>
<td>72</td>
<td>24</td>
</tr>
<tr>
<td>Wheat Total</td>
<td>10</td>
<td>31</td>
<td>27</td>
<td>67</td>
<td>21</td>
</tr>
</tbody>
</table>

*a Fusarium spp. other than *F. avenaceum*, *F. culmorum*, *F. graminearum*, *F. poae*, or *F. sporotrichioides*.  


CROP: Wheat
LOCATION: Saskatchewan

NAMES AND AGENCY:
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TITLE: LEAF SPOT DISEASES OF WHEAT IN SASKATCHEWAN IN 2018

ABSTRACT: Leaf spot disease severity was assessed in the upper canopy and the causal pathogens were identified in 48 wheat crops from across Saskatchewan in 2018. Leaf spot severity in most fields was observed to be at very slight levels, with only a few crops exhibiting moderate levels. *Stagonospora nodorum* (Berk.) Castellini & E. G. Germano, *Cochliobolus sativus* (Ito & Kuriyabashi) Drechs. ex Dastur, *Pyrenophora tritici-repentis* (Died.) Drechs., and *Septoria tritici* Roberge in Desmaz., were the wheat pathogens isolated and identified by laboratory examination of diseased leaves.

INTRODUCTION AND METHODS: In 2018, 48 wheat crops from 10 Saskatchewan crop districts (2B, 3BN, 5A, 5B, 6A, 6B, 7A, 8A, 8B, and 9A) were surveyed between July 24 and August 16. During the survey, the overall severity of leaf spot in the upper canopy was assessed and rated as: 0 (no visible symptoms), trace (<1% leaf area affected), very slight (1-5%), slight (6-15%), moderate (16-40%), and severe (41-100%). From each crop, 10 flag or penultimate leaves were collected, dried, and stored in paper bags. The pathogens involved were identified in the laboratory by cutting approximately a one centimetre-long strip from each leaf, which was then surface sterilized; 10 pieces of infected leaf tissue from 10 different leaves of each field were plated on water agar. The leaf sections were sterilized with a 5% NaOCl and distilled water solution for three minutes, triple rinsed in sterile water, air dried, and plated in a petri dish on water agar and incubated for 4 to 5 days under light at room temperature. The leaf spotting pathogens were then identified based on morphology (Zillinsky 1983).

RESULTS AND COMMENTS: Among the 48 crops, 12% were categorized as having trace leaf spot levels, 44% as very slight, 27% as slight, 14% as moderate, and 3% as severe. Leaf spotting pathogens were identified in 32 crops and included *Stagonospora nodorum* (stagonospora nodorum blotch), *Cochliobolus sativus* (spot blotch), *Pyrenophora tritici-repentis* (tan spot), and *Septoria tritici* (septoria tritici blotch). Stagonospora nodorum blotch was the most common leaf spot disease and was detected in 18 of the 48 crops surveyed (38%), with an incidence on leaves of 6.5% (Table 1). Spot blotch and tan spot were the next most common diseases, detected in 13 (27%) and 10 (21%) of the 48 crops, with an incidence on leaves of 3.5% and 3.8%, respectively (Table 1). *Septoria tritici* blotch was the least common disease, found in only 5 (10%) of crops, with 1% incidence on the leaves (Table 1).

It was noted that the majority of wheat crops surveyed were planted on either canola or other cereal stubble. The most highly infected crops were observed in the eastern half of the province. According to a crop report by Saskatchewan Agriculture (2018), most of the province experienced below average rainfall, although small areas in the north-west and east had average or above average rainfall. Due to hot and dry conditions throughout June and July, lower yields were expected at the time of surveying; however, many growers achieved average yields. It was also noted that disease incidence was very low, as expected with dry conditions.

ACKNOWLEDGEMENTS: We are thankful for all of our summer students who helped survey and plate leaf samples for pathogen identification.
REFERENCES:

Table 1. Number of fields infected, prevalence, and incidence of leaf spot pathogens in wheat in Saskatchewan in 2018.

<table>
<thead>
<tr>
<th>Pathogen</th>
<th>Number of crops infected of the 48 surveyed</th>
<th>Prevalence&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Incidence&lt;sup&gt;b&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Stagonospora nodorum</em></td>
<td>18</td>
<td>38</td>
<td>6.5</td>
</tr>
<tr>
<td><em>Pyrenophora tritici-repentis</em></td>
<td>10</td>
<td>21</td>
<td>3.8</td>
</tr>
<tr>
<td><em>Cochliobolus sativus</em></td>
<td>13</td>
<td>27</td>
<td>3.5</td>
</tr>
<tr>
<td><em>Septoria tritici</em></td>
<td>5</td>
<td>10</td>
<td>1.0</td>
</tr>
</tbody>
</table>

<sup>a</sup>Percentage of crops infected.<br>
<sup>b</sup>Percentage of diseased leaves of the 480 leaf samples examined.
CROP: Common and Durum Wheat
LOCATION: Saskatchewan

NAMES AND AGENCIES:
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TITLE: LEAF SPOTTING DISEASES OF COMMON AND DURUM WHEAT IN SASKATCHEWAN IN 2018

ABSTRACT: The leaf spot (LS) disease complex was evaluated in common and durum wheat crops across Saskatchewan in 2018. Disease severity was compared relative to wheat species, soil zone, crop district, and cultivar. Mean LS severity was lower than in any of the previous three years. Common wheat had a slightly numerically higher mean disease severity than durum wheat. For both common and durum wheat, mean severity was numerically highest in the Brown soil zone. Pyrenophora tritici-repentis was the most prevalent (> 80%) pathogen isolated from both wheat species.

INTRODUCTION AND METHODS: A survey for leaf spot (LS) diseases of common and durum wheat in Saskatchewan was conducted between the milk and dough growth stages in 2018. A total of 142 common and durum crops were sampled in 19 crop districts (CD) in the three soil zones, of which 116 were evaluated (Fig. 1, Table 1). The number of fields included 32 in the Brown soil zone, 28 in the Dark Brown soil zone, and 56 in the Black/Gray soil zone. Among the crops sampled, 101 were identified as common and 41 as durum wheat.

Information on the agronomic practices employed was obtained from the producers for most fields sampled. For common wheat, of the 88 samples with crop rotation history, 71 had been preceded by an oilseed crop, 7 by a pulse, and 7 by a cereal; while the most frequently grown crop two years previously was cereal (53), oilseed (8), and pulse (8). For durum wheat, of the 41 samples with crop rotation history, 19 had been preceded by an oilseed crop, 19 by a pulse, and 1 by a cereal; while the most frequently grown crop two years previously was cereal (21), pulse (8) and oilseed (5). Overall for all samples, the most frequent previous pulse crop was lentil at >70%, while the most frequent previous oilseed crop was canola at >90%. Summer fallow was the least common practice, with only 3 common, and 2 durum wheat fields having been left fallow the previous year, and 4 durum wheat fields having left fallow two years previously. The tillage system was classified as conventional, minimum, or zero-till. Of the 86 common wheat samples with tillage information, 51 were under zero-till, 18 under minimum-till, and 17 under conventional-till, while the 38 durum wheat samples with tillage information, 30 were under zero-till, 7 under minimum-till, and 1 under conventional-till.

In regards to fungicide use, of the 77 common wheat samples with fungicide use information, 48% had been sprayed with a fungicide, while of the 39 durum wheat samples with fungicide use information, 26% had been sprayed. The most common time of fungicide application was from late June to early July, which would have been around early flowering.

Twenty-four common, and 11 durum, wheat cultivars were identified among the samples, the most popular (grown in 5 fields or more) being the common wheat cultivars ‘AAC Brandon’ (32), ‘CDC Landmark’ (7), ‘Cardale’ (5), and the durum wheat cultivars ‘Transcend’ (16) and ‘Brigade’ (5).
In each field, 50 flag leaves were collected at random and air-dried at room temperature. The percentage of leaf area affected by LS (severity) was recorded for each leaf, and a mean percentage leaf area with LS was calculated for each crop and CD. For crops with the greatest LS and which had not been sprayed with a fungicide, 1 cm² surface-disinfested leaf pieces were plated on water agar for identification and quantification of the causal LS pathogens.

RESULTS AND COMMENTS: LS symptoms were observed in 75 of the 86 common, and 37 of the 39 durum, wheat crops evaluated in 2018. The rest of the samples collected were too dry for a proper evaluation of LS severity. In individual crops, percentage flag leaf area affected ranged from zero to 20%. Individual samples with >5% of the flag leaf area affected constituted only 7.9% of the common wheat and 2.4% of the durum wheat samples. The overall mean percentage of spotting on the flag leaf was 1.9%, which was numerically lower than in 2015 (7.6%), 2016 (7.2%), and 2017 (2.6%) (Fernandez et al. 2016, 2017, 2018). Mean severity was slightly higher for common (2.1%), than durum (1.7%) wheat (Table 1). The low disease levels in 2018 could be attributed to very dry conditions experienced throughout the growing season by most of the province (Fig. 2).

Crops that had been sprayed with a fungicide(s) had a numerically lower mean LS severity (1.9% and 1.1% for common and durum wheat, respectively) than unsprayed crops (2.6% and 1.9% for common and durum wheat, respectively).

Influence of soil zone and crop district on LS severity
Soil zone and CD information was available for 77 common and 39 durum wheat crops. For both common and durum wheat, mean LS severity was numerically greatest in the Brown soil zone (Table 1). For common wheat, disease severity was lowest in the Dark Brown soil zone. In regards to CD, the numerically greatest mean LS severity in common wheat was observed in 4A/4B (south-west) and 1A/1B (south-east), followed by 5A/5B (east). For durum wheat, CDs 4A/4B also had the greatest mean disease severity.

Influence of cultivar on LS severity
Overall, for the most frequently-grown cultivars, the common wheat ‘AAC Brandon’ (mean LS of 3.2%) and the durum wheat “Transcend” (mean LS of 2.3%) had numerically higher disease severities than the other cultivars.

Causal pathogens
In both common and durum wheat, the most frequently isolated leaf spotting pathogen was Pyrenophora tritici-repentis (tan spot) at an overall mean of 84%, followed by the septoria leaf blotch complex pathogens (Table 1). Cochliobolus sativus (spot blotch) was not isolated from any sample.

REFERENCES:
Fig 1. Soil zone and crop district map with common (blue) and durum (red) wheat fields surveyed across Saskatchewan in 2018.
Table 1. Incidence and severity of leaf spotting diseases and percentage isolation of the most common leaf spotting pathogens in common and durum wheat crops, surveyed in Saskatchewan in 2018.

<table>
<thead>
<tr>
<th>Soil zone/Crop district</th>
<th>No. of crops</th>
<th>Mean severity(^b)</th>
<th><em>Pyrenophora tritici-repentis</em>(^c)</th>
<th><em>Stagonospora nodorum</em>(^c)</th>
<th><em>Septoria tritici</em>(^c)</th>
<th><em>Stagonospora avenae f. sp. triticea</em>(^c)</th>
<th><em>Cochliobolus sativus</em>(^c)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Soil Zone</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Common wheat:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 (Brown)</td>
<td>6</td>
<td>3.3</td>
<td>80.8/1</td>
<td>5.0/1</td>
<td>4.2/1</td>
<td>10.0/1</td>
<td>-/0</td>
</tr>
<tr>
<td>2 (Dark Brown)</td>
<td>16</td>
<td>1.2</td>
<td>66.7/1</td>
<td>17.5/1</td>
<td>6.7/1</td>
<td>9.2/1</td>
<td>-/0</td>
</tr>
<tr>
<td>3 (Black/Gray)</td>
<td>55</td>
<td>2.3</td>
<td>92.0/4</td>
<td>3.8/2</td>
<td>2.3/2</td>
<td>2.0/2</td>
<td>-/0</td>
</tr>
<tr>
<td><strong>Mean/total:</strong></td>
<td>77</td>
<td>2.0</td>
<td>85.9/6</td>
<td>6.3/4</td>
<td>3.3/4</td>
<td>4.5/4</td>
<td>-/0</td>
</tr>
<tr>
<td><strong>Durum wheat:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 (Brown)</td>
<td>26</td>
<td>2.0</td>
<td>82.5/3</td>
<td>6.4/1</td>
<td>7.5/2</td>
<td>3.6/1</td>
<td>-/0</td>
</tr>
<tr>
<td>2 (Dark Brown)</td>
<td>12</td>
<td>1.2</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>3 (Black/Gray)</td>
<td>1</td>
<td>0.5</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td><strong>Mean/total:</strong></td>
<td>39</td>
<td>1.7</td>
<td>82.5/3</td>
<td>6.4/1</td>
<td>7.5/2</td>
<td>3.6/1</td>
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<tr>
<td><strong>Crop District</strong></td>
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<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Common wheat:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1A/1B</td>
<td>11</td>
<td>4.1</td>
<td>83.3/2</td>
<td>8.8/1</td>
<td>3.3/1</td>
<td>4.6/1</td>
<td>-/0</td>
</tr>
<tr>
<td>2A/2B</td>
<td>2</td>
<td>1.8</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>3A/3B(^d)</td>
<td>1</td>
<td>1.0</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>4A/4B</td>
<td>2</td>
<td>8.8</td>
<td>80.8/1</td>
<td>5.0/1</td>
<td>4.2/1</td>
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</tr>
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<tr>
<td>6A/6B</td>
<td>13</td>
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<td>7A/7B</td>
<td>6</td>
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<td>-</td>
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<td>-</td>
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<tr>
<td>9A/9B</td>
<td>17</td>
<td>1.3</td>
<td>88.6/1</td>
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<td><strong>Durum wheat:</strong></td>
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<tr>
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<td>3A/3B(^d)</td>
<td>13</td>
<td>1.9</td>
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<td>10.0/1</td>
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<tr>
<td>4A/4B</td>
<td>8</td>
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<td>78.8/2</td>
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<td>6A/6B</td>
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<td>7A/7B</td>
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<td>0.3</td>
<td>-</td>
<td>-</td>
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<td>-</td>
</tr>
</tbody>
</table>

\(^a\) Number of crops sampled.  
\(^b\) Mean percentage flag leaf affected.  
\(^c\) Mean percentage fungal isolation/number of crops where the pathogen occurred. The number of crops where *P. tritici-repentis* was isolated is equivalent to the number of crops plated for fungal identification and quantification.  
\(^d\) '3A' includes CD 3AS and 3AN, '3B' includes CDs 3BS and 3BN.
Fig 2. Three month (May 7-July 31) percent of average precipitation. Normal precipitation based on 1981-2010 (Agriculture and Agri-Food Canada 2018).
CROP: Spring Wheat (*Triticum aestivum* L.)
LOCATION: Northeast Alberta

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TITLE: THE OCCURRENCE OF CEREAL CROP DISEASES IN NORTHEAST ALBERTA IN 2018

ABSTRACT: A total of 58 commercial cereal crops in northeastern Alberta, including 45 spring wheat, 7 barley, and 6 oat crops were surveyed for the occurrence of disease in mid-July and late August 2018. Symptoms of leaf blight, tan spot and spot blotch of spring wheat were observed at all locations with incidence ranging from 2% to 100%, but usually low severity. Stripe rust of spring wheat occurred in four fields near Fort Saskatchewan. *Fusarium* spp. and *Bipolaris sorokiniana* were most frequently recovered from root rot samples of wheat.

INTRODUCTION AND METHODS: The occurrence and severity of cereal diseases were visually estimated in 58 commercial cereal crops distributed across northeastern Alberta, including Edmonton, Fort Saskatchewan, Gibbons, Lamont, Newbrook and Red Water in mid-July and late August 2018 (Table 1). Leaf blight (*Stagonospora nodorum*), tan spot (*Pyrenophora tritici-repentis*) and spot blotch (*Cochliobolus sativus*) of spring wheat often coexisted on the same leaves and therefore were evaluated together in the survey, with symptoms assessed based on symptoms described by Bailey et al. (2003). Five randomly selected points from each crop were surveyed using a 'W'-shaped sampling pattern. At each of the sampling sites, 100 plants were randomly selected from within a 1 m² area to examine the incidence and severity of foliar disease. Severity was assessed on a 0-4 scale, where: 0 = healthy leaves, 1 = 1-25% leaf area infected, 2 = 26-50%, 3 = 51-75% area infected, 4 = >76% leaf area infected on the top five leaves. Powdery mildew (*Blumeria graminis*) and spike diseases including ergot (*Claviceps purpurea*), smut (*Ustilago tritici*) and sooty mold (*Alternaria* spp.) also were evaluated. Stripe rust severity was evaluated on a modified Cobb scale (Kiss & Veres 2017). Diseased leaf samples from each location were collected and the roots of severely stunted plants from low lying areas were dug from the ground and transported back to the laboratory. Five tissue pieces (3 x 5 mm²) were excised from each discolored root sample with a scalpel and cultured as per Chang et al. (2005) to isolate the pathogens associated with the disease complex. Recovered microbes were examined under a microscope after one week of incubation to determine their identity.

RESULTS AND COMMENTS: Although rainfall was adequate in early summer throughout the region, precipitation was below average after late July, with hot, dry conditions continuing up until mid to late August. Precipitation in more northern and easterly areas was greater than in the Edmonton, Vegreville and Camrose regions. Accumulated precipitation from early May to August ranged from 120 mm to 180 mm in this region.

Four of 45 crops of spring wheat near Fort Saskatchewan (FS) showed stripe rust (*Puccinia striiformis* f. sp. *tritici*) symptoms with disease incidences (DI) ranging from 0.4% to 74% and disease severity (DS) ranging from 1 to 10 on the Cobb scale (Table 1). The disease was not evenly distributed in each crop. Disease incidence reached 100% with the highest severity (4) in some areas of one crop near FS.

Leaf blight, tan spot and spot blotch were present in all the spring wheat crops surveyed. The DI was high in certain crops, but severity was low in mid-July. Overall, the incidence of those foliar diseases ranged from 2% to 100% with an average of 52%. Powdery mildew, loose smut and sooty mold were of minor importance on spring wheat during this survey. Powdery mildew was observed on two crops near Lamont with an average DI of 5.5% and DS of 0.8. Loose smut occurred in one field near Lamont at an incidence of just 2.4%. Sooty mold of wheat appeared on the glumes in the spikes with a low average DI (<1%) in each of two fields near FS and Edmonton and three fields near Lamont. Ergot was detected in 40 of 45 wheat crops surveyed, although the DI was generally low and ranged from 0 to 17%. The
disease was particularly prevalent in 13 crops near FS (Fig. 1). The highest infection rate was 17 ergot-infected spikes/m² and up to 3 ergot sclerotia per spike. Most plants with heavy ergot infection were located within 25 m of the field margins indicating an edge effect, which also was observed by Campbell & Friesen (1959). Root rot occurred in some fields in low-lying areas. Various Fusarium spp. and Bipolaris sorokiniana were isolated from diseased roots and crowns.

Loose smut (U. nuda) and ergot of barley occurred at a low incidence in a small number of crops surveyed near Edmonton, FS and Red Water. The spot form of net blotch (Pyrenophora teres f. maculata) was the major foliar disease on barley, with DI ranging from 8% to 98% with an average of 45.6%. The DS ranged from 1 to 3.6 with an average of 2.0.

Severe infection of oats by leaf blotch (Pyrenophora avenae, Stagonospora avenae) occurred in a mixed cropped field with barley near Red Water. The average DI was 82% and the average DS was 2.0. Five crops near Newbrook had a low DI (17.6%) for leaf blotch. The average DS was 0.7. No ergot was present in those fields.

ACKNOWLEDGEMENTS: We gratefully acknowledge the financial support provided by the Department of Agriculture and Forestry, Government of Alberta. We also thank Tom Carleton, Sturgeon Valley Fertilizers Inc., St. Albert, AB, for providing field locations and grower contact information.

REFERENCES:
Table 1. Incidence and severity of diseases of cereal crops in 58 fields in northeast Alberta in 2018.

<table>
<thead>
<tr>
<th>Crop</th>
<th>Disease</th>
<th>No. crops infected</th>
<th>Location</th>
<th>Disease incidence (DI, %)</th>
<th>Disease severity (DS, 0-4)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Range Average</td>
<td>Range Average</td>
</tr>
<tr>
<td>Wheat</td>
<td>Stripe rust</td>
<td>4</td>
<td>Fort Sask-</td>
<td>0.4 - 74 21</td>
<td>1 - 10</td>
</tr>
<tr>
<td></td>
<td>Leaf &amp; spot blotch, tan spot</td>
<td>45</td>
<td>All locations</td>
<td>2 - 100 52</td>
<td>1.0 - 3.4 1.6</td>
</tr>
<tr>
<td></td>
<td>Ergot</td>
<td>38</td>
<td>GB, FS, LM, RW</td>
<td>0 - 17 1.7</td>
<td>- z -</td>
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<tr>
<td></td>
<td>Powdery mildew</td>
<td>2</td>
<td>Lamont</td>
<td>5.0 - 6.0 5.5</td>
<td>0 - 2.0 0.8</td>
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<tr>
<td></td>
<td>Loose smut</td>
<td>1</td>
<td>Lamont</td>
<td>1 - 4 2.4</td>
<td>- -</td>
</tr>
<tr>
<td></td>
<td>Sooty mold</td>
<td>7</td>
<td>FS, Lamont, Edmonton</td>
<td>0 - 4 0.4</td>
<td>0 - 4 1.1</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Barley</td>
<td>Loose smut</td>
<td>1</td>
<td>Red Water</td>
<td>0 - 4 1.8</td>
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<td></td>
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<td>1</td>
<td>FS</td>
<td>0 - 2 0.4</td>
<td>- -</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1</td>
<td>Edmonton</td>
<td>0 - 2 0.6</td>
<td>- -</td>
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<tr>
<td></td>
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<td>1</td>
<td>FS</td>
<td>0 - 1 &lt;1</td>
<td>- -</td>
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<tr>
<td></td>
<td>Net blotch</td>
<td>3</td>
<td>Edmonton</td>
<td>8 - 98 45.6</td>
<td>1 - 3.6 2.0</td>
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<tr>
<td>Oat</td>
<td>Leaf blotch</td>
<td>1</td>
<td>Red Water</td>
<td>80 - 90 82</td>
<td>1.0 - 3.0 2.0</td>
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<tr>
<td></td>
<td></td>
<td>5</td>
<td>Newbrook</td>
<td>0 - 80 17.6</td>
<td>0 - 2.0 0.7</td>
</tr>
</tbody>
</table>

*Stripe rust severity was evaluated on a modified form of the Cobb scale where 0 = healthy leaves; 12 = leaf covered completely by lesions.

*Gibbons = GB, Fort Saskatchewan = FS, Lamont = LM, Red Water = RW.

*Leaf blotch (Stagonospora nodorum), tan spot (Pyrenophora tritici-repentis), spot blotch (Cochliobolus sativus), powdery mildew (Blumeria graminis), loose smut (Ustilago tritici), sooty mold (Alternaria spp.), ergot (Claviceps purpurea) of wheat; spot form of net blotch (Pyrenophora teres f. maculata); loose smut (U. nuda) of barley; leaf blotch (Pyrenophora avenae, Stagonospora avenae) of oats.

*z “-” data is not available.
Fig. 1. Heavily infected wheat crop with many ergots near Fort Saskatchewan, AB in 2018.
CROP: Wheat
LOCATION: Alberta

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TITLE: STRIPE (YELLOW) RUST OF CEREALS IN ALBERTA

ABSTRACT: During the 2018 growing season, 85 wheat fields were surveyed for stripe rust incidence and severity. Data were collected from 60 spring and 25 winter wheat fields, in addition 10 fields of barley and 10 grassy land sites were also surveyed. The area surveyed extended from Camrose County in central AB to Cardston in the south (Fig. 1). Commercial fields of winter wheat were free of infection this year, but infection was reported on seven-spring wheat fields, but very late in the season. No stripe rust infection was found on barley and grassy lands. Only one wheat field in Cardston had infection rated as severe (40%) as measured using the modified Cobb scale. The disease was rare this year, but lack of pathogen overwintering during the winter of 2017 and the extensive use fungicides coupled with dry summer conditions may have limited infection by rust this year.

INTRODUCTION AND METHODS: Commercial fields of winter and spring wheat in several counties in the region of central and southern Alberta were surveyed from late May to mid-August. Fields were inspected in "W" pattern until 10 sites separated by approximately 25 m were evaluated for both disease incidence and severity. Incidence ratings were reported as the number of infected plants within a 1 m² area, and severity as the average percent of the total leaf surface area covered with stripes per plant. Fields were classified based on the severity of infection as follows: clean (0%), trace (1 to 3%), light (3-5%), moderate (6-19%), and severe (20 to 100%).

RESULTS AND COMMENTS: In total, 85 commercial wheat fields were surveyed in 2018 summer; of these seven (8%) were infected, with one field (1%) rated as severe, and six (7%) rated as moderate for infection level (Table 1, Figure 1). Infected wheat was also reported in the Peace River region. The pathogen, Puccinia striiformis f. sp. tritici, likely did not overwinter in Alberta this year. In fall of 2017, stripe rust was observed in central Alberta in October, but was not found in southern AB, while infections in the spring and summer of 2018 were very late with low incidence.

REFERENCES:
Fig. 1. A map showing the level of infection in surveyed fields in 2018, 2017, and 2016. The color-coded circles indicate the severity level of stripe rust infection on wheat fields and the number inside each circle indicates number of fields surveyed in that municipality. Also included were barley fields (triangle shape) and grassy sites (rectangular shape) surveyed in 2018. For the circles and triangles, the colour coding is as follows: Dark green - clean fields; light green - trace or light; orange - moderate; and red - severe.
Table 1. Number of wheat fields surveyed and the corresponding stripe rust severity levels recorded in southern and central Alberta during the summer of 2018, 2017, 2016 and 2011.

<table>
<thead>
<tr>
<th>Field infection type</th>
<th>2018</th>
<th>2017</th>
<th>2016</th>
<th>2011</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clean</td>
<td>79 (93%)</td>
<td>48 (75%)</td>
<td>33 (61%)</td>
<td>47 (51%)</td>
</tr>
<tr>
<td>Light/Trace</td>
<td>0</td>
<td>12 (19%)</td>
<td>5 (9%)</td>
<td>25 (27%)</td>
</tr>
<tr>
<td>Moderate</td>
<td>6 (7%)</td>
<td>3 (5%)</td>
<td>10 (18%)</td>
<td>7 (7%)</td>
</tr>
<tr>
<td>Severe</td>
<td>1 (1%)</td>
<td>1 (1.5%)</td>
<td>6 (11%)</td>
<td>12 (13%)</td>
</tr>
</tbody>
</table>
INTRODUCTION AND METHODS: Field surveys in Manitoba were conducted during July 5th to July 9th, 2018, and in Saskatchewan, during July 24th to August 27th, 2018 to assess the incidence and severity of the smut diseases caused by Ustilago hordei, U. niga, U. nuda, U. tritici, U. avenae and U. kolleri. The area surveyed in Manitoba included crop districts 1, 2, 3, 7, 8, 9 and 11 and in Saskatchewan, crop districts 2A, 2B, 3BN, 5A, 5B, 6A, 6B, 7A, 7B, 8A, 8B, 9AE, and 9B. Fields were selected at random at approximately 15-30 km intervals, depending on the frequency of the crops in the area. In Manitoba, an estimate of the percentage of infected plants (i.e., plants with sori) was made while walking an ovoid path of approximately 100 m in each field. Levels of smut greater than trace were estimated by counting plants in a one m² area at a minimum of two sites on the path. In Saskatchewan, the percentage of infected plants was estimated by assessing a 5 m row at five random locations in a field and counting all the heads, and the number of infected heads. Fields with <0.01 % and <0.05% were considered as trace infection levels in Manitoba and Saskatchewan, respectively.

An isolate of smut was collected from each field with smutted plants in Manitoba. This was compared with a carboxin-sensitive isolate, ‘72-66’, of U. nuda from Canada, and a carboxin-resistant isolate, ‘Viva’, of U. nuda (Newcombe & Thomas 1991) from France, using the teliospore germination assay of Leroux (1986) and Leroux & Berthier (1988) to determine resistance to the fungicide carboxin. Teliospores of each isolate were streaked onto half-strength potato dextrose agar (PDA) amended with 1.0 μg ml⁻¹ of carboxin or unamended PDA. The cultures were incubated at 20°C in a controlled environment chamber and examined for teliospore germination after 24 h.

RESULTS AND COMMENTS:
Manitoba: Thirty-two fields of awned, 2 fields of awnless spring bread wheat were assessed for smutted plants. Smutted plants (infected with U. tritici) were found in one field of awned spring wheat at a 0.01% infection level, in crop district 8. Eleven fields of 2-row barley and none of 6-row barley were assessed, with smut-infected plants (U. nuda) observed in a 2-row barley field at a 0.01% infection level in crop district 7. No smut infected plants were observed among nine oat fields.

Saskatchewan: A total of 75 wheat fields were assessed in Saskatchewan with no smutted plants found. Fifty-two 2-row and 6-row barley fields were assessed, with smutted plants observed in two fields, one in crop district 5A and the other in crop district 5B, at trace levels.

None of the Ustilago spp. strains collected in Manitoba in 2018 was able to germinate and grow on agar medium amended with carboxin. Smut collections from Saskatchewan were not assessed for carboxin sensitivity.
REFERENCES:
CROP: Spring Wheat
LOCATION: Central and eastern Ontario

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TITLE: DISEASES OF SPRING WHEAT IN CENTRAL AND EASTERN ONTARIO IN 2018

ABSTRACT: Twenty-nine spring wheat fields in Central and Eastern Ontario were surveyed for diseases in 2018. Of the 13 diseases observed, take-all, septoria glume blotch, and septoria/stagonospora leaf blotch were most prevalent, having moderate to severe levels of infection in 9, 5, and 3 fields, respectively. Fusarium head blight (FHB) was observed in 25 fields with low severities. Fusarium graminearum and F. poae were the predominant species isolated from the FHB-infected kernels.

INTRODUCTION AND METHODS: A survey for spring wheat diseases was conducted in Central and Eastern Ontario during the third week of July when plants were at the soft dough stage of development. Twenty-nine fields were chosen at random in regions where most of the spring wheat was grown. Foliar disease severity was determined on 10 flag and penultimate leaves sampled at each of the three random sites per field, using a rating scale of 0 (no disease) to 9 (severely diseased). Disease diagnosis was based on visual symptoms. Average severity scores of <1, <3, <6, and ≥6 were considered as trace, slight, moderate, and severe disease levels, respectively. The severity of ergot, loose smut, and take-all was based on the percentage of plants infected at each of the three random sites per field. FHB was rated for incidence (% infected spikes) and severity (% infected spikelets in the affected spikes) based on approximately 200 spikes at each of the three sites per field. An FHB index [(% incidence x % severity)/100] was determined for each field. The percentage of infected plants or FHB index values of <5, <10, <20, and ≥20% were considered as slight, moderate, severe, and very severe disease levels, respectively.

RESULTS AND COMMENTS: Thirteen diseases or disease complexes were observed (Table 1). Stagonospora glume blotch (Stagonospora nodorum) and septoria/stagonospora leaf blotch (normally associated with the pathogens Septoria tritici and Stagonospora spp.) were the most important foliar diseases and were found in 25 and 27 fields at average severities of 2.4 and 2.0 respectively. Moderate to severe levels of infection from the two diseases were observed in 5 and 3 fields, respectively. Yield reductions due to these diseases were estimated to have averaged <5% in affected fields. Other foliar diseases observed included bacterial leaf blight (Pseudomonas syringae pv. syringae), leaf rust (Puccinia triticina), powdery mildew (Blumeria graminis f. sp. tritici), spot blotch (Cochliobolus sativus), stem rust (Puccinia graminis), stripe rust (Puccinia striiformis f. sp. tritici) and tan spot (Pyrenophora tritici-repentis). These diseases were found in 22, 2, 1, 26, 5, 1, and 21 fields at average severities of 1.1, 1.5, 3.0, 1.2, 1.4, 2.0, and 1.6, respectively. No moderate or severe levels of infection were observed and these diseases likely caused little to no yield reduction.

Ergot (Claviceps purpurea), loose smut (Ustilago tritici) and take-all root rot (Gaeumannomyces graminis var. tritici) were observed in all fields at incidence levels of 0.6, 0.5, and 2.3%, respectively (Table 1). Moderate to severe levels of infection from ergot and loose smut were not observed, while moderate to...
severe take-all was found in nine fields. Yield reductions due to take-all were estimated to be >2% in affected fields.

FHB was observed in 25 fields at a mean FHB index of 1.5% (range 0.01-24.0%) (Table 1). Moderate to severe FHB infection was found in three fields only and the disease did result in a significant loss of grain yield and quality in 2018. Six *Fusarium* species were isolated from putative fusarium-damaged kernels (Table 2). *Fusarium graminearum* and *F. poae* predominated and occurred in 24% and 59% fields and on 3.2% and 3.7% of kernels, respectively. *Fusarium sporotrichioides* and *F. avenaceum* were less common and each found in 24-38% of fields and on 1.0-1.5% of kernels. *Fusarium acuminatum* and *F. equiseti* were least common, occurring in 7-10% of fields and 0.1-0.3% of kernels.

The 13 diseases observed on spring wheat in Ontario in 2018 were the same as those recorded for 2017 (Xue et al. 2018). Overall, the incidence and severity of these diseases were generally lower in 2018 than in 2017. The less frequent rain events in June and July in 2018 compared with 2017 in Central and Eastern Ontario were likely responsible for the decreased disease severities observed.

**REFERENCE:**

**Table 1.** Prevalence and severity of spring wheat diseases in Central and Eastern Ontario in 2018.

<table>
<thead>
<tr>
<th>Disease</th>
<th>No. of fields affected</th>
<th>Disease severity in affected fields&lt;sup&gt;a&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(n=29)</td>
<td>Mean</td>
</tr>
<tr>
<td>Bacterial blight</td>
<td>22</td>
<td>1.1</td>
</tr>
<tr>
<td>Leaf rust</td>
<td>2</td>
<td>1.5</td>
</tr>
<tr>
<td>Powdery mildew</td>
<td>1</td>
<td>3.0</td>
</tr>
<tr>
<td>Septoria glume blotch</td>
<td>25</td>
<td>2.4</td>
</tr>
<tr>
<td>Septoria/Stagonospora leaf blotch</td>
<td>27</td>
<td>2.0</td>
</tr>
<tr>
<td>Spot blotch</td>
<td>26</td>
<td>1.2</td>
</tr>
<tr>
<td>Stem rust</td>
<td>5</td>
<td>1.4</td>
</tr>
<tr>
<td>Stripe rust</td>
<td>1</td>
<td>2.0</td>
</tr>
<tr>
<td>Tan spot</td>
<td>21</td>
<td>1.6</td>
</tr>
<tr>
<td>Ergot (%)</td>
<td>29</td>
<td>0.6</td>
</tr>
<tr>
<td>Loose smut (%)</td>
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<td>0.5</td>
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<tr>
<td>Take-all (%)</td>
<td>29</td>
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<td>Fusarium head blight&lt;sup&gt;b&lt;/sup&gt;</td>
<td>25</td>
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<tr>
<td>Incidence (%)</td>
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<tr>
<td>Severity (%)</td>
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<tr>
<td>Index (%)</td>
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</table>

<sup>a</sup>Foliar disease severity was rated on a scale of 0 (no disease) to 9 (severely diseased); ergot, loose smut, and take-all severity was based on % plants infected.

<sup>b</sup>FHB Index = (% incidence x % severity)/100.
Table 2. Prevalence of *Fusarium* species isolated from fusarium damaged wheat kernels in central and eastern Ontario in 2018.

<table>
<thead>
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<th><em>Fusarium</em> spp.</th>
<th>% affected fields</th>
<th>% affected kernels</th>
</tr>
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<td><em>F. poae</em></td>
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<td>3.7</td>
</tr>
<tr>
<td><em>F. sporotrichioides</em></td>
<td>37.9</td>
<td>1.5</td>
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INTRODUCTION AND METHODS: In 2018, dry and hot weather in the months of May to July, and warm and rainy weather in August and September in most parts of Ontario resulted in higher heat units, faster growth of plants, and lower incidence and severity of almost all diseases compared to the previous three years (Jindal et al. 2016, 2017, and 2018). A total of 177 corn fields were surveyed across Ontario from September 10-20, 2018 to document the occurrence of various corn diseases, including anthracnose leaf blight and ear rot (ALB) (Colletotrichum graminicola (Ces.) G.W. Wilson); eyespot (Aureobasidium zeae (Narita & Hiratsuka) Dingley); gray leaf spot (GLS) (Cercospora zeae-maydis Tehon & E.Y. Daniels); northern corn leaf blight (NCLB) (Exserohilum turricum (Pass.) K.J. Leonard and E.G. Suggs); northern corn leaf spot (NLS) (Bipolaris zeicola (G.L. Stout) Shoemaker); common rust (Puccinia sorghi Schwein.); southern rust (P. polyspora Underw.); common smut (Ustilago maydis (DC.) Corda); head smut (Sphacelotheca reiliana (Kuhn) G.P. Clinton); physoderma brown spot (Physoderma maydis Miyabe (Miyabe)); ear rot (Fusarium spp.); stalk rot (Fusarium spp., and Colletotrichum graminicola); and Stewart’s bacterial wilt (Pantoea stewartii Mergaert et al.). The 2018 corn disease survey provides vital information on populations of endemic pathogens and scouting for new invasive pathogens such tar spot of corn (Phyllachora maydis Maubl. (Parbery 1967, 1971)) which was first detected in Illinois and Indiana in 2015, and Goss’s bacterial wilt and blight (Clavibacter michiganensis subsp. nebraskensis Vidaver & Mandel (Davis et al.) which has been reported from many parts of Manitoba and Alberta (Harding et al. 2018).

In addition to disease occurrence, the incidence (number of affected plants) and severity of the major leaf diseases (common rust, eyespot, GLS, NLS, and NCLB) were assessed visually in each of the 177 selected fields based on 20 plants at each of five points located approximately 10 m apart and 5 m from the field edge (Fig 1). A rating scale of 1-7 based on percent leaf area affected by the disease (1 = no
Disease incidence was recorded based on the number of plants with a particular disease symptom. Four to six leaves displaying typical NCLB symptoms (long, elliptical, 2-15 cm, tan or greyish-green necrotic lesions) were collected from each field visited for *E. turcicum* race identification and distribution patterns. Additional symptomatic plant parts were also collected for subsequent laboratory analysis, especially for unidentifiable or suspected Goss’s bacterial wilt and Stewart’s bacterial wilt. GPS coordinates of the sampled fields were also recorded and used to map locations (Fig. 1).

**RESULTS AND DISCUSSION:** Northern corn leaf blight, which has become the most common foliar corn disease in Ontario, was found in all the fields sampled with significantly higher disease severity and incidence compared to previous years (Table 1). Fifty-nine of the 177 fields with NCLB had incidences ≥30% and 77 had severity ratings ≥4. The most affected fields were found in 15 counties of the 17 surveyed across the province: Chatham-Kent (11), Huron (9), Oxford (8), Elgin (6), Middlesex (6), Lambton (5), Northumberland (5), Stormont, Dundas & Glengarry (5), Leeds and Greenville (4), Waterloo (4), Dufferin (3), Essex (3), Renfrew (3), Ottawa (2), and Perth (2), illustrating that NCLB is widespread across Ontario. Unlike earlier years, the disease was found in 100% of the fields sampled across the province; however, the mean disease incidence in affected fields was greater in Western (28.9±30.1%), Southern (24.3±18.6%), and Central Ontario (38.2±37.9%) than Eastern Ontario (19.8±23.2%). Only ten fields in Eastern Ontario had disease incidences of ≥30% compared to 30 in Southern Ontario. Mean disease severity in affected fields was near identical in Eastern (3.2±1.1), Southern (3.5±1.1) and Western (3.7±1.7) Ontario (Table 2). Furthermore, all seven seed corn fields surveyed in Chatham-Kent county had an identical disease severity (3.6±0.5) and disease incidence (23.6±9.4%) to the 20 commercial corn fields (3.3±1.2; 20.5±15.7%). The high incidence of NCLB in the Ontario corn crop, particularly in Southern Ontario, has always been a cause for concern since yield losses are associated with the disease. But, this year, overall incidence and severity was not as high as in previous years possibly due to a combination of climatic factors, fungicide applications and a change in hybrid use pattern. There is a need to keep an eye on the disease occurrence and to look for additional environmentally friendly disease management strategies such as development of new NCLB *Ht* gene/inbreds and their incorporation into high yielding commercial corn hybrids.

Variability in commercial corn hybrid reactions to NCLB was evident from inspection of the 17 Ontario Corn Committee (OCC) 2018 performance trials, of which four locations (Dundalk, Elora, Orangeville and Port Hope) had very high disease severity ratings (≥5) and one location (Bainsville) had a low disease severity rating ≤2 (Table 3).

The 177 surveyed sites will be used to map the geographical distribution of physiological races of *E. turcicum*. It is not uncommon to find both resistant and susceptible NCLB lesion types on the same leaf. Likewise, we observed that the reaction of some of the hybrids to NCLB differed depending on where they were grown in Ontario, suggesting the presence of different races of *E. turcicum*, as has been reported in previous years (Zhu et al. 2013; Jindal et al. 2019). To verify this, and to map the distribution of such races in corn-growing regions of Ontario, 180 leaf samples with NCLB symptoms were collected during the survey.

**Common rust** was the fourth most prevalent foliar disease detected in Ontario corn in 2018. It was found in 117 (66%) fields sampled (Table 1) at a mean disease severity of 2.0±1.1 and an incidence of 7.1±12.7% which is considerably lower than 2017 (Table 2). Only 3% of the sampled fields had disease incidence ≥40%. High levels of common rust (≥4) were recorded in 11 fields distributed across six of the 17 counties visited. Overall, like NCLB and eyespot, common rust severity in affected fields was near identical in Eastern (2.3±0.7), Southern (1.7±1.1) and Western (2.1±1.1) Ontario (Table 2). At all OCC sites, some of the commercial and experimental hybrids exhibited moderate to high resistance to common rust, assuming that infection was uniform and severe throughout the field. In the nine seed corn plots sampled, common rust was detected in three fields.
Southern rust, which has been common in regions of the southern and mid-central U.S., was found in eight of the 80 fields sampled in Southern Ontario with mean disease severity of 3.7 and incidence of 28.0%. Three sampled fields had an incidence of ≥50%. Southern rust was found only in one field in Eastern Ontario.

**Eyespot** was less prevalent in 2018 compared to previous years, particularly 2015. This disease was found in 140 (79%) of the fields sampled (Table 1) at a mean severity of 2.7±1.4 and an incidence of 14.3±20.9% (Table 2). Forty-one of the 140 affected fields had severity levels of ≥4 and 26 had disease incidence ≥35%. Like 2017, eyespot was less common in Southern Ontario (58%) compared to Eastern Ontario (94% of fields affected). However, five individual fields in Southern Ontario had high eyespot severity ratings of ≥4.0, compared to the mean eyespot severity of 2.7 in affected fields in Ontario. The less widespread distribution of eyespot in Ontario was further demonstrated by the elevated severity ratings of ≥4 in only one third of corn fields sampled. Many of the hybrids included in the OCC trials planted at Dundalk, Elora, Orangeville, Port Hope, Waterloo and Winchester, exhibited variable levels of resistance to eyespot. These hybrids need to be identified for cultivation in the province.

**Gray leaf spot** was found in 114 (64%) of the fields sampled (Table 1). Compared to last three years, GLS was more widely spread in Ontario in 2018. The disease was more severe in two Southern Ontario counties (Chatham-Kent and Essex), the same as reported in 2017 (Jindal et al. 2018). At the OCC trial in Belmont, Dresden, Ridgetown and Tilbury some hybrids were highly susceptible to GLS, as was the case for various hybrids in demonstration plots in Chatham-Kent and Essex. Like earlier years, GLS has been a major concern in the extreme southwest (Chatham-Kent and Essex) where factors such as increased corn residues, intensive hybrid and seed corn production, and humid conditions have favoured its development. This is in stark contrast to the U.S. Midwest corn-belt, where GLS occurs throughout the region and is the most economically important foliar corn disease (Wise 2012). In Eastern Ontario, where 48 fields were sampled, GLS was detected in 12 fields spread across three counties: Ottawa, Renfrew, and Stormont, Dundas & Glengarry but incidence was very low (1.3±0.5). This is the first time GLS was found in Eastern Ontario.

**Northern leaf spot** (NLS) was found in 159 fields (90%) out of 177 visited across Ontario. Incidence (11.4±13.7) and severity (2.6±1.0) were considerably higher compared to earlier years (Jindal et al. 2018). In Southern and Western Ontario, where 120 fields were sampled, NLS was detected in 107 fields with 12 fields having disease severity ≥4.0. The disease was also detected in 88% of the fields sampled in Eastern Ontario where incidence (3.7±4.7%) was significantly lower compared to Southern (17.0±16.7%) and Western Ontario (11.0±10.2%). There is a need to keep an eye on the distribution of NLS and to look for additional environmentally friendly disease management strategies to keep the disease in check.

**Other leaf diseases:** Another disease, with long narrow, linear (0.5-2 x 15-40 mm) lesions/streaks, greyish tan in colour surrounded by a light to dark pigmented border on the corn leaves, was detected in 40 of 177 fields sampled. Most of the fields were in Southern and Western Ontario. Symptoms were similar to bacterial leaf streak or race 3 of the NLS fungus. In the initial isolation, *Bipolaris zeicola* was obtained from the leaves with long streaks. Further work on isolations and diagnosis is in progress. Holcos leaf spot and physoderma leaf spot were other leaf spots found in a few fields visited.

**Anthracnose leaf blight and dieback** was detected in only 30 fields (17%); more than the last and previous years.

**Fungal ear and stalk rot diseases:** *Common smut* and *head smut* were found in 36 (20%) of sampled fields (Table 1); more than last year. There were only five fields with incidence greater than 3%. Head smut was found in one field in 2018. *Ear rot* was found in 75 (42%) of the fields visited at a low to high incidence (1 to 32 %) with an average incidence of 2.9±3.8%. Ear rot was detected in a significantly higher number of corn fields sampled in Southern and Western Ontario (47%) than in Eastern Ontario (25%). Average ear rot incidence was also higher in the fields sampled in Western (4.5%) compared to Southern (2.6%) or Eastern and Central Ontario (1.3%). In general, ears with exposed tips were found to have more *Fusarium* spp. infection compared to other fungi. *Stalk rot* was not found in any of the fields visited. The incidence and occurrence of ear and stalk diseases at the time of the survey suggests the
occurrence of these diseases was very high in 2018 compared to earlier years; however, timing of this survey was likely too early to detect exact levels of ear and stalk rots. Similar observations were made in another corn survey conducted by the Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA) along with Ontario Agri Business Association (OABA) from September 21 to 28, 2018, in which visual mold symptoms were more apparent compared to earlier years. Sixty percent of tested grain samples exhibited less than 2 ppm DON which was also much less than has been observed in recent years. Twenty-five percent of samples had a DON of 5% or greater which was a greater incidence of samples with elevated DON concentrations compared to earlier years (Rosser & Tenuta 2018).

Stewart's bacterial wilt, which historically has been the most economically important disease in Ontario seed corn production, once again was not detected in any of the seed or commercial corn fields sampled during 2018. The decline in Stewart's bacterial wilt in Ontario, as well as in the U.S., has been attributed to the effective control of its vector, the corn flea beetle, through the use of neonicotinoid seed treatment (Chaky et al. 2013). Likewise, Goss's bacterial wilt and blight was also not found in Ontario.

ACKNOWLEDGEMENTS: This survey was supported in part by the AAFC Growing Forward Partnership with the Canadian Field Crop Research Alliance (CFCRA) and GFO through funding from the Canadian Agricultural Partnership (CAP), a federal-provincial-territorial initiative which is administered by the Agricultural Adaptation Council. We would also like to thank our grower co-operators, various seed companies (Horizon Seeds, Hyland Seeds, Maizex Seeds, Mycogen Seeds, Pioneer Hi-Bred, and Pride Seeds) and the Ontario Corn Committee (OCC) for access to their fields.

REFERENCES:
Fig. 1. 2018 Ontario corn diseases survey sampling sites indicated by blue circles.
Table 1. Disease occurrence in Ontario corn crops in 2018 grouped by county and region.

<table>
<thead>
<tr>
<th>County</th>
<th>No. crops</th>
<th>ALB</th>
<th>Eye-spot</th>
<th>GLS</th>
<th>NCLB</th>
<th>NLS</th>
<th>Rusts</th>
<th>Smut</th>
<th>Ear rots</th>
<th>Stalk rot</th>
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ALB = anthracnose leaf blight and die back, GLS = gray leaf spot, NCLB = northern corn leaf blight, Rust = common and southern rust, Smut = common smut, Ear rot = includes gibberella ear rot and fusarium ear rot, Stalk rot = includes fusarium stalk rot and pythium stalk rot.
Table 2. Severity and incidence of major diseases in Ontario corn crop in 2018, grouped by county and region.

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<th>Mean ±SD</th>
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<td>4.2±2.0</td>
</tr>
<tr>
<td>Wellington</td>
<td>3.7±2.0</td>
</tr>
<tr>
<td>Central Ontario</td>
<td>4.1±1.5</td>
</tr>
<tr>
<td>Eastern Ontario</td>
<td>2.8±1.1</td>
</tr>
<tr>
<td>Southern Ontario</td>
<td>2.0±1.2</td>
</tr>
<tr>
<td>Western Ontario</td>
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<tr>
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<td>2.7±1.4</td>
</tr>
<tr>
<td></td>
<td>GLS</td>
</tr>
<tr>
<td></td>
<td>Severity a</td>
</tr>
<tr>
<td>Chatham-Kent</td>
<td>3.2±1.1</td>
</tr>
<tr>
<td>Dufferin</td>
<td>1.1±0.4</td>
</tr>
<tr>
<td>Durham</td>
<td>1.0±0.0</td>
</tr>
<tr>
<td>Elgin</td>
<td>2.1±0.9</td>
</tr>
<tr>
<td>Essex</td>
<td>3.1±0.7</td>
</tr>
<tr>
<td>Huron</td>
<td>1.6±0.7</td>
</tr>
<tr>
<td>Lambton</td>
<td>2.5±0.4</td>
</tr>
<tr>
<td>Leeds &amp; Grenville</td>
<td>1.0±0.0</td>
</tr>
<tr>
<td>Middlesex</td>
<td>3.0±1.7</td>
</tr>
<tr>
<td>Northumberland</td>
<td>2.0±0.0</td>
</tr>
<tr>
<td>Ottawa</td>
<td>1.3±0.5</td>
</tr>
<tr>
<td>Oxford</td>
<td>1.1±1.6</td>
</tr>
<tr>
<td>Perth</td>
<td>3.4±2.4</td>
</tr>
<tr>
<td>Renfrew</td>
<td>1.2±0.4</td>
</tr>
<tr>
<td>Stormont, Dundas &amp; Glengarry</td>
<td>1.1±1.2</td>
</tr>
<tr>
<td>Waterloo</td>
<td>1.9±0.8</td>
</tr>
<tr>
<td>Wellington</td>
<td>2.4±2.5</td>
</tr>
<tr>
<td>Central Ontario</td>
<td>1.3±1.3</td>
</tr>
<tr>
<td>Eastern Ontario</td>
<td>0.6±1.1</td>
</tr>
<tr>
<td>Southern Ontario</td>
<td>13.3±15.7</td>
</tr>
<tr>
<td>Western Ontario</td>
<td>2.2±2.2</td>
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<tr>
<td>All Ontario</td>
<td>6.8±12.2</td>
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<tr>
<td></td>
<td>NCLB</td>
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<tr>
<td></td>
<td>Severity a</td>
</tr>
<tr>
<td>Chatham-Kent</td>
<td>3.3±1.2</td>
</tr>
<tr>
<td>Dufferin</td>
<td>3.7±2.2</td>
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<tr>
<td>Durham</td>
<td>7.5±2.1</td>
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<tr>
<td>Elgin</td>
<td>4.0±0.8</td>
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<tr>
<td>Essex</td>
<td>3.0±1.0</td>
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<tr>
<td>Huron</td>
<td>2.6±0.4</td>
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<tr>
<td>Lambton</td>
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</tr>
<tr>
<td>Leeds &amp; Grenville</td>
<td>3.6±1.0</td>
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<tr>
<td>Middlesex</td>
<td>18.2±10.9</td>
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<tr>
<td>Northumberland</td>
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</tr>
<tr>
<td>Ottawa</td>
<td>2.8±0.3</td>
</tr>
<tr>
<td>Oxford</td>
<td>4.0±0.8</td>
</tr>
<tr>
<td>Perth</td>
<td>3.0±1.0</td>
</tr>
<tr>
<td>Renfrew</td>
<td>2.2±1.2</td>
</tr>
<tr>
<td>Stormont, Dundas &amp; Glengarry</td>
<td>3.6±1.0</td>
</tr>
<tr>
<td>Waterloo</td>
<td>2.8±0.3</td>
</tr>
<tr>
<td>Wellington</td>
<td>3.0±1.0</td>
</tr>
<tr>
<td>Central Ontario</td>
<td>4.0±0.8</td>
</tr>
<tr>
<td>Eastern Ontario</td>
<td>3.0±1.0</td>
</tr>
<tr>
<td>Southern Ontario</td>
<td>2.2±1.2</td>
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<tr>
<td>Western Ontario</td>
<td>3.6±1.0</td>
</tr>
<tr>
<td>All Ontario</td>
<td>2.5±1.1</td>
</tr>
</tbody>
</table>

a Disease severity in affected crop was rated as percentage of leaf area with symptoms; common rust, eyespot, GLS (gray leaf spot) and NLS (northern leaf spot) were rated on a 1-7 scale (1=no symptoms, 2=<1%, 3=1-5%, 4=6-20%, 5=21-50%, 6=51-75% leaf area with symptoms and 7=most of the leaves dead); NCLB (northern corn leaf blight) on 1-7 scale based on percentage of leaf area with symptoms (1=no symptoms; 2=<1% (1% leaves with symptoms); 3=1-5% (1-10% leaves with symptoms); 4=6-20% (11 to 25% leaves with symptoms); 5=21-50% (>50% lower leaves and >25% of the center and upper leaves with symptoms); 6=51-75% (lower leaves dead, >50 center leaves and >25% upper leaves with symptoms); 7=most leaves almost dead.)

b Incidence is number of affected plants/total number of plants observed x 100.
Table 3. Severity and incidence of major diseases observed at OCC\textsuperscript{a} corn trial sites in Ontario, 2018.

<table>
<thead>
<tr>
<th>OCC\textsuperscript{a} Trial Site</th>
<th>Common rust</th>
<th>Eyespot</th>
<th>GLS</th>
<th>NCLB</th>
<th>Ear rot</th>
</tr>
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<tbody>
<tr>
<td>Bainsville</td>
<td>1.5</td>
<td>3.0</td>
<td>2.0</td>
<td>1.5</td>
<td>1</td>
</tr>
<tr>
<td>Belmont</td>
<td>3.5</td>
<td>1.5</td>
<td>3.5</td>
<td>3.0</td>
<td>15</td>
</tr>
<tr>
<td>Blyth</td>
<td>2.5</td>
<td>15</td>
<td>2.0</td>
<td>2</td>
<td>4.0</td>
</tr>
<tr>
<td>Dresden</td>
<td>2.0</td>
<td>2</td>
<td>4.0</td>
<td>4.0</td>
<td>4.0</td>
</tr>
<tr>
<td>Dundalk</td>
<td>5.0</td>
<td>60</td>
<td>1.0</td>
<td>0</td>
<td>5.0</td>
</tr>
<tr>
<td>Elora</td>
<td>3.0</td>
<td>20</td>
<td>4.0</td>
<td>2</td>
<td>5.0</td>
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<tr>
<td>Exeter</td>
<td>1.5</td>
<td>3.0</td>
<td>2.0</td>
<td>2</td>
<td>3.5</td>
</tr>
<tr>
<td>Ilderton</td>
<td>2.5</td>
<td>5</td>
<td>2.0</td>
<td>5</td>
<td>4.0</td>
</tr>
<tr>
<td>Orangeville</td>
<td>4.0</td>
<td>33</td>
<td>1.0</td>
<td>0</td>
<td>5.0</td>
</tr>
<tr>
<td>Ottawa</td>
<td>2.5</td>
<td>5</td>
<td>2</td>
<td>0</td>
<td>3.0</td>
</tr>
<tr>
<td>Port Hope</td>
<td>3.5</td>
<td>25</td>
<td>2.0</td>
<td>2</td>
<td>5.0</td>
</tr>
<tr>
<td>Ridgetown</td>
<td>2.5</td>
<td>7</td>
<td>3.0</td>
<td>42</td>
<td>3.0</td>
</tr>
<tr>
<td>Tilbury</td>
<td>2.0</td>
<td>2</td>
<td>3.5</td>
<td>4</td>
<td>4.0</td>
</tr>
<tr>
<td>Waterloo</td>
<td>2.5</td>
<td>5</td>
<td>7.0</td>
<td>2.0</td>
<td>5.0</td>
</tr>
<tr>
<td>Winchester</td>
<td>3.5</td>
<td>30</td>
<td>1.0</td>
<td>0</td>
<td>3.5</td>
</tr>
<tr>
<td>Wingham</td>
<td>1.5</td>
<td>1</td>
<td>2.5</td>
<td>2</td>
<td>4.0</td>
</tr>
<tr>
<td>Woodstock</td>
<td>1.5</td>
<td>1</td>
<td>2.5</td>
<td>1.5</td>
<td>2</td>
</tr>
</tbody>
</table>

\textsuperscript{a}Ontario Corn Committee (OCC) 2018 performance trials

\textsuperscript{b}Disease severity in affected crop was rated as percentage of leaf area with symptoms; common rust, eyespot, GLS (gray leaf spot), and NLS (northern leaf spot) were rated on a 1-7 scale (1=no symptoms, 2=<1%, 3=1-5%, 4=6-20%, 5=21-50%, 6=>50 % leaf area with symptoms and 7=most of the leaves dead);

NCLB (northern corn leaf blight) on 1-7 scale based on percentage of leaf area with symptoms (1=no symptoms; 2=<1% (1% leaves with symptoms); 3=1-5% (1-10% leaves with symptoms); 4=6-20% (11 to 25% leaves with symptoms); 5=21-50% (>50% lower leaves and >25% of the centre and upper leaves with symptoms), 6=51-75% (lower leaves dead, >50 centre leaves and >25% upper leaves with symptoms); 7=most leaves almost dead).

\textsuperscript{c}Incidence is number of affected plants/total number of plants observed x 100.
OILSEEDS, PULSES, FORAGES AND SPECIAL CROPS / OLÉAGINEUX, PROTÉAGINEUX, PLANTES FOURRAGÈRES ET CULTURES SPÉCIALES

CROP: Faba bean
LOCATION: Central and southern Alberta; Saskatchewan

NAMES AND AGENCIES:
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TITLE: SURVEY OF FOLIAR DISEASES OF FABA BEAN IN ALBERTA AND SASKATCHEWAN IN 2017 AND 2018

ABSTRACT: Commercial faba bean fields from central-southern Alberta and Saskatchewan were surveyed for the presence of foliar diseases in 2017 and 2018. Foliar lesions were observed from all the fields surveyed but with a low disease severity (mean 1-2%). Botrytis spp., Fusarium spp., and Stemphylium spp. were frequently isolated from foliar lesions. While Botrytis spp. and Stemphylium spp. are foliar pathogens, Fusarium spp. are usually root pathogens of pulse crops.

INTRODUCTION AND METHODS: Faba bean (Vicia faba L.) is a re-emerging pulse crop in the Canadian Prairies, with approximately 20,000 hectares seeded in both Alberta and Saskatchewan in 2017 (Statistics Canada 2018). Chocolate spot, caused by Botrytis fabae Sard. and B. cinerea (teleomorph Botryotinia fuckeliana (de Bary) Whetzel) can reduce the yield by 60-80% on susceptible cultivars and total crop failure may occur under severe epidemic conditions (Bouhassan et al. 2004). Cool, wet and humid weather conditions favour sporulation and secondary infection. To determine the disease severity and presence of other foliar pathogens in faba bean, commercial field surveys were conducted in 2017 and 2018.

In 2017, 16 commercial faba bean fields from Saskatchewan and 19 from Alberta were surveyed while in 2018, 16 commercial faba bean fields from Saskatchewan and 8 from Alberta were surveyed at mid-pod stage (early August). Ten sites per field (at least 50 m apart) were sampled in an inverted U-shaped pattern, and the severity of foliar lesions on 10 plants per site was recorded. The disease severity in the upper, middle and lower canopy was rated on a scale of 1-5 (Table 1) (Bouhassan et al. 2004). However, an overall rating for the whole plant was made in the first year of the survey from Alberta.

If lesions were present, leaf samples were collected, pressed and dried and then shipped to Lethbridge Research and Development Centre for pathogen isolation and identification. At Lethbridge, leaf samples were photographed prior to plating, the leading edge of a lesion excised, surface disinfested using 10% bleach, and then plated onto PDA or V8 agar. Plates were incubated for 3 – 5 days, and then margins of colonies were transferred to a new plate in order to obtain pure cultures of each organism. Cultures were first grouped by colony morphology and given a presumptive genus identification. If the genus was not obvious from morphology, DNA was extracted from cultures, and ITS region sequenced to determine genus. The pathogenicity of the isolates was tested on the low tannin faba bean cultivar ‘CDC Snowdrop’. Fungal spores were collected from two-week-old cultures and quantified by counting colony forming units ml⁻¹. Faba bean seedlings in replicates of three were inoculated with the test fungi at the five-leaf stage by spraying the inoculum on the leaves. Leaves (3-4) were punctured with an orienteering punch to facilitate infection. The seedlings were covered immediately with a plastic bag to create a moist chamber for 48-72h. Plants were then kept in a greenhouse chamber at 16:8 h photoperiod with 22°C day and 18°C night temperatures, and watered as necessary. Disease severity was rated 7-14 days after the plastic bag was removed.
RESULTS AND COMMENTS: All faba bean crops surveyed in AB and SK had foliar lesions (i.e. 100% prevalence) in 2017 and 2018. At each site, plants with symptoms were estimated at 30 - 100% of plants in 2017 and 49 - 100% in 2018, but foliar disease symptoms were generally present at all 10 sites within each field. However, disease severity was very low across all fields with small discrete lesions covering 1-2% of the leaf surface (Table 2). Disease severity and incidence were always highest in the lower canopy and lowest in the upper canopy (Table 2).

A variety of symptoms were observed. Small, discrete reddish lesions characteristic of the non-aggressive phase of chocolate spot (caused by *B. fabae* and *B. cinerea*) were common. Large, coalescing black lesions with evidence of fungal sporulation were also observed. Black angular lesions, with well-defined margins, and sometimes with a bull's-eye pattern were also common. A number of fungal genera were isolated from lesions (Table 3). *Alternaria* spp. were the most commonly isolated, but caused very little disease in the pathogenicity tests (Table 4). *Alternaria* spp. were often present with other fungi, particularly *Botrytis or Stemphylium*, thus it is likely that it is acting as a secondary pathogen or saprophyte on lesions caused by more pathogenic species. *Fusarium* spp. were also frequently isolated from lesions; isolates caused low to moderate disease symptoms in pathogenicity testing, but not all isolates have been tested. *Fusarium* spp. are not usually foliar pathogens of pulse crops, so these results were unexpected, and further research on species identification and pathogenicity should be pursued. *Stemphylium* spp. were also frequently isolated and were also moderately pathogenic to faba beans leaves. In 2018, *Stemphylium* spp. (21%) were frequently isolated from medium lesions with blight symptoms that often started from the edge, while *Botrytis* spp. (8%) were isolated from flecked and small, discrete reddish lesions. Of the four most frequently isolated pathogens, *Botrytis* species caused the highest disease severity on faba bean leaves. The species isolated consisted of *B. cinerea, B. fabae, B. fabiopsis* and *B. aclada*. It is difficult to identify *Botrytis* to species in the absence of a sporulating structure, and *B. fabae*, in particular, is the most difficult to induce sporulation. We have been able to sporulate *B. fabae* on double strength malt yeast extract agar. However, not all isolates sporulate on this media. Identification of *Botrytis* species by sequencing different genes is in progress. Therefore, only isolates (i.e. mostly *B. cinerea*) that readily sporulated in culture have been assessed in pathogenicity tests so far. Results to date indicate that *B. cinerea* is a fairly aggressive pathogen, although isolates ranged from those that did not cause any disease (DS = 1) to those that caused extensive lesions and plant death (DS = 5). In all likelihood, *B. fabae* will be more aggressive (as all literature indicates that *B. fabae* is more aggressive than *B. cinerea*) (Sahile et al. 2012; Zhang et al. 2010). *Colletotrichum* spp., and *Sclerotinia sclerotiorum* had the highest disease severity in the pathogenicity tests, but their isolation was rare. *Colletotrichum* spp. cause anthracnose in other pulse crops (e.g. lentils, dry beans), and therefore its risk as a pathogen to faba bean should be monitored. *S. sclerotiorum* causes white mould in most pulse crops, and its presence in faba bean is not unexpected. It was only isolated from 1 sample, and will be a minor pathogen under dry conditions. Since, the disease surveys were conducted late in 2018 due to delayed sowing in the spring, fungal isolation is just completed, and therefore pathogenicity testing, DNA extraction and sequencing of the isolates is underway.

ACKNOWLEDGEMENTS
We gratefully acknowledge the significant contributions of staff from Saskatchewan Ministry of Agriculture, University of Saskatchewan, and Alberta Agriculture and Forestry for assistance with collecting faba bean leaf samples from Saskatchewan and Alberta. We also express appreciation for Saskatchewan and Alberta pulse producers that allowed access to their fields. This project is funded by the Saskatchewan Pulse Growers, Alberta Pulse Growers, Saskatchewan Ministry of Agriculture and Western Grains Research Foundation.

REFERENCES
Table 1. Chocolate spot disease severity rating scale.

<table>
<thead>
<tr>
<th>Rating</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>healthy plants</td>
</tr>
<tr>
<td>2</td>
<td>small, discrete lesions (2-3 mm), covering 1-2% of leaf surface</td>
</tr>
<tr>
<td>3</td>
<td>some coalesced lesions, covering 2-5% of leaf surface, some defoliation</td>
</tr>
<tr>
<td>4</td>
<td>large coalesced sporulating lesions covering 5-10% of leaf surface, 50% defoliation</td>
</tr>
<tr>
<td>5</td>
<td>extensive lesions on leaves, stems and pods covering &gt; 10% of leaf surface, severe defoliation, heavy sporulation, blackening</td>
</tr>
</tbody>
</table>

Table 2. Prevalence and average disease severity of foliar lesions from different canopy levels estimated from commercial faba bean fields in Alberta and Saskatchewan surveyed in 2017 and 2018.

<table>
<thead>
<tr>
<th>Disease measurement</th>
<th>2017 Alberta</th>
<th>2017 Saskatchewan</th>
<th>2018 Alberta</th>
<th>2018 Saskatchewan</th>
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<tbody>
<tr>
<td>Prevalence (%)</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Disease severity</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average</td>
<td>1.7</td>
<td>1.9</td>
<td>1.7</td>
<td>1.9</td>
</tr>
<tr>
<td>Minimum</td>
<td>1.4</td>
<td>1.2</td>
<td>1.3</td>
<td>1.3</td>
</tr>
<tr>
<td>Maximum</td>
<td>2.3</td>
<td>3.3</td>
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<td>3.3</td>
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<tr>
<td>Severity at different canopy</td>
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<td></td>
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<tr>
<td>Lower</td>
<td>-</td>
<td>2.4</td>
<td>2.1</td>
<td>2.1</td>
</tr>
<tr>
<td>Middle</td>
<td>-</td>
<td>1.9</td>
<td>1.7</td>
<td>1.9</td>
</tr>
<tr>
<td>Upper</td>
<td>-</td>
<td>1.5</td>
<td>1.3</td>
<td>1.6</td>
</tr>
</tbody>
</table>
Table 3. Foliar fungi isolated from foliar lesions on faba bean in 2017 and 2018.

<table>
<thead>
<tr>
<th>Fungal genera</th>
<th>2017 Total numbers</th>
<th>% of total fungi</th>
<th>2018 Total numbers</th>
<th>% of total fungi</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alternaria spp.</td>
<td>338</td>
<td>49.7</td>
<td>1125</td>
<td>54.5</td>
</tr>
<tr>
<td>Ascochyta spp.</td>
<td>0</td>
<td>0.0</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td><strong>Botrytis spp.</strong></td>
<td><strong>102</strong></td>
<td>15.0</td>
<td><strong>161</strong></td>
<td>7.8</td>
</tr>
<tr>
<td>B. fabiopsis/ B. aclada</td>
<td>9</td>
<td>1.3</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Cladosporium</td>
<td>-</td>
<td>-</td>
<td>124</td>
<td>6.0</td>
</tr>
<tr>
<td>Colletotrichum spp.</td>
<td>3</td>
<td>0.4</td>
<td>1</td>
<td>0.05</td>
</tr>
<tr>
<td>Epicoccum</td>
<td>15</td>
<td>2.2</td>
<td>33</td>
<td>1.6</td>
</tr>
<tr>
<td><strong>Fusarium spp.</strong></td>
<td><strong>113</strong></td>
<td><strong>16.6</strong></td>
<td><strong>54</strong></td>
<td><strong>2.6</strong></td>
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<td>Phaeosphaeria sp./Septoriella phragmites</td>
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<td>-</td>
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<td>0.1</td>
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<tr>
<td><strong>Stemphylium spp.</strong></td>
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<td><strong>10.9</strong></td>
<td><strong>433</strong></td>
<td><strong>21.0</strong></td>
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<tr>
<td>Unidentified</td>
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<td>-</td>
<td>135</td>
<td>6.5</td>
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</tbody>
</table>

*aIdentification to species is in progress.

Table 4. Average disease severity of fungi isolated from foliar lesions on faba bean.

<table>
<thead>
<tr>
<th>Isolate</th>
<th>2017 Number of isolates tested</th>
<th>Mean DS旷</th>
<th>DS range of isolates</th>
<th>2018 Number of isolates tested</th>
<th>Mean DS旷</th>
<th>DS range of isolates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alternaria spp.</td>
<td>2</td>
<td>1.6</td>
<td>1.3 – 2</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Botrytis fabiopsis</td>
<td>1</td>
<td>2.7</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Botrytis aclada</td>
<td>1</td>
<td>2.3</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Botrytis cinerea</td>
<td>19</td>
<td>3.7</td>
<td>1 – 5</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td><strong>Botrytis spp.</strong></td>
<td><strong>5</strong></td>
<td><strong>2.9</strong></td>
<td><strong>1.3 – 4.3</strong></td>
<td><strong>28</strong></td>
<td><strong>3.8</strong></td>
<td><strong>1.3 – 5.0</strong></td>
</tr>
<tr>
<td>Fusarium spp.</td>
<td>5</td>
<td>2.5</td>
<td>1 – 5</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Sclerotinia</td>
<td>1</td>
<td>5.0</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Stemphylium spp.</td>
<td>11</td>
<td>2.2</td>
<td>1 – 4.3</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Colletotrichum</td>
<td>1</td>
<td>4.7</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

*aDS rated on a scale of 1 = healthy to 5 = extensive, coalesced lesions

bOnly isolates and/or species that sporulate readily in culture have been tested.
ABSTRACT: Blackleg is a disease of canola (Brassica napus L.) caused by Leptosphaeria maculans (Sowerby) P. Karst. Cultivar resistance and crop rotation are the primary management tools for preventing economic losses to the disease. Symptoms of blackleg are common across Alberta however, disease severity is often very low where host resistance to blackleg is deployed (Kutcher et al. 2013; Harding et al. 2016, 2017). Stem rot on canola, caused by Sclerotinia sclerotiorum (Lib.) de Bary, is also a commonly occurring disease in Alberta. Both stem rot and blackleg may be found concurrently on canola plants within the same field. A survey for these diseases was undertaken to characterize the prevalence and incidence of stem rot as well as the prevalence, incidence and severity of blackleg in Alberta canola crops in 2018.

INTRODUCTION AND METHODS: Leptosphaeria maculans, the causal agent of blackleg, can cause disease symptoms on all above ground parts of a canola plant. Vascular colonization and the formation of basal stem cankers can result in major yield reductions and increased crop lodging in severe cases. As a result, blackleg is listed as a declared pest in Alberta’s Agricultural Pests Act and Regulation and the pathogen is monitored regularly for prevalence, incidence and severity in all crop regions of the province. Recent surveys in 2012, 2015, 2016 and 2017 have shown that while the pathogen is commonly found, cases of high disease severity are rare. A survey of canola fields was undertaken in 2018, targeting 1% of canola fields in each county/municipality, as defined by the 2016 Agricultural Census for Alberta (Statistics Canada, 2017). Surveyors were encouraged to visit canola fields the week prior to swathing, or post-swatthing if they were taken within a few days of cutting. Surveyors walked a W-shaped pattern, stopping at five locations within the field. Sampling locations were at least 20 m apart and at least 20 m from field margins. The lower stems (bottom 4 to 6 in) of twenty plants were collected at each sampling location for a total of 100 stems per field. All stems were sent directly to Alberta Agriculture and Forestry stations, either the Crop Diversification Centre North (Edmonton) or South (Brooks). Each canola stem sample was evaluated for the presence of blackleg symptoms such as stem cankers, lesions with pycnidia and internal stem blackening. Blackleg prevalence was calculated as percentage of fields with symptoms. Blackleg incidence was calculated as percentage of stems showing blackleg symptoms. Blackleg severity was estimated using 0- 5 scale for rating vascular discoloration (WCC/RCC, 2009; Table 1). Stem rot infections occurring on lower main stems, caused by Sclerotinia sclerotiorum, were also recorded for the majority of the fields sampled. Stems were considered to have stem rot infection when they were soft and would shred when twisted and/or when sclerotia were observed inside the stem. Prevalence was calculated as percentage of fields with stem rot and incidence as percentage of stems showing symptoms. As the stem rot survey method consists of a presence/absence, binomial rating, severity was not calculated.

RESULTS AND COMMENTS: A total of 339 canola fields were surveyed for blackleg, of which 273 were also rated for stem rot in 2018. A total of 273 fields were found to have blackleg symptoms for a prevalence of 80.5%. The incidence of blackleg on canola stems collected throughout the province was 13.25%, while overall average severity was 0.24 on a 0 to 5 scale. These numbers compare with values of 82.2%, 14.0% and 0.26 observed in the 2017 survey for prevalence, incidence and severity, respectively. These values continue to suggest that while blackleg is widespread, the severity of infections remains low in the majority of fields throughout the province. Blackleg survey results for each county are presented in Table 2 and Figure 1. Sclerotinia stem rot was observed in 105 of 273 fields for a prevalence of 38.5%. Mean disease incidence was 9.96% with a range up to 100% in a single field in southern Alberta. These numbers are a significant increase from values of 21.3% and 1.95% for disease prevalence and incidence in 2017. Stem rot results for each county/municipality are shown in Table 3.
ACKNOWLEDGEMENTS
We gratefully acknowledge the significant contributions of the Alberta Association of Agricultural Fieldmen and their staff for assistance with collecting canola stems from across the province. We also thank agronomists from the Canola Council of Canada who assisted with stem collections. Finally, we express appreciation for the landowners and producers that allowed access to their fields.

REFERENCES:
Western Canada Canola/Rapeseed Recommending Committee (WCC/RRC) Incorporated. 2009. Procedures of the Western Canada Canola/Rapeseed Recommending Committee for the evaluation and recommendation for registration of canola/rapeseed candidate cultivars in western Canada.

Table 1. A rating scale to estimate blackleg severity on canola (WCC/RCC 2009)

<table>
<thead>
<tr>
<th>Rating</th>
<th>Symptoms</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>No disease visible in the cross section</td>
</tr>
<tr>
<td>1</td>
<td>Diseased tissue occupies up to 25% of cross-section</td>
</tr>
<tr>
<td>2</td>
<td>Diseased tissue occupies 26 to 50% of cross-section</td>
</tr>
<tr>
<td>3</td>
<td>Diseased tissue occupies 51 to 75% of cross-section</td>
</tr>
<tr>
<td>4</td>
<td>Diseased tissue occupies more than 75% of cross-section with little or no constriction</td>
</tr>
<tr>
<td>5</td>
<td>Diseased tissue occupies 100% of cross-section with significant constriction; tissue dry and brittle; plant dead</td>
</tr>
</tbody>
</table>
Table 2. Blackleg prevalence, incidence and severity in canola fields in Alberta in 2018.

<table>
<thead>
<tr>
<th>County</th>
<th>No. fields</th>
<th>Prevalence (%)</th>
<th>Disease incidence (%)</th>
<th>Disease severity&lt;sup&gt;b&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Mean&lt;sup&gt;a&lt;/sup&gt;</td>
<td>Range</td>
</tr>
<tr>
<td>Athabasca</td>
<td>4/4</td>
<td>100.0</td>
<td>10.1</td>
<td>2-22.2</td>
</tr>
<tr>
<td>Barrhead</td>
<td>6/6</td>
<td>100.0</td>
<td>6.5</td>
<td>2-18</td>
</tr>
<tr>
<td>Beaver</td>
<td>10/10</td>
<td>100.0</td>
<td>19.7</td>
<td>5-66</td>
</tr>
<tr>
<td>Big Lakes</td>
<td>0/1</td>
<td>0.0</td>
<td>0.0</td>
<td>n/a</td>
</tr>
<tr>
<td>Birch Hills</td>
<td>6/18</td>
<td>33.3</td>
<td>2.3</td>
<td>0-14</td>
</tr>
<tr>
<td>Bonnyville</td>
<td>3/4</td>
<td>75.0</td>
<td>25.0</td>
<td>0-50</td>
</tr>
<tr>
<td>Calgary</td>
<td>0/1</td>
<td>0.0</td>
<td>0.0</td>
<td>n/a</td>
</tr>
<tr>
<td>Camrose</td>
<td>13/14</td>
<td>92.9</td>
<td>14.9</td>
<td>0-47</td>
</tr>
<tr>
<td>Cardston</td>
<td>6/16</td>
<td>37.5</td>
<td>6.0</td>
<td>0-27</td>
</tr>
<tr>
<td>Clearwater</td>
<td>2/2</td>
<td>100.0</td>
<td>2.5</td>
<td>2-3</td>
</tr>
<tr>
<td>Cypress</td>
<td>3/4</td>
<td>75.0</td>
<td>16.0</td>
<td>0-46</td>
</tr>
<tr>
<td>Edmonton</td>
<td>1/1</td>
<td>100.0</td>
<td>32.0</td>
<td>n/a</td>
</tr>
<tr>
<td>Flagstaff</td>
<td>15/15</td>
<td>100.0</td>
<td>9.9</td>
<td>1-32</td>
</tr>
<tr>
<td>Foothills</td>
<td>2/3</td>
<td>66.7</td>
<td>16.7</td>
<td>0-43</td>
</tr>
<tr>
<td>Grande Prairie</td>
<td>6/8</td>
<td>75.0</td>
<td>5.6</td>
<td>0-13</td>
</tr>
<tr>
<td>Greenview</td>
<td>3/3</td>
<td>100.0</td>
<td>1.0</td>
<td>0.5-1.5</td>
</tr>
<tr>
<td>Lac La Biche</td>
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<td>100.0</td>
<td>18.0</td>
<td>n/a</td>
</tr>
<tr>
<td>Lacombe</td>
<td>3/6</td>
<td>50.0</td>
<td>7.0</td>
<td>0-34</td>
</tr>
<tr>
<td>Lamont</td>
<td>6/9</td>
<td>66.7</td>
<td>5.3</td>
<td>0-19</td>
</tr>
<tr>
<td>Lethbridge</td>
<td>8/10</td>
<td>80.0</td>
<td>17.0</td>
<td>0-89</td>
</tr>
<tr>
<td>Minburn</td>
<td>10/12</td>
<td>83.3</td>
<td>10.8</td>
<td>0-34</td>
</tr>
<tr>
<td>Mountainview</td>
<td>4/6</td>
<td>66.7</td>
<td>12.8</td>
<td>0-39</td>
</tr>
<tr>
<td>Newell</td>
<td>2/3</td>
<td>66.7</td>
<td>20.3</td>
<td>0-46</td>
</tr>
<tr>
<td>Northern Sunrise</td>
<td>4/4</td>
<td>100.0</td>
<td>16.5</td>
<td>5-21</td>
</tr>
<tr>
<td>Parkland</td>
<td>1/2</td>
<td>50.0</td>
<td>3.5</td>
<td>0-7.0</td>
</tr>
<tr>
<td>Ponoka</td>
<td>5/5</td>
<td>100.0</td>
<td>13.8</td>
<td>2-31</td>
</tr>
<tr>
<td>Provost</td>
<td>6/6</td>
<td>100.0</td>
<td>25.8</td>
<td>11-45</td>
</tr>
<tr>
<td>Red Deer</td>
<td>7/9</td>
<td>77.8</td>
<td>6.0</td>
<td>0-24</td>
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<td>SA 2</td>
<td>2/2</td>
<td>100.0</td>
<td>13.0</td>
<td>1.0-25</td>
</tr>
<tr>
<td>SA 3</td>
<td>2/2</td>
<td>100.0</td>
<td>8.5</td>
<td>3.0-14</td>
</tr>
<tr>
<td>SA 4</td>
<td>4/4</td>
<td>100.0</td>
<td>17.5</td>
<td>6.0-36</td>
</tr>
<tr>
<td>Saddle Hills</td>
<td>10/18</td>
<td>55.6</td>
<td>2.7</td>
<td>0-18</td>
</tr>
<tr>
<td>Smoky River</td>
<td>11/16</td>
<td>68.8</td>
<td>10.3</td>
<td>0-47</td>
</tr>
<tr>
<td>St. Paul</td>
<td>4/4</td>
<td>100.0</td>
<td>23.0</td>
<td>10-31</td>
</tr>
<tr>
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<td>100.0</td>
<td>28.6</td>
<td>1.0-74</td>
</tr>
<tr>
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<td>6/7</td>
<td>85.7</td>
<td>16.7</td>
<td>0-58.2</td>
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<td>100.0</td>
<td>11.0</td>
<td>5.0-16</td>
</tr>
<tr>
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<td>5/5</td>
<td>100.0</td>
<td>16.4</td>
<td>2.0-31</td>
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<td>1.0-9.0</td>
</tr>
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<td>22.0</td>
<td>7.0-45</td>
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<tr>
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<td>24.0</td>
<td>2.0-74.1</td>
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<td>19/19</td>
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<td>26.9</td>
<td>2.0-62</td>
</tr>
<tr>
<td>Wainwright</td>
<td>6/6</td>
<td>100.0</td>
<td>22.8</td>
<td>3.0-76</td>
</tr>
<tr>
<td>Warner</td>
<td>3/5</td>
<td>60.0</td>
<td>17.8</td>
<td>0-62</td>
</tr>
<tr>
<td>Westlock</td>
<td>9/9</td>
<td>100.0</td>
<td>19.1</td>
<td>7.0-48</td>
</tr>
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<td>78.6</td>
<td>5.9</td>
<td>0-27</td>
</tr>
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<td>4/5</td>
<td>80.0</td>
<td>7.4</td>
<td>0-28</td>
</tr>
<tr>
<td>Yellowhead</td>
<td>1/1</td>
<td>100.0</td>
<td>5.0</td>
<td>n/a</td>
</tr>
</tbody>
</table>

| Total province | 273/339 | 80.5 | 13.25 | 0-89 | 0.24 | 0-2.05 |

<sup>a</sup> Means represent an average of all the crops surveyed.  
<sup>b</sup> Disease severity was assessed using a 0-5 scale.  
n/a – not applicable
Table 3. Prevalence and incidence of lower main stem infections by *S. sclerotiorum* in canola fields in Alberta in 2018.

<table>
<thead>
<tr>
<th>County or Municipality</th>
<th>No. fields affected</th>
<th>Disease prevalence (%)</th>
<th>Disease incidence (%)</th>
<th>Mean (%)</th>
<th>Range (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Athabasca</td>
<td>0/4</td>
<td>0.0</td>
<td>0.0</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>Big Lakes</td>
<td>0/1</td>
<td>0.0</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>Birch Hills</td>
<td>2/18</td>
<td>11.1</td>
<td>1.4</td>
<td>0-18</td>
<td></td>
</tr>
<tr>
<td>Bonnyville</td>
<td>1/4</td>
<td>25.0</td>
<td>10.0</td>
<td>0-40</td>
<td></td>
</tr>
<tr>
<td>Calgary</td>
<td>1/1</td>
<td>100.0</td>
<td>n/a</td>
<td>n/a</td>
<td></td>
</tr>
<tr>
<td>Cardston</td>
<td>12/16</td>
<td>75.0</td>
<td>21.5</td>
<td>0-100</td>
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<td>0.0</td>
<td>0.0</td>
<td>n/a</td>
<td></td>
</tr>
<tr>
<td>Cypress</td>
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<td>3.5</td>
<td>0-11</td>
<td></td>
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<tr>
<td>Flagstaff</td>
<td>4/15</td>
<td>26.7</td>
<td>8.6</td>
<td>0-76</td>
<td></td>
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<tr>
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<td>1/3</td>
<td>33.3</td>
<td>13.3</td>
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<td>Grande Prairie</td>
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<td>0.8</td>
<td>0-6.0</td>
<td></td>
</tr>
<tr>
<td>Greenview</td>
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<td>0.0</td>
<td>n/a</td>
<td></td>
</tr>
<tr>
<td>Lacombe</td>
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<td>50.0</td>
<td>6.8</td>
<td>0-27</td>
<td></td>
</tr>
<tr>
<td>Lamont</td>
<td>1/8</td>
<td>12.5</td>
<td>1.0</td>
<td>0-8.0</td>
<td></td>
</tr>
<tr>
<td>Lethbridge</td>
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<td>70.0</td>
<td>10.6</td>
<td>0-31</td>
<td></td>
</tr>
<tr>
<td>Minburn</td>
<td>4/12</td>
<td>33.3</td>
<td>3.7</td>
<td>0-22.2</td>
<td></td>
</tr>
<tr>
<td>Mountainview</td>
<td>4/6</td>
<td>66.7</td>
<td>22.3</td>
<td>0-47</td>
<td></td>
</tr>
<tr>
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<td>66.7</td>
<td>23.7</td>
<td>0-60</td>
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</tr>
<tr>
<td>Northern Sunrise</td>
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<td>30.5</td>
<td>17-42</td>
<td></td>
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<tr>
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<td>Red Deer</td>
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<td>0-8.0</td>
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</tr>
<tr>
<td>SA 3</td>
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<td>50.0</td>
<td>1.5</td>
<td>0-3.0</td>
<td></td>
</tr>
<tr>
<td>SA 4</td>
<td>1/4</td>
<td>25.0</td>
<td>1.3</td>
<td>0-5.0</td>
<td></td>
</tr>
<tr>
<td>Saddle Hills</td>
<td>5/18</td>
<td>27.8</td>
<td>11.5</td>
<td>0-67</td>
<td></td>
</tr>
<tr>
<td>Smoky River</td>
<td>1/16</td>
<td>6.3</td>
<td>0.9</td>
<td>0-15</td>
<td></td>
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<tr>
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<td>100.0</td>
<td>48.9</td>
<td>3.0-87</td>
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<td>Stettler</td>
<td>2/7</td>
<td>28.6</td>
<td>7.4</td>
<td>0-37</td>
<td></td>
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<td>Taber</td>
<td>5/5</td>
<td>100.0</td>
<td>13.6</td>
<td>2.0-32</td>
<td></td>
</tr>
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<td>18.2</td>
<td>0.8</td>
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<tr>
<td>Vulcan</td>
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<td>55.6</td>
<td>14.1</td>
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<td>Wainwright</td>
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<td>16.7</td>
<td>2.8</td>
<td>0-17</td>
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<tr>
<td>Warner</td>
<td>3/5</td>
<td>12.0</td>
<td>5.8</td>
<td>0-20</td>
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<td>50.0</td>
<td>14.6</td>
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<td>0.0</td>
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</tr>
<tr>
<td>Yellowhead</td>
<td>0/1</td>
<td>0.0</td>
<td>n/a</td>
<td>n/a</td>
<td></td>
</tr>
<tr>
<td><strong>Total province</strong></td>
<td><strong>105/273</strong></td>
<td><strong>38.5</strong></td>
<td><strong>9.96</strong></td>
<td><strong>0-100</strong></td>
<td></td>
</tr>
</tbody>
</table>

*a* Means represent an average of all the crops surveyed.

n/a – not applicable
Fig. 1. The location and severity of blackleg symptoms in 339 Alberta canola fields in 2018.
**CROP:** Canola  
**LOCATION:** Alberta

**NAMES AND AGENCIES:**  
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**TITLE:** THE OCCURRENCE AND SPREAD OF CLUBROOT ON CANOLA IN ALBERTA IN 2018

**ABSTRACT:** Five hundred and forty-three canola (*Brassica napus* L.) crops were surveyed for the occurrence of clubroot (*Plasmodiophora brassicaceae* Wor.) in Alberta, resulting in the identification of 79 new records of the disease. Another 221 cases were identified in inspections carried out by county and municipal personnel, for a total of 300 new clubroot infestations confirmed in 2018. A grand total of 3044 cases of clubroot have been confirmed in Alberta since 2003, and while the outbreak is still most severe in the central part of the province, the disease continues to spread in the Peace Country and more slowly in southern Alberta.

**METHODS:** A survey for the presence of clubroot (*Plasmodiophora brassicaceae* Wor.) was conducted in 543 canola (*Brassica napus* L.) crops across Alberta in 2018. Most fields were inspected after swathing in September or early October, and had either not been surveyed for clubroot previously, or had been surveyed with no clubroot identified. At least 50 canola roots were selected randomly from a 20-30 m² area near the entrance to each field and examined for the presence of clubroot. If symptoms of the disease were not detected on any of the roots, then no additional sampling was conducted. If clubroot symptoms were observed, then the entire field was surveyed more extensively by sampling the roots of all plants within a 1 m² area at each of 10 locations along the arms of a ‘W’ sampling pattern. This survey strategy was employed because clubroot is most often found near the field entrance (Cao et al. 2009). Each sampled canola plant was assessed for clubroot symptom severity on a 0-3 scale (Kuginuki et al. 1999), where: 0 = no galling, 1 = a few small galls, 2 = moderate galling and 3 = severe galling. An index of disease (ID) was then calculated for each crop using the symptom severity ratings on individual plants, following Horiuchi & Hori (1980) as modified by Strelkov et al. (2006). Visits to fields were coordinated with the agricultural fieldman in each municipality, and the results of any independent clubroot inspections carried out by county or municipal staff were collected and combined with the data from the Alberta-wide clubroot survey.

**RESULTS AND COMMENTS:** Clubroot was found in 79 of the 543 canola crops visited in 2018 (Table 1). The identification of the first records of the disease in Birch Hills, Greenview and Northern Sunrise suggest that clubroot is spreading in the Peace Country of northwestern Alberta (Fig. 1) following its initial detection in Big Lakes in 2017 (Strelkov et al. 2018b). Similarly, the first cases of clubroot in Rocky View indicate further spread in southern Alberta, although dissemination in that region appears to be occurring more slowly. Limited or no surveillance had been conducted in the City of Edmonton in recent years, and as such it was targeted as part of the Alberta-wide survey in 2018. The identification of 30 new cases of clubroot in rural areas of Edmonton (Table 1) reflects how widespread the disease has become there. This is consistent with the increasing prevalence of clubroot throughout much of central Alberta (Table 1; Fig. 1).

In most cases, clubroot severity was mild (ID < 10%; 59 crops) or moderate (ID = 10-60%; 15 crops), although five crops were found to be heavily infested (ID > 60%). Two of the most heavily infested crops represented clubroot resistant canola cultivars, and were among more than 70 fields found in 2018 with potential resistance issues. While the occurrence in these fields of new *P. brassicaceae* pathotypes able to overcome resistance must still be confirmed by greenhouse testing, it corresponds with a trend of increasing numbers of fields where first generation clubroot resistance has been broken or eroded (Strelkov et al. 2016, 2018a). The appearance of new pathotypes capable of overcoming resistance is one of the most important threats facing canola production in clubroot-infested regions of the Prairies, and should continue to be monitored.
In addition to the 79 new records of clubroot detected in the Alberta-wide survey, another 221 cases of the disease were found in independent inspections conducted by municipal personnel (Table 1). Collectively, clubroot surveillance activities identified 300 new clubroot infestations in Alberta in 2018, for a grand total of 3044 documented field infestations since 2003. These are distributed across 40 counties and municipal districts, plus Edmonton, Medicine Hat and the Town of Stettler (Fig. 1).


REFERENCES:
Table 1. Distribution of *Plasmodiophora brassicae*-infested canola fields identified in Alberta in 2018.

<table>
<thead>
<tr>
<th>County or municipality</th>
<th>Number of fields assessed in provincial survey</th>
<th>Number of new cases of <em>P. brassicae</em>-infested fields</th>
<th>Additional new cases identified by county/municipal staff</th>
<th>Total new cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>Athabasca</td>
<td>4</td>
<td>4</td>
<td>7</td>
<td>11</td>
</tr>
<tr>
<td>Barrhead</td>
<td>3</td>
<td>3</td>
<td>8</td>
<td>11</td>
</tr>
<tr>
<td>Big Lakes</td>
<td>0</td>
<td>--</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Birch Hills</td>
<td>26</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Bonnyville</td>
<td>22</td>
<td>3</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>Calgary</td>
<td>1</td>
<td>0</td>
<td>--</td>
<td>0</td>
</tr>
<tr>
<td>Camrose</td>
<td>0</td>
<td>--</td>
<td>24</td>
<td>24</td>
</tr>
<tr>
<td>Cardston</td>
<td>13</td>
<td>0</td>
<td>--</td>
<td>0</td>
</tr>
<tr>
<td>Clearwater</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>Cypress</td>
<td>2</td>
<td>0</td>
<td>--</td>
<td>0</td>
</tr>
<tr>
<td>Edmonton</td>
<td>43</td>
<td>27</td>
<td>3</td>
<td>30</td>
</tr>
<tr>
<td>Flagstaff</td>
<td>39</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Grande Prairie</td>
<td>8</td>
<td>0</td>
<td>--</td>
<td>0</td>
</tr>
<tr>
<td>Greenview</td>
<td>24</td>
<td>2</td>
<td>5&lt;sup&gt;a&lt;/sup&gt;</td>
<td>7</td>
</tr>
<tr>
<td>Lacombe</td>
<td>6</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Lac La Biche</td>
<td>0</td>
<td>--</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Lac Ste. Anne</td>
<td>0</td>
<td>--</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Lamont</td>
<td>26</td>
<td>5</td>
<td>20</td>
<td>25</td>
</tr>
<tr>
<td>Leduc</td>
<td>1</td>
<td>1</td>
<td>43</td>
<td>44</td>
</tr>
<tr>
<td>Lesser Slave River</td>
<td>22</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Lethbridge</td>
<td>10</td>
<td>0</td>
<td>--</td>
<td>0</td>
</tr>
<tr>
<td>Minburn</td>
<td>7</td>
<td>0</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Mountain View</td>
<td>6</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Northern Sunrise</td>
<td>24</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Paintearth</td>
<td>20</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Parkland</td>
<td>14</td>
<td>9</td>
<td>22</td>
<td>31</td>
</tr>
<tr>
<td>Provost</td>
<td>26</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Red Deer</td>
<td>22</td>
<td>4</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>Rocky View</td>
<td>18</td>
<td>3</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>Saddle Hills</td>
<td>17</td>
<td>0</td>
<td>--</td>
<td>0</td>
</tr>
<tr>
<td>Smoky Lake</td>
<td>2</td>
<td>2</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Special Area 2</td>
<td>1</td>
<td>0</td>
<td>--</td>
<td>0</td>
</tr>
<tr>
<td>Special Area 3</td>
<td>2</td>
<td>0</td>
<td>--</td>
<td>0</td>
</tr>
<tr>
<td>Special Area 4</td>
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<td>--</td>
<td>0</td>
</tr>
<tr>
<td>Starland</td>
<td>7</td>
<td>0</td>
<td>--</td>
<td>0</td>
</tr>
<tr>
<td>Stettler</td>
<td>7</td>
<td>0</td>
<td>11</td>
<td>11</td>
</tr>
<tr>
<td>St. Paul</td>
<td>28</td>
<td>6</td>
<td>11</td>
<td>17</td>
</tr>
<tr>
<td>Strathcona</td>
<td>0</td>
<td>--</td>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td>Sturgeon</td>
<td>0</td>
<td>--</td>
<td>15</td>
<td>15</td>
</tr>
<tr>
<td>Two Hills</td>
<td>0</td>
<td>--</td>
<td>15</td>
<td>15</td>
</tr>
<tr>
<td>Vermillion River</td>
<td>18</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Vulcan</td>
<td>20</td>
<td>0</td>
<td>--</td>
<td>0</td>
</tr>
<tr>
<td>Wainwright</td>
<td>5</td>
<td>0</td>
<td>--</td>
<td>0</td>
</tr>
<tr>
<td>Warner</td>
<td>6</td>
<td>0</td>
<td>--</td>
<td>0</td>
</tr>
<tr>
<td>Westlock</td>
<td>4</td>
<td>2</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Wheatland</td>
<td>6</td>
<td>0</td>
<td>--</td>
<td>0</td>
</tr>
<tr>
<td>Willow Creek</td>
<td>5</td>
<td>0</td>
<td>--</td>
<td>0</td>
</tr>
<tr>
<td>Woodlands</td>
<td>22</td>
<td>2</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Yellowhead</td>
<td>0</td>
<td>--</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>543</strong></td>
<td><strong>79</strong></td>
<td><strong>221</strong></td>
<td><strong>300</strong></td>
</tr>
</tbody>
</table>

<sup>a</sup>Identified in late 2017 but results not communicated in time for inclusion in 2017 survey report.
Fig. 1. The occurrence of clubroot on canola in Alberta as of November 2018. Since the start of clubroot surveillance in 2003, the disease has been confirmed in a total of 3044 fields representing 40 counties and municipal districts in the province, as well as in rural areas of the cities of Edmonton and Medicine Hat, and the Town of Stettler.
CROP: Field bean (*Phaseolus vulgaris* L.)

LOCATION: Southern Alberta

**NAMES AND AGENCY:**
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**TITLE:** WHITE MOLD OF DRY BEAN IN SOUTHERN ALBERTA IN 2018

**ABSTRACT:** Fifteen commercial seed alfalfa fields in southern Alberta were surveyed from flowering (end of July) to pod formation (end of August) in 2018. Disease incidence and severity peaked by mid-August, and despite being the driest growing season in the last 10 years, disease was found in all fields surveyed.

**INTRODUCTION AND METHODS:** White mould, caused by the fungal pathogen *Sclerotinia sclerotiorum* (Lib.) de Bary, is one of the main production constraints of dry bean (*Phaseolus vulgaris* L.) in southern Alberta (Balasubramanian et al. 2014). In 2018, weekly surveys of fifteen commercial dry bean fields were performed to assess the prevalence, incidence, and severity of white mold in dry bean fields in the production centres of southern Alberta (the regions of Bow Island, Cranford, and Rolling Hills). Surveys began at flowering (R1, July 23) and continued until pod maturity (R7, Aug 23) (Osorno et al. 2013). Ten sites in each field were assessed. Sites were >20 m apart from each other and the field border, and formed a U-shaped pattern. At each site, ten plants were rated for disease incidence and severity (1 = no white mold; 2 = white mold present on 1 branch; 3 = white mold present on 2 branches; 4 = white mold present on main stem) (Balasubramanian et al. 2014). On September 7, an additional six fields were surveyed, and at each of four sites per field, 25 plants were assessed for white mold presence and severity. The six fields evaluated on September 7 were inspected independently of the main survey and used a different rating scale where 0 = no symptoms; 1 = infections on pods only; 2 = one-quarter of plant affected; 3 = one-half of plant affected; 4 = three-quarters of plant affected; 5 = main stem lesion near base affecting entire plant (Johnston et al. 2005).

**RESULTS AND DISCUSSION:** Despite being the driest growing season in the last 10 years (Table 1, AAF 2018), incidence and severity of white mold were significant in many fields surveyed. At the beginning of the survey period about one-quarter of surveyed fields showed signs of white mold, although incidence and severity were, on average, both low (2% and 1.0, respectively). Incidence and severity increased until they peaked in mid-August (27% and 1.6, respectively) and remained at that level until the end of the month. Disease incidence was relatively low compared to previous years such as in 2016 when total precipitation was much greater and an average disease incidence of 61% was observed by early August (Harding et al. 2017). These data confirm that white mold can be an important constraint of dry bean production in any growing season, and not strictly correlated with the total precipitation values (Table 1). This may be due to the effect of irrigation in these fields, or perhaps the effects of isolated rain events, rather than total precipitation from May through August.

**ACKNOWLEDGEMENTS:** Funding for these surveys was provided by the Alberta Pulse Growers Commission and Agriculture and Agri-Food Canada through the CAP Pulse Cluster.

**REFERENCES:**
**Table 1**: Total precipitation received from May 1 to August 31 over the last 10 years in the three regions white mold surveys were performed in 2018.

<table>
<thead>
<tr>
<th>Year</th>
<th>Bow Island</th>
<th>Cranford</th>
<th>Rolling Hills</th>
<th>Incidence (%)^b</th>
</tr>
</thead>
<tbody>
<tr>
<td>2009</td>
<td>167</td>
<td>215</td>
<td>185</td>
<td>n.d.</td>
</tr>
<tr>
<td>2010</td>
<td>314</td>
<td>289</td>
<td>287</td>
<td>n.d.</td>
</tr>
<tr>
<td>2011</td>
<td>154</td>
<td>240</td>
<td>181</td>
<td>24</td>
</tr>
<tr>
<td>2012</td>
<td>257</td>
<td>228</td>
<td>234</td>
<td>n.d.</td>
</tr>
<tr>
<td>2013</td>
<td>214</td>
<td>230</td>
<td>154</td>
<td>26</td>
</tr>
<tr>
<td>2014</td>
<td>225</td>
<td>262</td>
<td>220</td>
<td>4</td>
</tr>
<tr>
<td>2015</td>
<td>81</td>
<td>106</td>
<td>105</td>
<td>18</td>
</tr>
<tr>
<td>2016</td>
<td>232</td>
<td>206</td>
<td>214</td>
<td>61</td>
</tr>
<tr>
<td>2017</td>
<td>136</td>
<td>114</td>
<td>127</td>
<td>5</td>
</tr>
<tr>
<td>2018</td>
<td>79</td>
<td>124</td>
<td>95</td>
<td>27</td>
</tr>
</tbody>
</table>

^a Alberta Agriculture and Forestry (2018).


**Table 2**: White mold prevalence, incidence, and severity in dry bean fields in southern Alberta in 2018.

<table>
<thead>
<tr>
<th>Date</th>
<th>Prevalence ^a (%)</th>
<th>Incidence (%)</th>
<th>Severity</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean Range</td>
<td>Mean Range</td>
<td></td>
</tr>
<tr>
<td>Jul 23-25</td>
<td>27 1.7 0 – 15</td>
<td>1.03 1.0 – 1.3</td>
<td></td>
</tr>
<tr>
<td>Jul 31</td>
<td>87 6.8 0 – 37</td>
<td>1.12 1.0 – 1.7</td>
<td></td>
</tr>
<tr>
<td>Aug 8-9</td>
<td>87 22.2 0 – 65</td>
<td>1.40 1.0 – 2.3</td>
<td></td>
</tr>
<tr>
<td>Aug 15-16</td>
<td>100 26.7 2 – 85</td>
<td>1.59 1.1 – 2.9</td>
<td></td>
</tr>
<tr>
<td>Aug 23</td>
<td>100 24.0 2 – 51</td>
<td>1.58 1.0 – 1.3</td>
<td></td>
</tr>
<tr>
<td>Sep 07^b</td>
<td>83 18.0 0 – 36</td>
<td>0.69c 0.0 – 1.3</td>
<td></td>
</tr>
</tbody>
</table>

^a Prevalence is the percentage of fields (n = 15 for most survey periods) exhibiting symptoms of white mold.

^b Surveys performed on September 7 followed a different protocol than the previous surveys; refer to Methods for details.

^c Disease severity ratings differed for the survey on September 7; refer to Methods for details.
CROP: Field pea
LOCATION: Alberta

NAMES AND AGENCY:
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TITLE: A PROVINCE-WIDE SURVEY FOR DISEASES OF FIELD PEA IN ALBERTA IN 2018

ABSTRACT: A survey of 74 field pea crops was conducted in 2018 that evaluated the prevalence, incidence and severity of root rots, mycosphaerella/aschchoya blight and bacterial blight. The survey covered twenty-four pea-growing municipalities, ranging from Cardston County in the southwest to the Municipal District of Vermillion River to the northeast. Root rot was present in all municipalities where the survey was conducted, while mycosphaerella blight was found in all but four of the municipalities. Bacterial blight was found, but only in trace amounts in two fields. Root rot prevalence remains very high throughout the province, while incidence and severity are slightly lower than in recent province-wide surveys. Mycosphaerella/aschchoya blight prevalence and incidence were slightly higher in 2018 than in recent years, primarily due to pockets of unusually wet weather in east central Alberta in June and July.

INTRODUCTION AND METHODS: Since 2006, surveyed pea crops (Pisum sativum L.) in Alberta have shown significant damage from root rot caused by Fusarium spp. (Chang et al. 2006). Additionally, the root rot pathogen, Aphanomyces euteiches Drechs., was first observed in Alberta fields in 2013 (Chatterton et al. 2014). In 2016 and 2017, approximately 725,000 ha (1.8 million acres) of dry peas were harvested in Alberta, and as such, these pathogens have the potential to become widespread in the province and cause significant economic loss. A survey of diseases on field pea was performed in Alberta in 2018 with the goal of assessing the prevalence, incidence and severity of root rots and to monitor other diseases of peas which could be visually rated in the field. Mycosphaerella blight, caused by Mycosphaerella pinodes (Berk. & A. Bloxam) Vestergr., and bacterial blight of peas, caused by Pseudomonas syringae pv. pisi Sackett, are potentially damaging pathogens that can be easily observed, visually, in the field. A total of 74 crops, representing approximately 1% of pea fields, were surveyed in southern and central Alberta for these pathogens.

Surveys were conducted at the early flowering stage (mid-June to July). At each field site, 100 pea plants were examined for foliar diseases and 25 to 50 roots were evaluated for root rot symptoms. Plants were collected from five sites in a W-shaped pattern, with at least 30 m between sampling sites. At each site, a canopy severity rating for general health was performed using a 1 to 5 scale (Table 1). Furthermore, a mycosphaerella blight incidence and severity rating was performed on 20 plants using the 1 to 7 scale shown in Table 2. Finally, five to 10 roots were excavated, excess soil removed, and rated for root rot incidence and severity according to the 1 to 7 scale (Table 3). Prevalence was calculated as percentage of fields positive for the pathogen, while incidence represents the percentage of plants positive for the pathogen. Severity is reported as an average rating of the values obtained using the respective disease severity, or canopy health, rating scales.

RESULTS AND COMMENTS: The results of each disease rating by county and for the province as a whole are shown in Table 4. The overall, average canopy health rating for the province was 2.03, indicating that most crops did not have severe, widespread above ground symptoms. The overall prevalence of root rots in the province was 90.4%, while the average root rot incidence was 52.7% with an average severity was 2.01. Mycosphaerella blight was present in 66.2% of fields with average incidence and severity of 54.7% and 2.00, respectively. Bacterial blight was observed at trace levels in two fields. Recent survey data utilizing the same rating scales are provided in Table 5. When compared to past surveys, root rot prevalence remains very high, however disease incidence and severity have declined since 2016. For mycosphaerella blight, disease incidence has been fairly consistent since 2016, however both prevalence and incidence in the east-central region of Alberta were much higher than those observed in other regions,
and in other years (Table 6). A wet cycle of precipitation persisted across portions of central Alberta where pea fields were surveyed that was in stark contrast to the drought in the south of the province. A snapshot of this phenomenon is shown in the 30-day precipitation accumulation map for Alberta from June 11 to July 10, 2018 (Figure 1). Precipitation was likely a factor in the higher levels of mycosphaerella blight in central Alberta, and the appearance of bacterial blight in the central region only.

**ACKNOWLEDGEMENTS:** We gratefully express our appreciation for the landowners and producers that allowed access to their fields for the collection of this data.

**REFERENCES:**

**Table 1.** The rating guide to estimate canopy health (Infantino et al. 2006).

<table>
<thead>
<tr>
<th>Rating</th>
<th>Canopy description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>healthy plants</td>
</tr>
<tr>
<td>2</td>
<td>Slight yellowing of lower leaves</td>
</tr>
<tr>
<td>3</td>
<td>Yellowing of the lower leaves up to the 3rd or 4th node, some stunting</td>
</tr>
<tr>
<td>4</td>
<td>Necrosis of at least half or more of the plants with some stunting</td>
</tr>
<tr>
<td>5</td>
<td>All plants dead or nearly so</td>
</tr>
</tbody>
</table>

**Table 2.** Rating guide to evaluate severity of mycosphaerella blight (modified from Schoeny et al. 2018).

<table>
<thead>
<tr>
<th>Rating</th>
<th>Lesions</th>
<th>% area affected</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>a few flecks on leaves, stems or pods</td>
<td>less than 5%</td>
</tr>
<tr>
<td>3</td>
<td>numerous small flecks</td>
<td>more than 5%</td>
</tr>
<tr>
<td>4</td>
<td>coalescing necrotic lesions</td>
<td>less than 25%</td>
</tr>
<tr>
<td>5</td>
<td>coalescing necrotic lesions</td>
<td>26% to 50%</td>
</tr>
<tr>
<td>6</td>
<td>coalescing necrotic lesions</td>
<td>51% to 75%</td>
</tr>
<tr>
<td>7</td>
<td>coalescing necrotic lesions</td>
<td>more than 75%</td>
</tr>
</tbody>
</table>
Table 3. The rating guide to evaluate root rot severity in peas (Chatterton et al. 2018).

<table>
<thead>
<tr>
<th>Rating</th>
<th>Description of lesions</th>
<th>% Root discoloration</th>
<th>Root mass reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>None</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>0.1-0.2 cm, Small reddish brown at hypocotyl base</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>3</td>
<td>Coalescing of localized root/hypocotyl lesions approximately 180° around the stem, with lesions from 0.5 to 1 cm</td>
<td>10-20%</td>
<td>0</td>
</tr>
<tr>
<td>4</td>
<td>Lesions extending and completely encircling the stem</td>
<td>95%</td>
<td>5-10%</td>
</tr>
<tr>
<td>5</td>
<td>Increasingly discolored and extended hypocotyl lesions</td>
<td>100%</td>
<td>20-50%</td>
</tr>
<tr>
<td>6</td>
<td>Hypocotyl lesions encircling the stem extending up to 2 cm</td>
<td>100%</td>
<td>50-80%</td>
</tr>
<tr>
<td>7</td>
<td>Pithy or hollow hypocotyl with very extended lesions</td>
<td>Dead</td>
<td>Dead</td>
</tr>
</tbody>
</table>

Table 4. Disease incidence and severity by individual municipality/county.

<table>
<thead>
<tr>
<th>Municipality/County</th>
<th>Canopy Rating (1-5)</th>
<th>Root rot Incidence (%)</th>
<th>Root rot Severity (1-7)</th>
<th>Mycosphaerella Incidence (%)</th>
<th>Mycosphaerella Severity (1-7)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Camrose</td>
<td>1.53</td>
<td>86.3</td>
<td>2.70</td>
<td>60.0</td>
<td>2.13</td>
</tr>
<tr>
<td>Cypress</td>
<td>3.50</td>
<td>94.0</td>
<td>3.09</td>
<td>100.0</td>
<td>5.50</td>
</tr>
<tr>
<td>Flagstaff</td>
<td>2.33</td>
<td>12.0</td>
<td>1.20</td>
<td>100.0</td>
<td>2.67</td>
</tr>
<tr>
<td>Forty Mile</td>
<td>1.41</td>
<td>48.9</td>
<td>1.96</td>
<td>0.0</td>
<td>1.00</td>
</tr>
<tr>
<td>Kneehill</td>
<td>2.59</td>
<td>64.5</td>
<td>2.34</td>
<td>59.5</td>
<td>1.89</td>
</tr>
<tr>
<td>Lacombe</td>
<td>1.68</td>
<td>74.0</td>
<td>1.94</td>
<td>25.0</td>
<td>1.48</td>
</tr>
<tr>
<td>Lethbridge</td>
<td>1.93</td>
<td>100.0</td>
<td>3.58</td>
<td>50.0</td>
<td>2.05</td>
</tr>
<tr>
<td>Minburn</td>
<td>1.73</td>
<td>34.0</td>
<td>1.67</td>
<td>100.0</td>
<td>2.13</td>
</tr>
<tr>
<td>Newell</td>
<td>3.00</td>
<td>7.0</td>
<td>1.07</td>
<td>100.0</td>
<td>3.00</td>
</tr>
<tr>
<td>Paintearth</td>
<td>1.00</td>
<td>29.0</td>
<td>1.66</td>
<td>0.0</td>
<td>1.00</td>
</tr>
<tr>
<td>Ponoka</td>
<td>1.60</td>
<td>80.0</td>
<td>2.20</td>
<td>100.0</td>
<td>3.30</td>
</tr>
<tr>
<td>Provost</td>
<td>2.60</td>
<td>17.0</td>
<td>1.47</td>
<td>100.0</td>
<td>2.60</td>
</tr>
<tr>
<td>Red Deer</td>
<td>1.61</td>
<td>94.0</td>
<td>2.48</td>
<td>70.0</td>
<td>2.05</td>
</tr>
<tr>
<td>Rocky View</td>
<td>3.33</td>
<td>54.7</td>
<td>2.10</td>
<td>66.7</td>
<td>2.67</td>
</tr>
<tr>
<td>Special Area 2</td>
<td>1.00</td>
<td>22.0</td>
<td>1.42</td>
<td>0.0</td>
<td>1.00</td>
</tr>
<tr>
<td>Special Area 3</td>
<td>3.20</td>
<td>56.0</td>
<td>1.77</td>
<td>100.0</td>
<td>3.20</td>
</tr>
<tr>
<td>Special Area 4</td>
<td>3.00</td>
<td>44.0</td>
<td>1.74</td>
<td>100.0</td>
<td>3.00</td>
</tr>
<tr>
<td>Stettler</td>
<td>1.47</td>
<td>100.0</td>
<td>2.96</td>
<td>20.0</td>
<td>1.30</td>
</tr>
<tr>
<td>Taber</td>
<td>1.01</td>
<td>54.0</td>
<td>1.62</td>
<td>0.0</td>
<td>1.00</td>
</tr>
<tr>
<td>Vermilion River</td>
<td>2.60</td>
<td>45.3</td>
<td>1.91</td>
<td>100.0</td>
<td>2.33</td>
</tr>
<tr>
<td>Wainwright</td>
<td>2.60</td>
<td>62.1</td>
<td>2.74</td>
<td>100.0</td>
<td>2.60</td>
</tr>
<tr>
<td>Warner</td>
<td>1.80</td>
<td>34.8</td>
<td>1.50</td>
<td>2.9</td>
<td>1.07</td>
</tr>
<tr>
<td>Wetaskiwin</td>
<td>1.40</td>
<td>100.0</td>
<td>2.04</td>
<td>40.0</td>
<td>1.60</td>
</tr>
<tr>
<td>Wheatland</td>
<td>2.93</td>
<td>36.0</td>
<td>1.82</td>
<td>100.0</td>
<td>2.93</td>
</tr>
<tr>
<td><strong>Alberta average</strong></td>
<td><strong>2.03</strong></td>
<td><strong>52.7</strong></td>
<td><strong>2.01</strong></td>
<td><strong>54.7</strong></td>
<td><strong>2.00</strong></td>
</tr>
</tbody>
</table>
Table 5. Recent field pea survey disease ratings.

<table>
<thead>
<tr>
<th>Survey</th>
<th>Root rot</th>
<th>Mycosphaerella</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Prevalence (%)</td>
<td>Incidence (%)</td>
</tr>
<tr>
<td>2015</td>
<td>99.0</td>
<td>79.0</td>
</tr>
<tr>
<td>2016</td>
<td>87.0</td>
<td>68.0</td>
</tr>
<tr>
<td>2017</td>
<td>97.0</td>
<td>73.0*</td>
</tr>
<tr>
<td>2018</td>
<td>90.4</td>
<td>52.7</td>
</tr>
</tbody>
</table>


S. Chatterton, unpublished.

Table 6. Mycosphaerella blight incidence and canopy health in 74 field pea crops in Alberta in 2018.

<table>
<thead>
<tr>
<th>Fields (no.)</th>
<th>Canopy (1-5)</th>
<th>Mycosphaerella</th>
<th>BB Prevalence (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Prevalence (%)</td>
<td>Incidence (%)</td>
<td>Severity (1-7)</td>
</tr>
<tr>
<td>East-Central AB</td>
<td>34</td>
<td>2.46</td>
<td>82.3</td>
</tr>
<tr>
<td>West-Central AB</td>
<td>23</td>
<td>1.72</td>
<td>78.3</td>
</tr>
<tr>
<td>Southern AB</td>
<td>17</td>
<td>1.61</td>
<td>17.7</td>
</tr>
<tr>
<td>Alberta Average</td>
<td>74</td>
<td>2.03</td>
<td>66.2</td>
</tr>
</tbody>
</table>
Fig. 1. Total accumulation of precipitation in Alberta from June 11 to July 10, 2018. (source: https://agriculture.alberta.ca/acis/climate-maps.jsp)
CROP: Soybean (Glycine max (L.) Merr.)
LOCATION: Central Alberta

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TITLE: SOYBEAN ROOT ROT IN CENTRAL ALBERTA IN 2018

ABSTRACT: In August 2018, 21 soybean fields near Bawlf, Camrose, Daysland and Lamont in central Alberta were surveyed for the occurrence of root rot. The disease was observed at all locations, with an average incidence of 90.3%, ranging from 59.7% to 100%, and with an average severity of 1.3, ranging from 0.7 to 2.2 on a 0-4 scale.

INTRODUCTION: Soybean (Glycine max L.) has great potential as a crop in the southern areas of western Canada (Dorff 2007). Root rot is a common constraint to soybean production, however, and its occurrence has been documented in all soybean crops surveyed in southern Alberta in the past few years (Chang et al. 2013, 2016; Nyandoro 2014, 2015, 2017; Fig. 1). Root rot has deleterious effects on plant stand, directly impacting productivity, and also allows weeds to outgrow the crop causing significant reductions in yield and quality (Chang et al. 2016). Recently, some growers have shown interest in growing soybean crops in central Alberta. A survey was conducted from mid- to late August 2018 across 21 fields in central Alberta to assess root rot and its impact on soybean crops.

METHODS: The survey was conducted when soybean crops were at the pod set to early pod filling stages. Root samples were collected from all fields visited. The samples were collected from five points in each field at the ends and elbows of W-shaped transects. Twenty plants were dug from the soil at each of the sampling points on the W-transect for a total of 100 root samples per soybean field. Soil samples also were collected outside the sampling points (primarily in low-lying areas) in cases where the soybeans were observed to be severely stunted, yellowing, or dead. Root samples were shaken gently to rid them of excess soil, placed in plastic bags and stored at 4°C until they were scored for disease. In the laboratory, the roots were washed gently under running water and then visually rated for root rot incidence and severity on the 0-4 scale described by Nyandoro et al. (2014).

RESULTS AND DISCUSSION: Root rot was observed in all 21 crops sampled, at a moderate to high incidence in most fields. The lowest incidence of the disease (59.7%) was found in samples collected at Camrose, while the highest (100%) was recorded at Lamont (Table 1; Fig. 1). Mean disease severity was highest (1.4) at Bawlf and lowest (1.1) at Camrose. Overall, root rot incidence was higher but severity was lower in 2018 compared with 2016 (Nyandoro et al. 2017). The higher incidence of root rot in Lamont was likely due to lower average spring temperatures relative to the other areas, which likely delayed crop emergence and provided more time for root infection. The selection of sites with good water drainage would be quite important for successful establishment of soybean crops.

White mold (Sclerotinia sclerotiorum (Lib.) De Bary) was also detected in adjacent susceptible crops as well as in the soybean crops near Lamont. The disease was characterized by yellowing leaves and the presence of white mycelium on the surface of the stems, which indicated that the primary inoculum came from airborne spores rather than from the soil. Given the wide host range of S. sclerotiorum, soybean crops should not be grown near any alternate hosts including canola (Brassica napus L.).

ACKNOWLEDGEMENTS:
This survey was supported financially by the Department of Agriculture and Forestry, Government of Alberta, and the Manitoba Pulse and Soybean Growers. We gratefully acknowledge Ms. Alexandra Abma for providing contact information for growers and information on field locations.
REFERENCES:
Dorff E. 2007. The soybean, agriculture’s jack-of-all-trades, is gaining ground across Canada. (www150.statcan.gc.ca/n1/pub/96-325-x2007000/article/10369-eng.htm)

Table 1. Root rot incidence and severity in 21 soybean crops in central Alberta in 2018.

<table>
<thead>
<tr>
<th>Location</th>
<th>No. of fields surveyed</th>
<th>Incidence (%)</th>
<th>Severity (0-4)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Range Mean</td>
<td>Range Mean</td>
</tr>
<tr>
<td>Bawlf</td>
<td>1</td>
<td>- 93.5</td>
<td>- 1.4</td>
</tr>
<tr>
<td>Camrose</td>
<td>7</td>
<td>59.7 – 97.7</td>
<td>0.7 – 1.6</td>
</tr>
<tr>
<td>Daysland</td>
<td>5</td>
<td>72.5 – 98.9</td>
<td>0.9 – 1.7</td>
</tr>
<tr>
<td>Lamont</td>
<td>8</td>
<td>70.6 – 100.0</td>
<td>0.9 – 2.2</td>
</tr>
<tr>
<td>Total / Average</td>
<td>21</td>
<td>59.7 – 100.0</td>
<td>0.7 – 2.2</td>
</tr>
</tbody>
</table>
Fig. 1. Soybean plants affected by severe root rot in low lying areas and exhibiting premature yellowing near Lamont, Alberta, in 2018. Plants in the upland areas are green and healthier.
CROP: Soybean
LOCATION: Alberta

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TITLE: A SURVEY FOR SOYBEAN DISEASES IN ALBERTA IN 2018

ABSTRACT: A survey of 17 soybean crops was conducted in 2018 that evaluated the prevalence, incidence and severity of root rots, brown spot and/or bacterial blight, and white mold. Nodulation was also evaluated and reported. The survey covered five soybean-growing municipalities, ranging from the Municipal District of Taber in the south to the Peace region of Alberta in the north. Incidence and prevalence were highest for the foliar diseases (brown spot and/or bacterial blight), followed by root rot, and white mold was the least prevalent. Nodulation was generally very good, but appeared to be more robust in fields with a longer history of soybean production. Despite relatively high disease prevalence, the incidence and severity were low in most fields. Cool fall weather and early snowfalls were likely a larger problem for Alberta soybean producers than were disease issues.

INTRODUCTION AND METHODS: Seventeen soybean fields in Alberta were surveyed for foliar diseases, root diseases and root nodulation. The locations of the fields are shown in Fig 1. In all cases, prevalence was calculated as the percentage of fields with symptoms, and incidence as the percentage of plants showing symptoms. Foliar infections due to bacterial blight (Fig 2A) and brown spot (Fig 2B) were not discriminated, but rated as one “foliar infection”. Foliar disease severity was rated using a 0 to 4 scale as described by Scherff (1973). Root rot pathogens were not identified, but root rot severity was rated using a 0 to 4 scale (Nyandoro et al. 2014). Nodulation in the root samples was rated using a 0 to 4 scale (Nyandoro et al. 2014).

RESULTS AND COMMENTS: Foliar infections had the highest prevalence and incidence, followed by root rots, while white mold had the lowest (Table 1). While disease prevalence was moderate to high for all diseases, the incidence and severity of these diseases were not. This indicated widespread distribution and occurrence of pathogens, but relatively low disease pressure. Nodulation was seen in every field, but varied slightly in incidence and in the numbers of nodules per root (Table 1). It appeared that fields with a longer history of soybean production were correlated with increased nodulation. Overall, diseases did not appear to be the major production constraint, rather the cold fall weather and early snowfall, leading to a shortened growing season and short harvest window, were likely a larger production problem, especially at the more northern latitudes.

ACKNOWLEDGEMENTS: The author expresses appreciation to landowners and producers that allowed access to their fields for the collection of these data.

REFERENCES:
Table 1. Average prevalence, incidence and severity of three soybean diseases, and nodulation, in 17 Alberta soybean fields in 2018.

<table>
<thead>
<tr>
<th>Disease</th>
<th>Prevalence (%)</th>
<th>Incidence (%)</th>
<th>Severity (0-4)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Average</td>
<td>Average</td>
<td>Range</td>
</tr>
<tr>
<td>Foliar Infection</td>
<td>94.1</td>
<td>45.6</td>
<td>9-19</td>
</tr>
<tr>
<td>Root Rot</td>
<td>88.2</td>
<td>26.8</td>
<td>0-94</td>
</tr>
<tr>
<td>White Mold</td>
<td>58.8</td>
<td>2.0</td>
<td>0-5</td>
</tr>
<tr>
<td>Nodulation</td>
<td>100.0</td>
<td>99.0</td>
<td>95-100</td>
</tr>
</tbody>
</table>

Fig. 1. Location of 17 soybean disease survey sites in Alberta, 2018.
Fig. 2. Foliar infections of soybean showing bacterial blight symptoms (A) and septoria brown spot symptoms (B).
CROP: Pulse crops (Pea, Lentil, and Chickpea)
LOCATION: Saskatchewan

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TITLE: SEED-BORNE PATHOGENS OF PULSE CROPS IN SASKATCHEWAN IN 2015

ABSTRACT: Results of commercial plate tests for seed-borne pathogens of 961 field pea, 1379 lentil and 40 chickpea samples in 2015 are summarized. All were found to be in normal ranges with the exception of *Ascochyta* spp. where declines were noted in field peas and lentil. Levels of *Ascochyta rabiei* increased in chickpeas.

METHODS: Test results from commercial agar plate tests for pathogens on seed samples of field pea, lentil, and chickpea across Saskatchewan are summarized. Three companies conducted the tests from the fall of 2015 through to the spring of 2016. The samples are assumed to be from the 2015 crop year. Presence or absence of the following pathogens was assessed:

a) *Mycosphaerella* (*Ascochyta*) *pinodes*, *Didymella* (*Ascochyta*) *pisi*, and *Phoma medicaginis* var. *pinodella* (*Ascochyta pinodella*) complex which causes ascochyta blight of field pea;
b) *Didymella* (*Ascochyta*) *lentis*, causal agent of ascochyta blight of lentil;
c) *Didymella* (*Ascochyta*) *rabiei*, causal agent of ascochyta blight of chickpea;
d) *Colletotrichum lentis*, causal agent of anthracnose of lentil;
e) *Botrytis* spp. which causes botrytis stem and pod rot (gray mold) of field pea, lentil and chickpea;
f) *Sclerotinia sclerotiorum*, causal agent of sclerotinia stem and pod rot (white mold) of field pea, lentil and chickpea.

All seed samples were tested for ascochyta blight pathogens and somewhat fewer for *Botrytis* spp., *Colletotrichum lentis* and *Sclerotinia sclerotiorum*. The mean incidence (%) of seed infection of diseased samples and percentage of pathogen-free samples were calculated for each crop district and a provincial average was determined.

RESULTS AND COMMENTS: In Saskatchewan, the 2015 crop year began with earlier than usual seeding (Saskatchewan Ministry of Agriculture 2015b). Conditions were dry and cool causing a delay in germination and seedling development across most of the province. A killing frost was widespread in late May causing many fields or portions thereof to be re-seeded (Saskatchewan Ministry of Agriculture 2015b). Conditions remained dry until the first week of July with the exception of the south-east which experienced significant precipitation in mid-June. Moisture conditions improved throughout the province from mid-July to the beginning of harvest. By mid-August, warm dry weather resulted in harvest being ahead of the 5-year average (Saskatchewan Ministry of Agriculture 2015b). However, late August saw significant moisture causing delays in what would have been an early harvest. Sprouting, bleaching, staining and lodging were reported and seed quality declined (Saskatchewan Ministry of Agriculture 2015). In the end, seed quality was close to or slightly below 10-year averages for the pulses (Saskatchewan Ministry of Agriculture 2015a). Average yield of peas was 31 bu/acre compared to a 10-year average of 33 bu/acre (Saskatchewan Ministry of Agriculture 2015b). The average lentil yield of 1392 lbs/acre was above the 10-year average of 1312 lbs/acre. Average chickpea yields improved to 1386 lbs/acre from a 10-year average of 1262 lbs/acre.

A total of 1379 lentil, 961 pea and 40 chickpea samples were processed during the period covered by this report. This represents a 217% increase for lentil, 195% increase for field pea and a 58% decline in chickpea samples reported compared to results reported in 2014 (Morrall et al. 2015). These differences
can be explained by a longer reporting period for this report and differences between seed testing labs contributing their data for this report. Based on the location of chickpea production, chickpea samples would originate from southern and south-western crop districts, but seed testing labs from these areas were under-represented.

**Pea** - The percentage of *Ascochyta*-free samples was 36.5% (Table 1), up from the 4% reported in 2014 (Morrall et al. 2015) or percentages reported for previous years. The mean % infection was 2.4 which was lower than reported in 2014 (Morrall et al. 2015) but higher than reported in 2013 (Morrall et al. 2014). Mean values above the provincial average were found in crop districts 2B, 3AN, 4A, 5A, 5B, 8A and 8B (Table 1). The percentage of *Botrytis*-free samples was 74.8% down from 84% reported in 2014 (Morrall et al. 2015). A mean level of infection of 1.6% was reported which is higher than the 0.1% for 2014 (Morrall et al. 2015). The highest level was from crop district 9A (Table 1). The percentage of *S. sclerotiorum*-free samples was 90.6% and the provincial mean *S. sclerotiorum* infection rate was 0.3% with the highest rates reported from crop districts 3AS and 6A (Table 1). The percentages of *S. sclerotiorum*-free samples reported in 2014 (Morrall et al. 2015) and 2013 (Morrall et al. 2014) were 85% and 95%, respectively, similar to 90.6% in 2017.

**Chickpea** - Chickpea production in Saskatchewan is largely centred in the southern and south-western portions of the province where reporting was reduced thus the small number of samples. The overall average of *A. rabiei*-free samples was 40% (Table 2) which is down from 60% in 2013 (Morrall et al. 2014) and 63% in 2012 (Morrall et al. 2013). The mean infection percentage was 4.1%, higher than the 0.4% for 2012 (Morrall et al. 2013), and even greater than the high end of the range reported for 2014 of 2.8% (Morrall et al. 2015). The frequency of *Botrytis*-free samples was 42.4% compared to 84% in 2014 (Morrall et al. 2015), 39% in 2013 (Morrall et al. 2014) and 78% in 2012 (Morrall et al. 2013). The mean percentage of infection was 3.9% compared to 0.2% in 2012 (Morrall et al. 2013), and 0-10% in 2014 (Morrall et al. 2015). The frequency of *S. sclerotiorum*-free samples was reported at 83.3% compared with 75% in 2013. The mean infection rate was 0.5% in 2015 which falls toward the mid-range of 0-1.3% reported for 2014 (Morrall et al. 2015) (Table 2).

**Lentil** - The percentage of *A. lentis*-free samples was 98.5% (Table 3) compared with 99% in 2014 (Morrall et al. 2015), 96% in 2013 (Morrall et al. 2014) and 90% in 2012 (Morrall et al. 2013). The provincial mean infection rate was 0.1% which, although higher than 2014 at 0.01% (Morrall et al. 2014), remains very low. The frequency of *Botrytis*-free samples reached 54.8% compared to 45% in 2014 (Morrall et al. 2015), 65% in 2013 (Morrall et al. 2014) and 78% in 2012 (Morrall et al. 2013). Mean percentage infection rates remain low with a provincial average of 1.8%. The percentages of *C. lentis*-free samples were 72.4% with a mean infection rate of 1.0% (Table 3), compared to 78% and 0.2% in 2014 (Morrall et al. 2015), 0.8% and 0.1% in 2013 (Morrall et al. 2014) and 71% with 0.3% in 2012 (Morrall et al. 2013). The frequency of *S. sclerotiorum*-free samples was 90.3% with a 0.4% mean infection rate (Table 3). In 2014, 49% of samples were free of *S. sclerotiorum* with a mean infection rate of 0.5% (Morrall et al. 2015) while in 2013, 65% of the samples were *S. sclerotiorum*-free (Morrall et al. 2014)

**ACKNOWLEDGEMENTS:** We would like acknowledge the cooperation of 20/20 Seed Labs Inc., Prairie Diagnostic Seed Lab and Discovery Seed Labs Ltd. in providing seed testing results thus making this report possible.

**REFERENCES:**


Saskatchewan Ministry of Agriculture. 2015 Final Crop Reports. Regina, SK.

http://www.agriculture.gov.sk.ca/cr151029
Table 1. Numbers of field pea samples tested from September to April, 2015 and the levels of infection with *Ascochyta* spp., *Botrytis* spp., and *Sclerotinia sclerotiorum* in relation to Saskatchewan Crop Districts.

<table>
<thead>
<tr>
<th>Crop district</th>
<th>2015 Field Peas</th>
<th>Ascochyta spp.</th>
<th>Botrytis spp.</th>
<th>Sclerotinia sclerotiorum</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No. tests</td>
<td>% PFS&lt;sup&gt;a&lt;/sup&gt;</td>
<td>Mean %&lt;sup&gt;b&lt;/sup&gt;</td>
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<sup>a</sup>% PFS = percent pathogen free samples

<sup>b</sup>Mean % = mean percent infection
Table 2. Number of chickpea samples tested from September to April, 2015 and levels of infection with *Ascochyta rabiei*, *Botrytis* spp., and *Sclerotinia sclerotiorum* in relation to Saskatchewan Crop Districts.

<table>
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<th>No. tests</th>
<th>% PFS</th>
<th>Mean %&lt;sup&gt;b&lt;/sup&gt;</th>
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<th>Mean %</th>
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<th>% PFS</th>
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</table>

<sup>a</sup> %PFS = percent pathogen free samples  
<sup>b</sup> Mean % = mean percent infection  
<sup>c</sup> nd = no data
Table 3. Numbers of lentil seed samples tested from September to April, 2015 and levels of infection with Ascochyta lentis, Colletotrichum lentis, Botrytis spp., and Sclerotinia sclerotiorum in relation Saskatchewan Crop Districts.

<table>
<thead>
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<tr>
<td></td>
<td>Ascochyta lentis</td>
<td>Colletotrichum lentis</td>
<td>Botrytis spp.</td>
<td>Sclerotinia sclerotiorum</td>
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<tr>
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<td>% PFS Mean %</td>
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</table>

\(^a\)%PFS = percent pathogen free samples

\(^b\)Mean % = mean percent infection

nd = no data
CROP: Pulse crops (Pea, Lentil, and Chickpea)
LOCATION: Saskatchewan

NAMES AND AGENCIES:
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⁷Saskatchewan Ministry of Agriculture, 3085 Albert St., Regina, SK S4S 0B1

TITLE: SEED-BORNE PATHOGENS OF PULSE CROPS IN SASKATCHEWAN IN 2016

ABSTRACT: Results of commercial plate tests for seed-borne pathogens of 1080 field pea, 1505 lentil and 64 chickpea samples are summarized. Numbers of Botrytis-free samples and S. sclerotiorum-free samples were significantly less in field peas and lentils compared to 2015, whereas the mean percent infection was higher. Levels of Ascochyta spp. remained high in peas and the numbers of anthracnose-free samples in lentils were at the lowest levels over the past five years.

METHODS: Test results from commercial agar plate tests for pathogens in seed samples of field pea, lentil, and chickpea across Saskatchewan (SK) were summarized. Three companies conducted the tests from the fall of 2016 through to the spring of 2017. The samples were assumed to be from the 2016 crop year. Seeds were assessed for the following pathogens:

a) Mycosphaerella (Ascochyta) pinodes, Didymella (Ascochyta) pisi, and Phoma medicaginis var. pinodella (Ascochyta pinodella) complex which cause ascochyta blights of field pea;
b) Didymella (Ascochyta) lentis, causal agent of ascochyta blight of lentil;
c) Didymella (Ascochyta) rabiei, causal agent of ascochyta blight of chickpea;
d) Colletotrichum lentis, causal agent of anthracnose of lentil;
e) Botrytis spp. which cause botrytis stem and pod rot (gray mold) of field pea, lentil and chickpea;
f) Sclerotinia sclerotiorum, causal agent of sclerotinia stem and pod rot (white mold) of field pea, lentil, and chickpea.

All seed samples were tested for ascochyta blight pathogens and somewhat fewer for Botrytis spp., Colletotrichum lentis and Sclerotinia sclerotiorum. The mean incidence (%) of seed infection of diseased samples and percentage of pathogen-free samples were calculated for each crop district and a provincial average was determined.

RESULTS AND COMMENTS: The 2016 crop year began with earlier than usual seeding and by mid-May, 81% of the crop was seeded compared to a 5-year average of only 59% (Saskatchewan Ministry of Agriculture 2016). The crop was considered in good condition due to timely rains. By mid-June, pulses were ahead of normal development. General, heavy rainfall through late June into mid-July led producers to become concerned about excess moisture and the presence of disease. Significant rainfall continued throughout most of the province into August (Sask. Ministry of Agriculture 2016). Fields were reported wet and crops were downgraded due to higher levels of disease. By early September, 32% of the crop was harvested ahead of the 5-year average of 28% (Sask. Ministry of Agriculture 2016). However, harvest stalled through much of September due to continued rainfall and wet field conditions. By October 3, 95% of the lentils had been harvested and 80% of the total harvest was completed which was below the 5-year average of 86%. Snow and continued rainfall further delayed harvest but, by November, 95% of the harvest was complete (Sask. Ministry of Agriculture 2016). The remainder was largely not harvested or harvested in the spring.

Field pea acreage was 2.18 million acres up from the 2.135 million acres in 2015 but below the 5-year average of 2.22 million acres (SK Ministry of Agriculture 2016). Yields were reported at 40.1 bu/acre up from the 2015 average yield of 30.9 bu/acre and the 10-year average of 33.8 bu/acre (Sask. Ministry of Agriculture 2016). Problems with root rot were reported (not included in this report).

Chickpea production continued to decline as 160,000 acres were seeded but only 100,000 acres were harvested due to inclement weather (Sask. Ministry of Agriculture 2016). Yields averaged 1658 lbs/acre up slightly from the 1600 lbs/acre in 2015 but below the 5-year average of 1754 lbs/acre. Grades indicated most production was destined for the feed market (Sask. Ministry of Agriculture 2016).

A total of 1080 field pea (Table 1), 1505 lentil (Table 2) and 64 chickpea (Table 3) samples were processed during the period covered by this report which represents a 12%, 9%, and 60% increase in samples, respectively, compared to results reported in 2015 (Olson et al. 2019). Although the number of chickpea samples increased by 60%, numbers still remained low. Based on the location of chickpea production, more samples should originate from southern and south-western crop districts but seed-testing labs from these areas are under-represented.

Pea - The percentage of Ascochyta-free samples was 8.4% (Table 1), down significantly from the 36.5% reported in 2015 (Olson et al. 2019) but in line with the 4% of 2014 (Morrall & Carriere 2015) and percentages reported in previous years (Morrall et al. 2013; 2014). The mean % infection was 5.4%, twice the 2015 level (Olson et al. 2019) but similar to values reported in 2014 (Morrall & Carriere 2015) and 2012 (Morrall et al. 2013). The highest levels were observed in crop districts 3AS, 3BN and 7A (Table 1). The percentage of Botrytis-free samples was 61.1%, down from previous years (Table 4). A mean level of infection of 0.9% was slightly less than last year but above 2014 (Morrall and Carriere 2015) and 2012 (Morrall et al. 2013) levels. The percentage of S. sclerotiorum-free samples was 78.3%, significantly down from previous years of approximately 90% (Table 4). The provincial mean % infection was 0.7% compared with 0.3% reported in 2015 (Olson et al. 2019).

Lentil - The percentage of A. lentis-free samples was 97.8% (Table 2), similar to reports from previous years (Table 4). The provincial mean % infection was 0.4%, higher than the 0.1% reported for 2015 (Olson et al. 2019) but remaining quite low. The percentage of C. lentis-free samples was 60.4% with a mean % infection of 0.8% (Table 2) compared to 72.4% and 1.0%, respectively, in 2015 (Olson et al. 2019) with similar values reported in previous years (Table 4). The frequency of Botrytis-free samples was 14.8% which is the lowest level reported over the last 5 years (Table 4). The mean % infection was 3.3%, which was higher than previously reported (Table 4). The frequency of S. sclerotiorum-free samples dropped significantly to 33.3% from 90.3% in 2015 (Olson et al. 2019) with an increase in the mean infection rate to 1.0% which was higher than in previous years (Table 4).

Chickpea - Chickpea production in Saskatchewan is largely centered in the southern and south-western portions of the province where reporting was reduced resulting in small numbers of samples. The overall average of Ascochyta rabiei-free samples was 65.6% (Table 3) which is higher than the 40% of 2015 (Olson et al. 2019) but consistent with 60% in 2013 (Morrall et al. 2014) and 63% in 2012 (Morrall et al. 2013). The mean infection percentage was 4.7%, similar to the 4.1% in 2015 (Olson et al. 2019) but higher than the 0.4% in 2012 (Morrall et al. 2013) and the range reported for 2014 of 0- 2.8% (Morrall & Carriere 2015). The frequency of Botrytis-free samples was 37% compared to 42.4% in 2015 (Olson et al. 2019), 84% in 2014 (Morrall & Carriere 2015), 39% in 2013 (Morrall et al. 2014), and 78% in 2012 (Morrall et al. 2013). The mean % infection was 8.4%, more than twice the 3.77% reported in 2015 (Olson et al. 2019). This is the highest recorded value in the past 5 years (Table 4). The frequency of S. sclerotiorum-free samples was 74.1%. This is down slightly from 83.3% in 2015 (Olson et al. 2019). The mean % infection rate was 2.0%, up slightly from 0.5% reported in 2015 (Olson et al. 2019).

ACKNOWLEDGEMENTS: We would like to acknowledge the cooperation of 20/20 Seed Labs Inc., Prairie Diagnostic Seed Lab and Discovery Seed Labs Ltd. in providing seed testing results. We also wish to recognize the financial support of the Saskatchewan Pulse Growers.
REFERENCES:
Table 1. Number of field pea samples tested from September 2016 to May 2017 and levels of infection with *Ascochyta* spp., *Botrytis* spp. and *Sclerotinia sclerotiorum* in relation to Saskatchewan Crop Districts.

<table>
<thead>
<tr>
<th>Crop district</th>
<th>2016 Field pea</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><em>Ascochyta</em> spp.</td>
<td># tests</td>
<td>% PFS&lt;sup&gt;a&lt;/sup&gt;</td>
<td>Mean % Infection</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><em>Botrytis</em> spp.</td>
<td># tests</td>
<td>% PFS&lt;sup&gt;a&lt;/sup&gt;</td>
<td>Mean % Infection</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><em>Sclerotinia</em> spp.</td>
<td># tests</td>
<td>% PFS&lt;sup&gt;a&lt;/sup&gt;</td>
<td>Mean % Infection</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1A</td>
<td>42</td>
<td>21.4</td>
<td>3.2</td>
<td>40</td>
<td>62.5</td>
<td>0.7</td>
</tr>
<tr>
<td>1B</td>
<td>15</td>
<td>0</td>
<td>6.1</td>
<td>14</td>
<td>85.7</td>
<td>0.5</td>
</tr>
<tr>
<td>2A</td>
<td>20</td>
<td>15.0</td>
<td>4.8</td>
<td>19</td>
<td>73.7</td>
<td>0.7</td>
</tr>
<tr>
<td>2B</td>
<td>12</td>
<td>8.3</td>
<td>3.6</td>
<td>12</td>
<td>50.0</td>
<td>0.7</td>
</tr>
<tr>
<td>3AN</td>
<td>2</td>
<td>0</td>
<td>1.8</td>
<td>2</td>
<td>0</td>
<td>&gt;0.05</td>
</tr>
<tr>
<td>3AS</td>
<td>65</td>
<td>0</td>
<td>7.8</td>
<td>56</td>
<td>78.2</td>
<td>0.7</td>
</tr>
<tr>
<td>3BN</td>
<td>51</td>
<td>7.8</td>
<td>7.5</td>
<td>50</td>
<td>70.0</td>
<td>0.6</td>
</tr>
<tr>
<td>3BS</td>
<td>12</td>
<td>41.7</td>
<td>3.4</td>
<td>6</td>
<td>50.0</td>
<td>0.5</td>
</tr>
<tr>
<td>4A</td>
<td>4</td>
<td>0</td>
<td>3.0</td>
<td>4</td>
<td>75.0</td>
<td>0.5</td>
</tr>
<tr>
<td>4B</td>
<td>10</td>
<td>0</td>
<td>5.9</td>
<td>7</td>
<td>85.7</td>
<td>0.5</td>
</tr>
<tr>
<td>5A</td>
<td>9</td>
<td>0</td>
<td>5.9</td>
<td>6</td>
<td>83.3</td>
<td>1.0</td>
</tr>
<tr>
<td>5B</td>
<td>49</td>
<td>10.2</td>
<td>4.4</td>
<td>33</td>
<td>54.5</td>
<td>1.0</td>
</tr>
<tr>
<td>6A</td>
<td>84</td>
<td>2.4</td>
<td>4.9</td>
<td>80</td>
<td>40</td>
<td>1.0</td>
</tr>
<tr>
<td>6B</td>
<td>196</td>
<td>6.1</td>
<td>5.5</td>
<td>172</td>
<td>64.5</td>
<td>0.8</td>
</tr>
<tr>
<td>7A</td>
<td>69</td>
<td>2.9</td>
<td>9.5</td>
<td>67</td>
<td>56.7</td>
<td>0.8</td>
</tr>
<tr>
<td>7B</td>
<td>116</td>
<td>2.6</td>
<td>6.8</td>
<td>109</td>
<td>64.2</td>
<td>0.8</td>
</tr>
<tr>
<td>8A</td>
<td>33</td>
<td>15.2</td>
<td>4.8</td>
<td>14</td>
<td>28.6</td>
<td>2.0</td>
</tr>
<tr>
<td>8B</td>
<td>66</td>
<td>18.2</td>
<td>3.8</td>
<td>43</td>
<td>51.2</td>
<td>1.5</td>
</tr>
<tr>
<td>9A</td>
<td>118</td>
<td>19.5</td>
<td>2.5</td>
<td>101</td>
<td>64.4</td>
<td>0.8</td>
</tr>
<tr>
<td>9B</td>
<td>109</td>
<td>4.7</td>
<td>4.0</td>
<td>74</td>
<td>58.1</td>
<td>1.0</td>
</tr>
<tr>
<td>Total/Mean</td>
<td>1080</td>
<td>8.4</td>
<td>5.4</td>
<td>909</td>
<td>61.1</td>
<td>0.9</td>
</tr>
</tbody>
</table>

<sup>a</sup>PFS = percent pathogen-free samples.
Table 2. Number of lentil seed samples tested from September 2016 to May 2017 and levels of infection with *Ascochyta* spp., *Colletotrichum lentis*, *Botrytis* spp., and *Sclerotinia sclerotiorum* in relation to Saskatchewan Crop Districts.

<table>
<thead>
<tr>
<th>Crop district</th>
<th>Total tests</th>
<th>2016 Lentil</th>
<th>2016 Lentil</th>
<th>Botrytis spp.</th>
<th>Sclerotinia sclerotiorum</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td><em>Ascochyta lentis</em></td>
<td><em>Colletotrichum lentis</em></td>
<td><em>Botrytis</em> spp.</td>
<td><em>Sclerotinia sclerotiorum</em></td>
</tr>
<tr>
<td></td>
<td></td>
<td># tests</td>
<td>% PFS</td>
<td>Mean %</td>
<td># tests</td>
</tr>
<tr>
<td>1A</td>
<td>47</td>
<td>47</td>
<td>100</td>
<td>0.0</td>
<td>47</td>
</tr>
<tr>
<td>1B</td>
<td>1</td>
<td>1</td>
<td>100</td>
<td>0.0</td>
<td>1</td>
</tr>
<tr>
<td>2A</td>
<td>113</td>
<td>113</td>
<td>100</td>
<td>0.0</td>
<td>113</td>
</tr>
<tr>
<td>2B</td>
<td>107</td>
<td>107</td>
<td>100</td>
<td>0.0</td>
<td>107</td>
</tr>
<tr>
<td>3AN</td>
<td>49</td>
<td>49</td>
<td>98.0</td>
<td>0.3</td>
<td>49</td>
</tr>
<tr>
<td>3AS</td>
<td>184</td>
<td>184</td>
<td>97.8</td>
<td>1.4</td>
<td>179</td>
</tr>
<tr>
<td>3BN</td>
<td>188</td>
<td>188</td>
<td>98.4</td>
<td>0.3</td>
<td>188</td>
</tr>
<tr>
<td>3BS</td>
<td>42</td>
<td>42</td>
<td>97.6</td>
<td>0.3</td>
<td>39</td>
</tr>
<tr>
<td>4A</td>
<td>8</td>
<td>8</td>
<td>100</td>
<td>0.0</td>
<td>8</td>
</tr>
<tr>
<td>4B</td>
<td>25</td>
<td>25</td>
<td>92.0</td>
<td>0.3</td>
<td>22</td>
</tr>
<tr>
<td>5A</td>
<td>7</td>
<td>7</td>
<td>100</td>
<td>0.0</td>
<td>7</td>
</tr>
<tr>
<td>5B</td>
<td>6</td>
<td>6</td>
<td>100</td>
<td>0.0</td>
<td>6</td>
</tr>
<tr>
<td>6A</td>
<td>78</td>
<td>78</td>
<td>100</td>
<td>0.0</td>
<td>78</td>
</tr>
<tr>
<td>6B</td>
<td>290</td>
<td>290</td>
<td>96.6</td>
<td>0.3</td>
<td>290</td>
</tr>
<tr>
<td>7A</td>
<td>235</td>
<td>235</td>
<td>96.2</td>
<td>0.3</td>
<td>235</td>
</tr>
<tr>
<td>7B</td>
<td>70</td>
<td>70</td>
<td>97.1</td>
<td>0.3</td>
<td>70</td>
</tr>
<tr>
<td>8A</td>
<td>1</td>
<td>1</td>
<td>100</td>
<td>0.0</td>
<td>0</td>
</tr>
<tr>
<td>8B</td>
<td>22</td>
<td>22</td>
<td>100</td>
<td>0.0</td>
<td>19</td>
</tr>
<tr>
<td>9A</td>
<td>23</td>
<td>23</td>
<td>100</td>
<td>0.0</td>
<td>23</td>
</tr>
<tr>
<td>9B</td>
<td>9</td>
<td>9</td>
<td>100</td>
<td>0.0</td>
<td>7</td>
</tr>
<tr>
<td><strong>Total/Mean</strong></td>
<td><strong>1505</strong></td>
<td><strong>1505</strong></td>
<td><strong>97.8</strong></td>
<td><strong>0.4</strong></td>
<td><strong>1488</strong></td>
</tr>
</tbody>
</table>

*a* PFS = percent pathogen-free samples.  
*b* Mean % = mean percent infection.  
*nd* = no data
Table 3. Number of chickpea seed samples tested from September 2016 to May 2017 and levels of infection with *Ascochyta rabiei*, *Botrytis* spp. and *Sclerotinia sclerotiorum* in relation to Saskatchewan Crop Districts.

<table>
<thead>
<tr>
<th>Crop district</th>
<th>2016 Chickpea</th>
<th>2016 Chickpea</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><em>Ascochyta</em> spp.</td>
<td><em>Botrytis</em> spp.</td>
</tr>
<tr>
<td></td>
<td># tests</td>
<td>% PFS&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>1A</td>
<td>nd</td>
<td>nd</td>
</tr>
<tr>
<td>1B</td>
<td>nd</td>
<td>nd</td>
</tr>
<tr>
<td>2A</td>
<td>4</td>
<td>75</td>
</tr>
<tr>
<td>2B</td>
<td>6</td>
<td>100</td>
</tr>
<tr>
<td>3AN</td>
<td>7</td>
<td>43</td>
</tr>
<tr>
<td>3AS</td>
<td>31</td>
<td>58</td>
</tr>
<tr>
<td>3BN</td>
<td>3</td>
<td>66.7</td>
</tr>
<tr>
<td>3BS</td>
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<td>100</td>
</tr>
<tr>
<td>4A</td>
<td>nd</td>
<td>nd</td>
</tr>
<tr>
<td>4B</td>
<td>nd</td>
<td>nd</td>
</tr>
<tr>
<td>5A</td>
<td>nd</td>
<td>nd</td>
</tr>
<tr>
<td>5B</td>
<td>nd</td>
<td>nd</td>
</tr>
<tr>
<td>6A</td>
<td>nd</td>
<td>nd</td>
</tr>
<tr>
<td>6B</td>
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<td>nd</td>
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<tr>
<td>7A</td>
<td>10</td>
<td>70</td>
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<tr>
<td>7B</td>
<td>nd</td>
<td>nd</td>
</tr>
<tr>
<td>8A</td>
<td>nd</td>
<td>nd</td>
</tr>
<tr>
<td>8B</td>
<td>nd</td>
<td>nd</td>
</tr>
<tr>
<td>9A</td>
<td>nd</td>
<td>nd</td>
</tr>
<tr>
<td>9B</td>
<td>nd</td>
<td>nd</td>
</tr>
<tr>
<td>Total/Mean</td>
<td>64</td>
<td>65.6</td>
</tr>
</tbody>
</table>

<sup>a</sup>PFS = percentage pathogen-free samples.  
<sup>nd</sup> = no data
Table 4. Summary of pulse seed samples tested from 2012 to 2016 in Saskatchewan.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>% PFS</td>
<td>Mean</td>
<td>% PFS</td>
<td>Mean</td>
<td>% PFS</td>
</tr>
<tr>
<td>Lentil</td>
<td>A. lentis</td>
<td>97.8</td>
<td>0.4</td>
<td>98.5</td>
<td>0.1</td>
<td>99</td>
</tr>
<tr>
<td></td>
<td>C. lentis</td>
<td>60.4</td>
<td>0.8</td>
<td>72.4</td>
<td>1.0</td>
<td>78</td>
</tr>
<tr>
<td></td>
<td>Botrytis spp.</td>
<td>14.8</td>
<td>3.3</td>
<td>54.8</td>
<td>1.8</td>
<td>45</td>
</tr>
<tr>
<td></td>
<td>S. sclerotiorum</td>
<td>33.3</td>
<td>1.0</td>
<td>90.3</td>
<td>0.4</td>
<td>49</td>
</tr>
<tr>
<td>Pea</td>
<td>Ascochyta spp.</td>
<td>8.4</td>
<td>5.4</td>
<td>36.5</td>
<td>2.4</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Botrytis spp.</td>
<td>61.1</td>
<td>0.9</td>
<td>74.8</td>
<td>1.6</td>
<td>84</td>
</tr>
<tr>
<td></td>
<td>S. sclerotiorum</td>
<td>78.3</td>
<td>0.7</td>
<td>90.6</td>
<td>0.3</td>
<td>85</td>
</tr>
<tr>
<td>Chickpea</td>
<td>A. rabiei</td>
<td>65.6</td>
<td>4.7</td>
<td>40</td>
<td>4.1</td>
<td>nd</td>
</tr>
<tr>
<td></td>
<td>Botrytis spp.</td>
<td>37.0</td>
<td>8.4</td>
<td>42.4</td>
<td>3.77</td>
<td>nd</td>
</tr>
<tr>
<td></td>
<td>S. sclerotorium</td>
<td>74.1</td>
<td>2.0</td>
<td>83.3</td>
<td>0.5</td>
<td>nd</td>
</tr>
</tbody>
</table>

References: 2015 (Olson et al. 2015); 2014 (Morrall & Carriere 2015); 2013 (Morrall et al. 2014); 2012 (Morrall et al. 2013).

%PFS = percent pathogen-free samples. Mean % = mean percent infection. nd = no data.
CROP: Pulse crops (Pea, Lentil, and Chickpea)
LOCATION: Saskatchewan

NAMES AND AGENCIES:
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⁷Lendon Seed Lab, 147 Hodsmann Road, Regina, SK S4N 5W5
⁸Saskatchewan Ministry of Agriculture, 3085 Albert St., Regina, SK S4S 0B1

TITLE: SEED-BORNE PATHOGENS OF PULSE CROPS IN SASKATCHEWAN IN 2017

ABSTRACT: Results of commercial plate tests for seed-borne pathogens of 956 field pea, 1263 lentil and 145 chickpea samples are summarized. Pathogen-free samples in all crops and for all pathogens were at historic highs. Mean percent infection was lower than most levels recorded for the past 5 years.

METHODS: Commercial agar plate tests for pathogens in seed samples of field pea, lentil, and chickpea across Saskatchewan were conducted from the fall of 2017 through to the spring of 2018. Samples were received from four companies. The samples were assumed to be from the 2017 crop year. Seeds were assessed for the presence of the following pathogens:

a) Mycosphaerella (Ascochyta) pinodes, Didymella (Ascochyta) pisi, and Phoma medicaginis var. pinodella (Ascochyta pinodella) complex, which causes ascochyta blight of field pea;
b) Didymella (Ascochyta) lentis, causal agent of ascochyta blight of lentil;
c) Didymella (Ascochyta) rabiei, causal agent of ascochyta blight of chickpea;
d) Colletotrichum lentis, causal agent of anthracnose in lentil;
e) Botrytis spp. which cause botrytis stem and pod rot (gray mold) of field pea, lentil and chickpea;
f) Sclerotinia sclerotiorum, causal agent of sclerotinia stem and pod rot (white mold) of field pea, lentil, and chickpea.

A total of 2364 samples were tested for ascochyta blight pathogens and 2285 samples were tested for Botrytis spp., C. lentis and S. sclerotiorum. The mean incidence (%) of seed infection in diseased samples and the percentage of pathogen-free samples were calculated for each crop district and a provincial average was determined.

RESULTS AND COMMENTS: The 2017 crop year began with cool, wet conditions which hampered the harvesting of the one million acres of the 2016 crop that overwintered in the field (Saskatchewan Ministry of Agriculture 2017). By late May, warm, dry winds had allowed the south to dry out while the north struggled with excess moisture. The southern areas of the province continued to remain dry as hot and windy conditions prevailed. Widespread rain in late June allowed crop development to approach normal. Spotty rainfall characterized the remainder of the crop year in the south with ample rainfall in the northern areas. By the first of August, harvest of pulses was in full swing and further rainfall had no effect on other crops. Harvest progressed from pulses to cereals and finally oilseeds with few delays. By October 19, 98% of the harvest was complete. Crop quality was reported to be No. 1 or No. 2 in most crops, with few reports of disease.

Lentil production in Saskatchewan decreased from 5.3 million acres seeded in 2016 to 3.9 million acres in 2017 (Government of Saskatchewan 2017). The 2017 yield was 1297 lbs/acre, up from the 1167 lbs/acre in 2016 but below the 5-year (2012-2016) average of 1436 lbs/acre.

Field pea acreage was 2.165 million acres, down slightly from the 2.18 million acres in 2016 (Government of Saskatchewan 2017). The 2017 average yield was reported at 33.8 bu/acre, down 16% from the 40.1 bu/acre of 2016 and 4% from the 5-year (2012-2016) average of 35.2 bu/acre.
Chickpea production increased slightly with 160,000 acres seeded in 2017 compared to 143,000 acres seeded in 2016 (Government of Saskatchewan 2017). However, yields declined by 28% from 1658 lbs/acre in 2016 to 1186 lbs/acre in 2017. The 2017 yield average was down 32.8% from the 5-year average of 1764 lbs/acre.

A total of 956 field pea, 1,263 lentil, and 145 chickpea samples were processed during the period covered by this report. This represents an increase of 127% in chickpea samples compared to 2016 (Olson et al. 2019a). Although chickpea samples have increased, sample numbers remain low. Based on the location of chickpea production, more samples should originate from southern and south-western crop districts but seed-testing labs from these areas are under-represented. Lentil samples declined by 16% and field peas by 11.5%. The lower number of samples received by some seed labs was indicative of producers' diminished concerns related to disease.

**Pea** - The percentage of Ascochyta-free samples was 66%, up dramatically from the 8.4% reported in 2016 and the highest reported in the past 5 years (Table 1). The mean percent infection was 1.6% (Table 2). This was the lowest reported level in the past 5 years. The percentage of Botrytis-free samples was 93.3%, up from previous years (Table 1). A mean level of infection of 0.6% represents a 0.3% decline from 2016. The percentage of S. sclerotiorum-free samples was 98.5%, the highest recorded in the past 5 years. The provincial mean percent infection was 0.4%. This is down from 0.7% in 2016 (Table 1).

**Lentil** - The percentage of A. lentis-free samples was 98.1% (Table 3), in line with previous years (Table 1). The provincial mean percent infection was 0.9%, higher than the 0.4% reported for 2016 but still quite low (Table 1). The percentage of C. lentis-free samples was 95.1% with a mean percent infection of 0.7% (Table 3) compared to 60.4% and 0.8% in 2016. The frequency of Botrytis-free samples was 90.3%, the highest level seen in the last 5 years (Table 1). The mean percent infection was 1.1%, down from 3.3% in 2016. The frequency of S. sclerotiorum-free samples rose significantly to 95.4% from only 33.3% in 2016 (Olson et al. 2019a). The mean infection rate of 0.8% was down slightly from 1.0% in 2016.

**Chickpea** - Chickpea production in Saskatchewan is largely centered in the southern and south-western portions of the province from where small numbers of samples were evaluated. The overall average of Ascochyta rabiei-free samples was 97.2% (Table 4) which is higher than the 65.6% of 2016 (Olson et al. 2019b). The mean infection percentage was 0.6%, lower than the 4.7% in 2016 but within the range reported for 2014 of 0 to 2.8% (Morrall & Carriere 2015). The frequency of Botrytis-free samples was 100% compared to 37.0% in 2016 (Olson et al. 2019b) and 42.4% in 2015 (Olson et al. 2019a). This is the highest recorded value in the past 5 years (Table 1). The mean percent infection was 0%, significantly lower than the 37.0% recorded in 2016. The frequency of S. sclerotiorum-free samples was reported at 100%. This is up from 74.1% in 2016. The mean percent infection rate was 0%, down from 2.0% in 2016.

**ACKNOWLEDGEMENTS:** We would like to acknowledge the cooperation of 20/20 Seed Labs Inc., Lendon Seed Lab, Prairie Diagnostic Seed Lab, and Discovery Seed Labs Ltd. in providing seed testing results. We also wish to recognize the financial support of the Saskatchewan Pulse Growers.

**REFERENCES:**
Table 1. Summary of pulse seed samples tested from 2013 to 2017 in Saskatchewan.

<table>
<thead>
<tr>
<th>Pathogen</th>
<th>2017 % PFS</th>
<th>Mean %</th>
<th>2016a % PFS</th>
<th>Mean %</th>
<th>2015b % PFS</th>
<th>Mean %</th>
<th>2014c % PFS</th>
<th>Mean %</th>
<th>2013d % PFS</th>
<th>Mean %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lentil A. lentis</td>
<td>98.1</td>
<td>0.9</td>
<td>97.8</td>
<td>0.4</td>
<td>98.5</td>
<td>0.1</td>
<td>99</td>
<td>0.01</td>
<td>96</td>
<td>nd</td>
</tr>
<tr>
<td>C. lentis</td>
<td>95.1</td>
<td>0.7</td>
<td>60.4</td>
<td>0.8</td>
<td>72.4</td>
<td>1.0</td>
<td>78</td>
<td>0.2</td>
<td>88</td>
<td>&gt;0.1</td>
</tr>
<tr>
<td>Botrytis spp.</td>
<td>0.3</td>
<td>1.1</td>
<td>14.8</td>
<td>3.3</td>
<td>54.8</td>
<td>1.8</td>
<td>45</td>
<td>nd</td>
<td>65</td>
<td>nd</td>
</tr>
<tr>
<td>S. sclerotiorum</td>
<td>95.4</td>
<td>0.8</td>
<td>33.3</td>
<td>1.0</td>
<td>90.3</td>
<td>0.4</td>
<td>49</td>
<td>0.5</td>
<td>65</td>
<td>nd</td>
</tr>
<tr>
<td>Pea Ascochyta spp.</td>
<td>66.4</td>
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<td>8.4</td>
<td>5.4</td>
<td>36.5</td>
<td>2.4</td>
<td>4</td>
<td>6.8</td>
<td>28</td>
<td>2.0</td>
</tr>
<tr>
<td>Botrytis spp.</td>
<td>93.3</td>
<td>0.6</td>
<td>61.1</td>
<td>0.9</td>
<td>74.8</td>
<td>1.6</td>
<td>84</td>
<td>0.1</td>
<td>73</td>
<td>nd</td>
</tr>
<tr>
<td>S. sclerotiorum</td>
<td>98.5</td>
<td>0.4</td>
<td>78.3</td>
<td>0.7</td>
<td>90.6</td>
<td>0.3</td>
<td>85</td>
<td>0.1</td>
<td>95</td>
<td>nd</td>
</tr>
<tr>
<td>Chick pea Ascochyta rabiei</td>
<td>97.2</td>
<td>0.6</td>
<td>65.6</td>
<td>4.7</td>
<td>40</td>
<td>4.1</td>
<td>nd</td>
<td>0-2.8</td>
<td>60</td>
<td>nd</td>
</tr>
<tr>
<td>Botrytis spp.</td>
<td>100</td>
<td>0</td>
<td>37.0</td>
<td>8.4</td>
<td>42.4</td>
<td>3.8</td>
<td>nd</td>
<td>0.2</td>
<td>39</td>
<td>nd</td>
</tr>
<tr>
<td>S. sclerotiorum</td>
<td>100</td>
<td>0</td>
<td>74.1</td>
<td>2.0</td>
<td>83.3</td>
<td>0.5</td>
<td>nd</td>
<td>0-1.3</td>
<td>75</td>
<td>0.5</td>
</tr>
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a 2016 (Olson et al. 2019a);
b 2015 Olson et al. 2019b);
c 2014 (Morrall & Carrier 2015);
d 2013 (Morrall et al. 2014).
e % PFS = percent pathogen-free samples.
f Mean % = mean percent infection.
nd = no data
Table 2. Numbers of field pea samples tested from September, 2017 to May, 2018 and levels of infection with *Ascochyta* spp., *Botrytis* spp. and *Sclerotinia sclerotiorum* for each Saskatchewan Crop District.

<table>
<thead>
<tr>
<th>Crop district</th>
<th><em>Ascochyta</em> spp.</th>
<th><em>Botrytis</em> spp.</th>
<th><em>Sclerotinia sclerotiorum</em></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>% PFS&lt;sup&gt;a&lt;/sup&gt;</td>
<td>Mean %&lt;sup&gt;b&lt;/sup&gt;</td>
<td>% PFS&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>1A</td>
<td>32 84.4</td>
<td>1.6</td>
<td>27 100</td>
</tr>
<tr>
<td>1B</td>
<td>17 58.8</td>
<td>0.6</td>
<td>11 100</td>
</tr>
<tr>
<td>2A</td>
<td>25 64.0</td>
<td>2.0</td>
<td>16 100</td>
</tr>
<tr>
<td>2B</td>
<td>61 91.8</td>
<td>0.7</td>
<td>61 100</td>
</tr>
<tr>
<td>3AN</td>
<td>11 72.7</td>
<td>0</td>
<td>8 100</td>
</tr>
<tr>
<td>3AS</td>
<td>61 62.3</td>
<td>0.6</td>
<td>47 100</td>
</tr>
<tr>
<td>3BN</td>
<td>26 65.4</td>
<td>0.6</td>
<td>26 96.2</td>
</tr>
<tr>
<td>3BS</td>
<td>4 75.0</td>
<td>1.0</td>
<td>4 100</td>
</tr>
<tr>
<td>4A</td>
<td>7 28.6</td>
<td>1.0</td>
<td>4 75.0</td>
</tr>
<tr>
<td>4B</td>
<td>12 83.3</td>
<td>4.8</td>
<td>12 91.7</td>
</tr>
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<td>5A</td>
<td>37 67.6</td>
<td>1.0</td>
<td>30 100</td>
</tr>
<tr>
<td>5B</td>
<td>35 71.4</td>
<td>0.9</td>
<td>32 71.9</td>
</tr>
<tr>
<td>6A</td>
<td>76 81.6</td>
<td>1.4</td>
<td>75 93.3</td>
</tr>
<tr>
<td>6B</td>
<td>177 68.4</td>
<td>1.0</td>
<td>177 98.9</td>
</tr>
<tr>
<td>7A</td>
<td>63 63.5</td>
<td>1.4</td>
<td>63 98.4</td>
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<tr>
<td>7B</td>
<td>71 63.4</td>
<td>2.3</td>
<td>69 89.9</td>
</tr>
<tr>
<td>8A</td>
<td>20 80.0</td>
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<td>20 85.0</td>
</tr>
<tr>
<td>8B</td>
<td>46 71.7</td>
<td>1.1</td>
<td>46 89.1</td>
</tr>
<tr>
<td>9A</td>
<td>105 55.2</td>
<td>1.6</td>
<td>101 81.2</td>
</tr>
<tr>
<td>9B</td>
<td>70 27.1</td>
<td>3.2</td>
<td>63 90.5</td>
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<tr>
<td><strong>Total / Mean</strong></td>
<td><strong>956 66.0</strong></td>
<td><strong>1.6</strong></td>
<td><strong>63 892</strong></td>
</tr>
</tbody>
</table>

<sup>a</sup>% PFS = percent pathogen-free samples.<br><sup>b</sup>Mean % = mean percent infection.
Table 3. Numbers of lentil seed samples tested from September, 2017 to May, 2018 and levels of infection with *Ascochyta lentis*, *Colletotrichum lentis*, *Botrytis* spp. and *Sclerotinia sclerotiorum* for each Saskatchewan Crop District.

<table>
<thead>
<tr>
<th>Crop district</th>
<th>Total tests</th>
<th>2017 Lentil</th>
<th>2017 Lentil</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td><em>Ascochyta lentis</em></td>
<td><em>Colletotrichum lentis</em></td>
</tr>
<tr>
<td></td>
<td># tests</td>
<td>% PFSa</td>
<td>Mean %b</td>
</tr>
<tr>
<td>1A</td>
<td>23</td>
<td>23 100 0</td>
<td>23 100 0</td>
</tr>
<tr>
<td>1B</td>
<td>5</td>
<td>5 100 0</td>
<td>5 100 0</td>
</tr>
<tr>
<td>2A</td>
<td>100</td>
<td>100 100 0</td>
<td>100 100 0</td>
</tr>
<tr>
<td>2B</td>
<td>247</td>
<td>247 95.5 1.3</td>
<td>247 99.2 0.3</td>
</tr>
<tr>
<td>3AN</td>
<td>32</td>
<td>32 100 0</td>
<td>32 100 0</td>
</tr>
<tr>
<td>3AS</td>
<td>152</td>
<td>152 98.7 0.8</td>
<td>152 99.3 0.3</td>
</tr>
<tr>
<td>3BN</td>
<td>105</td>
<td>105 99.0 0.3</td>
<td>105 95.2 0.7</td>
</tr>
<tr>
<td>3BS</td>
<td>28</td>
<td>28 100 0</td>
<td>27 100 0</td>
</tr>
<tr>
<td>4A</td>
<td>6</td>
<td>6 100 0</td>
<td>6 100 0</td>
</tr>
<tr>
<td>4B</td>
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<td>13 100 0</td>
<td>11 100 0</td>
</tr>
<tr>
<td>5A</td>
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<td>30 100 0</td>
<td>30 100 0</td>
</tr>
<tr>
<td>5B</td>
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<td>3 100 0</td>
<td>3 100 0</td>
</tr>
<tr>
<td>6A</td>
<td>95</td>
<td>95 97.9 1.1</td>
<td>93 94.6 0.8</td>
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<tr>
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<td>194</td>
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<td>7A</td>
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<td>6 100 0</td>
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<td>9A</td>
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<td>13 100 0</td>
<td>13 92.3 0.3</td>
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<tr>
<td>9B</td>
<td>5</td>
<td>5 100 0</td>
<td>5 100 0</td>
</tr>
<tr>
<td>Total/Mean</td>
<td>1263</td>
<td>1263 98.1 0.9</td>
<td>1255 95.1 0.7</td>
</tr>
</tbody>
</table>

a % PFS = percent pathogen-free samples.
b Mean % = mean percent infection.
Table 4. Number of chickpea seed samples tested from September, 2017 to May, 2018 and levels of infection with *Ascochyta rabiei*, *Botrytis* spp. and *Sclerotinia sclerotiorum* for each Saskatchewan Crop District.

<table>
<thead>
<tr>
<th>Crop district</th>
<th>2017 Chickpea</th>
<th>Ascochyta rabiei</th>
<th>Botrytis spp.</th>
<th>Sclerotinia sclerotiorum</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td># tests</td>
<td>% PFS&lt;sup&gt;a&lt;/sup&gt;</td>
<td>Mean %&lt;sup&gt;b&lt;/sup&gt;</td>
<td># tests</td>
</tr>
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<td>1B</td>
<td>0</td>
<td>nd&lt;sup&gt;3&lt;/sup&gt;</td>
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<tr>
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<td>2B</td>
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<td>97.2</td>
<td>0.6</td>
<td>138</td>
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</tbody>
</table>

<sup>a</sup> % PFS = percent pathogen-free samples.

<sup>b</sup> Mean % = mean percent infection.

nd = no data
SURVEY OF CANOLA DISEASES IN SASKATCHEWAN, 2018

ABSTRACT: The annual survey in Saskatchewan covered 240 canola fields across six large regions of the province. Blackleg was the most prevalent disease with basal stem cankers in 74% of the crops surveyed. The mean incidence of blackleg basal cankers among all crops surveyed in Saskatchewan was 11% but ranged from 5% to 15% among regions. Sclerotinia stem rot was observed in 58% of crops surveyed with a mean disease incidence of 6% (ranging from 1% to 12%).

METHOD: A total of 240 canola crops were surveyed between July 26 and Sept 27 in the major canola growing regions of Saskatchewan. In 2018, the number of surveyed crops was highest in the Northwest with 96 out of 240 fields being located in this region. The distribution of surveyed crops across the rest of the province was as follows: 33 (Northeast), 23 (West-central), 43 (East-central), 17 (Southwest) and 28 (Southeast) crops. The survey was conducted, where possible, before swathing when plants were between growth stages 5.1 and 5.5 (Harper & Berkenkamp 1975). In 2018, seventy-one of the crops were surveyed outside of this range and were recorded as swathed at the time of the survey. Disease assessments were made by examining 20 plants from each of five sites in each field. Individual sample sites were located at least 20 m from the field edge and separated from each other by at least 20 m. Fields were assessed for prevalence (per cent of fields with symptoms of the disease) of sclerotinia stem rot (Sclerotinia sclerotiorum), blackleg (Leptosphaeria maculans), aster yellows (AY phytoplasma), foot rot (Rhizoctonia spp., Fusarium spp.), alternaria black spot (Alternaria brassicae, A. raphani), and fusarium wilt (F. oxysporum f.sp. conglutinans). For sclerotinia stem rot, blackleg (basal cankers and stem lesions) and aster yellows, the incidence (per cent of plants surveyed with symptoms of the disease per field) of each disease was also recorded.

Severity ratings were also recorded for both sclerotinia stem rot and blackleg. For sclerotinia stem rot, each plant (100 per field) was rated for severity based on a rating scale of 0 to 5 (Kutcher & Wolf 2006) (Table 1). For blackleg, plant stems were cut at the soil surface and then scored for basal canker severity using a rating scale ranging from 0 to 5 (WCC/RRC 2009) (Table 2). Average severity values for blackleg and sclerotinia stem rot in each field were calculated as the sum of the severity ratings divided by the total number of plants surveyed. For all of the diseases assessed, prevalence and average disease incidence or severity values were calculated for the province and for each of the six regions within the province.

RESULTS AND COMMENTS: Approximately 5.0 million ha (12.3 million acres) of canola were seeded in Saskatchewan in 2018 (Statistics Canada 2018). Environmental conditions varied throughout the province in 2018, with the central and southern regions of the province being affected by an extended period of hot, dry conditions. Wet fall weather and early snowfall created difficult conditions for harvest in many areas of Saskatchewan. By November 5, 99% of the canola was harvested (Saskatchewan Ministry of Agriculture 2018).
Sclerotinia stem rot was observed in 58% of the canola crops surveyed. The average incidence in the province was 6% (10% in infested crops) (Table 3). This is slightly higher than the average disease incidence in 2017 (3%), but lower than in 2016 (23%) (Table 4) due to dry conditions in many areas of Saskatchewan in 2018. The incidence was highest in the Northwest region (12%) and lowest in the East-central region (1%). The average severity of sclerotinia stem rot in canola crops in Saskatchewan was 0.1. The severity of sclerotinia stem rot was highest in the Northwest region (0.3) and lowest in the Southeast region (<0.1) (Table 3).

Symptoms of blackleg basal infection (rated after cutting of lower stems) were present in 74% of the Saskatchewan canola crops included in the survey (Table 5). The average incidence in the province was 11% (15% in infested crops). The levels of blackleg were similar to levels in 2017 (73% prevalence), but higher than in 2016 (61% prevalence) and above the levels documented for the time period between 2011 and 2016 (Table 6). The high provincial average blackleg incidence, severity and prevalence in 2018 and 2017 compared to previous years was, in part, influenced by the higher proportion of surveyed field located in the Northwest region compared to other regions. In 2018, the average incidence was highest in the Northwest region (15%) and lowest in the Northeast region (5%). The average severity of blackleg basal cankers in the province was 0.2. The average severity was highest in the West-central region (0.3) and lowest in the Northeast region (0.1). Blackleg stem lesions were present in 22% of canola crops with an average incidence of 3% (data not shown). The highest average blackleg stem lesion incidence occurred in the West-central region (9%). The lowest incidence was in the Northeast region (0.1%). Both blackleg basal cankers and stem lesions were present on the same plant in 11% of crops across the province (data not shown).

Aster yellows had a prevalence of 15% with an average incidence of 0.1% (2% in infested fields). This is slightly lower than in 2017 where the average incidence in Saskatchewan was 0.3% (2% in infested fields) (Ziesman et al. 2018). The highest prevalence of aster yellows in 2018 was in the Southeast region (21%) with an average incidence of 0.4%. Province-wide, aster yellows were observed in 15% of surveyed canola fields (this includes observations in surveyed fields where infected plants were seen outside of the 100-plant sample) (Table 7).

Foot rot was recorded in 2% of canola crops in the province. The highest incidence was in the Northeast region (6%). Foot rot was not detected in the Northwest, West-central, Southeast, or Southwest regions of Saskatchewan (Table 7). In 2018, alternaria pod spot was recorded as present in 54% of canola crops surveyed in the province. Alternaria pod spot prevalence was highest in the Southeast (89%) and lowest in the Southwest regions (37%) (Table 7).

REFERENCES:
Western Canada Canola/Rapeseed Recommending Committee (WCC/RRC) Incorporated. 2009. Procedures of the Western Canada Canola/Rapeseed Recommending Committee for the evaluation and recommendation for registration of canola/rapeseed candidate cultivars in western Canada.
Table 1. Sclerotinia rating scale (Kutcher & Wolf 2006).

<table>
<thead>
<tr>
<th>Disease rating</th>
<th>Lesion location</th>
<th>Symptoms</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>None</td>
<td>No symptoms</td>
</tr>
<tr>
<td>1</td>
<td>Pod</td>
<td>Infection of pods only</td>
</tr>
<tr>
<td>2</td>
<td>Upper plant parts</td>
<td>Lesion situated on main stem or branch(es) with potential to affect up to ¼ of seed formation and filling on plant</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td>Lesion situated on main stem or on a number of branches with potential to affect up to ½ of seed formation and filling on plant</td>
</tr>
<tr>
<td>4</td>
<td></td>
<td>Lesion situated on main stem or on a number of branches with potential to affect up to ¾ of seed formation and filling on plant</td>
</tr>
<tr>
<td>5</td>
<td>Lower plant parts</td>
<td>Main stem lesion with potential effects on seed formation and filling of entire plant</td>
</tr>
</tbody>
</table>

Table 2. Blackleg rating scale (WCC/RRC 2009).

<table>
<thead>
<tr>
<th>Disease rating</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>No disease visible in the cross section</td>
</tr>
<tr>
<td>1</td>
<td>Diseased tissue occupies up to 25% of cross-section</td>
</tr>
<tr>
<td>2</td>
<td>Diseased tissue occupies 26 to 50% of cross-section</td>
</tr>
<tr>
<td>3</td>
<td>Diseased tissue occupies 51 to 75% of cross-section</td>
</tr>
<tr>
<td>4</td>
<td>Diseased tissue occupies more than 75% of cross-section with little or no constriction of affected tissues</td>
</tr>
<tr>
<td>5</td>
<td>Diseased tissue occupies 100% of cross-section with significant constriction of affected tissues; tissue dry and brittle; plant dead</td>
</tr>
</tbody>
</table>

Table 3. Mean disease incidence and severity of sclerotinia stem rot of canola in Saskatchewan in 2018.

<table>
<thead>
<tr>
<th>Region (no. of fields)</th>
<th>Sclerotinia stem rot all fields surveyed</th>
<th>Sclerotinia stem rot infected fields only</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Prevalence</td>
<td>Incidence</td>
</tr>
<tr>
<td>Northwest (96)</td>
<td>95</td>
<td>12</td>
</tr>
<tr>
<td>Northeast (33)</td>
<td>39</td>
<td>4</td>
</tr>
<tr>
<td>West-central (23)</td>
<td>22</td>
<td>2</td>
</tr>
<tr>
<td>East-central (43)</td>
<td>35</td>
<td>1</td>
</tr>
<tr>
<td>Southwest (17)</td>
<td>31</td>
<td>2</td>
</tr>
<tr>
<td>Southeast (28)</td>
<td>46</td>
<td>2</td>
</tr>
<tr>
<td>Overall mean (240)</td>
<td>58</td>
<td>6</td>
</tr>
</tbody>
</table>

$^a$Severity as divided by number of plants surveyed per field; (Severity as divided by the number of infected plants)
Table 4. Mean disease incidence and sclerotinia severity reported as both, the average severity across infected plants and the average severity across all plants surveyed per field from 2011-2018a.

<table>
<thead>
<tr>
<th>Year (no. of fields)</th>
<th>Sclerotinia stem rot all fields surveyed</th>
<th>Sclerotinia stem rot infected fields only</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Incidence</td>
<td>Severity(^b)</td>
</tr>
<tr>
<td>2011 (265)</td>
<td>20</td>
<td>0.56 (2.5)</td>
</tr>
<tr>
<td>2012 (253)</td>
<td>19</td>
<td>0.52 (2.5)</td>
</tr>
<tr>
<td>2013 (269)</td>
<td>5</td>
<td>0.10 (1.3)</td>
</tr>
<tr>
<td>2014 (274)</td>
<td>14</td>
<td>0.40 (2.2)</td>
</tr>
<tr>
<td>2015 (253)</td>
<td>7</td>
<td>0.15 (1.6)</td>
</tr>
<tr>
<td>2016 (224)</td>
<td>23</td>
<td>0.70 (2.8)</td>
</tr>
<tr>
<td>2017 (281)</td>
<td>3</td>
<td>0.11 (1.5)</td>
</tr>
<tr>
<td>2018 (240)</td>
<td>6</td>
<td>0.14 (1.4)</td>
</tr>
</tbody>
</table>

\(^b\)Severity as divided by number of plants surveyed per field; (Severity as divided by the number of infected plants per field).

Table 5. Mean disease incidence and severity of blackleg basal cankers in Saskatchewan in 2018.

<table>
<thead>
<tr>
<th>Region(^a) (no. of fields)</th>
<th>Blackleg basal cankers all fields surveyed</th>
<th>Blackleg basal cankers infected fields only</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Prevalence</td>
<td>Incidence</td>
</tr>
<tr>
<td>Northwest (96)</td>
<td>95</td>
<td>15</td>
</tr>
<tr>
<td>Northeast (33)</td>
<td>48</td>
<td>5</td>
</tr>
<tr>
<td>West-central (23)</td>
<td>61</td>
<td>14</td>
</tr>
<tr>
<td>East-central (43)</td>
<td>79</td>
<td>8</td>
</tr>
<tr>
<td>Southwest (17)</td>
<td>56</td>
<td>6</td>
</tr>
<tr>
<td>Southeast (28)</td>
<td>46</td>
<td>10</td>
</tr>
<tr>
<td>Overall mean (240)</td>
<td>74</td>
<td>11</td>
</tr>
</tbody>
</table>

\(^a\)Severity as divided by number of plants surveyed per field; (Severity as divided by the number of infected plants)
Table 6. Mean blackleg canker severity reported as both, the average severity across infected plants and the average severity across all plants surveyed per field from 2011-2018a.

<table>
<thead>
<tr>
<th>Regiona (no. of fields)</th>
<th>Blackleg basal cankers all fields surveyed</th>
<th>Blackleg basal cankers infected fields only</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Prevalence</td>
<td>Incidence</td>
</tr>
<tr>
<td>2011 (265)</td>
<td>42</td>
<td>3</td>
</tr>
<tr>
<td>2012 (253)</td>
<td>34</td>
<td>4</td>
</tr>
<tr>
<td>2013 (269)</td>
<td>25</td>
<td>2</td>
</tr>
<tr>
<td>2014 (274)</td>
<td>55</td>
<td>8</td>
</tr>
<tr>
<td>2015 (253)</td>
<td>59</td>
<td>9</td>
</tr>
<tr>
<td>2016 (224)</td>
<td>61</td>
<td>7</td>
</tr>
<tr>
<td>2017 (281)</td>
<td>73</td>
<td>11</td>
</tr>
<tr>
<td>2018 (240)</td>
<td>74</td>
<td>11</td>
</tr>
</tbody>
</table>

b Severity as divided by number of plants surveyed per field; (Severity as divided by the number of infected plants per field).

Table 7. Prevalence of alternaria pod spot, aster yellows, and foot rot of canola fields surveyed in Saskatchewan in 2018.

<table>
<thead>
<tr>
<th>Region (no. of fields)</th>
<th>Alternaria black spot</th>
<th>Aster yellowsa</th>
<th>Foot rot</th>
</tr>
</thead>
<tbody>
<tr>
<td>Northwest (96)</td>
<td>39</td>
<td>16</td>
<td>0</td>
</tr>
<tr>
<td>Northeast (33)</td>
<td>46</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>West-central (23)</td>
<td>48</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>East-central (43)</td>
<td>75</td>
<td>16</td>
<td>3</td>
</tr>
<tr>
<td>Southwest (17)</td>
<td>37</td>
<td>25</td>
<td>0</td>
</tr>
<tr>
<td>Southeast (28)</td>
<td>89</td>
<td>21</td>
<td>0</td>
</tr>
<tr>
<td>Overall mean (240)</td>
<td>54</td>
<td>15</td>
<td>2</td>
</tr>
</tbody>
</table>

a Prevalence of aster yellows when identified within 100 plant sample.
In 2018, 1523 fields were surveyed for the presence of clubroot and the clubroot pathogen in Saskatchewan. The majority of the fields surveyed (1452) were selected without any production history or landowner permission and were located across the northern agricultural region and along the east side of the province. The remaining 71 fields were located throughout Saskatchewan and were surveyed with producer permission. Two fields with visible clubroot symptoms were identified through the 2018 clubroot survey. An additional 38 fields with clubroot symptoms were reported to the Saskatchewan Ministry of Agriculture outside of the survey in 2018. The clubroot pathogen was detected at low levels in an additional three fields through DNA-based soil testing as part of the 2018 clubroot survey.

The survey area (illustrated in grey in Figure 1) represents the area with the highest clubroot risk in Saskatchewan due to close proximity to areas in neighboring provinces where clubroot and/or the clubroot pathogen are known to occur, areas with high canola production and areas where environmental conditions would favor disease development if the pathogen were to become established. One field was surveyed as close to the center of each township-range as possible to give an even distribution of fields across the survey area. Only township-ranges where canola fields could be located were surveyed. The remaining 71 fields were surveyed with producer permission and were located throughout the province.

The same survey protocol was followed for all fields surveyed in 2018. In each field, approximately ½ of a cup of soil was removed from the top 5-10 cm from five sites located near the main field entrance (approximately 20 m in from the field edge). The five soil samples were combined into one plastic-lined paper bag and submitted to Discovery Seed Labs Ltd (Saskatoon SK) for further analysis. Quantitative PCR was used to detect the clubroot pathogen and to quantify the level of the pathogen in the soil. The pH of each soil sample was also determined.

In the same area where the soil samples were taken, a minimum of 50 plants were uprooted and the roots examine for clubroot symptoms. If clubroot symptoms were not identified at the field entrance surveyors cleaned tools and exited the field. If clubroot symptoms were identified at the field entrance, the surveyor visited an addition 10 sites in a W pattern across the field with at least 50 m between each site. A total of 20 plants were uprooted at each site and examined for clubroot symptoms. When clubroot symptoms were present, the number of plants with symptoms was recorded to indicate disease incidence. For clubroot infested fields reported to the Ministry of Saskatchewan outside of the survey, clubroot identification was confirmed through tissue testing at Discovery Seed Labs, via photos of symptomatic plants or through discussions with agrologists experienced in clubroot identification.
When the location of the clubroot infested field was shared with the Saskatchewan Ministry of Agriculture, the field was visited to collect soil from the clubroot infested area to determine pH and the level of the pathogen through DNA-based testing at Discovery Seed Labs.

RESULTS AND COMMENTS: Previous to 2017, the clubroot pathogen (in the absence of visible clubroot symptoms) was detected at low levels in one Saskatchewan canola field in each of three years: 2008, 2012 and 2017 (Saskatchewan Ministry of Agriculture 2018). In 2011, visible symptoms of clubroot were confirmed in two private research sites in North-central Saskatchewan (Dokken-Bouchard et al. 2012). In 2017, visible symptoms of clubroot were reported in four commercial canola fields located in Northwest and North Central Saskatchewan. The location of only three of the four fields reported could be confirmed down to the rural municipality (RM) level. Since the location of the fourth field was not shared and it was not possible to ensure that it was unique from other fields with clubroot symptoms or that the clubroot pathogen was identified in 2017 or in previous years, clubroot was only considered to be confirmed in three commercial canola fields in 2017.

Through the 2018 clubroot survey, two fields were identified to have visible symptoms of clubroot. The incidence of clubroot in these two fields were 12% and 13% when averaged across the entire field; while the disease incidence was 50% and 60% at the field entrance. In addition to these fields, 38 fields with clubroot symptoms were reported to the Saskatchewan Ministry of Agriculture outside of the survey. The locations of 14 of these fields were shared to enable soil testing for pathogen confirmation and quantification as well as assessment of soil pH.

The level of the pathogen was found to range from 2,640 spores per gram of soil to 68 million spores per gram of soil. In these fields, the area with clubroot symptoms was not always found at the field entrance. Other common areas included water runs, low spots and old yard sites or grain storage areas. This information is valuable and can be used to guide clubroot monitoring efforts at the farm level. Soil pH was determined for 14 of the fields with clubroot symptoms (two fields identified through the 2018 survey and 12 fields reported external to the survey). The pH ranged from 4.6 to 7.3 with the majority of the fields having a pH of less than 5.9 (nine fields). Of the remaining fields, three had pH values between 6.0 and 6.9 and two fields had a pH of 7.0 and higher. This is consistent with the findings of Gossen et al. (2013) which indicate that clubroot is favoured by low pH (5.0 to 6.5) but can occur in higher pH soils. The wide pH range indicates that the disease is not restricted to only low pH soils and therefore all producers in areas where clubroot is known to occur should consider implementing clubroot management strategies proactively.

The clubroot pathogen was detected in three fields that did not have visible clubroot symptoms. The pathogen level in these fields ranged from 1,000 to 11,100 spores per gram of soil and the pH ranged from 5.5 to 7.6. Two of these fields were located in RMs where there were no other reports of the clubroot pathogen or visible symptoms of the disease. One the fields was located in an RM where visible symptoms of clubroot were also confirmed in 2018.

To date, including all findings from 2008 to 2018, visible symptoms of clubroot have been confirmed in 43 commercial canola fields and two private research sites located in 13 different RMs. The clubroot pathogen alone has been confirmed in six fields in six different RMs. This information was used to create a Saskatchewan Clubroot Distribution Map which illustrates the distribution of clubroot and the clubroot pathogen in the province (Figure 1). RMs are colored blue if the clubroot pathogen was detected in the absence of visible symptoms in at least one field, yellow if visible symptoms of clubroot were confirmed in 1 to 9 fields and orange if more than 10 fields were confirmed to have visible symptoms of clubroot.

ACKNOWLEDGEMENTS: We gratefully acknowledge financial support from the Saskatchewan Canola Development Commission and in-kind support from the Saskatchewan Association of Rural Municipalities for the 2018 Saskatchewan clubroot survey.
REFERENCES:
Fig. 1. Distribution of the clubroot pathogen in Saskatchewan from 2008 to 2018.
CROP: Lentil
LOCATION: Saskatchewan

NAMES AND AGENCIES:
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2University of Saskatchewan, 51 Campus Drive, Saskatoon, SK S7N 5A8

TITLE: 2018 SURVEY OF LENTIL DISEASES IN SASKATCHEWAN

ABSTRACT: A total of 70 lentil crops were surveyed in Saskatchewan in 2018. Root rot, anthracnose and stemphylium blight were the most prevalent diseases observed in the survey, though variation in the prevalence of these diseases was found across the five major lentil growing regions in Saskatchewan. Overall sclerotinia stem and pod rot, botrytis stem and pod rot and ascochyta blight levels were low across the province.

INTRODUCTION AND METHODOLOGY: Saskatchewan lentil crops were surveyed for the presence of lentil diseases in 2018 (70 fields). Fields were surveyed between July 18 and August 21 and ranged in growth stage from mid-pod to approximately 30% moisture content (desiccation stage). Regions surveyed were Northwest (3), West-central (15), Southwest (32), Southeast (9) and East-central (11). Disease assessments were made by examining 10 plants from each of 10 sites along a “W” pattern in each field. Sites were located at least 50 m from the fields edge and at least 50 m apart. Crops were assessed for the incidence of anthracnose (Colletotrichum lentis), ascochyta blight (Ascochyta lentis), sclerotinia stem and pod rot (Sclerotinia sclerotiorum), botrytis stem and pod rot (Botrytis cinerea) and stemphylium blight (Stemphylium spp.). The presence or absence of root rot complex (Fusarium spp. / Pythium spp. / Rhizoctonia solani / Aphanomyces euteiches) and all previously mentioned lentil diseases was also recorded for each crop.

Percentages of the crops surveyed showing symptoms (prevalence) of each of these diseases were calculated for each region surveyed (Tables 1-5), as well as provincial totals (Table 6) and totals from the previous five years (Ziesman et al. 2018). The average disease incidence of anthracnose, ascochyta blight, sclerotinia stem and pod rot, botrytis stem and pod rot, and stemphylium blight was calculated and averaged for each region and on a provincial level (Table 7).

RESULTS AND COMMENTS: Approximately 1.3 million hectares (3.3 million acres) of lentil were seeded in Saskatchewan in 2018. This is slightly lower than the 1.6 million hectares (3.9 million acres) seeded in 2017 and considerably lower than the 2.1 million hectares (5.2 million acres) seeded in 2016 (Statistics Canada 2018). This could be partially due to low lentil prices. Dry conditions throughout the growing season resulted in generally low levels of disease in lentil crops, particularly in the traditional lentil growing areas (brown soil zone – southwest and west-central SK). However, there was variation in the environmental conditions across the 2018 survey area. As of mid-November, 1.3 million hectares (3.3 million acres) of lentils were harvested in Saskatchewan (Statistics Canada 2018). The Saskatchewan Crop Report (Saskatchewan Ministry of Agriculture 2018) estimated that 100% of the Saskatchewan lentil crop had been harvested by November 5, 2018. Preliminary lentil grades from submitted harvest samples as of November 20, 2018 were 49% 1CAN, 41% 2CAN, 9% Extra 3CAN and 1% 3CAN (Canadian Grain Commission 2018).

For the lentil crops surveyed, the reported crop health conditions ranged from poor to very good. Approximately 40% of the surveyed crops were reported to be of good to very good crop health. In some crops there was evidence of environmental stress including moisture and heat stress with 24% and 20% of the surveyed crops affected, respectively.

At least 93% of the 70 fields surveyed in 2018 had one lentil disease present (root rot complex, anthracnose, ascochyta blight, sclerotinia stem and pod rot, botrytis stem and pod rot or stemphylium blight) with at least two diseases observed in 50% of the crops surveyed.
Ascochyta blight symptoms (*Ascochyta lentis*) were observed in 7% of crops surveyed in 2018. The prevalence of ascochyta blight has been low over the last five years and was also only observed in 6% of the surveyed lentil crops in 2017. The incidence of ascochyta blight in infected fields was low with an average incidence of <1% across the province. There were no symptoms of ascochyta blight present in any of the fields surveyed in the Southeast and Northeast regions. The low levels of ascochyta blight are thought to be due to improved resistance in lentil varieties. As a result, it is important to watch for and prevent the breakdown of resistance in lentil crops grown under tight rotations and/or when conditions are conducive to disease development.

Anthracnose (*Colletotrichum lentis*) was observed in 74% (52 fields) of the fields surveyed in 2018. The highest prevalence was found in the Northeast (100%), followed by the Southwest (84%), East-central and West-central (73%) regions. The lowest prevalence occurred in the Southeast (33%) region. The average incidence of anthracnose was 26% when averaged across the province. The highest incidence of anthracnose occurred in the Southwest (36%), followed by the West-central (22%) region.

Root rot was observed in 57% of the fields included in the 2018 survey. The highest prevalence was found in the Southeast region (89%), followed by the West-central (80%) and Southwest (50%) regions. Root rot was present in 36% of the fields surveyed in the East-central region and was not observed in the Northeast in 2018. Root rot has been a notable issue in pea and lentil crops in recent years, with a number of potential pathogenic causes (*Fusarium* spp. / *Pythium* spp. / *Rhizoctonia solani* / *Aphanomyces euteiches*) in addition to environmental stresses due to excess moisture (Chatterton et al. 2017). No sampling or further testing was performed to confirm causal pathogens.

Botrytis stem and pod rot / grey mold (*Botrytis cinerea*) was not observed in any of the fields surveyed. This is consistent with the survey results in 2017, but considerably lower than in 2016 where 66% of the fields had symptoms of botrytis stem and pod rot.

Sclerotinia stem and pod rot (*Sclerotinia sclerotiorum*) was noted in 7% of fields surveyed in 2018 and observed only in the Southwest (6%), East-central (9%) and West-central (13%) regions. The average incidence of sclerotinia stem and pod rot was also low across the province at <1%. The highest average incidence was observed in the West-central region (2%).

Stemphylium blight (*Stemphylium* spp.) was found in 16% of lentil fields surveyed. The highest prevalence was observed in the Northeast region (33%) followed by the West-central region (27%), the Southeast (22%) and Southwest (13%) regions. No symptoms of stemphylium blight were observed in the East-central region in 2018. This is the lowest level of prevalence recorded from 2012 to 2018 (Table 6). The incidence of stemphylium blight was also low (<1%) across the fields surveyed in 2018. The economic impact that stemphylium blight might have on lentil is not known and there are no commercial fungicides available to manage this disease.

REFERENCES:
### Table 1. Prevalence of plant diseases in lentil crops surveyed in West-central Saskatchewan, 2012-2018.

<table>
<thead>
<tr>
<th>Year (no. of crops)</th>
<th>Root rot</th>
<th>Anthracnose</th>
<th>Ascochyta blight</th>
<th>Sclerotinia stem and pod rot</th>
<th>Botrytis stem and pod rot</th>
<th>Stemphylium blight</th>
</tr>
</thead>
<tbody>
<tr>
<td>2012 (17)</td>
<td>76</td>
<td>76</td>
<td>24</td>
<td>24</td>
<td>24</td>
<td>53</td>
</tr>
<tr>
<td>2013 (12)</td>
<td>83</td>
<td>83</td>
<td>42</td>
<td>33</td>
<td>17</td>
<td>50</td>
</tr>
<tr>
<td>2014 (15)</td>
<td>67</td>
<td>80</td>
<td>7</td>
<td>67</td>
<td>0</td>
<td>40</td>
</tr>
<tr>
<td>2015 (15)</td>
<td>87</td>
<td>73</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>40</td>
</tr>
<tr>
<td>2016 (15)</td>
<td>94</td>
<td>88</td>
<td>0</td>
<td>94</td>
<td>69</td>
<td>63</td>
</tr>
<tr>
<td>2017 (20)</td>
<td>60</td>
<td>50</td>
<td>10</td>
<td>0</td>
<td>0</td>
<td>55</td>
</tr>
<tr>
<td>2018 (15)</td>
<td>80</td>
<td>73</td>
<td>13</td>
<td>13</td>
<td>0</td>
<td>27</td>
</tr>
</tbody>
</table>

### Table 2. Prevalence of plant diseases in lentil crops surveyed in Southwest Saskatchewan, 2012-2018.

<table>
<thead>
<tr>
<th>Year (no. of crops)</th>
<th>Root rot</th>
<th>Anthracnose</th>
<th>Ascochyta blight</th>
<th>Sclerotinia stem and pod rot</th>
<th>Botrytis stem and pod rot</th>
<th>Stemphylium blight</th>
</tr>
</thead>
<tbody>
<tr>
<td>2012 (2)</td>
<td>0</td>
<td>0</td>
<td>100</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2013 (16)</td>
<td>38</td>
<td>50</td>
<td>38</td>
<td>38</td>
<td>31</td>
<td>38</td>
</tr>
<tr>
<td>2014 (2)</td>
<td>100</td>
<td>100</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2015 (0)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>2016 (20)</td>
<td>65</td>
<td>50</td>
<td>0</td>
<td>85</td>
<td>60</td>
<td>100</td>
</tr>
<tr>
<td>2017 (15)</td>
<td>73</td>
<td>13</td>
<td>0</td>
<td>7</td>
<td>0</td>
<td>40</td>
</tr>
<tr>
<td>2018 (32)</td>
<td>50</td>
<td>84</td>
<td>6</td>
<td>6</td>
<td>0</td>
<td>13</td>
</tr>
</tbody>
</table>

### Table 3. Prevalence of plant diseases in lentil crops surveyed in Southeast Saskatchewan, 2012-2018.

<table>
<thead>
<tr>
<th>Year (no. of crops)</th>
<th>Root rot</th>
<th>Anthracnose</th>
<th>Ascochyta blight</th>
<th>Sclerotinia stem and pod rot</th>
<th>Botrytis stem and pod rot</th>
<th>Stemphylium blight</th>
</tr>
</thead>
<tbody>
<tr>
<td>2012 (9)</td>
<td>80</td>
<td>70</td>
<td>30</td>
<td>50</td>
<td>40</td>
<td>10</td>
</tr>
<tr>
<td>2013 (9)</td>
<td>89</td>
<td>44</td>
<td>0</td>
<td>22</td>
<td>33</td>
<td>11</td>
</tr>
<tr>
<td>2014 (0)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>2015 (2)</td>
<td>50</td>
<td>100</td>
<td>0</td>
<td>50</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>2016 (6)</td>
<td>33</td>
<td>83</td>
<td>0</td>
<td>67</td>
<td>50</td>
<td>100</td>
</tr>
<tr>
<td>2017 (10)</td>
<td>50</td>
<td>10</td>
<td>10</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2018 (9)</td>
<td>89</td>
<td>33</td>
<td>11</td>
<td>0</td>
<td>0</td>
<td>22</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Year (no. of crops)</th>
<th>Root rot</th>
<th>Anthracnose</th>
<th>Ascochyta blight</th>
<th>Sclerotinia stem and pod rot</th>
<th>Botrytis stem and pod rot</th>
<th>Stemphylium blight</th>
</tr>
</thead>
<tbody>
<tr>
<td>2012 (0)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>2013 (0)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>2014 (1)</td>
<td>100</td>
<td>100</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>100</td>
</tr>
<tr>
<td>2015 (1)</td>
<td>100</td>
<td>100</td>
<td>0</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>2016 (8)</td>
<td>63</td>
<td>100</td>
<td>38</td>
<td>88</td>
<td>88</td>
<td>100</td>
</tr>
<tr>
<td>2017 (7)</td>
<td>0</td>
<td>100</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2018 (11)</td>
<td>36</td>
<td>73</td>
<td>0</td>
<td>9</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>


<table>
<thead>
<tr>
<th>Year (no. of crops)</th>
<th>Root rot</th>
<th>Anthracnose</th>
<th>Ascochyta blight</th>
<th>Sclerotinia stem and pod rot</th>
<th>Botrytis stem and pod rot</th>
<th>Stemphylium blight</th>
</tr>
</thead>
<tbody>
<tr>
<td>2018 (3)</td>
<td>0</td>
<td>74</td>
<td>7</td>
<td>7</td>
<td>0</td>
<td>16</td>
</tr>
</tbody>
</table>


<table>
<thead>
<tr>
<th>Year (no. of crops)</th>
<th>Root rot</th>
<th>Anthracnose</th>
<th>Ascochyta blight</th>
<th>Sclerotinia stem and pod rot</th>
<th>Botrytis stem and pod rot</th>
<th>Stemphylium blight</th>
</tr>
</thead>
<tbody>
<tr>
<td>2012 (28)</td>
<td>75</td>
<td>71</td>
<td>32</td>
<td>32</td>
<td>29</td>
<td>36</td>
</tr>
<tr>
<td>2013 (37)</td>
<td>65</td>
<td>60</td>
<td>30</td>
<td>32</td>
<td>27</td>
<td>35</td>
</tr>
<tr>
<td>2014 (18)</td>
<td>72</td>
<td>83</td>
<td>6</td>
<td>56</td>
<td>0</td>
<td>39</td>
</tr>
<tr>
<td>2015 (18)</td>
<td>83</td>
<td>78</td>
<td>0</td>
<td>11</td>
<td>17</td>
<td>50</td>
</tr>
<tr>
<td>2016 (50)</td>
<td>70</td>
<td>74</td>
<td>6</td>
<td>86</td>
<td>66</td>
<td>88</td>
</tr>
<tr>
<td>2017 (52)</td>
<td>54</td>
<td>38</td>
<td>6</td>
<td>2</td>
<td>0</td>
<td>33</td>
</tr>
<tr>
<td>2018 (70)</td>
<td>57</td>
<td>74</td>
<td>7</td>
<td>7</td>
<td>0</td>
<td>16</td>
</tr>
</tbody>
</table>

Table 7. Average disease incidence in Saskatchewan lentil crops surveyed in 2018.

<table>
<thead>
<tr>
<th>Region(^a)</th>
<th>Incidence of disease (%) (incidence in only infected fields only)(^b)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Anthracnose</td>
</tr>
<tr>
<td>SW</td>
<td>36 (43)</td>
</tr>
<tr>
<td>SE</td>
<td>14 (43)</td>
</tr>
<tr>
<td>EC</td>
<td>14 (19)</td>
</tr>
<tr>
<td>WC</td>
<td>22 (30)</td>
</tr>
<tr>
<td>NE</td>
<td>10 (10)</td>
</tr>
<tr>
<td>Overall</td>
<td>26 (35)</td>
</tr>
</tbody>
</table>

\(^a\) Region: SW – Southwest, SE – Southeast, WC – West-central, EC – East-central, NE – North-central

\(^b\) Average incidence of disease for all crops surveyed (disease incidence averaged across only crops with disease symptoms)
CROP: Caraway and Coriander
LOCATION: Saskatchewan

NAMES AND AGENCIES:
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Telephone: (306) 966-1956; Facsimile: (306) 966-5015; E-mail: cheryl.cho@usask.ca
²Saskatchewan Crop Insurance Corporation, 484 Prince William Drive, Melville, SK S0A 2P0

TITLE: BLOSSOM BLIGHT IN SASKATCHEWAN CARAWAY AND CORIANDER IN 2018

ABSTRACT: Throughout most of Saskatchewan in 2018, dry conditions prevailed during flowering of caraway and coriander. Blossom blight observations in the surveyed fields of both crops were absent or negligible. The most prevalent coriander pathogen observed in previous seasons, tentatively identified as a *Heterosphaeria* species, was absent in all the umbel samples plated. *Didymella cari*, the recently named cause of caraway blossom blight, was detected at trace levels in two coriander fields.

INTRODUCTION AND METHODS: Blossom blight surveys have been conducted over the past four growing seasons in order to build an understanding of regional and seasonal differences in disease severity and causal organisms. The disease can be very destructive when weather is favorable for disease development, but dry conditions prevailed during much of the flowering period of both caraway and coriander in 2018. Within the province, a total of 14 caraway fields at eight locations were surveyed as well as 12 coriander fields at nine locations. Of these, fields at Moose Jaw, Tugaske and research plots at Saskatoon were sampled four times during the flowering period. Five umbels were collected from three locations in each field. Four floret clusters from each umbel were scored for the presence of brown ovaries, surface sterilized and plated on potato dextrose agar. Organisms observed on ovary tissues were recorded after two days and colonies arising from floral tissues were recorded after seven days. A total of 671 caraway and 688 coriander umbels were assessed.

RESULTS AND COMMENTS: Disease symptoms were absent in the caraway fields surveyed and in all collected caraway umbels. Late in flowering, however, a discrete patch of blossom blight was reported in a field near Lemberg, Saskatchewan (SK), which was associated with 15% recovery of *Didymella cari* (Armstrong-Cho, Banniza & Crous sp. nov.) the causal agent of blossom blight in caraway (Crous et al. 2018). Trace levels (<1%) of *D. cari* were also detected in a field near Francis, SK. In coriander, disease symptoms were absent or at trace levels (Elbow, Moose Jaw, Saskatoon and Francis). The incidence of potential pathogens of coriander that were recovered by conventional plating ranged from 0-2% for *Didymella cari*, 3-48% for *Fusarium* spp., 0-12% for *Botrytis* and 0-13% for *Sclerotinia* (not identified to species except where noted). An unnamed pathogen, tentatively identified as a *Heterosphaeria* species (K. Seifert, personal communication), was previously observed in coriander blossom blight surveys (Armstrong-Cho et al. 2017, 2018) but was not observed in the 2018 survey. These figures can be used to interpret the background level of floret and petal colonization by common saprophytic and potentially pathogenic fungi. At such levels, these organisms did not pose a danger to the crop under the dry weather conditions observed in 2018.

ACKNOWLEDGEMENTS: We gratefully acknowledge the participation of the Saskatchewan Crop Insurance Corporation and the Crop Development Centre staff for the collection of umbel samples and agronomic information. Sincere thanks to Maggi Bruce, Ningxing Zhou and Hillary Langlois for their technical assistance. This work was made possible by funding from the Saskatchewan Ministry of Agriculture (Agriculture Development Fund), Herb Spice and Specialty Agriculture and the Western Grains Research Foundation.
REFERENCES:

Table 1. Saskatchewan caraway fields sampled in 2018.

<table>
<thead>
<tr>
<th>Location</th>
<th>Number of fields</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arborfield</td>
<td>2</td>
</tr>
<tr>
<td>Caron</td>
<td>1</td>
</tr>
<tr>
<td>Francis</td>
<td>1</td>
</tr>
<tr>
<td>Lemberg</td>
<td>1</td>
</tr>
<tr>
<td>Marquis</td>
<td>1</td>
</tr>
<tr>
<td>Melfort</td>
<td>6</td>
</tr>
<tr>
<td>Nokomis</td>
<td>1</td>
</tr>
<tr>
<td>Zenon Park</td>
<td>1</td>
</tr>
</tbody>
</table>

Table 2. Saskatchewan coriander fields sampled in 2018.

<table>
<thead>
<tr>
<th>Location</th>
<th>Number of fields</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assiniboia</td>
<td>2</td>
</tr>
<tr>
<td>Balcarres</td>
<td>1</td>
</tr>
<tr>
<td>Elbow</td>
<td>1</td>
</tr>
<tr>
<td>Francis</td>
<td>3</td>
</tr>
<tr>
<td>Grenfell</td>
<td>2</td>
</tr>
<tr>
<td>Kenaston</td>
<td>1</td>
</tr>
<tr>
<td>Moose Jaw</td>
<td>1</td>
</tr>
<tr>
<td>Saskatoon</td>
<td>1(^a)</td>
</tr>
<tr>
<td>Tugaske</td>
<td>1</td>
</tr>
</tbody>
</table>

\(^a\)research plots.
CROP: Field bean
LOCATION: Manitoba

NAMES AND AGENCIES:
Y.M. Kim¹, D.L. McLaren¹, R.L. Conner², W.C. Penner² & T.J. Kerley¹
¹Agriculture and Agri-Food Canada (AAFC), Brandon Research and Development Centre, 2701 Grand Valley Rd., Brandon, MB R7A 5Y3
Telephone (204) 578-6691; Facsimile (204) 578-6524; E-mail: yongmin.kim@canada.ca
²AAFC, Morden Research and Development Centre, Unit 101, Route 100, Morden, MB R6M 1Y5

TITLE: DISEASES OF FIELD BEAN IN MANITOBA IN 2017

ABSTRACT: A total of 40 bean crops were surveyed for root and foliar diseases, respectively. Fusarium root rot was the most prevalent root disease and common bacterial blight the most widespread foliar disease throughout the province. Sclerotinia stem and pod rot and halo blight were also observed. In 2017, rhizoctonia root rot, anthracnose and rust were not observed in any of the 40 surveyed bean crops.

METHODS: Crops of field bean in Manitoba were surveyed for root and foliar diseases at 40 different locations. The survey for root diseases was conducted in mid- to late July when most plants were at the early to mid-flowering stage. During the root disease survey, the severity of halo blight (Pseudomonas syringae pv. phaseolicola) was also assessed. When the plants were starting to mature, the foliar survey was carried out from August 21st to 25th on the same fields assessed for root rot. The majority of the crops surveyed were selected at random from regions in southern Manitoba where most of the field bean crops are grown, with 10% of the crops located outside of the traditional bean growing regions.

For the root diseases, at least 10 plants were sampled at each of three random sites in each crop surveyed. Root diseases were rated on a scale of 0 (no disease) to 9 (death of plant). Fifteen symptomatic roots were collected from each of the 40 crops for fungal isolation and identification. Identification of Fusarium species involved visual assessment, microscopic examination and morphological characterization using the criteria of Leslie and Summerell (2006). Fifteen roots from each of the 40 crops surveyed were frozen for future PCR analysis of root rot pathogens. Foliar diseases were identified by their symptoms. Levels of common bacterial blight (CBB) (Xanthomonas axonopodis pv. phaseoli) were estimated based on the percent incidence of leaf infection and a severity scale of 0 (no disease) to 5 (50-100% of the leaf area covered by lesions). Anthracnose (Colletotrichum lindemuthianum), rust (Uromyces appendiculatus), white mold (Sclerotinia sclerotiorum) and halo blight (Pseudomonas syringae pv. phaseolicola) severity were assessed as percentages of infected plant tissue.

RESULTS AND COMMENTS:
Warm, dry, windy weather prevailed across the province early in May and rapidly improved seedbed conditions (Manitoba Agriculture 2017a). In mid-May, warmer weather and favourable seedbed conditions occurred with approximately 30% of seeding being completed in the central region of the province by May 23rd (Manitoba Agriculture 2017b). In July, precipitation amounts were below average for much of the province (Manitoba Agriculture 2017c; 2017d). Bean harvest began in early September with yield reports of 1800-2000 lb/ac for pinto beans and 2000 lb/ac for cranberry beans (Manitoba Agriculture 2017e).

One root disease was identified (Table 1). Fusarium root rot was observed in all 40 field bean crops surveyed, with severity ratings ranging from 3.1 to 5.9, and a mean of 4.2. It has remained the most prevalent root disease of dry bean for several years (Conner et al. 2011; Henriquez et al. 2013; Kim et al. 2017). A number of Fusarium spp. including F. redolens, F. oxysporum, F. acuminatum and F. solani were isolated from symptomatic root tissue. Rhizoctonia root rot (Rhizoctonia solani) and Pythium root rot (Pythium spp.) were not detected in any of the crops surveyed. Twenty-five crops (63%) had average root rot severity ratings above 4 (i.e., symptoms were present on 50% of the root system and plants were stunted) and this would have had a detrimental effect on yield. In 2016, a much wetter year, 93% of bean crops had severity ratings above 4 which represents the highest percentage of bean crops surveyed with yield-robbing root rot severity ratings over the past six years. Halo blight was assessed in the 40 crops surveyed and was observed in three crops with a disease severity of 5% infected plant tissue in each crop.
Two foliar diseases were observed during the survey in August (Table 2). Common bacterial blight symptoms were observed in all 40 crops. The incidence of CBB leaf infection ranged from 3.0 to 26.7% with a mean of 9.2%, while severity ranged from 0.7 to 2.3, with a mean of 1.6. Anthracnose was not detected from 2014 to 2017, unlike many years prior to this period. Rust was not observed in any of the crops surveyed. White mold symptoms were detected in 27 crops with a percentage of tissue infection that ranged from 0.3% to 18.3%, with an average of 2.6%. This represents a decrease from 2016 in the mean disease severity (Kim et al. 2017). Seasonal precipitation in many of the bean growing regions of Manitoba in 2017 was below normal, which would have contributed to the reduced risk of yield losses due to white mold in these crops. For example, in the Morden area, 162 mm, 371 mm and 238 mm of precipitation were received during May to August in 2017, 2016 and 2015, respectively, compared with the 30-year average of 305 mm for this four-month period (Government of Canada 2017).

REFERENCES:
www.climate.weather.gc.ca/index_e.html
Table 1. Prevalence and severity of root diseases and halo blight in 40 crops of field bean in Manitoba in mid- to late July in 2017.

<table>
<thead>
<tr>
<th>Disease</th>
<th># of crops affected</th>
<th>Disease severity</th>
<th>Incidence of leaf infection</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Mean^a</td>
<td>Range</td>
</tr>
<tr>
<td>Fusarium root rot^b</td>
<td>40</td>
<td>4.2</td>
<td>3.1-5.9</td>
</tr>
<tr>
<td>Rhizoctonia root rot^b</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Halo blight (%)</td>
<td>3</td>
<td>5%</td>
<td>5%</td>
</tr>
</tbody>
</table>

^a Means are based on an average of the crops in which the diseases were observed.
^b Root diseases were rated on a scale of 0 (no disease) to 9 (death of plant).

Table 2. Prevalence and severity of foliar diseases in 40 crops of field bean in Manitoba in late August in 2017.

<table>
<thead>
<tr>
<th>Disease</th>
<th># of crops affected</th>
<th>Disease severity^a</th>
<th>Incidence of leaf infection</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Mean^b</td>
<td>Range</td>
</tr>
<tr>
<td>Common bacterial blight</td>
<td>40</td>
<td>1.6</td>
<td>0.7-2.3</td>
</tr>
<tr>
<td>Anthracnose (%)</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Rust (%)</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>White mold (%)</td>
<td>27</td>
<td>2.6%</td>
<td>0.3-18.3%</td>
</tr>
</tbody>
</table>

^a White mold severity was rated as the percentage of infected plant tissue; common bacterial blight severity was rated on a scale of 0 (no disease) to 5 (50-100% of leaf area diseased) and on the incidence of leaves with symptoms.
^b Means are based on an average of the crops in which the diseases were observed.
CROP: Field bean  
LOCATION: Manitoba

NAMES AND AGENCIES:  
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¹Agriculture and Agri-Food Canada (AAFC), Brandon Research and Development Centre, 2701 Grand Valley Rd., Brandon, MB R7A 5Y3  
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²AAFC, Morden Research and Development Centre, Unit 101, Route 100, Morden, MB R6M 1Y5

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ABSTRACT: A total of 40 bean crops were surveyed for root and foliar diseases, respectively. Fusarium root rot was the most prevalent root disease and common bacterial blight the most widespread foliar disease throughout the province. Sclerotinia stem and pod rot, rhizoctonia root rot, rust and halo blight were also observed. In 2018, anthracnose was not detected in any of the 40 surveyed bean crops.

METHODS: Crops of field bean in Manitoba were surveyed for root and foliar diseases at 40 different locations. The survey for root diseases was conducted in mid- to late July when most plants were at the mid- to late flowering stage. During the root disease survey, the severity of halo blight (Pseudomonas syringae pv. phaseolicola) was also assessed. When the plants were starting to mature during mid-August, the foliar disease survey was carried out on the same fields assessed for root rot. The majority of the crops surveyed were selected at random from regions in southern Manitoba where most of the field bean crops are grown, with 10% of the crops located outside of the traditional bean growing regions.

For the root diseases, at least 10 plants were sampled at each of three random sites in each crop surveyed. Root diseases were rated on a scale of 0 (no disease) to 9 (death of plant). Fifteen symptomatic roots were collected from each of the 40 crops for fungal isolation and identification. Identification of Fusarium species involved visual assessment, microscopic examination and morphological characterization using the criteria of Leslie & Summerell (2006). Fifteen roots from each of the 40 crops were frozen for future PCR analysis of root rot pathogens. Foliar diseases were identified by their symptoms. Common bacterial blight (CBB) (Xanthomonas axonopodis pv. phaseoli) was assessed based on the percent incidence of leaf infection and on a severity scale of 0 (no disease) to 5 (50-100% of the leaf area covered by lesions). Anthracnose (Colletotrichum lindemuthianum), rust (Uromyces appendiculatus), white mould (Sclerotinia sclerotiorum) and halo blight (Pseudomonas syringae pv. phaseolicola) severity were assessed as percentages of infected plant tissue.

RESULTS AND COMMENTS: Warm, dry, windy weather and variable soil moisture prevailed across many areas of the province early in May with no substantial precipitation (Manitoba Agriculture 2018a). By May 28th, seeding of the field bean crop was 65-75% completed. Most areas of the province received rainfall, although amounts were variable with additional precipitation needed in many regions (Manitoba Agriculture 2018b). By mid-August, bean crops were ripening prematurely due to the hot, dry weather conditions (Manitoba Agriculture 2018c) and harvest was 40% complete by September 4th with yield reports of 1400-2000 lb/ac for pinto beans and 1500-1800 lb/ac for cranberry beans (Manitoba Agriculture 2018d). Field bean harvest was delayed due to rainfall events following a drier than normal summer, but was completed by October 29th with average yields in the 1400 to 2000 lb/ac range (Manitoba Agriculture 2018e).

One root disease was identified (Table 1). Fusarium root rot was observed in all of the 40 field bean crops surveyed, with severity ratings ranging from 2.8 to 6.4, and a mean of 4.6. It has remained the most prevalent root disease of field bean for several years (Conner et al. 2011; Henriquez et al. 2013; Kim et al. 2017). A number of Fusarium spp. including F. redolens, F. oxysporum, F. acuminatum and F. solani were isolated from symptomatic root tissue. Rhizoctonia root rot (Rhizoctonia solani) and pythium root rot (Pythium spp.) were not detected in any of the crops surveyed based on microscopic examination and morphological characterization. Twenty-seven crops (68%) had average root rot severity ratings above 4 (i.e., symptoms were present on 50% of the root system and plants were stunted) and this would have had a detrimental effect on yield. These results are similar to those from 2017. However, in 2016, a much wetter year, 93% of bean crops had severity ratings above 4, which represents the highest percentage of
bean crops surveyed with yield-robbing root rot severity ratings over the past six years. Halo blight was assessed in the 40 crops surveyed and was observed in four (10%) crops with an average of 7% leaf area infected.

Three foliar diseases were observed during the survey in August (Table 2). Common bacterial blight symptoms were observed in all 40 crops. The incidence of CBB leaf infection ranged from 1.7 to 50.0% with a mean of 20.7%, while severity ranged from 0.7 to 4.3, with a mean of 2.3. Anthracnose was not detected from 2014 to 2018, unlike many years prior to this period. Rust was observed in three of the crops surveyed and the percentage of infected plant tissue ranged from 5.0% to 11.7% with a mean of 8.3%. White mould symptoms were detected in one crop with 1% of tissue infection. Seasonal precipitation in many of the bean growing regions of Manitoba was above normal in 2016, but below normal in both 2017 and 2018 which would have contributed to the reduced risk of yield losses due to white mould in the latter two years. For example, in the Morden area, 371 mm, 162 mm and 213 mm of precipitation were received during May to August in 2016, 2017 and 2018, respectively, compared with the 30-year average of 305 mm for this four-month period (Government of Canada 2018).

REFERENCES:
Table 1. Prevalence and severity of root diseases and halo blight in 40 crops of field bean in Manitoba in mid- to late July in 2018.

<table>
<thead>
<tr>
<th>Disease</th>
<th># of crops affected</th>
<th>Disease severity</th>
<th>Incidence of leaf infection</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Mean(^a)</td>
<td></td>
</tr>
<tr>
<td>Fusarium root rot(^b)</td>
<td>40</td>
<td>4.6</td>
<td>20.7%</td>
</tr>
<tr>
<td>Rhizoctonia root rot</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Pythium root rot</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Halo blight (%)</td>
<td>4</td>
<td>7.0%</td>
<td>1.7-50.0%</td>
</tr>
</tbody>
</table>

\(^a\)Means are based on an average of the crops in which the diseases were observed.
\(^b\)Root diseases were rated on a scale of 0 (no disease) to 9 (death of plant).

Table 2. Prevalence and severity of foliar diseases in 40 crops of field bean in Manitoba in August in 2018.

<table>
<thead>
<tr>
<th>Disease</th>
<th># of crops affected</th>
<th>Disease severity(^a)</th>
<th>Incidence of leaf infection</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Mean(^b)</td>
<td></td>
</tr>
<tr>
<td>Common bacterial blight</td>
<td>40</td>
<td>2.3</td>
<td>20.7%</td>
</tr>
<tr>
<td>Anthracnose (%)</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Rust (%)</td>
<td>3</td>
<td>8.3%</td>
<td>5.0-11.7%</td>
</tr>
<tr>
<td>White mold (%)</td>
<td>1</td>
<td>1%</td>
<td>1%</td>
</tr>
</tbody>
</table>

\(^a\)White mold and rust severity were rated as the percentage of infected plant tissue; common bacterial blight severity was rated on a scale of 0 (no disease) to 5 (50-100% of leaf area diseased) and on the incidence of leaves with symptoms.
\(^b\)Means are based on an average of the crops in which the diseases were observed.
CROP: Field pea
LOCATION: Manitoba

NAMES AND AGENCIES:
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TITLE: FIELD PEA DISEASES IN MANITOBA IN 2018

ABSTRACT: A total of 45 and 44 pea crops were surveyed in Manitoba for root and foliar diseases,
respectively. Fusarium root rot was the most prevalent root disease and mycosphaerella blight the most
widespread foliar disease throughout the province. Diseases that were less frequently observed included
rust and downy mildew. White mold, bacterial blight, septoria leaf blotch and anthracnose were not
observed in any of the crops surveyed in 2018. Root samples collected from a total of 60 pea fields in 2016
(30) and 2017 (30) indicated that Aphanomyces euteiches was present in 77% and 47% of these fields,
respectively. The 2018 PCR results for A. euteiches were not available at the time of this report.

METHODS: Field pea crops were surveyed for root and foliar diseases at 45 and 44 different locations,
respectively, in Manitoba. The crops surveyed were randomly chosen from regions in south-central and
southwest Manitoba, where field pea is commonly grown. For the root disease survey, five of the 40 crops
were from the Swan River area. The area seeded to field pea in Manitoba has increased in recent years
from approximately 22,000 and 26,000 ha in 2014 and 2015, respectively (Manitoba Pulse and Soybean
Growers 2015). The area sown to field pea in 2016 more than doubled with 66,000 ha in Manitoba based
on an increased demand for peas (Manitoba Agriculture and Agri-Food Statistics 2017). However, in 2017,
the seeded area dropped to 26,200 ha mainly as a result of wet, unfavourable growing conditions for peas
during the 2016 field season which deterred many growers from seeding peas in the following year
(Manitoba Agriculture 2017). The area seeded to field pea in Manitoba increased from 26,200 ha in 2017 to
34,000 ha in 2018 (Manitoba Agricultural Services Corporation 2018).

The survey of root diseases was conducted during late June (40 fields) to late July (5 fields) when most
plants were at the early to late flowering stages. At least ten plants were sampled from each of three
random sites in each crop surveyed. Root diseases were rated on a scale of 0 (no disease) to 9 (death of
plant) (Xue 2000). To confirm the visual disease identification, 15 symptomatic roots were collected from
each crop for fungal isolation and identification. Identification of Fusarium species involved visual
assessment, microscopic examination and morphological characterization using the criteria of Leslie &
Summerell (2006). Unfortunately, due to the late arrival of samples from the five fields in the Swan River
area, roots were rated for disease severity, but could not be processed in the laboratory as described
above. However, fifteen roots from each of the 45 pea crops were frozen for future PCR analysis of the
root rot pathogens.

Roots from 10 sites from each of 40 fields were dug up in late June of 2018 during the root rot survey and
shipped to Dr. Chatterton (AAFC-Lethbridge) for Aphanomyces euteiches assessment using PCR assays
(Gangneux et al. 2014).

Foliar diseases were assessed from mid- to late July when most plants were at the intermediate to round
pod stage. A minimum of 30 plants (10 plants from each of 3 sites) was assessed in each of the 44 fields.
Foliar diseases were identified based on their symptoms. The severity of mycosphaerella blight, sclerotinia
stem rot and anthracnose was estimated using a scale of 0 (no disease) to 9 (whole plant severely
diseased). Powdery mildew, downy mildew, rust, septoria leaf blotch and bacterial blight were rated as the
percentage of foliar area infected.
**RESULTS AND COMMENTS:** Warm, dry, windy weather and variable soil moisture prevailed across many areas in the province early in May with no meaningful precipitation (Manitoba Agriculture 2018a). By May 28th, seeding was 94% completed. Most areas of the province received rainfall, although amounts were variable with additional precipitation being needed in many regions (Manitoba Agriculture 2018b). By the end of July, crops were advancing rapidly and harvest began in pea fields in the Holland to Treherne area with below average yields due to the dry growing conditions (Manitoba Agriculture 2018c). Field pea harvest was completed by August 20th with variable yields depending on the amount of in-season rainfall (Manitoba Agriculture 2018d). Pea yields ranging from 25 to 80 bu/ac were reported throughout the province (Manitoba Agriculture 2018e).

Two diseases were identified based on laboratory assessment of the roots collected from 40 pea crops (Table 1). Fusarium root rot was the most prevalent as in previous years (McLaren et al. 2017; 2018) with *F. avenaceum* being the most predominant *Fusarium* spp. Of all crops surveyed, root rot severity ratings ranged from 1.5 to 4.9 with a mean of 3.1. Rhizoctonia root rot (*Rhizoctonia solani*) was not detected in any of the crops sampled. Ten (22%) pea crops had average root rot severity ratings above 4 (i.e., symptoms were present on 50% of the root system) and this would have had a detrimental effect on crop yield. *Fusarium oxysporum*, an efficient root colonizer known to cause wilt of pea, was detected in 30 of the 40 crops sampled for fungal isolation and identification. Assessment of frozen samples for root pathogens using PCR is planned for the near future.

*Aphanomyces euteiches* was detected in root samples collected from 77% (23/30) and 47% (14/30) of pea fields in 2016 and 2017, respectively. Aphanomyces root rot is favoured by wet, poorly drained soils and is most severe under flooded soil conditions. Seasonal precipitation in many of the pea growing regions of Manitoba in 2016 was above normal, which would have contributed to the increased incidence of aphanomyces root rot. Drier conditions prevailed in 2017. Assessment of the 2018 samples for *A. euteiches* is ongoing and results are pending at this time.

Three foliar diseases were observed (Table 2). Mycosphaerella blight (*Mycosphaerella pinodes*) was the most prevalent, as in previous years (McLaren et al. 2017; 2018), and was present in all the crops surveyed. Disease severity ranged from 2.3 to 8.6 with a mean of 4.9. Downy mildew (*Peronospora viciae*) was detected in seven (16%) of the crops surveyed and the percentage of leaf area infected ranged from trace to 1%. Rust (*Uromyces viciae-fabae*) was observed in 39% (17/44) of the crops with the percentage of leaf area infected ranging from 0.5 to 1.4% with a mean of 0.6%. Powdery mildew (*Erysiphe pisi*) was not observed in any of the surveyed crops. All newly registered pea cultivars are required to have resistance to powdery mildew, so the absence of this disease could be mainly attributed to the use of new cultivars by growers or that the early seeded crops escaped infection.

Symptoms of white mold (*Sclerotinia sclerotiorum*), anthracnose (*Colletotrichum pisi*), septoria leaf blotch (*Septoria pisi*) and bacterial blight (*Pseudomonas syringae pv. pisi*) were not observed in any of the surveyed crops.

**REFERENCES:**
Table 1. Prevalence and severity of root diseases in 40 crops of field pea in Manitoba in 2018.

<table>
<thead>
<tr>
<th>Disease</th>
<th># Crops affected (%)</th>
<th>Disease severity (0-9) a</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Mean</td>
</tr>
<tr>
<td>Fusarium root rot</td>
<td>40 (100)</td>
<td>3.1</td>
</tr>
<tr>
<td>Rhizoctonia root rot</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Fusarium oxysporum</td>
<td>30 (75)</td>
<td>3.2</td>
</tr>
<tr>
<td>Aphanomyces root rot</td>
<td>TBAb</td>
<td>n/a</td>
</tr>
</tbody>
</table>

aAll diseases were rated on a scale of 0 (no disease) to 9 (death of plant). Mean values are based only on crops in which the disease was observed.
bAssessment of the 2018 samples for A. euteiches is ongoing and results are pending at this time.

Table 2. Prevalence and severity of foliar diseases in 44 crops of field pea in Manitoba in 2018.

<table>
<thead>
<tr>
<th>Disease</th>
<th># Crops affected (%)</th>
<th>Disease severity (0-9 or % leaf area diseased) a</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Mean</td>
</tr>
<tr>
<td>Mycosphaerella blight</td>
<td>44 (100)</td>
<td>4.9</td>
</tr>
<tr>
<td>Sclerotinia stem rot</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Powdery mildew</td>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td>Downy mildew</td>
<td>7 (16)</td>
<td>&lt;1.0%</td>
</tr>
<tr>
<td>Anthracnose</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Rust</td>
<td>17 (39)</td>
<td>0.6%</td>
</tr>
<tr>
<td>Bacterial blight</td>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td>Septoria leaf blotch</td>
<td>0</td>
<td>0%</td>
</tr>
</tbody>
</table>

aPowdery mildew, downy mildew, rust, septoria leaf blotch and bacterial blight severity were rated as the percentage of leaf area infected; other diseases were rated on a scale of 0 (no disease) to 9 (whole plant severely diseased). Mean values are only based on crops in which the disease was observed.
SURVEY OF CANOLA DISEASES IN MANITOBA IN 2018

ABSTRACT: A total of 180 canola crops were surveyed in Manitoba for the prevalence and incidence or severity of sclerotinia stem rot, blackleg, alternaria pod spot, aster yellows, fusarium wilt, foot rot and clubroot. Blackleg and sclerotinia stem rot were the most prevalent diseases throughout the province. No canola plants collected from the 180 surveyed canola crops were confirmed to have clubroot. However, symptomatic plant samples from 15 canola crops outside of the regular canola survey tested positive for clubroot. Verticillium stripe was identified in 31 canola samples submitted to the Manitoba Crop Diagnostic Centre.

METHODS: A total of 180 canola crops were surveyed in the southwest (75), northwest (39), eastern/interlake (15) and central (51) regions of Manitoba in August. All crops were Brassica napus and the majority were surveyed before swathing while plants were between growth stages 5.1 and 5.5 (Harper & Berkenkamp 1975). In each canola crop, 100 plants were selected in a regular pattern starting at a corner of the field or at a convenient access point. The edges of the fields were avoided. Twenty plants were removed from each of five points of a “W” pattern in the field. Points of the “W” were at least 20 paces apart. All plants were pulled up, removed from the field and examined for the presence of diseases. For soil collection, samples were obtained from each of the five points of the “W”, or if the field entrance was identifiable, they were collected at 5 points near the entrance.

Canola crops were assessed for the prevalence (percent crops infested) and incidence (percent plants infected per crop) of sclerotinia stem rot (Sclerotinia sclerotiorum), aster yellows (Candidatus Phytoplasma asteris), foot rot (Fusarium spp. and Rhizoctonia sp.), blackleg (Leptosphaeria maculans), fusarium wilt (F. oxysporum f. sp. conglutinans) and clubroot (Plasmodiophora brassicae). For sclerotinia stem rot, each
RESULTS: A number of diseases were present in each of the four regions of Manitoba. Although no clubroot symptoms were observed in the 180 Manitoba canola crops surveyed in 2018, symptomatic plant samples from 15 canola crops outside of the regular canola survey were confirmed to have clubroot and included two rural municipalities that were previously clubroot-free (Froese et al. 2018). Information on the monitoring and occurrence of clubroot in Manitoba in previous years is provided by Kubinec et al. (2014) and Derksen et al. (2013). A map of clubroot distribution in Manitoba (2009-2018) is available online (Manitoba Agriculture 2018) and, to date, has been updated only for the 2018 canola crops where clubroot symptoms were identified. The 2018 soil analysis data has not been added as testing is ongoing.

Sclerotinia stem rot and blackleg were the most prevalent diseases throughout the province in 2018 (Tables 1, 2 and 3). The prevalence of sclerotinia-infested crops ranged from a high of 53% in the eastern/interlake region to 19% in the southwest region with a provincial mean of 36%. Mean disease incidence averaged across all crops was 2.8% and ranged from 5.4% in the central region to 0.9% in the southwest region. For infested crops only, mean disease incidence was 7.9%. Throughout the province, mean severity of sclerotinia stem rot was 0.7 and ranged from 1.1 in the eastern/interlake region to 0.3 in the southwest region.

Aster yellows was observed in 5% of canola crops in Manitoba with an average disease incidence of 2.8% in these crops (Table 2). The prevalence of this disease was substantially less than in 2012 (95%), when record high levels of aster yellows were observed in all regions of Manitoba. Contributing factors to the high level of aster yellows in 2012 included drought in the midwestern United States, the early arrival of aster leafhoppers from the southern U.S. and the higher than normal percentage of infected individuals in the leafhopper population. Aster leafhopper numbers have been considerably lower since then, thereby (Canola Council of Canada 2013; Gavloski 2014, 2015, 2016, 2017) reducing the risk of this disease.

Blackleg basal cankers occurred in 73% of the crops surveyed in 2018 (Table 1), with prevalence ranging from 82% in the central region to 63% in the southwest region. The mean incidence of basal cankers averaged across all crops was 13.1%, while the mean incidence in infested crops was 18.2%. The severity of blackleg basal cankers was similar in recent years with mean ratings of approximately 2 or less. A value of 2 indicates that 26-50% of the basal stem cross-section was diseased. The mean prevalence of blackleg stem lesions in 2018 was 54%. In previous years, 65%, 71% and 52% of crops had stem lesions in 2015, 2016 and 2017, respectively (McLaren et al. 2016, 2017, 2018). The average incidence of blackleg stem lesions was 7.4% in infested crops and 3.9% in all crops.

The mean prevalence of alternaria pod spot in 2018 was 16% and ranged from 33% in the central and eastern/interlake regions to 3% in the southwest region (Table 2). The severity of alternaria pod spot was low with a mean of 2% in infested crops.

Fusarium wilt was observed in 7.9% of canola crops surveyed in Manitoba, with a mean incidence of 2.6% in diseased fields and an average severity of 1.9 in these crops (Table 1). Foot rot occurred in 4.5% of canola crops surveyed with a provincial mean disease incidence of <1%. Foot rot was observed in the central and northwest regions only. White rust (Albugo candida) has not been confirmed in any crop of B. napus since 2011 (McLaren et al. 2012). No canola samples symptomatic of verticillium stripe were
observed in the regular survey. Thirty-one samples submitted to the Crop Diagnostic Centre were confirmed positive for verticillium stripe. This represents approximately 15 canola crops, with multiple samples submitted from some of these fields.

ACKNOWLEDGEMENTS: We thank the Manitoba Canola Producers for their continued support of this survey work and both the Manitoba Canola Growers Association and the Canola Council of Canada for their financial assistance.

REFERENCES:
Table 1. Mean prevalence, incidence and severity of sclerotinia stem rot and blackleg in Manitoba in 2018.

<table>
<thead>
<tr>
<th>Crop region</th>
<th>Sclerotinia stem rot</th>
<th>Blackleg basal cankers</th>
<th>Blackleg stem lesions</th>
</tr>
</thead>
<tbody>
<tr>
<td>(no. of crops)</td>
<td>P&lt;sup&gt;a&lt;/sup&gt;</td>
<td>Inc.&lt;sup&gt;b&lt;/sup&gt;</td>
<td>Inc.&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
<tr>
<td>Central</td>
<td>51</td>
<td>5.4</td>
<td>10.6</td>
</tr>
<tr>
<td>(51)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>East/Inter.</td>
<td>53</td>
<td>4.5</td>
<td>8.5</td>
</tr>
<tr>
<td>(15)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Northwest</td>
<td>39</td>
<td>2.2</td>
<td>5.6</td>
</tr>
<tr>
<td>(39)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Southwest</td>
<td>19</td>
<td>0.9</td>
<td>4.9</td>
</tr>
<tr>
<td>(75)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All regions</td>
<td>36</td>
<td>2.8</td>
<td>7.9</td>
</tr>
<tr>
<td>(180)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<sup>a</sup> Prevalence (P).
<sup>b</sup> Disease incidence (DI) or severity (Sev.) across all surveyed crops.
<sup>c</sup> Disease incidence or severity in infested crops.
Table 2. Mean prevalence and incidence or severity of alternaria pod spot, aster yellows, fusarium wilt and foot rot in Manitoba in 2018.

<table>
<thead>
<tr>
<th>Crop region (no. of crops)</th>
<th>Alternaria pod spot</th>
<th>Aster yellows</th>
<th>Fusarium wilt</th>
<th>Foot rot</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>P&lt;sup&gt;a&lt;/sup&gt;</td>
<td>Inc.&lt;sup&gt;b&lt;/sup&gt;</td>
<td>Inc.&lt;sup&gt;c&lt;/sup&gt;</td>
<td>P&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Central (51)</td>
<td>33</td>
<td>2.8</td>
<td>12</td>
<td>0.4</td>
</tr>
<tr>
<td>East/Inter. (15)</td>
<td>33</td>
<td>0.3</td>
<td>7</td>
<td>0.1</td>
</tr>
<tr>
<td>Northwest (39)</td>
<td>13</td>
<td>1.3</td>
<td>5</td>
<td>&lt;0.1</td>
</tr>
<tr>
<td>Southwest (75)</td>
<td>3</td>
<td>1.0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>All regions (180)</td>
<td>16</td>
<td>2.1</td>
<td>5</td>
<td>0.1</td>
</tr>
</tbody>
</table>

<sup>a</sup> Prevalence (P).
<sup>b</sup> Disease incidence (DI) and severity (Sev.) across all surveyed crops.
<sup>c</sup> Disease incidence and severity in infested crops.

Table 3. Distribution of incidence (sclerotinia, blackleg, aster yellows, fusarium wilt and foot rot) and severity (alternaria pod spot) classes in 180 crops of *Brassica napus* in Manitoba in 2018.

<table>
<thead>
<tr>
<th>Incidence range</th>
<th>Sclerotinia stem rot</th>
<th>Blackleg basal cankers</th>
<th>Blackleg stem lesions</th>
<th>Aster yellows</th>
<th>Fusarium wilt</th>
<th>Foot rot</th>
<th>Alternaria pod spot</th>
</tr>
</thead>
<tbody>
<tr>
<td>0%</td>
<td>65</td>
<td>28</td>
<td>47</td>
<td>95</td>
<td>92</td>
<td>95</td>
<td>83</td>
</tr>
<tr>
<td>1-5%</td>
<td>22</td>
<td>24</td>
<td>30</td>
<td>4</td>
<td>7</td>
<td>3</td>
<td>15</td>
</tr>
<tr>
<td>6-10%</td>
<td>4</td>
<td>10</td>
<td>12</td>
<td>0</td>
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<td>11-20%</td>
<td>5</td>
<td>17</td>
<td>8</td>
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<td>&gt;50%</td>
<td>0</td>
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</tbody>
</table>
CROP: Canola
LOCATION: Manitoba

NAMES AND AGENCIES:
R.D. Froese¹, H. Derksen¹, X. Guo² & D.L. McLaren³
¹Manitoba Agriculture, Primary Agriculture, Box 1149, Carman, MB R0G 0J0
Telephone: (204) 745-5660; Facsimile: (204) 745-5690; E-mail: dane.froese@gov.mb.ca
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³Agriculture and Agri-Food Canada, 2701 Grand Valley Road, Brandon, MB R7A 5Y3

TITLE: MONITORING AND OCCURRENCE OF CLUBROOT IN MANITOBA IN 2018

ABSTRACT: Symptomatic plants from 15 canola fields were identified and tested positive for clubroot (Plasmodiophora brassicae) in the 2018 growing season through independent submission. No plants were identified through the annual canola disease survey. Thirty-three fields have tested positive for clubroot DNA since 2013.

METHODS: Between late July and mid-September, soil samples (~1L) were obtained from 19 separate fields in 2018, external to the annual canola disease survey. Visual symptoms were apparent in 16 of these fields. The samples were analysed for the presence of Plasmodiophora brassicae Woronin (clubroot) using the PCR based diagnostic test of Cao et al. (2007) and an adaptation of the quantitative PCR (qPCR) protocol of Rennie et al. (2011). Soil samples from 19 separate fields were submitted to the Pest Surveillance Initiative (PSI) Lab for qPCR analysis to determine quantity of spores per gram of soil, as per the modified method of Cao et al. (2007). In cases where visual field symptoms were observed, clubroot galling was rated on a scale of 0 to 3 (Kuginuki et al. 1999).

RESULTS AND COMMENTS: Fifteen of 19 soil samples collected in 2018 were confirmed positive for clubroot using the PCR-based diagnostic test of Cao et al. (2007). Plant samples from these same 15 fields were confirmed to have visual symptoms of clubroot. Thirteen of the 15 new confirmed clubroot-positive fields were found within rural municipalities previously known to have positive clubroot cases. Two newly identified clubroot-positive rural municipalities are Lorne and Dufferin.

Prior to the 2018 survey, clubroot symptoms were found on plants from 18 fields across five rural municipalities in the province. Clubroot symptoms on plants had not been found in field surveys prior to 2013. Terminology for field classification for clubroot in Manitoba is based on in-field symptoms, presence of clubroot DNA in soil and/or plants (Table 1). If symptoms are present on plants, or DNA is quantifiable in the soil sample, or symptoms occur under greenhouse conditions, then the field is classified as positive for clubroot. If no DNA is found in soil and/or plants and no symptoms are observed in the field or in a bioassay then the field is negative. If DNA is identified in the soil, but no symptoms are visible in-field or in a bioassay, the field is classified as a ‘non-symptomatic field of concern’. All fields classified as positive or ‘non-symptomatic fields of concern’ are subject to recurrent monitoring by Manitoba Agriculture staff.

REFERENCES:


**Table 1:** Terminology for different types of clubroot cases based on field, lab and greenhouse testing.

<table>
<thead>
<tr>
<th>Term</th>
<th>In-field symptoms</th>
<th>Soil DNA test</th>
<th>Plant bioassay</th>
</tr>
</thead>
<tbody>
<tr>
<td>Positive clubroot&lt;sup&gt;a&lt;/sup&gt;</td>
<td>Yes/No</td>
<td>Yes/No</td>
<td>Yes/No</td>
</tr>
<tr>
<td>Non-Symptomatic Field of Concern</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Negative / Free of Clubroot</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
</tbody>
</table>

<sup>a</sup> Must have two of three positive responses.
CROP: Flax
LOCATION: Manitoba and Saskatchewan

NAMES AND AGENCY:
K. Y. Rashid¹, B. Ziesman³, C. Jacob³, L. Hicks³, K. Kindrachuk³, C. Peru³, H.R. Kutcher², T. Islam², P. Cholango-Martinez², T. Cabernel¹, M. Penner¹ & M.P. Pradhan⁴
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TITLE: DISEASES OF FLAX IN MANITOBA AND SASKATCHEWAN IN 2018

ABSTRACT: A survey of 17 flax crops in Manitoba and 85 crops in Saskatchewan revealed that pasmo was the most prevalent disease observed in 100% of crops in Manitoba and 54% in Saskatchewan followed by alternaria blight in 70% of crops surveyed in both provinces. Traces of powdery mildew and aster yellows were observed in a few crops. No signs of rust or sclerotinia stem rot were evident in 2018.

METHODS: A total of 102 flax crops were surveyed in 2018: 17 in Manitoba and 85 in central, southern and eastern Saskatchewan. Crops surveyed were selected at random along pre-planned routes in the major areas of flax production. All crops were surveyed during the last two weeks in August. Each crop was sampled by two people walking ~100 m in opposite directions to each other following an "M" pattern. Diseases were identified by visible symptoms and the incidence and severity of fusarium wilt (Fusarium oxysporum lini), pasmo (Septoria linicola), powdery mildew (Oidium lini), rust (Melampsora lini), alternaria blight (Alternaria spp.), sclerotinia stem infection (Sclerotinia sclerotiorum), and aster yellows (AY Phytoplasma) were recorded. Stand establishment, vigour, and maturity were rated on a scale of 1 to 5 (1 = very good/early, and 5 = very poor/very late).

In addition, 11 samples of flax plants were submitted for analysis to the Crop Diagnostic Centre of Manitoba Agriculture by agricultural representatives and growers.

RESULTS AND COMMENTS: Seventy-eight percent of the flax crops surveyed in 2018 (100% in Manitoba and 74% in Saskatchewan) had excellent stands and the rest were good to fair. Fifty-four percent of the crops surveyed were early maturing (82% in Manitoba and 48% in Saskatchewan). Sixty-nine percent of the crops had excellent vigour (70% in Manitoba and 68% in Saskatchewan) and the rest were poor. All 102 crops were brown seed-colour flax. Weed infestation was very low in 63% of the crops surveyed in 2018 and the remaining 37% had medium to high weed infestation. The 2018 season was dry with below normal soil moisture conditions in Manitoba and Saskatchewan especially in July and August. Total flax area was ~353,000 ha, approximately 92% in Saskatchewan according to Statistics Canada (2018).

The 2018 disease survey showed lower incidences and severity of pasmo, fusarium wilt, and aster yellows in Manitoba than in Saskatchewan. Pasmo, the most prevalent disease was observed in 100% of the crops surveyed in Manitoba and 54% in Saskatchewan with a range in severity from trace amounts to 5% in 53% of the crops, from 6-10% in 5% of the crops, from 11-20% in 3% of the crops and over 21% in 1% of the crops (Table 1). The prevalence and severity on stems were generally lower than in previous years (Rashid et al. 2016, 2017, 2018), due probably to the dry conditions occurring in July and August of 2018.

Root infections and fusarium wilt were observed in 6% of the crops surveyed (19% in Manitoba and 1% in Saskatchewan). Incidence was very low (trace to 5%) even in the most affected crops (Table 1). The prevalence of this disease in 2018 was lower than in previous years (Rashid et al. 2016, 2017, 2018).

Powdery mildew was observed only in one crop in Manitoba and in five crops in Saskatchewan in 2018 due perhaps to the late arrival of the inoculum and the dry weather conditions in July and August in both provinces. Powdery mildew was observed on the top few leaves of the late maturing crops but no precise data could be collected in 2018 due to the pre-mature drying and senescing of the flax leaves prior to the survey.
Rust was not observed in any of the crops surveyed in 2018, nor in the flax rust trap nurseries planted at Morden and Portage la Prairie in Manitoba, and at Indian Head and Saskatoon in Saskatchewan.

Aster yellows was present at trace levels in 6% of the crops surveyed (24% in Manitoba and 2% in Saskatchewan). This is less frequent than in 2017 but similar to a normal crop season. Aster yellows is transmitted by the aster leafhopper (*Macrostele quadrilineatus*) that usually migrates from the south during the growing season. Alternaria blight was observed at trace to 5% levels in 73% of the crops (71% in Manitoba and 73% in Saskatchewan). Sclerotinia stem infections were not encountered in 2018, and lodging was observed in a few crops.

Of the 11 samples submitted to the Manitoba Agriculture Crop Diagnostic Centre in 2018, two were affected by fusarium wilt, one by root rot caused by *Pythium* spp. and *Rhizoctonia* spp., one by environmental stress, and seven by herbicide injury.

REFERENCES:

<table>
<thead>
<tr>
<th>Fusarium Wilt</th>
<th>Pasmo</th>
</tr>
</thead>
<tbody>
<tr>
<td>Disease class</td>
<td>Incidence</td>
</tr>
<tr>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>1-5%</td>
<td>1-5%</td>
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<tr>
<td>6-12%</td>
<td>6-10%</td>
</tr>
<tr>
<td>21-40%</td>
<td>11-20%</td>
</tr>
<tr>
<td>&gt;40%</td>
<td>&gt;21-40%</td>
</tr>
</tbody>
</table>

*a Disease incidence = Percentage of infected plants in each crop.
*b Disease severity = Percentage of roots affected by fusarium wilt, and of stems affected by pasmo.*
CROP: Soybean
LOCATION: Manitoba and Saskatchewan

NAMES AND AGENCIES:

1Agriculture and Agri-Food Canada (AAFC), Brandon Research and Development Centre, 2701 Grand Valley Road, Brandon, MB R7A 5Y3
Telephone: (204) 578-6691; Facsimile: (204) 578-6524; E-mail: yongmin.kim@canada.ca
2AAFC, Morden Research and Development Centre, Unit 101, Route 100, Morden, MB R6M 1Y5
3Manitoba Agriculture, 65-3rd Ave. NE, Carman, MB R0G 0J0
4Saskatchewan Pulse Growers, 207-111 Research Drive, Saskatoon, SK S7N 3R3
5Alberta Agriculture and Forestry, Crop Diversification Centre North, 17507 Fort Road NW, Edmonton, AB T5Y 6H3
6AAFC, Saskatoon Research and Development Centre, 107 Science Place, Saskatoon, SK S7N 0X2
7Manitoba Pulse and Soybean Growers, P.O. Box 1760, Carman, MB R0G 0J0
8Government of Saskatchewan, Ministry of Agriculture, 113-110 Souris Ave., Weyburn, SK S4H 2Z8

TITLE: SOYBEAN ROOT ROT (MANITOBA) AND PHYTOPHTHORA ROT (MANITOBA AND SASKATCHEWAN) IN 2018

ABSTRACT: In 2018, 95 soybean crops were surveyed in Manitoba for root diseases. Samples from all fields were rated for root rot and from 42 fields, roots were processed for fungal isolation and identification. In the 42 fields, fusarium root rot was the most prevalent root disease. All 95 soybean crops as well as one additional crop were assessed for Phytophthora root rot. Thirty percent of Manitoba soybean crops (29/96) tested positive for the presence of Phytophthora rot. In Saskatchewan, Phytophthora sojae was detected in seven percent (1/15) of the soybean crops surveyed.

INTRODUCTION: For the first time in a decade, Manitoba soybean production was lower in 2018 than in 2017 with 2.3 million acres and 1.9 million acres seeded in 2017 and 2018, respectively (Statistics Canada 2018). Seeded area in Saskatchewan increased from 240,000 acres in 2016 to 850,000 acres in 2017, but declined in 2018 to 407,500 acres (SoyCanada 2018). Attractive wheat prices and dry weather contributed to the decline in area seeded to soybean in both provinces in 2018. Root rot is a problem in Manitoba and Saskatchewan and is also a constraint in other areas of Canada where soybean production has been established (Chang et al. 2013; OMAFRA 2011). This disease complex may become more of an issue in Manitoba and Saskatchewan, which are now two of the four largest soybean producing provinces in Canada. Phytophthora rot has been identified in Manitoba soybean crops and therefore the survey for this disease was expanded into southeast Saskatchewan as soybean is a relatively new crop for Saskatchewan growers.

METHODS: Soybean crops were surveyed for root diseases at 95 different locations in Manitoba in 2018. Areas of the crop survey were expanded to include not only randomly chosen fields from regions in south-central and southwest Manitoba, where soybean is commonly grown, but fields from non-traditional soybean areas into which the crop is expanding.

The survey for root diseases was conducted during mid-July to early August with at least ten plants were uprooted at each of three random sites in each crop surveyed. Root diseases were rated on a scale of 0 (no disease) to 9 (death of plant) for all 95 fields. For 42 crops, 15 symptomatic roots were collected for fungal isolation and identification. For Fusarium spp., identification involved visual assessment, microscopic examination and morphological characterization using the criteria of Leslie and Summerell (2006). Fifteen roots from each of the 42 soybean crops surveyed were frozen for future PCR analysis of root rot pathogens.

In Manitoba, ninety-five crops that were previously surveyed for root rot and one additional crop were assessed in mid-July to late-August for phytophthora rot. Soybean plants were collected by staff at AAFC-Brandon, AAFC-Morden, Manitoba Agriculture and the Manitoba Pulse and Soybean Growers. In Saskatchewan during late July to early September, soybean plants were collected from 15 crops by AAFC-Saskatoon, the Saskatchewan Pulse Growers and the Government of Saskatchewan, Ministry of
Agriculture. Those plants that were symptomatic for phytophthora disease were identified at AAFC-Brandon and AAFC-Morden for further assessment in the laboratory. Approximately 207 and 64 stems from Manitoba and Saskatchewan soybean plants, respectively, were placed on selective media to identify Phytophthora spp. based on morphological characteristics (Gallegly & Hong 2008).

RESULTS AND COMMENTS: Warm, dry, windy weather and variable soil moisture prevailed across many areas of the province early in May with no substantial precipitation (Manitoba Agriculture 2018a). By May 28th, seeding was 75-100% completed. Most areas of the province received rainfall, although amounts were variable with additional precipitation needed in many regions (Manitoba Agriculture 2018b). By the end of July/early August, crops were advancing rapidly with many exhibiting moisture stress on hills or light land (Manitoba Agriculture 2018c). With continuing warm, dry conditions, soybean crops were ripening prematurely in some areas of the province (Manitoba Agriculture 2018d). From mid-September into early October, harvest was frequently delayed due to precipitation, high humidity and cool temperatures. Soybean harvest was 98% completed by October 29th with variable yields depending on the amount of in-season rainfall. Soybean yields ranging from 15 to 55 bu/ac were reported throughout the province (Manitoba Agriculture 2018e).

Root rot was observed in all 95 Manitoba soybean crops surveyed with root rot severity ratings that ranged from 3.4 to 7.3 with a mean of 4.6. The microorganisms most frequently isolated from roots of infected plants from 42 crops belonged to Fusarium spp. (Table 1). Rhizoctonia root rot (Rhizoctonia solani) was not confirmed in any of these 42 crops surveyed in 2018. Pythium root rot was not detected in any of the 42 soybean crops surveyed in 2018. Assessment of frozen samples for root pathogens using PCR is planned for the near future.

Phytophthora rot was identified in 30% (29/96) of Manitoba fields and 7% (1/15) of Saskatchewan fields surveyed for this disease (Table 1). Each symptomatic plant that was positive for P. sojae had a discoloured taproot with lesions that progressed up the stem. Sequencing of DNA was conducted to confirm the species identification of P. sojae. Race identification of Phytophthora isolates will begin shortly at both AAFC-Brandon and AAFC-Morden.

REFERENCES:
Table 1. Prevalence and severity of root rot in 95 crops of soybean in Manitoba and prevalence of Phytophthora rot in 96 and 15 crops of soybean in Manitoba and Saskatchewan, respectively.

<table>
<thead>
<tr>
<th>Disease</th>
<th>No. crops affected</th>
<th>Disease severity (0-9) a</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Mean</td>
</tr>
<tr>
<td>Root rot</td>
<td>95</td>
<td>4.6</td>
</tr>
<tr>
<td>Fusarium root rot b</td>
<td>42</td>
<td>4.8</td>
</tr>
<tr>
<td>Pythium root rot b</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Rhizoctonia root rot b</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Phytophthora rot (MB) c</td>
<td>29</td>
<td>n/a</td>
</tr>
<tr>
<td>Phytophthora rot (SK) c</td>
<td>1</td>
<td>n/a</td>
</tr>
</tbody>
</table>

a All diseases, excluding Phytophthora rot, were rated on a scale of 0 (no disease) to 9 (death of plant). Mean values are based only on crops in which the disease was observed.
b Based on isolations from 42 crops.
c Based on isolations from 96 and 15 crops in Manitoba and Saskatchewan, respectively.
n/a = no disease severity ratings were available.
CROP: Soybean
LOCATION: Manitoba

NAMES AND AGENCIES:

1Manitoba Agriculture, Box 1149, Carman, MB R0G 0J0
2Manitoba Agriculture, Box 969, Altona, MB R0G 0B0
3Manitoba Agriculture, Box 50, Beausejour, MB R0E 0C0
4Manitoba Pulse and Soybean Growers, Box 1760, Carman MB R0G 0J0
5Department of Plant Science, University of Manitoba, 66 Dafoe Road, Winnipeg, MB R3T 2N2
6Manitoba Agriculture, 1129 Queens Ave, Brandon, MB R7A 1L9

TITLE: SURVEY OF SOYBEAN FOLIAR DISEASES IN MANITOBA IN 2018

ABSTRACT: A total of 95 soybean crops at the R3 (beginning pod) stage were surveyed in Manitoba for prevalence as well as incidence and/or severity of bacterial blight, septoria brown spot, downy mildew, white mold, pod/stem blight, anthracnose, and frogeye leaf spot. The same 95 fields plus one additional field were surveyed at the R6 (full seed) stage for the foliar diseases listed above. Bacterial blight was the most prevalent disease observed at both the R3 and R6 growth stages.

METHODS: A provincial soybean survey coordinated by Manitoba Agriculture and the Manitoba Pulse and Soybean Growers was conducted in 2018. All results are based on visual assessment of diseases within the surveyed crops. A total of 95 fields were surveyed at the “early” stage (R3 stage). A total of 96 fields were surveyed at the “late” stage (R6 stage). Plants were given incidence and severity ratings for bacterial blight, septoria brown spot, and downy mildew. Incidences of white mold, pod/stem blight, anthracnose, and frogeye leaf spot were also measured. Severity of foliar disease was rated on a 0-5 scale (0-no symptoms; 1-trace symptoms; 2-symptoms in lower canopy; 3-symptoms in mid-upper canopy; 4-severe symptoms in mid-upper canopy; 5-severe symptoms in mid-upper canopy with defoliation) (Bisht et al. 2014). The numbers of surveyed fields in each region, based on the number of acres planted to soybeans the previous year, were 35, 29, 9 and 23 in the central, eastern/Interlake, northwest and southwest regions, respectively.

RESULTS (EARLY SURVEY): Bacterial blight was present in 96% of the surveyed fields with the highest prevalence in the eastern/Interlake, northwest and southwest regions (100%) and lowest in the central region (88%) (Table 1). The average incidence of bacterial blight in infested fields was 57%. The incidence was highest in the eastern/Interlake region (64%) and lowest in the northwest region (54%). The average severity of bacterial blight was 1.5. The severity was highest in the central region (1.7) and lowest in the northwest region (1.2).

Septoria brown spot was present in 93% of the fields surveyed with the highest prevalence in the eastern/Interlake and northwest regions (100%) and lowest in the southwest region (87%) (Table 1). The average incidence of septoria brown spot in infested fields was 57%. The incidence was highest in the eastern/Interlake region (64%) and lowest in the northwest region (54%). The average severity of septoria brown spot was 1.3. The severity was highest in the northwest region (1.7) and lowest in the eastern/Interlake region (1.0).

Downy mildew was present in 23% of the fields surveyed (Table 1). The prevalence of this disease was highest in the southwest region (39%) and lowest in the eastern/Interlake (11%). The average incidence of downy mildew in infested fields was 16%. The incidence was highest in the northwest region (23%). The average severity of downy mildew was 1.1. The severity was highest in the eastern/Interlake region (1.3).

White mold was not detected in any fields surveyed at the early timing. Pod/stem blight was detected in 3% of surveyed fields with the highest prevalence observed in the northwest region (13%) (Table 1). The average incidence of pod/stem blight was 5%. Anthracnose was present in 2% of surveyed fields and found only in the central region at 6% prevalence. The average incidence of anthracnose in infested fields was 8%. Frogeye leaf spot was present in 13% of fields, in all except the northwest region, with the highest...
prevalence occurring in the southwest region (22%). The average incidence of frogeye leaf spot in infested fields was 6%. The incidence was highest in the central region (9%).

**RESULTS (LATE SURVEY):** Bacterial blight was present in 99% of the fields surveyed (Table 2). The prevalence was highest in the central, eastern/Interlake and southwest regions (100%) and lowest in the northwest region (89%). The average incidence of bacterial blight in infested fields was 67%. The incidence was highest in the central region (77%) and lowest in the eastern/Interlake (56%). The average severity of bacterial blight was 1.6. The severity was highest in the central region (2.0) and lowest in the eastern/Interlake region (1.2).

Septoria brown spot was present in 92% of the fields surveyed (Table 2). The prevalence was highest in the central region (96%) and lowest in the northwest region (67%). The average incidence of septoria brown spot in infested fields was 66%. The incidence was highest in the eastern/Interlake region (84%) and lowest in the northwest (49%). The average severity of septoria brown spot was 1.4. The severity was highest in the central region (1.6) and lowest in the eastern/Interlake and southwest regions (1.2).

Downy mildew was present in 30% of the fields surveyed (Table 2). The prevalence was highest in the northwest region (56%) and lowest in the eastern/Interlake region (17%). The average incidence of downy mildew in infested fields was 37%. The incidence was highest in the eastern/Interlake and northwest regions (52%) and lowest in the central region (22%). The average severity of downy mildew was 1.3. The severity was highest in the central region (1.5) and lowest in the eastern/Interlake and southwest regions (0.6).

White mould was present in 3% of the fields surveyed (Table 2) and was detected only in the northwest region at a prevalence of 33%. The average incidence of white mold in infested fields was 8%.

Pod/stem blight was present in 4% of the fields surveyed (Table 2). This disease was detected only in the central and eastern/Interlake regions at 6% and 7% prevalence, respectively. The average incidence of pod/stem blight in infested fields was 3%.

Anthracnose was present in 2% of the fields surveyed (Table 2) and was detected only in the central and eastern/Interlake regions at 3% prevalence. The average incidence of anthracnose in infested fields was 7%. The incidence was highest in the central region (12%).

Frogeye leaf spot was present in 44% of the fields surveyed (Table 2). The prevalence was highest in the central region (59%) and lowest in the northwest region (11%). The average incidence of frogeye leaf spot in infested fields was 8%. The incidence was highest in the southwest region (10%).

Symptoms resembling those caused by sudden death syndrome were observed at two locations in the survey. Laboratory testing is underway to confirm the causal agent.

**ACKNOWLEDGEMENTS:** This survey work was coordinated with research being conducted by Agriculture and Agri-Food Canada.

**REFERENCES:**
### Table 1. Manitoba soybean disease survey results at the early survey timing (R3) in 2018.

<table>
<thead>
<tr>
<th>Disease</th>
<th>Rating</th>
<th>Region (no. fields)</th>
<th>Central (35)</th>
<th>Eastern/Interlake (29)</th>
<th>Northwest (9)</th>
<th>Southwest (23)</th>
<th>Manitoba (95)</th>
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</thead>
<tbody>
<tr>
<td>Bacterial Blight</td>
<td>Prev(^a)</td>
<td>88%</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
<td>96%</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Inc(^b) (Inc(^c))</td>
<td>62% (55%)</td>
<td>64% (64%)</td>
<td>54% (54%)</td>
<td>55% (55%)</td>
<td>57% (55%)</td>
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</tr>
<tr>
<td></td>
<td>Sev(^d)</td>
<td>1.7</td>
<td>1.3</td>
<td>1.2</td>
<td>1.4</td>
<td>1.5</td>
<td></td>
</tr>
<tr>
<td>Septoria Brown Spot</td>
<td>Prev(^a)</td>
<td>91%</td>
<td>100%</td>
<td>100%</td>
<td>87%</td>
<td>93%</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Inc(^b) (Inc(^c))</td>
<td>63% (57%)</td>
<td>74% (74%)</td>
<td>74% (74%)</td>
<td>17% (15%)</td>
<td>57% (54%)</td>
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</tr>
<tr>
<td></td>
<td>Sev(^d)</td>
<td>1.4</td>
<td>1.0</td>
<td>1.7</td>
<td>1.2</td>
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<td></td>
</tr>
<tr>
<td>Downy Mildew</td>
<td>Prev(^a)</td>
<td>18%</td>
<td>11%</td>
<td>38%</td>
<td>39%</td>
<td>23%</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Inc(^b) (Inc(^c))</td>
<td>15% (3%)</td>
<td>3% (0%)</td>
<td>23% (9%)</td>
<td>17% (7%)</td>
<td>16% (4%)</td>
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<tr>
<td></td>
<td>Sev(^d)</td>
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<tr>
<td>White Mold</td>
<td>Prev(^a)</td>
<td>0%</td>
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<td>0% (0%)</td>
<td>0% (0%)</td>
<td>0% (0%)</td>
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<td></td>
</tr>
<tr>
<td>Pod/Stem Blight</td>
<td>Prev(^a)</td>
<td>0%</td>
<td>0%</td>
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<td>3%</td>
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<tr>
<td></td>
<td>Inc(^b) (Inc(^c))</td>
<td>0% (0%)</td>
<td>5% (0%)</td>
<td>4% (1%)</td>
<td>0% (0%)</td>
<td>5% (0%)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sev(^d)</td>
<td>0%</td>
<td>7%</td>
<td>0%</td>
<td>0%</td>
<td>2%</td>
<td></td>
</tr>
<tr>
<td>Anthracnose</td>
<td>Inc(^b) (Inc(^c))</td>
<td>8% (0%)</td>
<td>0% (0%)</td>
<td>0% (0%)</td>
<td>0% (0%)</td>
<td>8% (0%)</td>
<td></td>
</tr>
<tr>
<td>Frogeye Leaf Spot</td>
<td>Prev(^a)</td>
<td>9%</td>
<td>14%</td>
<td>0%</td>
<td>22%</td>
<td>13%</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Inc(^b) (Inc(^c))</td>
<td>9% (1%)</td>
<td>6% (1%)</td>
<td>0% (0%)</td>
<td>5% (1%)</td>
<td>6% (1%)</td>
<td></td>
</tr>
</tbody>
</table>

\(^a\) Average percent prevalence across all fields surveyed.
\(^b\) Average percent incidence in infested fields.
\(^c\) Average percent incidence across all fields surveyed.
\(^d\) Average disease severity in infested fields.

### Table 2. Manitoba soybean disease survey results at the late survey timing (R6) in 2018.

<table>
<thead>
<tr>
<th>Disease</th>
<th>Rating</th>
<th>Region (no. fields)</th>
<th>Central (34)</th>
<th>Eastern/Interlake (29)</th>
<th>Northwest (9)</th>
<th>Southwest (24)</th>
<th>Manitoba (96)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bacterial Blight</td>
<td>Prev(^a)</td>
<td>100%</td>
<td>100%</td>
<td>89%</td>
<td>100%</td>
<td>99%</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Inc(^b) (Inc(^c))</td>
<td>77% (77%)</td>
<td>56% (56%)</td>
<td>76% (68%)</td>
<td>64% (64%)</td>
<td>67% (66%)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sev(^d)</td>
<td>2.0</td>
<td>1.2</td>
<td>1.6</td>
<td>1.4</td>
<td>1.6</td>
<td></td>
</tr>
<tr>
<td>Septoria Brown Spot</td>
<td>Prev(^a)</td>
<td>96%</td>
<td>86%</td>
<td>67%</td>
<td>89%</td>
<td>92%</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Inc(^b) (Inc(^c))</td>
<td>60% (57%)</td>
<td>84% (72%)</td>
<td>49% (33%)</td>
<td>50% (44%)</td>
<td>66% (58%)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sev(^d)</td>
<td>1.6</td>
<td>1.2</td>
<td>1.5</td>
<td>1.2</td>
<td>1.4</td>
<td></td>
</tr>
<tr>
<td>Downy Mildew</td>
<td>Prev(^a)</td>
<td>40%</td>
<td>17%</td>
<td>56%</td>
<td>23%</td>
<td>30%</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Inc(^b) (Inc(^c))</td>
<td>22% (9%)</td>
<td>52% (9%)</td>
<td>52% (29%)</td>
<td>44% (10%)</td>
<td>37% (11%)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sev(^d)</td>
<td>1.5</td>
<td>0.6</td>
<td>1.4</td>
<td>1.2</td>
<td>1.3</td>
<td></td>
</tr>
<tr>
<td>White Mould</td>
<td>Prev(^a)</td>
<td>0%</td>
<td>0%</td>
<td>33%</td>
<td>0%</td>
<td>3%</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Inc(^b) (Inc(^c))</td>
<td>0% (0%)</td>
<td>0% (0%)</td>
<td>8% (3%)</td>
<td>0% (0%)</td>
<td>8% (0%)</td>
<td></td>
</tr>
<tr>
<td>Pod/Stem Blight</td>
<td>Prev(^a)</td>
<td>6%</td>
<td>7%</td>
<td>0%</td>
<td>0%</td>
<td>4%</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Inc(^b) (Inc(^c))</td>
<td>3% (0%)</td>
<td>3% (0%)</td>
<td>0% (0%)</td>
<td>0% (0%)</td>
<td>3% (0%)</td>
<td></td>
</tr>
<tr>
<td>Anthracnose</td>
<td>Prev(^a)</td>
<td>3%</td>
<td>3%</td>
<td>0%</td>
<td>0%</td>
<td>2%</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Inc(^b) (Inc(^c))</td>
<td>12% (0%)</td>
<td>2% (0%)</td>
<td>0% (0%)</td>
<td>0% (0%)</td>
<td>7% (0%)</td>
<td></td>
</tr>
<tr>
<td>Frogeye Leaf Spot</td>
<td>Prev(^a)</td>
<td>59%</td>
<td>28%</td>
<td>11%</td>
<td>54%</td>
<td>44%</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Inc(^b) (Inc(^c))</td>
<td>8% (5%)</td>
<td>3% (1%)</td>
<td>2% (0%)</td>
<td>10% (6%)</td>
<td>8% (3%)</td>
<td></td>
</tr>
</tbody>
</table>

\(^a\) Average percent prevalence across all fields surveyed.
\(^b\) Average percent incidence in infested fields.
\(^c\) Average percent incidence across all fields surveyed.
\(^d\) Average disease severity in infested fields.
CROP: Sunflower
LOCATION: Manitoba

NAMES AND AGENCY:
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²Manitoba Agriculture, Crop Diagnostic Centre, 201-545 University Crescent, Winnipeg, MB R3T 5S6

TITLE: DISEASES OF SUNFLOWER IN MANITOBA IN 2018

ABSTRACT: A survey of 27 sunflower crops in Manitoba in 2018 revealed that sclerotinia wilt/basal stem rot was the most prevalent disease and was found in 82% of the crops followed by verticillium wilt in 78%, septoria leaf infections in 33%, sclerotinia head rot in 22%, rust in 11% and downy mildew in 7%. Disease severity was lower in 2018 than in previous years with no severe epidemics.

METHODS: A total of 27 sunflower crops were surveyed in 2018 in Manitoba during the last two weeks in August. The crops were surveyed along pre-planned routes in the major areas of sunflower production in southern Manitoba. Each crop was sampled by two persons walking ~100 m in opposite directions to each other following an "M" pattern in the field. Diseases were identified by symptoms and the percent incidences of downy mildew (Plasmopara halstedii), sclerotinia wilt or head and stem infections (Sclerotinia sclerotiorum), rhizopus head rot (Rhizopus spp.), and verticillium wilt (Verticillium dahliae) were estimated. Disease severity for rust (Puccinia helianthi), leaf spots (Septoria helianthi and Alternaria spp.), powdery mildew (Erysiphe cichoracearum) and stem diseases (Phoma spp. and Phomopsis spp.) were estimated as percent leaf or stem area infected. A disease index was calculated for each disease in every crop based on disease incidence or disease severity (Table 1). Stand establishment, vigour, and maturity were rated on a scale of 1 to 5 (I = very good/early, and 5 = very poor/very late).

In addition, seven samples of sunflower plants were submitted for analysis to the Crop Diagnostic Centre of Manitoba Agriculture by agricultural representatives and growers.

RESULTS AND COMMENTS: All the sunflower crops surveyed in 2018 had excellent to good stands, but only 74% had good vigour, and the rest had fair to poor vigor. Only 67% of the sunflower crops were early maturing, and the remaining 33% were late to very late (Table 1). The crops surveyed were split 70/30% between oilseed and confectionery hybrids, thus showing a steady decrease in the confection acreage in 2018 compared with previous years (Rashid et al. 2016, 2017, 2018). The 2018 growing season started with normal soil moisture with growers seeding shallow-rooted crops instead of sunflower and this contributed to the decrease in the area seeded to sunflower in Manitoba (~25,000 ha in 2018 in comparison with ~30,000 ha in 2016 (Statistics Canada 2018). Growing conditions were relatively dry throughout the growing season with below normal precipitation throughout the summer especially in July-August. Very low disease incidence and severity were observed in 2018 for all sunflower diseases especially for downy mildew and rust in comparison with previous years (Rashid et al. 2016, 2017, 2018).

Sclerotinia wilt/basal stem rot was present in 82% of the crops surveyed in 2018, mostly at trace to 5% disease incidence (Table 1). Sclerotinia head rot and mid-stem infections, caused by airborne ascospores, were observed at trace to 5% levels in most of the 22% of infested crops. The prevalence and incidence of both sclerotinia wilt and head rot in 2018 were similar to those in 2017 but lower than in previous years due perhaps to the below normal precipitation and above normal temperatures in July and August, 2018 (Rashid et al. 2016, 2017, 2018).

Rust was present in 11% of the crops surveyed, with severity ranging from trace to 5% leaf area affected in most fields but as high as 20% leaf area affected only in two crops (Table 1). Rust infections started relatively late in 2018 and did not develop rapidly in most of the crops surveyed. Preliminary analysis of the few rust isolates collected indicates the prevalence of race 737 of P. helianthi, which is virulent on most commercial sunflower hybrids. Rust incidence and severity in 2018 were similar to 2017 but lower than in previous years (Rashid et al. 2016, 2017, 2018), probably due to the late onset of infection and the above normal temperatures in July and August.
Verticillium wilt was present in 78% of the crops surveyed in 2018 with trace to 5% severity in the oilseed hybrids, and 10-40% severity in the confection sunflower hybrids (Table 1). The incidence and severity of verticillium wilt were similar in 2018 to the previous two years but lower than in 2015 (Rashid et al. 2016, 2017, 2018).

Downy mildew was observed in 7% of the crops in 2018, much lower than in previous years (Table 1). The incidence ranged from trace to 1%, a record low of downy mildew for the seventh year in a row due to the genetic resistance to this pathogen in present sunflower hybrids and the relatively dry soil conditions at the seedling stage (Rashid et al. 2016, 2017, 2018). Preliminary analysis of isolates collected indicates the presence of races 772, 762 and 742 with 100% resistance to metalaxyl seed treatment.

Traces to 5% leaf area infected by *Septoria helianthi* were observed in 33% of the crops as well as some infection by *Alternaria* spp. in a few crops (Table 1); these results are similar to those reported in 2017 but with higher severity and prevalence than in previous years (Rashid et al. 2016, 2017, 2018). Traces of stem lesions caused by *Phoma* spp. and *Phomopsis* spp. were observed in a few crops but levels were lower than in 2017 and previous years.

Traces to 1% infestations of the sunflower beetle (*Zygogramma exclamationis*) were observed in a few crops. Infestations at traces to 5% levels with sunflower midge (*Contarinia schulzi*) were encountered in 37% of the crops. Traces of infestation with grasshoppers were observed in 78% of the crops. Moderate infestations by aphids were encountered in 45% of the crops in 2018.

Of the seven samples submitted to the Manitoba Agriculture Crop Diagnostic Centre in 2018, two were affected by *Alternaria* spp., one by fusarium root rot, one by environmental stress, and three by herbicide injury.

REFERENCES:
Table 1. Prevalence and index of diseases in 27 crops of sunflower in Manitoba in 2018.

<table>
<thead>
<tr>
<th>Disease</th>
<th>Crops affected</th>
<th>Disease Index&lt;sup&gt;a&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No. of crops</td>
<td>% of crops</td>
</tr>
<tr>
<td>Sclerotinia wilt/basal stalk rot</td>
<td>22</td>
<td>82%</td>
</tr>
<tr>
<td>Sclerotinia head/stem rot</td>
<td>6</td>
<td>22%</td>
</tr>
<tr>
<td>Verticillium wilt</td>
<td>21</td>
<td>78%</td>
</tr>
<tr>
<td>Downy mildew</td>
<td>2</td>
<td>7%</td>
</tr>
<tr>
<td>Rust</td>
<td>3</td>
<td>11%</td>
</tr>
<tr>
<td>Leaf spot (&lt;i&gt;Septoria &amp; Alternaria&lt;/i&gt;)</td>
<td>9</td>
<td>33%</td>
</tr>
<tr>
<td>Phoma stem lesions</td>
<td>3</td>
<td>11%</td>
</tr>
<tr>
<td>Phomopsis stem lesions</td>
<td>1</td>
<td>4%</td>
</tr>
<tr>
<td>Lateness&lt;sup&gt;b&lt;/sup&gt;</td>
<td>9</td>
<td>33%</td>
</tr>
<tr>
<td>Poor stand</td>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td>Poor vigour</td>
<td>7</td>
<td>26%</td>
</tr>
</tbody>
</table>

<sup>a</sup>Disease index on a scale of T to 5: T (Trace) = < 1%, 1 = 1-5%, 2= 5-20%, 3= 20-40%, 4= 40-60% and 5= > 60% disease levels. Index is for disease incidence with downy mildew, verticillium wilt and sclerotinia. Disease severity for rust and leaf spots was measured as % leaf and stem area affected.

<sup>b</sup>Indexes for lateness, stand, and vigour are based on a 1-5 scale (1= early/very good and 5=very late / very poor).
VEGETABLES / LÉGUMES

CROP: Cabbage, Kale, Cauliflower
LOCATION: Sumas Prairie region of the Fraser Valley, British Columbia

NAMES AND AGENCIES:
R. R. Burlakoti¹, S. Grant² & R. Prasad²
¹Agassiz Research and Development Centre, Agriculture and Agri-Food Canada, 6947 Hwy#7, Agassiz, BC V0M 1A0
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²University of the Fraser Valley, 45300 Vimy Avenue, Chilliwack, BC, V2R 5X6

TITLE: DISEASES OF BRASSICA VEGETABLES IN THE BRITISH COLUMBIA FRASER VALLEY IN 2018

ABSTRACT: Eleven fields of brassica vegetables in the Sumas Prairie region of the BC Fraser Valley were monitored between the last week of May and mid-September 2018 to assess diseases of these crops. Several fungal diseases, such as alternaria leaf spot, downy mildew, white mold/sclerotinia rot and clubroot were observed. One bacterial disease, black rot (Xanthomonas spp.) was also found in cabbage.

METHODS: Eleven fields of brassica vegetable crops in the Sumas Prairie region of the BC Fraser Valley were monitored weekly between the last week of May and mid-September 2018 (Table 1). The crops included green, purple and savoy cabbage, kale and cauliflower. In each field, ~ 24-30 of total plants from 8-10 arbitrarily selected spots were monitored to assess diseases. The infected plant materials were sampled and processed in the laboratory to identify the causal agents.

RESULTS AND COMMENTS: Crops, names of diseases and causal agents are listed in Table 1. Alternaria leaf spot (Alternaria spp.) was most common foliar disease, observed in five cabbage and one cauliflower field. The disease was first observed during the first week of June and throughout the season thereafter, but the disease pressure was low. Downy mildew (Hyaloperonospora parasitica) was observed in four cabbage fields and one kale field. The disease was first detected in kale on June 5. The disease pressure was low to moderate. Black rot (Xanthomonas spp.) was observed in two cabbage fields during the first week of July and the final week of August. Among soil-borne diseases, sclerotinia rot (Sclerotinia sclerotiorum) was observed in two cabbage fields. The sclerotinia rot was first observed in the first week of August. A few patches of stunted plants were found in cabbage fields during the first two weeks of August. Examination of roots of those stunted plants confirmed clubroot symptoms.

ACKNOWLEDGEMENTS: Funding was provided for summer student S. Grant’s salary by the Lower Mainland Horticultural Improvement Fund, the Processing Vegetable Industry Development fund and the Brassica Levy Fund.
Table 1: Monitored fields and crops, and identified diseases of brassica vegetables in the Fraser Valley of British Columbia, 2018.

<table>
<thead>
<tr>
<th>Field no.</th>
<th>Crop</th>
<th>Date disease observed</th>
<th>Diseases identified</th>
<th>Causal agents</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Green Cabbage</td>
<td>July 4</td>
<td>Alternaria leaf spot</td>
<td>Alternaria spp.</td>
</tr>
<tr>
<td>2</td>
<td>Green Cabbage</td>
<td>August 8, August 8, 29</td>
<td>Clubroot, Sclerotinia rot, Downy mildew</td>
<td>Plasmodiophora brassicae, Sclerotinia sclerotiorum, Hylloperonospora parasitica, (Peronospora parasitica)</td>
</tr>
<tr>
<td>3</td>
<td>Green Cabbage</td>
<td>August 8, 22</td>
<td>Sclerotinia rot</td>
<td>Sclerotinia sclerotiorum</td>
</tr>
<tr>
<td>4</td>
<td>Green Savoy Cabbage</td>
<td>July 11</td>
<td>Downy mildew</td>
<td>Hylloperonospora parasitica, (Peronospora parasitica)</td>
</tr>
<tr>
<td>5</td>
<td>Kale</td>
<td>June 5, August 29</td>
<td>Downy mildew</td>
<td>Hylloperonospora parasitica, (Peronospora parasitica)</td>
</tr>
<tr>
<td>6</td>
<td>Purple and Green Cabbage</td>
<td>June 27</td>
<td>Alternaria leaf spot</td>
<td>Alternaria spp.</td>
</tr>
<tr>
<td>7</td>
<td>Purple cabbage</td>
<td>June 20</td>
<td>Downy mildew</td>
<td>Hylloperonospora parasitica, (Peronospora parasitica)</td>
</tr>
<tr>
<td>8</td>
<td>Green Cabbage</td>
<td>June 7, 12, 27, July 4</td>
<td>Alternaria leaf spot</td>
<td>Alternaria spp.</td>
</tr>
<tr>
<td>9</td>
<td>Cauliflower</td>
<td>July 4</td>
<td>Black rot</td>
<td>Xanthomonas spp.</td>
</tr>
<tr>
<td>10</td>
<td>Purple Cabbage</td>
<td>June 27</td>
<td>Alternaria leaf spot</td>
<td>Alternaria spp.</td>
</tr>
<tr>
<td>11</td>
<td>Green Savoy Cabbage</td>
<td>August 27</td>
<td>Black rot</td>
<td>Xanthomonas spp.</td>
</tr>
</tbody>
</table>
CROP: Wasabi
LOCATION: British Columbia

NAME AND AGENCY:
E.C. Betz, A.J. Roberts & Z.K. Punja
Simon Fraser University, Department of Biological Sciences, 8888 University Drive, Burnaby, BC V5A 1S6
Telephone: (778) 782-3090; Facsimile: (778) 782-3496; E-mail: punja@sfu.ca

TITLE: 2017 AND 2018 SURVEYS OF MICROBES ASSOCIATED WITH WASABI DISEASES IN BRITISH COLUMBIA GREENHOUSES

ABSTRACT: Six wasabi greenhouses in the Lower Mainland and Vancouver Island areas of British Columbia were surveyed for disease symptoms during the summers of 2017 and 2018. Disease symptoms were observed at low to moderate levels, depending on the greenhouse sampled. Over the two years, 86 symptomatic plants were collected and a total of 16 potential pathogens were identified, including 12 fungi, 1 oomycete, 2 bacteria, and 1 virus.

INTRODUCTION AND METHODS: A survey of fungal pathogens on wasabi (Wasabia japonica syn. Eutrema japonicum) was conducted from May to August in 2017 and 2018. A total of 86 plant samples were taken from six greenhouses in British Columbia – four in the Lower Mainland (Abbotsford, Burnaby and Surrey) and two on Vancouver Island (Sooke and Sointula). Diseased tissues were surface-sterilized in 0.4% sodium hypochlorite (commercial bleach) for 20 s, followed by 70% ethanol for 20 s, then rinsed with sterile distilled water. Microbes were then isolated by plating tissues onto potato dextrose and vegetable juice (V-8) agars with 100 mg/mL streptomycin sulfate. Microbes of interest were identified by microscopic and macroscopic features. Fungal species were further identified through sequencing of the ITS1-5.8S-ITS2 rDNA region using primers UN-UP18S42 (5’-CGTAACAAGGTTTCCGTAAGTGAAC-3’) and UN-LO28S22 (5’-GTTCCTTTTTCCCTCGCTTATGATG-3’). Bacterial species were further identified using MicroLog®. Obligate pathogens were identified based on morphological features and disease symptoms.

RESULTS AND COMMENTS: In 2017, 42 plant samples were collected from which nine potential fungal pathogens, as well as one oomycete, two bacterial pathogens, and one virus were identified. In 2018, 44 plant samples were collected from which 12 potential fungal pathogens, as well as one oomycete, two bacterial pathogens, and one virus were identified. Several diseases previously reported on wasabi were isolated over the two survey years and confirmed (Table 1) (Rodríguez & Punja 2007, 2009; MacDonald & Punja 2016; Park et al. 2016; Punja et al. 2016; Betz & Punja 2018). Moderate to severe levels of powdery mildew infection were recorded at half of the locations surveyed (Betz & Punja 2018). Phoma leaf spot was recorded in moderate levels in three of six greenhouses. Root rot, thought to be caused in part by Fusarium species, was also found at low levels across locations. Bacterial soft rot was also present in low levels across multiple greenhouses. Multiple species that have phytopathogenic capability were also isolated (Table 2). Pathogenicity of these species will need to be confirmed in further studies through Koch’s Postulates.

ACKNOWLEDGMENTS: We thank Dr. Laila Benkrima, Your Wasabi Farms Ltd., for assisting in sample collections and Dr. Siva Sabaratnam, B.C. Ministry of Agriculture, for providing pathogen cultures for comparison. Funding for this survey was provided by Growing Forward 2 (URAGF-406), a federal-provincial-territorial initiative.
REFERENCES:

<table>
<thead>
<tr>
<th>Crop</th>
<th>Disease/Symptom</th>
<th>Causl organism</th>
<th>No. of samples (2017)</th>
<th>No. of samples (2018)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wasabi</td>
<td>Crown rot, leaf blight</td>
<td><em>Botrytis cinerea</em></td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td><em>(Wasabia japonica)</em></td>
<td>Anthracnose</td>
<td><em>Colletotrichum higginsianum</em></td>
<td>-</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Powdery mildew</td>
<td><em>Erysiphe cruciferarum</em></td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Leaf spot, vascular blackening</td>
<td><em>Leptosphaeria biglobosa</em></td>
<td>6</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>White rust</td>
<td><em>Albugo candida</em></td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Soft rot</td>
<td><em>Pectobacterium carotovorum</em></td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Ringspots, leaf mottle</td>
<td><em>Wasabi Mottle Virus</em></td>
<td>6</td>
<td>4</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Crop</th>
<th>Disease/Symptom</th>
<th>Possible associated organism</th>
<th>No. of samples (2017)</th>
<th>No. of samples (2018)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wasabi</td>
<td>Root rot, wilt</td>
<td><em>Acremonium sclerotigenum</em></td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td><em>(Wasabia japonica)</em></td>
<td>Leaf spot</td>
<td><em>Alternaria tenuissima</em></td>
<td>-</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Root rot, blight</td>
<td><em>Drechslera dematioides</em></td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Root rot, wilt</td>
<td><em>Fusarium avenaceum</em></td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Root rot, wilt</td>
<td><em>Fusarium oxysporum</em></td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Root rot, wilt</td>
<td><em>Plectosphaerella cucumerina</em></td>
<td>3</td>
<td>3</td>
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<tr>
<td></td>
<td>Wilt, vascular blackening</td>
<td><em>Verticillium isacii</em></td>
<td>5</td>
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<tr>
<td></td>
<td>Leaf spot</td>
<td><em>Stemphylium vesicatorum</em></td>
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<tr>
<td></td>
<td>Soft rot</td>
<td><em>Pseudomonas marginalis</em></td>
<td>5</td>
<td>1</td>
</tr>
</tbody>
</table>
CROP: Carrot (Daucus carota)
LOCATION: Ontario

NAMES AND AGENCIES:
T. Blauel¹, D. Van Dyk², K. Vander Kooi¹, Q. Yu³ & M.R. McDonald¹
¹University of Guelph, Dept. of Plant Agriculture, Muck Crops Research Station
²Ontario Ministry of Agriculture, Food and Rural Affairs, Guelph, ON
³Agriculture and Agri-Food Canada, Ottawa, ON

TITLE: THE DISTRIBUTION OF CARROT CYST NEMATODE IN COMMERCIAL CARROT FIELDS IN ONTARIO, CANADA IN 2018

ABSTRACT: Heterodera carotae (carrot cyst nematode) was recently identified in carrot fields in the Holland Marsh, Ontario, Canada for the first time. Heterodera carotae parasitism on carrots causes stunting and forking resulting in unmarketable carrots. In 2018, a survey was conducted to examine the distribution of this nematode in the Holland Marsh and other carrot-growing counties in Ontario. Soil samples were collected from 20 carrot fields in six counties of Ontario. Heterodera carotae nematodes were identified in 11 of 20 soil samples and found in two counties in Ontario.

INTRODUCTION: Heterodera carotae Jones, 1950 (carrot cyst nematode) is a plant-parasitic nematode that is known to parasitize commercial and wild carrot (Daucus carota L.) (Greco 1986). The nematode is known to be present in Europe and Michigan, U.S.A. (Graney 1985; Greco 1986). Recently, the nematode was identified and found to be prevalent in carrot fields in the Holland Marsh, Ontario (Yu et al. 2017). Parasitism by this nematode causes stunting and forking, rendering the carrot unmarketable (Greco 1986). In 2017, Ontario produced 180,601 tonnes of carrots with a farmgate value of ~$45 million (OMAFRA 2018). In the Holland Marsh, H. carotae is believed to be responsible for upwards of 35% yield loss in some fields (Yu et al. 2017). The distribution of H. carotae in other commercial carrot-growing counties in Ontario is unknown.

METHODS: Soil samples were collected from 20 carrot fields throughout carrot-growing counties in Ontario. Three fields were located in Simcoe, 10 in York, 2 in Lambton, 2 in Middlesex, 2 in Essex, and 1 in Chatham-Kent County. Both muck (organic) and mineral soils used to grow carrots were surveyed. Carrot fields were surveyed in an "X" pattern, collecting the bottom 6" of soil from an 8" soil core. Heterodera carotae juveniles and males were extracted from the soil using the Baermann pan method. Female (cyst) Heterodera carotae nematodes were extracted using the Fenwick method. Nematodes were examined and identified morphologically to genus using a stereo microscope. Soil samples were sent to the University of Guelph Laboratory Services for sequencing to confirm the Heterodera species present in the soil.

RESULTS AND DISCUSSION: Heterodera carotae nematodes were found in two of the six counties surveyed (Table 1). High populations of H. carotae nematodes were found in York and Simcoe counties (Table 2).

Heterodera carotae is present and widespread in the muck soils of carrot fields located in York and Simcoe county, including the Holland Marsh and Keswick Marsh. To date, Heterodera carotae has not been found in any mineral soil carrot field in Ontario.

REFERENCES:
Table 1. Percentage of field soils infested with *Heterodera carotae* in six Ontario counties in 2018.

<table>
<thead>
<tr>
<th>County</th>
<th>No. of fields sampled</th>
<th>% of fields infested with <em>Heterodera carotae</em></th>
</tr>
</thead>
<tbody>
<tr>
<td>York</td>
<td>10</td>
<td>80</td>
</tr>
<tr>
<td>Simcoe</td>
<td>3</td>
<td>100</td>
</tr>
<tr>
<td>Middlesex</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Lambton</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Essex</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Chatham-Kent</td>
<td>1</td>
<td>0</td>
</tr>
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</table>

Table 2. Populations of female (cyst), juvenile and male *Heterodera carotae* nematodes extracted from 20 field soils in six Ontario counties in 2018.

<table>
<thead>
<tr>
<th>County</th>
<th>Soil type</th>
<th><em>Heterodera carotae</em> nematodes per kg of dry soil</th>
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</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Females (Cysts)</td>
</tr>
<tr>
<td>York</td>
<td>Muck</td>
<td>6420</td>
</tr>
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<td>York</td>
<td>Muck</td>
<td>5958</td>
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<tr>
<td>York</td>
<td>Muck</td>
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<td>York</td>
<td>Muck</td>
<td>1522</td>
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<tr>
<td>York</td>
<td>Muck</td>
<td>1019</td>
</tr>
<tr>
<td>York</td>
<td>Muck</td>
<td>815</td>
</tr>
<tr>
<td>York</td>
<td>Muck</td>
<td>666</td>
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<td>Muck</td>
<td>0</td>
</tr>
<tr>
<td>York</td>
<td>Mineral</td>
<td>0</td>
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<tr>
<td>York</td>
<td>Mineral</td>
<td>0</td>
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<td>0</td>
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<tr>
<td>Essex</td>
<td>Mineral</td>
<td>0</td>
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<tr>
<td>Essex</td>
<td>Mineral</td>
<td>0</td>
</tr>
<tr>
<td>Chatham-Kent</td>
<td>Mineral</td>
<td>0</td>
</tr>
</tbody>
</table>
CROP: Carrot and Onion
LOCATION: Bradford / Holland Marsh, Ontario

NAMES AND AGENCY:
Z. Telfer & M.R. McDonald
Muck Crops Research Station, University of Guelph, 1125 Woodchoppers Lane, King, ON L7B 0E9
Telephone: (905) 775-3783; E-mail: ztelfer@uoguelph.ca; www.uoguelph.ca/muckcrop/

TITLE: DISEASES IDENTIFIED IN ONION AND CARROT FIELDS SURVEYED IN THE HOLLAND MARSH IN 2018

ABSTRACT: As part of the Integrated Pest Management (IPM) program provided by the Muck Crops Research Station (MCRS) in Holland Marsh / Bradford, Ontario, commercial onion and carrot fields were monitored throughout the entire season and surveyed for diseases prior to harvest. In 2018, 28 onion fields and 23 carrot fields were included in the MCRS IPM program. At harvest, ten plants were randomly sampled from ten locations throughout each field by MCRS IPM scouts.

INTRODUCTION AND METHODS: As part of the Integrated Pest Management program, the plant disease diagnostic laboratory of the Muck Crops Research Station (MCRS) provides scouting of onion and carrot fields in and around the Holland Marsh region. Trained scouts examine fields belonging to participating growers twice weekly throughout the growing season. Just prior to harvest, ten plants from ten random locations in each field are assessed for disease presence on the roots or bulbs.

RESULTS AND COMMENTS: In 2018, 28 onion and 23 carrot fields were scouted. Compared to the previous 10-year average, air temperatures in 2018 were above average for May (15.8°C), August (21.9°C) and September (17.5°C), average for June (18.4°C) and July (22.0°C) and below average for October (8.3°C). Monthly rainfall was above the 10-year average for August (109 mm), average for May (82 mm), July (104 mm) and October (69 mm) and below average for June (59 mm) and September (20 mm). A summary of the diseases identified in the scouted carrot and onion fields in 2018 is presented in Table 1. Carrot roots were predominately affected by common diseases in the region: cavity spot and crater rot. Forked or split carrots were ubiquitous across fields; these symptoms can be caused by nematodes, or abiotic factors within the field. The weather was conducive for downy mildew on onion to occur, however this disease was not seen in any scouted fields. White rot was the most damaging disease identified on onion bulbs in 2018. Stemphylium leaf blight was ubiquitous across all onion fields scouted. Although foliar diseases such as Stemphylium leaf blight and purple blotch can cause yield loss, yield loss is difficult to quantify in the field and severity ratings are not presented.

ACKNOWLEDGEMENTS: Funding was provided in part by the Bradford Cooperative Storage Ltd., agrochemical companies and growers participating in the Muck Crops Research Station IPM program.
Table 1. Diseases identified during field surveys in carrot and onion fields in the Holland Marsh, 2018.

<table>
<thead>
<tr>
<th>Crop</th>
<th>Disease</th>
<th>Causal agent</th>
<th>Incidence(^a) (%)</th>
<th>Range of severity(^b) (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carrot</td>
<td>Cavity spot</td>
<td><em>Pythium</em> spp.</td>
<td>74</td>
<td>1-14</td>
</tr>
<tr>
<td></td>
<td>Fusarium dry rot</td>
<td><em>Fusarium</em> spp.</td>
<td>9</td>
<td>2-3</td>
</tr>
<tr>
<td></td>
<td>Crater rot</td>
<td><em>Rhizoctonia</em> spp.</td>
<td>52</td>
<td>1-19</td>
</tr>
<tr>
<td></td>
<td>Crown gall</td>
<td><em>Agrobacterium tumefaciens</em></td>
<td>49</td>
<td>1-12</td>
</tr>
<tr>
<td></td>
<td>Aster yellows</td>
<td>phytoplasma</td>
<td>9</td>
<td>1-2</td>
</tr>
<tr>
<td></td>
<td>Forking / split</td>
<td><em>Heterodera carotae</em> and</td>
<td>100</td>
<td>1-44</td>
</tr>
<tr>
<td></td>
<td>Nematode damage</td>
<td><em>Meloidogyne hapla</em></td>
<td>65</td>
<td>1-24</td>
</tr>
<tr>
<td>Onion</td>
<td>White rot</td>
<td><em>Sclerotium cepivorum</em></td>
<td>25</td>
<td>1-12</td>
</tr>
<tr>
<td></td>
<td>Bacterial rot / soft rot</td>
<td><em>Pectobacterium carotovorum</em></td>
<td>11</td>
<td>1-3</td>
</tr>
<tr>
<td></td>
<td>Smut</td>
<td><em>Urocystis cepulae</em></td>
<td>21</td>
<td>1-5</td>
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<tr>
<td></td>
<td>Stemphylium leaf blight</td>
<td><em>Stemphylium vesicarium</em></td>
<td>100</td>
<td>n/d</td>
</tr>
<tr>
<td></td>
<td>Purple blotch</td>
<td><em>Alternaria porri</em></td>
<td>7</td>
<td>n/d</td>
</tr>
</tbody>
</table>

\(^a\) Incidence refers to the percent of fields in which the disease was found.

\(^b\) Range of severity refers to the degree to which roots or bulbs of the crop were affected at harvest.

n/d = no data
ABSTRACT: Phytophthora fruit rot (Phytophthora capsici Leonian) is a destructive disease of tomato (Solanum lycopersicum L.). Processing tomato fields in Essex County, Ontario, were surveyed to determine the prevalence of P. capsici in the region. Phytophthora capsici was widespread on green and red fruit and detected in 87% of fruit and 93% of fields sampled.

RESULTS AND COMMENTS: Buckeye rot, soft rot and mycelial growth with sporulation were common and P. capsici was present in 87% of fruit tested (Table 1, Figure 1). Fruit from thirteen of fourteen sites had at least one fruit test positive for P. capsici. At some locations, dead and dying plants with characteristic symptoms of phytophthora crown and root rot were observed (Figure 1). Fusarium spp., Pythium spp., and other Phytophthora spp. were also commonly identified in samples (Table 1).

ACKNOWLEDGEMENTS: The Ontario Tomato Research Institute and the Ontario Ministry of Agricultural, Food and Rural Affairs provided funding.

Table 1. Pathogens detected in processing tomato fruit in Essex County, Ontario, 2018.

<table>
<thead>
<tr>
<th>Item</th>
<th>P. capsici</th>
<th>Other Phytophthora spp.</th>
<th>Pythium spp.</th>
<th>Fusarium oxysporum</th>
<th>Fusarium solani</th>
</tr>
</thead>
<tbody>
<tr>
<td>Samples (n = 30)</td>
<td>87</td>
<td>13</td>
<td>97</td>
<td>87</td>
<td>80</td>
</tr>
<tr>
<td>Sites (n = 14)</td>
<td>93</td>
<td>29</td>
<td>100</td>
<td>93</td>
<td>86</td>
</tr>
<tr>
<td>Green fruit (n = 17)</td>
<td>88</td>
<td>12</td>
<td>100</td>
<td>94</td>
<td>94</td>
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<tr>
<td>Red fruit (n = 13)</td>
<td>85</td>
<td>15</td>
<td>92</td>
<td>77</td>
<td>62</td>
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<tr>
<td>Buckeye rot (n = 21)</td>
<td>86</td>
<td>19</td>
<td>100</td>
<td>95</td>
<td>90</td>
</tr>
<tr>
<td>Soft rot (n = 18)</td>
<td>83</td>
<td>11</td>
<td>94</td>
<td>83</td>
<td>72</td>
</tr>
<tr>
<td>White sporulation (n = 13)</td>
<td>85</td>
<td>15</td>
<td>100</td>
<td>100</td>
<td>100</td>
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</table>
Fig. 1. Fruit rot symptoms observed in Essex County processing tomato fields including a) crown rot, b), buckeye rot, c) and d) soft rot and white mycelial growth.
<table>
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<th>Page 1</th>
<th>Name</th>
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<tr>
<td>Kim, Y.M.</td>
<td>210, 213, 216, 228</td>
<td>Rioux, S.</td>
<td>109</td>
</tr>
<tr>
<td>Kindrachuk, K.</td>
<td>195, 200, 204, 226</td>
<td>Roberts, A.J.</td>
<td>239</td>
</tr>
<tr>
<td>Kirby, I.</td>
<td>231</td>
<td>Roberts, S.</td>
<td>195, 200, 204, 228</td>
</tr>
<tr>
<td>Klein-Gibbinck, H.</td>
<td>135</td>
<td>Roszell, L.</td>
<td>200</td>
</tr>
<tr>
<td>Kristjanson, I.</td>
<td>219</td>
<td>Sarkes, A.</td>
<td>24, 155</td>
</tr>
<tr>
<td>Kumar, K.</td>
<td>89, 131, 135</td>
<td>Schmidt, L.</td>
<td>231</td>
</tr>
<tr>
<td>Kutzer, H.R.</td>
<td>85, 94, 101, 107, 124, 138, 226</td>
<td>Senko, S.</td>
<td>195</td>
</tr>
<tr>
<td>Kwasnicki, J.</td>
<td>200</td>
<td>Shallow, N.</td>
<td>56</td>
</tr>
<tr>
<td>Lageyre, J.</td>
<td>160</td>
<td>Shan, X.</td>
<td>42</td>
</tr>
<tr>
<td>Lange, D.</td>
<td>219, 231</td>
<td>Simpson, E.</td>
<td>200</td>
</tr>
<tr>
<td>Larkan, N.J.</td>
<td>195</td>
<td>Sliva, T.</td>
<td>29, 81, 121</td>
</tr>
<tr>
<td>Lewick, M.</td>
<td>219</td>
<td>Sommerville, R.</td>
<td>195</td>
</tr>
<tr>
<td>Liew, A.G.</td>
<td>124</td>
<td>Stevenson, L.</td>
<td>216, 228, 231</td>
</tr>
<tr>
<td>Lokuruge, P.</td>
<td>126</td>
<td>Stonehouse, K.</td>
<td>195, 200</td>
</tr>
<tr>
<td>MacLeod, A.</td>
<td>78</td>
<td>Strelkov, S.E.</td>
<td>131, 160, 171</td>
</tr>
<tr>
<td>Makohonuk, K.</td>
<td>200</td>
<td>Sweetman, G.</td>
<td>29</td>
</tr>
<tr>
<td>Manolii, V.P.</td>
<td>160</td>
<td>Telfer, Z.</td>
<td>54, 243</td>
</tr>
<tr>
<td>McCallum, B.</td>
<td>119</td>
<td>Tenuta, A.U.</td>
<td>143</td>
</tr>
<tr>
<td>McCracken, M.</td>
<td>219</td>
<td>Tesfaendrias, M.T.</td>
<td>75</td>
</tr>
<tr>
<td>McLaren, D.L.</td>
<td>210, 213, 216, 219, 228</td>
<td>Tetzlaff, T.</td>
<td>164</td>
</tr>
<tr>
<td>McConnell, C.L.</td>
<td>155</td>
<td>Thompson, M.J.</td>
<td>216</td>
</tr>
<tr>
<td>McDonald, M.R.</td>
<td>54, 241, 243</td>
<td>Tkachuk, C.</td>
<td>216, 228, 231</td>
</tr>
<tr>
<td>McNabb, W.</td>
<td>119</td>
<td>Trueeman, C.L.</td>
<td>245</td>
</tr>
<tr>
<td>Melzer, M.</td>
<td>42</td>
<td>Turkington, T.K.</td>
<td>87</td>
</tr>
<tr>
<td>Mendoza, E.</td>
<td>219</td>
<td>Turnbull, G.D.</td>
<td>171</td>
</tr>
<tr>
<td>Menzies, J.G.</td>
<td>98, 138</td>
<td>Ursu, K.</td>
<td>200</td>
</tr>
<tr>
<td>Minshull, H.</td>
<td>219</td>
<td>Valentino, M.</td>
<td>219</td>
</tr>
<tr>
<td>Miranda, D.</td>
<td>111, 113, 115, 117</td>
<td>Van Dyk, D.</td>
<td>241</td>
</tr>
<tr>
<td>Mitchell, L.</td>
<td>219</td>
<td>Vander Kooi, K.</td>
<td>241</td>
</tr>
<tr>
<td>Molina, O.</td>
<td>119</td>
<td>Vandermeulen, E.</td>
<td>219</td>
</tr>
<tr>
<td>Nameth, V.</td>
<td>151</td>
<td>Van Humbeck, C.</td>
<td>219</td>
</tr>
<tr>
<td>Neisz, D.</td>
<td>200</td>
<td>Vicurevich, C.</td>
<td>166</td>
</tr>
<tr>
<td>Noble, A.</td>
<td>195, 200</td>
<td>Vivancos, J.</td>
<td>56</td>
</tr>
<tr>
<td>Nuga, B.</td>
<td>219</td>
<td>Waechli, F.</td>
<td>126, 200</td>
</tr>
<tr>
<td>Nyandoro, R.</td>
<td>131, 171</td>
<td>Wang, X.</td>
<td>83, 96, 105</td>
</tr>
<tr>
<td>Olson, B.D.</td>
<td>177, 182, 189</td>
<td>Wang, Y.</td>
<td>24</td>
</tr>
<tr>
<td>Penner, W.C.</td>
<td>210, 213, 226, 228, 234</td>
<td>Wangman, B.</td>
<td>195</td>
</tr>
<tr>
<td>Peru, C.</td>
<td>81, 121, 126, 151, 195, 200, 204, 226</td>
<td>Ward, W.</td>
<td>195</td>
</tr>
<tr>
<td>Phelps, S.</td>
<td>177, 182, 189</td>
<td>Waterman, S.</td>
<td>89</td>
</tr>
<tr>
<td>Picard, R.</td>
<td>219</td>
<td>Wiens, J.</td>
<td>124</td>
</tr>
<tr>
<td>Piderbsky, E.</td>
<td>195</td>
<td>Wigness, M.</td>
<td>228</td>
</tr>
<tr>
<td>Podolsky-MacMillan, K.</td>
<td>231</td>
<td>Wu, L.F.</td>
<td>171</td>
</tr>
<tr>
<td>Popovic, Z.</td>
<td>98, 138</td>
<td>Xi, K.</td>
<td>89, 131, 135</td>
</tr>
<tr>
<td>Pradhman, M.P.</td>
<td>35, 219, 226, 234</td>
<td>Xue, A.G.</td>
<td>91, 98, 103, 140</td>
</tr>
<tr>
<td>Prasad, R.</td>
<td>237</td>
<td>Yang, Y.</td>
<td>24</td>
</tr>
<tr>
<td>Prasad, T.</td>
<td>189</td>
<td>Yu, Q.</td>
<td>241</td>
</tr>
<tr>
<td>Pugh, C.A.</td>
<td>155</td>
<td>Zahr, K.</td>
<td>24, 155</td>
</tr>
<tr>
<td>Punja, Z.K.</td>
<td>239</td>
<td>Zegeye, T.</td>
<td>120</td>
</tr>
<tr>
<td>Rauhala, N.E.</td>
<td>87</td>
<td>Zhou, Q.</td>
<td>24</td>
</tr>
<tr>
<td>Rashid, K.Y.</td>
<td>226, 234</td>
<td>Zhu, X.</td>
<td>143</td>
</tr>
<tr>
<td>Reich, J.D.</td>
<td>164</td>
<td>Ziesman, B.</td>
<td>29, 81, 121, 126, 177, 182, 189, 195, 200, 204, 226</td>
</tr>
<tr>
<td>Reid, L.M.</td>
<td>143</td>
<td>24, 155</td>
<td></td>
</tr>
<tr>
<td>Reid, P.</td>
<td>19</td>
<td>Zuzak, K.</td>
<td>24, 155</td>
</tr>
<tr>
<td>Reimer, E.</td>
<td>119</td>
<td></td>
<td>124</td>
</tr>
</tbody>
</table>
LIST OF FIGURES / LISTE DE FIGURES

Soil zone and crop district map with common (blue) and durum (red) wheat fields surveyed across Saskatchewan in 2018 ................................................................. 128

Three month (May 7-July 31) percent of average precipitation. Normal precipitation based on 1981-2010 (Agriculture and Agri-Food Canada 2018) ................................................................. 130

Heavily infected wheat crop with many ergots near Fort Saskatchewan, AB in 2018 .......................... 134

A map showing the level of infection in surveyed fields in 2018, 2017, and 2016 ........................................ 135

2018 Ontario corn diseases survey sampling sites indicated by blue circles ........................................ 147

The location and severity of blackleg symptoms in 339 Alberta canola fields in 2018 .......................... 159

The occurrence of clubroot on canola in Alberta as of November 2018. Since the start of clubroot surveillance in 2003, the disease has been confirmed in a total of 3044 fields representing 40 counties and municipal districts in the province, as well as in rural areas of the cities of Edmonton and Medicine Hat, and the Town of Stettler ................................................................. 163

Total accumulation of precipitation in Alberta from June 11 to July 10, 2018 ........................................ 170

Soybean plants affected by severe root rot in low lying areas and exhibiting premature yellowing near Lamont, Alberta, in 2018. Plants in the upland areas are green and healthier ........................................ 173

Location of 17 soybean disease survey sites in Alberta, 2018 ................................................................. 175

Foliar infections on soybean including bacterial blight symptoms and septoria brown spot symptoms ......... 176

Distribution of the clubroot pathogen in Saskatchewan from 2008 to 2018 ........................................... 203

Fruit rot symptoms observed in Essex County processing tomato fields including crown rot, buckeye rot, soft rot and white mycelial growth ................................................................. 246