2017

THE CANADIAN PHYTOPATHOLOGICAL SOCIETY

CANADIAN PLANT DISEASE SURVEY

DISEASE HIGHLIGHTS

SOCIÉTÉ CANADIENNE DE PHYTOPATHOLOGIE

INVENTAIRE DES MALADIES DES PLANTES AU CANADA

APERÇU DES MALADIES

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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Contents: **DISEASE HIGHLIGHTS** - 2016 GROWING SEASON
(+ earlier years for historical significance)

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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

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 ou à Phytoprotection.

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Diagnostic Laboratories /Laboratoires Diagnostiques

CROP / CULTURE: Commercial Crops – Plant Health Laboratory Report
LOCATION / RĖGION: British Columbia

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TITLE: DISEASES/SYMPTOMS DIAGNOSED ON COMMERCIAL CROPSAMPLES SUBMITTED TO THE BRITISH COLUMBIA MINISTRY OF AGRICULTURE (BCAGRI) PLANT HEALTH LABORATORY IN 2016

ABSTRACT: The B.C. Ministry of Agriculture 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, 2016, the laboratory received 915 samples of Christmas trees, field crops, greenhouse vegetable and floriculture crops, forest seedling, herbaceous and woody ornamentals, small fruit, tree fruit, nuts and specialty crops for diagnosis. No significantly noticeable or unusually high level of any disease was detected in the samples.

METHODS: The B.C. Ministry of Agriculture 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. The following data reflect samples 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 immuno sorbent assay (ELISA). Molecular techniques (polymerase chain reactions (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, 2016 was an average year for B.C. in terms of rainfall and sunshine. The laboratory received a total of 915 samples between January 1 and November 30, 2016. Forest nursery seedling and field vegetable samples especially garlic submissions (seed growers) were significantly higher than previous years. Summaries of diseases and their causal agents diagnosed on crop samples submitted to the laboratory are presented in the following tables (1 to13) organized under crop category. Under each table, the total number of samples submitted includes abiotic disorders such as nutritional stress, pH imbalance, water stress, drought stress, physiological response to growing conditions, genetic abnormalities, environmental and chemical stresses including herbicide damage, fruit abortion due to lack of pollination, insects and insect-related injury and damage where no conclusive causal factor was identified.

Table 1. Diseases/disorders detected in **Christmas tree** samples submitted to the BCAGRI Plant Health Laboratory between January 1 and November 30, 2016.

CROP	DISEASE / DISORDER	CAUSAL / ASSOCIATED ORGANISM	NUMBER OF SAMPLES
Abies spp.	Needle blight	*Rhizosphaera kalkhoffii*	2
	Twig canker	*Phomopsis* sp.	1

Total number of samples = 3

Table 2. Diseases/disorders detected in **field crop** samples submitted to the BCAGRI Plant Health Laboratory between January 1 and November 30, 2016.

CROP	DISEASE / DISORDER	CAUSAL / ASSOCIATED ORGANISM	NUMBER OF SAMPLES
Forage crop	Nematode damage	*Pratylenchus* sp. and *Meloidogyne* sp.	1
Soybean	Seed rot	*Alternaria* sp.	1

Total number of samples = 4

Table 3. Diseases/disorders detected in **greenhouse floriculture** samples submitted to the BCAGRI Plant Health Laboratory between January 1 and November 30, 2016.

CROP	DISEASE / DISORDER	CAUSAL / ASSOCIATED ORGANISM	NUMBER OF SAMPLES
Carex sp.	Anthracnose	*Colletotrichum* sp.	1
Celosia	Fusarium stem rot	*Fusarium* sp.	1
	Root rot	*Pythium* sp.	1
	Stem rot	*Phoma* sp.	1
Chamaerops humilis	Anthracnose	*Colletotrichum gloeosporioides*	1
Chrysanthemum	Fusarium wilt	*Fusarium oxysporum* f.sp. *chrysanthemi*	1
Eustoma grandiflorum	Fusarium crown/stem rot	*Fusarium avenaceum*	1
	Pythium root rot	*Phythium* sp.	1
Hosta	Crown/stem rot	*Botrytis cinerea*	1
Hydrangea	Leaf spot	*Cladosporium* sp.	1
	Leaf spot and stem rot	*Ascochyta hyndrangea*	1
Lavandula sp.	Botrytis blight	*Botrytis cinerea*	2
Lobelia	Leaf spot	*Mycovellosiella* sp.	1
Narcissus	Nematode damage	*Ditylenchus* sp.	1
Petunia	Powdery mildew	*Podosphaera xanthii*	1
Sedum	Leaf spot	*Cladosporium* sp.	3
		Phyllosticta sp.	1
	Powdery mildew	*Erysiphe* sp.	1
Senecio cineraria	Phytophthora root rot	*Phytophthora* sp.	1
	Thielaviopsis root rot	*Thielaviopsis basicola*	1

Total number of samples submitted to the lab = 37

Table 4. Diseases/disorders detected in **forest nursery samples** submitted to the BCAGRI Plant Health Laboratory during between January 1 and November 30, 2016.

CROP	DISEASE / DISORDER	CAUSAL / ASSOCIATED ORGANISM	NUMBER OF SAMPLES
Abies spp.	Fusarium root rot	*Fusarium* sp.	2
Larix spp.	Botrytis blight	*Botrytis cinerea*	2
	Cylindrocarpon root rot	*Cylindrocarpon* sp.	1
	Fusarium root rot	*Fusarium* sp.	1
	Pythium root rot	*Pythium* sp.	1
Picea spp.	Fusarium root rot	*Fusarium* sp.	2
	Rhizoctonia blight	*Rhizoctonia solani*	1
Picea glauca	Cylindrocarpon root rot	*Cylindrocarpon* sp.	2
	Fusarium root rot	*Fusarium* sp.	4
		Fusarium proliferatum	1
	Phoma blight	*Phoma* sp.	1
	Rhizoctonia root rot	*Rhizoctonia* sp.	1
	Root colonization	*Basidiomycete*	3
	Thielaviopsis root rot	*Thielaviopsis basicola*	1
Pinus spp.	Cylindrocarpon root rot	*Cylindrocarpon* sp.	6
	Fusarium root rot	*Fusarium* sp.	2
	Pythium root rot	*Pythium* sp.	1
	Thielaviopsis root rot	*Thielaviopsis basicola*	2
Pinus contorta	Botrytis blight	*Botrytis cinerea*	1
	Cylindrocarpon root rot	*Cylindrocarpon* sp.	1
	Foliar blight	*Diplodia pinea*	4
	Needle blight	*Cytospora* sp.	1
		Sirococcus sp. and *Diplodia* sp.	1
	Phoma blight	*Phoma* sp.	2
	Pythium root rot	*Pythium* sp.	2
	Sirococcus blight	*Sirococcus strobilinus*	2
Pinus monticola	Botrytis blight	*Botrytis cinerea*	2
	Cylindrocarpon root rot	*Cylindrocarpon* sp.	23
	Foliar blight	*Alternaria* sp.	1
	Fusarium root rot	*Fusarium* sp.	13
		Fusarium proliferatum	7
	Needle blight	*Lophodermium pinastri*	2
	Phoma blight	*Phoma* sp.	5
	Phomopsis blight	*Phomopsis* sp.	2
	Pythium root rot	*Pythium* sp.	2
	Root rot	*Cylindrocarpon* sp. and *Fusarium* sp.	3
	Root infection	*Basidiomycete*	1
	Thielaviopsis root rot	*Thielaviopsis basicola*	1

Table 4 (cont.)

CROP	DISEASE / DISORDER	CAUSAL / ASSOCIATED ORGANISM	NUMBER OF SAMPLES
Pinus resinosa	Cylindrocarpon root rot	*Cylindrocarpon* sp.	3
	Foliar blight	*Diplodia pinea*	1
	Fusarium root rot	*Fusarium* sp.	3
	Phoma blight	*Phoma* sp.	1
Pseudotsuga menziesii	Cylindrocarpon root rot	*Cylindrocarpon* sp.	5
	Fusarium root rot	*Fusarium proliferatum*	8
		Fusarium sp.	3
	Phoma blight	*Phoma eupyrena*	1
		Phoma sp.	2
	Pythium root rot	*Pythium* sp.	1
Pseudotsuga menziesii var. *glauca*	Cylindrocarpon root rot	*Cylindrocarpon* sp.	1
	Fusarium root rot	*Fusarium proliferatum*	5
	Thielaviopsis root rot	*Thielaviopsis basicola*	1
Pseudotsuga menziesii var. *menziesii*	Foliar blight	*Phoma* sp.	5
	Cylindrocarpon root rot	*Phoma* sp. and *Glomerella* sp.	1
	Fusarium root rot	*Cylindrocarpon* sp.	5
		Fusarium proliferatum	3
	Needle blight	*Fusarium* sp.	8
	Root rot	*Phomopsis* sp.	1
		Cylindrocarpon sp. and *Fusarium* sp.	3
		Pythium sp., *Cylindrocarpon* sp. and *Fusarium* sp.	1
Tsuga mertensiana	Botrytis blight	*Botrytis cinerea*	2
	Sirococcus blight	*Sirococcus strobilinus*	1

Total number of samples submitted to the lab = 111

Table 5. Diseases/disorders detected in **greenhouse vegetable** samples submitted to the BCAGRI Plant Health Laboratory between January 1 and November 30, 2016.

CROP	DISEASE / DISORDER	CAUSAL / ASSOCIATED ORGANISM	NUMBER OF SAMPLES
Cucumber	Fusarium stem/root rot	*Fusarium oxysporum* f.sp. *radicis-cucumerinum*	1
	Pythium root rot	*Pythium irregulare*	1
Pepper	Fusarium wilt	*Fusarium oxysporum*	1
	Pythium root rot	*Pythium* sp.	1

Total number of samples submitted to the lab = 5

Table 6. Diseases/disorders detected in **herbaceous perennial** samples submitted to the BCAGRI Plant Health Laboratory between January 1 and November 30, 2016.

CROP	DISEASE / DISORDER	CAUSAL / ASSOCIATED ORGANISM	NUMBER OF SAMPLES
Buxus spp.	Boxwood blight	*Cylindrocladium pseudonaviculatum*	2
	Volutella blight	*Volutella buxi*	1
Dahlia	Stunted plant	Cucumber mosaic virus	1
		Tobacco mosaic virus	1
Hydrangea	Leaf spot	*Phyllosticta* sp.	1
	Stem canker	*Phoma / Ascochyta* sp.	1
Paeonia spp.	Bacterial leaf spot	*Pseudomonas syringae* pv. *Syringae*	1
	Leaf blotch	*Cladosporium paeoniae*	2
		Hainesia lythri	1
	Leaf spot	*Phyllosticta* sp.	1
	Root rot	*Cylindrocarpon* sp.	1
Ranunculus	Bacterial blight	*Pseudomonas syringae* pv. *Syringae*	1
	Ramularia leaf spot	*Ramularia didyma*	1
Sedum	Leaf spot	*Phyllosticta* sp.	1
	Powdery mildew	*Erysiphe sedi*	1
Yucca dismetiana	Anthracnose	*Colletotrichum circinans*	1
	Leaf spot	*Cercospora* sp.	1
	Stem rot	*Fusarium solani*	1

Total number of samples submitted to the lab = 22

Table 7. Diseases/disorders detected in **nut crop** samples submitted to the BCAGRI Plant Health Laboratory between January 1 and November 30, 2016.

CROP	DISEASE / DISORDER	CAUSAL / ASSOCIATED ORGANISM	NUMBER OF SAMPLES
Hazelnut	Nectria Canker	*Nectria galligena*	1
Walnut	Armillaria root rot	*Armillaria nabsnona*	1

Total number of samples submitted to the lab = 5

Table 8. Diseases/disorders detected in **small fruit (berry**) crop samples submitted to the BCAGRI Plant Health Laboratory between January 1 and November 30, 2016.

CROP	DISEASE / DISORDER	CAUSAL / ASSOCIATED ORGANISM	NUMBER OF SAMPLES
Blackberry	Anthracnose	*Elsinoe veneta*	2
	Botrytis fruit rot	*Botrytis cinerea*	1
	Cane blight	*Leptosphaeria coniothyrium*	1
	Nematode damage	*Pratylenchus* sp.	1
	Root rot	*Phytophthora rubi*	1
	Spur blight	*Didymella applanata*	1
	Uneven fruit ripening	Arabis mosaic virus (and mites)	2
		Tomato spotted wilt virus (and mites)	1
Blueberry	Armillaria root rot	*Armillaria* sp.	3
	Bacterial blight	Pseudomonas syringae pv. syringae	5
	Blueberry Scorch Virus	Blueberry scorch virus	8
	Blueberry Shock Virus	Blueberry shock virus	4
	Botrytis blight	*Botrytis cinerea*	4
	Coniothyrium canker	*Coniothyrium* sp.	1
	Fruit rot	*Botrytis cinerea*	1
	Leaf spot	*Alternaria* sp.	2
		Gloeosporium sp., *Alternaria* sp., and *Diaporthe* sp.	1
	Nematode damage	*Xiphinema* sp.	1
	Phomopsis canker	*Phomopsis* sp.	10
	Phytophthora root rot	*Phytophthora* sp.	22
Blueberry (Brazelberry)	Bacterial blight	*Pseudomonas syringae*	1
	Rust	*Thekopsora minima*	1
Cranberry	Bitter rot	*Glomerella cingulate*	1
	Blotch rot	*Physalospora vaccinii*	1
	Coniothyrium canker	*Coniothyrium* sp.	1
	Fruit rot	*Coleophoma empetri*	2
	Leaf and fruit scarring	Blueberry shock virus	1
	Leaf scarring	Blueberry scorch virus	1
	Leaf spot	*Allantophomopsis cytisporea*	1
		Allantophomopsis sp.	3
		Coleophoma sp.	1
		Discosia sp. and *Phyllosticta* sp.	1
		Discosia sp., *Phyllosticta* sp. and *Physalspora* sp.	1
		Glomerella cingulata	1
		Godronia sp., *Discosia* sp. and *Botrytosphaeria* sp.	1
		Phyllosticta sp.	2
		Physalospora sp.	1
	Runner Rot	*Cytospora* sp.	1
	Uprightdieback	*Diaporthe / Phomopsis* sp.	3
		Godronia sp.	1

Table 8 (cont.)

CROP	DISEASE / DISORDER	CAUSAL / ASSOCIATED ORGANISM	NUMBER OF SAMPLES
Haskap	Black root rot	*Thielaviopsis basicola*	3
	Leaf and stem blight	*Alternaria s*p.	3
	Phytophthora root rot	*Phytophthora* sp.	1
Raspberry	Anthracnose	*Colletotrichum* sp.	2
		Elsinoe veneta	6
		Phlyctema vagabunda	6
	Ascospora dieback	*Clethridium corticola*	6
	Botrytis blight	*Botrytis cinerea*	1
	Cane blight	*Coniothyrium fuckelii*	4
		Didymella applanata and *Clethridium corticola*	1
		Leptosphaeria coniothyrium	2
	Cane canker	*Marsonina* sp.	1
	Nematode damage	*Botryosphaeria* sp.	2
		Pratylenchus sp. *and Xiphinema* sp.	7
	Phytophthora root rot	*Pratylenchus* sp.	22
	Spur blight	*Phytophthora* sp.	14
		Didymella applanata	9
Strawberry	AnthracnoseBlack root rot	*Colletotrichum acutatum*	1
	Leaf blotch	*Cylindrocarpon* sp. and *Rhizoctonia* sp.	1
		Gnomonia comari	2
	Mucor fruit rot	*Mucor* sp.	1
	Nematode damage	*Pratylenchus* sp.	11
		Pratylenchus sp. and *Xiphinema* sp.	2
	Powdery mildew	*Sphaerotheca macularis*	1
	Rhizoctonia root rot	*Rhizoctonia fragariae*	2
		Rhizoctonia sp.	3
	Root rot	*Rhizoctonia* sp., and *Fusarium* sp.	1
	Verticillium wilt	*Verticillium* sp.	5

Total number of samples submitted to the lab = 311

Table 9. Diseases/disorders detected in **specialty crop** samples submitted to the BCAGRI Plant Health Laboratory between January 1 and November 30, 2016.

CROP	DISEASE / DISORDER	CAUSAL / ASSOCIATED ORGANISM	NUMBER OF SAMPLES
Basil	Downy mildew	*Peronospora belbahrii*	1
Ginseng	Alternaria blight	*Alternaria panax*	1
	Cylindrocarpon root rot	*Cylindrocarpon destructans*	4
	Fusarium root rot	*Fusarium* sp.	4
	Phytophthora foliar blight	*Phytophthora* sp.	1
Hop	Iternaria cone disorder	*Alternaria alternate*	2
	Apple mosaic virus	*Apple mosaic virus*	5
	Crown and root rot	*Rhizoctonia solani* and *Cylindrocarpon* sp.	1
	Downy mildew	*Pseudoperonospora humuli*	2
	Fusarium canker	*Fusarium sambucinum*	1
	Leaf spot	*Alternaria* sp.	1
		Alternaria sp. and *Cladoposrium* sp.	1
		Botrytis cinerea	2
		Phoma / Ascochyta sp.	2
		Pseudomonas syringae pv. *syringae*	1
	Nematode damage	*Pratylenchus* sp.	1
	Powdery mildew	*Podosphaera macularis*	2
	Rhizoctonia root rot	*Rhizoctonia solani*	1
	Root damage	*Mesocriconema* sp.	1
		Pratylenchus sp.	2
	Sooty mould	*Cladosporium* sp.	2
	Sooty mould / cone disorder	*Cladosporium* sp. and *Alternaria* sp.	1
	Stem canker	*Rhizoctonia solani*	1
Wasabi	Leaf blight	*Botrytis cinerea*	1

Total number of samples submitted to the lab = 24

Table 10. Diseases/disorders detected in **tree fruit and grape** samples submitted to the BCAGRI Plant Health Laboratory between January 1 and November 30, 2016.

CROP	DISEASE / DISORDER	CAUSAL / ASSOCIATED ORGANISM	NUMBER OF SAMPLES
Apple	Bacterial canker	*Pseudomonas syringae* pv. *syringae*	1
	Cytospora canker	*Cytospora* sp.	1
	Phoma leaf spot	*Phoma pomorum*	1
	Stem canker	*Diplodia seriata*	1
Crabapple	Nematode damage	*Pratylenchus* sp.	1
Fig	Chlorotic flecking / mosaic	Fig mosaic virus	3
Grape	Botrytis blight	*Botrytis cinerea*	1
	Fruit rot	*Peniciliium* sp. and *Botrytis* sp.	1
	Leaf spot	*Phyllosticta* sp.	1
Pear	Bacterial canker	*Pseudomonas syringae* pv. *syringae*	1
	Cytospora canker	*Cytospora* sp.	1
	Fire blight	*Erwinia amylovora*	1
	Nematode damage	*Pratylenchus* sp.	1
	Sprinkler rot	*Phytophthora cactorum*	1
Pear (Asian)	Anthracnose	*Cryptosporiopsis sp.*	1
	Bacterial canker	*Pseudomonas syringae*	1
	Cytospora canker	*Cytospora* sp.	1
	Nematode damage	*Pratylenchus* sp.	1
	Phomopsis canker	*Phomopsis* sp.	2
	Stem canker	*Coniothyrium* sp.	1

Total number of samples submitted to the lab = 33

Table 11. Diseases/disorders detected in **turf grass, sports field and lawn** samples submitted to the BCAGRI Plant Health Laboratory between January 1 and November 30, 2016.

CROP	DISEASE / DISORDER	ORGANISM CAUSAL / ASSOCIATED	NUMBER OF SAMPLES
Sports field	Ascochyta blight	*Ascochyta* sp.	1
	Leptosphaerulina blight	*Leptosphaerulina* sp.	1
	Localized dry spot	Basidiomycete	1
Turf (sod or green)	Localized dry spot	Basidiomycete	1
	Nematode damage	*Rhizoctonia cerealis*	1
		Meloidogyne sp.	1
		Helicotylenchus sp.	2
		Meloidogyne sp. and *Helicotylenchus* sp.	1
	Yellow patch	*Meloidogyne* sp. and *Tylenchorhynchus* sp.	3

Total number of samples submitted to the lab = 8

Table 12. Diseases/disorders detected in **field vegetable** samples submitted to the BCAGRI Plant Health Laboratory between January 1 and November 30, 2016.

CROP	DISEASE/DISORDER	CAUSAL / ASSOCIATED ORGANISM	NUMBER OF SAMPLES
Bean	Alternaria leaf and pod spot	*Alternaria* sp.	1
	Bacterial brown spot	*Pseudomonas syringae* pv.*syringae*	1
	Gray mould	Botrytis cinerea	1
Beet	Downy mildewFusarium root rot	*Peronospora farinosa* f. sp. *betae*	1
		Fusarium sp.	1
		Rhizoctonia solani	1
	Rhizoctonia root rot	*Alternaria* sp.	1
	Storage rot	*Botrytis cinerea*	1
		Fusarium solani	2
		Fusarium sp.	2
		Penicillium sp.	1
Brussel Sprout	Alternaria spot	*Alternaria* sp.	1
Cabbage	Damping off	*Pythium* sp.	1
	White mould	*Sclerotinia sclerotiorum*	2
Carrot	Pythium root rot	*Pythium* sp.	1
Corn	Fusarium root rot	*Fusarium proliferatum*	1
	Rhizoctonia crown rot	*Rhizoctonia solani*	1
Cucumber	Vascular wilt	*Fusarium oxysporum*	1
Garlic	Blue mould	*Penicillium* sp.	11
	Botrytis neck rot	*Botrytis allii*	2
	Bulb and stem rot	*Ditylenchus* sp.	1
	Bulb rot	*Botrytis porri*	6
		Fusarium proliferatum	18
		Fusarium sp.	3
		Fusarium sp., *Penicillium* sp. and *Mucor* sp.	1
		Penicilliium sp., *Rhizopus* sp. and *Fusarium* sp.	
		Penicillium sp. and *Rhizopus* sp.	1
		Embellisia allii	
		Fusarium culmorum	1
	Embellisia skin blotch	*Fusarium proliferatum*	65
	Fusarium basal rot	*Fusarium* sp.	1
	Fusarium bulb rot	Potyvirus	8
		Leek yellow stripe virus	1
	Leaf streak and/or chlorosis	*Rhizopus* sp.	51
	Leaf streaking		3
	Mushy rot		1

Table 12 (cont.)

CROP	DISEASE / DISORDER	CAUSAL / ASSOCIATED ORGANISM	NUMBER OF SAMPLES
Garlic (cont.)	Nematode damage	*Ditylenchus dipsaci* and *Pratylenchus* sp.	1
		Ditylenchus dipsaci and *Aphelenchoides* sp.	1
		Pratylenchus sp.	3
		Rhizoctonia sp.	1
	Root rot	*Puccinia allii*	3
	Rust	*Physiological*	1
	Waxy breakdown	*Sclerotium cepivorum*	3
	White rot		
Leek	Damping off	*Pythium* sp.	1
Lettuce	Pythium wilt	*Pythium* sp.	1
Okra	Pod rot	*Botrytis cinerea*	1
Pepper	Root rot	Oomycete	1
	Wire stem	*Rhizoctonia solani*	1
Potato	Black dot	*Colletotrichum coccodes*	5
	Black leg	*Pectobacterium atrosepticum*	1
		Pectobacterium carotovorum ssp. *carotovorum*	1
	Black scurf	*Rhizoctonia solani*	6
	Common scab	*Streptomyces scabies*	2
	Fusarium dry rot	*Fusarium solani*	1
	Powdery scab	*Spongospora subterranea*	2
	Pythium leak	*Pythium ultimum*	1
	Silver scurf	*Helminthosporium solani*	5
Rhubarb	Anthracnose	*Colletotrichum* sp.	1
	Crown and root rot	*Cylindrocarpon* sp.	2
	Downy mildew	*Peronospora* sp.	1
	Leaf/stalk spot	*Ascochyta rhei*	4
	Nematode damage	*Pratylenchus* sp. and *Xiphinema* sp.	1
	Ramularia leaf blight	*Ramularia rhei*	3
	Root damage	*Pratylenchus* sp.	2
Squash	Nematode damage	*Pratylenchus* sp.	1
Squash -spaghetti	Bacterial spot	*Pseudomonas syringae* pv. *syringae*	1
	Fusarium fruit rot	*Fusarium* sp.	1
	Scab	*Cladosporium cucumerinum*	1
Squash -butternut	Fusarium rot	*Fusarium* spp.	1
	Scab	*Cladosporium cucumerinum*	1
Tomato	Leaf deformation/mosaic	Tobacco mosaic virus	1
		Cucumber mosaic virus	1
Zucchini	Angular leaf spot	*Pseudomonas syringae* pv. *lachrymans*	1

Total number of samples submitted to the lab = 167

Table 13. Diseases/disorders detected in **woody ornamental**samples submitted to the BCAGRI Plant Health Laboratory between January 1 and November 30, 2016.

CROP	DISEASE / DISORDER	CAUSAL / ASSOCIATED ORGANISM	NO. OF SAMPLES
Abies balsamea	Needle blight	*Rhizosphaera kalkhoffii*	1
Abies concolor	Needle blight	*Rhizosphaera kalkhoffii*	1
Acer sp.	Leaf spot	*Alternaria alternate*	1
	Twig canker	*Diplodina acerina*	1
Acer circinatum	Phomopsis canker	*Phomopsis* sp.	1
Acer palmatum	Anthracnose	*Aureobasidium apocryptom* and *Discula* sp.	1
	Armillaria root rot	*Armillaria nabsnona*	1
Amelanchier	Fire blight	*Erwinia amylovora*	1
Arbutus menziesii	Phytophthora crown rot	*Phytophthora cactorum*	1
Betula papyrifera	Twig canker	*Cytospora* sp.	2
	Twig die-back	*Cytosporina (Eutypa* sp.*)*	4
		Gelatinosporium betulinum	2
		Melanconium sp.	5
		Phragmotrichum sp.	2
		Pleomassaria sp.	1
		Prosthemium neobetulinum	3
		Sirococcus strobilinus	3
Chamaecyparis	Phytophthora root rot	*Phytophthora* sp.	1
Choisya ternata	Armillaria root rot	*Armillaria gallica*	1
Clematis	Root rot	*Phytophthora* sp.	1
	Stem canker	*Ascochyta clematidina*	1
Cornus sp.	Powdery mildew	*Microsphaera* sp.	1
Corylus spp.	Fungus on dead stem	*Diapleela* sp.	1
	Phomopsis canker	*Diaporthe* sp.	1
Cotoneaster	Crown and root rot	*Phytophthora* sp.	1
	Fire blight	*Erwinia amylovora*	1
Crataegus sp.	Fire blight	*Erwinia amylovora*	1
Cypress	Foliar blight	*Sclerophoma* sp.	1
Halesia sp.	Twig die-back	*Diaporthe* sp.	1
Ilex sp.	Dieback	*Diaporthe* sp.	1
	Stem die back	*Leptosphaeria* sp.	1
		Botryosphaeria sp.	1
Juniperus sp.	Anthracnose	*Colletotrichum* sp.	1
	Phytophthora root rot	*Phytophthora* sp.	1
	Stem rot	*Fusarium* sp.	1

Table 13 (cont.)

CROP	DISEASE / DISORDER	CAUSAL / ASSOCIATED ORGANISM	NO. OF SAMPLES
Laurus nobilis	Leaf spot	*Cladosporium* sp. and *Alternaria* sp.	1
Lonicera sp.	Honeysuckle leaf blight	*Insolibasidium deformans*	1
	Root rot	*Pythium* sp.	1
		Rhizoctonia solani	1
	Seedling blight	*Botrytis cinerea*	1
Magnolia	Powdery mildew	*Microsphaera penicillata*	1
Malus sp.	Bacterial blight	*Pseudomonas syringae* pv. *syringae*	1
	Leaf spot	*Alternaria* sp.	1
	Twig blight/dieback	*Phomopsis* sp.	2
Oenothera	Foliar blight	*Botrytis cinerea*	1
Philadelphus sp.	Bacterial blight	*Pseudomonas syringae*	1
Photinia	Leaf spot	*Pestalotia* sp.	1
Picea sp.	Phomopsis canker	*Phomopsis* sp.	1
Picea omorika	Phomopsis canker	*Phomopsis* sp.	1
Picea pungens	Cylindrocarpon root rot	*Cylindrocarpon* sp.	1
Platanus acerifolia	Anthracnose	*Apiognomonia* sp.	1
Prunus sp.	Anthracnose	*Colletotrichum gloeosporioides*	1
	Cytospora canker	*Cytospora* sp.	1
	Phomopsis canker	*Phomopsis* sp.	1
	Powdery mildew	*Podosphaera tridactyla*	1
	Root rot	*Thielaviopsis basicola*	1
Prunus serrulata	Crown gall	*Agrobacterium tumefaciens*	1
Prunus virginiana	Branch canker	*Coniothyrium* sp.	1
Pseudotsuga menziesii	Laminated root rot	*Phellinus weirii*	2
	Needle blight	*Rhizosphaera kalkhoffii*	2
Quercus sp.	Anthracnose	*Discula umbrinella*	1
Rhododendron	Botryosphaeria dieback	*Botryosphaeria dothidea*	1
	Leaf and stem blight	*Pestalotia* sp.	1
	Phomopsis dieback	*Diaporthe / Phomopsis* sp.	2
Ribes sanguineum	Phytophthora root rot	*Phytophthoral sp.*	1
Ribes uva-crispa	Anthracnose	*Drepanopeziza ribis*	1
Rosa sp.	Black spot	*Diplocarpon rosae*	1
	Powdery mildew	*Podosphaera pannosa*	1

Table 13 (cont.)

CROP	DISEASE / DISORDER	CAUSAL / ASSOCIATED ORGANISM	NO. OF SAMPLES
Sorbus sp.	Leucostoma canker	*Valsa leucostoma*	1
Syringa sp.	Bacterial blight	*Pseudomonas syringae* pv. *syringae*	1
	Leaf mottling	Lilac leaf chlorosis virus	1
Thuja spp.	Foliar blight	*Kabatina thujae*	1
		Pestalotiopsis sp.	2
	Phomopsis blight	*Diaporthe sp.*	1
	Phytophthora root rot	*Phytophthora sp.*	2
Thuja occidentalis	Phomopsis blight	*Phomopsis juniperovora*	1
	Stem die back	*Leptosphaeria coniothyrium*	1
Tsuga heterophyla	Annosus root rot	*Heterobasidium occidentale / annosum*	4
	Stringy butt rot	*Perenniporia subacida*	1
	White trunk rot	*Phellinus hartigii*	1
	White laminated root rot	*Ceriporiopsis rivulosa*	1

Total number of samples submitted to the lab = 129

CROPS / CULTURE: Commercial Ornamental Nursery and Landscape Crops
LOCATION / RĖGION: British Columbia

NAME AND AGENCY:
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TITLE: DISEASES DIAGNOSED ON ORNAMENTAL NURSERY AND LANDSCAPE CROPS IN BRITISH COLUMBIA, 2016

ABSTRACT: Diseases of commercial nursery and landscape ornamental crops and causal agents identified by Elmhirst Diagnostics & Research in south coastal British Columbia in 2016 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. Powdery mildew of *Monarda didyma* (bee balm) was 100% homologous to *Erysiphe biocellatus* (*Golovinomyces biocellatus*) by DNA sequencing and BLAST comparison in GenBank. *E. biocellatus* attacks other plants in the mint family, plus *Salvia* and *Oreganum*. DNA extracted from the *Monarda* mildew amplified strongly with PCR primers for *E. cichoracearum*, but *E. biocellatus* is now considered a separate species.

Table 1. Diseases diagnosed in 2016 on ornamental nursery and landscape crops in British Columbia by Elmhirst Diagnostics & Research.

CROP	SYMPTOM/DISEASE	CAUSAL AGENT	NUMBER OF SAMPLES
Acer x freemanii	Bacterial canker	*Pseudomonas syringae*	1
Arctostaphylos uva-ursi	Bacterial leaf spot	*Pseudomonas syringae*	1
Azalea x ‘Autumn Princess’, ‘Autumn Chiffon’	Root rot / dieback	*Phytophthora* sp.	1
Buxus sempervirens ‘Suffruticosa’	Volutella blight	*Pseudonectria buxi (Volutella buxi)*	1
Buxus sempervirens ‘Suffruticosa’	Fusarium blight	*Cyanonectria buxi (Fusarium buxicola = Fusarium lateritium* var. *buxi)*	1
Buxus microphylla koreana x *sempervirens* ‘Green Gem’, ‘Green Mountain’,’Green Velvet’, ‘Variegata’, ‘Winter Gem’	Fusarium blight	*Cyanonectria buxi (Fusarium buxicola = Fusarium lateritium* var. *buxi*	5

Table 1 (cont.)

Buxus microphylla koreana x *sempervirens* 'Green Gem', 'Green Mountain','Green Velvet', 'Variegata', 'Winter Gem'	Volutella blight	*Pseudonectria buxi* *(Volutella buxi)*	5
Cornus alba 'Elegantissima'	Anthracnose	*Discula destructiva*	1
Cornus stolonifera 'Arctic Fire'	Stem dieback	*Melanconium* sp.	1
Dianthus caryophyllus	Fusarium wilt	*Fusarium oxysporum*	1
Hydrangea arborescens 'Invincibelle Spirit'	Crown and root rot	*Phytophthora* sp.	1
Hydrangea paniculata 'Bobo'	Stem canker	*Ascochyta hydrangeae*	2
Juniperus horizontalis 'Bar Harbour'	Root rot / dieback	*Phytophthora* sp.	1
Juniperus squamata 'Blue Star'	Root rot / dieback	*Phytophthora* sp.	1
Monarda didyma 'Fireball', 'Snow White'	Powdery mildew	*Golovinomyces biocellatus* *(Erysiphe biocellatus)**	2
Picea pungens 'Iseli Fastigiate'	Sirococcus blight	*Sirococcus conigenus*	1
Pinus mugo	Root rot / dieback	*Phytophthora* sp.	1
Rhododendron x 'Wine and Roses'	Root rot / dieback	*Phytophthora* sp.	1
Rosa x 'Champlain'	Powdery mildew	*Podosphaera pannosa*	1
Rosa x 'Morden Blush'	Black spot	*Diplocarpon rosae*	1
Rosa x 'Yellow Submarine'	Cercospora leaf spot	*Cercospora rosicola*	1
Sarcoccoca hookeriana var. *humilis* 'Fragrant Mountain', 'Fragrant Valley'	Root and crown rot / dieback	*Rhizoctonia solani / Phytophthora* sp.	2
Sarcoccoca hookeriana var. *humilis*	Volutella blight and stem canker	*Pseudonectria buxi* *(Volutella buxi)*	1
Sedum x 'Thunderhead'	Powdery mildew	*Erysiphe sedi*	1
Syringa x 'Tinkerbelle'	Root and crown rot / dieback	*Phytophthora* sp.	1
Syringa x *hyacinthflora*	Bacterial leaf spot	*Pseudomonas syringae*	1
Thuja occidentalis 'Emerald Green'	Root rot / dieback	*Pythium* sp. / *Phytophthora* sp.	1
Thuja occidentalis 'Tom Thumb'	Root rot / dieback	*Pythium* sp. / *Phytophthora* sp.	1
	Foliar nematodes	*Aphelenchoides* sp.	1
Total			**40**

*Confirmed by DNA sequencing and BLAST comparison to GenBank sequences.

CROP / CULTURE: Diagnostic Laboratory Report - All Crops
LOCATION / RĖGION: Alberta

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TITLE: DISEASES DIAGNOSED ON CROP SAMPLES SUBMITTED TO THE ALBERTA PLANT HEALTH LAB IN 2016

ABSTRACT: The Alberta Plant Health Lab (APHL), part of Alberta Agriculture and Forestry, provides plant pest diagnosis and expertise to Alberta's agricultural industry. The lab has been fully functional since January 2016 and currently accepts samples exclusively from agricultural fieldmen, academic institutions, applied research associations and municipal pest management departments. A total of 290 samples were processed for disease diagnosis in the 2016 crop year. Fungal, oomycete, protist, phytoplasma, bacterial and viral pathogens were identified in these samples as the causal agents of disease. Late blight was identified in one potato and one tomato sample, both collected from the same site. *Aphanomyces euteiches* was identified in two field pea samples. Among the 147 *Fusarium* strains isolated from corn, 74 were identified as *F. graminearum*, with the 15-ADON as the predominant chemotype. Dutch elm disease was not identified in any of the 15 submitted suspect samples. Canola samples from twelve fields with verticillium wilt (VW) symptoms were analyzed by qPCR. None of these samples were confirmed to contain the VW causal agent *Verticillium longisporum*.

METHODS: The Alberta Plant Health Lab (APHL) provides diagnosis primarily for diseases of crops in Alberta. Samples are submitted to the laboratory 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, confirmation of late blight on potato and tomato was conducted using the Agdia ImmunoStripkit for *Phytophthora* species (http://www.agdia.com). 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). *Fusarium* species were identified by PCR using the primers reported by Demeke et al. (2005). Phytoplasmas were detected by PCR using the primer pairs P1/Tint and R16MF2n/R16MR2n (Smart et al. 1996). Diagnosis of *Verticillium longisporum* was conducted by qPCR using two primer pairs designed by the APHL, targeting the intron in the rDNA small subunit. The sequences of these primers are: F1: gggaggactcacagatcgaa, R1: ccgtgaattcagaggcagat and Probe1: tcacgacctctggtcatgac; and F2: cccattcttctccctctcct, R2: ctgaccagacgaacctccat and Probe 2: gctaacgggagcgagtatgt.
RESULTS: A total of 290 disease diagnoses were completed between January 11 and December 9, 2016. Categories of samples diagnosed included cereals (21%), canola (2%), potato (2%), corn (52%), legume (9%), tree and fruit (8%), vegetable (2%) and other (4%). The category 'other' covers samples such as mint, sunflower and sugar beet. In most samples, one or more causal agents were identified. Summaries of diseases 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.

There was one laboratory-confirmed incidence of potato late blight identified on potato and tomato from the same site. *Aphanomyces euteiches* was identified on two field pea samples. Among the 147 *Fusarium* isolates from corn, 74 were identified as *F. graminearum*, with the 15 ADON as the predominant chemotype. Fifteen samples were submitted for Dutch elm disease diagnosis and none of them tested positive. However, in six of the samples, *Dothiorella ulmi* was present. In addition to routine samples, canola samples from 12 fields collected by Alberta Agriculture and Forestry, as a part of the CFIA 2015 National Verticillium Survey, were analyzed for verticillium wilt by qPCR. None of these samples were VW-positive.

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Table 1: Summary of diseases diagnosed on **cereal crops** submitted to the Alberta Plant Health Lab in 2016.

Crop	Symptom	Causal agent(s)	Number of Samples
Wheat	Leaf lesions	*Alternaria* sp.	6
	Leaf lesions and / or root rot	*Fusarium* sp.	5
	Leaf and stem pustules	*Sclerophthora macrospora*	1
	Black root rot	*Gaeumannomyces graminis*	2
	Yellow leaf streaking and wilting	*Phytoplasma**	7
	Yellow leaf streaking and wilting	Negative for phytoplasma*	4
	Leaf and stem pustules	*Blumeria graminis* f.sp. *tritici*	1
	Leaf blotch (dark lesions)	*Parastagonospora nodorum*	1
	Tan-colored lesions on leaves	*Pyrenophora tritici-repentis*	1
	Leaf chlorosis	Virus	2
Winter wheat	Yellow leaf streaking and wilting	Phytoplasma*	2
Barley	Dark brown spores on leaves	*Alternaria* sp.	5
	Yellow leaf striping	*Bacterial pathogen*	5
	Necrotic lesions on leaves	*Fusarium* sp.	5
	Loose smut	*Ustilago nuda*	3
	Necrotic and chlorotic leaf lesions	*Rhynchosporium commune*	4
	Chlorotic striping on leaves	*Phytoplasma**	1
	Chlorotic striping on leaves	*Negative for phytoplasma**	1
Durum	Leaf chlorosis	Virus	1
	Leaf yellowing	Negative for phytoplasma*	2
Oats	Leaf yellowing and mold	*Fusarium* sp.	1
Triticale	Necrotic and chlorotic leaf lesions	*Alternaria* sp.	1
	Necrotic and chlorotic leaf lesions	*Fusarium* sp.	1

*These samples were submitted specifically for phytoplasma testing.

Table 2: Summary of diseases diagnosed on **canola samples** submitted to the Alberta Plant Health Lab in 2016.

Crop	Symptom	Causal agent(s)	Number of Samples
Canola	Black root	*Leptosphaeria maculans*	4
	Stem rot	*Sclerotinia sclerotiorum*	1
	Wilting plant	Undetermined	1

Table 3: Summary of diseases diagnosed on **potato samples** submitted to the Alberta Plant Health Lab in 2016.

Crop	Symptom	Causal agent(s)	Number of Samples
Potato	Leaf spots	*Alternaria solani*	1
	Black dot on tuber	*Colletotrichum coccodes*	1
	Dark lesions and scabs on tuber	*Pseudomonas* sp.	1
	Wilting and necrotic plants	*Phytophthora* sp.	1
	Chlorosis on leaves	*Phytoplasma*	

Table 4: Summary of diseases diagnosed on **corn samples and corn stalk-derived fungal cultures** submitted to the Alberta Plant Health Lab in 2016.

Crop	Symptom	Causal agent(s)	Number of Samples
Corn	Culture plates	*Fusarium graminearum*	74
	Culture plates	*Fusarium culmorum*	46
	Culture plates	*Fusarium graminearum* and *F. culmorum*	1
	Culture plates	*Fusarium avenaceum*	14
	Culture plates	*Fusarium tricinctum*	3
	Culture plates	*Fusarium equiseti*	2
	Culture plates	*Fusarium pseudograminearum*	2
	Culture plates	Unidentified	5
	Root rot	*Fusarium* sp.	2
	Wilting plant	*Clavibacter michiganensis* subsp. *nebraskensis*	1

Table 5: Summary of diseases diagnosed on **legumes** submitted to the Alberta Plant Health Lab in 2016.

Crop	Symptom	Causal agent(s)	Number of Samples
Pea	Leaf spot / blight	*Stemphyllium globuliferan*	4
	Mycelia on leaves	*Stemphyllium vesicarium*	1
	Leaf spot	*Stemphyllium solani*	1
	Root rot	*Pythium* sp., *Rhizoctonia* sp., *Fusarium* spp.	5
	Root rot	*Fusarium* sp.	5
	Root rot	*Aphanomyces euteiches*	2
	Stem rot	*Sclerotinia s*p.	1
	Leaf and pod lesions		2
Chickpea	Mycelia on leaves	*Bjerkandera adusta*	3
Lentil	Post-emergence plant death	*Fusarium* spp. and *Sclerotinia* spp.	1
Dry bean	Leaf lesions and chlorosis	*Fusarium* spp. and *Sclerotinia* spp.	1

Table 6: Summary of diseases diagnosed on **trees and fruit crops** submitted to the Alberta Plant Health Lab in 2016.

Crop	Symptom	Causal agent(s)	Number of Samples
Elm	Wilting twig	*Dothiorella ulmi*	6
	Wilting twig	Unidentified	9
Pine	Stem curling / crooking	*Phoma* and *Cylindrocarpon* spp.	1
	Needle discoloration	*Alternaria alternata*	1
Apple tree	Leaf discoloration	*Alternaria* spp.	2
Maple	Leaf chlorosis	Phytoplasma*	1
Raspberry	Cane and leaf discoloration	Bacteria spp.	1
	Leaf chlorosis	Negative for phytoplasma*	1

*These samples were submitted specifically for phytoplasma testing.

Table 7: Summary of diseases diagnosed on **vegetable crops** submitted to the Alberta Plant Health Lab in 2016.

Crop	Symptom	Causal agent(s)	Number of Samples
Tomato	Wilting plant	Herbicide damage	1
	Scabby lesions and circular scarring on leaves	Tomato spotted wilt virus	1
	Wilting plants	Tomato spotted wilt virus	1
Coriander	Leaves in a plate	*Pseudomonas syringae*	1
Carrot	Chlorosis on tuber	Negative for phytoplasma*	1
Garlic	Mycelia on bulb samples	*Fusarium proliferatum*	1
	Root rot	*Fusarium* sp.	1

*This sample was submitted specifically for phytoplasma testing.

Table 8: Summary of diseases diagnosed on **other crops** submitted to the Alberta Plant Health Lab in 2016.

Crop	Symptom	Causal agent(s)	Number of Samples
Mint	Mycelia on leaves	*Plectosphaerella cucumerina*, *Chaetomium* sp., *Fusarium tricinctum*	1
Sunflower	Wilting plant	Environmental injury	2
Sugar beet	Leaf lesions and chlorosis	*Pythium* and *Alternaria* spp.	1
Catnip	Mycelia on leaves	*Fusarium* and *Alternaria* spp.	1
Lilac	Leaf lesions and wilting	*Alternaria alternata*	1
Sod/turf grass	Root rot	*Rhizoctonia* and *Pythium* spp.	1
Geranium	Leaf chlorosis	Negative for phytoplasma*	1
Begonia	Leaf chlorosis	Negative for phytoplasma*	1
Clematis	Leaf chlorosis	Negative for phytoplasma*	2
Potato vine	Leaf chlorosis	Negative for phytoplasma*	1

*These samples were submitted specifically for phytoplasma testing.

CROP / CULTURE: Diagnostic Laboratory Report
LOCATION / RÉGION: Saskatchewan

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TITLE: DISEASES DIAGNOSED ON CROP SAMPLES SUBMITTED TO THE SASKATCHEWAN MINISTRY OF AGRICULTURE CROP PROTECTION LABORATORY IN 2016

ABSTRACT: In 2016, 448 samples were diagnosed for plant disease at the Crop Protection Laboratory in Saskatchewan, including 249 crop samples and 199 elm tree samples for Dutch elm disease testing. Most diagnoses were of fungal plant diseases, most notably root rots, but a large number of samples (almost 1/3 of the field crop samples) exhibited symptoms consistent with herbicide damage.

METHOD: 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. Services include disease diagnosis and insect and weed identification, as well as testing of weed seeds for herbicide resistance. The CPL also provides a (free) Dutch elm disease (DED) service under which American elm (*Ulmus americana*) and Siberian elm (*U. pumila*) samples are tested for DED and dothiorella wilt. Samples for DED testing are submitted by the Saskatchewan Ministry of Environment, cities/towns including City of Regina and City of Saskatoon, or homeowners. Agricultural crop samples are usually submitted by growers and agronomists, Saskatchewan Ministry of Agriculture and Saskatchewan Crop Insurance Corporation staff, or market / home gardeners. Diagnosis of fungal plant diseases is performed primarily through visual assessment of plant symptoms, microscopic examination and the isolation of fungal organisms on artificial media. Diagnoses of injuries suspected to be due to herbicide damage and/or nutrient deficiencies are 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). Diagnoses are aided by the receipt of representative samples and adequately detailed information in submission forms.

RESULTS AND COMMENTS: In 2016, 249 samples of field crops (including cereals, forages, fruit, oilseeds, pulses, vegetables, and special crops), ornamentals and trees were submitted to the Saskatchewan Crop Protection Laboratory for disease diagnosis. An additional 199 elm tree samples were received for DED testing in 2016. A dry spring followed by excess moisture throughout the growing season, delayed harvest of crops and led to plant stress and high disease pressure in Saskatchewan in 2016. As a result of these conditions, along with a high acreage of lentil, pulses were by far the most common type of field crop submitted. The root rot complex was the most common disease diagnosed visually and by culturing on pulse crops. Summaries of diagnoses on samples submitted to the CPL in 2016 are presented in Tables 1 to 10.

Table 1. Summary of diseases diagnosed on cereal crop samples submitted to the Saskatchewan Crop Protection Laboratory in 2016.

Crop	Disease/Injury	Causal Agent(s)	Number of Samples
Barley	Common root rot	*Cochliobolus sativus*	1
	Environmental stress	*Various stresses*	2
	Fusarium head blight	*Fusarium spp.*	1
	Leaf spot	*Suspect Phoma glomerata*	1
	Loose smut	*Ustilago nuda*	1
	Root rot / seedling blight (complex)	*Fusarium spp.**	2
	Spot blotch	*Cochliobolus sativus*	1
	Consistent with herbicide damage	*Suspect various herbicide groups*	3
Durum wheat	Common root rot	*Cochliobolus sativus*	3
	Environmental stress	Various stresses	3
	Fusarium head blight	*Fusarium* spp.	1
	Root, crown, and foot rot (complex)	*Fusarium* spp.*	2
	Stagonospora blotch	*Stagonospora nodorum*	1
	Stripe rust	*Puccinia striiformis*	1
	Consistent with herbicide damage	Suspect various herbicide groups	2
	Wheat Streak Mosaic Virus	Wheat Streak Mosaic Virus	6
Oats	Environmental stress	Sunburn	1
Wheat	Environmental stress	Various stresses	4
	Fusarium head blight	*Fusarium* spp.*	3
	Leaf rust	*Puccinia triticina*	1
	Leaf spot	*Cochliobolus sativus, Stagonospora nodorum*, and *Pyrenophora tritici-repentis**	2
	Pseudo-black chaff	Melanism	1
	Root, crown, and foot rot (complex)	*Fusarium* spp.*	1
	Seedling blight (complex)	*Fusarium* spp*	2
	Consistent with herbicide damage	Suspect various herbicide groups	4
	Wheat Streak Mosaic Virus	Wheat Streak Mosaic Virus	3
Winter wheat	Environmental stress	Frost damage	1
	Powdery mildew	*Blumeria graminis*	2
	Stagonospora blotch	*Stagonospora nodorum*	1

*Testing to confirm the presence of other pathogens was not conducted.

Table 2. Summary of diseases diagnosed on forage crop samples submitted to the Saskatchewan Crop Protection Laboratory in 2016.

Crop	Disease/Injury	Causal Agent(s)	Number of Samples
Alfalfa	Unknown	*Phoma* spp.	2
Sweet clover	Consistent with herbicide damage	Undetermined	1
Timothy	Leaf spot	Undetermined	1
	Purple eyespot	*Cladosporium phlei*	2

Table 3. Summary of diseases diagnosed on fruit crop samples submitted to the Saskatchewan Crop Protection Laboratory in 2016.

Crop	Disease/Injury	Causal Agent(s)	Number of Samples
Apple	Fire blight	*Erwinia amylovora*	1

Table 4. Summary of diseases diagnosed on oilseed crop samples submitted to the Saskatchewan Crop Protection Laboratory in 2016.

Crop	Disease/Injury	Causal Agent(s)	Number of Samples
Canola	Alternaria black spot	*Alternaria* spp.	2
	Aster Yellows	AY Phytoplasma	
	Blackleg	*Leptosphaeria maculans*	1
	Environmental stress	Various stresses	2
	Hybridization nodules	Unknown	1
	Sclerotinia white mould	*Sclerotinia* spp.	3
	Consistent with herbicide damage	Suspect various groups	13
	Suspect nutrient deficiency	Undetermined	1
	Wire stem	*Rhizoctonia* spp.	1
Flax	Aster Yellows	AY Phytoplasma	1
	Environmental stress	Various stresses	2
	Consistent with herbicide damage	Suspect various herbicide groups	6

Table 5. Summary of diseases diagnosed on ornamental crop samples submitted to the Saskatchewan Crop Protection Laboratory in 2016.

Crop	Disease/Injury	Causal Agent(s)	Number of Samples
Flowering crabapple	Fire blight	*Erwinia amylovora*	1
Petunia	Stem rot	*Sclerotinia* spp.	1

Table 6. Summary of diseases diagnosed on pulse crop samples submitted to the Saskatchewan Crop Protection Laboratory in 2016.

Crop	Disease/Injury	Causal Agent(s)	Number of Samples
Chickpea	Ascochyta blight	*Ascochyta rabiei*	1
	Root rot (complex)	*Fusarium* spp.*	3
	Consistent with herbicide damage	Suspect herbicide Group 2 injury	10
Fababean	Chocolate spot	*Botrytis* spp.	2
	Stemphylium blight	*Stemphylium* spp.	1
	Consistent with herbicide damage	Suspect herbicide Group 2 injury	1
Field Pea	Foot rot	*Ascochyta* spp. complex	1
	Root rot (complex)	*Fusarium* spp.*	11
		Fusarium spp. and oomycete(s)*	12
		Oomycete(s)*	10
	Consistent with herbicide damage	Suspect herbicide Group 2 injury	8
Lentil	Anthracnose	*Colletotrichum lentis*	2
	Botrytis grey mould / stem and pod rot	*Botrytis* spp.	2
	Environmental stress	Various stresses	13
	Root rot (complex)	*Fusarium* spp.*	11
		Fusarium spp. and oomycete(s)*	5
		Oomycete(s)*	10
	Stemphylium blight	*Stemphylium* spp.	2
	Consistent with herbicide damage	Suspect various herbicide groups	13
Soybean	Environmental stress	Various stresses	1
	Stem rot	*Phytophthora* spp.	1

*Testing to confirm the presence of other pathogens was not conducted.

Table 7. Summary of diseases diagnosed on special crop samples submitted to the Saskatchewan Crop Protection Laboratory in 2016.

Crop	Disease/Injury	Causal Agent(s)	Number of Samples
Canaryseed	Root, crown, and foot rot (complex)	*Fusarium* spp.*	1
	Consistent with herbicide damage	Suspect various herbicide groups	1
Coriander	Blossom blight (complex)	*Botrytis* spp., *Fusarium* spp. and *Alternaria* spp.*	1
Corn	Consistent with herbicide damage	Unidentified contact herbicide	1
	Suspected nutrient deficiency	Consistent with zinc deficiency	1
	Suspected nutrient deficiency	Consistent with zinc deficiency	1
Quinoa	Suspected Phoma stalk rot	Unconfirmed *Phoma* spp.	1
	Unknown disease / injury	*Fusarium* spp.	
	Unknown disease/injury	*Fusarium* spp.	1

*Testing to confirm the presence of other pathogens was not conducted.

Table 8. Summary of diseases diagnosed on tree samples submitted to the Saskatchewan Crop Protection Laboratory in 2016.

Crop	Disease/Injury	Causal Agent(s)	Number of Samples
Evergreen	Environmental stress	Winter damage	1
	Consistent with herbicide damage	Undetermined	1
Maple	Environmental stress	Undetermined	1
Plains cottonwood	Leaf rust	*Melampsora* spp.	1

Table 9. Summary of diseases diagnosed on elm samples submitted to the Saskatchewan Crop Protection Laboratory in 2016.

Crop	Disease/Injury	Causal Agent(s)	Number of Samples
Elm	Suspect anthracnose	*Gloeosporium* spp.	1
	Dothiorella wilt	*Dothiorella ulmi*	17
	Dutch elm disease (DED)	Confirmed *Ophiostoma ulmi*	55
	Samples testing negative for disease	No pathogens detected	127

Table 10. Summary of diseases diagnosed on vegetable samples submitted to the Saskatchewan Crop Protection Laboratory in 2016.

Crop	Disease/Injury	Causal Agent(s)	Number of Samples
Cucumber	Septoria leaf spot	*Septoria cucurbitacearum*	1
Garlic	Environmental stress	Various stresses	1
Horseradish	Consistent with herbicide damage	Suspect herbicide Group 14 injury	1
Potato	Late blight	*Phytophthora infestans*	1
Tomato	Environmental stress Late blight	Hail damage *Phytophthora infestans*	1 1

CROP / CULTURE: Diagnostic Laboratory Report
LOCATION / RÉGION: Manitoba

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TITLE: 2016 MANITOBA AGRICULTURE CROP DIAGNOSTIC CENTRE LABORATORY SUBMISSIONS

ABSTRACT: This report summarizes the diseases and disorders diagnosed on plant samples analyzed by the Manitoba Agriculture Crop Diagnostic Centre in 2016. Samples received by the laboratory covered most crops grown in Manitoba and also included ornamentals, turf grasses and trees.

METHODS: The Manitoba Agriculture, Crop Diagnostic Centre provides diagnoses and control recommendations for disease problems of agricultural crops and ornamentals. Samples are submitted by Manitoba Agriculture Crop Industry Branch specialists, extension and other departmental personnel, farmers, agri-business representatives and the general public. Diagnostic methods used included 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 to11 and cover the time period from January 1 to November 30, 2016.

Table 1. Summary of diseases diagnosed on **herbaceous ornamental plant samples** submitted to the Manitoba Agriculture Crop Diagnostic Centre in 2016.

CROP	SYMPTOM/ DISEASE	CAUSAL AGENT	NUMBER OF SAMPLES
Carnation	Leaf spot	*Alternaria dianthi*	1
Rose	Black spot	*Marssonina rosae*	1
Rose	Crown gall	*Agrobacterium tumefaciens*	1

Table 2. Summary of diseases diagnosed on **greenhouse crop samples** submitted to the Manitoba Agriculture Crop Diagnostic Centre in 2016.

CROP	SYMPTOM/ DISEASE	CAUSAL AGENT	NUMBER OF SAMPLES
Basil	Early blight	*Alternaria solani*	2
	Root rot	*Rhizoctonia* sp.	1
Tomato	Fusarium wilt	*Fusarium* sp.	1
	Environmental injury		2

Table 3. Summary of diseases diagnosed on **cereal crop samples** submitted to the Manitoba Agriculture Crop Diagnostic Centre in 2016.

CROP	SYMPTOM/ DISEASE	CAUSAL AGENT	NUMBER OF SAMPLES
Wheat	Bacterial leaf blight	*Pseudomonas syringae* pv. *syringae*	5
	Bacterial leaf streak	*Xanthomonas sp.*	1
	Black head moulds	*Epicoccum nigrum, Alternaria sp.*	1
	Black point	*Alternaria sp., Cladosporium sp., Epicoccum nigrum*	3
	Common root rot	*Cochliobolus sativus*	1
	Fusarium head blight	*Fusarium sp.*	3
	Glume blotch	*Septoria sp.*	1
	Leaf spot	*Septoria sp.*	6
	Powdery mildew	*Blumeria graminis*	3
	Root rot	*Fusarium sp., Pythium sp., Rhizoctonia solani*	9
	Stripe rust	*Puccinia striiformis*	2
	Tan spot	*Pyrenophora tritici-repentis*	15
	Environmental injury		14
	Physiological disorders	*Undetermined*	2
	Physiological leaf spot	*Chloride deficiency*	3
	Herbicide injury		4
	Nutrient deficiency		10
Barley	Bacterial leaf blight	*Pseudomonas syringae* pv. *Syringae*	2
	Common root rot	*Cochliobolus sativus*	1
	Fusarium head blight	*Fusarium graminearum, F. avenaceum*	6
	Leaf rust	*Puccinia sp.*	1
	Leaf spot	*Septoria sp.*	1
	Loose smut	*Ustilago nuda*	2
	Net blotch	*Drechslera teres*	2
	Root rot	*Fusarium sp.*	1
	Herbicide injury		1
	Environmental injury		1
	Nutrient deficiency	*Undetermined*	1
Oat	Bacterial blight	*Pseudomonas syringae*	5
	Fusarium head blight	*Fusarium graminearum, F. avenaceum*	1
	Root rot	*Fusarium sp.*	1
Rye	Bacterial leaf streak	*Xanthomonas* sp.	1
	Root rot complex	*Fusarium* sp., *Cochliobolus* sp.	1

Table 4. Summary of diseases diagnosed on **vegetable crop samples** submitted to the Manitoba Agriculture Crop Diagnostic Centre in 2016.

CROP	SYMPTOM/ DISEASE	CAUSAL AGENT	NUMBER OF SAMPLES
Basil	Leaf spot	*Botrytis sp.*	1
Beet	Cercospora leaf spot	*Cercospora* sp.	1
Cabbage	Root rot	*Fusarium oxysporum*	2
		Pythium sp.	2
	Black rot	*Xanthomonas campestris pv. campestris*	2
	General stress	Environmental stress	2
Cauliflower	Bacterial leaf spot	*Pseudomonas syringae*	1
	Black rot	*Xanthomonas campestris pv. Campestris*	2
Chard	Cercospora leaf spot	*Cercospora* sp.	1
Cucumber	Alternaria leaf spot	*Alternaria cucumerina*	1
	Powdery mildew	*Erysiphe cichoracearum*	1
Garlic	Fusarium basal rot	*Fusarium* sp.	2
	Blue mould	*Penicillium* sp.	2
Lettuce	Downy mildew	*Bremia lactucae*	1
Onion	Neck rot	*Botrytis allii*	1
	Fusarium basal rot	*Fusarium* sp.	4
	Herbicide injury		1
Parsnip	Environmental injury		1
Pepper	Early blight	*Alternaria solani*	2
	Herbicide injury		1
	General stress	Environmental stress	1
Pumpkin	Root rot	*Fusarium oxysporum, Fusarium* spp.	2
Rhubarb	Environmental injury		1
Squash	Bacterial fruit blotch	*Pseudomonas* sp.	1
Tomato	Black mould (fruit)	*Alternaria alternate*	5
	Cercospora leaf mould	*Pseudocercospora fuligena*	1
	Early blight	*Alternaria solani*	1
	General stress	*Environmental stress*	4
	Late blight	*Phytophthora infestans*	6
	Herbicide injury		3
Zucchini	Gummy stem blight	*Phoma cucurbitacearum*	1
	General stress	Environmental stress	1
	Herbicide injury		1

Table 5. Summary of diseases diagnosed on **potato crop samples** submitted to the Manitoba Agriculture Crop Diagnostic Centre in 2016.

SYMPTOM/ DISEASE	CAUSAL AGENT	NUMBER OF SAMPLES
Bacterial soft rot	*Pectobacterium carotovorum* subsp. *carotovorum*	2
Black dot(tuber)	*Colletotrichum coccodes*	8
Blackleg	*Pectobacterium carotovorum* subsp. *atrosepticum*	2
Black scurf (tuber)	*Rhizoctonia solani*	2
Brown spot	*Alternaria alternata*	1
Early blight (foliar)	*Alternaria solani*	3
Fusarium dry rot	*Fusarium sambucinum*	2
Late blight	*Phytophthora infestans*	14
Leak	*Pythium* sp.	3
Pink eye	Unknown	1
Pink rot	*Phytophthora erythroseptica*	10
Potato Mop Top	*Furovirus*	3
Root rot	*Rhizoctonia solani, Fusarium* spp.	1
Scab, common	*Streptomyces* spp.	2
Scab, powdery	*Spongospora subterranea*	2
Silver scurf	*Helminthosporium solani*	9
Slime mold	*Stemonitis* sp.	1
Tobacco Rattle Virus	*Tobravirus*	1
Herbicide injury		2

Table 6. Summary of diseases diagnosed on **shelterbelt trees** and **woody ornamental plants** submitted to the Manitoba Agriculture Crop Diagnostic Centre in 2016.

CROP	SYMPTOM/ DISEASE	CAUSAL AGENT	NUMBER OF SAMPLES
Ash (*Fraxinus* sp.)	AnthracnoseCanker	*Gloeosporium aridum*	21
	Fire blight	*Cytospora sp.*	2
	Environmental injury	*Erwinia amylovora*	3
	Herbicide injury		3
Crabapple	Canker	*Cytospora* sp.	2
(*Malus* spp.)	Frogeye leaf spot	*Botryosphaeria obtusa*	1
	Fire blight	*Erwinia amylovora*	2
Basswood	Anthracnose	*Apiognomonia tiliae*	1
(Tilia americana)	Canker	*Nectria sp.*	1
	Canker	*Phoma sp.*	1
	Herbicide injury		3
Caragana	Canker	*Cytospora* sp.	1
(*Caragana* sp.)	Leaf Spot	*Septoria* sp.	1

Table 6 (cont.)

Cotoneaster	Environmental injury		1
(*Cotoneaster* sp.)	Nutritional deficiency		1
Crabapple	Canker	*Cytospora* sp.	3
(*Malus* spp.)	Fire blight	*Erwinia amylovora*	2
	Frogeye leaf spot	*Botryosphaeria obtusa*	1
	Environmental injury		2
	Nutrient deficiency		1
Elm, American	Anthracnose	*Gnomonia ulmea*	8
(*Ulmus americana*)	Botryosphaeria canker	*Botryosphaeria sp.*	3
	Coniothyrium canker	*Coniothyrium sp.*	2
	Cytospora canker	*Cytospora sp.*	3
	Dutch elm disease	*Ophiostoma ulmi*	42
	Verticillium wilt	*Verticillium albo-atrum*	6
	Environmental injury		1
Juniper	Canker	*Cytospora* sp.	1
(*Juniperus* sp.)	Twig blight	*Phomopsis* sp.	2
Lilac	Herbicide injury		2
(*Syringa vulgaris*)			
Maple, Manitoba (	Leaf spot	Phoma sp.	1
Acer negundo)	Environmental injury		1
	Herbicide injury		1
Maple, silver	Anthracnose	*Gloeosporium* sp.	1
(*Acer saccharinum*)	Environmental injury		1
Oak	Anthracnose	*Discula* sp.	61
(*Quercus macrocarpae)*	Leaf blister	*Taphrina caerulescens*	2
	Canker	*Phoma sp.*	1
	Environmental injury		
Pine, Scots	Needle cast	*Lophodermium* sp.	2
(*Pinus sylvestris*)	Winter injury	Environmental stress	2
Poplar	Canker	*Cytospora* sp.	1
(*Populus* spp.)	Bronze leaf disease	*Apioplagiostoma populi*	2
	Herbicide injury		1
Spruce	Canker	*Undetermined*	2
(*Picea* spp.)	Canker	*Cytospora sp.*	2
	Needle blight	*Lirula sp.*	2
	Needle cast	*Rhizosphaera kalkhoffii*	7
	Stigmina needle blight	*Stigmina lautii*	7
	Twig canker	*Phoma sp.*	1
	Environmental injury		15
	Nutrient deficiency		55

Table 7. Summary of diseases diagnosed on **oilseed crop samples** submitted to the Manitoba Agriculture Crop Diagnostic Centre in 2016.

CROP	SYMPTOM/ DISEASE	CAUSAL AGENT	NUMBER OF SAMPLES
Canola	Blackleg	*Leptosphaeria maculans*	15
	Black spot	Alternaria brassicae	3
	Clubroot	Plasmodiophora brassicae	0
	Root rot	Fusarium sp., Pythium sp.	16
	Root rot	Rhizoctonia solani	1
	Stem rot	Sclerotinia sclerotiorum	1
	Wilt	Fusarium oxysporum	1
	Wilt	Verticillium sp.	4
	Nutrient deficiency	Undetermined	2
	Nutrient deficiency	Possible sulphur / phosphorus deficiency	2
	Nutrient deficiency		1
	Nutrient deficiency	Possible nitrogen deficiency	2
	Physiological disorder	Undetermined	3
	Environmental injury	Undetermined	5
	Herbicide injury		23
Flax	Pasmo	*Septoria linicola*	1
	Fusarium wilt	*Fusarium oxysporum*	2
	Root rot	*Pythium* sp., *Rhizoctonia* sp.	1
	Herbicide injury		5
Sunflower	Leaf spot	*Alternaria* sp.	2
	Root rot	*Fusarium* sp.	1
	Root rot	*Pythium* sp.	1
	Head rot	*Sclerotinia sclerotiorum*	1
	Stem canker	*Phomopsis helianthi*	2
	Stalk rot	*Sclerotinia sclerotiorum*	1
	Herbicide injury		3

Table 8. Summary of diseases diagnosed on **fruit crop samples** submitted to the Manitoba Agriculture Crop Diagnostic Centre in 2016.

CROP	SYMPTOM/ DISEASE	CAUSAL AGENT	NUMBER OF SAMPLES
Apple	Fire blight	*Erwinia amylovora*	3
	Frogeye leaf spot and fruit spot	Botryosphaeria obtusa Diplodia sp.	2
	Twig canker	Coniothyrium sp.	1
		Cytospora sp.	3
		Nectria sp.	2
		Unidentified	2
	Fruit disorder	Virus-like, graft-transmissible disease	1
	Environmental injury		3
	Nutrient deficiency		1
Cherry	Anthracnose	*Gloeosporidiella variabilis*	1
	Fire blight	*Erwinia amylovora*	1
	Twig canker	*Botryosphaeria* sp.	1
	Twig blight	*Coniothyrium* sp.	1

Table 8 (cont.)

Grape	Leaf spot	*Phoma* sp.	1
		Phyllosticta sp.	1
Raspberry	Anthracnose	*Elsinoë veneta*	1
	Bacterial blight	*Pseudomonas syringae*	2
	Fire blight	*Erwinia amylovora*	1
	Spur blight	*Didymella applanata*	1
Saskatoon berry	Rust	*Gymnosporangium clavipes*	1
	Twig canker	*Cytospora* sp.	4
	Environmental injury		2
	Herbicide injury		1
Strawberry	Anthracnose	*Colletotrichum acutatum Botrytis*	4
	Flower blight	*cinerea*	3
	Fruit rot	*Botrytis cinerea*	1
	Root rot	*Rhizoctonia* sp., *Fusarium* sp.,	4
	Slime Mould	*Cylindrocarpon* sp., *Phytophthora*	1
	Environmental injury	sp.	3
		Slime mould	

Table 9. Summary of diseases diagnosed on **forage legume crop samples** submitted to the Manitoba Agriculture Crop Diagnostic Centre in 2016.

CROP	SYMPTOM/ DISEASE	CAUSAL AGENT	NUMBER OF SAMPLES
Alfalfa	Leptosphaerulina leaf spot	*Leptosphaerulina* sp.	1
	Spring black stem / leaf spot	*Phoma medicaginis*	3
	Stemphylium leaf spot	*Stemphylium* sp.	2
	Summer black stem / leaf spot	*Cercospora medicaginis*	1
	Root rot	*Pythium* sp.	1
	Herbicide injury		2
	Environmental injury		1
	Nutrient deficiency		1
Hairy Vetch (*Vicia villosa*)	Powdery mildew	*Erysiphe* sp.	1

Table 10. Summary of diseases diagnosed on **forage grass** and **turfgrass samples** submitted to the Manitoba Agriculture Crop Diagnostic Centre in 2016.

CROP	SYMPTOM/ DISEASE	CAUSAL AGENT	NUMBER OF SAMPLES
Timothy	Environmental injury		1
Turfgrass	Root rot	*Pythium* sp.	1
	Herbicide injury		1

Table 11. Summary of diseases diagnosed on **special crop samples** submitted to the Manitoba Agriculture Crop Diagnostic Centre in 2016.

CROP	SYMPTOM/ DISEASE	CAUSAL AGENT	NUMBER OF SAMPLES
Canary seed	Fusarium head blight	*Fusarium* sp.	1
	Root rot	*Fusarium* sp.	1
Corn	Stewart's bacterial blight	*Xanthomonas* sp.	4
	Goss's wilt	*Clavibacter michiganensis* subsp. *nebraskensis*	5
	Holcus spot	*Pseudomonas syringae*	1
	Root rot	*Fusarium* sp.	1
	Nutrient deficiency		1
Dry bean	Common blight	*Xanthomonas axonopodis* pv. *Phaseoli*	2
	Halo blight	*Pseudomonas syringae* pv. *phaseolicola*	1
	Nutrient deficiency		1
	Herbicide injury		5
Faba bean	Alternaria leaf spot	*Alternaria alternata*	1
Field pea	Alternaria leaf spot	*Alternaria* sp.	2
	Anthracnose	*Colletotrichum pisi*	4
	Root rot	*Aphanomyces sp.*	4
	Root rot	*Fusarium sp.*	15
	Root rot	*Fusarium sp., Rhizoctonia sp.*	3
	Environmental stress		2
	Nutrient deficiency		1
	Herbicide injury		10
Hemp	Flower blight	*Fusarium graminearum, F. sporotrichioides*	1
	Root and stem rot	*Fusarium oxysporum*	2
Quinoa	Leaf and stem spot	*Ascochyta* sp.	1
	Stem canker	*Phoma* sp.	1
Soybean	Alternaria leaf spot	*Alternaria* sp.	2
	Anthracnose	*Colletotrichum sp.*	2
	Bacterial blight	*Pseudomonas sp.*	1
	Brown spot	*Septoria glycines*	12
	Downy mildew	*Peronospora manshurica*	1
	Leaf spot	*Phyllosticta sojicola*	2
	Pod and seed rot	*Phomopsis sp.*	2
	Root rot	*Fusarium spp., Pythium spp.,*	3
	Root rot	*Rhizoctonia solani*	4
	Stem blight	*Phytophthora sojae*	5
	Stem blight	*Phomopsis longicolla*	1
	Stem rot	*Phomopsis sp.*	7
	Environmental stress	*Sclerotinia sclerotiorum*	9
	Nutrient deficiency		14
	Herbicide injury		2
	Physiological stress		31

CROP / CULTURE: Commercial Crops **-** Diagnostic Laboratory Report
LOCATION / RĖGION: Ontario

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TITLE: DISEASES DIAGNOSED ON PLANT SAMPLES SUBMITTED TO THE PEST DIAGNOSTIC CLINIC, UNIVERSITY OF GUELPH IN 2016

ABSTRACT: Diseases and their causal agents diagnosed on plant samples received by the Pest Diagnostic Clinic, University of Guelph in 2016 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 Pest Diagnostic Clinic of the University of Guelph provides plant pest diagnostic services to growers, agri-businesses, provincial and federal governments and homeowners across Canada. Services include disease diagnosis, plant parasitic nematode identification and enumeration, pathogen detection from soil and water, and insect and plant identification. The following data are for samples received by the laboratory for disease diagnosis in 2016. 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 2016, from January 1 to December 31, the Pest Diagnostic Clinic received samples representing plants in over 100 genera for disease diagnosis. Results are presented in Tables 1 to 6 below. For various reasons, the frequency of 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 2016 are commonly diagnosed.

Table 1. Summary of plant diseases diagnosed on **vegetable** samples (including **greenhouse vegetables**) submitted to the University of Guelph Pest Diagnostic Clinic in 2016.

CROP NAME	DISEASE	CAUSAL AGENT	NO. OF SAMPLES
Beet (*Beta vulgaris*)	Rot	*Fusarium oxysporum*	1
Cabbage (*Brassica oleracea* var. *capitata*)	Black rot	*Xanthomonas campestris*	2
	Root rot	*Fusarium oxysporum*	2
	Root rot	*Fusarium solani*	1
	Root rot	*Pythium aphanidermatum*	1
	Root rot	*Pythium ultimum*	1
	Root rot	*Rhizoctonia solani*	1
Carrot (*Daucus carota*)	Cavity spot	*Pythium ultimum*	1
	Root rot	*Rhizoctonia solani*	1
	Rot	*Fusarium oxysporum*	2
	Rot	*Fusarium solani*	1
Cauliflower (*Brassica oleracea* var. *botrytis*)	Downy mildew	*Hyaloperonospora* sp.	1

Table 1 (cont.)

Celery (*Apium graveolens*)	Crown and root rot	*Fusarium oxysporum*	1
	Crown and root rot	*Fusarium solani*	1
	Crown and root rot	*Pythium irregulare*	1
	Crown and root rot	*Pythium ultimum*	1
Cucumber (*Cucumis sativus*)	Bacterial wilt	*Erwinia tracheiphila*	1
	Blight	*Phytophthora capsici*	1
	Canker	*Phomopsis sp.*	2
	Crazy root	*Agrobacterium sp.*	3
	Crown rot	*Fusarium oxysporum*	1
	Crown rot	*Fusarium solani*	1
	Crown and root rot	*Fusarium oxysporum*	3
	Crown and root rot	*Fusarium solani*	1
	Crown and root rot	*Phytophthora capsici*	1
	Crown and root rot	*Pythium aphanidermatum*	1
	Crown and root rot	*Pythium dissotocum*	1
	Crown and root rot	*Pythium irregulare*	1
	Crown and root rot	*Pythium ultimum*	
	Cucumber Green Mottle Mosaic Virus	*Cucumber Green Mottle Mosaic Virus (CGMMV)*	19
	Gummy stem blight	*Didymella bryoniae*	3
	Powdery mildew	*Oidium sp.*	4
	Root rot	*Fusarium oxysporum*	5
	Root rot	*Fusarium solani*	1
	Root rot	*Phytophthora capsici*	1
	Root rot	*Pythium sp.*	1
	Root rot	*Pythium aphanidermatum*	6
	Root rot	*Pythium dissotocum*	1
	Root rot	*Pythium irregulare*	1
	Root rot	*Pythium sylvaticum*	2
	Tobacco Ringspot Virus	*Tobacco Ringspot Virus (TRSV)*	1
	Tobacco Streak Virus	*Tobacco Steak Virus (TSV)*	2
	White mould	*Sclerotinia sclerotiorum*	1
Eggplant (*Solanum melongena*)	Root rot	*Pythium ultimum*	1
	Verticillium wilt	*Verticillium dahliae*	1
Garlic (*Allium sativum*)	Garlic Common Latent Virus	Garlic Common Latent Virus (GCLV)	1
	Gray mould	*Botrytis cinerea*	1
	Neck rot	*Botrytis sp.*	2
	Plate rot	*Fusarium oxysporum*	1
	Plate rot	*Fusarium solani*	1
	Potyvirus	*Potyvirus*	6
	Root rot	*Pythium ultimum*	2
	Rot	*Fusarium oxysporum*	8
	Rot	*Rhizopus sp.*	1
Lettuce (*Lactuca sativa*)	Drop	*Sclerotinia sclerotiorum*	1
	Root rot	*Pythium dissotocum*	1
	Root rot	*Pythium irregulare*	1
Melon (*Cucumis* sp.)	Crown rot	*Fusarium oxysporum*	1
	Crown rot	*Fusarium solani*	1
	Crown rot	*Pythium aphanidermatum*	1
	Crown rot	*Pythium irregulare*	1

Table 1 (cont.)

Onion (*Allium cepa*)	Basal rot	*Fusarium oxysporum*	3
	Basal rot	*Fusarium solani*	3
	Leaf blight	*Stemphylium sp.*	2
	Root rot	*Fusarium oxysporum*	2
	Root rot	*Fusarium solani*	2
	Root rot	*Pythium sp.*	1
	Root rot	*Pythium ultimum*	2
Pepper (*Capsicum* sp.)	Anthracnose	*Colletotrichum* sp.	1
	Anthracnose	*Colletotrichum capsici*	1
	Bacterial leaf spot	*Pseudomonas syringae*	1
	Bacterial leaf spot	*Xanthomonas campestris*	2
	Blight	*Phytophthora capsici*	1
	Crown and root rot	*Fusarium sp.*	1
	Crown and root rot	*Fusarium oxysporum*	4
	Crown and root rot	*Fusarium solani*	5
	Crown and root rot	*Phytophthora capsici*	1
	Crown and root rot	*Pythium dissotocum*	1
	Crown and root rot	*Pythium irregulare*	1
	Crown and root rot	*Pythium sylvaticum*	2
	Crown and root rot	*Pythium ultimum*	1
	Fruit rot	*Colletotrichum capsici*	1
		Geotrichum sp.	
	Fruit rot	*Pectobacterium carotovorum*	1
	Fruit rot	*Phytophthora capsici*	2
	Fruit rot	*Rhizopus sp.*	3
	Impatiens Necrotic Spot Virus	*Impatiens Necrotic Spot Virus (INSV)*	3 1
	Powdery mildew	*Oidiopsis sicula*	1
	Root rot	*Fusarium oxysporum*	5
	Root rot	*Fusarium solani*	2
	Root rot	*Phytophthora capsici*	1
	Root rot	*Pythium dissotocum*	1
	Root rot	*Pythium ultimum*	1
	Root rot	*Rhizoctonia solani*	2
	Tomato Spotted Wilt Virus	*Tomato Spotted Wilt Virus (TSWV)*	1
Potato (*Solanum tuberosum*)	Crown and root rot	*Rhizoctonia solani*	1
	Dry rot	*Fusarium sp.*	2
	Root rot	*Fusarium oxysporum*	1
	Root rot	*Fusarium solani*	1
	Root rot	*Pythium ultimum*	1
	Soft rot	*Pectobacterium carotovorum*	1
	Verticillium wilt	*Verticillium dahliae*	3
Pumpkin (*Cucurbita pepo*)	Anthracnose	*Colletotrichum* sp.	1
	Blight	Phytophthora capsici	1
	Fruit rot	Phytophthora capsici	3
	Powdery mildew	Oidium sp.	1
	Potyvirus	Potyvirus	1
	Squash Mosaic Virus	Squash Mosaic Virus (SqMV)	1
Radish (*Raphanus sativus*)	Bacterial leaf spot	*Xanthomonas campestris*	1

Table 1 (cont.)

Rutabaga (*Brassica napus*)	Downy mildew	*Hyaloperonospora* sp.	1
Shallot (*Allium cepa*)	Basal rot	*Fusarium* sp.	1
Squash (*Cucurbita argyrosperma*)	Powdery mildew Root rot	*Oidium* sp.	2
	Root rot	*Fusarium sp.*	1
	Root rot	*Pythium irregulare*	1
	Root rot	*Pythium ultimum*	1
		Thielaviopsis basicola	1
Swiss chard (*Beta vulgaris* subsp. *vulgaris*)	Root rot	*Pythium dissotocum*	1
Tomato (*Lycopersicon esculentum*)	Anthracnose	*Colletotrichum dematium*	2
	Anthracnose	*Colletotrichum coccodes*	4
	Black mould	*Alternaria alternata*	1
	Crazy root	*Agrobacterium sp.*	16
	Crown rot	*Fusarium oxysporum*	1
	Crown and root rot	*Fusarium oxysporum*	11
	Crown and root rot	*Fusarium solani*	4
	Crown and root rot	*Phytophthora capsici*	2
	Crown and root rot	*Pythium sp.*	1
	Crown and root rot	*Pythium aphanidermatum*	1
	Crown and root rot	*Pythium dissotocum*	6
	Crown and root rot	*Pythium irregulare*	1
	Crown and root rot	*Pythium ultimum*	3
	Crown and root rot	*Rhizoctonia solani*	1
	Fruit rot	*Cladosporium sp.*	7
	Fruit rot	*Rhizopus sp.*	2
	Leaf mould	*Fulvia fulva*	1
	Pepino Mosaic Virus	*Pepino Mosaic Virus (PepMV)*	10
	Pith necrosis	*Pseudomonas marginalis*	1
	Pospiviroid	*Pospiviroid*	1
	Root rot	*Fusarium oxysporum*	7
	Root rot	*Fusarium solani*	1
	Root rot	*Phytophthora cryptogea*	1
	Root rot	*Pythium sp.*	3
	Root rot	*Pythium aphanidermatum*	1
	Root rot	*Pythium dissotocum*	4
	Sour rot	*Geotrichum sp.*	5
	Stem rot	*Pectobacterium chrysanthemi*	1
	Tomato bacterial canker	*Clavibacter michiganensis subsp. michiganensis*	6
	Tomato Spotted Wilt Virus	*Tomato Spotted Wilt Virus (TSWV)*	4
	Verticillium wilt	*Verticillium dahliae*	1

Table 2. Summary of plant diseases diagnosed on **fruit** samples submitted to the University of Guelph Pest Diagnostic Clinic in 2016.

CROP NAME	DISEASE	CAUSAL AGENT	NO. OF SAMPLES
Apple (*Malus* sp.)	Anthracnose Bitter rot	*Colletotrichum* sp.	1
	Black rot	Colletotrichum sp.	1
	Canker	Botryosphaeria obtusa	12
	Canker	Botryosphaeria sp.	6
	Canker	Cytospora sp.	5
	Canker	Diplodia seriata	1
	Canker	Fusarium sp.	1
	Canker	Nectria cinnabarina	1
	Fire blight	Phomopsis sp.	20
	Leaf spot	Erwinia amylovora	14
	Root rot	Phomopsis sp.	1
	Root rot	Phytophthora cactorum	2
	Rot	Pythium ultimum	3
		Trametes versicolor	2
Cranberry (*Vaccinium* sp.)	Leaf spot	*Pyrenobotrys compacta*	3
Grape (*Vitis* sp.)	Black rot	*Guignardia bidwellii*	1
	Grapevine Leafroll-associated Virus	*Grapevine Leafroll-associated Virus (GLRaV)*	10
	Grapevine Red Blotch-associated Virus	*Grapevine Red Blotch-associated Virus (GRBaV)*	11
Raspberry (*Rubus* sp.)	Crown and root rot	*Phytophthora cactorum*	1
	Crown and root rot	*Pythium sp.*	1
	Leaf spot	*Sphaerulina rubi*	1
	Potyvirus	*Potyvirus*	1
Strawberry (*Fragaria* sp.)	Anthracnose	*Colletotrichum* sp.	
	Anthracnose	*Colletotrichum acutatum*	3
	Crown rot	*Fusarium sp.*	1
	Crown and root rot	*Fusarium oxysporum*	3
	Crown and root rot	*Fusarium solani*	3
	Crown and root rot	*Gnomonia sp.*	1
	Crown and root rot	*Phytophthora cactorum*	1
	Crown and root rot	*Pythium irregulare*	2
	Gray mold	*Botrytis cinerea*	3
	Phytoplasma	*Phytoplasma*	2
	Strawberry Mild Yellow Edge Virus	*Strawberry Mild Yellow Edge Virus (SMYEV)*	4
	Strawberry Mottle Virus	*Strawberry Mottle Virus (SMoV)*	3
	Strawberry Pallidosis Virus	*Strawberry Pallidosis Virus (SPaV)*	23
	Strawberry Vein Banding Virus	*Strawberry Vein Banding Virus (SVBV)*	3
	Root rot	*Cylindrocarpon sp.*	3
	Root rot	*Pythium ultimum*	4
	Root rot	*Rhizoctonia solani*	2
	Verticillium wilt	*Verticillium dahliae*	1

Table 3. Summary of plant diseases diagnosed on **herbaceous ornamental** samples submitted to the University of Guelph Pest Diagnostic Clinic in 2016.

CROP NAME	DISEASE	CAUSAL AGENT	NO. OF SAMPLES
Annual bluegrass (*Poa annua*)	Anthracnose	*Colletotrichum graminicola*	1
	Blight	*Curvularia sp.*	1
	Root rot	*Pythium irregulare*	1
Athyrium sp.	Gray mould	*Botrytis cinerea*	1
Begonia (*Begonia* sp.)	Crown and root rot	*Pythium ultimum*	1
	Gray mould	*Botrytis cinerea*	1
	Root rot	*Pythium dissotocum*	2
Bentgrass (*Agrostis* sp.)	Anthracnose	*Colletotrichum graminicola*	2
	Blight	*Curvularia sp.*	1
	Leaf spot	*Bipolaris sp.*	1
	Root rot	*Pythium aphanidermatum*	1
	Root rot	*Pythium graminicola*	1
	Root rot	*Pythium irregulare*	1
	Take-all patch	*Gaeumannomyces graminis*	1
Bird-of-Paradise (*Strelitzia reginae*)	Crown and root rot	*Phytophthora nicotianae*	1
Bluegrass (*Poa* sp.)	Anthracnose	*Colletotrichum graminicola*	1
	Root rot	*Pythium graminicola*	1
	Root rot	*Pythium irregulare*	1
Calibrachoa (*Calibrachoa* sp.)	Gray mould	*Botrytis cinerea*	1
	Root rot	*Fusarium oxysporum*	3
	Root rot	*Pythium dissotocum*	2
	Root rot	*Thielaviopsis basicola*	9
Canna lily (*Canna* sp.)	Potyvirus	Potyvirus	1
Christmas cactus (*Schlumbergera* sp.)	Root rot	*Fusarium oxysporum*	2
	Root rot	*Pythium aphanidermatum*	1
	Root rot	*Pythium dissotocum*	1
	Root rot	*Pythium ultimum*	1
Chrysanthemum (*Chrysanthemum* sp.)	Bacterial soft rot	*Pectobacterium carotovorum*	2
	Stem rot	*Sclerotinia sclerotiorum*	1
Coleus (*Solenostemon* sp.)	Downy mildew	*Peronospora* sp.	2
	Gray mould	Botrytis cinerea	1
	Root rot	Pythium sp.	1
Cyclamen sp.	Gray mould	*Botrytis cinerea*	1
Dahlia (*Dahlia* sp.)	Crown rot	*Rhizoctonia solani*	1
	Gray mould	*Botrytis cinerea*	1
	Leaf spot	*Alternaria sp.*	1
	Root rot	*Fusarium oxysporum*	2
	Root rot	*Pythium dissotocum*	1
	Root rot	*Pythium irregulare*	1
Dipladenia (*Dipladenia* sp.)	Root rot	*Fusarium oxysporum*	4
	Root rot	*Fusarium solani*	3
	Root rot	*Phytophthora nicotianae*	2
	Root rot	*Pythium irregulare*	1
	Root rot	*Thielaviopsis basicola*	1

Table 3 (cont)

Echinacea (*Echinacea* sp.)	Root rot Tobacco Mosaic Virus	*Pythium dissotocum* Tobacco Mosaic Virus (TMV)	1 1
English ivy (*Hedera helix*)	Root rot Root rot Root rot Root rot Root rot	*Fusarium oxysporum* *Fusarium solani* *Phytophthorasp.* *Pythium dissotocum* *Pythium irregulare*	2 2 8 10 6
Geranium (*Pelargonium* sp.)	Bacterial blight Gray mould Root rot	*Xanthomonas campestris* *Botrytis cinerea* *Pythium sp.*	2 2 1
Gladiolus (*Gladiolus* sp.)	Potyvirus	Potyvirus	1
Grass (Gramineae)	Anthracnose Anthracnose Blight Blight Crown and root rot Crown and root rot Crown and root rot Crown and root rot Dollar spot Fusarium patch Leaf spot Leaf spot Necrotic ring spot Red thread Root rot Take-all patch	*Colletotrichum graminicola* *Microdochium bolleyi* *Curvularia sp.* *Fusarium culmorum* *Pythium sp.* *Pythium aphanidermatum* *Pythium graminicola* *Pythium irregulare* *Sclerotinia homoeocarpa* *Microdochium nivale* *Bipolaris sp.* *Spermospora sp.* *Leptosphaeria korrae* *Laetisaria fuciformis* *Fusarium culmorum* *Gaeumannomyces graminis*	8 5 2 4 6 7 12 8 6 13 6 1 6 3 1 1
Heuchera sp.	Root rot	*Thielaviopsis basicola*	1
Heucherella sp.	Root rot	*Thielaviopsis basicola*	1
Hibiscus sp.	Leaf spot	*Alternaria* sp.	1
Hosta (*Hosta* sp.)	Leaf spot	*Alternaria* sp.	1
Kalanchoe (*Kalanchoe* sp.)	Root rot Stem canker	*Phytophthora nicotianae* *Corynespora cassiicola*	1 1
Lavender (*Lavandula* sp.)	Crown and root rot Crown and root rot Gray mould Root rot Root rot Root rot Root rot Root rot	*Phytophthora nicotianae* *Pythium irregulare* *Botrytis sp.* *Fusarium oxysporum* *Fusarium solani* *Phytophthora sp.* *Pythium sp.* *Thielaviopsis basicola*	1 1 4 1 1 1 1 4
Leucanthemum sp.	Stem rot	*Fusarium solani*	1
Lily (*Lilium* sp.)	Bulb and root rot Gray mould	*Pythium* sp. *Botrytis* sp.	1 1
Lisianthus (*Eustoma grandiflorum*)	Root rot Stem rot	*Pythium* sp. *Fusarium oxysporum*	1 1
Lobelia (*Lobelia* sp.)	Crown gall	*Agrobacterium* sp.	8

Table 3 (cont.)

Monarda sp.	Gray mould Root rot	*Botrytis cinerea* *Thielaviopsis basicola*	4 2
Morning glory (*Ipomoea* sp.)	Crown and root rot Crown and root rot	*Fusarium oxysporum* *Pythium* sp.	2 1
Moth orchid (*Phalaenopsis* sp.)	Bacterial leaf spot	*Acidovorax avenae*	1
Orchid (Orchidaceae)	Cymbidium Ringspot Virus Odontoglossum Ringspot Virus Potyvirus Tobacco Mosaic Virus	Cymbidium Ringspot Virus (CymRSV) Odontoglossum Ringspot Virus (ORSV) Potyvirus Tobacco Mosaic Virus (TMV)	1 1 1 1
Pansy (*Viola* sp.)	Gray mould Root rot	*Botrytis cinerea* *Phythium* sp.	1 1
Persian violet (*Exacum* sp.)	Gray mould	*Botrytis cinerea*	4
Peony (*Paeonia* sp.)	Gray mould	*Botrytis cinerea*	1
Petunia (*Petunia* sp.)	Gray mould	*Botrytis cinerea*	1
Poinsettia (*Euphorbia pulcherrima*)	Crown and root rot Crown and root rot Crown and root rot Crown and root rot Crown and root rot Root rot Root rot	*Fusarium* sp. *Fusarium oxysporum* *Fusarium solani* *Pythium irregulare* *Rhizoctonia solani* *Fusarium oxysporum* *Pythium aphanidermatum*	1 11 1 1 2 1 3
Potentilla (*Potentilla* sp.)	Root rot	*Phytophthora drechsleri*	1
Sage (*Salvia* sp.)	Potyvirus	Potyvirus	1
Sedum (*Sedum* sp.)	Anthracnose Crown and root rot Crown and root rot Crown and root rot Gray moldmould Powdery mildew Root rot Root rot Root rot Root rot Root rot Stem rot	*Colletotrichum* sp. *Fusarium oxysporum* *Fusarium solani* *Pythium dissotocum* *Botrytis cinerea* *Oidium sp.* *Fusarium oxysporum* *Fusarium solani* *Pythium irregulare* *Pythium ultimum* *Rhizoctonia solani* *Fusarium sp.*	1 1 1 2 1 2 4 3 4 3 3 1
Senna corymbosa	Potyvirus	Potyvirus	1
Snapdragon (*Antirrhinum* sp.)	Root rot Root rot	*Fusarium oxysporum* *Thielaviopsis basicola*	1 2
Spurge (*Euphorbia* sp.)	Root rot Root rot	*Fusarium solani* *Thielaviopsis basicola*	1 1

Table 3 (cont.)

Sweet potato vine (*Ipomoea butatas*)	Crown and root rot	*Fusarium oxysporum*	1
Sweet woodruff (*Galium odoratum*)	Downy mildew Root rot	*Peronospora* sp. *Pythium ultimum*	1 1
Vinca sp.	Arabis Mosaic Virus Cucumber Mosaic Virus	Arabis Mosaic Virus (ArMV) Cucumber Mosaic Virus (CMV)	1 2

Table 4. Summary of plant diseases diagnosed on **woody ornamental** samples submitted to the University of Guelph Pest Diagnostic Clinic in 2016.

CROP NAME	DISEASE	CAUSAL AGENT	NO. OF SAMPLES
Balsam poplar (*Populus balsamifera*)	Canker	*Cytospora* sp.	1
Black cherry (*Prunus serotina*)	Root rot	*Fusarium oxysporum*	1
	Root rot	*Fusarium solani*	1
	Root rot	*Pythium ultimum*	1
Boxwood (*Buxus* sp.)	Blight	*Fusarium* sp.	4
	Canker	*Volutella buxi*	19
	Dieback	*Phoma* sp.	4
	Leaf blight	*Volutella buxi*	47
	Root rot	*Fusarium oxysporum*	6
	Root rot	*Phytophthora* sp.	1
	Root rot	*Phytophthora nicotianae*	3
	Root rot	*Pythium* sp.	1
	Root rot	*Pythium dissotocum*	2
	Root rot	*Pythium irregulare*	1
	Root rot	*Thielaviopsis basicola*	6
Colorado blue spruce (*Picea pungens*)	Needlecast	*Rhizosphaera kalkhoffii*	6
	Needlecast	*Setomelanomma holmii*	2
	Needlecast	*Stigmina sp.*	3
	Tip blight	*Sphaeropsis sapinea*	1
Cornus sericea	Leaf spot	*Septoria cornicola*	1
Cotoneaster (*Cotoneaster* sp.)	Canker	*Phomopsis* sp.	1
Crabapple (*Malus* sp.)	Canker	*Botryosphaeria* sp.	2
	Fire blight	*Erwinia amylovora*	1
	Scab	*Venturia inaequalis*	2
Dogwood (*Cornu s*sp.)	Leaf spot	*Septoria* sp.	1
Deutzia gracilis	Root rot	*Fusarium solani*	1
	Root rot	*Pyhium dissotocum*	1
Douglas fir (*Pseudotsuga menziesii*)	Root rot	*Thielaviopsis basicola*	1
Eastern white cedar (*Thuja occidentalis*)	Needle blight	*Phyllosticta thujae*	1
	Tip blight	*Pestalotiopsis* sp.	1
Eastern white pine (*Pinus strobus*)	Root rot	*Fusarium oxysporum*	1
	Root rot	*Fusarium solani*	1
	Root rot	*Pythium sp.*	
Elm (*Ulmus* sp.)	Canker	*Botryosphaeria* sp.	1
	Dutch elm disease	Ophiostoma sp.	1
Euonymus (*Euonymus* sp.)	Bacterial leaf spot	*Pseudomonas syringae*	1
	Powdery mildew	*Oidium* sp.	1
Forsythia (*Forsythia* sp.)	Root rot	*Fusarium oxysporum*	1
	Root rot	*Fusarium solani*	1
	Root rot	*Phytophthora nicotianae*	1
Fraser fir (*Abies fraseri*)	Root rot	*Fusarium oxysporum*	1
	Root rot	*Pythium irregular*	1

Table 4 (cont.)

Hazelnut (*Corylus* sp.)	Bacterial blight Bacterial blight Powdery mildew	*Xanthomonas arboricola* *Xanthomonas campestris* *Phyllactinia guttata*	1 1 1
Heather (*Calluna vulgaris*)	Gray mould	*Botrytis cinerea*	1
Honey locust (*Gleditsia triacanthos*)	Canker	*Thyronectria austro-americana*	1
Honeysuckle (*Lonicera* sp.)	Root rot	*Fusarium* sp.	1
Hornbeam (*Carpinus* sp.)	Anthracnose	*Monostichella robergei*	1
Hydrangea (*Hydrangea* sp.)	Bacterial leaf blight Crown and root rot Gray mould Hydrangea Ringspot Virus Leaf spot Root rot Root rot	*Pseudomonas cichorii* *Pythium aphanidermatum* *Botrytis cinerea* *Hydrangea Ringspot Virus (HdRSV)* *Phoma sp.* *Fusarium oxysporum* *Pythium irregulare*	1 2 3 1 2 1 1
Ironwood (*Ostrya virginiana*)	Anthracnose	*Monostichella robergei*	1
Japanese kerria (*Kerria japonica*)	Twig and leaf blight	*Blumeriella kerriae*	1
Juniper (*Juniperus* sp.)	Tip blight	*Diplodia* sp.	1
Larch (*Larix* sp.)	Gray mould Root rot	*Botrytis* sp. *Thielaviopsis basicola*	1 1
Lilac (*Syringa vulgaris*)	Root rot Root rot Root rot Root rot	*Phytophthora* sp. *Phytophthora cryptogea* *Pythium dissotocum* *Pythium irregulare*	2 1 3 1
London plane tree (*Platanus* x *acerifolia*)	Powdery mildew	*Oidium* sp.	1
Mountain ash (*Sorbus* sp.)	Canker	*Nectria cinnabarina*	1
Northern catalpa (*Catalpa speciosa*)	Canker and dieback	*Botryosphaeria obtusa*	1
Norway spruce (*Picea abies*)	Needlecast	*Rhizosphaera kalkhoffii*	4
Pagoda dogwood (*Cornus alternifolia*)	Root rot Root rot Root rot Root rot	*Fusarium oxysporum* *Fusarium solani* *Phytophthora sp.* *Pythium ultimum*	1 1 1 1
Pea shrub (*Caragana* sp.)	Bacterial canker	*Pseudomonas syringae*	1
Pinus sp.	Tip blight	*Diplodia* sp.	5
Poplar (*Populus* sp.)	Crown gall	*Agrobacterium* sp.	1
Prunus sp.	Dieback	*Phomopsis* sp.	1
Purple-leaf sand cherry (*Prunus* x *cistena*)	Crown and root rot	*Rhizoctonia solani*	1

Table 4 (cont.)

Red osier dogwood (*Cornus sericea*)	Bacterial leaf spot Root rot	*Pseudomonas syringae* *Phytophthora sp.*	2 1
Red pine (*Pinus resinosa*)	Root rot Root rot	*Fusarium oxysporum* *Fusarium solani*	1 1
Rose (*Rosa* sp.)	Powdery mildew Rose rosette disease	*Oidium* sp. Rose Rosette Virus (RRV)	2 1
Scarlet oak (*Quercus coccinea*)	Canker	*Botryosphaeria* sp.	1
Serviceberry (*Amelanchier* sp.)	Canker	*Biscogniauxia* sp.	1
Silver maple (*Acer saccharinum*)	Leaf spot	*Phyllosticta* sp.	1
Spirea (*Spirea* sp.)	Root rot Root rot	*Fusarium* sp. *Phytophthora nicotianae*	1 1
Spruce (*Picea* sp.)	Blight Needlecast Needlecast Needlecast Root rot Root rot Root rot Root rot Root rot Root rot	*Phoma* sp. *Lophodermium* sp. *Rhizosphaera kalkhoffii* *Setomelanomma holmii* *Fusarium oxysporum* *Fusarium solani* *Phytophthora* sp. *Phytophthora cryptogea* *Pythium dissotocum* *Thielaviopsis basicola*	1 1 1 2 2 1 1 1 2
Sugar maple (*Acer saccharum*)	Canker Wilt	*Cytospora chryosperma* *Verticillium sp.*	1 1
Tartarian dogwood (*Cornus alba*)	Bacterial leaf spot Leaf spot	*Pseudomonas syringae* *Septoria* sp.	2 1
Tartarian maple (*Acer tataricum*)	Anthracnose	*Aureobasidium apocryptum*	1
Viburnum lentago	Root rot Root rot Root rot Root rot	*Phytophthora cactorum* *Pythium sp.* *Pythium ultimum* *Thielaviopsis basicola*	2 1 1 2
White oak (*Quercus alba*)	Anthracnose	*Apiognomonia quercina*	1
White pine (*Pinus strobus*)	White pine blister rust	*Cronartium ribicola*	1
Willow (*Salix* sp.)	Canker Canker	*Cytospora* sp. *Glomerella miyabeana*	1 1
Winterberry (*Gaultheria* sp.)	Anthracnose Dieback Dieback	*Colletotrichum* sp. *Pestalotiopsis sp.* *Phoma sp.*	1 1 1
Witch hazel (*Hamamelis virginiana*)	Root rot Root rot Root rot Root rot	*Phytophthora cactorum* *Phytophthora drechsleri* *Pythium aphanidermatum* *Thielaviopsis basicola*	1 1 1 1

Table 5. Summary of plant diseases diagnosed on**field crop**samples submitted to the University of Guelph Pest Diagnostic Clinic in 2016.

CROP NAME	DISEASE	CAUSAL AGENT	NO. OF SAMPLES
Adzuki bean (*Vigna angularis*)	Anthracnose	*Colletotrichum* sp.	1
	Brown spot	*Pseudomonas syringae* pv. *Syringae*	3
	Charcoal rot	*Macrophomina phaseolina*	1
	Stem rot	*Fusarium sp.*	2
Barley (*Hordeum vulgare*)	Crown and root rot	*Bipolaris* sp.	1
	Crown and root rot	*Fusarium culmorum*	1
	Crown and root rot	*Rhizoctonia solani*	1
	Root rot	*Pythium* sp.	1
Bean (*Phaseolus vulgaris*)	Anthracnose	*Colletotrichum* sp.	1
Corn (*Zea mays*)	Anthracnose	*Colletotrichum graminicola*	4
	Northern corn leaf blight	*Exserohilum turcicum*	2
	Northern corn leaf spot	*Bipolaris zeicola*	3
	Root rot	*Pythium aphanidermatum*	1
	Rust	*Puccinia sorghi*	1
Oats (Avena sativa)	Crown rust	*Puccinia coronate*	17
	Crown and root rot	*Pythium sylvaticum*	1
Quinoa (*Chenopodium quinoa*)	Downy mildew	*Peronospora* sp.	1
Soybean (*Glycine max*)	Anthracnose	*Colletotrichum* sp.	1
	Brown spot	*Septoria glycines*	2
	Crown and root rot	*Fusarium oxysporum*	1
	Crown and root rot	*Fusarium solani*	1
	Crown and root rot	*Pythium irregulare*	1
	Crown and root rot	*Pythium ultimum*	1
	Crown and root rot	*Rhizoctonia solani*	1
	Charcoal rot	*Macrophomina phaseolina*	1
	Root rot	*Fusarium oxysporum*	2
	Root rot	*Fusarium solani*	4
	Root rot	*Phytophthora sp.*	3
	Root rot	*Pythium sp.*	1
	Root rot	*Pythium irregulare*	1
	Root rot	*Thielaviopsis basicola*	1
	Seed decay	*Phomopsis longicolla*	1
Sugar beet (*Beta vulgaris*)	Root rot	*Fusarium oxysporum*	2
	Root rot	*Fusarium solani*	1
	Root rot	*Rhizoctonia solani*	1
Wheat (*Triticum* sp.)	Blotch	*Septoria* sp.	1
	Root rot	*Fusarium culmorum*	1
	Root rot	*Fusarium oxysporum*	1
	Root rot	*Fusarium solani*	1
	Root rot	*Pythium irregulare*	1
	Root rot	*Pythium sylvaticum*	1
	Root rot	*Pythium tracheiphilum*	3
	Root rot	*Pythium ultimum*	1
	Rust	*Puccinia* sp.	1
	Snow mould	*Microdochium nivale*	2
	Tan spot	*Drechslera tritici-repentis*	1

Table 6. Summary of plant diseases diagnosed on **herb and special crop** samples submitted to the University of Guelph Pest Diagnostic Clinic in 2016.

CROP NAME	DISEASE	CAUSAL AGENT	NO. OF SAMPLES
Basil (*Ocimum basilicum*)	Gray mould	*Botrytis* sp.	1
Centrapalus sp.	Crown and root rot	*Fusarium oxysporum*	1
	Crown and root rot	*Pythium ultimum*	1
	Stem blight	*Phomopsis sp.*	1
Ginseng (*Panax* sp.)	Leaf blight	*Phytophthora cactorum*	1
	Root rot	*Fusarium oxysporum*	6
	Root rot	*Fusarium solani*	3
	Root rot	*Phytophthora sp.*	1
	Root rot	*Pythium sp.*	1
	Root rot	*Pythium dissotocum*	1
	Root rot	*Pythium irregulare*	4
		Pythium ultimum	2
Goldseal (*Hydrastis canadensis*)	Root rot	*Fusarium oxysporum*	1
	Root rot	*Pythium intermedium*	1
Hop (*Humulus lupulus*)	Apple Mosaic Virus	Apple Mosaic Virus (ApMV)	13
	Crown rot	*Fusarium oxysporum*	1
	Crown rot	*Fusarium solani*	1
	Hop Mosaic Virus	Hop Mosaic Virus (HpMV)	3
	Hop Stunt Viroid	Hop Stunt Viroid (HSVd)	2

CROP / CULTURE: Muck Crops Research Station report
LOCATION / RĖGION: Bradford/Holland Marsh, Ontario

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TITLE: DISEASES DIAGNOSED ON PLANT SAMPLES SUBMITTED TO THE MUCK CROPS RESEARCH STATION IN 2016

ABSTRACT: As part of the Integrated Pest Management (IPM) program provided by the Muck Crops Research Station (MCRS), diagnostics service is provided to vegetable growers around the Holland Marsh/Bradford, Ontario. In 2016,121 samples were submitted to the MCRS for identification and possible control recommendations. Samples included plants with disease and physiological disorders. This report covers diseases and physiological disorders diagnosed on plant samples submitted to the MCRS.

INTRODUCTION AND METHODS: As part of the Integrated Pest Management program, the Muck Crops Research Station provides diagnosis and control recommendations for diseases of vegetable crops to growers in the Bradford/Holland Marsh and surrounding area of Ontario. The program objectives are to scout grower's fields, provide growers with disease and insect forecasting information and to identify and diagnose diseases, insect pests and weeds. Samples are submitted to the MCRS 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: From 5 February to 3 November, 2016, the MCRS received 121 samples for diagnosis. Of these, 71% were diseases (86 samples) and 29% physiological disorders (35 samples). These samples were associated with the following crops: onion (47.9%), carrot (31.4%), celery (5.8%), tomato (4.1%) and other crops (10.8%). Weather conditions in the 2016 growing season were hot and dry which is not conducive for the development of many fungal pathogens. There was below average rainfall May to September and dry conditions. A summary of diseases diagnosed and causal agents on crop samples submitted to the MCRS in 2016 is presented in Table 1.

ACKNOWLEDGEMENTS: This project was funded in part through Growing Forward 2 (GF2), a federal-provincial-territorial initiative. The Agricultural Adaptation Council assists in the delivery of GF2 in Ontario. Funding was also provided in part by the Bradford Cooperative Storage Ltd., agrochemical companies and growers participating in the Muck Crops Research Station IPM program.

Table 1: Summary of diseases diagnosed on plants submitted to the Muck Crops Research Station in 2016.

CROP	DISEASE	CAUSAL AGENT	NUMBER OF SAMPLES
Beet	Excessive hairy roots	*Pythium* spp.	1
Cabbage	Bottom rot	*Rhyzoctonia solani*	1
Carrot	Aster yellows	*Phytoplasma*	11
	Black rot	*Alternaria radicina*	1
	Carrot cyst nematode	*Heterodera carotae*	1
	Cavity spot	*Pythium spp.*	2
	Root knot nematode	*Meloidogyne hapla*	1
	Lesion nematode	*Pratylenchus penetrans*	1
	Leaf blight	*Alternaria dauci and Cercospora carotae*	11 4
	Growth crack (split)	*Fluctuating moisture level*	1
	Pythium root dieback	*Pythium spp.*	5
	Chemical injury	*Herbicide damage*	
Celery	Celery leaf curl	*Colletotrichum spp.*	3
	Pink rot	*Sclerotinia sclerotiorum*	2
	Blackheart	*Calcium deficiency*	2
Cucumber (high tunnel)	Physiological disorder	High salt content in soil	1
Garlic	Stem and bulb nematode	*Ditylenchus dipsaci*	1
Lettuce	Bacterial rot	*Erwinia carotovora*	1
Sunflower sprouts	Leaf blight	*Alternaria* sp.	1
Onion	Stemphylium leaf blight	*Stemphylium vesicarium*	14
	Pink root	*Phoma terrestris*	7
	Purple blotch	*Alternaria porri*	9
	Botrytis leaf blight	*Botrytis squamosa*	1
	White rot	*Sclerotium cepivorum*	2
	Bacterial rot/soft rot	*Erwinia carotovora*	3
	Tip burn	*Heat stress*	7
	Smut	*Urocystis cepulae*	4
	Chemical injury	*Herbicide damage*	6
	Environmental injury	*Pelting rain injury/wind*	5
Parsnip	Canker in storage	*Itersonilia perplexans*	1
Potato	Early blight	*Alternaria solani*	2
	Dry rot	*Fusarium* sp.	1
Swiss chard (green)	Physiological disorder	Possible herbicide injury	1
Spinach	Physiological disorder	Micronutrient deficiency	1
Tomato	Physiological disorder	High soil moisture	1
Tomato (high tunnel)	Physiological disorder	High salt content in soil	1
	Weak plant	Nutrient deficiency	1
	Wilt	*Fusarium oxysporum*	1
	Early blight	*Alternarium solani*	1
Turnip	Club root	*Plasmodiophora brassicae*	1
DISEASED SAMPLES			**86**
ABIOTIC AND OTHER DISORDERS			**35**
TOTAL SUBMISSIONS			**121**

CULTURES / CROP: Échantillons reçus en 2016 au Laboratoire de diagnostic en phytoprotection
RÉGION / LOCATION: Québec

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http://www.agrireseau.qc.ca/lab/

TITRE: MALADIES ET PROBLÈMES ABIOTIQUES DIAGNOSTIQUÉS SUR LES ÉCHANTILLONS DE PLANTES REÇUS EN 2016 AU LABORATOIRE DE DIAGNOSTIC EN PHYTOPROTECTION DU MAPAQ

RÉSUMÉ: Du 1er janvier au 20 octobre 2016, parmi 1663 échantillons traités par la section phytopathologie du laboratoire; une proportion importante d'échantillons (40 %) étant soumis pour la détection d'un ou de plusieurs agents phytopathogènes spécifiques. Tandis que 60 % des échantillons étaient soumis pour le diagnostic de problématiques phytosanitaires inconnues du client. Les échantillons reçus comprennent les plantes maraîchères (serres et champs), les petits fruits, les grandes cultures, 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.

MÉTHODES: Le Laboratoire de diagnostic en phytoprotection du ministère de l'Agriculture, des Pêcheries et de l'Alimentation du Québec (MAPAQ) offre un service de diagnostic des maladies parasitaires pour les producteurs, conseillers, particuliers et instances gouvernementales. Les données rapportées présentent les maladies identifiées sur les échantillons de plantes reçues jusqu'à présent en 2016. Tous les échantillons de diagnostic font l'objet d'un examen visuel préalable suivi généralement d'un examen à la loupe binoculaire. Selon les symptômes, un ou plusieurs tests diagnostiques sont réalisés dans le but de détecter ou d'identifier l'agent ou les agents phytopathogène(s).

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 espèces (lorsque possible) sont identifiés par microscopie et par des techniques de biologie moléculaire *Polymerase Chain Reaction* (PCR). Les champignons sont isolés sur des milieux de culture gélosés, identifiés selon leurs caractéristiques morphologiques ou par des techniques de biologie moléculaire (PCR et séquençage d'ADN). Les bactéries sont isolées sur des milieux de culture gélosés puis identifiées par des tests biochimiques Biolog^{R} ou à l'aide des tests sérologiques *Enzyme-Linked immunosorbent Essay* (ELISA) et de techniques de biologie moléculaire (PCR et séquençage d'ADN). Les phytoplasmes sont détectés par des techniques de biologie moléculaire (PCR et séquençage d'ADN). Les virus sont, quant à eux, détectés par des tests sérologiques ELISA ou par PCR.

RÉSULTATS ET DISCUSSIONS: Les tableaux 1 à 12 présentent le sommaire des maladies identifiées sur les échantillons de plantes reçus. Au tableau 1, les maladies des plantes maraîchères de plein champ regroupent aussi les transplants provenant des serres et des pépinières. Les maladies des légumes entreposés, listées au tableau 2, incluent les légumes de courte et de longue durée d'entreposage. Au tableau 11, les plantes ornementales d'extérieur (pépinière, aménagement paysager) et d'intérieur (serriculture) sont essentiellement des espèces herbacées annuelles ou vivaces.

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 ou que 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 regroupent entre autres les désordres minéraux, les pH et les conductivités électriques de sols et de solutions nutritives inadéquats, les structures de sols inadaptées, les phytotoxicités causées par l'usage de produits phytosanitaires, une irrigation inappropriée, les blessures mécaniques, etc. Les stress climatiques pour leur part concernent les insolations, le gel, le froid et l'excès de chaleur, les polluants atmosphériques, l'intumescence (œdème), 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 tests et/ou de discussions avec le client.

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Tableau 1. Sommaire des maladies diagnostiquées parmi les **cultures maraîchères de champ** reçues au Laboratoire de diagnostic en phytoprotection du MAPAQ en 2016.

CULTURE	AGENT PATHOGÈNE ou CAUSE	MALADIE ou SYMPTÔME	NOMBRE
Ail	*Alternaria* sp.	Alternariose	3
	Botrytis sp.	Pourriture du col / dépérissement	8
	Burkholderia cepacia / *Burkholderia* sp.	Pourriture bactérienne	4
	*Cladosporium*sp.	Pourriture	1
	Colletotrichum sp.	Anthracnose	2
	Ditylenchus dipsaci / Ditylenchus sp.	Maladie vermiculair de l'oignon	11
	Embellisia sp.	Tache et pourriture du bulbe	3
	Enterobacter cloacae	Pourriture du bulbe	3
	Fusarium proliferatum / Fusarium sp.	Pourriture du bulbe / fusariose	39
	Pantoea agglomerans	Pourriture des feuilles	7
	pH inadéquat		2
	Pratylenchus sp.	Lésions des racines	1
	Pseudomonas marginalis	Pourriture des feulilles	7
	Pythium sp.	Pourriture phythienne	9
	Rhizoctania sp.	Rhizoctone	13
Asperge	*Fusarium* sp.	Fusariose	1
Aubergine	*Pseudomonas syringae*	Pourriture des feuilles	1
Betterave	Facteur abiotique		2
	Fusarium sp.	Fusariose	3
	Phoma sp.	Pourriture racinaire	1
	Ramularia sp	Tache ramularienne	1
	Verticillium sp.	Verticilliose	3
Brocoli	*Alternaria* sp.	Tache alternarienne	2
Cantaloup	*Pseudomonas syringae*	Tach bactérienne	1
Carotte	Conductivité électrique élevée		2
	pH inadéquat		2
Céleri	*Collectotichum acutatum / Colletotrichum* sp.	Anthracnose / enroulement de la feuille	4
	Fusarium sp.	Pourriture fusarienne	6
	Pectobacterium carotovorum	Pourriture molle bactérienne	3
	Pseudomonas marginalis	Tache foliaire	4
	Pythium sp.	Pourriture bactérienne	3
		Pourriture pythienne	6
Chou chinois	*Fusarium* sp.	Pourriture fusarienne	1
	Pectobacterium sp.	Pourriture molle bactérienne	1
	Pseudomonas marginalis	Tache foliaire	1
Chou pommé	*Alternaria* sp.	Tache alternarienne	1
	Fusarium sp.	Fusariose	2
	Facteur abiotique	Moucheture noire	1
	Rhizoctonia sp.	Rhizoctone	2

Tableau 1 cont'd

CULTURE	AGENT PATHOGÈNE ou CAUSE	MALADIE ou SYMPTÔME	NOMBRE
Ciboulette	*Fusarium oxysporum*	Fusariose	1
	Pythium sp.	Pourriture pythienne	1
Citrouille / Courge à moelle	*Colletotrichum* sp.	Anthracnose	1
	Fusarium sp.	Fusariose	2
	Phytophthora capsici	Pourriture des fruits	1
	Pythiuml sp.	Pourriture pythienne	1
Concombre	*Alternaria cucumerina / Alternaria* sp.	Tache alternarienne	2
	Erwinia tracheiphila	Flérussenebt bactérien	1
	Facteur abiotique		1
	Fusarium sp.	Pourriture fusarienne	6
	Geotrichum sp.	Pourriture aquese	1
	Oedème		1
	Pectobacterium carotovorum / Pectobacterium sp.	Pourriture molle bactérienne	2
	Phoma sp.	Pourriture noire	1
	Plectosporium sp.	Brûlure plectosporienne	3
	Pseudomonas sp. / *Pseudomonas syringae*	Tache foliaire et pourriture bactérienne	2
	Pseudoperonospora sp.	Mildiou	2
	Pythium sp.	Pourriture phythienne	5
	Sclerotinia sp.	Sclérotiniose	1
Courge	*Alternaria* sp.	Tach alternarienne	5
	Cladosporium sp.	Gale	1
	Colletotrichum sp.	Anthracnose	1
	Facteur abiotique		2
	Fusarium equiseti / Fusarium sp.	Fusariose	9
	Geotrichum candicum / Geotrichum sp.	Pourriture aqueuse	3
	Pectobacterium carotovorum	Pourriture molle bactérienne	2
	Phytophthora capsici / Phytophthora sp.	Pourriture des fruits	5
	Potyvirus	Anomalie de coloration sur fruit	1
	Pseudomonas syringae	Tache foliaire	1
	Septoria sp.	Tache septorienne	2
Courgette	*Alternaria* sp.	Tach alternarienne	2
	Cladosporium sp.	Gale	14
	Fusarium sp.	Pourriture fusarienne	2
	Facteur abiotique	Macule physiologique	1
	Oidium sp.	Blanc	1
	Pectobacterium carotovorum / Pectobacterium sp.	Pourriture molle bactérienne	2
	Phoma sp.	Pourriture noir	1
	Phytophthora capsici / Phytophthora sp.	Pourriture des fruits	4
	Pseudomonas syringae	Tache foliaire et sur frit	2
	Pythium sp.	Pourriture de fruit	1

Tableau 1 cont'd

CULTURE	AGENT PATHOGÈNE ou CAUSE	MALADIE ou SYMPTÔME	NOMBRE
Épinard	*Fusarium* sp.	Pourriture fusarienne	2
	Pythium sp.	Pourriture pythienne	2
Gourgane / féverole	*Alternaria* sp.	Tache alternarienne	1
	Bortrytis sp.	Pourriture grise	1
	Cladosporium sp.	Pourriture	4
	Colletotrichum sp.	Anthracnose	1
	Cylindrocarpon sp.	Pourriture racinaire	3
	Fusarium sp.	Fusariose	6
	Helicotylenchus sp.	Nématode spiralé	4
	Meloidogyne sp.	Nodosité racinaire	3
	Pratylenchus sp.	Lésions des racines	4
	Pythium sp.	Pourriture pythienne	3
	Rhizoctonia sp.	Rhizoctone	6
Haricot / haricot adzuki	*Fusarium* sp.	Fusariose	2
	Pseudomonas syringae	Tache foliaire	4
	Facteur abiotique		1
Laitue romaine	*Bremia lactucae*	Mildiou	1
	Fusarium sp.	Fusariose	1
	Pseudomonas cichorii	Tache foliaire	1
	Pseudomonas syringae	Tache foliaire	1
	Pythium sp.	Pourriture pythienne	1
Melon / melon d'eau / Pastèque	*Alternaria cucumerina*	Alternariose	1
	Erwinia tracheiphila	Flétrissement bactérien	2
	Fusarium sp.	Fusariose	4
	Rhizoctonia sp.	Rhizoctone	2
Oignon / oignon espagnol	*Burkholderia gladioli*	Pourriture bactérienne	2
	Enterobacter cloacae	Oourriture du bulbe	3
	Fusarium sp.	Pourriture fusarienne	11
	Pantoea agglomerans	Pourriture des feuilles	1
	Penicillium sp.	Pourriture du bulbe	3
	Pythium sp.	Pourriture pythienne	1
Piment (piment fort)	*Fusarium* sp.	Fusariose	2
	Phytophthora sp.	Pourriture des fruits	2
Poireau	*Fusarium* sp.	Fusariose	3
Pois vert / Petit pois	*Fusarium* sp.	Fusariose	2
Poivron (piment doux)	*Fusarium solani / Fusarium* sp.	Fusariose	4
	Phytophthora capsici / Phytophthora sp.	Pourriture des fruits	5
	Polluant gazeux – ozone		2
	Rhizoctonia sp.	Rhizoctone	3
	Xanthomonas campestris	Tache bactérienne	1

Tableau 1 cont'd

CULTURE	AGENT PATHOGÈNE ou CAUSE	MALADIE ou SYMPTÔME	NOMBRE
Pomme de terre	*Cladosporium* sp.	Pourriture	1
	Colletotrichum sp.	Dartrose	5
	Facteur abiotique	Cœur noir	1
	Facteur abiotique		2
	Fusarium graminearum / Fusarium sp.	Fusariose	17
	Geotrichum sp.	Pourriture caoutchouc	10
	*Helminthosporium*sp.	Gale argentée	1
	PMTV (Potato Mo—Top Virus)	Anneaux bruns dans le tuberclue	1
	Pectobacterium atrosepticum / Pectobacterium carotovorum / Pectobacterium sp.	Pourriture molle bactérienne / jambe noire	14
	Phytophthora sp.	Pourriture rose	3
	Pythium sp.	Pourriture aqueuse	6
	Spongospora subterranea	Gale poudreuse	1
	Streptomysces sp.	Gale commune	1
	Verticillim sp.	Verticilliose	8
Rhubarbe	ArMV (Arabis Mosaic Virus)	Anomalie de coloration foliaire	1
	Colletotrichum sp.	Anthracnose	6
	Cylindrocarphon sp.	Pourriture racinaire	4
	Helicotylenchus sp.	Nématode spiralé	4
	Paratylenchus sp.	Nématode épingle	4
	Pratylenchus sp.	Lésions des racines	4
	Rhizoctonia sp.	Rhizoctone	3
	ToRSV (Tomato Ringspot Virus)	Anomalie de coloration foliaire	2
	Xiphinema sp.	Nématode dague	4
Roquette	*Fusarium* sp.	Pourriture fusarienne	1
Scarole / chicorée scarole	Facteur abiotique		2
Tomate	*Alternaria alternata*	Taches foliaires	1
	Clavibacter michiganensis subsp. Michiganensis	Chancre bactérien de la tomate	2
	Fusarium *sp.*	Fusariose	6
	Pythium sp.	Pourriture pythienne	4

Tableau 2. Sommaire des maladies diagnostiquées parmi les **légumes d'entrepôt** reçus au Laboratoire de diagnostic en phytoprotection du MAPAQ en 2016.

CULTURE	AGENT PATHOGÈNE ou CAUSE	MALADIE ou SYMPTÔME	NOMBRE
Ail	*Embellisia* sp.	Tache et pourriture du bulbe	4
	Facteur abiotique		2
	Fusarium sp.	Pourriture du bulbe / fusariose	3
Betterave	*Pseudomonas syringae*	Pourriture bactérienne	1
Carotte	*Botrytis* sp.	Pourriture grise	1
Chou frisé	*Fusarium* sp.	Pourriture fusarienne	3
Chou pommé	*Botrytis* sp.	Pourriture grise	1
Navet	*Rhizoctonia* sp.	Rhizoctone	1
Poivron (piment doux)	*Fusarium* sp.	Fusariose	3
	Pythium sp.	Pourriture pythienne	3
Pomme de terre	Blessure mécanique		2
	Facteur abiotique	Cœur noir	1
	Colletotrichum coccodes / *Colletotrichum* sp.	Dartrose	4
	Facteur abiotique		2
	Fusarium sp.	Pourriture sèche	4
	Geotrichum candidum / *Geotrichum* sp.	Pourriture caoutchouc	3
	Helminthosporium sp.	Gale argentée	2
	PMTV (Potato Mop-Top Virus)	Anneaux bruns dans le tubercule	3
	Rhizoctonia sp.	Rhizoctone	1
	Spongospora sp.	Gale poudreuse	1
Tomate cerise	*Penicillium* sp.	Pourriture de fruit	1

Tableau 3. Sommaire des maladies diagnostiquées parmi les **plantes maraîchères de serre** reçues au Laboratoire de diagnostic en phytoprotection du MAPAQ en 2016.

CULTURE	AGENT PATHOGÈNE ou CAUSE	MALADIE ou SYMPTÔME	NOMBRE
Ail	*Botrytis* sp.	Pourriture du col / Dépérissement	1
	Enterobacter cloacae	Pourriture du bulbe	4
	Fusarium sp.	Pourriture du bulbe / fusariose	8
Bok Choy / pak choi	Facteur abiotique		1
	Pseudomonas marginalis	Tache foliaire	1
	Verticillium sp.	Verticilliose	1
Chou pommé	*Alternaria brassicicola*	Tache alternarienne	3
Ciboulette	*Fusarium graminearum*	Fusariose	1
Concombre	*Cladosporium cucumerinum* / *Cladosporium* sp.	Gale	5
	Conductivité électrique élevée		3
	Erwinia tracheiphila	Flétrissement bactérien	2
	Fusarium oxysporum / *Fusarium* sp.	Fusariose	11
	Pectobacterium carotovorum	Pourriture molle bactérienne	2
	Pythium sp.	Pourriture pythienne	5
	Ulocladium sp.	Tache foliaire	2
Laitue	*Fusarium* sp.	Fusariose	6
	Phytophthora cryptogea	Pourriture phytophthoréenne	4
	Pythium dissotocum	Pourriture pythienne	8
Piment (piment fort)	*Xanthomonas campestris*	Tache bactérienne	1
Poivron (piment doux)	*Fusarium* sp.	Fusariose	1
	pH inadéquat		2
Pomme de terre	*Colletotrichum* sp.	Dartrose	2
Tomate	*Clavibacter michiganensis* subsp. *michiganensis*	Chancre bactérien de la tomate	8
	Colletotrichum sp.	Anthracnose	1
	Facteur abiotique		3
	Fusarium oxysporum / *Fusarium* sp. / *Fusarium sporotrichioides*	Fusariose	11
	Facteur abiotique	Moucheture dorée	1
	Oedème		3
	PepMV (Pepino Mosaic Virus)	Multisymptomatique	15
	Pseudomonas sp.	Anomalie de coloration tige	1
	Pythium sp. / *Pythium ultimum*	Pourriture pythienne	5
	TSWV (Tomato Spotted Wilt Virus)	Anomalie de coloration et brûlure foliaire	2

Tableau 4. Sommaire des maladies diagnostiquées parmi les **petits fruit** reçues au Laboratoire de diagnostic en phytoprotection du MAPAQ en 2016.

CULTURE	AGENT PATHOGÈNE ou CAUSE	MALADIE ou SYMPTÔME	NOMBRE
Amélanchier	*Nectria cinnabarina*	Chancre de tige	3
Argousier	*Alternaria* sp.	Alternariose	2
	Aureobasidium sp.	Pourriture des fruits	1
	Cylindrocarpon sp.	Pourriture racinaire	3
	Cylindrocladium sp.	Chancre de tige	2
	Facteur abiotique		1
	Fusarium sp.	Fusariose	14
	Meloidogyne sp.	Nodosité	5
	Phomopsis sp.	Brûlure phomopsienne	5
	Pratylenchus sp.	Lésions des racines	8
	Pythium sp.	Pourriture phythienne	6
	Verticillium dahliae	Verticilliose	2
	Xiphinema sp.	Néematode dague	5
Bleuetier en corymbe	*Agrobacteium* sp.	Tumeur du collet	2
	Alternaria sp.	Alternariose	1
	Aureobasidium sp.	Pourriture des fruits	1
	BlShV (Blueberry Shock Virus)	Brûlure phomopsienne	9
	Botrytis sp.	Lésions des racines	1
	Exobasidium sp.	Pourriture pythienne	5
	Facteur abiotique		4
	Fusarium sp.	Fusarios	2
	Fusicoccum sp.	Chancre de tige	7
	Pestalotiopsis sp.	Chancre de tige	1
	Phomopsis sp.	Brûlurephomopsienne	1
	Phytoplasme	Malformation foliaire et de tige	3
	Pratylenchus sp.	Lésions des racines	1
	Pseudomonas syringae / Pseudomonas sp.	Brûlure bactérienne	4
	Pyrenchoaeta sp.	Pourriture racinaire	2
	Seimatosporium sp.	Dépérissement	7
	Septoria sp.	Tache septorienne	1
Bleuetier nain	*Aureobasidium* sp.	Pourriture des friuts	2
	Colletotrichum sp.	Anthracnose	1
	Facteur abiotique		1
	Ramularia sp.	Tache ramularienne	2
	Septoria sp.	Tache septorienne	4
Camérisier	*Alternaria* sp.	Alternariose	4
	Aureobasidium sp.	Pourriture des fruits	1
	Cylindrocarpon sp.	Pourriture racinaire	3
	Facteur abiotique		1
	Fusarium sp.	Fusariose	10
	Meloidogyne sp.	Nodosité racinaire	1
	Microsphaera sp.	Blanc	4
	pH inadéquat		1

Tableau 4 cont'd

CULTURE	AGENT PATHOGÈNE ou CAUSE	MALADIE ou SYMPTÔME	NOMBRE
Camérisier (suite)	*Pratylenchus* sp.	Lésions des racines	1
	Pythium sp.	Pourriture pythienne	2
	Rhizoctonia sp.	Rhizoctone	8
Canneberge	*Allantophomopsis cytisporea*	Pouriture noire de fruits	1
	Coleophoma sp.	Pouriture des fruits	1
	Colletotrichum acutatum / Colletotrichum sp.	Tache foliaire	3
	Exobasidium sp.	Tache foliaire	2
	Facteur abiotique		2
	Phyllosticta elongata / Phyllosticta sp.	Tache foliaire / pourriture des fruits	8
	Physalospora sp.	Pourriture tachetée	1
	Protoventuria sp.	Tache folliaire	5
Fraisier américain	*Botrytis* sp.	Pourriture grise	1
	Pythium sp.	Pourriture phthienne	2
	Rhizoctonia sp.	Rhizoctone	2
Fraisier cultivé	*Botrytis* sp.	Pourriture grise	7
	Colletotrichum sp.	Anthracnose	3
	Conductivité électrique élevée		5
	Cylindrocarpon sp.	Pourriture racinaire	20
	Facteur abiotique		1
	Fusarium sp. / *Fusarium oxysporum*	Pourriture fusarienne	60
	Gel		7
	Hainesia sp.	Pourriture bestre	1
	Helicotylenchus sp.	Nématode spiralé	2
	Longidorus sp.	Nématode aiguille	3
	Meloidogyne sp.	Nodosité racinaire	3
	pH inadéquat		3
	Phomopsis sp.	Brûlures des feuilles	2
	Phytophthora cactorum / Phytophthora sp.	Pourriture collet et racines	29
	Phytoplasme	Malformation / phyllodie	2
	Phytotoxicité – Atrazine		1
	Podospaera sp.	Blanc	1
	Pourriture noire des racines	Pourriture racinaire	40
	Pratylenchus sp.	Lésions des racine	6
	Pythium sp.	Pourriture pythienne	56
	Rhizoctonia sp.	Rhizoctone	51
	SMov (Strawberry Mottle Virus)	Dépérissement	16
	SMYEV (Strawberry Mild Yellow Edge Virus)	Dépérissement	10
	SVBV (Strawberry Vein Banding Virus)	Dépérissement	6
	SPaV (Strawberry Pallidosis Virus)	Dépérissement	1
	Verticillium dahliae / Verticillium sp.	Verticilliose	2
	Xanthomonas fragariae	Tache angulaire	3
	Zythia sp. / *Gnomonia* sp.	Brûlure pétiole / tache foliaire	2

Tableau 4 cont'd

CULTURE	AGENT PATHOGÈNE ou CAUSE	MALADIE ou SYMPTÔME	NOMBRE
Framboisier	*Agrobacterium* sp.	Tumeur du collet / tumeur de la tige	13
	Botrytis sp.	Pourriture grise	1
	Collectotrichum sp.	Anthracnose	1
	Cylindrocarpon sp.	Pourriture racinaire	9
	Didymella applanata	Brûlure des dards	1
	Facteur abiotique		1
	Fusarium sp.	Fusariose	12
	Heliocotylenchus sp.	Nématode spiralé	5
	Pourriture noire de racines	Pourriture racinaire	6
	Pratylenchus sp.	Lésions des racines	6
	Pythium sp.	Pourriture pythienne	6
	Rhizoctonia sp.	Rhizoctone	8
	ToRSV (Tomato Ringspot Virus)	Anamalie de coloration foliaire / malformation foliaire / grenaille des fruits	2
Mûrier	*Gnomonia* sp.	Chancre de tige	1
Sureau	*Alternaria* sp.	Tache alternarienne	1
	Cladosporium sp.	Tache foliaire	1
	Fusarium sp.	Fusariose	5
	Helicotylenchus sp.	Nématode spiralé	2
	Meloidogyne sp.	Nodosité racinaire	2
	Plectosporium sp.	Dépérissement	4
	Pratylenchus sp.	Lésions des racines	2
	Pseudomonas syringae	Pourriture bactérienne	6
	Pythium sp.	Pourriture pythienne	1
	Rhizoctonia sp.	Rhizoctone	1
Vigne / Vigne cultivée	*Agrobacterium* sp. / *Agrobacterium vitis*	Tumeur du collet	2
	Botrytis sp.	Pourriture grise	1
	Cladosporium sp.	Pourriture de fruits / tache foliaire	3
	Colletotrichum sp.	Anthracnose	2
	Cylindrocarpon sp.	Pied noir	3
	Diatrypella verruciformis	Pourriture de tige	1
	Facteur abiotique		10
	Fusarium sp.	Fusariose	4
	Pestalotia sp.	Chancre de tige	1
	Phoma negriana / Phoma sp.	Tache Foliaire / dépérissement	4

Tableau 5. Sommaire des maladies diagnostiquées parmi les **céréales et cultures associées** reçues au Laboratoire de diagnostic en phytoprotection du MAPAQ en 2016.

CULTURE	AGENT PATHOGÈNE / CAUSE	MALADIE / SYMPTÔME	NOMBRE
Avoine	*Ustilago* sp.	Charbon	1
Blé	*Bipolaris* sp.	Tache helminthosporienne	2
	Fumagine	Fumagine	1
	Fusarium sp.	Piétin fusarien / pourriture fusarienne / fusariose	4
	Microdochium sp.	Pourriture racinaire	1
	Puccinia sp.	Rouille	2
	Pythium sp.	Piétin brun	5
Quinoa	*Cladosporium* sp.	Pourriture	1
	Corynespora sp.	Tache foliaire	1
	Fusarium sp.	Fusariose	2
	Pythium sp.	Pourriture pythienne	4
Chia	*Fusarium* sp.	Fusariose	3
	Pythium sp.	Pourriture pythienne	3
Orge	*Alternaria* sp.	Alternariose	1
	Bipolaris sp.	Tache helminthosporienne	2
	Cladosporium sp.	Moisissure noire	1
Sarrasin	*Fusarium* sp.	Fusariose	2
	Pythium sp.	Pourriture pythienne	2
	Rhizoctonia sp.	Rhizoctone	2

Tableau 6. Sommaire des maladies diagnostiquées parmi les **grandes cultures** (**protéagineuses, oléagineuses, textiles et autres cultures associées**) reçues au Laboratoire de diagnostic en phytoprotection du MAPAQ en 2016.

CULTURE	AGENT PATHOGÈNE ou CAUSE	MALADIE ou SYMPTÔME	NOMBRE
Houblon	*Alternaria* sp.	Alternariose	2
	Cladosporium sp.	Pourriture	1
	Facteur abiotique		1
	Fusarium sp.	Fusariose	2
	Pseudoperonospora sp.	Mildiou	2
Maïs grain	Carence en phosphore		2
	Fusarium sp.	Fusariose	6
	Kabatiella sp.	Kabatiellose	1
	Pythium sp.	Piétin brun	4
	Rhizoctonia sp.	Rhizoctone	2
Soya	*Alternaria* sp.	Tache alternarienne	2
	Cercospora sp.	Cercosporose	6
	Colletotrichum sp.	Anthracnose	6
	Corynespora sp.	Tache concentrique / pourriture racinaire	1
	Cylindrocarpon sp.	Pourriture racinaire	3
	Facteur abiotique		1
	Fusarium oxysporum / Fusarium sp.	Pourriture fusarienne	37
	Helicotylenchus sp.	Nématode spiralé	1
	pH inadéquat		6
	Phomopsis sp.	Chancre de tiges	3
	Phytophthora sp.	Pourriture phytophthoréenne	15
	Pratylenchus sp.	Lésions des racines	3
	Pseudomonas syringae	Tache foliaire	1
	Pythium sp.	Pourriture pythienne	26
	Rhizoctonia sp.	Rhizoctone	6
	Septoria sp.	Septoriose	4
Tabac d'Australie	INSV (Impatiens Necrotic Spot Virus)	Anomalie de coloration foliaire	2

Tableau 7. Sommaire des maladies diagnostiquées parmi les **plantes fourragères** reçues au Laboratoire de diagnostic en phytoprotection du MAPAQ en 2016.

CULTURE	AGENT PATHOGÈNE / CAUSE	MALADIE / SYMPTÔME	NOMBRE
Fléole des prés	*Colletotrichum* sp.	Anthracnose	1
Luzerne	*Alternaria* sp.	Tache alternarienne	2
	Cladosporium sp.	Tache foliaire	1
	Pseudopeziza sp.	Tache commune	1
Ray-grass	*Puccinia* sp.	Rouille	2
Sorgho	*Alternaria* sp.	Tache alternarienne	1
	Curvularia sp.	Tache foliaire	1
	Fusarium sp.	Fusariose	3
	Pythium sp.	Piétin brun	3
Trèfle	Facteur abiotique		2

Tableau 8. Sommaire des maladies diagnostiquées parmi les **arbres et arbustes fruitiers** reçus au Laboratoire de diagnostic en phytoprotection du MAPAQ en 2016.

CULTURE	AGENT PATHOGÈNE ou CAUSE	MALADIE ou SYMPTÔME	NOMBRE
Cerisier nain	*Alternaria* sp.	Alternariose	7
	Aureobasidium sp.	Rousselure	6
	Cladosporium sp.	Pourriture	4
	Facteur abiotique		4
	Fusarium sp.	Pourriture fusarienne	2
	Pseudomonas syringae	Brûlure bactérienne	11
	Thielaviopsis sp.	Pourriture racinaire	2
Citronnier	*Fusarium* sp.	Fusariose	3
Groseillier	*Puccinia* sp.	Rouille	2
	Sphaerotheca sp.	Blanc	1
Poirier	Phytoplasme	Anomalie de coloration foliaire	2
Pommier	*Erwinia amylovora*	Brûlure bactérienne	4
	Facteur abiotique		6
	Fusarium sp.	Dépérissement	7
	Phytophthora cactorum	Pourriture phytophthoréenne	1
	Pratylenchus sp.	Lésions des racines	1
	Pythium sp.	Pourriture pythienne	3
	Sphaeropsis sp.	Pourriture noire	2
	Nectria cinnabarina	Chancre nectrien	3
Prunier domestique	Facteur abiotique		5

Tableau 9. Sommaire des maladies diagnostiquées parmi les **graminées à gazon** reçues au Laboratoire de diagnostic en phytoprotection du MAPAQ en 2016.

CULTURE	AGENT PATHOGÈNE ou CAUSE	MALADIE ou SYMPTÔME	NOMBRE
Agrostide (gazon)	*Colletotrichum* sp.	Anthracnose	1
	Fusarium sp.	Piétin-échaudage	2
	Magnaporthe sp.	Dépérissement	2
	Microdochium sp. / *Microdochium nivale*	Moisissure nivéale rosée	7
	Phyllosticta sp.	Tache foliaire	2
	Puccinia sp.	Rouille	2
	Pythium sp. / *Pythium torulosum*	Pourriture pythienne	8

Tableau 10. Sommaire des maladies diagnostiquées parmi les **arbres** et **arbustes ornementaux** reçus au Laboratoire de diagnostic en phytoprotection du MAPAQ en 2016.

CULTURE	AGENT PATHOGÈNE ou CAUSE	MALADIE ou SYMPTÔME	NOMBRE
Châtaignier	*Cryphonectria* sp	Chancre du châtaignier	2
Épinette noire	*Phomopsis* sp.	Chancre de tige	1
Érable de l'Amur	*Phyllosticta* sp.	Tache foliaire	1
Lilas	Phytoplasme	Anomalie de coloration foliaire	2
Noisetier	*Phomopsis* sp.	Chancre de tige	1
Orme d'Amérique	*Ophiostoma* sp.	Maladie hollandaise de l'orme	1
Palmier royal	*Fusarium* sp.	Pourriture fusarienne	2
Rhododendron / azalée	*Pestalotiopsis* sp.	Chancre de tige	2
	Phomopsis sp.	Chancre de tige	1
Sapin / sapin baumier	*Cylindrocarpon* sp.	Pourriture racinaire	1
	Fusarium sp.	Dépérissement	1
	Phytotoxicité – Glyphosate		2
	Phytophthora europaea	Pourriture phytophthoréenne	1

Tableau 11. Sommaire des maladies diagnostiquées parmi les **plantes ornementales herbacées** reçues au Laboratoire de diagnostic en phytoprotection du MAPAQ en 2016.

CULTURE	AGENT PATHOGÈNE ou CAUSE	MALADIE ou SYMPTÔME	NOMBRE
Alpiste	*Rhizoctonia* sp.	Rhizoctone	1
Anémone	AltMV (Alternanthera Mosaic Virus)	Anomalie de coloration foliaire	1
Arabette des dames	*Pythium irregulare*	Pourriture pythienne	1
Arnica	*Fusarium* sp.	Pourriture fusarienne	2
	Pythium sp.	Pourriture pythienne	2
	Rhizoctonia sp.	Rhizoctone	2
Asclépiade	*Alternaria* sp.	Alternariose	2
	Colletotrichum sp.	Anthracnose	2
	Facteur abiotique		2
Bacopa	AltMV (Alternanthera Mosaic Virus)	Anomalie de coloration foliaire	2
Bégonia	*Botrytis* sp.	Pourriture grise	1
Calibrachoa	*Acidovorax* sp.	Tache bactérienne	1
	Facteur abiotique		2
Chrysanthème	*Agrobacterium tumefaciens*	Tumeur du collet	1
Échinacée	*Fusarium* sp.	Pourriture fusarienne	1
	Pseudomonas marginalis	Brûlure bactérienne	1
	Pythium sp.	Pourriture pythienne	1
	Rhizoctonia sp.	Rhizoctone	2
Géranium / pélargonium	*Pseudomonas cichorii*	Pourriture bactérienne	1
Hémérocalle / lis d'un jour	*Aureobasidium* sp.	Tache foliaire	1
Heuchère	*Colletotrichum sp.*	Anthracnose	1
Impatiente / Impatiente de Nouvelle-Guinée	*Botrytis* sp.	Pourriture grise	3
	Facteur abiotique		2
	Fusarium sp.	Pourriture fusarienne	2
	Pythium sp.	Pourriture pythienne	3
Lavande	*Fusarium* sp.	Dépérissement	1
	Pythium sp.	Pourriture pythienne	1
Lobélie	TSWV (Tomato Spotted Wilt Virus)	Anomalie de coloration foliaire	1

Tableau 11 cont'd

CULTURE	AGENT PATHOGÈNE ou CAUSE	MALADIE ou SYMPTÔME	NOMBRE
Lupin / Lupin indigo	*Fusarium oxysporum*	Fusariose	1
	Pythium irregulare	Pourriture pythienne	1
	Pseudomonas viridiflava	Tache foliaire	1
Marguerite vivace	*Agrobacterium tumefaciens*	Tumeur du collet	1
	Rhodococcus fascians	Fasciation / galles feuillées	1
Mauve	*Fusarium* sp.	Pourriture fusarienne	4
	Pythium irregulare / Pythium sp.	Pourriture pythienne	5
Némésie	INSV (Impatiens Necrotic Spot Virus)	Anomalie de coloration foliaire	1
Œillet	CarMV (Carnation Mottle Virus)	Anomalie de coloration foliaire	3
	Fusarium sp.	Pourriture fusarienne	3
	pH inadéquat		1
Papyrus / Souchets	*Botrytis cinerea*	Pourriture grise	1
Pavot	*Colletotrichum* sp.	Anthracnose	1
Pennisetum	*Fusarium oxysporum*	Fusariose	1
Pensée / Violette	*Fusarium* sp.	Pourriture fusarienne	1
	Pythium sp.	Pourriture pythienne	1
Pétunia Série Wave	*Fusarium* sp.	Pourriture fusarienne	2
	Pythium sp.	Pourriture pythienne	2
	Thielaviopsis sp.	Pourriture racinaire	2
Phlox paniculé / phlox vivace	*Pseudomonas* sp.	Pourriture bactérienne	1
Pivoine	*Xanthomonas arboricola*	Tache bactérienne	1
Pourpier	*Pythium* sp.	Pourriture pythienne	1
Reine-des-prés	*Cylindrocarpon* sp.	Pourriture racinaire	2
	Fusarium sp.	Pourriture fusarienne	2
Rose trémière	*Fusarium* sp.	Pourriture fusarienne	1
	Phytophthora sp.	Pourriture phytophthoréenne	1
	Pythium ultimum	Pourriture pythienne	1
Sanvitalie	*Botrytis* sp.	Pourriture grise	1
Sauge ornementale	*Botrytis* sp.	Pourriture grise	1
	Xanthomonas arboricola	Tache bactérienne	1

Tableau 11 cont'd

CULTURE	*AGENT PATHOGÈNE ou CAUSE*	MALADIE ou SYMPTÔME	NOMBRE
Sédum / orpin	INSV (Impatiens Necrotic Spot Virus)	Anomalie de coloration foliaire	1
Véronique	AltMV (Alternanthera Mosaic Virus)	Anomalie de coloration foliaire	1
	Phytoplasme	Anomalie de coloration foliaire / malformation	2
	Puccinia sp.	Rouille	1
	Rhodococcus fascians	Fasciation / galles feuillées	2
	Sphaerotheca sp.	Blanc	1
	Sclerotinia sp.	Sclérotiniose	1
Zinnia	TSWV (Tomato Spotted Wilt Virus)	Anomalie de coloration foliaire	2

Tableau 12. Sommaire des maladies diagnostiquées parmi les **plantes aromatiques et médicinales** reçues au Laboratoire de diagnostic en phytoprotection du MAPAQ en 2016.

CULTURE	AGENT PATHOGÈNE ou CAUSE	MALADIE ou SYMPTÔME	NOMBRE
Aneth	*Fusarium* sp.	Pourriture fusarienne	6
	Pythium sp.	Pourriture pythienne	6
	Rhizoctonia sp.	Rhizoctone	3
Basilic	*Botrytis cinerea*	Pourriture grise	2
	Fusarium sp.	Pourriture fusarienne	4
Coriandre	Carence minérale		1
	Colletotrichum sp.	Anthracnose	1
	Fusarium sp.	Fusariose	1
	Pythium sp.	Pourriture pythienne	1
	Sclerotinia sp.	Sclérotiniose	1
Persil	*Septoria* sp.	Tache septorienne	2
Plantain majeur	AltMV (Alternanthera Mosaic Virus)	Anomalie de coloration foliaire / malformation foliaire	3
	Fusarium sp.	Pourriture fusarienne	1
	Phytoplasme	Malformation	2
	Pythium sp.	Pourriture pythienne	1
	Rhizoctonia sp.	Rhizoctone	1
Romarin	*Pseudomonas viridiflava*	Tache foliaire	1
Sauge aromatique	*Corynespora cassiicola*	Tache foliaire	1
	Peronospora sp.	Mildiou	1

CROP/ CULTURE: Diagnostic Laboratory Report
LOCATION / RÈGION: Quebec

NAMES AND AGENCY:
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http://www.agrireseau.qc.ca/lab/

TITLE: DISEASES / ABIOTIC PROBLEMS DIAGNOSED ON PLANT SAMPLES SUBMITTED TO THE MAPAQ - LABORATOIRE DE DIAGNOSTIC EN PHYTOPROTECTION IN 2016

ABSTRACT: From January 1st to October 20th, 1,663 plant samples were processed by the Laboratoire de diagnostic en phytoprotection team for the diagnosis of plant pathogenic agents. The samples consisted of field and greenhouse vegetables, ornamentals (herbaceous, shrubs and trees), field crops, forage crops, berry crops, fruit trees and turfgrass as well as aromatic and medicinal plants. Diagnoses were accomplished by visual and miocroscopic examination and where required, molecular and other diagnostic tests. This report presents the diseases diagnosed on the plant samples.

METHODS: The Laboratoire de diagnostic en phytoprotection du ministère de l'Agriculture, des Pêcheries et de l'Alimentation du Québec (MAPAQ) provides plant disease diagnostic services for growers, their advisers, government and homeowners. All diagnoses are accomplished by visual identification, generally followed by microscopic examination. Depending on the symptoms observed, one or more diagnostic tests are then made in order to determine the presence of plant pathogens.

Diagnosis are based mainly on these tests: nematodes are extracted from the soil and plant tissue by Baermann funnel and cyst nematodes are extracted from the soil with the Fenwick can; genus and species are identified according to their morphological characteristics or by polymerase chain reaction (PCR). Fungi are isolated on artificial media and identified by microscopy or by molecular techniques (PCR and DNA sequencing). Bacteria are isolated on artificial media and identified by biochemical identification (BIOLOG®), detected by enzyme-linked immunosorbent essay (ELISA) or by PCR and DNA sequencing. Phytoplasmas are detected by PCR and DNA sequencing. Finally, presence of virus is revealed by ELISA or PCR.

RESULTS AND COMMENTS: The following tables (1 to 12) present a summary of the diseases identified on plant samples received between January 1 and October 20, 2016. Table 1 (field vegetables) includes transplants from greenhouses and nurseries as well as field-grown vegetables. Table 2 (warehouse vegetables) including short and long term storage. Table 11 (herbaceous and floriculture ornamental plants) are essentially herbaceous plants (perennial or annual).

The number of diseases diagnosed does not correspond to the number of samples processed because some plant samples presented more than one disorder or disease. Negative or non-conclusive diagnoses are not included in the report.

Abiotic problems such as mineral deficiencies or excesses, inadequate pH, water stress, drought stress, physiological response to growing conditions, genetic abnormalities, environmental and chemical stresses including herbicide injuries and damage where no conclusive causal factor was identified are also included in this report. These diagnoses are based on the presence of characteristic symptoms, tests results and / or case history.

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Table 1. Summary of diseases diagnosed on **field vegetables** received at the Laboratoire de diagnostic en phytoprotection - MAPAQ in 2016.

CROP	PATHOGENIC AGENT or CAUSE	DISEASE or SYMPTOM	NUMBER
Garlic	*Alternaria* sp.	Alternaria leaf spot / purple blotch	3
	Botrytis sp.	Botrytis rot / gray mold	8
	Burkholderia cepacia / Burkholderia sp.	Bacterial rot	4
	Cladosporium sp.	Bulb rot	1
	Colletotrichum sp.	Anthracnose	2
	Ditylenchus dipsaci / Ditylenchus sp.	Stem and bulb nematode	11
	Embellisia sp.	Embellisia skin blotch	3
	Enterobacter cloacae	Bulb rot	3
	Fusarium proliferatum / Fusarium sp.	Plate rot / fusarium rot	39
	Pantoea agglomerans	Leaf necrosis	7
	Inadequate pH		2
	Pratylenchus sp.	Lesion nematode damage	1
	Pseudomonas marginalis	Bacterial leaf rot	7
	Pythium sp.	Pythium root rot	9
	Rhizoctonia sp.	Rhizoctonia root rot	13
Asparagus	*Fusarium* sp.	Fusarium crown and root rot	1
Eggplant	*Pseudomonas syringae*	Bacterial rot	1
Beet	Abiotic factor		2
	Fusarium sp.	Fusarium root rot	3
	Phoma sp.	Phoma root rot	1
	Ramularia sp.	Ramularia leaf spot	1
	Verticillium sp.	Verticillium wilt	3
Broccoli	*Alternaria* sp.	Alternaria leaf spot	2
Cantaloup	*Pseudomonas syringae*	Bacterial leaf spot	1
Carrot	High electrical conductivity		2
	Inadequate pH		2
Celery	*Colletotrichum acutatum / Colletotrichum* sp.	Anthracnose / leaf curl	4
	Fusarium sp.	Fusarium rot	6
	Pectobacterium carotovorum	Bacterial soft rot	3
	Pseudomonas cichorii	Bacterial leaf spot	4
	Pseudomonas marginalis	Bacterial soft rot	3
	Pythium sp.	Pythium root rot	6
Chinese cabbage	*Fusarium* sp.	Fusarium rot	1
	Pectobacterium sp.	Bacterial soft rot	1
	Pseudomonas marginalis	Bacterial leaf spot	1
Cabbage	*Alternaria* sp.	Alternaria leaf spot	1
	Fusarium sp.	Fusarium yellows / wilt	2
	Abiotic disorder *Rhizoctonia* sp.	Black speck Damping off / head rot / wire stem / bottom rot	1 2

Table 1 (cont).

CROP	*PATHOGENIC AGENT or CAUSE*	DISEASE or CAUSE	NUMBER
Chive	*Fusarium oxysporum*	Fusarium root rot	1
	Pythium sp.	Pythium root rot	1
Pumpkin /	*Colletotrichum* sp.	Anthracnose	1
marrow squash	*Fusarium* sp.	Fusarium root rot / fruit rot	2
	Phytophthora capsici	Phytophthora blight	1
	Pythium sp.	Pythium root rot	1
Cucumber	*Alternaria cucumerina / Alternaria* sp.	Alternaria leaf blight / leaf spot	2
	Erwinia tracheiphila	Bacterial wilt	1
	Abiotic factor		1
	Fusarium sp.	Fusarium rot	6
	Geotrichum sp.	Sour rot	1
	Oedema		1
	Pectobacterium carotovorum / Pectobacterium sp.	Bacterial soft rot	2
	Phoma sp.	Phoma root rot	1
	Plectosporium sp.	Plectosporium blight	3
	Pseudomonas sp. / *Pseudomonas syringae*	Bacterial leaf spot / bacterial rot	2
	Pseudoperonospora sp.	Downy mildew	2
	Pythium sp.	Pythium root rot	5
	Sclerotinia sp.	White mold	1
Squash	*Alternaria* sp.	Alternaria leaf spot	5
	Cladosporium sp.	Scab	1
	Colletotrichum sp.	Anthracnose	1
	Abiotic factor		2
	Fusarium equiseti / Fusarium sp.	Fusarium crown and root rot	9
	Geotrichum candicum / Geotrichum sp.	Sour rot	3
	Pectobacterium carotovorum	Bacterial soft rot	2
	Phytophthora capsici / Phytophthora sp.	Phytophthora blight	5
	Potyvirus	Fruit discoloration	1
	Pseudomonas syringae	Bacterial leaf spot	1
	Septoria sp.	Septoria leaf spot	2
Zucchini	*Alternaria* sp.	Alternaria leaf spot	2
	Cladosporium sp.	Scab	14
	Fusarium sp.	Fusarium rot	2
	Abiotic factor	Silvering	1
	Oidium sp.	Powdery mildew	1
	Pectobacterium carotovorum / Pectobacterium sp.	Bacterial soft rot	2
	Phoma sp.	Phoma root rot	1
	Phytophthora capsici / Phytophthora sp.	Phytophthora blight	4
	Pseudomonas syringae	Bacterial leaf / fruit spot	2
	Pythium sp.	Pythium fruit rot	1
Spinach	*Fusarium* sp. *Pythium sp.*	Fusarium rot Pythium root rot	2 2

Table 1 (cont).

CROP	*PATHOGENIC AGENT or CAUSE*	DISEASE or CAUSE	NUMBER
Broad bean	*Alternaria* sp.	Alternaria leaf spot	1
	Botrytis sp.	Gray mould	1
	Cladosporium sp.	Cladosporium rot	4
	Colletotrichum sp.	Anthracnose	1
	Cylindrocarpon sp.	Cylindrocarpon root rot	3
	Fusarium sp.	Fusarium crown and root rot	6
	Helicotylenchus sp.	Spiral nematode damage	4
	Meloidogyne sp.	Root-knot nematode damage	3
	Pratylenchus sp.	Lesion nematode damage	4
	Pythium sp.	Pythium root rot	3
	Rhizoctonia sp.	Rhizoctonia root rot	6
Bean / adzuki bean	*Fusarium* sp.	Fusarium crown and root rot	2
	Pseudomonas syringae	Bacterial leaf spot	4
	Abiotic factor		1
Romaine lettuce	*Bremia lactucae*	Downy mildew	1
	Fusarium sp.	Fusarium crown and root rot	1
	Pseudomonas cichorii	Bacterial leaf spot	1
	Pseudomonas syringae	Bacterial leaf spot	1
	Pythium sp.	Pythium root rot	1
Melon / Watermelon	*Alternaria cucumerina*	Alternaria leaf blight / leaf spot	1
	Erwinia tracheiphila	Bacterial wilt	2
	Fusarium sp.	Fusarium crown and root rot	4
	Rhizoctonia sp.	Rhizoctonia root rot	2
Onion / Spanish onion	*Burkholderia gladioli*	Bacterial soft rot	2
	Enterobacter cloacae	Bulb rot	3
	Fusarium sp.	Fusarium rot	11
	Pantoea agglomerans	Leaf necrosis	1
	Penicillium sp.	Bulb rot	3
	Pythium sp.	Pythium root rot	1
Pepper (hot pepper)	*Fusarium* sp.	Fusarium crown and root rot	2
	Phytophthora sp.	Phytophthora blight	2
Leek	*Fusarium* sp.	Fusarium crown and root rot	3
Green pea / pea	*Fusarium* sp.	Fusarium crown and root rot	2
Pepper (sweet pepper)	*Fusarium solani / Fusarium* sp.	Fusarium crown and root rot	4
	Phytophthora capsici / Phytophthora sp.	Phytophthora blight	5
	Air pollution – ozone		2
	Rhizoctonia sp.	Rhizoctonia root rot	3
	Xanthomonas campestris	Bacterial leaf spot	1
Potato	*Cladosporium* sp.	Cladosporium rot	1
	Colletotrichum sp.	Black dot	5
	Abiotic factor	Blackheart	1

Table 1 (cont).

CROP	PATHOGENIC AGENT or CAUSE	DISEASE or CAUSE	NUMBER
Potato (continued)	Abiotic factor		2
	Fusarium graminearum / Fusarium sp.	Dry rot / tuber rot	17
	Geotrichum sp.	Rubbery rot	10
	Helminthosporium sp.	Silver scurf	1
	PMTV (Potato Mop-Top Virus)	Tuber internal necrosis	1
	Pectobacterium atrosepticum / Pectobacterium carotovorum / Pectobacterium sp.	Black leg / bacterial soft rot	14
	Phytophthora sp.	Pink rot	3
	Pythium sp.	Pythium leak	6
	Spongospora subterranea	Powdery scab	1
	Streptomyces sp.	Potato scab	1
	Verticillium sp.	Verticillium wilt	8
Rhubarb	ArMV (Arabis Mosaic Virus)	Foliar discoloration	1
	Colletotrichum sp.	Anthracnose	6
	Cylindrocarpon sp.	Cylindrocarpon root rot	4
	Helicotylenchus sp.	Spiral nematode damage	4
	Paratylenchus sp.	Pin nematode damage	4
	Pratylenchus sp.	Lesion nematode damage	4
	Rhizoctonia sp.	Rhizoctonia crown and root rot	3
	ToRSV (Tomato Ringspot Virus)	Foliar discoloration	2
	Xiphinema sp.	Dagger nematode damage	4
Rocket	*Fusarium* sp.	Fusarium rot	1
Escarole / chicory escarole	Abiotic factor		2
Tomato	*Alternaria alternata*	Alternaria leaf spot	1
	Clavibacter michiganensis subsp. *michiganensis*	Tomato bacterial canker	2
	Fusarium sp.	Fusarium crown and root rot	6
	Pythium sp.	Pythium root rot	4

Table 2. Summary of diseases diagnosed on **stored vegetables** received at the Laboratoire de diagnostic en phytoprotection - MAPAQ in 2016.

CROP	PATHOGENIC AGENT or CAUSE	DISEASE or SYMPTOM	NUMBER
Garlic	*Embellisia* sp.	Embellisia skin blotch	4
	Abiotic factor		2
	Fusarium sp.	Basal plate rot / fusarium rot	3
Beet	*Pseudomonas syringae*	Bacterial rot	1
Carrot	*Botrytis* sp.	Gray mold	1
Kale	*Fusarium* sp.	Fusarium rot	3
Cabbage	*Botrytis* sp.	Gray mold	1
Turnip	*Rhizoctonia* sp.	Rhizoctonia root rot / storage rot	1
Pepper (sweet pepper)	*Fusarium* sp.	Fusarium crown and root rot	3
	Pythium sp.	Pythium root rot	3
Potato	Mechanical injury		2
	Abiotic factor	Blackheart	1
	Colletotrichum coccodes / Colletotrichum sp.	Black dot	4
	Abiotic factor		2
	Fusarium sp.	Dry rot / tuber rot	4
	Geotrichum candidum / Geotrichum sp.	Rubbery rot	3
	Helminthosporium sp.	Silver scurf	2
	PMTV (Potato Mop-Top Virus)	Tuber internal necrosis	3
	Rhizoctonia sp.	Black scurf / root rot	1
	Spongospora sp.	Powdery scab	1
Cherry tomato	*Penicillium* sp.	Blue mould / fruit rot	1

Table 3. Summary of diseases diagnosed on **greenhouse crops** received at the Laboratoire de diagnostic en phytoprotection - MAPAQ in 2016.

CROP	PATHOGENIC AGENT or CAUSE	DISEASE or SYMPTOM	NUMBER
Garlic	*Botrytis* sp.	Botrytis rot / gray mould	1
	Enterobacter cloacae	Bulb rot	4
	Fusarium sp.	Basal plate rot / fusarium rot	8
Bok Choy / Pak Choy	Abiotic factor		1
	Pseudomonas marginalis	Bacterial leaf spot	1
	Verticillium sp.	Verticillium wilt	1
Cabbage	*Alternaria brassicicola*	Black spot	3
Chive	*Fusarium graminearum*	Basal plate rot / fusarium rot	1
Cucumber	*Cladosporium cucumerinum / Cladosporium* sp.	Scab	5
	High electrical conductivity		3
	Erwinia tracheiphila	Bacterial wilt	2
	Fusarium oxysporum / Fusarium sp.	Fusarium crown and root rot	11
	Pectobacterium carotovorum	Bacterial soft rot	2
	Pythium sp.	Pythium root rot	5
	Ulocladium sp.	Ulocadium leaf spot	2
Lettuce	*Fusarium* sp.	Fusarium crown and root rot	6
	Phytophthora cryptogea	Phytophthora root rot	4
	Pythium dissotocum	Pythium root rot	8
Pepper (hot pepper)	*Xanthomonas campestris*	Bacterial leaf spot	1
Pepper (sweet pepper)	*Fusarium* sp.	Fusarium crown and root rot	1
	Inadequate pH		2
Potato	*Colletotrichum* sp.	Black dot	2
Tomato	*Clavibacter michiganensis* subsp. *michiganensis*	Tomato bacterial canker	8
	Colletotrichum sp.	Anthracnose	1
	Abiotic factor		3
	Fusarium oxysporum / Fusarium sp. / *Fusarium sporotrichioides*	Fusarium crown and root rot / Wilt	11
	Abiotic factor	Gold fleck	1
	Oedema		3
	PepMV (Pepino Mosaic Virus)	Multi-symptomatic	15
	Pseudomonas sp.	Tomato pith necrosis	1
	Pythium sp. / *Pythium ultimum*	Pythium root rot	5
	TSWV (Tomato Spotted Wilt Virus)	Foliar discoloration / foliar blight	2

Table 4. Summary of diseases diagnosed on **small fruits** received at the Laboratoire de diagnostic en phytoprotection - MAPAQ in 2016.

CROP	PATHOGENIC AGENT or CAUSE	DISEASE or CAUSE	NUMBER
Amelanchier	*Nectria cinnabarina*	Stem canker	3
Sea buckthorn	*Alternaria* sp.	Alternaria leaf spot	2
	Aureobasidium sp.	Fruit rot	1
	Cylindrocarpon sp.	Cylindrocarpon root rot	3
	Cylindrocladium sp.	Stem canker	2
	Abiotic factor		1
	Fusarium sp.	Fusarium crown and root rot	14
	Meloidogyne sp.	Root-knot nematode damage	5
	Phomopsis sp.	Stem canker	5
	Pratylenchus sp.	Lesion nematode damage	8
	Pythium sp.	Pythium root rot	6
	Verticillium dahliae	Verticillium wilt	2
	Xiphinema sp.	Dagger nematode damage	5
Highbush blueberry	*Agrobacterium* sp.	Crown gall	2
	Alternaria sp.	Alternaria leaf spot	1
	Aureobasidium sp.	Fruit rot	1
	BlShV (Blueberry Shock Virus)	Blueberry shock disease	9
	Botrytis sp.	Gray mould	1
	Exobasidium sp.	Exobasidium leaf / fruit spot	5
	Abiotic factor		4
	Fusarium sp.	Fusarium crown and root rot	2
	Fusicoccum sp.	Stem canker	7
	Pestalotiopsis sp.	Stem canker	1
	Phomopsis sp.	Stem canker	1
	Phytoplasma	Blueberry stunt	3
	Pratylenchus sp.	Lesion nematode damage	1
	Pseudomonas syringae / Pseudomonas sp.	Bacterial blight	4
	Pyrenochaeta sp.	Pyrenochaeta root rot	2
	Seimatosporium sp.	Decline	7
	Septoria sp.	Septoria leaf spot	1
Lowbush blueberry	*Aureobasidium* sp.	Fruit rot	2
	Colletotrichum sp.	Anthracnose	1
	Abiotic factor		1
	Ramularia sp.	Ramularia leaf spot	2
	Septoria sp.	Septoria leaf spot	4
Honeysuckle	*Alternaria* sp.	Alternaria leaf spot	4
	Aureobasidium sp.	Fruit rot	1
	Cylindrocarpon sp.	Cylindrocarpon root rot	3
	Abiotic factor		1
	Fusarium sp.	Fusarium crown and root rot	10
	Meloidogyne sp.	Root-knot nematode damage	1
	Microsphaera sp.	Powdery mildew	4
	Inadequate pH		1

Table 4 (cont.)

CROP	PATHOGENIC AGENT or CAUSE	DISEASE or CAUSE	NUMBER
Honeysuckle (continued)	*Pratylenchus* sp.	Lesion nematode damage	1
	Pythium sp.	Pythium root rot	2
	Rhizoctonia sp.	Rhizoctonia root rot	8
Cranberry	*Allantophomopsis cytisporea*	Black rot	1
	Coleophoma sp.	Ripe rot	1
	Colletotrichum acutatum / Colletotrichum sp.	Bitter rot	3
	Exobasidium sp.	Exobasidium leaf spot	2
	Abiotic factor		2
	Phyllosticta elongata / Phyllosticta sp.	Berry speckle / phyllosticta leaf spot	8
	Physalospora sp.	Blotch rot	1
	Protoventuria sp.	Berry speckle / protoventuria leaf spot	5
American strawberry	*Botrytis* sp.	Gray mould	1
	Pythium sp.	Pythium root rot	2
	Rhizoctonia sp.	Rhizoctonia root rot	2
Strawberry	*Botrytis* sp.	Gray mould	7
	Colletotrichum sp.	Anthracnose	3
	High electrical conductivity		5
	Cylindrocarpon sp.	Cylindrocarpon root rot	20
	Abiotic factor		1
	Fusarium sp. / *Fusarium oxysporum*	Fursarium rot	60
	Frost		7
	Hainesia sp.	Tan brown rot	1
	Helicotylenchus sp.	Spiral nematode damage	2
	Longidorus sp.	Needle nematode damage	3
	Meloidogyne sp.	Root-knot nematode damage	3
	Inadequate pH		3
	Phomopsis sp.	Phomopsis leaf blight	2
	Phytophthora cactorum / *Phytophthora* sp.	Phytophthora root rot	29
	Phytoplasma	Phyllody	2
	Atrazine injury		1
	Podosphaera sp.	Powdery mildew	1
	Black root rot	Black root rot	40
	Pratylenchus sp.	Lesion nematode damage	6
	Pythium sp.	Pythium root rot	56
	Rhizoctonia sp.	Rhizoctonia root rot	51
	SMoV (Strawberry Mottle Virus)	Strawberry virus decline	16
	SMYEV (Strawberry Mild Yellow Edge Virus)	Strawberry virus decline	10
	SVBV (Strawberry Vein Banding Virus)	Strawberry virus decline	6
	SPaV (Strawberry Pallidosis Virus)	Strawberry virus decline	1
	Verticillium dahliae / Verticillium sp.	Verticillium wilt	2
	Xanthomonas fragariae	Bacterial angular leaf spot	3
	Zythia sp. / *Gnomonia* sp.	Gnomonia leaf blotch / petiole blight / root rot / fruit rot	2

Table 4 (cont.)

CROP	PATHOGENIC AGENT or CAUSE	DISEASE or CAUSE	NUMBER
Raspberry	*Agrobacterium* sp.	Crown gall / cane gall	13
	Botrytis sp.	Gray mould	1
	Colletotrichum sp.	Anthracnose	1
	Cylindrocarpon sp.	Cylindrocarpon root rot	9
	Didymella applanata	Spur blight	1
	Abiotic factor		1
	Fusarium sp.	Fusarium crown and root rot	12
	Helicotylenchus sp.	Spiral nematode damage	5
	Black root rot	Black root rot	6
	Pratylenchus sp.	Lesion nematode damage	6
	Pythium sp.	Pythium root rot	6
	Rhizoctonia sp.	Rhizoctonia root rot	8
	ToRSV (Tomato Ringspot Virus)	Foliar discoloration / crumbly berry	2
Blackberry	*Gnomonia* sp.	Stem canker	1
Elderberry	*Alternaria* sp.	Alternaria leaf spot	1
	Cladosporium sp.	Cladosporium leaf spot	1
	Fusarium sp.	Fusarium crown and root rot	5
	Helicotylenchus sp.	Spiral nematode damage	2
	Meloidogyne sp.	Root-knot nematode damage	2
	Plectosporium sp.	Decline	4
	Pratylenchus sp.	Lesion nematode damage	2
	Pseudomonas syringae	Bacterial rot	6
	Pythium sp.	Pythium root rot	1
	Rhizoctonia sp.	Rhizoctonia root rot	1
Grape	*Agrobacterium* sp. / *Agrobacterium vitis*	Crown gall	2
	Botrytis sp.	Gray mould	1
	Cladosporium sp.	Fruit rot / leaf spot	3
	Colletotrichum sp.	Anthracnose	2
	Cylindrocarpon sp.	Black foot	3
	Diatrypella verruciformis	Wood decay	1
	Abiotic factor		10
	Fusarium sp.	Fusarium crown and root rot	4
	Pestalotia sp.	Stem canker	1
	Phoma negriana / Phoma sp.	Phoma leaf spot / root rot	4

Table 5. Summary of diseases diagnosed on **cereals and associated crops** received at the Laboratoire de diagnostic en phytoprotection - MAPAQ in 2016.

CROP	PATHOGENIC AGENT or CAUSE	DISEASE or SYMPTOM	NUMBER
Oat	*Ustilago* sp.	Loose smut	1
Wheat	*Bipolaris* sp.	Spot blotch	2
	Sooty mould	Sooty mould	1
	Fusarium sp.	Fusarium root rot	4
	Microdochium sp.	Microdochium root rot	1
	Puccinia sp.	Rust	2
	Pythium sp.	Pythium root rot	5
Quinoa	*Cladosporium* sp.	Cladosporium rot	1
	Corynespora sp.	Corynespora leaf spot	1
	Fusarium sp.	Fusarium crown and root rot	2
	Pythium sp.	Pythium root rot	4
Chia	*Fusarium* sp.	Fusarium crown and root rot	3
	Pythium sp.	Pythium root rot	3
Barley	*Alternaria* sp.	Alternaria leaf spot	1
	Bipolaris sp.	Spot blotch	2
	Cladosporium sp.	Sooty mold	1
Buckwheat	*Fusarium* sp.	Fusarium root rot	2
	Pythium sp.	Pythium root rot	2
	Rhizoctonia sp.	Rhizoctonia root rot	2

Table 6. Summary of diseases diagnosed on **oilseeds, pulses, textiles and associated crops** received at the Laboratoire de diagnostic en phytoprotection - MAPAQ in 2016.

CROP	PATHOGENIC AGENT or CAUSE	DISEASE or SYMPTOM	NUMBER
Hop	*Alternaria* sp.	Alternaria leaf spot	2
	Cladosporium sp.	Cladosporium rot	1
	Abiotic factor		1
	Fusarium sp.	Cone tip blight / fusarium root rot	2
	Pseudoperonospora sp.	Downy mildew	2
Corn	Phosphorus deficiency		2
	Fusarium sp.	Fusarium root rot	6
	Kabatiella sp.	Eyespot	1
	Pythium sp.	Pythium root rot	4
	Rhizoctonia sp.	Rhizoctonia root rot	2
Soybean	*Alternaria* sp.	Alternaria leaf spot	2
	Cercospora sp.	Cercospora leaf spot	6
	Colletotrichum sp.	Anthracnose	6
	Corynespora sp.	Target spot / root rot	1
	Cylindrocarpon sp.	Cylindrocarpon root rot	3
	Abiotic factor		1
	Fusarium oxysporum / Fusarium sp.	Fusarium rot	37
	Helicotylenchus sp.	Spiral nematode damage	1
	Inadequate pH		6
	Phomopsis sp.	Stem canker	3
	Phytophthora sp.	Phytophthora root rot	15
	Pratylenchus sp.	Lesion nematode damage	3
	Pseudomonas syringae	Bacterial leaf spot	1
	Pythium sp.	Pythium root rot	26
	Rhizoctonia sp.	Rhizoctonia root rot	6
	Septoria sp.	Septoria brown spot	4
Tobacco (Australian)	INSV (Impatiens Necrotic Spot Virus)	Foliar discoloration	2

Table 7. Summary of diseases diagnosed on **forages** received at the Laboratoire de diagnostic en phytoprotection - MAPAQ in 2016.

CROP	PATHOGENIC AGENT or CAUSE	DISEASE or SYMPTOM	NUMBER
Timothy grass	*Colletotrichum* sp.	Anthracnose	1
Alfalfa	*Alternaria* sp.	Alternaria leaf spot	2
	Cladosporium sp.	Cladosporium leaf spot	1
	Pseudopeziza sp.	Common leaf spot	1
Perennial rye grass	*Puccinia* sp.	Rust	2
Sorghum	*Alternaria* sp.	Alternaria leaf spot	1
	Curvularia sp.	Curvularia leaf spot	1
	Fusarium sp.	Fusarium root rot	3
	Pythium sp.	Pythium root rot	3
Clover	Abiotic factor		2

Table 8. Summary of diseases diagnosed on **fruit trees** received at the Laboratoire de diagnostic en phytoprotection - MAPAQ in 2016.

CROP	PATHOGENIC AGENT or CAUSE	DISEASE or SYMPTOM	NUMBER
Dwarf sour cherry	*Alternaria* sp.	Alternaria leaf spot	7
	Aureobasidium sp.	Fruit rot	6
	Cladosporium sp.	Cladosporium rot	4
	Abiotic factor		4
	Fusarium sp.	Fusarium rot	2
	Pseudomonas syringae	Bacterial blight	11
	Thielaviopsis sp.	Black root rot	2
Lemon	*Fusarium* sp.	Fusarium crown and root rot	3
Gooseberry	*Puccinia* sp.	Rust	2
	Sphaerotheca sp.	Powdery mildew	1
Pear	Phytoplasma	Pear decline	2
Apple	*Erwinia amylovora*	Fire blight	4
	Abiotic factor		6
	Fusarium sp.	Fusarium rot	7
	Phytophthora cactorum	Phytophthora root rot	1
	Pratylenchus sp.	Lesion nematode damage	1
	Pythium sp.	Pythium root rot	3
	Sphaeropsis sp.	Sphaeropsis rot	2
	Nectria cinnabarina	Nectria canker	3
Plum	Abiotic factor		5

Table 9. Summary of diseases diagnosed on **turfgrass** received at the Laboratoire de diagnostic en phytoprotection - MAPAQ in 2016.

CROP	PATHOGENIC AGENT or CAUSE	DISEASE or SYMPTOM	NUMBER
Bentgrass	*Colletotrichum* sp.	Anthracnose	1
	Fusarium sp.	Fusarium patch	2
	Magnaporthe sp.	Summer patch	2
	Microdochium sp. / *Microdochium nivale*	Pink snow mold	7
	Phyllosticta sp.	Phyllosticta leaf spot	2
	Puccinia sp.	Rust	2
	Pythium sp. / *Pythium torulosum*	Pythium root rot	8

Table 10. Summary of diseases diagnosed on **woody ornamentals** received at the Laboratoire de diagnostic en phytoprotection - MAPAQ in 2016.

CROP	PATHOGENIC AGENT or CAUSE	DISEASE or SYMPTOM	NUMBER
Chestnut	*Cryphonectria* sp	Chestnut blight	2
Black spruce	*Phomopsis* sp.	Stem canker	1
Amur maple	*Phyllosticta* sp.	Phyllosticta leaf spot	1
Lilac	Phytoplasma	Witches' broom	2
Hazel	*Phomopsis* sp.	Stem canker	1
Elm	*Ophiostoma* sp.	Dutch elm disease	1
Royal palm	*Fusarium* sp.	Fusarium rot	2
Rhododendron / azalea	*Pestalotiopsis* sp.	Stem canker	2
	Phomopsis sp.	Stem canker	1
Fir / balsam fir	*Cylindrocarpon* sp.	Cylindrocarpon root rot	1
	Fusarium sp.	Fusarium rot	1
	Glyphosate injury		2
	Phytophthora europaea	Phytophthora root rot	1

Table 11. Summary of diseases diagnosed on **herbaceous and floriculture ornamental plants** received at the Laboratoire de diagnostic en phytoprotection - MAPAQ in 2016.

CROP	PATHOGENIC AGENT or CAUSE	DISEASE or SYMPTOM	NUMBER
Canary seed	*Rhizoctonia* sp.	Rhizoctonia root rot	1
Anemone	AltMV (Alternanthera Mosaic Virus)	Foliar discoloration	1
Arabidopsis thaliana	*Pythium irregulare*	Pythium root rot	1
Arnica	*Fusarium* sp.	Fusarium rot	2
	Pythium sp.	Pythium root rot	2
	Rhizoctonia sp.	Rhizoctonia root rot	2
Asclepias	*Alternaria* sp.	Alternaria leaf spot	2
	Colletotrichum sp.	Anthracnose	2
	Abiotic factor		2
Bacopa	AltMV (Alternanthera Mosaic Virus)	Foliar discoloration	2
Begonia	*Botrytis* sp.	Gray mould	1
Calibrachoa	*Acidovorax* sp.	Bacterial leaf spot	1
	Abiotic factor		2
Chrysanthemum	*Agrobacterium tumefaciens*	Crown gall	1
Echinacea	*Fusarium* sp.	Fusarium rot	1
	Pseudomonas marginalis	Bacterial blight	1
	Pythium sp.	Pythium root rot	1
	Rhizoctonia sp.	Rhizoctonia root rot	2
Geranium / Pelargonium	*Pseudomonas cichorii*	Bacterial rot	1
Daylily	*Aureobasidium* sp.	Aureobasidium leaf spot	1
Heuchera	*Colletotrichum sp.*	Anthracnose	1
Impatiens /	*Botrytis* sp.	Gray mould	3
New Guinea	Abiotic factor		2
impatiens	*Fusarium* sp.	Fusarium rot	2
	Pythium sp.	Pythium root rot	3
Lavender	*Fusarium* sp.	Fusarium rot	1
	Pythium sp.	Pythium root rot	1
Lobelia	TSWV (Tomato Spotted Wilt Virus)	Foliar discoloration	1

Table 11 (cont.)

CROP	PATHOGENIC AGENT or CAUSE	DISEASE or CAUSE	NUMBER
Baptisia / *Baptisia australis*	*Fusarium oxysporum*	Fusarium crown and root rot	1
	Pythium irregulare	Pythium root rot	1
	Pseudomonas viridiflava	Bacterial leaf spot	1
Perennial daisy	*Agrobacterium tumefaciens*	Crown gall	1
	Rhodococcus fascians	Shoot proliferation / leafy gall	1
Malva sylvestris	*Fusarium* sp.	Fusarium rot	4
	Pythium irregulare / Pythium sp.	Pythium root rot	5
Nemesia	INSV (Impatiens Necrotic Spot Virus)	Foliar discoloration	1
Carnation	CarMV (Carnation Mottle Virus)	Foliar discoloration	3
	Fusarium sp.	Fusarium rot	3
	Inadequate pH		1
Cyperus alternifolius	*Botrytis cinerea*	Gray mould	1
Poppy	*Colletotrichum* sp.	Anthracnose	1
Pennisetum	*Fusarium oxysporum*	Fusarium root rot	1
Pansy / violet	*Fusarium* sp.	Fusarium rot	1
	Pythium sp.	Pythium root rot	1
Petunia (wave)	*Fusarium* sp.	Fusarium rot	2
	Pythium sp.	Pythium root rot	2
	Thielaviopsis sp.	Black root rot	2
Perennial phlox	*Pseudomonas* sp.	Bacterial rot	1
Peony	*Xanthomonas arboricola*	Bacterial leaf spot	1
Purslane	*Pythium* sp.	Pythium root rot	1
Meadowsweet	*Cylindrocarpon* sp.	Cylindrocarpon root rot	2
	Fusarium sp.	Fusarium rot	2
Hollyhock	*Fusarium* sp.	Fusarium rot	1
	Phytophthora sp.	Phytophthora root rot	1
	Pythium ultimum	Pythium root rot	1
Sanvitalia	*Botrytis* sp.	Gray mould	1
Ornamental sage	*Botrytis* sp.	Gray mould	1
	Xanthomonas arboricola	Bacterial leaf spot	1
Sedem / orpin	INSV (Impatiens Necrotic Spot Virus	Foliar discoloration	1

Table 11 (cont.)

CROP	PATHOGENIC AGENT or CAUSE	DISEASE or CAUSE	NUMBER
Veronica	AltMV (Alternanthera Mosaic Virus)	Foliar discoloration	1
	Phytoplasma	Foliar discoloration / distortion	2
	Puccinia sp.	Rust	1
	Rhodococcus fascians	Shoot proliferation / leafy gall	2
	Sphaerotheca sp.	Powdery mildew	1
	Sclerotinia sp.	White mould	1
Zinnia	TSWV (Tomato Spotted Wilt Virus)	Foliar discoloration	2

Table 12. Summary of diseases diagnosed on **herbs and medicinal plants** received at the « Laboratoire de diagnostic en phytoprotection - MAPAQ » in 2016.

CROP	PATHOGENIC AGENT or CAUSE	DISEASE or SYMPTOM	NUMBER
Dill	*Fusarium* sp.	Fusarium rot	6
	Pythium sp.	Pythium root rot	6
	Rhizoctonia sp.	Rhizoctonia root rot	3
Basil	*Botrytis cinerea*	Gray mold	2
	Fusarium sp.	Fusarium rot	4
Coriander	Mineral deficiency		1
	Colletotrichum sp.	Anthracnose	1
	Fusarium sp.	Fusarium root rot	1
	Pythium sp.	Pythium root rot	1
	Sclerotinia sp.	White mould	1
Parsley	*Septoria* sp.	Septoria leaf spot	2
Broad-leaved plantain	AltMV (Alternanthera Mosaic Virus)	Foliar discoloration / distortion	3
	Fusarium sp.	Fusarium rot	1
	Phytoplasma	Foliar distortion	2
	Pythium sp.	Pythium root rot	1
	Rhizoctonia sp.	Rhizoctonia root rot	1
Rosemary	*Pseudomonas viridiflava*	Bacterial leaf spot	1
Aromatic sage	*Corynespora cassiicola*	Corynespora leaf spot	1
	Peronospora sp.	Downy mildew	1

CROP / CULTURE: Diagnostic Laboratory Report
LOCATION / RÈGION: New Brunswick

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TITLE: DISEASES DIAGNOSED ON PLANT SAMPLES SUBMITTED TO THE NBDAAF PLANT DISEASE DIAGNOSTIC LABORATORY IN 2016

ABSTRACT: The New Brunswick Department of Agriculture, Aquaculture and Fisheries (NBDAAF) Plant Disease Diagnostic Laboratory provides diagnostic services and disease management recommendations to growersand the agricultural industry in New Brunswick. In 2016, a total of 151 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 2 February to 30 November, 2016, the Plant Disease Diagnostic Laboratory received 150 diseased plant samples for diagnosis. Of these, 83% were infectious diseases (125 in total) and 17% physiological disorders (25 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 diagnosed and causal agents on plant tissue samples submitted to the NBDAAF Plant Disease Diagnostic Laboratory in 2016 are presented in Tables 1 to 5 by crop category.

Table 1: Summary of diseases diagnosed on fruit tree crops submitted to the NBDAAF Plant Disease Diagnostic Laboratory in 2016.

CROP	DISEASE	CAUSAL AGENT	NUMBER OF SAMPLES
Apple	Apple scab	*Venturia inaequalis*	3
	Black rot	*Botryosphaeria obtusa*	2 4
	Canker (black rot)	*Botryosphaeria obtusa*	2
	Crown and collar rot	*Phytophthora cactorum*	2
	Frogeye leaf spot	*Botryosphaeria obtusa*	2
	Perennial canker	*Neofabraea perennans*	1
	Chemical injury	Pesticide damage	2
Plum	Brown rot	*Monilinia fructicola*	1
DISEASED SAMPLES			15
ABIOTIC DISORDERS			2
TOTAL SUBMISSIONS			17

Table 2: Summary of diseases diagnosed on berry crops submitted to the NBDAAF Plant Disease Diagnostic Laboratory in 2016.

CROP	DISEASE	CAUSAL AGENT	NUMBER OF SAMPLES
Blackcurrant	Mycosphaerella leaf spot	*Mycosphaerella ribis*	1
Blueberry (lowbush)	Septoria leaf spot	*Septoria* spp.	1
	Valdensinia leaf spot	*Valdensinia heterodoxa*	1
	Botrytis blight	*Botrytis cinerea*	1
	Exobasidium leaf and fruit spot	*Exobasidium vaccinii*	1
	Leaf rust	*Thekopsora minima*	1
	Monilinia blight	*Monilinia vaccinii-corymbosi*	1
	Red leaf	*Exobasidium vaccinii*	1
	Chemical injury	Herbicide injury	2
	Environmental injury	Frost injury	2
	Phomosis canker	*Phomopsis vaccinii*	1
Blueberry (highbush)	Botrytis blight	*Botrytis cinerea*	1
	Environmental injury	Frost injury	1
Grape	Downy mildew	*Plasmopara viticola*	1
Haskap	Powdery mildew	Erysiphales	1
Raspberry	Spur blight	*Didymella applanata*	1
	Gray mould	*Botrytis cinerea*	1
	Late leaf rust	*Pucciniastrum americanum*	1
Strawberry	Black root rot	*Fusarium* spp.,*Pythium* sp., *Rhizoctonia* spp.	5
	Anthracnose fruit rot	*Colletotrichum* spp.	3
	Crown rot	*Phytophthora cactorum*	2
	Gray mould	*Botrytis cinerea*	2
	Powdery mildew	*Sphaerotheca macularis* f.sp. *fragariae*	4
	Verticillium wilt	*Verticillium dahliae*	1
	Leaf scorch	*Diplocarpon earlianum*	2
	Leaf spot	*Mycosphaerella fragariae*	2
	Environmental injury	Frost injury	1
DISEASED SAMPLES			36
ABIOTIC DISORDERS			6
TOTAL SUBMISSIONS			42

Table 3: Summary of diseases diagnosed on vegetable (field and greenhouse) crops submitted to the NBDAAF Plant Disease Diagnostic Laboratory in 2016.

CROP	DISEASE	CAUSAL AGENT	NUMBER OF SAMPLES
Bean	Anthracnose	*Colletotrichum* sp.	1
	Environmental injury	Chilling injury	1
	Environmental injury	Herbicide damage	1
Beet	Cercospora leaf spot	*Cercospora betae*	1
		Alternariabrassicae and *A. brassicicola*	2
Brussels sprout	Alternaria leaf spot	*Alternaria brassicae* and *A. brassicicola*	2

Table 3 (cont.)

Cabbage	Black leaf spot	*Alternaria brassicae* and *A. brassicicola*	1
		Physiological disorder	1
	Pepper spot	*Sclerotinia sclerotiorum*	1
	Cottony soft rot		
Cantaloupe	Fruit cracking	Moisture fluctuation	1
Carrot	Leaf blight	*Alternaria dauci* and *Cercospora carotae*	2
	Gray mould	*Botrytis cinerea*	1
	Cavity spot	*Pythium* spp.	2
	Crater rot	*Rhizoctonia carotae*	1
	Pythium root dieback	*Pythium* spp.	2
	Environmental injury	Herbicide damage	1
Celeriac	Soft rot	*Erwinia carotovora*	1
Celery	Black heart	Ca deficiency	1
	Nutrient deficiency	N deficiency	1
Cucumber	Damping-off	*Pythium* spp.	1
	Alternaria leaf blight	*Alternaria* spp.	3
	Scab	*Cladosporium cucumerinum*	2
	White mould	*Sclerotinia sclerotiorum*	1
Garlic	Basal rot	*Fusarium oxysporum* f. sp. *cepae*	1
	Purple blotch	*Alternaria porri*	1
	Bulb and stem nematode	*Ditylenchus dipsac*	2
Leek	Basal rot	*Fusarium* sp.	1
	Bulb and stem nematode	Ditylenchus dipsaci	1
Lettuce	Lettuce drop	*Sclerotinia sclerotiorum*	1
Melon	Alternaria leaf blight	*Alternaria* spp.	2
	Environmental injury	Hail damage	1
	Environmental injury	Drought stress	1
Onion	Neck rot	*Botrytis* spp.	1
	Purple blotch	*Alternaria porri*	2
	Smudge	*Colletotrichum* sp.	1
Pepper	Blossom end rot	Environmental injury	2
	Sunscald	Environmental injury	1
Squash	Alternaria leaf blight	*Alternaria* spp.	1
	Black rot	*Didymella bryoniae*	1
Spinach	Cladosporium leaf spot	*Cladosporium* spp.	1
Tomato	Leaf mould	*Passalora fulva*	6
	Powdery mildew	*Oidium neolycopersici*	3
	Early blight	*Alternaria solani*	6
	Bacterial spot	*Xanthomonas campestris* pv.*vesicatoria*	1
	Septoria leaf spot	*Septoria lycopersici*	1
	Gray mould	*Botrytis cinerea*	1
	White mould	*Sclerotinia sclerotiorum*	3
	Anthracnose	*Colletotrichum* sp.	1
	Blossom end rot	Environmental injury	1
	Environmental injury	Drought stress	1
	Edema	Environmental injury	1
Turnip	Rhizoctonia rot	*Rhizoctonia* sp.	1
DISEASED SAMPLES			62
ABIOTIC DISORDERS			14
TOTAL SUBMISSIONS			76

Table 4: Summary of diseases diagnosed on field crops (cereals, legume and sugar beet) submitted to the NBDAAFPlant Disease Diagnostic Laboratory in 2016.

CROP	DISEASE	CAUSAL AGENT	NUMBER OF SAMPLES
Barley	Tip burn	Environmental injury	1
Corn	Ear rot	*Fusarium*sp.	1
Soybean	Pod and stem blight	*Diaporthe phaseolorum* var. *sojae*	1
Wheat	Tip burn	Environmental injury	1
Sugar beet	Alternaria leaf spot	*Alternaria* spp.	1
DISEASED SAMPLES			3
ABIOTIC DISORDERS			2
TOTAL SUBMISSIONS			5

Table 5: Summary of diseases diagnosed on trees and ornamental plants submitted to the NBDAAFPlant Disease Diagnostic Laboratory in 2016.

CROP	DISEASE	CAUSAL AGENT	NUMBER OF SAMPLES
Austrian pine	Diplodia tip blight	*Sphaeropsis sapinea*	1
Asian pine	Diplodia tip blight	*Sphaeropsis sapinea*	1
Red maple	Phyllosticta leaf spot	*Phyllosticta minima*	1
Spruce	Rhizospahera needle cast	*Rhizospahera kalkloffi*	2
Rose	Powdery mildew	*Podosphaera pannosa*	1
Geranium	Bacterial leaf spot	*Pseudomonas syringae*	2
	Edema	Environmental injury	1
Zinnia	Botrytis blight	*Botrytis cinerea*	1
DISEASED SAMPLES			9
ABIOTIC DISORDERS			1
TOTAL SUBMISSIONS			10

CROP / CULTURE: Diagnostic Laboratory Report - All Crops
LOCATION / RĖGION: Prince Edward Island

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TITLE: DISEASES DIAGNOSED ON COMMERCIAL CROP SAMPLES SUBMITTED TO THE PRINCE EDWARD ISLAND PLANT DISEASE DIAGNOSTIC SERVICE (PDDS) IN 2016

ABSTRACT: The Prince Edward Island Department of Agriculture's Plant Disease Diagnostic Service (PDDS) provides diagnosis and control recommendations primarily for disease problems of commercial crops produced on PE. A total of 153 samples were processed for the 2016 crop year. The 2016 growing season was unusually dry followed with some heavy rain periods at the end of the growing season. There were four confirmed incidences of potato late blight. Three cases of pink rot (*Phytophthora erythroseptica*) in potatoes were confirmed in Prince County and were tested for metalaxyl-resistance. They were found to be sensitive to metalazyl. Fusarium isolates from faba bean were found to be sensitive to difenoconazole, fludioxonil and thiabendazole.

METHODS: The Prince Edward Island Department of Agriculture's Plant Disease Diagnostic Service (PDDS) provides diagnosis and control recommendations primarily for disease problems of commercial crops produced on PE. Samples are submitted to the laboratory by agriculture extension staff, producers, 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 one or more causal agents were identified.

RESULTS: A total of 153 samples were processed for the 2016 crop year. A total of 310 disease diagnoses were completed during the period June 1st to October 31st 2016. Categories of samples received were: potatoes (64.50%), cereal and soybean crops (11.73%), vegetable and fruit crops (20.85%), and other (2.93 %). The category 'other' covers samples such as cherry, elm and faba bean. 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.

There were four confirmed incidences of potato late blight. The plant source for *Phytophthora infestans* inoculum for potatoes has changed from potato tubers to home garden tomato plants in recent years. The US23 late blight genotype that was discovered in 2012 is now the predominant strain in PE. Late blight incidence in potatoes has been reduced since this genotype is more aggressive in tomato plants than potato plants. However, the US23 genotype is aggressive in potato tubers. Isolates of fusarium from faba bean were found to be sensitive to fungicides difenoconazole, fludioxonil and thiabendazole. One faba bean field was exhibiting a girdling root rot and isolates of *Pythium*, *Rhizoctonia* and a new *Fusarium* isolate, *Fusarium cerealis,* were involved in the disease phenomenon. At the beginning of the growing season, rainfall was limited and some early potato varieties exhibited symptoms of wilt. Fungal organisms involved in this wilt syndrome included *Verticillium albo-atrum, Rhizoctonia solani*, *Verticillium dahliae*, *Colletotrichum coccodes* and *Fusarium* spp. Two potato samples with blackleg tested positive for *Pectobacterium carotovorum* subsp. *carotovorum* which is the common, less aggressive bacterium involved in bacterial blackleg disease.

Table 1: Summary of diseases diagnosed on commercial crop samples submitted to the Plant Disease Diagnostic Laboratory, Prince Edward Island Department of Agriculture in 2016.

CROP	DISEASE	CAUSAL AGENT / PLANT PATHOGEN	FREQUENCY OF IDENTIFICATION
VEGETABLES:			
Cabbage	Abiotic disease	Edema	2
Carrot	Bacterial soft rot	*Clostridium sp.*	1
		Pseudomonas sp.	1
	Fusarium root rot	*Fusarium oxysporum*	3
Cauliflower	Abiotic disease	Nutritional imbalance	1
	Leaf spot	*Alternaria sp.*	1
	Fusarium wilt	*Fusarium oxysporum*	1
	Wirestem	*Rhizoctonia sp.*	2
Cucumber	Bacterial wilt	*Pectobacterium sp.*	2
	Leaf spot	*Ulocladium sp.*	2
Onion	Abiotic disease	Tip burn	1
Potato	Abiotic disease	Elephant hide	1
		Growth cracks	1
	Bacterial soft rot	*Clostridium sp.*	7
		Pectobacterium sp.	3
		Pseudomonas sp.	2
	Black dot	*Colletotrichum coccodes*	18
	Black scurf	*Rhizoctonia solani*	5
	Blackleg	*Pectobacterium sp.*	2
	Botrytis gray mould	*Botrytis cinerea*	9
	Brown spot	*Alternaria alternata*	4
	Common scab	*Streptomyces scabies*	7
	Early blight	*Alternaria solani*	1
	Fusarium dry rot	*Fusarium coeruleum*	3
		Fusarium oxysporum	2
		Fusarium sambucinum	4
		Fusarium solani	1
		Fusarium sp.	3
	Tuber rot	*Pythium sp.*	2
	Tuber rot	*Rhizoctonia solani*	7
	Fusarium wilt	*Fusarium avenaceum*	1
		Fusarium oxysporum	2
		Fusarium solani	2
		Fusarium sp.	11
	Late Blight	*Phytophthora infestans*	4
	Leak	*Pythium sp.*	9

Table 1 (cont.)

Potato (cont.)	Physiological disorders	Bruising	1
		Burn	2
		Elephant hide	1
		Off-type	1
		Thickened stems	1
		Translucent end	1
		Wind damage	2
	Pink rot	*Phytophthora erythroseptica*	3
	Pinkeye	*Pseudomonas sp.*	3
		Unknown cause	4
	Pocket rot	*Phoma exigua*	1
	Rhizoctonia canker	*Rhizoctonia solani*	30
	Seed piece decay	*Clostridium sp.*	2
		Fusarium sp.	1
		Geotrichum sp.	2
		Pythium sp.	1
	Silver scurf	*Helminthosporium solani*	3
	Verticillium wilt	*Verticillium albo-atrum*	2
		Verticillium dahliae	5
		Verticillium sp.	25
	White mould	*Sclerotinia sclerotiorum*	2
Rutabaga	Blackleg	*Phoma lingam*	1
	Root rot	*Rhizoctoniasolani*	1
Spinach	Fusarium wilt	*Fusarium oxysporum*	2
CEREAL / FIELD CROPS:			
Barley	Common root rot	*Bipolaris sp.*	3
		Fusarium graminearum	1
		Fusarium avenaceum	1
		Stemphylium sp.	1
	Fusarium head blight	*Gibberella zeae*	1
	Net blotch	*Pyrenophora sp.*	1
	Scald	*Rhynchosporium secalis*	1
	Smut	*Ustilago sp.*	1
	Sooty mould	*Alternaria sp.*	1
		Aspergillus sp.	1
		Cladosporium sp.	1
		Stemphylium sp.	1
		Bipolaris sp.	1
Soybean	Anthracnose	*Colletotrichum sp.*	2

Table 1 (cont.)

Soybean (cont.)	Wilt	*Verticillium sp.*	1
	Abiotic disorder	Nutritional imbalance	1
	Brown spot	*Septoria sp.*	3
	Downy mildew	*Peronospora sp.*	1
	Pod and stem blight	*Colletotrichum sp.*	1
		Diaporthe sp.	3
		Fusarium sp.	2
		Phomopsis sp.	2
		Rhizoctonia sp.	1
	Rhizoctonia root rot	*Rhizoctonia solani*	4
SMALL FRUITS:			
Blueberry	Fusicoccum canker	*Fusicoccum sp.*	2
	Leaf spot	*Phomopsis sp.*	2
	Phomopsis canker	*Phomopsis sp.*	1
	Powdery mildew	*Microsphaera sp.*	1
	Red Leaf	*Exobasidium sp.*	2
	Septoria leaf spot	*Septoria sp.*	1
	Witches' broom	*Pucciniastrum goeppertianum*	2
Grape	Abiotic disease	Herbicide damage	1
Strawberry	Anthracnose	*Colletotrichum sp.*	1
		Gloeosporium sp.	1
	Black root rot	*Certobasidium sp.*	2
		Pythium sp.	2
		Rhizoctonia sp.	2
	Leaf spot	*Botrytis cinerea*	1
	Leaf blight	*Phomopsis sp.*	4
	Abiotic disease	Winter injury	4
	Powdery mildew	*Sphaerotheca macularis*	6
	Root / crown rot	*Rhizoctonia sp.*	2
	Verticillium wilt	*Verticillium dahlia*	1
		Verticillium sp.	1
OTHER CROPS:			
Cherry	Leaf spot	*Blumeriella jaapii*	1
Elm	Dutch elm disease	*Ophiostoma ulmi*	1
Faba bean	Leaf spot	*Alternaria sp.*	1
		Stemphylium sp.	1
	Rhizoctonia root rot	*Rhizoctonia sp.*	2
	Root rot	*Pythium sp.*	1
		Fusarium cerealis	1
		Rhizoctonia sp.	1
Total			**310**

CEREALS / CÉRÉALES

CROP / CULTURE: Barley
LOCATION / RÉGION: Manitoba

NAMES AND AGENCY / NOMS ET ÉTABLISSEMENT:
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TITLE / TITRE: FUSARIUM HEAD BLIGHT OF BARLEY IN MANITOBA – 2016

ABSTRACT: Forty nine barley fields in Manitoba were surveyed for fusarium head blight (FHB) in 2016 to assess disease severity and the causal *Fusarium* species. FHB severity in 2016 was much higher than 2015 with a mean FHB index of 2.1%. *F. graminearum* was the predominant *Fusarium* species identified, followed by *F. poae*, *F. avenaceum*, *F. sporotrichioides*, *and F. equiseti*.

INTRODUCTION AND METHODS: A total of 49 barley (38 two-row, 11 six-row) fields in Manitoba were examined for the prevalence of fusarium head blight from July 18-August 5 when crops were at the early- to soft- dough (ZGS 79-82) stages of growth. Fields were selected at regular intervals approximately 20-25 km along the survey routes, depending on crop availability and accessibility. 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 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.

Consequently, 1 gm of infected kernel removed from 15 randomly selected panicles from each field was frozen in liquid nitrogen and ground to a powder using Spex Sample Prep 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 primer to various *Fusarium* species frequently obtained in cereal samples grown in western Canada (Demeke et al. 2005).

RESULTS AND COMMENTS: In 2016, growing conditions throughout Manitoba were conducive for the development of fusarium head blight, largely due to excessive rain, hail, wind resulting in lodging and stalk breakage. Quality of the crop was downgraded due to high disease pressure. Higher disease pressure was also noted in many crop types in 2016.

Barley was grown on 352,348 acres in Manitoba in 2016, representing almost similar acreages compared to 2015 (MASC, 2016). The 2-row cultivar 'CDC Austenson' was the most widely planted barley in 2016, occupying 21.8% and the acreage increased from 16.6% in 2015. The acreage of CDC Conlon decreased from 24.4% in 2015 to 19.5% in 2016 (MASC, 2016; Yield Manitoba, 2016). 'Celebration' was the third most widely planted cultivar, occupying 9.3 of the area. These three cultivars made up half of the barley acreage in Manitoba in 2016 (MASC, 2016).

Putative symptoms of FHB were detected in all fields surveyed. The mean incidence of FHB in 2-row barley was 13.71% (range 4.59 – 31%) and SPI was 11.76 % (range 3.0 – 30.0%). In six-row barley, the incidence was 13.41% (range 5.66 – 39%) and SPI 16.19% (range 3 - 30%). The resulting mean Fusarium Head Blight Index (FHB-I) [%incidence X %SPI / 100] for two-row barley was 1.82% (range 0.228-7.9%), and that for six-row barley 2.72 % (range 0.1689-11.7%). The FHB-I in 6-row vs. 2-row barley was higher than reported for 2009 to 2015 (Tekauz et al. 2010, Tekauz et al. 2011, Banik et al.

2014, 2016, Beyene et al. 2015). This FHB-I would likely had effect on crop yields and grain quality in 2016.

Fusarium infection was detected in all 49 fields. The individual *Fusarium* species amplified from infected kernels DNA are listed in Table 1. *F. graminearum* predominated and was present in 95.9 % of the fields. Similar results were also obtained in 2009 and 2010 (Tekauz et al. 2010, 2011). In contrast, *F. poae* was detected in 82% of the fields and was the most common *Fusarium* species recovered from the infected kernels in Manitoba since 2011 (Tekauz et al. 2013, Banik et al. 2014, 2016; Beyene et al. 2015). *F. avenaceum* and *F. sporotrichoides* were detected in 37% and 29% of fields respectively. *F. equiseti* was also detected, but only occurred at low levels (Table 1). Excess moisture during growing season was likely more favourable for *F. graminearum* infection than *F. poae*.

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Table 1: *Fusarium* spp. identified by PCR from FHB-affected barley kernels from 49 fields in Manitoba in 2016.

***Fusarium* spp.**	**Percent of fields**
F. avenaceum	37.0
F. equiseti	8.12
F. graminearum	95.92
F. poae	82
F. sporotrichioides	29

CROP / CULTURE: Barley
LOCATION / RÉGION: Saskatchewan

NAMES AND AGENCIES / NOMS ET ÉTABLISSEMENT:
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TITLE / TITRE: LEAF SPOT DISEASES IN BARLEY IN SASKATCHEWAN IN 2016

ABSTRACT: The most prevalent diseases observed in barley during 2016 were spot blotch (*Cochliobolus sativus*), net blotch (*Pyrenophora teres*) and septoria leaf blotch (*Septoria passerinii*). Among 37 crops surveyed, 78% were categorized as having trace to slight leaf spot disease severity, 19% were moderately severe and 3% of the crops were in the severe category.

INTRODUCTION AND METHODS: A survey was conducted by Saskatchewan Crop Insurance Corporation from July to mid-August, 2016. Thirty seven commercial fields were selected randomly from 15 crop districts (1A, 2A, 3BN, 3BS, 4B, 5A, 5B, 6A, 6B, 7A, 8A, 8A, 8B, 9A, 9B). More than 25 leaves were collected and put in paper envelops. At the Cereal and Flax Pathology lab of the University of Saskatchewan, ten leaves were visual assessed for severity of various leaf diseases. The average severity was categorized as: trace (0-10%), light (6-10%), moderate (11-40%) and severe (41-100%). Ten leaves were chosen and cut into multiple pieces; ten leaf pieces were randomly chosen and surface-sterilized using ethanol (70%) for 1 min and then rinsed three times in sterile water. The leaf pieces were plated on filter paper and after 7 days the presence of net blotch (*Pyrenophora teres* Drechsler), spot blotch (*Cochliobolus sativus* Ito & Kuribayashi Drechs. ex Dast.) and septoria leaf blotch (*Septoria passerinii* Sacc.) on the leaves was identified and recorded.

RESULT AND CONCLUSIONS: Weather conditions in 2016 were warm and dry at the beginning of the season, which allowed growers to start seeding early. For the balance of the season frequent precipitation events occurred well into the fall. These conditions affected development of the leaf diseases in barley. The prevalence of leaf diseases at trace to slight levels was higher in 2016 than in 2015 (Tran et al., 2016). Among the 37 barley crops surveyed, leaf diseases were detected in 78% at trace to slight levels, 19% were moderate and 3% were severe (Table 1). The most common pathogen on barley (prevalence and incidence) was *Cochliobolus sativus,* present in 84% of surveyed crops, followed by *P. teres* (68%) and *S. passerinii* (46%) (Table 2). *Cochliobolus sativus* was the most prevalent pathogen in 2014 (Lui et. al. 2015) and 2015 (Tran et al. 2016), although incidence was higher in 2014. The incidence of the second most common pathogen, *P. teres*, was higher than in the two previous years. Prevalence and incidence of *Septoria passerinii* was the least of the three pathogens.

ACKNOWLEDGEMENTS:
We thank the Saskatchewan Crop Insurance Corporation for sample collection during the growing season 2016.

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Table 1. Leaf spot disease severity in Saskatchewan 2016.

Severity (%)	# Fields	Percentage of crops in each category
Trace <1%	4	11
Very slight 1-5%	12	32
Slight 6-15%	13	35
Moderate 16-40%	7	19
Severe 41-100%	1	3

Table 2. Leaf spot disease severity in Saskatchewan 2016.

	Prevalence (% of crops)	Incidence* (%)
Cochliobolus sativus	84	55
Pyrenophora teres	68	34
Septoria passerinii	46	11

*Incidence: percentage of leaf pieces that were infected with each pathogen.

CROP / CULTURE : Barley
LOCATION / RÉGION: Central Alberta

NAMES AND AGENCY / NOMS ET ÉTABLISSEMENT :
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TITLE / TITRE: 2016 BARLEY DISEASE SURVEY IN CENTRAL ALBERTA

ABSTRACT: In 2016, 20 random commercial barley crops were surveyed for disease levels in central Alberta. Leaf disease levels were lower than in previous years, while common root rot levels were average compared to previous years.

INTRODUCTION AND METHODS: A survey to document diseases of barley was conducted in 20 fields in Central Alberta from July 26-28, 2016. Growers were contacted for permission to access their land, with the evaluation 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 made 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 (PLAD) 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 poor in May with much lower levels of precipitation but with near average temperatures, while June, July, and August were close to average for both precipitation and temperature. Disease development was similar to the previous year throughout the surveyed region (Rauhala and Turkington, 2016). Scald (*Rhynchosporium secalis*) severity ranged from 0.1 to 5 % in 7 fields, while 3 fields had a PLAD rating between 6% and 11%, and one field having 21 %, with all remaining fields having no scald. Netted net blotch (*Pyrenophora teres* f. *teres*) was found in 7 of the 20 surveyed fields and ranged from 0.1% to 2% with one field having a level of 15%. Spot blotch (*Cochliobolus sativus*) was isolated from 50 % of the other leaf spot symptoms, while spotted net blotch was isolated from 65% of the other leaf spot symptoms. Severity ranged from 0.1 to 5% in 17 fields while 3 fields had 6-11% PLAD. *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 and Turkington, 2016).

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

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Table 1. Disease incidence and severity in 20 commercial barley fields in Central Alberta, 2016.

Disease (severity rating scale)	% of fields affected	Overall average severity	Range in average severity per field
Scald (PLAD*)	55	2.3	0 –20
Netted net blotch (PLAD)	40	<1	0 – 15
Other leaf spots (PLAD)	100	2.4	1 – 11
Total leaf area diseased (PLAD)	100	5.5	1 – 32
Common root rot (0-4)	100	1.8	1 - 3

*Percentage leaf area diseased

CROP / CULTURE: Barley
LOCATION / RÉGION: Central and Eastern Ontario

NAMES AND AGENCY / NOMS ET ÉTABLISSEMENT:
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TITLE / TITRE: DISEASES OF BARLEY IN CENTRAL AND EASTERN ONTARIO IN 2016

ABSTRACT: Thirty barley crops in central and eastern Ontario were surveyed for diseases in 2016. Of the 14 diseases observed, none had severe level of infection. Spot blotch, take-all and barley yellow dwarf were the most prevalent and moderate levels of these were found in 6, 5 and 3 fields, respectively. Slight infection by Fusarium head blight (FHB) was found in all field and *Fusarium poae*, *F. sporotrichioides*, and *F. graminearum* were the predominant species causing the FHB.

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 2016. Thirty crops 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.

Severity of covered smut, ergot, leaf stripe, loose smut, and take-all was based on the percent of plants infected. FHB was rated for incidence (% infected spikes) and severity (% infected spikelets in the affected spikes) based on approximately 200 spikes at each of three random sites per field. A FHB index [(% incidence x % severity)/100] was determined for each field. The percentage of infected plants or FHB index values of <1, <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 spikes collected from each field. The spikes were air-dried at room temperature and threshed. Fifty discolored kernels per sample were chosen at random, surface sterilized in 1% NaOCl for 60 sec. 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 light. *Fusarium* species isolated from kernels were identified by microscopic examination using standard taxonomic keys.

RESULTS AND COMMENTS: The survey included 4 two-row and 26 six-row barley fields. A total of 14 diseases or disease complexes were observed (Table 1). Spot blotch (*Cochliobolus sativus*), net blotch (normally associated with the pathogen *Pyrenophora teres*) and barley yellow dwarf (BYDV) were the most common, and were found in 30, 28, and 26 fields at average severities of 2.6, 1.4, and 2.0 respectively. Severe infection from these diseases was not found, but moderate disease levels from spot blotch, net blotch, and barley yellow dwarf were observed in 6, 1, and 3 fields, respectively. Yield reductions due to these diseases were estimated to have averaged <3% in affected fields. Other foliar diseases observed included leaf rust (*Puccinia hordei*), powdery mildew *(Blumaria graminis*), 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*); they were observed in 19, 10, 5, 23, and 7 fields at mean severities of 1.3, 1.4, 1.0, 1.4, and 1.4, respectively. Although one field had a moderate level of leaf rust and another field had a moderate level of septoria complex (Table 1), none of these diseases would have resulted in substantive damage to the crop.

Ergot (*Claviceps purpurea*), loose smut (*Ustilago nuda*) and the root disease take-all (*Gaeumannomyces graminis*) were observed in all fields at mean incidences of 1.0, 0.4, and 1.8%, respectively (Table 1). Severe infection from these diseases was not observed, but moderate disease levels due to ergot and take-all were found in 3 and 5 fields, respectively. Yield reductions by ergot and take-all were estimated to be <3% in affected fields.

FHB was observed in all surveyed fields at a mean FHB index of 0.1% (range 0.01% to 0.25%) (Table 1). Overall, the disease did not result in a significant loss in barley grain yield or quality in 2016. Six *Fusarium* species were isolated from putatively infected kernels (Table 2). *Fusarium poae*, *F sporotrichioides*, and *F. graminearum* predominated and occurred in 93.3, 70.0, and 63.3% of surveyed fields and on 21.3, 7.9, and 6.6% of infected kernels, respectively. *Fusarium acuminatum*, *F. avenaceum,* and *F. equiseti* were less common, occurring in 26.7-53.3% of fields and 1.1-3.7% of kernels.

The 14 diseases observed on barley in Ontario in 2016 were the same as those recorded in 2015 (Xue and Chen, 2016). Overall, the incidence and severity of these diseases were generally lower in 2016 than in 2015. A slight FHB infection occurred in all surveyed fields and no significant reductions in grain yield and quality were observed. The less frequent rain events in June and July in 2016 compared with 2015 in central and eastern Ontario were likely responsible for the reduced disease severities observed this year.

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Table 1: Prevalence and severity of barley diseases in central and eastern Ontario in 2016.

Disease	No. field affected (n=30)	Disease severity in affected fields*	
		Mean	Range
Barley yellow dwarf	26	2.0	1.0-5.0
Leaf rust	19	1.3	1.0-4.0
Net blotch	28	1.4	1.0-4.0
Powdery mildew	10	1.4	1.0-3.0
Scald	5	1.0	1.0-1.0
Septoria complex	23	1.4	1.0-4.0
Spot blotch	30	2.6	1.0-4.0
Stem rust	7	1.4	1.0-2.0
Cover smut (%)	4	1.0	1.0-1.0
Ergot (%)	30	1.0	0.1-5.0
Leaf stripe (%)	1	1.0	1.0-1.0
Loose smut (%)	30	0.4	0.1-3.0
Take-all (%)	30	1.8	0.5-5.0
Fusarium head blight**	30		
Incidence (%)		1.9	1.0-5.0
Severity (%)		3.0	1.0-5.0
Index (%)		0.1	0.01-0.25

*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.
** FHB Index = (% incidence x % severity)/100.

Table 2: Prevalence of *Fusarium* species isolated from fusarium-damaged barley kernels in central and eastern Ontario in 2016.

***Fusarium* spp.**	**% affected fields**	**% affected kernels**
Total *Fusarium*	100.0	42.7
F. acuminatum	26.7	1.1
F. avenaceum	30.0	2.0
F. equiseti	53.3	3.7
F. graminearum	63.3	6.6
F. poae	93.3	21.3
F. sporotrichioides	70.0	7.9

CROP / CULTURE: Canary seed
LOCATION / RÉGION: Saskatchewan

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TITLE / TITRE: LEAF MOTTLE AND *FUSARIUM* SPP. IN CANARY SEED IN SASKATCHEWAN IN 2016

ABSTRACT: Leaf mottle (*Septoria triseti* Speg.) was detected in 20 out of the 24 canary seed crops surveyed, with disease severities of trace to moderate. *Fusarium graminearum* Schwabe was the most prevalent fusarium species on canary seed crops (48%), followed by *F. avenaceum* (12%), *F. poae* (8%) and *F. equiseti* (4%). The incidence of fusarium species was lower than in the two previous years.

INTRODUCTION AND METHODS: A survey of canary seed crops was conducted between August 3rd and 19th 2016. Twenty-four randomly selected crops varied between BBCH growth stages 65 - 89 (full flower - maturity) (Lancashire et al. 1991). Ten leaves were assessed for leaf mottle severity and categorized as follows: trace (<1% of leave tissue affected), very slight (1-5%), slight (6-15%), moderate (16-40%) and severe (41-100%). Ten leaves from each of the 24 crops, with or without symptoms (necrosis with black pycnidia) were collected and cut into pieces, surface sterilized with a 5% bleach (NaOCl) solution for 1 min and then rinsed 3 times in sterile water. The leaf pieces were plated on filter paper; after 24 h the presence of cirrhi on the leaf surface confirmed the presence of *Septoria triseti.*

Incidence of seed infected by *Fusarium* spp. was determined in 24 crops (100 seeds per crop). Seeds were surface sterilized in 5% bleach (NaOCl) solution for 1 min and rinsed three times in sterile water and dried. Seeds were then plated on PDA and placed under a 12 hour light/dark regime at room temperature for 5 days (Warham at al. 1995). *Fusarium* spp. were identified morphologically from examination of spores and mycelial growth (Gerlach and Nirenberg 1982).

Prevalence of *Septoria triseti* and *Fusarium* spp. was determined by counting the proportion of crops affected, and incidence by counting the number of leaves (from the 10 leaves plated) and number of seeds affected by each *Fusarium* sp. of the 100 plated for each canary seed crop.

RESULTS AND CONCLUSIONS: Prevalence of leaf mottle was 83%; 17% (eight crops) were free of leaf mottle. Among the 24 fields, 13% were categorized as trace, 13% as very slight, 21% as slight, and 38% as moderate; none of the crops were assessed as severe (Table 1). Among the 240 leaf pieces plated, 105 were affected by *Septoria triseti*, with an incidence of 44%. The most highly infected crops were observed in the Kindersley area, where precipitation was 40% higher than the long term average.

The prevalence of fusarium species on seeds of canary seed was 64% (Table 2). The prevalence and incidence of *F. graminearum* in 2016 was lower than in 2015 (Cholango-Martinez et. al. 2015). Among the 24 crops, 32% were surveyed during flowering, 24% at milk, 28% soft and 16% hard dough stage. This indicated that 56% of the fields were surveyed during the growth stage where the presence of fusarium seed infection was not able to be detected, resulting in the lower incidence of fusarium seed infection reported in 2016. In addition, four species were identified: *F. graminearum, F. avenaceum, F. equiseti* and *F. poae*. The most common species observed was *F. graminearum* (48%).

ACKNOWLEDGEMENTS: We thank Mallory Dyck and CFPATH group for survey coordination.

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Table 2. Leaf mottle disease severity of canary seed in Saskatchewan in 2016.

Severity (%)	# Fields	Percentage of crops in each category (%)
None	4	17
Trace <1%	3	13
Very slight 1-5%	3	13
Slight 6-15%	5	21
Moderate 16-40%	9	38
Severe 41-100%	0	0

Table 2. Prevalence and incidence of *Fusarium* spp. isolated from 24 Saskatchewan canary seed crops, in 2016.

	Prevalence (%)[1]	Incidence (%)[2]
Total *Fusarium* spp.	64	0.7
F. graminearum	48	0.5
F. poae	8	0.1
F. avenaceum	12	0.1
F. equiseti	4	0.04

[1]Proportion of crops with *Fusarium* spp.
[2]Based on a 100 seed sample per crop.

Table 3. Incidence (%) of *Fusarium* spp. on 100-seed samples of canary seed from 24 Saskatchewan crops in 2016.

Field #	Crop District	*F. graminearum* (%)	*F. poae* (%)	*F. avenaceum* (%)	*F. equiseti* (%)
1	2B	1	0	0	0
2	2B	0	0	0	0
3	2B	0	1	0	0
4	2B	1	0	0	0
5	2B	1	0	0	0
6	2B	1	0	0	0
7	2B	1	0	0	0
8	2B	1	0	0	0
9	3B	0	0	1	0
10	3B	0	0	0	0
11	3B	0	0	0	0
12	3B	0	0	0	0
13	3B	1	0	0	0
14	4B	1	0	0	1
15	4B	0	1	0	0
16	4B	1	0	1	0
17	7A	0	0	0	0
18	7A	0	0	0	0
19	7A	0	0	0	0
20	7A	0	0	0	0
21	7A	0	0	1	0
22	7A	0	0	0	0
23	7A	1	0	0	0
24	7A	1	0	0	0
25	7A	1	0	0	0

CROP / CUTURE: Oat
LOCATION / RÉGION: Manitoba

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TITLE / TITRE: FUSARIUM HEAD BLIGHT OF OAT IN MANITOBA – 2016

ABSTRACT: Forty three oat fields in Manitoba were surveyed for fusarium head blight (FHB) to assess severity and the causal *Fusarium* species. Visual symptoms were observed in most of the fields and *Fusarium* spp. were identified from the infected kernels of all 43 fields. *F. graminearum* was the predominant species detected, followed by *F. poae, F. sporotrichioides, F. avenaceum and F. equiseti.*

INTRODUCTION AND METHODS:
A total of 43 oat fields in Manitoba were monitored for the prevalence of fusarium head blight from July 18-August 5 when crops were at the early- to soft- dough (ZGS 79-83) 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 HWY 67 and 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 by sampling 95-110 panicles at three locations and averaging the scores. Subsequently, 1 g of infected kernels was removed from 15 randomly selected panicles from each field and was frozen in liquid nitrogen and ground to a powder using Spex Sample Prep 2010 Geno/Grinder. DNA was extracted from the ground grain sample from each field using the QIAGEN DNeasy Mini Kit (QIAGEN). Molecular techniques such as conventional polymerase chain reaction (PCR) or quantitative real-time PCR were performed using *Fusarium* species-specific oligonucleotide primers commonly detected in cereal crops (Demeke et al. 2005; Nicolaisen et al. 2009). Real time PCR was executed with the Real-Time PCR system CFX96 PCR system (BioRad) using 2XSsoFast EvaGreen supermixes (BioRad) and 37 cycles threshold (Ct) cut-off detection limit was used to detect and quantify the *Fusarium* species present.

RESULTS AND COMMENTS: In 2016, crop growing conditions in Manitoba were wetter than normal due to extreme weather such as rain, hail, and wind, which resulted in lodging and stalk breakage. A total of 336,427 acres of oat were seeded in Manitoba, a reduction of 25% compared to 2015. 'Summit', 'Souris', and 'CS Cadman' were top three cultivars grown and made up to 72.4% of the total oat production area in Manitoba (MASC, 2016), while 'Summit' was the top most cultivated (32%) variety. In contrast, 'Souris' was the top most cultivated (37%) variety in 2015 (Yield Manitoba, 2016).

Most of oat crops surveyed showed definitive FHB symptoms, such as orange-pink discolouration of spikelets. In some fields a few spikelets of a panicle or the entire panicle exhibited discoloration or bleaching. The later situation is unusual and made disease diagnosis equivocal.

Fusarium infection was detected in all 43 fields by PCR (Table 1). *F. graminearum* was the most predominant species detected in the surveyed fields (41 fields), followed by *F. poae* (12 fields), *F. sporotrichioides* (10 fields), *F. avenaceum* (9 fields) and *F. equiseti* (4 fields) (Table 1). In contrast, *F. poae* was the most common species in previous survey years (Tekauz et al. 2011; 2016ab). Similar to oat fields, *F. graminearum* was also found in higher level in barley fields in 2016. Extreme weather conditions in 2016 appear to have favoured oat kernel infestation by *F. graminearum* compared with other *Fusarium* species. Symptoms of fusarium head blight in 2016 were at the highest levels observed since surveys in oat in Manitoba were initiated in 2002 and resulted in an estimated 5-10% loss in yield or quality in the commercial oat crop based on visual symptoms.

Real-time PCR was performed with *F. poae* and *F. sporotrichioides* primers to detect and quantify these species. *F. poae* and *F. sporotrichioides* were detected from a total of 36 and 31 of the fields where conventional PCR detected only in 12 and 10 of the fields, respectively. The amounts of DNA for both species in a few samples were at a higher level, and ranged from 0.001-200pg/ ng and 0.009—160pg/ng respectively (Table 2). A comparison of the two DNA-based methods for identification indicates that real-time PCR was more sensitive for detecting the presence and quantity of *Fusarium* spp. than conventional PCR.

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Table 1. *Fusarium* spp. detected by PCR of FHB-affected kernels from 43 oat fields in Manitoba in 2016.

***Fusarium* spp.**	**Percentage of positive fields**
F. avenaceum	21.3
F. graminearum	95.35
F. poae	27.9
F. sporotrichioides	23.25
F.equiseti	9.3

Table 2. Amount of *F. poae* and *F. sporotrichioides* DNA detected by real-time PCR from FHB-affected kernels in Manitoba in 2016.

***Fusarium* spp.**	**% of fields**	**Range**	**Mean**
F. poae	84	1-200.5	20.52
F.sporotrichiodes	72	0.9-160.3	16.66

CROP / CULTURE: Oat
LOCATION / RÉGION: Manitoba, Saskatchewan and Ontario

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TITLE / TITRE: CROWN RUST OF OAT IN MANITOBA, SASKATCHEWAN AND ONTARIO IN 2015

ABSTRACT: In 2015, 100 fields with wild oats and 66 fields of common oats were surveyed for the incidence and severity of *Puccinia coronata* f. sp. *avenae* in Manitoba and eastern Saskatchewan. Crown rust infected plants were found in 82 (82%) and 45 (69%) of all wild and common oat fields at mean incidences of 26% and 23%, and mean severities of 2 MS and 3 MS, respectively. No virulence was detected to resistance gene *Pc94* in common oat collections from Manitoba and Saskatchewan. Only 4 collections were viable from Ontario and no virulence was detected to the resistance genes *Pc45*, *Pc50*, *Pc51, Pc54, Pc58, Pc59, Pc64, Pc91, Pc94, PC96, PC97, Pc98, PC101*, and *Pc103-1* in those collections.

INTRODUCTION AND METHODS: Surveys for incidence and severity of oat crown rust (caused by *Puccinia coronata* Cda f. sp. *avenae* Eriks.) were conducted in Manitoba and Saskatchewan from August 2 to August 10, 2015. The areas surveyed were in crop districts 1, 2, 3, 7, 8, 9, 11 and 12 in Manitoba and crop districts 1, 2, 5, and 6 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 commercial farm 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. Samples from fields in Ontario 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:
One hundred fields with wild oats and 66 fields of common oat lines were surveyed in Manitoba and Saskatchewan. Wild oat plants infected with *P. coronata* f. sp. *avenae* were found in 82 (82%) of the fields, and infected common oat plants were found in 45 (69%) of the fields.

Crown rust incidence on wild oats ranged from 0 to 100%, with a mean incidence of 26%. The severity of crown rust on wild oats ranged from 0 to 20S with a mean severity of 2MS. The incidence and severity of crown rust infection on wild oats was higher in southcentral Manitoba.

Crown rust incidence on commercial oats ranged from 0 to 100%, with a mean incidence of 23%. The severity of crown rust on common oats ranged from 0 to 5S and 10MS with a mean severity of 3MS. The incidence and severity of crown rust infection on common oats was generally higher in Manitoba crop districts 8 and 9 and Saskatchewan crop district 1.

One hundred sixteen spi were made from wild oats and 111 races were identified from these spi. The number of spi of each race was usually one, but occasionally two. Virulence to each *Pc* gene was observed in the wild oat spi, although it was not common (5% or less) for genes *Pc50* and *Pc94* (Table 1).

Fifty three spi were made from common oat collections with 52 races identified from these spi. None of the common oat derived spi had virulence to the resistance gene *Pc94* and virulence to *Pc97* was not common (2%) (Table 1).

Twenty five spi were made from collections from the Uniform Rust Nursery and 24 races identified. Virulence to *Pc64* and *Pc94* was not observed using the Uniform Rust Nursery spi (Table 1) and virulence to *Pc96, Pc98* and *Pc101* was not common (4%).

Only 4 spi were made from the eastern Canada collections, and 4 races identified. All four races were virulent to *Pc38, Pc39, Pc48, Pc52, Pc56* and *Pc68* (Table 1). With only 4 spi, virulence to a number of *Pc* genes was not observed in 2015.

Greater than 50% of all spi from the 2015 collections possessed virulence to resistance genes *Pc38, Pc39, Pc45, Pc46, Pc51, Pc56, Pc68* and *Pc91*. 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. The high levels of virulence to *Pc91* likely reflect its recent deployment in commercial oat lines.

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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 2015.

Oat lines and *Pc* gene present	**Wild Oat**		**Commercial Oat Field**		**Uniform Rust Nursery**		**Eastern Canada**	
	No. of isolates	**Percent**	**No. of isolates**	**Percent**	**No. of isolates**	**Percent**	**No. of isolates**	**Percent**
Standard								
Pc38	115	99	53	100	25	100	4	100
Pc39	112	97	53	100	25	100	4	100
Pc40	41	35	9	17	7	28	1	25
Pc45	71	61	30	57	11	44	0	0
Pc46	69	59	33	62	15	60	1	25
Pc48	42	36	33	62	20	80	4	100
Pc50	6	5	3	6	2	8	0	0
Pc51	91	78	41	77	15	60	0	0
Pc52	39	34	29	55	17	68	4	100
Pc54	19	16	5	9	4	16	0	0
Pc56	111	96	53	100	23	92	4	100
Pc58[a]	20	17	10	19	2	8	0	0
Pc59[a]	26	22	11	21	5	20	0	0
Pc62	25	22	14	26	6	24	1	25
Pc64	21	18	5	9	0	0	0	0
Pc68	66	57	32	60	14	56	4	100
Supplemental								
Pc91	67	58	40	75	15	60	0	0
Pc94	3	3	0	0	0	0	0	0
Pc96	9	8	6	11	1	4	0	0
Temp_Pc97	11	9	1	2	2	8	0	0
Temp_Pc98	10	9	3	6	1	4	0	0
Pc101	11	9	3	6	1	4	0	0
Pc103-1	22	19	13	25	2	8	0	0
Pc104	20	17	7	13	8	32	1	25
Total	116		53		25		4	

[a]The *Pc58*-differential was shown to carry three linked genes, and the *Pc59*-differential three unlinked genes (Chong et al. 2008).

CROP / CULTURE: Oat
LOCATION / REGION: Saskatchewan

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TITLE / TITRE: FUSARIUM INFECTION OF OAT PANICLES IN SASKATCHEWAN IN 2016

ABSTRACT: *Fusarium* species were identified based on macrospore morphology on seed samples of 30 oat crops collected across Saskatchewan in 2016. Prevalence and incidence were calculated for each species found. Two species were identified *Fusarium poae* (Peck) Wollenweber and *F. graminearum* Schwabe, with *F. poae* having a higher prevalence and incidence.

INTRODUCTION AND METHODS: In 2016, 30 oat crops in 15 crop districts across Saskatchewan were surveyed in August with approximately 15 panicles collected from each crop. The samples were dried, stored in paper bags, and hand threshed. The seeds were then surface 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 h light/dark periods. The *Fusarium* species present in each sample were identified based on macrospore morphology (Zillinsky, 1983; Gerlach and Nirenburg, 1982). Prevalence (number of crops in which *Fusarium* spp. were detected of the 30 crops) and incidence (number of seeds from which *Fusarium* spp. were isolated of the 900 seeds plated) were calculated for each *Fusarium* sp.

RESULTS AND COMMENTS: Of the 30 crops surveyed, *Fusarium spp.* were detected in 18 (60%). Two species were identified: *F. poae* and *F. graminearum.* Prevalence of *F. poae* was 60%, which was greater than *F. graminearum at 23%* (Table 1). Incidence of *F. poae* was also higher than *F. graminearum,* 9.3% and 0.9%, respectively.

The two *Fusarium spp*. observed in 2016 were fewer than in 2015, when *F. avenaceum* and *F. culmorum* were detected in addition to *F. poae* and *F. graminearum* (Dyck et al. 2016). The prevalence of the two *Fusarium spp.* combined in 2016 was lower than in 2015, however, the prevalence and incidence of *F. poae* was higher in 2016 than 2015.

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

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Table 1. Prevalence and isolation frequency of *Fusarium* spp. on oat seed (incidence) in Saskatchewan in 2016.

Pathogen	Prevalence (% crops)	Incidence† (% of seeds)
Fusarium poae	60	9.3
Fusarium graminearum	23	0.9

† incidence – percentage of seeds from which each pathogen was isolated.

CROP / CULTURE: Oat
LOCATION / RÉGION: Central and eastern Ontario

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TITLE / TITRE: DISEASES OF OAT IN CENTRAL AND EASTERN ONTARIO IN 2016

ABSTRACT: Twenty-three oat crops in central and eastern Ontario were surveyed for diseases in 2016. Of the 11 diseases observed, stagonospora leaf blotch, barley yellow dwarf, and take-all were most prevalent. Fusarium head blight (FHB) was found in all fields, but only at slight levels. *Fusarium poae* was the predominant species causing FHB.

INTRODUCTION AND METHODS: A survey to document diseases in central and eastern Ontario oat crops was conducted in the third week of July 2016 when plants were at the soft dough stage of development. Twenty-three 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 trace, slight, moderate, and severe disease levels, respectively. Severity of ergot, loose smut, and take-all was based on the percent of plants infected. FHB was rated for incidence (% infected panicles) and severity (% infected spikelets in the affected panicles) based on approximately 200 panicles at each of three random sites per field. A FHB index [(% incidence x % severity)/100] was determined for each field. The percentage of infected plants or FHB index values of <1, <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 and all, except for stem rust (*Puccinia graminis* f. sp. *tritici*), were commonly observed (Table 1). Stagonospora leaf blotch (normally associated with the pathogen S*tagonospora avenae* f. sp. *avenaria*), and barley yellow dwarf (BYDV) were the most important diseases and were found in 22 and 23 fields at average severities of 2.4 and 2.0, respectively. Severe infection from the two diseases was not found, but moderate disease levels of stagonospora leaf blotch and BYDV were observed in 4 and 3 fields, respectively. Other foliar diseases observed were crown rust (*Puccinia coronata* f. sp. *avenae*), halo blight (*Pseudomonas syringae* pv. *coronafaciens*), pyrenophora leaf blotch (*Pyrenophora avenae*), spot blotch (*Cochliobolus sativus*), and stem rust. Severe levels of these diseases were not found except for crown crust that was observed in one field. These diseases collectively likely resulted in yield reductions of <3% in affected crops.

Ergot (*Claviceps purpurea*), loose smut (*Ustilago nuda*) and take-all root rot (*Gaeumannomyces graminis* var. *avenae*) were observed in all fields at incidence levels of 0.2, 0.4, and 2.1%, respectively (Table 1). Severe infection from these diseases was not observed, but moderate disease levels of loose smut and take-all were found in 3 and 7 fields, respectively. Yield reductions by loose smut and take-all were estimated <5% in affected fields.

Fusarium head blight occurred in all fields at a mean FHB index of 0.3% (range 0.01-2.0%) (Table 1). The disease was recorded at slight levels in affected crops. Seven *Fusarium* species were isolated from discoloured kernels (Table 2). *Fusarium poae* predominated and occurred in 87% of fields and on 14.1%

of kernels. *Fusarium avenaceum, F. equiseti, F. graminearum* and *F. sporotrichioides* were less common and found in 30, 22, 17, and 17% of fields and on 1.0, 1.5, 0.7, and 2.1% of kernels. *Fusarium acuminatum* and *F. oxysporum* were least common, occurring in 4-9% of fields and on 0.1-0.6% of kernels.

The 11 diseases observed on oat in Ontario in 2016 were the same as those recorded in 2015 except for stem rust that was not found in 2015 (Xue and Chen, 2016). Overall, the incidence and severity of these diseases were generally lower in 2016 than in 2015. A slight FHB infection occurred in all surveyed fields and no significant reductions in grain yield and quality were observed. The less frequent rain events in June and July in 2016 compared with 2015 in central and eastern Ontario were likely responsible for the reduced disease severities observed this year.

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Table 1: Prevalence and severity of oat diseases in central and eastern Ontario in 2016.

DISEASE	No. field affected (n=23)	Disease severity in affected fields*	
		Mean	Range
Barley yellow dwarf	23	2.0	1.0-4.0
Crown rust	11	2.9	1.0-6.0
Halo blight	14	1.0	1.0-1.0
Pyrenophora leaf blotch	18	1.4	1.0-3.0
Spot blotch	15	1.0	1.0-1.0
Stagonospora leaf blotch	22	2.4	1.0-4.0
Stem rust	4	1.5	1.0-2.0
Ergot (%)	23	0.2	0.1-1.0
Loose smut (%)	23	0.4	0.1-1.5
Take-all (%)	23	2.1	0.5-7.0
Fusarium head blight**	23		
Incidence (%)		5.2	1-20.0
Severity (%)		4.5	1-10.0
Index (%)		0.3	0.01-2.0

*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.
**FHB Index = (% incidence x % severity)/100.

Table 2. Prevalence of *Fusarium* species isolated from discolored kernels of oat in central and eastern Ontario in 2016.

***Fusarium* spp.**	**% affected fields**	**% affected kernels**
Total *Fusarium*	100.0	20.0
F. acuminatum	8.7	0.6
F. avenaceum	30.4	1.0
F. equiseti	21.7	1.5
F. graminearum	17.4	0.7
F. oxysporum	4.3	0.1
F. poae	87.0	14.1
F. sporotrichioides	17.4	2.1

CROP / CULTURE: Barley and Oat
LOCATION / RÉGION: Manitoba

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TITLE / TITRE: BARLEY AND OAT LEAF SPOT DISEASES IN 2016 IN MANITOBA

ABSTRACT: In 2016, 92 commercial barley and oat fields were assessed for leaf spot diseases in Manitoba. *Cochliobolus sativus* (spot blotch) and *Pyrenophora teres* (net blotch) were the principal pathogens isolated from barley fields whereas *Pyrenophora avenae and Stagonospora avenae* were the predominant pathogens isolated from oat fields. Disease severity was higher than reported in earlier years due to extreme weather in 2016.

INTRODUCTION AND METHODS: In 2016, barley and oat leaf spot diseases in Manitoba were assessed by surveying 92 farm fields (49 barley, 43 oat fields) from July18-August 5, when most crops were at the early to soft-dough stages of growth (ZGS 79-82). Fields were sampled at regular intervals approximately 20-25 km along the survey routes, depending on crop availability. The area sampled was bounded by HWY 67 and 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 their occurrence 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– Leaf spot symptoms were observed in both upper and lower leaf canopies in 98% and 100% of the barley fields respectively. In the upper canopies, trace to slight and moderate to severe leaf spot symptoms were observed in 62% and 36% of the fields, respectively.

Disease levels in the lower leaf canopies were found to be trace in 6% of fields, very slight or slight in 16%, moderate in 24%, and severe in 53% of the fields. These severity levels were much higher than those reported in previous years from 2012 to 2015 (Tekauz et al. 2013, Wang et al. 2015, Banik et al. 2014, 2016). The heightened leaf spot severity observed in 2016 was likely due to unusually higher precipitation. The observed disease levels, especially in the upper canopies, would suggest that leaf spot also caused considerable yield losses in Manitoba in 2016.

Cochliobolus sativus (causal agent of spot blotch) and *Pyrenophora teres* (net blotch) were the principal pathogens isolated from infected leaf tissues and caused most of the leaf spot damage observed. *Cochliobolus sativus* was isolated from 36 fields and *Pyrenophora teres* from 17 fields (Table1). *Septoria passerinnii* (speckled leaf blotch), a minor pathogen of leaf spot complex was also detected from 3 fields, and was not identified in previous two years (Wang et al. 2015; Banik et al. 2016).

Oat – In the upper leaf canopies, 5% of fields showed no visible leaf spot symptoms, trace levels were observed in 32% of the fields, very slight or slight in 30% of the fields, and moderate levels in 23% of the fields, while in 9% of fields, leaves had senesced. In the lower canopies, 100% of the fields showed visible symptoms, trace to very slight levels in 32% of the fields, and moderate to severe levels were observed in the remaining 68% of the fields.

Pyrenophora avenae, causal agent of pyrenophora leaf blotch, was the most prevalent pathogen and caused most of the damage observed in oat fields (Table 2). This occurred at much higher level than reported in 2015 (Banik et al. 2016), but at similar to levels found in 2011 and 2012 (Tekauz et al. 2012, 2013). *Stagonospora avenae* f. sp. *avenaria* (stagonospora leaf blotch) was found to be the second most prevalent pathogen and was the most predominant pathogen reported in 2010 (Tekauz et al. 2011). *Stagonospora avenae* f. sp. *avenaria* was not detected at all in previous year (Banik et al. 2016) and this was due to the occurrence of very low level of leaf spot diseases. *Cochliobolus sativus* (spot blotch) was also detected in four fields, and was a minor component of the oat leaf spot complex remaining at low levels in Manitoba (Table 2).

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Table 1. Incidence and isolation frequency of leaf spot pathogens of barley in Manitoba in 2016.

Pathogen	Incidence (% of fields)	Frequency (% of isolations)
Cochliobolus sativus	73.5	95.9
Pyrenophora teres	34.7	25.4
Septoria passerinii	6.1	3.7

Table 2. Incidence and isolation frequency of leaf spot pathogens of oat in Manitoba in 2016.

Pathogen	Incidence (% of fields)	Frequency (% of isolation)
Pyrenophora avenae	51.1	77.6
Stagonospora avenae	23.3	16.3
Cochliobolus sativus	9.3	6.1

CROP / CULTURE: Oat
LOCATION / RÉGION: Saskatchewan

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TITLE / TITRE: LEAF SPOT DISEASES OF OAT IN SASKATCHEWAN IN 2016

ABSTRACT: Leaf spot disease severity was assessed and the causal pathogens identified in 43 oat crops in 2016. Disease severity was trace to slight in the majority of surveyed crops with a few showing moderate levels. *Pyrenophora avenae* (pyrenophora leaf blotch) and *Cochliobolus sativus* (spot blotch) were the two oat pathogens isolated from diseased leaves. *Stagonospora avenae* f. sp. *avenaria* (stagonospora leaf blotch) was not observed in 2016.

INTRODUCTION AND METHODS: In 2016, leaf spotting diseases of oat were surveyed across Saskatchewan in early August, when the crops were at the milk to soft dough growth stages. Forty-three crops were surveyed in 2016 and disease severity was assessed in each crop based on two to four plants collected at each of five points located approximately 15 m apart and 30 m from the field edge. Oat plants in each crop were rated based on disease severity on the upper (flag and penultimate leaves) and lower canopies 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 25 leaves were collected from each crop, dried and stored in paper envelopes. Pathogens were identified in the laboratory by cutting and surface sterilizing 10 pieces of infected leaf tissue from 10 different leaves. The leaf cuttings were placed on water agar plates containing a 1:1000 dilution of 85% lactic acid for four days to promote sporulation of pathogens. The identities of the causal agents of the leaf spots were determined by spore size and shape. Identified pathogens were transferred to V8 Juice Agar (V8A) plates and single spore technique was used to obtain pure cultures of *P. avenae* and *C. sativus* which were then stored in cryopreservation fluid at -65°C.

RESULTS AND COMMENTS: Leaf spots were observed in the canopies of all 43 crops sampled in 2016 however, disease severity was assessed for only 25 of the 43 crops. Leaf spot severity in the upper canopy varied from trace to slight in 22 crops and moderate in three crops, while severity in the lower canopy was rated as moderate in 14 crops, severe in two and slight in the remaining nine.

Only two leaf-spot pathogens were identified from the plated oat leaf tissues (Table 1), *P. avenae* and C*. sativus,* with *P. avenae* being more common. *S. avenae* was not observed in any of the samples, as was the case in 2015. The prevalence and incidence (Table 1) of *P. avenae* and *C. sativus* was lower when compared to that of 2015 when *P. avenae* and *C. sativus* were present in 65% and 37% of crops sampled, respectively (Grewal et al. 2016). The results from 2015 and 2016 surveys differed from the surveys conducted prior to 2015 (Tekauz et al. 2012, Taylor et al. 2014, Taylor et al. 2015) in which *S. avenae* was observed in all years and with greater prevalence than *C. sativus* in most years (2011-2013). The results from 2015 and 2016 suggest that higher average temperatures (as observed in both years), as opposed to precipitation amount (which different across these two years) may favour the growth of *C. sativus* over *S. avenae*, while results from 2011-2016 indicate that *P. avenae* is consistently the most prevalent oat leaf spot pathogen regardless of growing conditions.

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Table 1. Oat leaf blotch disease prevalence and incidence in 43 Saskatchewan oat crops surveyed in 2016.

Pathogen	Prevalence (% crops)	Incidence (% isolations)*
Pyrenophora avenae	33	8
Cochliobolus sativus	9	1

*Number of leaf sections from which pathogens were isolated per total number of leaf sections sampled. Indicative of the relative amount of foliar damage observed.

CULTURES / CROPS: Avoine, Orge, Blé
RÉGION / LOCATION: Québec

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TITRE / TITLE: **MALADIES OBSERVÉES CHEZ LES CÉRÉALES AU QUÉBEC EN 2016**

RÉSUMÉ: En 2016, la rouille jaune du blé a été observée seulement dans les régions où la neige était encore présente au sol au moment des gels d'avril et où la maladie était présente à l'été 2015. Encore cette année, la rouille jaune a affecté plus fortement le blé d'hiver, alors que la rouille brune ainsi que l'oïdium, présents dans les régions centrales, étaient plus intenses sur le blé de printemps. Moins répandue qu'à l'habitude, la rouille couronnée de l'avoine a été notée à deux stations seulement. Chez l'orge, la rouille des feuilles, habituellement absente, a été décelée à deux stations des régions centrales et l'oïdium à une seule de ces stations. Comme à l'habitude, les taches foliaires étaient présentes sur tout le territoire. Finalement, la fusariose de l'épi n'a pas été un problème en 2016.

ABSTRACT: In 2016, yellow stripe rust on wheat was observed only in regions where snow was still present on the ground when frosts occurred in April and where the disease occurred in the summer 2015. Again this year, stripe rust was more severe on winter wheat, while brown leaf rust and powdery mildew, present in the central regions, were more severe on spring wheat. Less widespread than usual, crown rust on oats was assessed at only two locations. In barley, brown leaf rust, usually absent, was detected at two locations in the central regions and powdery mildew at one of these locations. As usual, leaf spots were widespread on the territory. Finally, fusarium head blight was not a problem in 2016.

MÉTHODES: Sept à neuf essais d'enregistrement et de performance de céréales de printemps et quatre essais de blé d'hiver répartis dans différentes régions du Québec (RGCQ 2016), ont été visités une fois durant l'été 2016 pour y dépister les maladies du feuillage. Le stade de développement de la céréale au moment de la visite se situait entre laiteux moyen et pâteux moyen. Les maladies ont été identifiées sur la base des symptômes visuels et l'intensité des symptômes a été notée selon une échelle de notation de 0 à 9; la catégorie 0 correspondant à aucun symptôme et 9 à des symptômes sur plus de 50 % de la surface de la feuille étendard. Le nom des agents pathogènes normalement associés à ces maladies est mentionné dans le texte à titre indicatif. Les valeurs de 0 à 4 réfèrent à une faible intensité, les valeurs de 4 à 7 à une intensité moyenne et les valeurs de 7 à 9 à une intensité élevée. La Financière agricole du Québec (FADQ) a fourni le nombre d'avis de dommages aux cultures de blé et d'orge qui avaient comme cause principale la fusariose (Michel Malo, FADQ, communication personnelle).

RÉSULTATS et COMMENTAIRES: En 2016 (FADQ, 2016), les semis des céréales de printemps ont été réalisés dans de bonnes conditions puisque les températures pendant cette période, fin avril et mai, ont été clémentes et les précipitations normales pour l'ensemble des régions du Québec. En juin les précipitations ont été abondantes dans les régions centrales, de l'est et du nord de la province, alors qu'elles ont été inférieures à la normale dans les régions du sud et de l'ouest.

En 2016, comme à chaque année, la tache ovoïde (*Stagonospora avenae*) de l'avoine s'est manifestée dans toutes les régions visitées. L'intensité des symptômes était moyenne pour l'ensemble des lignées/cultivars évalués. La rouille couronnée (*Puccinica coronata*) a été moins répandue en 2016 qu'au cours des deux dernières années. Elle a été observée seulement à Saint-Étienne-de-Lauzon (région de Québec) et La Pocatière (Bas-Saint-Laurent) et l'intensité des symptômes variait de faible à moyenne.

La rouille jaune du blé (*Puccinia striiformis*), en 2016, a touché le blé d'hiver dans les régions où la neige était encore suffisamment abondante pour empêcher le gel du feuillage du blé, soit à Saint-Augustin-de-Desmaures (région de Québec) et à La Pocatière. Elle était cependant absente à Normandin qui présentait un bon couvert de neige mais qui a eu très peu de rouille jaune à l'été 2015. Elle n'a pas été observée aux stations plus au sud de Princeville (Centre-du-Québec) et Saint-Mathieu-de-Beloeil

(Montérégie-Est), qui sont situées dans des régions qui étaient exemptes de neige au sol au moment des gels d'avril. L'intensité des symptômes variait de faible à élevée dépendamment des cultivars/lignées. La rouille jaune s'est aussi manifestée chez le blé de printemps, mais faiblement et seulement dans la région de Québec (Saint-Augustin et Saint-Étienne-de-Lauzon). Elle a également été observée à Normandin sur quelques lignées de printemps. La rouille brune (*Puccinia triticina*) présente sur le blé de printemps, mais faiblement tout comme la rouille jaune, était restreinte à la région de Québec. Quant aux taches foliaires (*Drechslera tritici-repentis*, *Stagonospora nodorum* et *Cochliobolus sativus*), elles ont été notées dans tous les essais de blé d'hiver et de printemps et présentaient des symptômes d'intensité moyenne, sauf pour le blé d'hiver à Saint-Mathieu-de-Beloeil où l'intensité était plutôt faible. L'oïdium (*Blumeria graminis* f. sp*. tritici*, syn. *Erysiphe graminis*), qui a été observé à Princeville et dans la région de Québec a plus affecté le blé de printemps (intensité variant de faible à élevée) que le blé d'hiver (faible intensité pour tous les cultivars/lignées). La fusariose de l'épi n'a pas été un problème en 2016 alors que seulement 0,7 % des producteurs de blé assurés (10 sur 1456) ont signalé des dommages à leur culture attribuables à cette maladie. Ce ratio est le plus bas des ratios enregistrés par la FADQ depuis le début des prises de données qui date de 2004.

Les taches foliaires de l'orge (*Drechslera teres*, *Rhynchosporium secalis* et *Cochliobolus sativus*), surtout la rayure réticulée (*D. teres*), étaient présentes dans tous les essais visités et l'intensité des symptômes a varié de moyenne à élevée. La rouille des feuilles (*Puccinia hordei*) chez l'orge est peu fréquente au Québec. Elle s'est toutefois manifestée en 2016 à Princeville et Saint-Augustin. Les symptômes étaient cependant peu intenses pour la majorité des cultivars/lignées. Pour ce qui est de l'oïdium (*Blumeria graminis* f.sp*. hordei*, syn. *Erysiphe graminis*) il s'est manifesté seulement à Saint-Augustin et faiblement. Finalement la fusariose de l'épi de l'orge, tout comme pour le blé, n'a pas été un problème en 2016; seulement 0,7 % des producteurs d'orge assurés (4 sur 565) à la FADQ ont rapporté des dommages dus à la maladie.

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CROP / CULTURE: Spring Wheat
LOCATION / RÉGION: Manitoba

NAMES AND AGENCIES / NOMS ET ÉTABLISSEMENTS:
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TITLE / TITRE: FUSARIUM HEAD BLIGHT OF SPRING WHEAT IN MANITOBA IN 2016

ABSTRACT: In 2016, fusarium head blight incidence and severity were assessed in 70 spring wheat fields in Manitoba. The disease occurred in 87% of the wheat fields surveyed at a provincial mean FHB severity (FHB Index) of 2.0 %. The most prevalent *Fusarium* species was *F. graminearum*, followed by *F. poae* and *F. avenaceum*.

INTRODUCTION AND METHODS: Spring wheat in Manitoba was surveyed for fusarium head blight (FHB) at 70 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. In contrast to other disease surveys conducted in Manitoba, the fields were not surveyed at random. Instead, information on their location was obtained from the producers. The proportion of infected spikes per field (incidence) and the proportion of infected spikelets in each spike (severity) were recorded in 10 spikes from ten random sites in each field surveyed. The FHB index (overall severity) was determined for each field surveyed: [Average % incidence X Average % severity] / 100.

From each field, at least 50 spikes were processed for pathogen isolation and identification in the laboratory. Ten kernels from each field surveyed were surface-sterilized in a laminar flow bench placed on Spezieller Nährstoffarmer Agar (SNA) media. Identification of *Fusarium* species involved microscopic examination and morphological characterization using the criteria of Leslie and Summerell (2006).

RESULTS AND COMMENTS: According to Manitoba Agricultural Services Corporation's Variety Market Share Report (MASC 2016), there were approximately 2.2 million acres of spring wheat seeded in Manitoba in 2016. The top five cultivars, based on seed acreage, were 'AAC Brandon' (37.9%), 'Cardale' (17.1%), 'Carberry' (10.2%) and 'Glenn' (7.1%). 'AAC Brandon' and 'Cardale' were the predominant spring wheat cultivars grown in the fields sampled in this survey.

FHB occurred in 87% of the surveyed spring wheat fields in Manitoba (Table 1). The provincial mean FHB severity (FHB Index) was 2.0 %. The range in severity varied from a minimum of zero to a maximum of 15.1%. Prevalence and severity of FHB in spring wheat were lowest in the Northwest and Interlake region and most prevalent in the Central (90%) and Eastern regions (92%). The highest mean severity was in the Southwest region. The sample with the highest FHB severity (15.11%) was from a spring wheat field in the Central region.

Overall, the 2016 provincial mean FHB index was higher than in previous years, *i.e*., 1.7% in 2010, 1.1% in 2012, 1.0 % in 2014 and 0.3% in 2015 (Gilbert et al. 2011, 2012, 2013; Derksen and de Rocquigny 2015, Henriquez et al. 2016). However, the 2016 provincial mean FHB index was almost similar to 2011 (2.1%) (Gilbert et al. 2012).

Isolation results from 700 kernels plated on SNA media showed that *Fusarium graminearum* was the most frequently isolated pathogen species, accounting for 93.6% of isolations (Table 2). It was detected in 83.3% of surveyed fields. Three other species were found at lower levels, including *F. poae* detected in 3.3% of fields and 1.1% of total *Fusarium* isolations, and *F. avenaceum* detected in 3.3% of fields and 1.1% of total *Fusarium* isolations. Unidentified *Fusarium* spp. are listed as *Fusarium* spp.

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.

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Table 1. Fusarium head blight incidence and severity (FHB index) in spring wheat fields in Manitoba in 2016.

Region	No. Crops	FHB Prevalence %	Mean FHB Index %	Mean FHB Index % (Range)
Central	39	90	2.2	0 - 15.11
Eastern	12	92	1.4	0 - 5.27
Interlake	5	80	0.5	0 - 0.96
Northwest	5	80	0.2	0 - 0.8
Southwest	9	78	4.0	0.62 - 8.52
Mean/Total	70	87	2.0	0 - 15.11

[1]Number of fields sampled.
[2]Prevalence (%) = Number of fields affected / total fields surveyed.
[3]Mean FHB Index: [Average % incidence X Average % severity] / 100.

Table 2. *Fusarium* species isolated from kernels in FHB- affected spring wheat fields in Manitoba in 2016.

	Prevalence %	Frequency %
F. graminearum	83.3	93.6
F. poae	3.3	1.1
F. avenaceum	3.3	1.1
F. acuminatum	1.7	1.4
F. equiseti	1.7	0.4
Fusarium spp.	5.0	2.5

[1]Prevalence = % of spring wheat fields from which the pathogen was isolated
[2]Frequency = % of *Fusarium* species (as the % of the total *Fusarium* isolations)

CROP / CULTURE: Winter Wheat
LOCATION / RÉGION: Manitoba

NAMES AND AGENCIES / NOMS ET ÉTABLISSEMENTS:
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TITLE / TITRE: FUSARIUM HEAD BLIGHT OF WINTER WHEAT IN MANITOBA IN 2016

ABSTRACT: In 2016, fusarium head blight incidence and severity were assessed in 39 winter wheat fields in Manitoba. FHB occurred in 87% of the surveyed winter wheat fields. The provincial mean FHB severity (FHB Index) was 2.1 %. The most prevalent pathogen species was *Fusarium graminearum*, followed by *F. poae* and *F. culmorum*.

INTRODUCTION AND METHODS: Winter wheat in Manitoba was surveyed for fusarium head blight (FHB) incidence and severity at 39 field locations. The survey was conducted during late June to early July when most of the fields were at growth stage ZGS 73 – 85. 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 in 10 spikes from ten random sites in each field surveyed. The FHB index (overall severity) was determined for each field surveyed as follows: [Average % incidence X Average % severity] / 100.

From each field, at least 50 spikes were processed for pathogen isolation and identification in the laboratory. Ten kernels from the field surveyed were surface-sterilized in a laminar flow bench and placed on Spezieller Nährstoffarmer Agar (SNA) media. Identification of *Fusarium* species involved microscopic examination and morphological characterization using the criteria of Leslie and Summerell (2006).

RESULTS AND COMMENTS: According to Manitoba Agricultural Services Corporation's Variety Market Share Report (MASC 2016), there were approximately 134,000 acres of commercial winter wheat seeded in Manitoba for 2016. The top five cultivars, based on their seed acreage, were 'Emerson' (64.7%), 'CDC Falcon' (12.4%), 'AAC Gateway' (10.1%), 'CDC Buteo' (5.5%) and 'Flourish' (2.3%). 'Emerson' was the predominant winter wheat cultivar grown in the fields sampled in this survey.

FHB occurred in 87% of the surveyed winter wheat fields in Manitoba (Table 1). The provincial mean FHB severity (FHB Index) was 2.1%. The range in severity varied widely from a minimum of zero to a maximum of 9.9%. Prevalence and severity of FHB in winter wheat was lower in the Interlake region and most prevalent in the Central region (100%). The highest mean severity was in the Eastern region. The sample with the highest FHB severity (9.9%) was from a crop in the Eastern region.

Overall, the 2016 provincial mean FHB index was considerably lower than in 2014 (11.6%) (Derksen and de Rocquigny 2015) and higher than 2015 (1.1%) (Henriquez et al. 2016). Based on the survey results, FHB likely caused zero to minimal damage in Manitoba winter wheat fields in 2016.

The results from kernels plated on SNA media showed that *Fusarium graminearum* was the most frequently isolated species, accounting for 87.5% of isolations (Table 2). This species was detected in 58.3% of surveyed fields, followed by *F. poae* and *F. culmorum.* Unidentified *Fusarium* spp. are listed as *Fusarium* spp.

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.

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Table 1. Fusarium head blight (FHB) index in winter wheat fields in Manitoba in 2016.

Region	No. Crops	FHB Prevalence %	Mean FHB Index %	Mean FHB Index % (Range)
Central	26	85	1.8	0 - 9.0
Eastern	7	100	3.8	0.2 - 9.9
Interlake	6	83	1.1	0 - 4.4
Mean/Total	39	87	2.1	0 - 9.9

[1]Number of fields sampled.
[2]Prevalence (%) = Number of fields affected / total fields surveyed.
[3]Mean FHB Index: [Average % incidence X Average % severity] / 100.

Table 2. *Fusarium* species isolated from kernels in FHB- affected winter wheat fields in Manitoba in 2016.

	Prevalence %	Frequency %
F. graminearum	58.3	87.5
F. poae	8.3	4.4
F. avenaceum	2.8	5.0
F. culmorum	8.3	2.5
Fusarium spp.	2.8	0.6

[1]Prevalence = % of winter wheat fields from which the pathogen was isolated
[2]Frequency = % of *Fusarium* species (as the % of total *Fusarium* isolations)

CROP / CULTURE: Spring Wheat
LOCATION / RÉGION: Manitoba

NAMES AND AGENCIES / NOMS ET ÉTABLISSEMENTS:
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TITLE / TITRE: LEAF SPOT DISEASES OF SPRING WHEAT IN MANITOBA IN 2016

ABSTRACT: In 2016, leaf spot diseases were assessed in 65 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 2016 (ZGS 73 – 85). A total of 65 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 cm^2 surface-disinfested leaf pieces from 10 leaves were plated on V8 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 Manitoba Agricultural Services Corporation's Variety Market Share Report (MASC 2016), there were approximately 2.2 million acres of spring wheat seeded in Manitoba in 2016. The top five cultivars, based on seed acreage, were 'AAC Brandon' (37.9%), 'Cardale' (17.1%), 'Carberry' (10.2%) and 'Glenn' (7.1%). 'AAC Brandon' and 'Cardale' were the predominant spring wheat cultivars grown in the fields sampled in this survey.

Leaf spot diseases were observed in all of the fields surveyed (Table 1). The provincial mean LS severity was 5.6%. This severity was lower than in 2015 (15.7%) (Henriquez et al. 2016). The range in severity varied widely from a minimum of one to a maximum of 35%. LS severity was lowest in the Central region (3.3%) and highest in the Southwest region (17.8%). The sample with the highest LS severity was from the Southwest region (35.0%).

As reported for previous years (Gilbert et al. 2012, 2013) *Pyrenophora tritici-repentis* (tan spot) was the most prevalent and widespread LS pathogen in Manitoba (Table 2). The results of 650 samples of leaf tissue analyzed showed that *Pyrenophora tritici-repentis*, causal agent of tan spot, was the most frequently isolated species, accounting for 97.9% of isolations. This species was detected in 53.8% of surveyed fields, and was followed by *Stagonospora nodorum* (2.1%) (stagonospora blotch) which was detected in 3.1% 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.

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Table 1. Leaf spot (LS) severity in spring wheat fields in Manitoba in 2016.

Region	No. Crops	LS Prevalence %	Mean LS Severity %	Mean LS Severity % (Range)
Central	39	100	3.3	1 - 30
Eastern	12	100	6.2	1 - 20
Interlake	5	100	7.4	1 - 15
Northwest	5	100	10.6	1 - 25
Southwest	4	100	17.8	1 - 35
Mean/Total	65	100	5.6	1 - 35

[1]Number of fields sampled.
[2]Prevalence (%) = Number of fields affected / total fields surveyed.
[3]Mean percentage flag leaf affected. Rated on a scale of 1 (slightly affected) to 50 (leaves dead).

Table 2. Prevalence and isolation frequency of leaf spot pathogens in spring wheat fields in Manitoba in 2016.

	Prevalence %	Frequency %
Pyrenophora tritici-repentis	53.8	97.9
Stagonospora nodorum	3.1	2.1

[1]Prevalence = % of spring wheat fields from which the pathogen was isolated.
[2]Frequency = % of leaf spot pathogen(as the % of the total pathogen isolations)

CROP / CULTURE: Winter Wheat
LOCATION / RÉGION: Manitoba

NAMES AND AGENCIES / NOMS ET ÉTABLISSEMENTS:
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TITLE / TITRE: LEAF SPOT DISEASES OF WINTER WHEAT IN MANITOBA IN 2016

ABSTRACT: In 2016, leaf spot diseases were assessed in 37 winter 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 *Cochiobolus sativus* and *Stagonospora nodorum*.

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). A total of 37 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 cm^2 surface-disinfested leaf pieces from 10 leaves were plated on V8 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 Manitoba Agricultural Services Corporation's Variety Market Share Report (MASC 2016), there were approximately 134,000 acres of commercial winter wheat seeded in Manitoba for 2016. The top five cultivars, based on their seed acreage, were 'Emerson' (64.7%), 'CDC Falcon' (12.4%), 'AAC Gateway' (10.1%), 'CDC Buteo' (5.5%) and 'Flourish' (2.3%). 'Emerson' was the predominant winter wheat cultivar grown in the fields sampled in this survey.

Leaf spot diseases were observed in 100% of fields surveyed (Table 1). The provincial mean LS severity was 5.9%. This severity was lower than in 2015 (9.5%) (Henriquez et al. 2016). The range in severity varied widely from a minimum of 1.0% to a maximum of 30%. LS severity was lowest in the Eastern region (4.6%) and highest in the Interlake region (9.5%). The sample with the highest LS severity was from the Central region (30%).

As reported for previous years (Tekauz et al. 2011, 2013) *Pyrenophora tritici-repentis* (tan spot) was the most prevalent and widespread LS pathogen in Manitoba (Table 2). The results of 370 samples of leaf tissue analyzed showed that *Pyrenophora tritici-repentis* was the most frequently isolated species, accounting for 91.3% of isolations. This species was detected in 64.9% of surveyed fields. This was followed by *Cochiobolus sativus* (7.5%) (spot blotch) and *Stagonospora nodorum* (1.3%) (stagonospora blotch) detected in 8.1% and 2.7% of surveyed fields, respectively.

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.

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Table 1. Leaf spot (LS) severity in winter wheat fields in Manitoba in 2016.

Region	No. Crops	LS Prevalence %	Mean LS Severity %	Mean LS Severity % (Range)
Central	26	100	5.4	1 - 30
Eastern	7	100	4.6	1 - 15
Interlake	6	100	9.5	1 - 20
Mean/Total	39	100	5.9	1 - 30

[1]Number of fields sampled.
[2]Prevalence (%) = Number of fields affected / total fields surveyed.
[3]Mean percentage flag leaf affected. Rated on a scale of 1 (slightly affected) to 50 (leaves dead).

Table 2. Prevalence and isolation frequency of leaf spot pathogens in winter wheat fields in Manitoba in 2016.

	Prevalence %	Frequency %
Pyrenophora tritici-repentis	64.9	91.3
Cochiobolus sativus	8.1	7.5
Stagonospora nodorum	2.7	1.3

[1]Prevalence = % of winter wheat fields from which the pathogen was isolated.
[2]Frequency = % of leaf spot pathogen(as the % of the total pathogen isolations).

CROP / CULTURE: Spring and Winter Wheat
LOCATION / RÉGION: Manitoba and eastern Saskatchewan

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TITLE / TITRE: LEAF RUST AND STRIPE RUST OF WHEAT IN MANITOBA AND EASTERN SASKATCHEWAN IN 2016

ABSTRACT: Field surveys for leaf and stripe rust were conducted during July and August 2016 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. Favorable spring weather facilitated early seeding of wheat in and the rust epidemic built up slowly. Stripe rust was widely found in Manitoba and Saskatchewan with varying levels of infection depending on location.

INTRODUCTION AND METHODS: Trap nurseries and commercial fields of wheat in Manitoba and eastern Saskatchewan were surveyed for the incidence and severity of leaf rust (*Puccinia triticina* Erikss.) and stripe rust (*Puccinia striiformis* f. sp. *tritici* Erikss.) during July and August 2016. Winter wheat trials were examined for rust at 8 trap nurseries in Manitoba in July. In August, spring wheat trials at 11 trap nurseries were surveyed in Manitoba and south eastern Saskatchewan.

RESULTS AND COMMENTS: Early seeding resulted in an early maturing wheat crop in southern Manitoba. The leaf rust epidemic built up slowly, but steadily to higher levels later in the season on lines that were not sprayed with foliar fungicides. Leaf rust was found at most locations surveyed across southern Manitoba. In Saskatchewan during the latter part of August, leaf rust was also found widely spread at relatively low levels. In Manitoba Crop Variety Evaluation Trials (MCVET), low levels of leaf rust were found on winter wheat entries with 35% leaf infection occasionally recorded on lines. In MCVET trials and Saskatchewan Variety Performance Group (SVPG) trials where spring wheat lines were tested, susceptible lines such as AAC Indus had 50-60% flag leaf infection. At Uniform Rust Nursery (URN) trials, leaf rust levels reached as high as 90% on highly susceptible lines such as Morocco.

Stripe rust was found widely distributed in Manitoba, with some winter wheat lines having up to 70% leaf infection at the Portage location, but spring wheat lines generally showing only trace levels of stripe rust. It was widely reported in Saskatchewan, and during our survey of eastern Saskatchewan we found it in diverse locations at low levels of infection (less than 5% flag leaf coverage). At the URN in Indian Head, SK, 45% stripe rust infection was noted on susceptible lines.

CROP / CULTURE: Barley, Oat and Wheat
LOCATION / RÉGION: Manitoba and eastern Saskatchewan

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TITLE / TITRE: STEM RUSTS OF CEREALS IN WESTERN CANADA IN 2016

ABSTRACT: Field surveys for stem rust were conducted from July to September 2016 in Manitoba and eastern Saskatchewan. No stem rust was observed in wheat and was at trace levels in barley and oat fields. For wheat stem rust, races TMRTF (29%), QFCSC (27%), and MCCFC (18%) were the most common, with races RKQQF, RHTSF, and TPMKC detected at lower frequency. For oat stem rust, race TJS was dominant (71%), followed by race TJJ (9%). Ten other races of oat stem rust were detected at low frequency in 2016.

INTRODUCTION AND METHODS: A total of 166 oat and 85 wheat and barley fields, as well as trap nurseries of barley, oat, and wheat, were monitored in 2016 to assess severity of infection of stem rust *(Puccinia graminis* Pers. f. sp. *tritici* Erikss. & E. Henn. and *P. graminis* Pers. f. sp. *avenae* Erikss. & E. Henn.) and determine the virulence spectrum in each pathogen population. The surveys were conducted in July, August, and September and infected stem tissue samples were collected from each field surveyed. Urediniospores were obtained from collections and evaluated for virulence specialization on sets of host differential lines (Fetch et al. 2015, Fetch and Jin, 2007).

RESULTS AND COMMENTS: Warm (0 to +2°C) conditions in May were conducive for normal seeding of crops. Mean temperature was normal (-2 to +2°C) over the growing season, but mean precipitation was much above average (115-200%) in July when rust infection normally occurs. Environmental conditions for stem rust infection were generally favourable across the prairies in the 2016 crop season, but infection was as trace levels in barley and commercial oat fields.

In contrast to 2015 (Fetch and Zegeye, 2016), stem rust pustules were commonly found in stands of wild barley (*Hordeum jubatum*) in 2016. Six races [TMRTF (29%), QFCSC (27%), MCCFC (18%), RHTSF (12%), RKQQF (9%) and TPMKC (6%)] were detected. In contrast to previous years where QFCSC was the dominant or only race detected, historical races last frequently found over a decade ago were found. The reason for this is unclear, but is worthwhile to note that these races with high virulence are still present in the North American population of *Puccinia graminis* f. sp. *tritici*.

Stem rust in cultivated and wild oat stands was at trace levels in western Canada in 2016. Race TJS was dominant (71%) in 2016 and attacks all commonly grown oat cultivars in Canada and the United States. The next prevalent race was TJJ (NA67) at 9%, while races TGN and TJN were at 3% in the population. The high prevalence of race TJS may be due to use of the *Pg-a* resistance gene in USA oat cultivars.

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CROP / CULTURE: Common and durum wheat
LOCATION / RÉGION: Saskatchewan

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TITLE / TITRE: **LEAF SPOTTING DISEASES OF COMMON AND DURUM WHEAT IN SASKATCHEWAN IN 2016**

ABSTRACT: The leaf spot (LS) disease complex was evaluated in 148 common and durum wheat crops across Saskatchewan. Disease severity was compared relative to wheat species, soil zone, crop district, cultivar, tillage method, and previous crop. Mean LS severity was lower than in 2014 and 2012, but similar to 2013 and 2015. Overall, there was no difference in LS levels between common and durum wheat. LS severity was lowest in the Dark Brown, and highest in the Brown soil zone. *Pyrenophora tritici-repentis* was the most prevalent pathogen in durum while *Septoria tritici* was the most prevalent pathogen in common wheat.

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 2016. A total of 148 common and durum crops were sampled in 21 crop districts (CD) in the various soil zones (Fig. 1, Table 1). There were 41 fields surveyed in the Brown soil zone, 55 in the Dark Brown soil zone, and 52 in the Black/Gray soil zone. Among the crops sampled, 85 were identified as common and 63 as durum wheat.

Information on the agronomic practices employed was obtained from the producers for most fields sampled. Twenty-nine common, and 10 durum, wheat cultivars were identified among the samples, the most popular (grown in 5 fields or more) being the durum wheat cultivars 'Transcend' (13), 'Strongfield' (12), 'Brigade' (9), 'CDC Verona' (5) and the common wheat cultivars 'Cardale' (9), 'AAC Brandon' (6), 'Goodeve VB' (5), and 'CDC Utmost VB' (5). Information on whether the sampled fields had been sprayed with fungicide(s) was obtained from most of the producers. There were more crops sprayed with fungicides (75) than unsprayed (57) but no information was obtained on timing of fungicide applications. Information on the crop grown in 2015 and 2014 (or if summer-fallowed), and tillage method was also obtained from producers for most of the fields surveyed. For common wheat, the most frequent previous crop was an oilseed (59 fields); fewer common wheat crops were preceded by a pulse (10) or a cereal (5) crop, while the most frequently grown crop two years previously was a cereal (57) or an oilseed (8). For durum wheat, the most frequent previous crop was a pulse (29) or an oilseed (17), while the most frequently grown crop two years previously was a cereal (31) followed by an oilseed (11) or pulse (7). Summer fallow was the least common practice, with only 6 common, and 10 durum, wheat fields having been left fallow the previous year or two years previously. Tillage system was classified as conventional, minimum-, or zero-till. Most of the common wheat crops for which agronomic information was provided were under zero-till (61), followed by fields under minimum-till (14), with only 8 fields being managed conventionally; by contrast, all durum wheat fields surveyed were under zero-till (49) or minimum-till (9).

In each field, 50 flag leaves were collected at random and air-dried at room temperature. 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 severities and which had not been

sprayed with a fungicide (total of 57 crops), 1 cm^2 surface-disinfested leaf pieces were plated on water agar for identification and quantification of the causal LS pathogens.

RESULTS AND COMMENTS: LS were observed in all crops surveyed in 2016 (Table 1). In individual crops, percentage flag leaf area affected ranged from trace to 18%. The overall mean LS severity on flag leaves of 7.2%, was similar to 2013 (7.6%) and 2015 (7.6%) but lower than 2012 (10.0%) and 2014 (9.8%) (Fernandez et al. 2013, 2014, 2015, 2016a). Overall, for all crops sampled in 2016, there was no difference in LS severity between common and durum wheat. This agrees with observations made in 2012, 2013, and 2015. There was a large variation in disease severity among and within regions that could be attributed, at least partly, to the weather conditions throughout the summer.

Influence of soil zone and crop district on LS severity

For all common wheat fields sampled, mean LS severity was greater in the Brown and Black/Gray soil zones than in the Dark Brown soil zone, while for durum wheat disease severity was highest in the Brown soil zone (Table 1). For common wheat, the highest LS severity occurring in the Brown soils zone does not agree with results from previous years where the Black/Gray soil zone had the highest disease severity (Fernandez et al. 2013, 2014, 2015, 2016a). This can be explained, at least partly, by the higher than normal rainfall levels in the Brown soil zone in the 2016 growing season (Fig. 2). For durum wheat, the higher disease level in the Brown vs. the Dark Brown soil zone agrees with observations made in 2014 and 2015.

When grouped by CDs, common wheat crops in 1A/1B (south-east), 5A/5B (east), 8A/8B (north-east) and 3A/3B (south-central) had the greatest mean LS severity, while those in 2A/2B (south-east), 7A/7B (west-central), and 6A/6B (central) had the lowest disease levels (Table 1). For durum wheat, CDs 4A/4B (south-west) had the greatest mean disease severity followed by 3A/3B (south-central). The mean LS severities in the remaining CDs were less than 5%.

Influence of cultivar on LS severity

Overall, for the most frequently-grown common wheat cultivars, 'Carberry' (mean LS of 9.0%), 'Goodeve VB' (8.0%), and 'AAC Brandon' (7.9%) had the highest disease severities, with 'CDC Utmost VB' (4.1%) and 'Cardale' (5.2%) having the lowest LS levels. Among the durum wheat cultivars grown in five or more fields, the greatest disease severities were observed in 'Transcend' (7.8%) and 'Strongfield' (6.3%), followed by 'CDC Verona' (4.4%) and 'Brigade' (3.3%). In 2015, 'Transcend' and 'Strongfield' also had among the greatest, and 'CDC Utmost VB' among the lowest, mean LS severities (Fernandez et al. 2016a).

Causal pathogens

Unlike previous years, *Septoria tritici* (a component of the septoria leaf complex) was the most prevalent LS pathogen in common wheat while, like previous years, *Pyrenophora tritici-repentis* (tan spot) was the most prevalent pathogen in durum wheat (Fernandez et al., 2013, 2014, 2015, 2016a) (Table 1). The remainder of infections was caused primarily by *P. tritici-repentis* in common wheat and the septoria leaf complex in durum wheat. The least commonly isolated pathogen was *Cochliobolus sativus* (spot blotch). Percentage isolation of each of the pathogens among the soil zones was similar for common wheat, while for durum wheat *S. tritici* was isolated at the highest and *C. sativus* at the lowest levels in the Brown soil zone.

Influence of environment on LS severity and pathogens

Overall, in 2016, total precipitation during the growing season across most of the province exceeded the long-term average (Fig. 2). The highest amounts of precipitation fell in the south-west and south-east areas of the province (Fig. 2) which coincides with crop districts 1A/1B (south-east) having the highest LS severity in common wheat, and CDs 4A/4B (south-west) having the highest LS severity in durum wheat (Table 1). Mean monthly temperatures across most of the province were generally normal to above (0 to 2°C) normal in May and June (maps not shown, Agriculture and Agri-Food Canada, 2016). Mean temperatures in July were up to 2ºC lower than normal in the south and west-central areas (Fig. 3). The lower temperatures might explain the increased prevalence of *S. tritici* relative to *P. tritici-repentis,* and the lower levels of *C. sativus*, relative to previous years (Fernandez et al. 2016b).

Influence of tillage method

Zero-till was the most common tillage method in common wheat fields (63 fields) followed by minimum-till (13 fields) and conventional tillage (8 fields). There was no difference in LS severity among the three methods, and they also followed the same pattern of distribution of the pathogens (Table 2).

Influence of previous crop

Oilseeds were the most common previous crops (59 fields) followed by pulses (10 fields) and cereals (5 fields). Common wheat grown on cereal stubble had the highest LS severity followed by wheat on oilseed or pulse stubble (Table 3). The distribution of the LS pathogens varied among the different stubbles. *P. tritici-repentis* was isolated at the highest levels when the previous crop was a pulse, while *S. tritici* was isolated at the highest levels when the previous crop was a cereal or oilseed.

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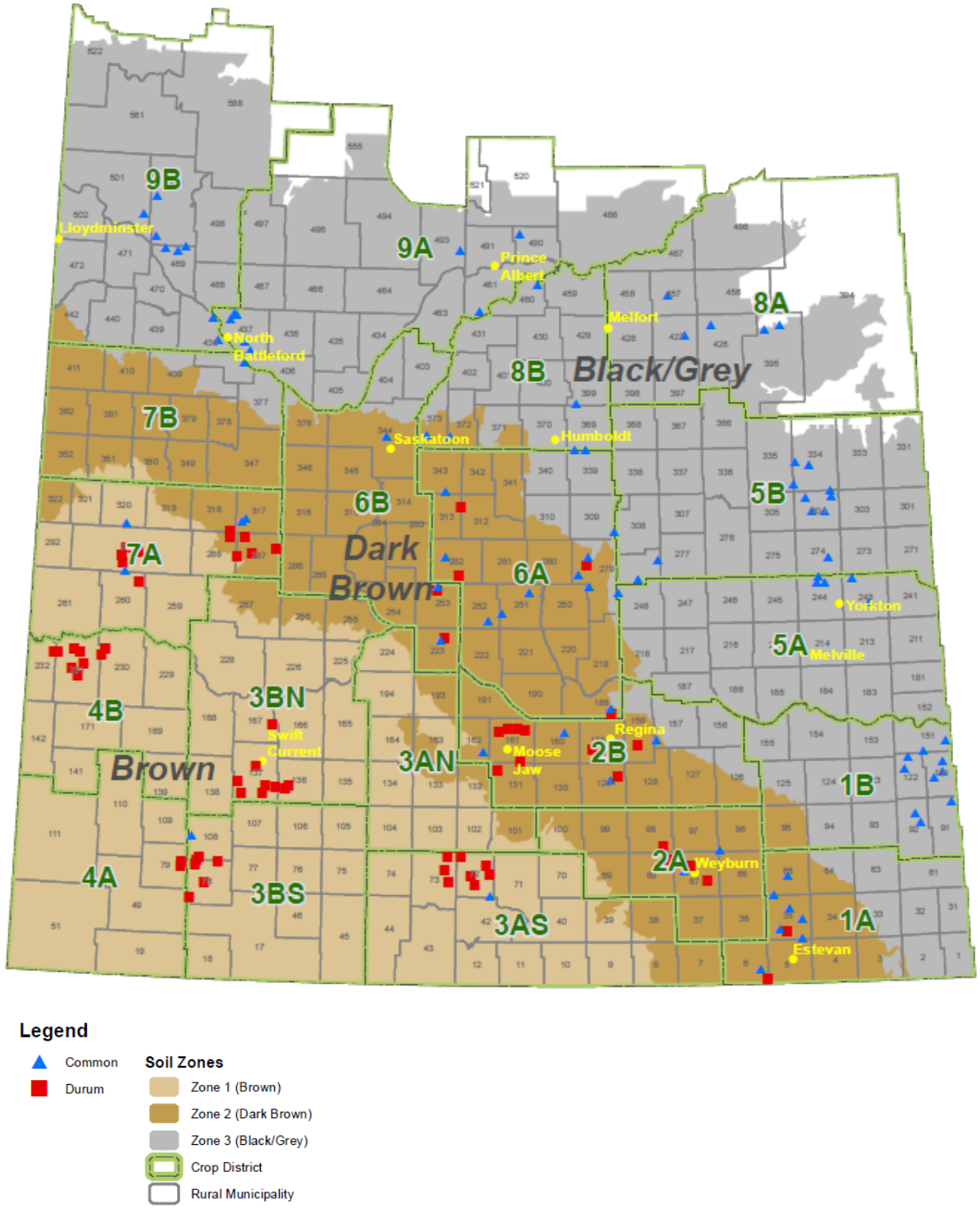

Fig.1. Soil zone map with common and durum wheat fields surveyed across Saskatchewan in 2016.

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 2016.

Soil Zone/ Crop District	No. of Crops[1]	Mean Severity[2]	*Pyrenophora tritici-repentis*[3]	*Stagonospora nodorum*[3]	*Septoria tritici*[3]	*Stagonospora avenae* f. sp. *triticea*[3]	*Cochliobolus sativus*[3]
		----------%----------					
Soil Zone							
Common wheat:							
1 (Brown)	4	8.8	22.7/2	25.6/2	30.0/2	21.7/2	-/0
2 (Dark Brown)	29	6.3	17.3/7	23.2/7	35.8/7	23.7/7	-/0
3 (Black/ Gray)	52	7.7	25.2/16	20.4/15	34.3/16	19.4/16	3.7/8
Mean/total:	**85**	**7.3**	**22.8/25**	**21.7/24**	**34.4/25**	**20.8/25**	**3.7/8**
Durum wheat:							
1 (Brown)	37	9.4	52.7/12*	11.3/12	16.5/13	11.6/13	23.7/7
2 (Dark Brown)	26	4.0	48.5/6	10.3/5	7.7/6	10.8/6	48.9/3
Mean/total:	**63**	**7.1**	**51.3/18**	**11.0/17**	**13.7/19**	**11.4/19**	**31.2/10**
Crop District							
Common wheat:							
1A/1B	17	11.4	24.8/5	22.8/5	25.4/5	24.8/5	3.6/3
2A/2B	6	4.4	36.9/2	26.3/2	19.0/2	17.9/2	-/0
3A/3B[4]	2	9.0	30.9/1	8.6/1	40.0/1	20.5/1	-/0
5A/5B	15	6.7	5.9/4	22.9/4	49.7/4	21.4/4	0.5/1
6A/6B	15	5.2	6.6/4	19.3/4	47.3/4	24.6/4	9.0/1
7A/7B	5	4.6	14.5/1	42.5/1	20.0/1	23.0/1	-/0
8A/8B	9	9.6	3.3/4	23.2/4	50.4/4	21.9/4	2.4/2
9A/9B	16	5.7	66.0/4	13.5/3	11.3/4	11.4/4	4.5/1
Durum wheat:							
1A/1B	2	4.5	75.7/1	12.1/1	10.7/1	1.4/1	-/0
2A/2B	13	4.8	51.7/3	1.2/2	5.0/3	7.9/3	51.4/2
3A/3B	21	9.6	54.2/6**	9.7/6	13.4/7	10.2/7	29.1/3
4A/4B	10	13.0	36.9/4	10.1/4	19.4/4	14.8/4	25.1/3
6A/6B	6	3.9	41.7/1	5.6/1	3.3/1	5.6/1	43.9/1
7A/7B	11	2.1	41.0/3	19.4/3	20.2/3	18.3/3	3.3/1

[1]Number of crops sampled. All crops had leaf spot lesions on the flag leaves.
[2]Mean percentage flag leaf affected.
[3]Mean percentage fungal isolation/number of crops where the pathogen occurred. For each crop district, the number of crops where *P. tritici-repentis* was isolated is equivalent to the total number of crops plated for fungal identification and quantification. See below for exceptions.
*There were 13 crops plated for fungal identification but *P. tritici-repentis* was only isolated from 12.
**There were 7 crops plated for fungal identification but *P. tritici-repentis* was only isolated from 6.
[4]'3A' includes CDs 3AS and 3AN; '3B' includes CDs 3BS and 3BN.

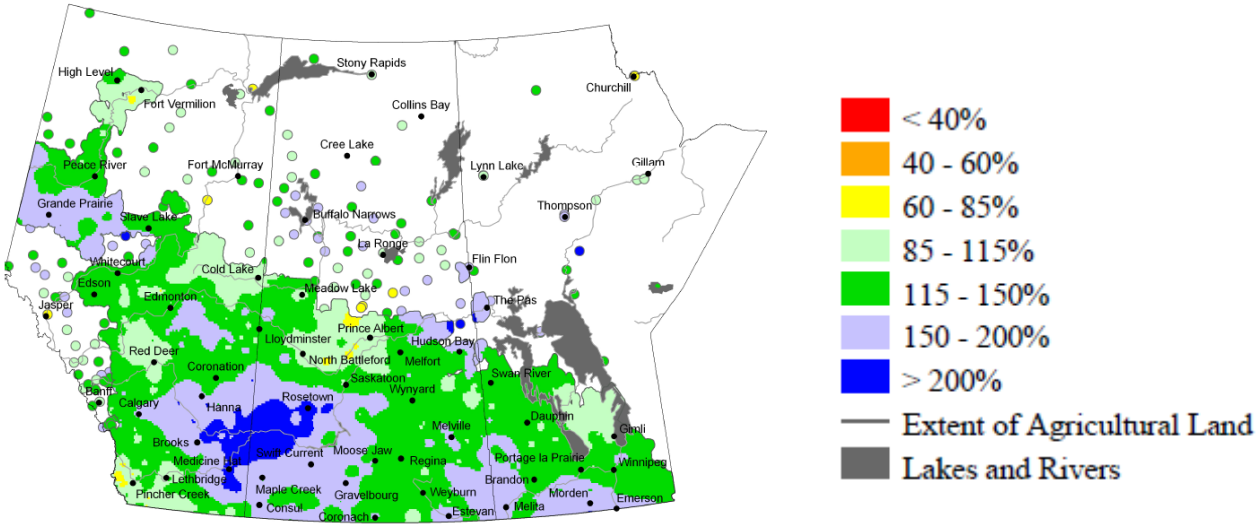

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Fig. 2. Three month (May 11- Aug 8) percent of average precipitation. Normal precipitation based on 1981-2010 (Agriculture and Agri-Food Canada, 2016).

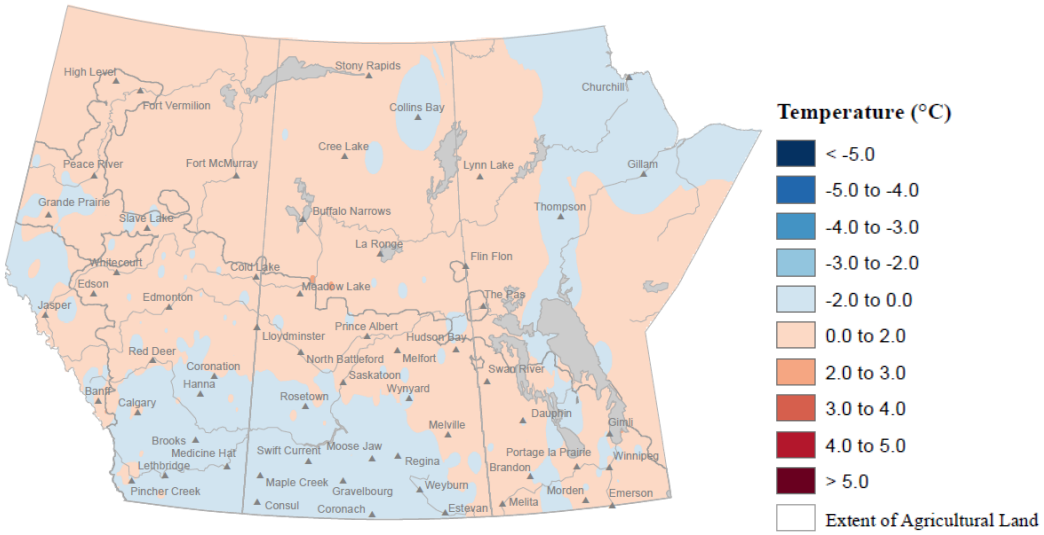

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Fig. 3. Monthly mean temperature (ºC) difference from normal for July 2016. Normal temperature based on 1981-2010 (Agriculture and Agri-Food Canada, 2016).

Table 2. Incidence and severity of leaf spotting diseases and mean percentage isolation of the most common leaf spotting pathogens, by tillage method, for common wheat crops surveyed in Saskatchewan in 2016.

Tillage method	No. of crops[1]	Mean severity[2]	*Pyrenophora tritici-repentis*[3]	*Stagonospora nodorum*[3]	*Septoria tritici*[3]	*Stagonospora avenae* f.sp. *triticea*[3]	*Cochliobolus sativus*[3]
		----------%----------					
Conventional	8	7.3	15.0/3	20.2/3	41.5/3	23.0/3	1.0/1
Minimum	13	7.3	21.6/5	21.0/5	37.1/5	18.1/5	5.6/2
Zero	61	7.5	24.6/17	22.2/16	32.3/17	21.3/17	3.5/5

[1]Number of crops sampled by tillage method category.
[2]Mean percentage flag leaf area infected estimated on leaf samples that were still green when sampled.
[3]Mean percentage fungal isolation/number of wheat crops where pathogen occurred.

Table 3. Incidence and severity of leaf spotting diseases and mean percentage isolation of the most common leaf spotting pathogens, by previous crop, for common wheat crops surveyed in Saskatchewan in 2016.

Previous Crop	No. of crops[1]	Mean severity[2]	*Pyrenophora tritici-repentis*[3]	*Stagonospora nodorum*[3]	*Septoria tritici*[3]	*Stagonospora avenae* f.sp. *triticea*[3]	*Cochliobolus sativus*[3]
		----------%----------					
Cereal	5	12.2	11.4/3	13.3/3	52.7/3	21.5/3	1.6/2
Oilseed	59	7.9	20.9/18	23.7/17	33.6/18	21.6/18	1.5/6
Pulse	10	5.6	43.1/3	22.7/3	18.6/3	15.6/3	-/0

[1]Number of crops sampled that were seeded to the corresponding crop category in 2015. All crops had leaf spot lesions on the flag leaves.
[2]Mean percentage flag leaf area infected estimated on leaf samples that were still green when sampled.
[3]Mean percentage fungal isolation/number of wheat crops where pathogen occurred.

CROP / CULTURE: Spring Wheat, Winter Wheat, Durum Wheat
LOCATION / RÉGION: Saskatchewan

NAMES AND AGENCIES / NOMS ET ÉTABLISSEMENTS:
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TITLE / TITRE: STRIPE RUST OF WHEAT IN SASKATCHEWAN IN 2015 AND 2016

ABSTRACT: A stripe rust survey of wheat was conducted in 2015 and 2016 with stripe rust detected in 21% and 35% of crops, respectively. In 2015, stripe rust disease pressure was very low due to dry conditions. In 2016, favourable weather resulted in widespread occurrence of stripe rust, although major yield losses did not occur. Severe stripe rust on susceptible winter wheat cultivars was observed at Swift Current and Outlook in experimental plots in 2016.

INTRODUCTION AND METHODS: Stripe rust, caused by *Puccinia striiformis* f. sp. *tritici* Erikss., has become one of the most important diseases of wheat in western Canada since 2000 and regional epidemics of the disease in 2005, 2006, 2011 were reported (Brar et al. 2016). Stripe rust severity in western Canada is largely dependent on the inoculum level and disease pressure in the United States; in Saskatchewan, inoculum comes from the Pacific Northwest, as well as the Puccinia Pathway through the Great Plains in the USA (Brar and Kutcher 2016). Recent epidemics of the disease makes it imperative that we study pathogen virulence, for which disease surveys are of key importance. Disease surveys also help in framing future needs for wheat breeding programs.

Twenty-eight and 20 commercial crops of spring wheat, durum wheat, and winter wheat were surveyed in 2015 and 2016, respectively. The survey in 2015 was conducted in July and for 2016 in July and August. In 2016, in addition to commercial crops, stripe rust was also assessed in experimental plots and hills at Outlook and Swift Current. The crops surveyed were separated from each other by at least 20 km. Each crop was traversed in a "V" pattern (Puchalski et al. 2012) within which individual plants from five sites separated by about 40 m were evaluated for incidence and severity of stripe rust. Incidence was estimated as the proportion of infected plants exhibiting at least trace levels of stripe rust in a 5 m segment of row in the crop. The modified Cobb scale (Peterson et al. 1948) was used to assess stripe rust severity on the flag leaves of 50 plants per field (10 leaves per site). A six-category scale was used to assess stripe rust severity in each field: clean (no visible symptoms); trace (<3% leaf area affected); light (3-15%); moderate (>15-20%); and severe (>20%).

RESULTS AND COMMENTS: In 2015, stripe rust was observed in six of the 28 crops (21%) surveyed (Table 1). The four fields with trace levels of stripe rust were all spring wheat in west-central Saskatchewan (Table 1). Stripe rust severity was light in two winter wheat crops by late July. Due to very dry conditions in 2015, disease pressure was very low in the province. Stripe rust was mainly observed in western Saskatchewan, but not in eastern Saskatchewan.

In 2016, stripe rust was observed in seven of the 20 commercial crops (35%) surveyed (Table 2). Crop Districts 2B, 3B-N, and 7A were surveyed in August when crops were near maturity. None of the crops in these crop districts had stripe rust symptoms. Two crops had moderate and one field had severe levels of stripe rust (Table 2). Stripe rust was widespread in the province in 2016, but did not cause severe damage to many crops. Stripe rust severity was higher in south-western Saskatchewan compared with other parts of the province. Severe stripe rust infection was observed on susceptible winter wheat varieties including 'AC Radiant' in experimental plots at Agriculture and Agri-Food Canada, Swift Current and was severe by June 10, which was earlier than in previous years. The early occurrence of stripe rust in western Canada may indicate overwintering of *P. striiformis* f. sp. *tritici* (Brar and Kutcher 2016), however, severe infection could also be attributed to inoculum build-up under favourable conditions

created by precipitation in early May and June. Stripe rust usually appears in the northern USA and southern Alberta earlier than the rest of Alberta or Saskatchewan (Brar et al. 2015). Similar to Swift Current, severe stripe rust infection was observed on susceptible winter wheat varieties at Outlook in mid-July. Regular precipitation and favourable conditions in 2016 resulted in stripe rust inoculum build-up, although it did not to our knowledge, cause epidemics in commercial wheat crops.

ACKNOWLEDGEMENTS:
The assistance of Mallory Dyck, Everett Boots, Angel Liew, and summer students of the Cereal and Flax Pathology of the Crop Development Centre is appreciated.

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Table 1. Prevalence and severity categories for stripe rust on commercial wheat crops in 2015 in Saskatchewan by crop district.

Crop District	Prevalence*	Severity				
		Clean	Trace	Light	Moderate	Severe
2B	1/4	3	0	1	0	0
3A-N	0/4	4	0	0	0	0
3B-N	0/10	10	0	0	0	0
6A	3/4	1	2	1	0	0
6B	1/4	3	1	0	0	0
7A	1/2	1	1	0	0	0
Total	**6/28**	**22**	**4**	**2**	**0**	**0**

*Proportion of crops or trap plots affected.

Table 2. Prevalence and severity categories for stripe rust on commercial wheat crops in 2016 in Saskatchewan by crop district.

Crop District	Prevalence*	Severity				
		Clean	Trace	Light	Moderate	Severe
2B	0/3	3	0	0	0	0
3B-N	0/4	4	0	0	0	0
6B	4/5	1	1	1	2	0
7A	0/2	2	0	0	0	0
7B	2/4	2	0	1	0	1
8B	1/2	1	0	1	0	0
Total	**7/20**	**13**	**1**	**3**	**2**	**1**

*Proportion of crops or trap plots affected.

CROP / CULTURE: Wheat
LOCATION / RÉGION: Alberta

NAMES AND AGENCY / NOMS ET ÉTABLISSEMENT:
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TITLE / TITRE: WHEAT STREAK MOSAIC VIRUS IN ALBERTA IN 2015 AND 2016

ABSTRACT: In 2015 a few fields were confirmed to have *Wheat streak mosaic virus* (WSMV) in Alberta. In 2016, an awareness campaign was initiated inviting cereal producers, agronomists, agricultural fieldmen and crop scouts to submit any wheat samples with possible WSMV symptoms. Twenty samples were tested for WSMV and 14 were positive for a prevalence of 70%.

INTRODUCTION AND METHODS: WSMV is a Group IV (+ssRNA) in the Potyviridae. It is vectored semi-persistently by the wheat curl mite (*Aceria tosichella* Keifer). The virus can infect many hosts in the Poaceae family, but wheat (*Triticum* spp.) is the most susceptible crop. Over 6.5 million acres of wheat are grown in Alberta, however, WSMV is a relatively rare problem, with reports of only a few outbreaks between 2000 and 2015. A recent increase in wheat viruses in the Great Plains region of North America has been reported (Burrows et al. 2009). Warm, open fall weather, mild winters and green bridges caused by early-seeded winter wheat, volunteer cereals and grassy weeds may have helped bring about the increase in wheat viruses in the USA Great Plains region, and may also have contributed to the Alberta situation in 2015 and 2016.

Wheat samples were evaluated for the presence of WSMV using a commercially available Enzyme Linked Immunosorbent Assay (ELISA) purchased from Agdia, Inc. (Elkhart, IN). Samples were processed and evaluated according to the manufacturer's recommendations and using a BIO-TEK® Synergy HT multi-detection microplate reader (BIO-TEK® Instruments, Winooski, VT) with appropriate controls and standards.

RESULTS AND COMMENTS: Four and 20 samples were tested in 2015 and 2016, respectively. All four samples in 2015 were positive and were all collected from within a 150 km^2 area just east or southeast of Lethbridge, AB (Fig. 1). Seventy percent (14 of 20) of wheat fields in 2016 were positive for WSMV and their locations can be seen in Fig. 2. The 20 samples tested in 2016 came from an area of approximately 13,500 km^2 that included most of southern Alberta (Fig. 1). Early seeding of winter wheat, and warm, open fall conditions in 2016 may provide an opportunity for additional cases of WSMV in Alberta in 2017.

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ACKNOWLEDGEMENTS
We gratefully acknowledge the submissions of suspicious samples from producers, agronomists and agricultural fieldmen.

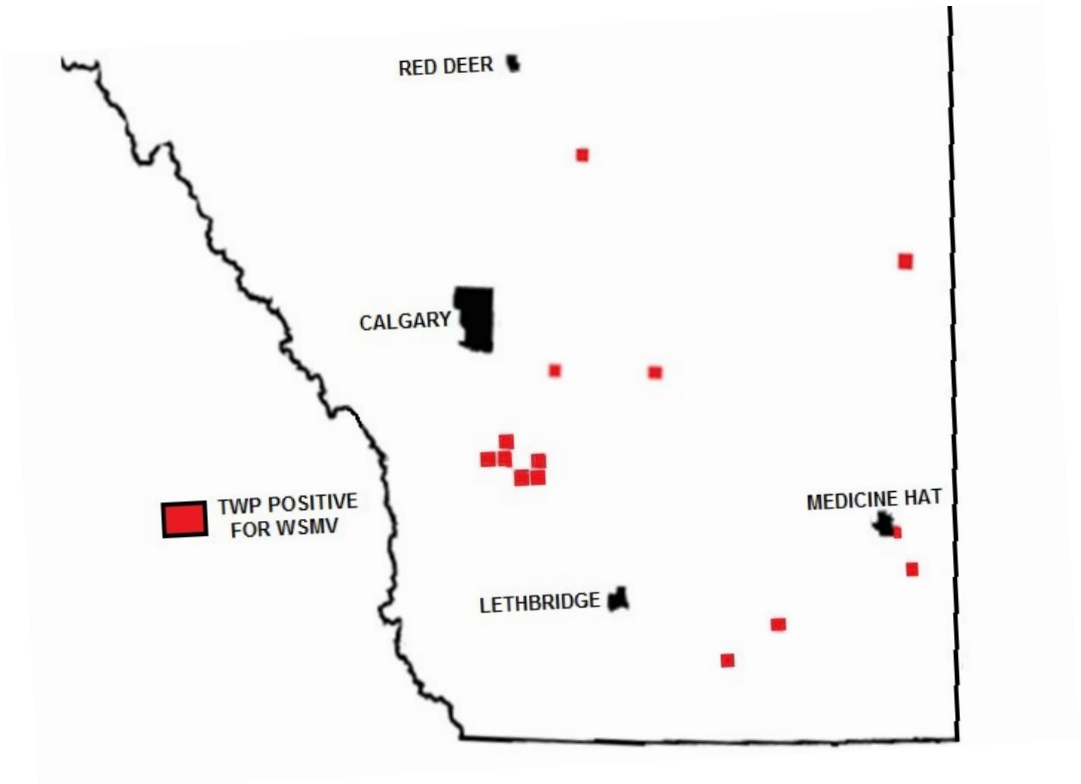

Figure 1. The locations of confirmed WSMV samples in Alberta in 2016.

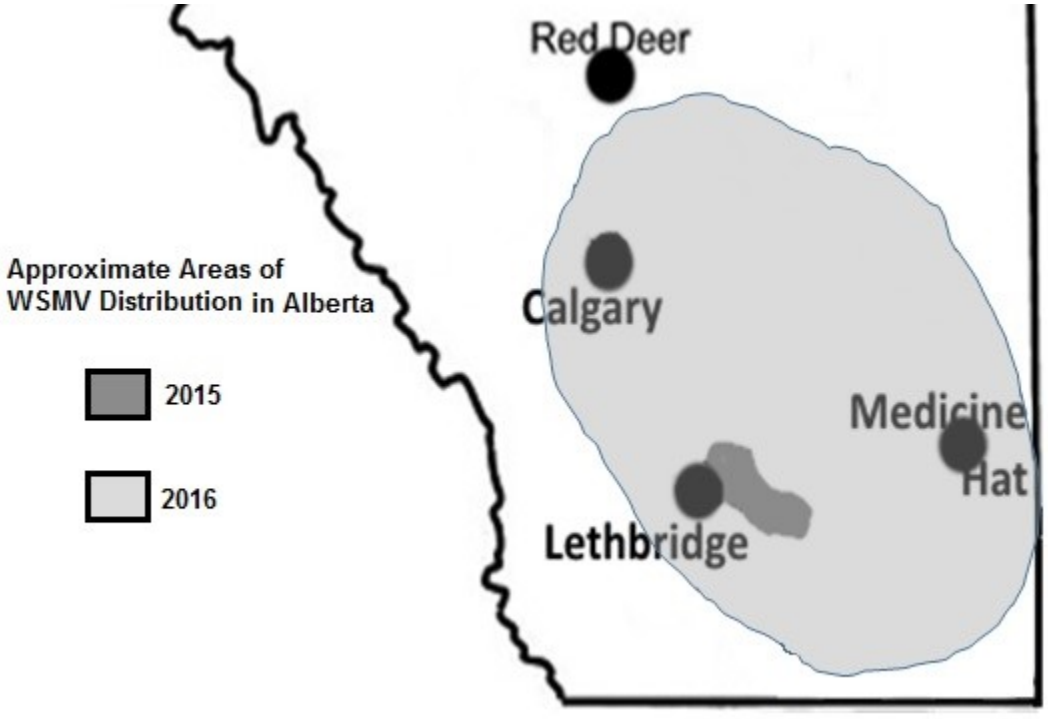

Figure 2. Approximate distribution of WSMV in Alberta in 2015 and 2016.

CROPS / CULTURES: Durum Wheat, Spring Wheat, Winter Wheat, Barley, Oat
LOCATION / RÉGION: Manitoba, Saskatchewan

NAMES AND AGENCIES / NOMS ET ÉTABLISSEMENTS:
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TITLE / TITRE: **CEREAL SMUT SURVEYS, 2016**

ABSTRACT: In Manitoba in 2016, 39 spring wheat fields, 10 barley fields, and five oat fields were surveyed for the smut diseases caused by *Ustilago* spp. One wheat field was infested with *U. tritici*-infected plants, at 1% severity, one 2-row barley field was infested with *U. nuda*-infected plants at a 25% severity, and no oat fields had infected plants. In Saskatchewan, seven fields of spring wheat, two fields of durum wheat and two fields of winter wheat were surveyed. Three spring wheat fields were infested with *U. tritici*-infected plants at trace severity levels. No carboxin-resistant strains of *Ustilago* were identified.

INTRODUCTION AND METHODS: Two surveys, one in Manitoba and one in Saskatchewan, were conducted during July to early August in 2016 to assess the incidence and severity of the smut diseases caused by *Ustilago hordei, U. nigra, 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 6B, 7B, and 8B. 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 (<0.01%) were estimated by counting plants in a one m^2 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 5 random locations in a field and counting the number of total heads, and of infected heads. Fields with <0.01 % were considered as trace infection levels in Manitoba, and <0.05% infections were considered as trace in Saskatchewan.

An isolate of smut was collected from each field with smutted plants. 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 and Thomas 1991) from France, using the teliospore germination assay of Leroux (1986) and Leroux and Berthier (1988) to determine if resistance to the fungicide carboxin may be present. Teliospores of each isolate were streaked onto half-strength potato dextrose agar amended with 0 or 1.0 µg ml^{-1} of carboxin. The cultures were incubated at 20°C in a controlled environment chamber and examined for teliospore germination after 24 h.

RESULTS AND COMMENTS:
Manitoba: Of the 39 fields of spring what assessed, 33 were of awned wheat and six of awnless wheat. One (3%) field of awned wheat in Manitoba crop district 9 was infested with smut (*U. tritici*) at a 1% severity. No field of awnless wheat was infested with smutted plants. Eight fields of 2-row barley and two fields of 6-row barley were assessed, with loose smut (*U. nuda*) being observed only in one 2-row barley field in Manitoba crop district 2 at a 25% severity level. No smut infection was observed in the five oat fields surveyed.

Saskatchewan: A total of 11 wheat fields were assessed in Saskatchewan: two fields of winter wheat, two fields of durum wheat and seven fields of spring wheat. No smutted plants were found in the fields of winter wheat or durum wheat. Three (43%) fields of spring wheat were infested with smutted plants at a trace severity levels. Two of these fields were found in Saskatchewan crop district 6B, and one field was in Saskatchewan crop district 7B.

None of the *Ustilago* spp. strains collected in Manitoba or Saskatchewan in 20164 was able to germinate and grow on agar medium amended with carboxin.

REFERENCES :

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CROP / CULTURE: Spring wheat
LOCATION / RÉGION: Central and eastern Ontario

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TITLE / TITRE: DISEASES OF SPRING WHEAT IN CENTRAL AND EASTERN ONTARIO IN 2016

ABSTRACT: Twenty-six spring wheat crops in central and eastern Ontario were surveyed for diseases in 2016. Of the 11 diseases observed, septoria/stagonospora leaf blotch, septoria glume blotch, and take-all were most prevalent. Fusarium head blight (FHB) was found in 22 fields, but only at slight levels. *Fusarium graminearum* and *F. sporotrichioides* were the predominant species causing FHB.

INTRODUCTION AND METHODS: A survey for spring wheat diseases was conducted in central and eastern Ontario in the third week of July when plants were at the soft dough stage of development. Twenty-six 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 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 trace, slight, moderate, and severe levels, respectively. Severity of ergot, loose smut, and take-all was based on the percent plants infected. FHB was rated for incidence (% infected spikes) and severity (% infected spikelets in the affected spikes) based on approximately 200 spikes at each of three random sites per field. A FHB index [(% incidence x % severity)/100] was determined for each field. The percentage of infected plants or FHB index values of <1, <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 30 infected spikes collected from each field. The spikes were air-dried at room temperature and subsequently threshed. Thirty discolored kernels per sample were chosen at random, surface sterilized in 1% NaOCI 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 provided by fluorescent and long wavelength ultraviolet tubes. *Fusarium* species isolated from kernels were identified by microscopic examination using standard taxonomic keys.

RESULTS AND COMMENTS: Eleven diseases or disease complexes were observed in the crops surveyed (Table 1). Septoria/stagonospora leaf blotch (normally associated with the pathogens *Septoria tritici* and *Stagonospora* spp.), stagonospora glume blotch (*Stagonospora nodorum*), and tan spot (*Pyrenophora tritici-repentis*) were the most common diseases identified, and were each found in 23 surveyed fields at average severities of 1.9, 1.9, and 1.3, respectively. Severe infection levels by stagonospora glume blotch and tan spot were not observed, but septoria/stagonospora leaf blotch was found in 1 field. Yield reductions due to these four diseases were estimated to have averaged <2% 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*), and spot blotch (*Cochliobolus sativus*). These diseases were found in 15, 10, 4, and 14 fields at average severities of 1.1, 1.0, 2.3, and 1.1, respectively. No severe levels of infection were observed and these diseases likely caused little or 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 0.4, 0.2, and 1.8%, respectively (Table 1). Severe infection from these diseases was not observed, but moderate disease levels by ergot and take-all were found in 1 and 6 fields, respectively. Yield reductions by ergot and take-all were estimated <3% in affected fields.

FHB was observed in 22 fields at a mean FHB index of 0.02% (range 0.01-0.09%) (Table 1). Overall, FHB did not result in a significant loss of grain yield and quality in 2016. Six *Fusarium* species were isolated from putative fusarium-damaged kernels (Table 2). *Fusarium sporotrichioides* and *F. graminearum* predominated and occurred in 54 and 35% of fields and on 6.0 and 3.1% of kernels, respectively. *Fusarium equiseti* and *F. poae* were less common and found in 31and 42% of fields and on 1.2 and 1.8% of kernels, respectively. *Fusarium acuminatum* and *F. avenaceum* were least common, occurring in 4-19% of fields and 0.2-0.6% of kernels.

The 11 diseases observed on spring wheat in Ontario in 2016 were the same as those recorded for 2015 except for stem rust that was not found in 2016 (Xue and Chen 2016). Overall, the incidence and severity of these diseases were generally lower in 2016 than in 2015. A slight FHB infection occurred in 22 surveyed fields and no significant reductions in grain yield and quality were observed. The less frequent rain events in June and July in 2016 compared with 2015 in central and eastern Ontario were likely responsible for the reduced disease severities observed this year.

REFERENCE:

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Table 1. Prevalence and severity of spring wheat diseases in central and eastern Ontario in 2016.

Disease	No. field affected (n=26)	Disease severity in affected fields*	
		Mean	Range
Bacterial blight	15	1.1	1.0-2.0
Leaf rust	10	1.0	1.0-1.0
Powdery mildew	4	2.3	1.0-4.0
Septoria glume blotch	23	1.9	1.0-5.0
Septoria/Stagonospora leaf blotch	23	1.9	1.0-7.0
Spot blotch	14	1.1	1.0-2.0
Tan spot	23	1.3	1.0-2.0
Ergot (%)	26	0.4	0.1-2.0
Loose smut (%)	26	0.2	0.1-1.0
Take-all (%)	26	1.8	0.5-5.0
Fusarium head blight**	22		
Incidence (%)		1.4	1.0-3.0
Severity (%)		1.5	1.0-5.0
Index (%)		0.02	0.01-0.09

*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.
**FHB Index = (% incidence x % severity)/100.

Table 2. Prevalence of *Fusarium* species isolated from fusarium-damaged wheat kernels in central and eastern Ontario in 2016.

***Fusarium* spp.**	**% affected fields**	**% affected kernels**
Total *Fusarium*	92.3	12.9
F. acuminatum	19.2	0.6
F. avenaceum	3.8	0.2
F. equiseti	30.8	1.2
F. graminearum	34.6	3.1
F. poae	42.3	1.8
F. sporotrichioides	53.8	6.0

CROP / CULTURE: Winter wheat
LOCATION / RÉGION: Ontario

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TITLE / TITRE: 2016 SURVEY FOR STRIPE RUST OF WINTER WHEAT IN ONTARIO

ABSTRACT: Stripe rust was the most important disease of winter wheat in Ontario in 2016 with severities reaching 8 (0 to 9 scale). Yield, TW and TKW were significantly affected by the disease.

INTRODUCTION AND METHODS: Stripe rust (*Puccinia striiformis* f. sp. *tritici* Erikss.) severity and the effect of the disease on yield, test weight (TW) and thousand kernel weight (TKW) was assessed on 12 current Ontario winter wheat cultivars. Plots were planted in mid-October in 2015 at Ridgetown (four replicates) and at Centralia (two replicates), Ontario, in a randomized complete block design following standard agronomic practices for Ontario. The plots were planted in six rows, at a row spacing of 17.8 cm, and 4 m in length. Stripe rust was evaluated in June 2016 using a 0 to 9 scale, where 0 = no disease and 9 = more than 90% of leaf tissue affected by symptoms. No artificial inoculation was used. Yield was assessed for Ridgetown and Centralia trials. Thousand kernel weight (TKW) and test weight (TW) were calculated for Ridgetown plots. Pearson's correlation coefficients between stripe rust and yield, TKW and TW were calculated using the PROC CORR statement (SAS Institute Inc. 2013).

RESULTS AND COMMENTS: Stripe rust was the most important disease of winter wheat in Ontario in 2016. Some cultivars had good resistance to the disease (Table 1). 'Gallus' and 'Priesley' had the lowest stripe rust levels of 1 (Centralia) and 2 (Ridgetown) using a 0 to 9 scale. The highest disease score was recorded in the soft white winter wheat 'Venture' with 8.0 and 7.5 severity at Centralia and Ridgetown, respectively. 'Venture' showed the lowest yield (1.4 t/ha at Centralia and 3.9 t/ha in Ridgetown), TW (70.6 kg/hl) and TKW (21.1 g) in the trial. Yield varied from 1.4 to 5.7 t/ha at Centralia, and from 3.9 to 8.5 t/ha at Ridgetown. Yield, TW and TKW were significantly affected by the stripe rust disease at Ridgetown with negative correlation of -0.79 (P= 0.0022); -0.65 (P= 0.0217) and -0.83 (P= 0.0008), respectively. At Centralia, the correlation between yield and stripe rust was -0.88 (P=0.0001). Results indicate that stripe rust might be an important disease in winter wheat in Ontario in the future. To avoid yield losses, it is important to conduct stripe rust studies to better understand and manage the disease.

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Table 1. Stripe rust, yield, test weight (TW) and thousand kernel weight (TKW) in winter wheat in Ontario in 2016.

	Stripe rust (0 to 9 scale)		Yield (t/ha)		TW (kg/hl)	TKW (g)
Genotype	**Centralia**	**Ridgetown**	**Centralia**	**Ridgetown**	**Ridgetown**	**Ridgetown**
Gallus	1.0	2.0	5.7	7.8	81.8	41.8
Priesley	1.0	2.0	4.7	8.1	76.6	37.1
Branson	1.5	2.0	5.3	8.0	78.1	31.5
Marker	1.5	4.5	5.2	7.5	77.3	31.3
UGRC DH5-28	3.5	4.5	4.4	7.9	76.8	31.8
UGRC Ring	4,0	4.0	5.7	8.5	76.7	35.2
UGRC C2-5	6.0	4.5	3.6	7.5	75.3	35.3
AC Morley	6.5	4.9	3.4	6.2	80.3	34.9
UGRC GL-164	6.5	6.0	3.6	6.8	78.2	22.7
Emmit	7.5	5.0	3.0	6.3	77.7	31.9
OAC Flight	8,0	7.0	1.9	5.6	75.4	26.8
Venture	8.0	7.5	1.4	3.9	70.6	21.1

CROP / CULTURE: Corn
LOCATION / RÉGION: Manitoba

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TITLE / TITRE: DISTRIBUTION OF GOSS'S WILT DISEASE IN CORN CROPS IN MANITOBA IN 2016

ABSTRACT: Corn production has increased in recent years and is no longer limited to traditional corn growing areas in Manitoba. Grain and silage corn can be found in all crop reporting districts in Manitoba. According to Manitoba Agricultural Services Corporation (MASC), approximately 422,000 acres in Manitoba were seeded to grain and silage corn in 2016. This is a significant increase in corn acres in Manitoba compared to 281,000 seeded acres of grain and silage corn in 2015 (MASC). As corn acres are increasing, the spread of Goss's wilt disease is also on the rise across the province, especially in the areas where shorter crop rotation is practiced. Therefore, a survey to determine Goss's wilt disease distribution was conducted across all crop reporting districts in Manitoba. The survey results indicated that 42 percent of the surveyed fields were affected by Goss's wilt disease. The highest percentage of positive identifications for Goss's wilt disease was made in Interlake, Eastern and Central regions of Manitoba, respectively.

METHODS: Thirty-seven rural municipalities (RM) in five crop reporting districts in Manitoba were surveyed in 2016. A total of 142 corn fields were surveyed throughout August and September 2016. The number of fields surveyed in each RM was determined on the basis of corn acres in each RM. Visual inspections of the fields were done to assess the presence of Goss's wilt in the surveyed fields.

RESULTS: Goss's wilt disease was detected in 42 percent of the surveyed fields and in 24 out of 37 surveyed RMs (Tables 1 and 2). A total of 59 putatively positive identifications for Goss's Wilt were made by visual inspections during the 2016 survey (Table 2). These detections were later confirmed by PCR and pathogenicity test. Most of the corn fields surveyed are in Central (97), Eastern (24) and Interlake (8) regions of Manitoba, respectively (Table 2). Among these regions, the Interlake region had the highest percentage of positive identifications (77%). Also, all five surveyed RMs in Interlake region were found to be positive for Goss's wilt disease. The preliminary results of the survey indicate that the incidence of Goss's wilt may be dependent on the type of corn hybrid planted and the field history.

In addition to 59 positively identified fields during the 2016 Goss's wilt disease survey, one field in the RM of Portage la Prairie, two in the RM of Oakland and one in the RM of North Cypress-Langford were also found to be positive for Goss's wilt disease.

Table 1. Number of positively identified RMs in different crop reporting districts (CRD).

CRD	No. of RM's surveyed	No. of positive RMs
Northwest	1	0
Southwest	4	2
Central	19	12
Interlake	5	5
Eastern	8	5
Total	37	24

Table 2. Number of Goss's wilt positive fields in different crop reporting districts (CRD).

CRD	No. of fields surveyed	No. of positive fields	% of positive identifications
Northwest	4	0	0
Southwest	8	2	25
Central	97	34	35
Interlake	9	7	77
Eastern	24	16	66
Total	142	59	42

CROP / CULTURE: Corn
LOCATION/ REGION: Ontario

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TITLE / TITRE: STATUS OF CORN DISEASES IN ONTARIO, 2016 CROP SEASON

ABSTRACT: Northern corn leaf blight (NCLB), common rust and eyespot were the most common leaf diseases found in Ontario corn fields in 2016, but overall the severity and incidence of these diseases was lower compared to earlier years. NCLB and common rust were found in ≥92% of fields visited in Southern and Western Ontario with only 16% and 9% of the affected fields having incidence levels of ≥25%, and only three fields of 122 visited having severities of ≥5 (>20% leaf area affected). NCLB incidence was less in fields sampled in Eastern Ontario (4%) compared to Southern Ontario (18%). Common rust incidence was also greater in Southern Ontario (10%) compared to Eastern (3%) and Western Ontario (7%). Eyespot was found in 75% of the fields sampled at a mean severity of 2.1 and an incidence of 4.4% of the fields visited. Grey leaf spot (GLS) was localized primarily in Southern Ontario where it was observed in 72% of the fields sampled. Ear and stalk rot diseases were insignificant at the time of survey. Neither Stewart's bacterial wilt nor Goss's bacterial wilt and blight were detected in Ontario in 2016.

INTRODUCTION AND METHODS: Favourable spring conditions in most of Ontario resulted in many corn fields being planted in first quarter of May. The warm and dry weather during the 2016 growing season in conjunction with early planting led to rapid crop development which resulted in a decrease in the incidence and severity of many foliar diseases compared to 2014 and 2015 (Jindal et al. 2015, 2016). A total of 165 corn fields were surveyed across Ontario from September 06-16, 2016 to document the occurrence of various corn diseases, including: anthracnose leaf blight and die back (ALB) (*Colletotrichum graminicola* (Ces.) G.W. Wils), eyespot (*Aureobasidium zeae* (Narita & Hiratsuka) Dingley), grey leaf spot (GLS) (*Cercospora zeae-maydis* Tehon & E.Y. Daniels), northern corn leaf blight (NCLB) (*Exserohilum turcicum* (Pass.) K.J. Leonard and E.G. Suggs), northern corn leaf spot (*Bipolaris zeicola* (G.L. Stout) Shoemaker), southern corn leaf blight (*Bipolaris maydis* (Y. Nisik. & C. Miyake) 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 2016 corn disease survey provides vital information on endemic pathogen populations and allows for scouting of new invasive pathogens such as Goss's bacterial wilt and blight (*Clavibacter michiganensis* subsp. *nebraskensis* (Vidaver & Mandel) Davis et al.) which has been detected in other areas of Canada (Manitoba and Alberta) and bordering US Great Lakes states, including Michigan (Harding et al. 2016).

In addition to disease occurrence, the incidence (number of affected plants) and severity of the major leaf diseases (eyespot, GLS, NCLB and common rust) were also recorded in all 165 surveyed fields (Fig. 1). Severity of common rust, eyespot, GLS and NCLB was rated on the 1-7 scale of Reid and Zhu (2005). Leaves displaying NCLB symptoms were collected for *E. turcicum* race identification and distribution patterns. Additional symptomatic plants parts were collected for subsequent laboratory analysis, especially for unidentifiable or suspect Goss's bacterial wilt and Stewart's bacterial wilt samples. GPS coordinates of the fields visited were also recorded and used to plot the map.

RESULTS AND DISCUSSION:

Northern corn leaf blight continues to be the most common foliar corn disease in the province. In 2016 the disease was detected in 136 (82.4%) of fields sampled (Table 1). Seventeen of the 136 fields with NCLB had incidences ≥30% and 15 had severity ratings ≥4. The most severely affected fields were found in six counties of 19 surveyed across the province (Chatham-Kent (12/37), Leeds and Grenville (1/7), Oxford (1/12), Elgin (1/9), Ottawa (1/2), Middlesex (2/13)), illustrating that this year NCLB was not widespread in Ontario, although it is still the most widely spread and economically important foliar disease of corn. The disease was found in almost all the fields sampled in Southern and Western Ontario (96%), and nearly half the fields in Eastern Ontario (51%). Mean disease incidence in affected fields was also considerably lower in Eastern Ontario (4%) and Central Ontario (1.5%) compared to Southern (18%) and Western Ontario (4%); only four fields in Eastern Ontario had disease incidences of ≥18%. Mean disease severity in affected fields was near identical in Central (1.8), Eastern (1.8), Southern (2.7) and Western Ontario (1.9) (Table 2). Furthermore, all seed corn fields surveyed in Chatham-Kent and Essex counties had a higher mean disease severity (3.4; range 1.5-5.0) and a higher mean disease incidence (44.0%; range 3-90%) than those recorded for commercial corn fields. The high incidence of NCLB in Ontario is concerning since yield losses are associated with the disease, which erodes producer profits. Thus, there is a need to look for additional disease management strategies other than use of foliar fungicides, which increases production costs and can be an environmental risk. In future, sustainable and economic corn production will require the 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) 2016 performance trials, of which 3 locations (Elora, Ottawa, and Ridgetown) had very high disease severity ratings (≥4) and 7 locations (Belmont, Blyth, Exeter, Lindsey, Orangeville, Tilbury and Wingham) had low disease severity ratings (≥2) (Table 3).

The 165 sites surveyed will be used to map the geographical distribution of physiological races of *E. turcicum* as it is not uncommon to find both resistant and susceptible NCLB lesion types on the same leaf. Likewise one can observe that the reactions of some hybrids to NCLB differ depending on where they are 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. 2016). To verify this, and to subsequently map the distribution of such races in corn growing regions of Ontario, 125 leaf samples with NCLB symptoms were collected during the survey.

Eyespot was less prevalent in 2016 compared to earlier years particularly to 2015. The disease was found in 123 (75%) of the sites sampled (Table 1) at a mean severity of 2.1 and an incidence of 4.4% of the fields visited (Table 2). Only six of 123 affected fields had severity levels of 4 and an incidence of 5-35% of plants affected. As with NCLB, eyespot was less common in Eastern Ontario (67% of fields affected) compared to Southern and Western Ontario (78%). However, 4 individual fields in Eastern Ontario had high eyespot severity ratings of 4.0, compared to the mean eyespot severity of 2.1 in affected fields in Ontario. The less widespread distribution of eyespot in Ontario in 2016 was demonstrated by the elevated severity ratings of ≥4 only in 6 corn fields. Many of the hybrids included in the OCC trials planted at Belmont, Ilderton and Winchester, as well as many entries in seed company demonstration plots, exhibited variable levels of resistance to eyespot. These hybrids need to be identified for cultivation in the province.

Common rust was also one of the more common foliar diseases detected in Ontario corn in 2016. Common rust was found in 139 (84%) fields (Table 1) at a mean disease severity of 2.3 and an incidence of 7.5% (Table 2). In contrast to NCLB and eyespot, common rust severity and incidence was similar across the province. High levels of common rust (≥4) were recorded in 12 fields in 5 counties [Wellington (1), Chatham-Kent (8), Dufferin (1), Durham (1), Waterloo (1) and Wellington (1)]. At all OCC sites, some of the commercial and developmental hybrids exhibited moderate to high resistance to common rust, assuming that infection was uniform throughout the field. In seed corn, three of 17 fields visited had female inbreds that were moderately susceptible (severity rating of 4.0) to common rust.

Southern rust, which has been common in southern and mid-central U.S. regions, was not found in any of the fields sampled.

Grey leaf spot was found in 58 (35%) of the fields sampled (Table 1). Compared to 2014 and 2015, GLS was more widely spread in Ontario in 2016. The disease was most prevalent (95% of fields) in five counties, Chatham-Kent, Elgin, Essex, Middlesex and Oxford in Southern Ontario like 2015 (Jindal et al 2016). In Eastern Ontario, where 51 fields were sampled, GLS was detected only in one field. GLS severity and incidence was more (≤3.5 and ≤25.0, respectively) in 9 of 15 seed corn fields sampled compared to commercial hybrids grown in the area. At the OCC trial in Dresden and Belmont, some hybrids were highly susceptible to GLS, as was the case for various hybrids in demonstration plots in Chatham-Kent and Essex. Usually, GLS has been of major concern in the extreme southwest counties of Essex and Chatham-Kent where factors such as increased corn residues, intensive corn and seed corn production, and warm 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).

Anthracnose leaf blight and dieback was detected in 56 fields (34%), more than in earlier years. Twenty-three of these fields were in Eastern Ontario and 20 in Western Ontario. Overall the severity and incidence were low with the exception of four fields in Southern Ontario (≤3.0 and ≤10.0), respectively. ALB was also observed in 4 of the 15 seed corn fields and 9 of the 17 OCC trial sites.

Other leaf spots: Northern leaf spot was found in 65 fields (40%) in Southern and Western Ontario. Its incidence was high in Chatham-Kent and Elgin counties. **Physoderma Brown spot** was found in many fields visited throughout the province, however, its severity and incidence were low in the majority of fields. **Phaeosphaeria leaf spot** caused by *Phaeosphaeria maydis* (Henn.) Rane, Payak, & Renfro was found in one field in Southern Ontario. Holcos leaf spot was not observed in any of the fields visited.

Fungal ear and stalk diseases: **Common smut** and **head smut** were found in 46 (28%) of sampled fields (Table 1). This was more than last year but the incidence of either was not high. Only two fields had an incidence of more than 3%. Head smut was found in 6 fields in 2016. **Ear rot** was found in 10 fields at a low incidence level. Ears with exposed kernels were found to have more *Fusarium* spp. infection. **Stalk rot** was not found in any field. The low incidence and occurrence of ear and stalk diseases at the time of the survey suggests these diseases were less important in 2016 compared to earlier years, however, this survey may have been conducted too early to detect high levels of ear and stalk rots. **Ear rots** (*Diplodia, Fusarium* and *Penicillium*) were seldom observed at harvest as was **Gibberella ear rot** and its accompanying vomitoxin (DON) in the majority of the province. In another survey conducted in the last week of September, 2016 by OMAFRA to assess the presence of corn ear mould and grain vomitoxin, mould symptoms were much more prevalent (26% of samples above 2 ppm DON) compared to recent years (Rosser and Tenuta, 2016).

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 in 2016. The decline in Stewart's bacterial wilt in Ontario, as well as the U.S., has been attributed to the effective control of its vector, the corn flee beetle through the use of neonicotinoid seed treatment (Chaky et al. 2013). Likewise, **Goss's bacterial wilt and blight** was not found in Ontario in 2016.

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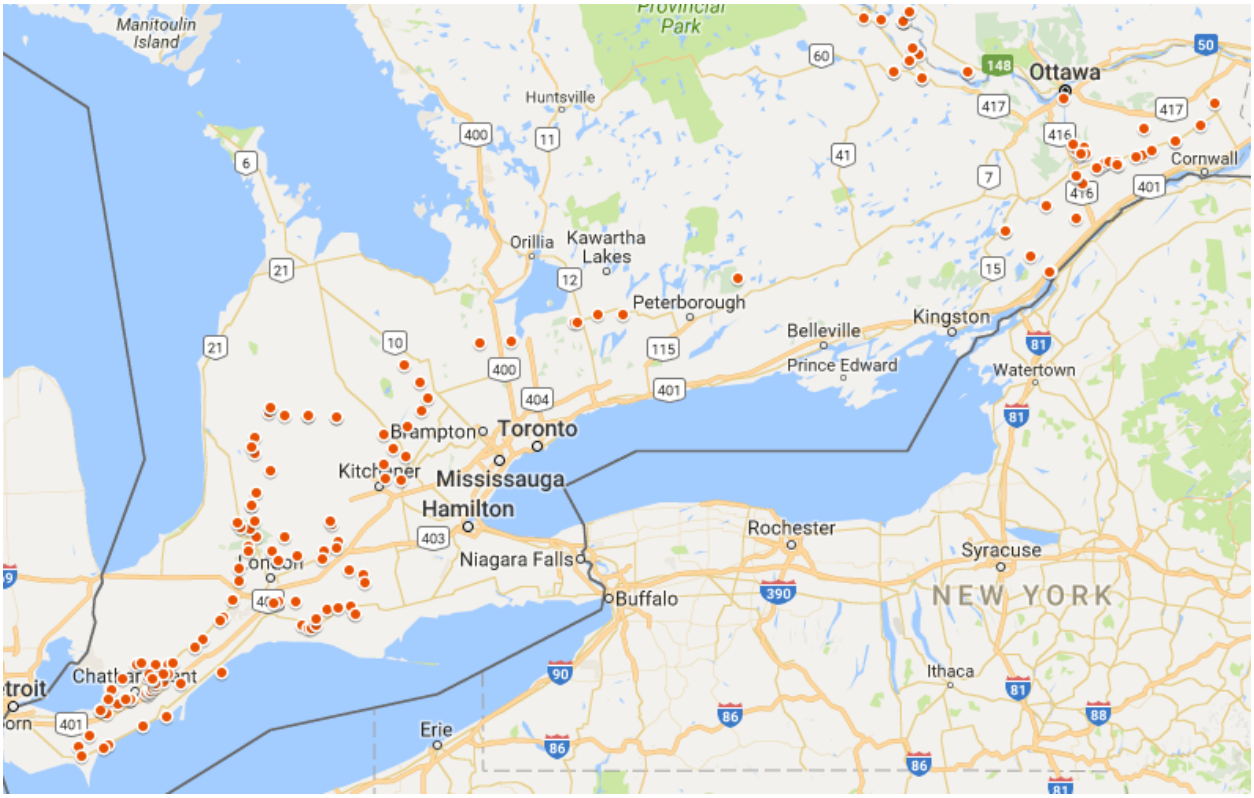

Figure 1. 2016 Ontario corn diseases survey sampling sites.

Table 1. Disease occurrence in Ontario corn crops in 2016 grouped by county and region.

County	No. crops	Disease / number of crops affected (n=165)							
		ALB	Eye-spot	GLS	NCLB	Rust	Smut	Ear rot	Stalk rot
Chatham-Kent	37	3	27	35	37	35	6	3	0
Dufferin	4	4	4	0	4	4	3	3	0
Durham	2	1	2	0	2	1	1	0	0
Elgin	9	6	8	7	9	9	1	1	0
Essex	3	0	2	2	3	3	0	1	0
Grey	5	1	0	0	2	1	1	0	0
Huron	9	4	5	0	8	8	1	0	0
Lanark	1	1	1	0	1	1	1	0	0
Leeds & Grenville	9	6	8	0	7	8	5	0	0
Middlesex	13	1	12	7	13	13	0	0	0
Norfolk	3	0	3	1	3	3	0	0	0
Ottawa	5	2	3	0	2	3	3	1	0
Oxford	12	2	10	4	12	12	2	0	0
Perth	8	6	8	1	8	7	3	0	0
Prescott & Russell	1	0	1	0	1	0	1	0	0
Renfrew	18	2	6	0	0	11	5	0	0
Stormont, Dundas & Glengarry	17	12	15	1	15	11	12	1	0
Waterloo	3	2	3	0	3	3	0	0	0
Wellington	6	3	5	0	6	6	1	0	0
Central Ontario	2	1	2	0	2	1	1	0	0
Eastern Ontario	51	23	34	1	26	34	27	2	0
Southern Ontario	77	12	62	56	77	75	9	5	0
Western Ontario	35	20	25	1	31	29	9	3	0
Ontario	165	56	123	58	136	139	46	10	0

ALB = Anthracnose leaf blight and die back, **GLS** = Grey leaf spot, **NCLB** = Northern corn leaf blight, **Rust** = Common 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 2016, grouped by county and region

County	Eyespot				GLS				NCLB				Common Rust			
	Severity[1]		Incidence (%)[2]		Severity[1]		Incidence (%)[2]		Severity[1]		Incidence (%)[2]		Severity[1]		Incidence (%)[2]	
	Mean	Range	Mean	Range	Mean	Range	Mean	Range	Mean	Range	Mean	Range	Mean	Range	Mean	Range
Chatham-Kent	1.9	1.0-3.5	3.4	0-20	2.9	1-5.5	22.4	0-100	3.0	1.5-5.0	26.0	2-90	2.9	1-5.5	15.6	0-100
Dufferin	1.9	1.5-2.0	1.3	1-2	-	-	-	-	2.0	1.5-2.5	1.0	1.0	2.8	1.5-4	14.8	1-50
Durham	2.5	2.0-3.0	3.0	1-5	-	-	-	-	1.8	1.5-2.0	1.5	1-2	2.5	1.0-4.0	40.0	0-80
Elgin	2.3	1.0-4.0	4.4	0-15	2.2	1.0-4.0	6.9	0-35	2.5	1.5-4.5	9.0	1-50	2.3	2.0-3.5	4.6	1-20
Essex	1.7	1.0-2.0	1.7	0-3	2.0	1.0-3.0	2.3	0-5	2.0	2.0	4.0	2-5	2.3	2.0-3.0	3.0	2-5
Grey	-	-	-	-	-	-	-	-	1.4	1.0-2.0	1.0	0-2	1.4	1.0-3.0	2.0	0-10
Huron	1.6	1.0-3.5	3.1	0-20	-	-	-	-	2.0	1.0-3.0	4.0	0-15	2.1	1.0-3.0	4.6	0-15
Lanark	2.0	2.0	3.0	3	-	-	-	-	2.0	2.0	2.0	2.0	2.5	2.5	4.0	4
Leeds & Grenville	2.4	1.0-4.0	6.0	0-30	-	-	-	-	2.1	1.0-4.5	6.0	0-50	2.5	1.0-3.0	4.8	0-9
Middlesex	2.8	1.0-4.0	11.4	0-30	1.6	1.0-2.5	1.9	0-5	2.8	2.0-5.5	19.0	1-100	2.5	2.0-3.0	7.8	2-34
Norfolk	2.0	2.0	2.0	2	1.5	1.0-2.5	1.7	0-5	2.0	2.0	2.0	1-3	2.0	2.0	2.0	2
Ottawa	2.0	1.0-3.0	3.0	0-8	-	-	-	-	1.9	1.0-4.0	9.0	0-45	1.7	1.0-3.0	3.6	0-15
Oxford	2.1	1.5-3.0	4.6	0-20	1.3	1.0-2.0	1.1	0-5	2.3	1.5-3.5	9.0	3-70	2.2	1.5-3.0	3.6	1-11
Perth	2.1	1.5-3.5	3.3	1-10	1.1	1.0-1.5	0.1	0-1	1.9	1.5-3.5	5.0	1-10	2.1	1.0-3.0	3.4	0-12
Prescott & Russell	2.5	2.5	2.0	2	-	-	-	-	2.5	2.5	2.0	2	-	-	-	-
Renfrew	1.5	1.0-3.0	1.1	0-5	-	-	-	-	-	-	-	-	1.9	1.0-3.5	2.6	0-10
Stormont, Dundas & Glengarry	2.8	1.0-4.0	9.7	0-35	1.1	1.0-2.5	0.2	0-3	2.4	1.0-3.5	6.0	0-25	1.9	1.0-3.5	2.3	0-8
Waterloo	2.3	2.0-3.0	3.0	2-5	-	-	-	-	2.2	1.5-3.0	8.0	2-20	2.7	2.0-4.0	8.0	1-20
Wellington	2.1	1.0-3.0	1.8	0-4	-	-	-	-	2.2	1.5-4.0	6.0	1-28	2.3	15-4.5	12.0	1-60
Central Ontario	2.5	2.0-3.0	3.0	1-5	-	-	-	-	1.8	1.5-2.0	1.5	1-2	2.5	1.0-4.0	40.0	0-80
Eastern Ontario	2.2	1.0-4.0	5.1	0-35	1.0	1.0-2.5	0.1	1-3	1.8	1.0-4.5	4.0	0-50	2.0	1.0-3.5	2.9	0-15
Southern Ontario	2.2	1.0-4.0	4.9	0-30	2.3	1.0-5.5	12.2	1-100	2.7	1.5-5.5	18.0	1-100	2.6	1.0-5.5	10.1	0-100
Western Ontario	1.8	1.0-3.5	2.3	0-20	1.0	1.0-1.5	0.0	0-1	1.9	1.0-4.0	4.2	0-28	2.2	1.0-4.5	6.7	0-60
All Ontario	**2.1**	**1.0-4.0**	**4.4**	**0-100**	**1.6**	**1.0-5.5**	**5.7**	**0-100**	**2.3**	**1.0-5.5**	**10.7**	**0-100**	**2.3**	**1.0-5.5**	**7.5**	**0-100**

[1]Disease severity in affected crop was rated as percentage of leaf area with symptoms; **eyespot**, GLS (**Grey leaf spot**) and **common rust** 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% (2-10% 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.

[2]Incidence is number of affected plants/total number of plants observed x 100; A 'hyphen' indicates disease not found in the fields sampled.

Table 3. Severity and incidence of major diseases observed at OCC[1] corn trial sites in Ontario, 2016.

OCC[1] trial site	ES		GLS		NCLB		Common Rust	
	Severity[2]	Incidence (%)[3]	Severity[2]	Incidence (%)[3]	Severity[2]	Incidence (%)[3]	Severity[2]	Incidence (%)[3]
Alma	2.5	2	1.0	0	2.5	3	3.5	7
Belmont	4.0	15	4.0	35	2.0	4	3.5	10
Blyth	1.5	1	1.0	0	2.0	3	3.0	15
Dresden	2.0	2	4.5	50	2.5	5	3.5	10
Dundalk	1.0	0	1.0	0	1.0	0	1.0	0
Elora	2.0	2	1.0	0	4.0	28	4.5	60
Exeter	2.0	3	1.0	0	2.0	4	2.0	3
Ilderton	4.0	30	2.0	3	2.5	5	2.5	4
Linsay	2.0	1	1.0	0	2.0	2	1.0	0
Orangeville	2.0	1	1.0	0	1.5	1	2.5	3
Ottawa	3.0	8	1.0	0	4.0	45	3.0	15
Ridgetown	3.0	8	2.0	3	4.0	20	3.0	6
Tilbury	2.0	5	2.0	2	1.5	15	2.0	5
Waterloo	2.0	2	1.0	0	3.0	20	4.0	20
Winchester	4.0	24	2.5	3	3.0	5	3.5	8
Wingham	1.5	1	1.0	0	2.0	1	2.0	2
Woodstock	2.5	10	1.0	0	2.5	4	2.5	11

[1]OCC - Ontario Corn Committee

[2]Disease severity in affected crop was rated as percentage of leaf area with symptoms; **eyespot**, GLS (**Grey leaf spot**) and **common rust** 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% (2-10% 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.

[3]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 / CULTURE: Caraway and Coriander
LOCATION /RÉGION: Saskatchewan

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TITLE / TITRE: BLOSSOM BLIGHT IN SASKATCHEWAN CARAWAY AND CORIANDER IN 2016

ABSTRACT: Field observations of blossom blight were coupled with conventional flower plating analysis. Blossom blight occurred at three of seven caraway locations sampled, and at seven of 13 coriander locations. Incidence of the pathogen in flowers ranged from 0-78% in brown caraway umbels and 0-16% in green (asymptomatic) caraway umbels. In coriander, incidence of the pathogen ranged from 3-70% in brown and 0-33% in green umbels.

INTRODUCTION AND METHODS: Blossom blight is an important production issue in caraway and coriander. Limited availability of information and disease management tools make production challenging. Several pathogens have been reported to play a role in blossom blights in these crops (Dennis 2002; Duczek and Slinkard, 2003), but information on their relative importance is lacking.

A survey was undertaken to observe the occurrence of blossom blight disease in Saskatchewan. Sampling of flowers prior to epidemic development and sampling of green as well as brown umbels, were strategies employed to reduce the confounding effects of secondary pathogens and saprophytes. Sampling was carried out from early to late flower in both crops.

Umbels from 12 caraway fields from seven Saskatchewan locations were collected during the 2016 growing season. In coriander, 28 fields and 1 urban garden were sampled from 13 Saskatchewan locations. Five umbels were collected from three sites in each field, and each umbel was scored as green or brown. Four floret clusters from each umbel were surface sterilized and plated on potato dextrose agar (PDA). Organisms arising from ovary tissues were recorded after two days and colonies arising from tissues were recorded after seven days. The incidence of the various organisms observed in plate testing was summarized and correlated with field observations. In this way, one (major) pathogen candidate for each crop was identified. The incidence of this pathogen in plate tests was then used as an indicator of disease incidence. In both caraway and coriander, their respective candidate pathogens resemble blossom blight pathogens previously reported in the province (Duczek and Slinkard, 2003; Thomson and Waterer, 2008).

RESULTS AND COMMENTS: Blossom blight was observed at three of the seven caraway locations sampled. The pathogen candidate could be observed in green as well as brown tissues from these sites, as well as at a low level (2%) in a field at Odessa where disease symptoms were not noted in the field (Table 1).

Blossom blight was observed in seven of 13 coriander growing locations in Saskatchewan, three of which (Lemberg, Duff, and Neudorf), were clustered east of the Qu'Appelle region. Of note was severe disease observed at Eston, Saskatchewan despite two fungicide applications. In the Saskatoon area, severe disease was observed in a home garden, but research plots both at AAFC and the University of Saskatchewan's Kernen Crop Research Farm remained healthy.

The pathogen candidate was detected in flowers from all diseased fields, with 3-20% incidence in brown umbels and 4-33% incidence in green umbels. Although the flowers collected at Grayson appeared

healthy, 33% were infected with the pathogen candidate and symptoms in the field were noted by the grower shortly after sampling. Where disease was not noted in the field, recovery of the pathogen candidate was low (0-8%). Although disease symptoms were noted at Watrous, recovery of the pathogen candidate was low (0-4%), but *Botrytis* recovery was high compared to other sites, with 40% observed in green umbels and 72% in brown umbels. Generally, however, the incidence of *Botrytis* on coriander umbels did not correlate well with field disease observations. Excluding Watrous samples, mean *Botrytis* incidence was 15% from sites with disease and 18% from sites without disease.

Despite frequent rainfall in much of the province in 2016, blossom blight of caraway and coriander was observed at less than half of the locations sampled. Many questions remain about disease transmission of blossom blight, the variation in pathogen prevalence among years and locations, the impact of agronomic practises on disease development and the efficacy of fungicides. Accurate identification of primary pathogens is also needed.

ACKNOWLEDGEMENTS:
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Table 1. Incidence of a blossom blight (%) pathogen candidate isolated from green and brown caraway umbels.

Sask. Location (number of fields)	in the field	brown umbels	green umbels
Assiniboia (2)	no	0	0
Carrot River (2)	no	0	0
Choiceland (1)	yes	78	16
Hudson Bay (1)	no	n/a	0
Lemberg (3)	yes	36	7
Duff (2)	yes	13	7
Odessa (1)	no	2	0

Table 2. Incidence of a blossom blight pathogen candidate (%) isolated from green and brown coriander umbels.

Sask. Location (number of fields)	Disease noted in the field	Incidence of coriander pathogen candidate (%)	
		brown umbels	**green umbels**
Assiniboia (1)	no	8	0
Eston (2)	yes	70	4
Francis (2)	no	n/a	0
Grayson (3)	yes	n/a	33
Lemberg (3)	yes	51	5
Duff (1)	yes	64	27
Leross (6)	yes	3	20
Neudorf (1)	yes	8	8
Odessa (1)	no	n/a	0
Saskatoon AAFC (1)	no	n/a	2
Saskatoon Kernen (1)	no	n/a	0
Saskatoon garden (1)	yes	45	n/a
Tyvan (1)	no	n/a	2
Watrous (3)	yes	4	0
Wolseley (2)	no	n/a	0

CROP / CULTURE Canola
LOCATION / RÉGION: Alberta

NAMES AND AGENCIES / NOMS ET ÉTABLISSEMENTS
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TITLE: OCCURRENCE AND SPREAD OF CLUBROOT ON CANOLA IN ALBERTA IN 2016

ABSTRACT: A survey of 570 commercial canola (*Brassica napus* L.) crops representing 40 counties and municipalities in Alberta revealed 68 new fields infested with clubroot (*Plasmodiophora brassicae* Woronin). Another 221 new cases of the disease were found during surveillance by municipal and county personnel, for a total of 289 new clubroot-infested fields in 2016. Clubroot infestations have been confirmed in a grand total of 2443 fields in Alberta since surveys for this disease commenced in 2003.

METHODS: A survey for clubroot (*Plasmodiophora brassicae* Woronin) was carried out in 570 commercial canola (*Brassica napus* L.) crops distributed across 40 counties and municipalities in Alberta. Fields included in the survey had either not been inspected previously for clubroot, or had been surveyed earlier and found to be free of the disease. Most fields were visited in September shortly after swathing. A 20 to 30 m^2 area was selected near the field entrance and at least 50 canola roots were sampled randomly within that area. If no symptoms of clubroot were found, then no more sampling was carried out. If clubroot was found, then the crop was surveyed more extensively by inspecting the roots of all plants within a 1 m^2 area at each of 10 locations along the arms of a 'W' sampling pattern. This approach was used because most clubroot infestations are initiated at field entrances (1). Clubroot symptom severity on each sampled canola plant was assessed on a scale of 0 to 3 according to Kuginuki et al. (2), where: 0 = no galling, 1 = a few small galls, 2 = moderate galling and 3 = severe galling. The individual ratings were used to calculate an index of disease (ID) for each crop, based on the method of Horiuchi and Hori (3) as modified by Strelkov et al. (4). Whenever possible, surveillance activities were coordinated with the agricultural fieldman in each municipality. Survey information from independent clubroot inspections conducted by county and municipal staff was collected and combined with the data from the Alberta-wide survey, in order to produce the most complete assessment possible of clubroot infestation in the province.

RESULTS AND COMMENTS: Symptoms of clubroot were found in 68 of 570 canola crops inspected. Disease severity ranged from mild to severe, with an average ID <10% in 45 crops, 10-60% in 20 crops, and >60% in three crops. The three cases of severe clubroot were found in susceptible hybrids. In addition to the new records of clubroot identified in the province-wide survey, another 221 new cases of the disease were found during surveillance by county and municipal personnel in the counties of Athabasca, Camrose, Lacombe, Lamont, Leduc, Minburn, Parkland, Smoky Lake, Stettler, Strathcona, Sturgeon, Westlock, Wetaskiwin and Woodlands (Table 1). Since Athabasca, Lacombe, Lamont, Minburn, Parkland, Stettler and Wetaskiwin were not visited as part of the province-wide survey coordinated by the University of Alberta and Alberta Agriculture and Forestry, the only data on clubroot occurrence in those counties came from the municipal personnel. Further monitoring of canola crops in the Peace River Region of Alberta by Ministry of Agriculture and Forestry staff revealed no instances of clubroot there (data not shown), and the region still appears to be free of the disease. In total, 289 new clubroot infestations were recorded in Alberta in 2016, for a grand total of 2443 fields with confirmed infestations since surveys began in 2003 (Fig. 1).

While most of the 289 new records of clubroot were found on susceptible canola hybrids or hybrids of unknown resistance, symptoms of the disease also were identified in 42 fields that had been planted to clubroot-resistant hybrids. Galled canola root tissue was collected from each of these fields in order to

recover the corresponding pathogen populations and evaluate their virulence under controlled environmental conditions. Novel virulence phenotypes of *P. brassicae*, capable of overcoming the resistance in most clubroot resistant hybrids, have been recently identified in Alberta (5). As such, it is important to monitor for further shifts in pathogen virulence that could decrease the effectiveness of genetic resistance as a clubroot management tool.

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Table 1. Distribution of *Plasmodiophora brassicae*-infested canola fields identified in Alberta in 2016.

County or municipality	Number of fields assessed in provincial survey	Number of new cases of *P. brassicae*- infested fields	Additional new cases identified by county/ municipal staff	Total new cases
Acadia	2	0	0	0
Athabasca	0	--	3	3
Beaver	24	2	0	2
Bonnyville	24	0	0	0
Brazeau	7	0	0	0
Camrose	20	5	34	39
Cardston	10	0	0	0
Clearwater	21	2	0	2
Edmonton (City)	3	1	0	1
Flagstaff	24	0	0	0
Foothills	10	0	0	0
Forty Mile	10	0	0	0
Lac Ste. Anne	21	2	0	2
Lacombe	0	--	5	5
Lamont	0	--	3	3
Leduc	12	6	94	100
Lesser Slave River	23	0	0	0
Minburn	0	--	1	1
Mountain View	16	1	0	1
Newell	20	0	--	0
Paintearth	22	0	0	0
Parkland	0	--	38	38
Pincher Creek	10	0	0	0
Ponoka	21	4	0	4
Smoky Lake	26	10	1	11
Special Area 2	10	0	0	0
Starland	20	0	0	0
Stettler	6	0	5	5
St. Paul	22	2	0	2
Strathcona	3	0	10	10
Sturgeon	35	13	12	25
Taber	10	0	0	0
Two Hills	18	4	0	4
Vulcan	14	0	0	0
Warner	10	0	0	0
Westlock	48	11	1	12
Wetaskiwin	0	--	12	12
Wheatland	20	0	0	0
Willow Creek	10	0	0	0
Woodlands	18	5	2	7
TOTAL	570	68	221	289

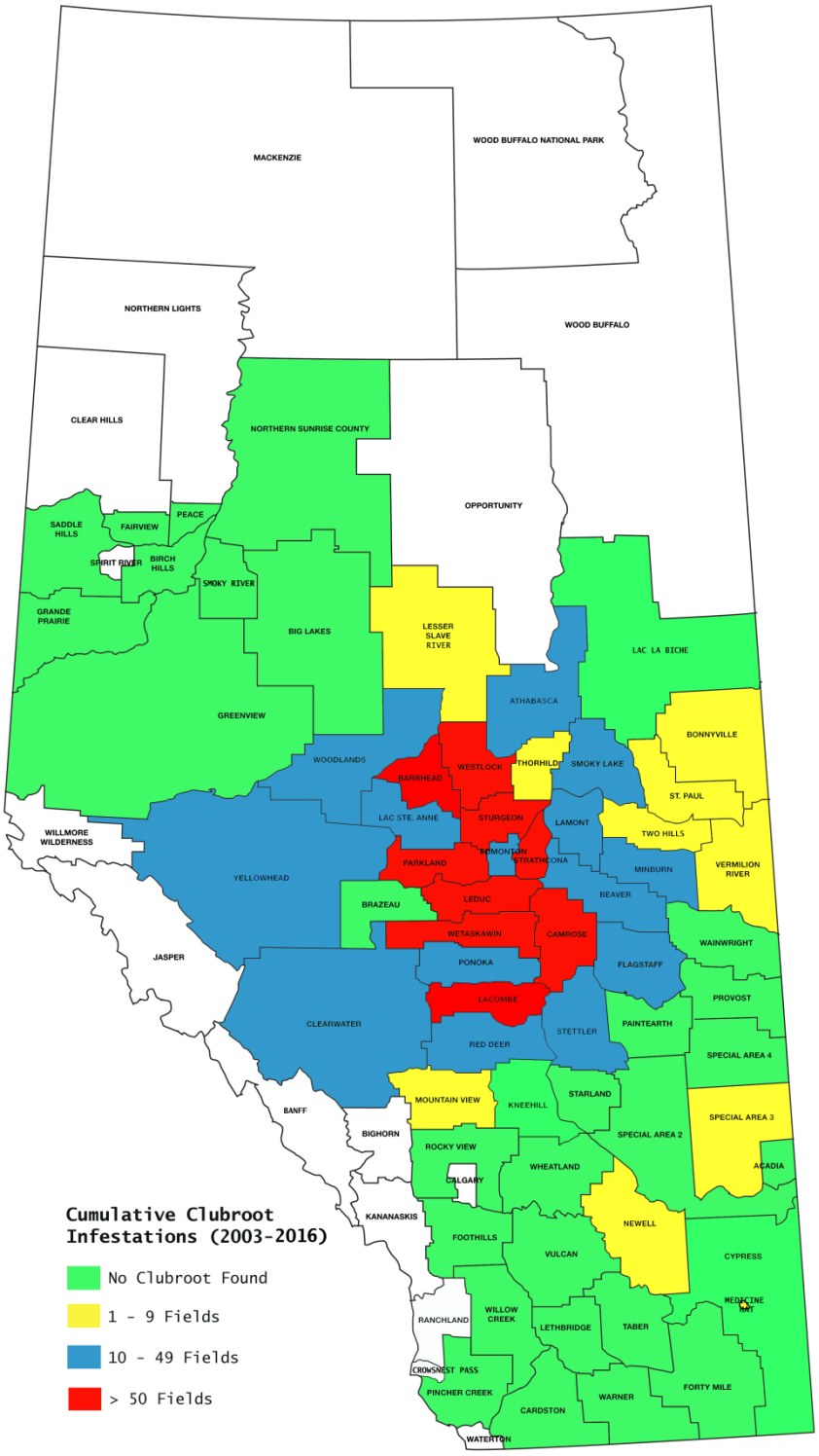

Figure 1. The occurrence of clubroot on canola in Alberta. Since surveys for clubroot were initiated in 2003, the disease has been confirmed in a total of 2443 fields representing 31 counties and municipal districts in the province, as well as in rural areas of the cities of Edmonton and Medicine Hat, and the Town of Stettler.

CROP / CULTURE: Canola
LOCATION / RÉGION: Alberta

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TITLE / TITRE: A SURVEY FOR BLACKLEG AND SCLEROTINIA STEM ROT ON CANOLA IN ALBERTA IN 2016

ABSTRACT: Blackleg on canola (*Brassica napus* L.), caused by *Leptosphaeria maculans* (Sowerby) P. Karst., is a disease commonly found across Alberta and can be responsible for serious yield losses if not managed. However, where cultivar resistance is utilized, the disease severity is often very low (Kutcher et al., 2013; Harding et al., 2016). Stem rot caused by *Sclerotinia sclerotiorum* (Lib.) de Bary is also a very common disease on canola in Alberta, but strong genetic resistance is not available as a management option (Garg et al., 2010; Uloth et al., 2013). A survey for blackleg and stem rot on canola was undertaken to characterize the prevalence, incidence and severity of the diseases in Alberta in 2016.

INTRODUCTION AND METHODS: *Leptosphaeria maculans*, the causal agent of blackleg, is a declared pest in Alberta's *Agricultural Pests Act and Regulation*. The recent surveys for blackleg on canola in Alberta in 2012 and 2015 indicated that, while the pathogen is commonly found across the province, cases of high severity are extremely rare. Since it is important to understand the distribution, prevalence and severity of this pathogen, a survey for blackleg in Alberta was undertaken in 2016. A survey target of 1% of canola fields in each county was established based on the most recent Agricultural Census for Alberta. The total survey target for Alberta was 378 canola fields. Surveyors were encouraged to visit canola fields the week prior to swathing. Post-swathing ratings were discouraged unless they were taken within a few days of cutting. Surveyors walked a W-shaped pattern, stopping at five locations in the field. Sampling locations were at least 20 m apart and at least 20 m from field margins. The lower stems (bottom 6 in) of twenty plants were collected at each sampling location (100 stems per field). All stems were sent directly to Alberta Agriculture and Forestry stations, either the Crop Diversification Centre North (Edmonton, AB) or South (Brooks, AB). 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 a percentage of fields with symptoms. Blackleg incidence was calculated as a percentage of stem samples showing blackleg symptoms. Blackleg severity was estimated using 0-5 scale for rating vascular discoloration (WCC/RCC, 2009; Table 1).

Stem rot infections on lower main stems, caused by *Sclerotinia sclerotiorum,* were also recorded from 311 of the fields sampled. Stems were considered to have stem rot infection caused by *S. sclerotiorum* when stems were soft and would shred when twisted, or when sclerotia were observed inside the stem. Prevalence was calculated as the percentage of fields with stem rot and incidence as the percentage of samples showing stem rot symptoms.

RESULTS AND COMMENTS: In total, 480 canola fields were surveyed for blackleg and 311 fields for stem rot in 2016. A total of 432 were found to have blackleg symptoms for a prevalence of 90%. Symptoms were seen on 10,178 out of 48,519 canola stems for an overall blackleg incidence of 21.2%. The overall average severity was 0.42. Survey results are presented in Table 2 and Figure 1.
Stem rot was observed in 252 of the 311 fields evaluated for a prevalence of 81.0%. The incidence of stem rot ranged from 0 to 100% with an overall incidence of 30.7% (Table 3).

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

Rating	Symptoms
0	No disease visible in the cross section
1	Diseased tissue occupies up to 25% of cross-section
2	Diseased tissue occupies 26 to 50% of cross-section
3	Diseased tissue occupies 51 to 75% of cross-section
4	Diseased tissue occupies more than 75% of cross-section with little or no constriction
5	Diseased tissue occupies 100% of cross-section with significant constriction; tissue dry and brittle; plant dead

Table 2. Blackleg prevalence, incidence and severity in canola fields in Alberta in 2016.

County or Municipality	# fields affected	Disease Prevalence (%)	Disease Incidence (%)		Disease Severity[2]	
			Mean[1]	Range	Mean[1]	Range
Acadia	2/2	100	5.8	5.5-6.2	0.055	0.05-0.06
Athabasca	3/3	100	8.7	3.0-13.0	0.090	0.03-0.14
Barrhead	2/3	33.3	2.1	0-3.5	0.23	0-0.40
Beaver	6/7	85.7	17.8	0-52.0	0.48	0-1.63
Big Lakes	10/10	100	12.9	2.0-27.6	0.16	0.06-0.45
Birch Hills	3/9	33.3	2.7	0 - 9.9	0.029	0 – 0.10
Bonnyville	3/3	100	4.0	1.8 - 5.8	0.043	0.02 – 0.06
Camrose	14/14	100	32.2	8.0 – 81.0	0.79	0.1 – 2.51
Cardston	6/8	75	4.2	0 – 10.4	0.068	0 – 0.24
Clear Hills	4/4	100	15.7	11.0 – 22.1	0.35	0.29 – 0.40
Cypress	3/3	100	20.1	18.1 – 22.0	0.29	0.21 – 0.40
Fairview	15/15	100	35.7	4.0 – 84.3	0.46	0.04 – 1.22
Flagstaff	5/7	71.4	37.2	0 – 87.8	1.26	0 – 3.23
Foothills	8/8	100	12.9	5.0 – 23.8	0.19	0.05 – 0.43
Forty Mile	6/6	100	26.5	8.0 – 58.2	0.33	0.08 – 0.88
Grande Prairie	9/9	100	27.8	10.4 – 48.1	0.37	0.11 – 0.75

Table 2 (cont'd.)

Greenview	4/4	100	13.9	1.1 – 20.8	0.17	0.01 – 0.27
Kneehill	7/7	100	17.8	4.0 – 34.3	0.37	0.08 – 0.76
Lac La Biche	1/1	100	1.0	n/a	0.02	n/a
Lac Ste Anne	3/3	100	12.9	7.9 – 20.0	0.2	0.08 – 0.12
Lacombe	6/7	85.7	25.7	0 – 51.8	0.53	0 – 1.17
Lamont	5/5	100	23.3	11.4 – 55.0	0.35	0.12 – 1.07
Leduc	8/8	100	16.8	2.1 – 25.8	0.22	0.02 – 0.35
Lethbridge	5/9	55.6	3.3	0 – 14.4	0.04	0 – 0.21
Mackenzie	20/20	100	37.9	6.7 – 89.0	1.2	0.07 – 3.81
Minburn	13/13	100	33.6	5.1 – 100	0.83	0.05 – 3.13
Mountain View	4/6	66.7	3.3	0 – 7.8	0.053	0 – 0.21
Newell	10/10	100	29.8	7.0 – 78.1	0.62	0.12 – 2.19
Northern Lights	9/9	100	39.7	5.2 – 82.2	0.61	0.05 – 1.51
Paintearth	5/6	83.3	6.3	0 – 12.6	0.065	0 – 0.13
Parkland	2/2	100	12.6	11.5 – 13.7	0.13	0.12 – 0.13
Peace	2/2	100	25.5	10.1 – 40.9	0.47	0.16 – 0.77
Pincher Creek	5/5	100	4.9	1.0 – 10.7	0.07	0.01 – 0.17
Ponoka	5/5	100	16.1	3.1 – 33.0	0.19	0.03 – 0.45
Provost	2/2	100	47.4	21.2 – 73.7	0.43	0.34 – 0.51
Red Deer	16/16	100	12.2	2.0 – 49.0	0.24	0.02 – 1.38
Rocky View	12/12	100	12.3	1.0 – 43.0	0.24	0.01 – 1.23
SA 2	2/2	100	2.5	2.0 – 3.0	0.065	0.04 – 0.09
Saddle Hills	4/7	57.1	0.9	0 – 2.3	0.01	0 – 0.03
Smoky Lake	17/20	85	30.0	0 – 68.9	0.42	0 – 1.31
Smoky River	15/15	100	32.5	6.9 – 70.0	0.48	0.07 – 1.23
Spirit River	0/10	0	0	n/a	0	n/a
St. Paul	2/2	100	5.1	4.2 – 6.0	0.05	0.04 – 0.06
Starland	7/7	100	5.1	2.1 – 11.1	0.05	0.02 – 0.11
Stettler	12/12	100	25.7	3.8 – 58.0	0.56	0.04 – 1.52
Sturgeon	18/18	100	38.9	6.0 – 90.1	1.18	0.07 – 3.67
Taber	14/14	100	35.4	1.0 – 88.0	0.56	0.01 – 3.14
Thorhild	0/2	0	0	n/a	0	n/a
Two Hills	11/11	100	40.8	11.0 – 60.0	1.04	0.16 – 1.98
Vermillion River	12/15	80	20.3	0 – 72.5	0.43	0 – 1.5
Vulcan	17/17	100	16.9	1.0 – 59.8	0.30	0.01 – 1.32
Wainwright	6/10	60	9.3	0 – 22.0	0.12	0 – 0.31
Warner	6/6	100	10.7	3.0 – 14.9	0.21	0.03 – 0.45
Westlock	10/12	83.3	22.1	0 – 49.0	0.53	0 – 1.38
Wetaskiwin	6/6	100	10.0	5.1 – 14.8	0.12	0.05 – 0.15
Wheatland	19/19	100	19.2	4.0 – 76.8	0.27	0.02 – 0.92
Willow Creek	10/11	90.9	15.3	0 – 55.0	0.25	0 – 1.14
Woodlands	1/1	100	4.9	n/a	0.05	n/a
Total or Avg.	**432/480**	**90.0**	**21.2**	**0 – 100**	**0.42**	**0 – 3.81**

[1]Means represent an average of all the crops surveyed.
[2]Disease severity was assessed using a 0-5 scale.

Table 3. Prevalence and incidence of lower main stem infections by *S. sclerotiorum* in canola fields in Alberta in 2016.

County or Municipality	Number of Fields affected	Disease Prevalence (%)	Disease Incidence (%)	
			Mean[1]	Range
Acadia	2/2	100	40.4	40.2 – 40.6
Athabasca	3/3	100	80.9	75.7 – 84.8
Barrhead	3/3	100	39.4	24.3 – 48.1
Beaver	4/4	100	27.2	7.7 – 43.4
Big Lakes	7/10	70	3.9	0 – 21.1
Birch Hills	4/9	44.4	14.2	0 – 50.4
Bonnyville	3/3	100	87.1	80.0 – 92.7
Camrose	4/4	100	59.9	41.4 – 93.5
Cardston	0/5	0	0	n/a
Clear Hills	4/4	100	12.2	9.3 – 15.4
Cypress	0/3	0	0	n/a
Fairview	7/10	70	15.5	0 – 46.6
Flagstaff	7/7	100	83.6	39.8 – 100
Foothills	5/5	100	64.8	48.0 – 81.2
Forty Mile	0/6	0	0	n/a
Grande Prairie	9/9	100	30.4	3.8 – 47.7
Greenview	4/4	100	53.9	4.4 – 94.4
Kneehill	6/6	100	13.9	4.0 – 26.9
Lac La Biche	1/1	100	83.3	n/a
Lac Ste Anne	2/2	100	44.9	8.9 – 80.9
Lacombe	7/7	100	19.1	4.8 – 77.1
Lamont	4/4	100	72.2	69.2 – 77.1
Leduc	8/8	100	23.5	4.0 – 82.6
Lethbridge	0/6	0	0	n/a
Mackenzie	6/9	66.7	8.6	0 – 28.0
Minburn	6/6	100	42.8	9.8 – 72.4
Mountain View	6/6	100	53.6	41.9 – 60.4
Newell	0/4	0	0	n/a
Northern Lights	9/9	100	11.0	5.0 – 17.7
Paintearth	6/6	100	34.5	12.6 – 66.3
Parkland	2/2	100	27.8	13.5 – 42.1
Peace	2/2	100	25.2	24.2 – 26.1
Pincher Creek	2/2	100	0.88	0.83 – 0.93
Ponoka	5/5	100	39.2	0.94 – 94.1
Provost	2/2	100	57.0	19.2 – 94.7
Red Deer	8/8	100	50.8	22.0 – 79.4
Rocky View	7/7	100	24.5	9.7 – 45.8
SA 2	2/2	100	8.9	3.0 – 14.9
Saddle Hills	0/7	0	0	n/a
Smoky Lake	2/2	100	88.5	87.0 – 89.9
Smoky River	13/15	86.7	33.9	0 – 83.3
Spirit River	n.d.	n.d.	n.d.	n.d.
St. Paul	2/2	100	97.9	95.8 – 100
Starland	7/7	100	49.4	30.3 – 60.4
Stettler	6/6	100	46.5	13.3 – 68.5
Sturgeon	8/8	100	43.6	17.0 – 86.9
Taber	5/10	50	1.8	0 – 3.9
Thorhild	2/2	100	53.4	52.0 – 54.8
Two Hills	4/4	100	58.7	49.5 – 63.6

Table 3 (cont'd.)

Vermillion River	15/15	100	36.1	2.4 – 100
Vulcan	n.d.	n.d.	n.d.	n.d.
Wainwright	10/10	100	50.1	13.0 – 85.4
Warner	3/5	60	1.2	0 – 3.9
Westlock	4/4	100	77.8	58.8 – 87.9
Wetaskiwin	5/5	100	49.7	20.8 – 96.1
Wheatland	4/8	50	2.7	0 – 7.0
Willow Creek	4/5	80	10.9	0 – 20.6
Woodlands	0/1	0	0	n/a
Total or Avg.	252/311	81.0%	30.7%	0 - 100

[1]Means represent an average of all the crops surveyed.
n.d. = not determined.

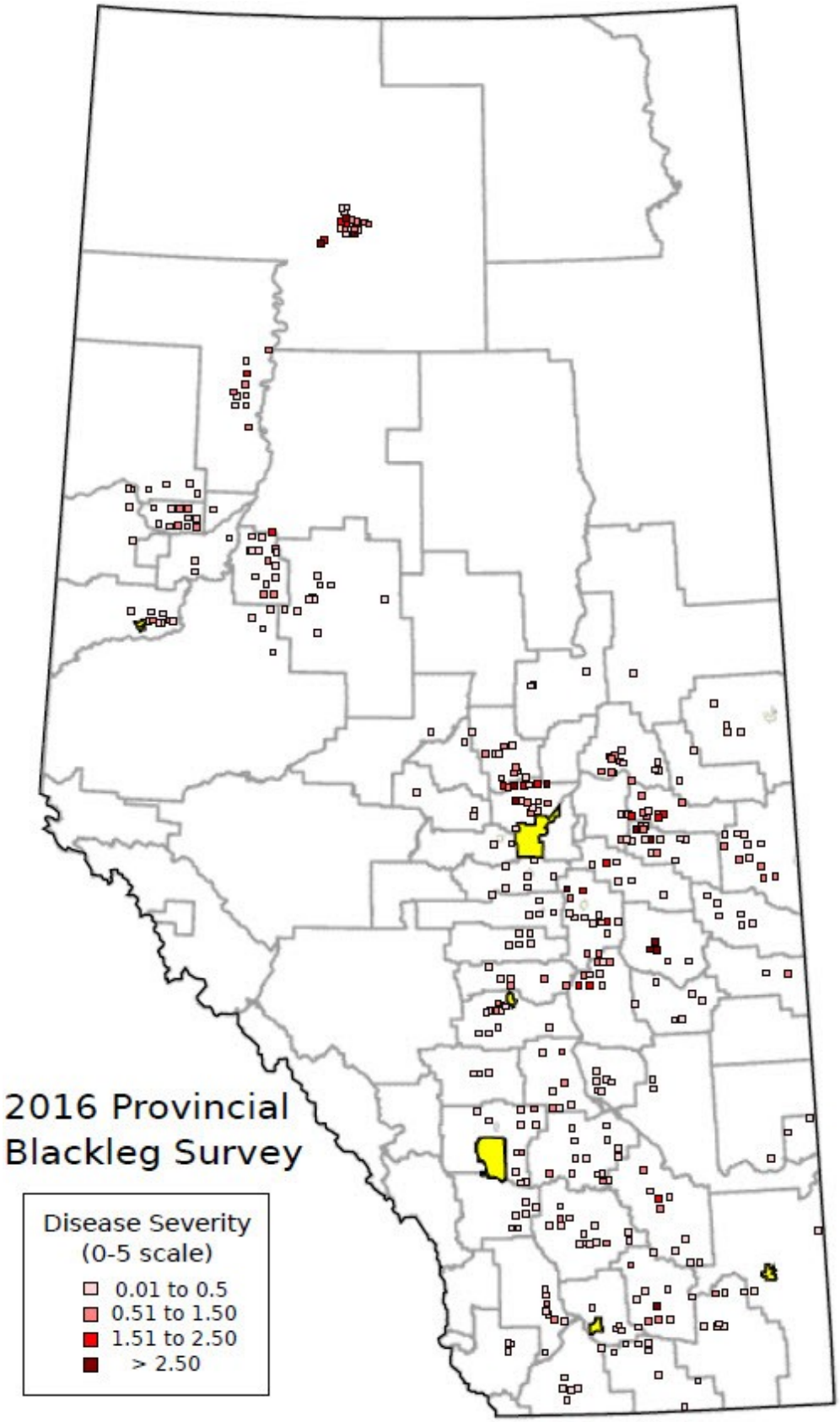

Figure 1. The location and severity of blackleg in 480 canola fields in Alberta in 2016.

CROP / CULTURE: Canola
LOCATION / RÉGION: Saskatchewan

NAMES AND AGENCIES / NOMS ET ÉTABLISSEMENTS

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TITLE: SURVEY OF CANOLA DISEASES IN SASKATCHEWAN 2016

ABSTRACT: The annual survey in Saskatchewan covered 224 crops across six large regions of the province. Sclerotinia stem rot was the most prevalent disease, occurring in 92% of the crops surveyed. The mean sclerotinia stem rot disease incidence among all crops surveyed in Saskatchewan was 24% but ranged from 42% to 18% among regions. Blackleg basal cankers were observed in 61% of crops surveyed, with a mean disease incidence of 7% (ranging from1% to 13% among regions).

METHOD: A total of 224 canola crops were surveyed between July 18 and Sept 28 in the major canola growing regions of Saskatchewan. The number of crops in each region was approximately proportionate to the canola production area within each region (although slightly below target in the northeast) and consisted of 44 (northwest), 23 (northeast), 24 (west-central), 64 (east-central) 36 (southwest) and 33 (southeast) crops. The survey was conducted where possible before swathing while plants were between growth stages 5.1 and 5.5 (Harper and Berkenkamp, 1975). Thirty-seven of the fields 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 (percentage 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),* fusarium wilt (*F. oxysporum* f.sp. *conglutinans*), and clubroot (*Plasmodiophora brassicae*). Incidence (percentage of plants surveyed with symptoms of the disease per field) was recorded for sclerotinia stem rot, blackleg (basal cankers and stem lesions) and aster yellows.

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 and 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 forthe province and for each of the six regions within the province.

Soil samples (~1L) were collected from 127 fields and are being analyzed for the presence of *P. brassicae* at the Saskatchewan Ministry of Agriculture's Crop Protection Laboratory using a quantitative (q)PCR-based diagnostic test (Rennie et al. 2011).

RESULTS AND COMMENTS: Approximately 4.4 million ha (10.9 million acres) of canola were seeded in Saskatchewan in 2016 (Statistics Canada 2016). Wet conditions were conducive for disease development throughout most of Saskatchewan in 2016. Late season rains and snow in early October created harvest delays in some parts of the province. Eighty percent of the canola crops were combined by October 24, 2016 compared to 97% by October 19, 2015 (Government of Saskatchewan 2015, 2016).

Sclerotinia stem rot was observed in 92% of the canola crops surveyed. The average incidence in the province was 24% (26% in infested crops) (Table 3). The incidence was highest in the West-central region (43%) and lowest in the East-central region (18%). The average severity of sclerotinia stem rot in canola crops in Saskatchewan was 0.7. The severity of sclerotinia stem rot was highest in the West-central region (1.4) and lowest in the Southeast and Southwest regions (<0.6) (Table 3).

Symptoms of blackleg basal infection (rated after cutting of lower stems) were present in 61 % of the Saskatchewan canola crops included in the survey (Table 4). The average incidence in the province was 7 % (12 % in infested crops). The average incidence was highest in the Northwest region (90%) and lowest in the Southwest region (44%). The average severity of blackleg basal cankers in the province was 0.1. The average severity was highest in the West-central region (0.2) and lowest in the Southwest region (0.01). Blackleg stem lesions were present in 25% of canola crops with an average incidence of 2% (data not shown). The highest average blackleg stem lesion incidence occurred in the Southeast and West-central regions (33%). The lowest incidence was in the Southwest region (11%). Stem samples that were symptomatic of internal blackleg infection and collected from 45 crops across the province were assessed via culturing for fungal isolation and identification. Only 17 of the samples (38%) produced *Leptosphaeria maculans*, the causal agent of blackleg disease. *Alternaria*- and *Fusarium*-like species were each cultured from 42% of the samples, with 31% of samples producing mixtures of fungal species.

Aster yellows had a prevalence of 24% with an average incidence of 1% (5% in infected fields). This is higher than in 2015 where the average incidence in Saskatchewan was 8% (3% in infected fields). The highest prevalence of aster yellows in 2016 was in the Northwest region (66%) with an average incidence of 6%. Province-wide, aster yellows was observed in 72% of surveyed canola fields (includes surveyed fields where infected plants were seen outside of the 100 plant sample) (Table 5).

Foot rot was recorded in 10% of canola crops in the province. The highest incidence was in the Northeast region (21%). Foot rot was not detected in the Southwest region of Saskatchewan (Table 5).

In 2016, alternaria pod spot was recorded as present in 88% of canola crops surveyed in the province. Alternaria pod spot prevalence was highest in the Northwest (100%) and lowest in the Southwest region (77%) (Table 5).

A total of 127 soil samples were collected for the Saskatchewan clubroot survey and submitted to the Saskatchewan Crop Protection Laboratory for analysis by qPCR testing. Clubroot or the causal agent (*P. brassicae*) was not detected or quantifiable in any of the samples.

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Table 1. Sclerotinia rating scale (Kutcher and Wolf 2006).

Disease Rating	Lesion Location	Symptoms
0	None	No symptoms
1	Pod	Infection of pods only
2	Upper plant parts	Lesion situated on main stem or branch(es) with potential to affect up to ¼ of seed formation and filling on plant
3		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
4		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
5	Lower plant part	Main stem lesion with potential effects on seed formation and filling of entire plant

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

Rating	Description
0	No disease visible in the cross section
1	Diseased tissue occupies up to 25% of cross-section
2	Diseased tissue occupies 26 to 50% of cross-section
3	Diseased tissue occupies 51 to 75% of cross-section
4	Diseased tissue occupies more than 75% of cross-section with little or no constriction of affected tissues
5	Diseased tissue occupies 100% of cross-section with significant constriction of affected tissues; tissue dry and brittle; plant dead

Table 3. Mean disease incidence and severity of sclerotinia stem rot of canola in Saskatchewan in 2016.

REGION (NO. OF FIELDS)	**Sclerotinia Stem Rot All Fields Surveyed**		**Sclerotinia Stem Rot Infected Fields Only**	
	Incidence	**Severity[1]**	**Incidence**	**Severity[2]**
Northwest (44)	30	0.75 (2.1)	32	0.77 (2.1)
Northeast (23)	20	0.72 (3.4)	22	0.79 (3.4)
West-central (24)	43	1.40 (3.3)	42	1.40 (3.3)
East-central (64)	18	0.60 (3.2)	20	0.66 (3.5)
Southwest (36)	20	0.55 (2.8)	22	0.58 (3.0)
Southeast (33)	19	0.46 (2.3)	23	0.58 (2.9)
Overall mean (224)	24	0.7 (2.8)	26	0.75 (3.0)

[1]Severity as divided by the number of plants surveyed per field.
[2]Severity as divided by the number of infected plants per field.

Table 4. Mean disease incidence and severity of blackleg basal cankers in Saskatchewan in 2016.

REGION[1] (NO. OF FIELDS)	Blackleg Basal Cankers All Fields Surveyed			Blackleg Basal Cankers Infected Fields Only	
	Prevalence	Incidence	Severity[1]	Incidence	Severity[2]
Northwest (44)	90	12	0.18 (1.2)	13	0.20 (1.4)
Northeast (23)	52	7	0.1 (0.64)	14	0.20 (1.2)
West-central (24)	71	13	0.20 (0.91)	19	0.28 (1.3)
East-central (64)	58	6	0.11 (1.0)	10	0.20 (1.7)
Southwest (36)	44	1	0.01 (0.54)	3	0.03 (1.2)
Southeast (33)	45	5	0.06 (0.58)	12	0.14 (1.3)
Overall mean (224)	61	7	0.11 (0.85)	12	0.18 (1.4)

[1]Severity as divided by the number of plants surveyed per field.
[2]Severity as divided by the number of infected plants per field.

Table 5. Prevalence of alternaria pod spot, aster yellows, and foot rot of canola fields surveyed in Saskatchewan in 2016.

REGION (NO. OF FIELDS)	Alternaria Pod Spot	Aster Yellows[1]	Aster Yellows Field Total[2]	Foot Rot
Northwest (44)	100	66	66	5
Northeast (23)	96	26	74	17
West-central (24)	83	9	61	21
East-central (64)	87	17	89	12
Southwest (36)	78	0	41	0
Southeast (33)	82	12	77	12
Overall mean (224)	88	24	74	10

[1]Prevalence of aster yellows when identified within 100 plant sample.
[2]Prevalence of aster yellows including fields where aster yellows was indicated outside of the 100 plant sample.

Table 6. 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 2011-2016.

YEAR (NO. OF FIELDS)	Sclerotinia Stem Rot All Fields Surveyed		Sclerotinia Stem Rot Infected Fields Only	
	Incidence	Severity[1]	Incidence	Severity[2]
2011 (265)	20	0.56 (2.5)	22	0.61 (2.7)
2012 (253)	19	0.52 (2.5)	21	0.57 (2.8)
2013 (269)	5	0.10 (1.3)	9	0.17 (2.2)
2014 (274)	14	0.40 (2.2)	18	0.51 (2.8)
2015 (253)	7	0.15 (1.6)	11	0.24 (2.4)
2016 (224)	23	0.70 (2.8)	26	0.75 (3.0)

[1]Severity as divided by the number of plants surveyed per field.
[2]Severity as divided by the number of infected plants per field.

Table 7. Mean blackleg canker severity reported as both, the average severity across infected plants and the average severity across all plants surveyed per field from 2011-2016 (Dokken-Bouchard et al. 2016).

REGION[1] (NO. OF FIELDS)	Blackleg Basal Cankers All Fields Surveyed			Blackleg Basal Cankers Infected Fields Only	
	Prevalence	Incidence	Severity[1]	Incidence	Severity[2]
2011 (265)	42	3	0.041 (0.59)	7	0.10 (1.4)
2012 (253)	34	4	0.069 (0.54)	11	0.21 (1.7)
2013 (269)	25	2	0.029 (0.34)	8	0.12 (1.4)
2014 (274)	55	8	0.10 (0.7)	15	0.19 (1.3)
2015 (253)	59	9	0.11 (0.81)	15	0.19 (1.4)
2016 (224)	61	7	0.11 (0.85)	12	0.18 (1.4)

[1]Severity as divided by the number of plants surveyed per field.
[2]Severity as divided by the number of infected plants per field.

CROP / CULTURE: Canola
LOCATION/ RÉGION: Manitoba

NAMES AND AGENCIES / NOMS ET ÉTABLISSEMENTS

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TITLE / TITRE: SURVEY OF CANOLA DISEASES IN MANITOBA IN 2016

ABSTRACT: A total of 105 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. There were no canola plants collected from the 105 surveyed canola crops that were confirmed to have clubroot. One plant sample from the 2016 survey of 105 canola crops was confirmed to have verticillium wilt.

METHODS: A total of 105 canola crops were surveyed in the southwest (48), northwest (31), eastern/interlake (14) and central (12) regions of Manitoba from July 29 to August 30. All crops were *Brassica napus* and the majority were surveyed before swathing while plants were between growth stages 5.1 and 5.5 (Harper and 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 (AY phytoplasma), foot rot (*Fusarium* spp. and *Rhizoctonia* spp.), blackleg (*Leptosphaeria maculans*), fusarium wilt (*F. oxysporum* f. sp. *conglutinans*) and clubroot (*Plasmodiophora brassicae*). For sclerotinia stem rot, each plant was also scored based on the possible impact of infection on yield using a disease severity scale of 0 (no symptoms) to 5 (main stem lesion with potential effects on seed formation and filling of entire plant) (Kutcher and Wolf, 2006). Blackleg lesions that occurred on the upper portions of the stem were assessed separately from basal stem cankers. Stem lesions were recorded as present or absent. Basal stem cankers were scored using a disease severity scale of 0 to 5 based on area of diseased tissue in the stem cross-section where 0 = no diseased tissue visible in the cross section and 5 = diseased tissue occupying 100% of the cross section and plant dead (WCC/RRC, 2009). If present, clubroot symptoms were rated using a scale of 0 to 3 where 0 = no galling and 3 = severe galling (Kuginuki et al. 1999).The

prevalence and percent severity (Conn et al. 1990) of alternaria pod spot (*Alternaria* spp.) were also determined. When diseases were observed in the crop, but not in the sample of 100 plants, they were recorded as “trace” for incidence and counted as 0.1%. Mean disease incidence or severity values were calculated for each region. In addition to the visual assessment of diseases, soil samples were collected from 50 of the surveyed canola fields in Manitoba for DNA analysis (Cao et al., 2007) to test for the presence of the clubroot pathogen.

RESULTS: A number of diseases were present in each of the four regions of Manitoba. However, no clubroot symptoms were observed in the 105 Manitoba canola crops surveyed in 2016. Information on the recent monitoring and occurrence of clubroot in Manitoba in 2011, 2012 and 2013 is provided by Derksen et al. (2013) and Kubinec et al. (2014).

Sclerotinia stem rot and blackleg were the most prevalent diseases throughout the province in 2016 (Tables 1, 2 and 3). The prevalence of sclerotinia-infested crops ranged from a high of 100% in the central and eastern/interlake regions to 87% in the northwest region with a provincial mean of 93%. Mean disease incidence averaged across all crops was 14.4% and ranged from 20.3% in the central region to 10.9% in the southwest region. For infested crops only, mean disease incidence was 15.5%. Throughout the province, mean severity of sclerotinia stem rot was 3.0 and ranged from 3.6 in the southwest and central regions to 2.2 in the eastern/interlake region.

Aster yellows was observed in 17% of canola crops in Manitoba with a mean disease incidence of 1.8% in these crops (Table 2). The prevalence of this disease was substantially less than in 2012, when aster yellows was observed in 95% of canola crops with a mean disease incidence of 9.9%. Contributing factors to the record high level of aster yellows in all regions of Manitoba 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. In 2013, 2014, 2015 and 2016, aster leafhopper numbers were considerably lower than in 2012 (Canola Council of Canada 2013; Gavloski 2014, 2015, 2016) reducing the risk of this disease.

Blackleg basal cankers occurred in 82% of the crops surveyed in 2016 (Table 1), with prevalence ranging from 92% in the central region to 54% in the eastern/interlake region. The mean incidence of basal cankers averaged across all crops was 12.3%, while the incidence in infested crops was 15.1%. In 2015, basal cankers were found in 80% of crops surveyed with a mean disease incidence of 18% in infested crops. The severity of blackleg basal cankers was similar in both years, with mean ratings of 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 2016 was 71%. In previous years, 64%, 68%, 63%, 71% and 65% of crops had stem lesions in 2011, 2012, 2013, 2014 and 2015, respectively (McLaren et al. 2014; 2015; 2016). The mean incidence of blackleg stem lesions was 13.4% in infested crops and 9.5% in all crops.

The mean prevalence of alternaria pod spot in 2016 was 29% and 32% for crops surveyed in the eastern/interlake and northwest regions, respectively (Table 2). The severity of alternaria pod spot was low with means < 2% in these regions. No pod spot was recorded in the central and southwest regions.

Fusarium wilt was observed in 10% of canola crops surveyed in Manitoba, with a mean incidence of 5% in diseased fields and an average severity of 4.7 (Table 1). Foot rot occurred in 2% of canola crops surveyed with a provincial mean incidence of <1%. Foot rot was observed in the northwest region only. White rust (*Albugo candida*) has not been confirmed in any crop of *B. napus* since 2011 (McLaren et al. 2012). One plant sample from the 2016 survey of 105 canola crops was confirmed to have verticillium wilt. In addition, wilt caused by *Verticillium* spp. was identified in four different canola fields from plant samples (one per field) submitted to the Manitoba Crop Diagnostic Centre.

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Table 1. Mean prevalence, incidence and severity of sclerotinia stem rot and blackleg in Manitoba in 2016.

Crop Region	**Sclerotinia stem rotSclerotinia stem rot**					**Blackleg basal cankersBlackleg basal cankers**					**Blackleg stem lesions**		
(No. of crops)	P[1]	Inc.[2]	Inc[3]	Sev.[2]	Sev.[3]	P[1]	DI[2]	DI[3]	Sev.[2]	Sev.[3]	P[1]	DI[2]	DI[3]
Central	100	20.3	20.3	3.6	3.6	92	17.9	19.6	1.5	1.8	58	9.5	16.3
(12)													
East./Inter.	100	17.8	17.8	2.2	2.2	54	10.5	19.6	0.7	1.3	38	5.8	15.0
(14)													
Northwest	87	16.2	18.6	2.3	2.6	81	18.1	22.5	1.1	1.4	61	3.6	5.8
(31)													
Southwest	94	10.9	11.6	3.6	3.8	88	7.6	8.7	1.3	1.5	89	14.4	16.1
(48)													
All regions	93	14.4	15.5	3.0	3.3	82	12.3	15.1	1.2	1.5	71	9.5	13.4
(105)													

[1] Prevalence (P).
[2]Disease incidence (DI) or severity (Sev.) across all surveyed crops.
[3]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 2016.

Crop Region	Alternaria pod spot		Aster yellows			Fusarium wilt			Foot rot				
(No. of crops)	P[1]	Sev.[3]	P[1]	Inc.[2]	Inc.[3]	P[1]	Inc.[2]	Inc.[3]	Sev.[2]	Sev.[3]	P[1]	Inc.[2]	Inc.[3]
Central	0	0	0	0	0	8	0.8	1.0	0.2	2.0	0	0	0
(12)													
East./Inter.	29	1.0	21	0.3	1.3	21	8.0	37.3	0.5	5.7	0	0	0
(14)													
Northwest	32	1.0	35	0.7	2.0	13	0.4	3.3	0.5	5.3	7	0.3	4.5
(31)													
Southwest	0	0	8	0.1	1.5	6	0.5	8.0	0.3	4.5	0	0	0
(48)													
All regions	47	1.1	17	0.3	1.8	10	1.4	13.6	0.4	4.7	2	0.1	4.5
(105)													

[1] Prevalence (P).
[2]Disease incidence (DI) and severity (Sev.) across all surveyed crops.
[3]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 105 crops of *Brassica napus* in Manitoba in 2016.

Percentage of crops with							
Incidence range	**Sclerotinia stem rot**	**Blackleg basal cankers**	**Blackleg stem lesions**	**Aster yellows**	**Fusarium wilt**	**Foot rot**	**Alternaria pod spot**
0%	7	19	30	83	91	98	86
1-5%	27	32	30	17	6	1	14
6-10%	19	13	14	0	2	1	0
11-20%	26	17	13	0	1	0	0
21-50%	19	15	10	0	0	0	0
>50%	2	4	3	0	0	0	0

CROP / CULTURE: Field Bean (*Phaseolus vulgaris* L.)
LOCATION / RÉGION: Southern Alberta

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TITLE / TITRE: WHITE MOULD ON DRY BEAN IN ALBERTA IN 2016

ABSTRACT: Dry bean production in southern Alberta averages approximately 49,230 tonnes on 19,405 hectares (Government of Alberta, 2016). The main disease affecting production is white mould caused by *Sclerotinia sclerotiorum* (Lib.) de Bary. A survey for white mould in 26 commercial dry bean (*Phaseolus vulgaris* L.) fields in southern Alberta was conducted in 2016. White mould symptoms were observed in all fields surveyed. Disease prevalence, incidence and severity were the highest reported for at least the past seven years.

INTRODUCTION AND METHODS: Dry bean is a high value pulse crop for many irrigated farms in southern Alberta. White mould caused by *S. sclerotiorum* is a commonly occurring disease and, in some years, is the greatest production constraint for bean producers. Cultivars with upright architecture and small, quantitative, genetic tolerance can avoid disease to some extent, but no strong, genetic resistance to white mould is known (Balasubramanian et al., 2013). As a result, the disease is managed mainly using fungicides and cultural practices. Since 2011, white mould incidences and severities have typically ranged from 18% to 29%, and 0.1 to 0.75, respectively (Harding et al., 2016; M.W. Harding unpublished) with the exception of 2014 when white mould incidence average in mid-August was 4.1% and severity was 0.11 (Chatterton et al., 2015). A survey was conducted in mid-August, 2016 to evaluate white mould prevalence, incidence and severity on dry bean in southern Alberta.
Twenty-six irrigated, commercial dry bean fields in southern Alberta were surveyed on August 8-9, 2015 for white mould (*S. sclerotiorum*). Each field was evaluated for white mould in 2 m of two adjacent rows at three locations.The incidence of disease was calculated as a percent of infected plants with white mould symptoms, and the disease severity was estimated using a rating scale of 1 to 4 where a score of ’1’ was given when no disease was observed, up to a score of ’4’ which was assigned when the disease had killed the host plant (Table 1; Balasubramanian et al., 2013).

RESULTS AND COMMENTS: White mould disease was found in all 26 fields for a prevalence of 100%. The disease incidence ranged from 14.3% to 75% with an overall average incidence of 60.8% and severity ranged from 1.0 to 2.2 with overall average severity of 1.2 (Table 2 and Figure 1).
White mould prevalence, incidence and severity on dry bean were higher than any year on record since at least 2010. Coincidentally, precipitation in July was much higher relative to long-term normal values, especially in areas where white mould incidence was ≥ 75% (Figure 2). The very wet conditions in July may have contributed to the higher than average levels of white mould in dry bean in Alberta in 2016.

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This survey was supported by Alberta Agriculture and Forestry. Thanks to Viterra’s Alberta Bean Division for assistance, and to the producers for allowing access to their fields.

Table 1. A rating scale to estimate severity of white mould on dry edible bean.[1]

Rating	Symptoms
1	healthy;
2	single stem infected;
3	multiple stems infected;
4	lower part of main stem infected or dead plant.

[1]Balasubramanian et al., 2013

Table 2. White mould prevalence, incidence and severity in dry bean fields in southern Alberta in 2016.

No. crops affected	Disease Prevalence (%)	Disease Incidence (%)		Disease Severity[2]	
		Mean[1]	Range	Mean[1]	Range
26/26	100	60.8	14.3 – 75.0	1.2	1.0 – 2.2

[1]Means represent an average of all the crops surveyed.
[2]Disease severity was assessed using a 1-4 scale.

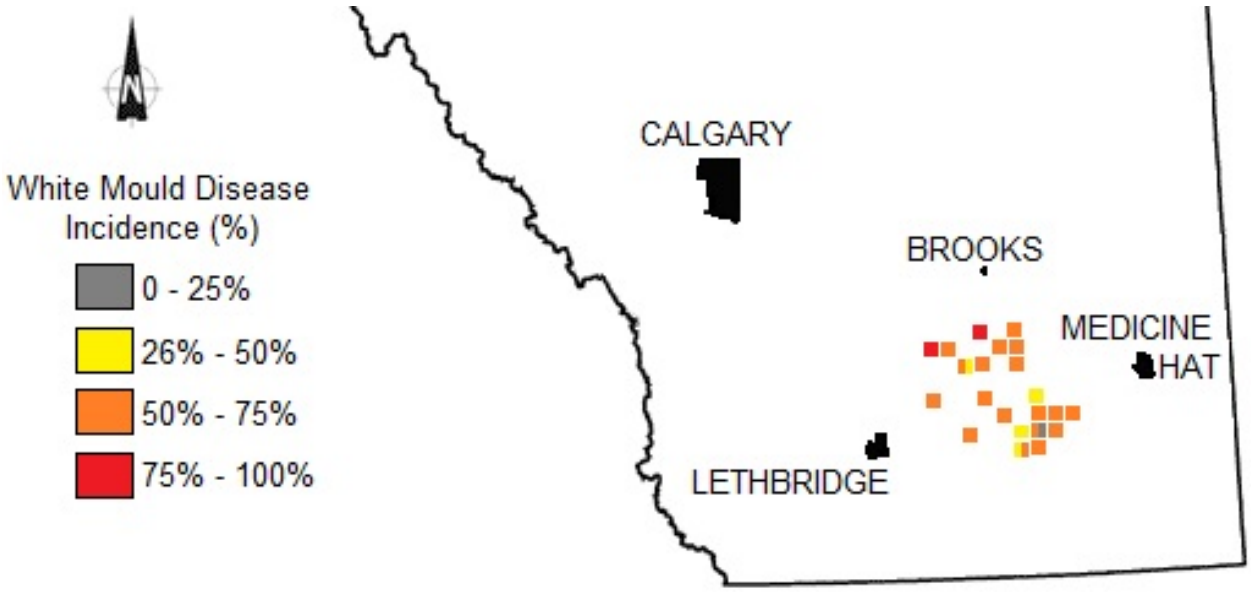

Figure 1. White mould on dry bean: Distribution map of disease incidence in Alberta in 2016.

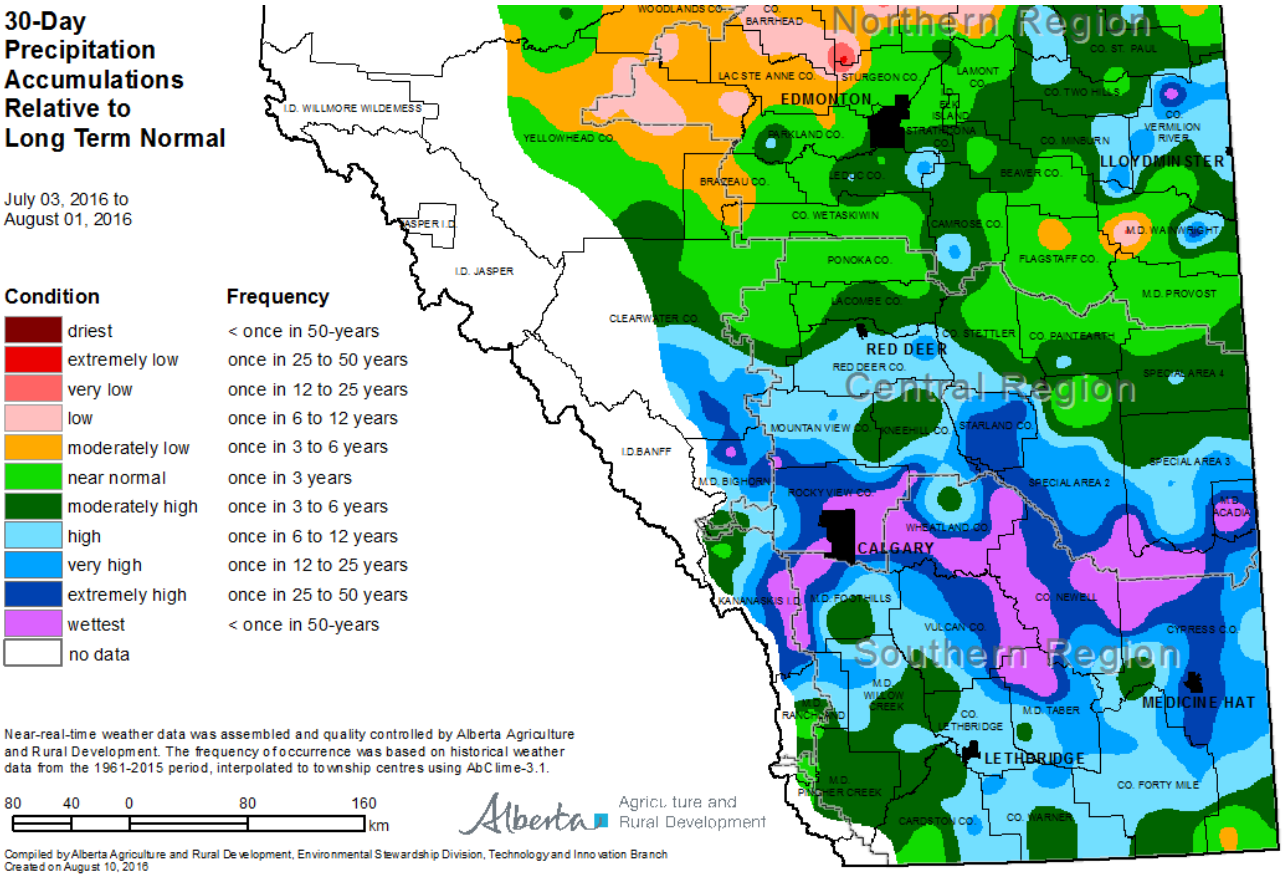

Figure 2. Precipitation map for southern Alberta in July, 2016.
(source: http://agriculture.alberta.ca/acis/climate-maps.jsp)

CROP / CULTURE: Field bean
LOCATION / RÉGION: Manitoba

NAMES AND AGENCY / NAMES AND AGENCIES / NOMS ET ÉTABLISSEMENTS:
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TITLE: DISEASES OF FIELD BEAN IN MANITOBA IN 2016

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. Diseases of less importance included rhizoctonia root rot, white mould and halo blight. In 2016, 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 on August 18, 19, 22 and 25 on the same fields assessed for root rot. The crops surveyed were selected at random from regions in southern Manitoba where most of the field bean crops are grown.

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 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 mould (*Sclerotinia sclerotiorum*) and halo blight (*Pseudomonas syringae* pv. *phaseolicola*) severity were assessed as percentages of infected plant tissue.

RESULTS AND COMMENTS: The 2016 growing season was challenging for many producers throughout Manitoba. The major challenge was precipitation with localized hail storms that caused damage earlier in the season in a number of areas (Manitoba Agriculture, 2016; Manitoba Pulse and Soybean Growers, 2016a). In mid-season, high rainfall amounts drowned out some fields resulting in significant yield losses (Manitoba Agriculture, 2016). Later in the season, excess moisture created less than ideal conditions for harvest (Manitoba Pulse and Soybean Growers, 2016b).

Two root diseases were identified (Table 1). Fusarium root rot was observed in all 40 field bean crops surveyed, with severity ratings ranging from 3.5 to 7.0, and a mean of 5.5. It has remained the most prevalent root disease of dry bean for several years (Conner et al. 2011; Henriquez et al. 2013; McLaren et al. 2016). 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*) was detected in 1 of the 40 crops sampled with a severity rating of 5.6. Pythium root rot was not detected in any of the crops surveyed. Thirty-seven crops (93%) 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 the last five years, this represents the highest percentage of bean crops surveyed with root rot severity ratings that would impact yield. Halo blight was assessed in 20 of the 40 crops surveyed and was observed in two crops with a disease severity of 1% infected plant tissue in each crop.

Two diseases were observed during the survey of foliar diseases (Table 2). Common bacterial blight was the most prevalent and symptoms were observed in all 40 crops. The incidence of CBB ranged from 1.7 to 40% with a mean of 17.7%, while severity ranged from 0.3 to 4.0, with a mean of 2.2. Anthracnose was not detected in 2014, 2015 and 2016, unlike many years prior to this period. Rust was not observed in any of the crops surveyed. White mould symptoms were detected in 16 crops with a percent of tissue infection that ranged from 0.3% to 40%, and an average of 7.3%. This represents an increase from 2015 in the disease severity (McLaren et al. 2016). Seasonal precipitation in many of the bean growing regions of Manitoba in 2016 was above normal, which would have contributed to the increased risk of white mould in these crops. For example, in the Morden area, 371 mm and 238 mm of precipitation were received during May to August in 2016 and 2015, respectively, compared with the 30-year average of 305 mm for this four month period (Agriculture and Agri-Food Canada, 2016; Government of Canada, 2016).

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Table 1. Prevalence and severity of root diseases in 40 crops and halo blight in 20 crops of field bean in Manitoba in 2016.

	No. Crops	Disease Severity	
Disease	**Affected**	**Mean[1]**	**Range**
Fusarium root rot[2]	40	5.5	3.5-7.0
Rhizoctonia root rot[2]	1	5.6	5.6
Halo blight (%)	2	1%	1%

[1]Means are based on an average of the crops in which the diseases were observed.
[2]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 2016.

	No. Crops	Disease Severity[1]		Incidence of Leaf Infection	
Disease	**Affected**	**Mean[2]**	**Range**	**Mean[2]**	**Range**
Common bacterial blight[3]	40	2.2	0.3-4.0	17.7%	1.7-40.0%
Anthracnose (%)	0	0	0		
Rust (%)	0	0	0		
White mould (%)	16	7.3	0.3-40%		

[1]White mould 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.
[2]Means are based on an average of the crops in which the diseases were observed.

CROP / CULTURE: Field bean
LOCATION / RÉGION: Western Ontario

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TITLE: ROOT DISEASES OF FIELD BEAN IN WESTERN ONTARIO IN 2016

ABSTRACT: A total of 26 bean crops were surveyed for root diseases in the main production regions of western Ontario. Fusarium root rot was the most prevalent root disease and was observed in all the crops surveyed.

METHODS: Crops of field bean in western Ontario were surveyed for root diseases at 26 different locations. The survey was conducted from July 10th to July 26th with crops ranging from the early flower to the pod development growth stages. The crops were selected from the counties of Huron, Perth, Middlesex and Oxford where most field bean crops are grown.

At least 20 plants were sampled at each of two random sites within each crop surveyed. Root diseases were rated on a scale of 0 (no disease) to 9 (death of plant) (Conner et al. 2011). Ten roots with disease symptoms were chosen from each crop for isolation of the causal organisms in the laboratory by plating onto potato dextrose agar. 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 26 bean crops surveyed were frozen for future PCR detection of root rot pathogens.

RESULTS AND COMMENTS: The 2016 cropping season in southern Ontario began early with dry weather affecting a large portion of the crop. By June 9th, planting was 70% complete, but emergence in some fields was slow due to lack of moisture (OMAFRA, 2016). Dry weather pushed maturity ahead and harvest occurred earlier than usual. By August, the edible bean crop was too far along in maturity to benefit significantly from August rainfall. Yields are expected to be below average due to the dry conditions (M. Moran, pers. comm.).

Two root diseases were observed (Table 1). Fusarium root rot (*Fusarium* spp.) was detected in all 26 crops surveyed for root diseases. Similar results have been reported previously in Ontario (Henriquez et al. 2015a; Kim et al. 2016) and elsewhere in Canada (Conner et al. 2011; Henriquez et al. 2015b, McLaren et al. 2016). Crops in which *Fusarium* spp. were isolated had root rot severity ratings that ranged from 3.5 to 5.7 with a mean of 4.7. Rhizoctonia root rot (*Rhizoctonia solani*) and pythium root rot (*Pythium* spp.) were not detected in any of the 26 crops surveyed. Molecular detection methods to confirm the identity of other fungi isolated from six surveyed crops are currently in progress. Twenty-three of 26 crops had an average root rot severity rating 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.

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Table 1. Prevalence and severity of root diseases in 26 crops of field bean in Ontario in 2016.

	No. Crops	Disease Severity	
Disease[1]	**Affected**	**Mean[2]**	**Range**
Fusarium root rot	26	4.7	3.5-5.7
Rhizoctonia root rot	0	0	0
Pythium root rot	0	0	0
Other	6	4.6	3.8-5.2

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

CROP / CULTURE: Field pea (*Pisum sativum* L.)
LOCATION / RÉGION: Alberta

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TITLE: THE OCCURRENCE OF AND MICROORGANISMS ASSOCIATED WITH ROOT ROT OF FIELD PEA IN ALBERTA IN 2016

ABSTRACT: The occurrence and severity of root rot disease on field pea was investigated in five counties across Alberta in July, 2016. A total of 71 fields were surveyed. Root rot symptoms were found at all locations, with an average incidence of 57.6%, ranging from 2% to 100%. Symptom severity ranged from 0.01 to 3.4 on a scale of 0-4, with an average of 1.3. The pathogens associated with the root rot complex were isolated from infected root tissues. Species of *Fusarium* were recovered most frequently, followed by *Pythium* spp., *Aphanomyces euteiches* and *Rhizoctonia* spp. The frequent co-occurrence of *Fusarium* spp. and *Pythium* spp. suggests that interactions between these pathogens contribute to the incidence and severity of root rot on field pea.

METHODS: The occurrence and severity of root rot on field pea (*Pisum sativum* L.) were investigated in a total of 71 commercial fields distributed across five counties in Alberta from July 8 to July 24, 2016. Five random sites with a 'W' shape sampling pattern were surveyed in each crop. At each of the five sampling sites, 20 pea plants were randomly selected and dug from the ground. Soil was carefully cleaned off from the root samples to preserve the intact root system. The percentage of symptomatic plants sampled within a field was recorded, while root rot severity was rated on scale of 0-4 (Chang et al. 2013). Ten pieces from each infected root sample were used to isolate the pathogens associated with the root rot complex, as described by Chang et al. (2005). The root pieces were transferred onto Petri dishes filled with potato dextrose agar (PDA) or selective MBV medium (Pfender et al. 1984) for *Aphanomyces euteiches* isolation.

RESULTS AND COMMENTS: The distribution ofroot rot was uneven across the 71 pea fields surveyed (Table 1). The mean incidence of the disease was similar in the fields sampled at Edmonton, Drumheller and Sturgeon Counties, with an average of 68.7% ranging from 7% to 100% (Fig.1). At Vermillion and Westlock, root rot incidence was lower, with a mean of 41% ranging from 2-100%. Across all fields surveyed in Alberta, the mean disease incidence was 57.6%, while the average severity was 1.3 with a range of 0.01 to 3.4.

A total of 364 symptomatic root samples were cultured on PDA and MBV for pathogen isolation. Species of *Fusarium* were isolated most commonly from these roots, followed by *Pythium* spp., *A. euteiches* and *Rhizoctonia* spp. (Table 2). A mixture of *Fusarium* spp. and *Pythium* spp. was recovered from 66.6% of the roots, which suggested that an interaction between these two species frequently results in root rot. *Rhizoctonia* spp. were identified only from Sturgeon County at an incidence of 5%.

ACKNOWLEDGEMENTS:
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Table 1. Incidence and severity of pea root rot in Alberta in 2016.

County	No. of fields surveyed	Root rot incidence (%)		Root rot severity (0-4)	
		Mean	Range	Mean	Range
Edmonton	5	63	7-100	1.4	0.9-2.5
Drumheller	2	69	38-100	1.8	0.1-3.0
Sturgeon	19	74	13-100	1.6	0.2-3.0
Vermillion	26	43	9-92	0.8	0.1-2.4
Westlock	19	39	2-100	0.9	0.01-3.4
Total/Average	**71**	57.6	**2-100**	1.3	**0.01-3.4**

Table 2. Incidence (%) of the pathogens recovered from pea roots collected in Alberta in 2016 and showing symptoms of root rot

County	No. Roots tested	No. Field tested	*Fusarium* spp. (*F*)	*Pythium* spp. (*P*)	F + P	*Aphanomyces** *euteiches*	*Rhizoctonia* spp.
Edmonton	39	3	97	92	90	5	0
Drumheller	18	2	100	44	44	6	0
Sturgeon	144	17	76	44	74	0	5
Vermillion	40	4	95	68	65	0	0
Westlock	123	15	85	62	60	5	0
Total / Avg.	**364**	**41**	**90.6**	**62**	**66.6**	**3.2**	**1**

* Data were obtained on the selective medium MBV.

Figure 1. Field pea plants affected by severe root rot in a low-lying area of a field in Sturgeon County.

CROP / CULTURE: Field pea (*Pisum sativum* L.), Lentil (*Lens culinaris* Medik.)
LOCATION / RÉGION: Alberta, Saskatchewan, Manitoba

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TITLE / TITRE: SURVEY OF ROOT ROT IN ALBERTA, SASKATCHEWAN AND MANITOBA FIELD PEA AND LENTIL IN 2016

ABSTRACT: A total of 185 field pea (*Pisum sativum*) and 93 lentil (*Lens culinaris*) crops were surveyed in Alberta, Saskatchewan and Manitoba (field pea only) for root rot. Root rot was present in all regions in 92% of pea crops and 95% of lentil crops. Roots with symptoms of aphanomyces root rot were observed in all regions surveyed, and the presence of *Aphanomyces euteiches* was confirmed by isolation on culture media and/or PCR tests.

INTRODUCTION AND METHODS: Field pea and lentil crops reached record production in Alberta and Saskatchewan, with 2.4 million ha of lentil and 1.6 million ha of pea seeded across both provinces in 2016 (1). Root rots caused by *Fusarium* spp. have become a severe problem for many Alberta pea producers (2). The destructive root rot pathogen *Aphanomyces euteiches* was reported to be present in Saskatchewan and Alberta pea fields in 2012 and 2013, respectively (3, 4). To assess the prevalence, incidence and severity of root rot in Alberta, Saskatchewan and Manitoba, pea and lentil crops were surveyed at flowering in June-July 2016 for above- and below-ground symptoms of root rot. Representative samples were collected from each field to allow the causal agents to be isolated and identified.

Crops were evaluated at 10 sites per field along a U-shaped pattern, with a minimum of 20 m between sites. Fields surveyed were categorized according to soil zone (black, brown, dark brown) for analysis of root rot incidence and severity. To assess root rot, roots from 5-10 plants were dug up at each of the 10 sampling sites per field, bagged and stored at ~4^{o}C until processing. Samples from Manitoba, Saskatchewan and central Alberta were shipped to the Lethbridge Research and Development Centre for root rot rating and processing. Roots were washed under running tap water for 10 min, and individual roots were assigned a visual rating for disease severity (1=healthy, 7=dead) (5). Roots collected early in the season (early June) in southern Alberta from fields with symptoms of aphanomyces root rot were kept for isolation of *A. euteiches*. For pathogen isolations, lateral roots were examined for presence of oospores under a microscope, and roots with oospores were plated (without surface sterilization) onto cornmeal agar amended with metalaxyl, benomyl and vancomycin (MBV) (6). All other roots with a severity rating of 4 – 6 were processed for DNA extraction. Roots from each site per field were bulked, cut into 0.5 cm pieces, freeze-dried and 30 mg removed for DNA extractions using the BioSprint Plant DNA kit (Qiagen). Extracted DNA was then used in a series of four multiplex end-point PCR reactions, using previously published species-specific primers, designed to test for presence/absence of *A. euteiches* (7), nine *Fusarium* spp., *Rhizoctonia solani*, *Pythium ultimum* and *P. irregulare*.

RESULTS AND DISCUSSION:
Field pea: Root rot symptoms were found in 87% of pea crops surveyed in Alberta and 100% of fields in Saskatchewan and Manitoba. In Manitoba, mean root incidence was 95% and severity was 3.9 (Table 1). In Saskatchewan, mean root rot incidence was 88% and severity was 3.3. In the black soil zone, 96% of

360 sample sites had root rot, with a mean severity of 3.5. Root rot severity was highest in the brown soil zone at 4.3, with a mean incidence of 92%. Fields in the dark brown zone had the lowest incidence and severity (82% and 3.2).

In Alberta, mean root rot incidence was 68% and severity was 2.7. As in Saskatchewan, mean root rot incidence and severity were highest in the brown soil zone (74%, 2.9). Incidence and severity were slightly lower (63%, 2.8) in the dark brown soil and in the black soil zone (66%, 2.5) (Table 1).

Lentil: Root rot symptoms were found in 86% of lentil crops surveyed in Alberta and 100% of fields in Saskatchewan. In Alberta, lentil is grown almost exclusively in the brown soil zone, where root rot incidence was 76% with a mean severity of 2.8. In Saskatchewan, root rot incidence and severity was highest in the black soil zone (96%, 3.5), but only 10 fields were surveyed because fewer lentils are grown in this region. Mean incidence and severity was lower in the dark brown soil zone (94%, 3.1), and lowest in the brown soil zone (89%, 2.7).

Identification of causal agents: *A. euteiches* was isolated from roots from 12 fields in southern Alberta that were surveyed from June 10-24. Roots sampled after these dates yielded primarily *Fusarium* spp., and therefore attempts to isolate *A. euteiches* did not continue from fields surveyed in July.

At the time this report was submitted, PCR assays and analysis for presence/absence of *A. euteiches* for most samples retained from diseased fields were complete. However, the results for *Fusarium* spp., *R. solani* and *Pythium* spp. have not yet been scored and analyzed. *A. euteiches* frequency was higher in pea than lentil crops, with Alberta showing the highest frequency of infected fields at 61%, followed by Manitoba at 58% and then Saskatchewan at 44% (Table 2). In initial assessments, 32% of lentil fields in Saskatchewan were positive for *A. euteiches* and 29% were positive in Alberta. However, some PCR tests are being repeated because the results were either not consistent between duplicates or the amplification strength was weak. Two fields each of dry bean and alfalfa gave weakly positive results for *A. euteiches*, and these fields will be re-tested to confirm presence / absence. Preliminary assessment of PCR results for *Fusarium* spp. indicates that these were the predominant fungi present in roots, as banding patterns indicating presence of at least one *Fusarium* sp. were observed from almost all samples. *Rhizoctonia solani* and *Pythium* spp. were also detected, but at much lower frequencies.

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Table 1. Root rot prevalence, incidence and severity in field pea (Alberta, Saskatchewan and Manitoba) and lentil (Alberta and Saskatchewan) crops in 2016.

Soil zone	No. fields surveyed	Root rot prevalence (%)	Root rot incidence (%)	Severity (1-7)	Severity Range
Pea, Alberta					
Black	21	95	66	2.5	1.0 – 7.0
Dark brown	22	82	63	2.8	1.0 – 6.8
Brown	41	83	74	2.9	1.0 – 7.0
Total / Mean / Range	84	87	68	2.7	1.0 – 7.0
Pea, Saskatchewan					
Black	36	100	92	3.5	1.0 – 6.6
Dark brown	17	100	82	3.2	1.0 – 7.0
Brown	15	100	92	4.3	1.0 – 7.0
Grey	3	100	85	2.4	1.0 – 4.2
Total / Mean / Range	71	100	90	3.5	1.0 – 7.0
Pea, Manitoba	30	100	95	3.9	2.0 – 7.0
Lentil, AB and SK					
Alberta (brown)	29	86	76	2.8	1.0 – 6.0
Saskatchewan					
Black	10	100	96	3.5	1.0 – 6.4
Dark brown	24	100	94	3.1	1.0 – 7.0
Brown	30	100	89	2.7	1.0 – 6.0
Total / Mean / Range	64	100	92	3.0	1.0 – 7.0

Table 2. Number of fields and root samples in Alberta, Saskatchewan, and Manitoba that tested positive for *Aphanomyces euteiches* using a PCR assay.

Location/Crop	No. fields tested	No. fields positive	% fields positive[b]	No. samples tested	No. samples positive[c]	% samples positive
Alberta						
Pea	62	38 (8)[a]	61	262	178	67
Lentil	21	6 (2)	29	100	32	32
Dry bean	7	(2)	0	9	0	0
Alfalfa	4	(2)	0	7	0	0
Saskatchewan						
Pea	66	29 (11)	44	282	159	56
Lentil	62	20 (20)	32	242	131	54
Manitoba						
Pea	26	15 (8)	58	117	95	81

[a]Number in brackets indicates additional number of fields testing positive but PCR result was not consistent between duplicate reactions, or band intensity was weak and difficult to score.
[b]Only includes fields that had a strong positive reaction or the PCR result was consistent between duplicate reactions.
[c]Only includes samples that had a strong positive reaction or the PCR result was consistent between duplicate reactions.

CROP / CULTURE: Field pea
LOCATION / RÉGION: Manitoba

NAMES AND AGENCIES / NOMS ET ÉTABLISSEMENTS

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TITLE: FIELD PEA DISEASES IN MANITOBA IN 2016

ABSTRACT: A total of 40 and 38-40 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 less frequently observed included sclerotinia stem rot and downy mildew. Rust, bacterial blight, septoria leaf blotch and anthracnose were not observed in any of the crops surveyed in 2016.

METHODS: Field pea crops were surveyed for root and foliar diseases at 40 and 38-40 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. The area seeded to field pea in Manitoba has increased in recent years with approximately 20,000, 22,000 and 26,000 ha in 2013, 2014 and 2015, respectively (Manitoba Pulse and Soybean Growers 2015). However, 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 Pulse and Soybean Growers 2016).

The survey of root diseases was conducted during late June to mid-July when most plants were at the early to late flowering stages. At least ten 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) (Xue 2000). To confirm the visual disease identification, 15 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 pea crops were frozen for future PCR analysis of the root rot pathogens.

Foliar diseases were assessed during the late July when most plants were at the intermediate to round pod stage. Severe hail damage prevented foliar disease assessment in two fields with the exception of downy mildew when samples were collected prior to the damaging storm. A minimum of 30 plants (10 plants at each of 3 sites) was assessed in each field. Foliar diseases were identified by 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: Favorable weather and field conditions allowed seeding operations to get underway in many areas of Manitoba by May 2, 2016 (Manitoba Agriculture 2016a). In mid-May, cool weather and excess moisture impacted crop development in some regions (Manitoba Agriculture 2016b). Thunderstorm activity in July resulted in heavy rainfall, strong winds and hail in areas of Manitoba resulting in crop damage (Manitoba Agriculture 2016c). Several producers reported difficulty harvesting the crop due to lodging. Continuing wet conditions in some areas of Manitoba delayed the 2016 harvest, with reports of average to below average pea yields.

Two diseases were identified based on laboratory assessment of the roots collected from the 40 pea crops (Table 1). Fusarium root rot was the most prevalent as in previous years (McLaren et al. 2015, 2016). The 40 crops from which *Fusarium* spp. were isolated had root rot severity ratings ranging from 0.9 to 5.9 with a mean of 2.8. The most predominant *Fusarium* spp. isolated in 2016 were *F. acuminatum*

and *F. avenaceum*. Rhizoctonia root rot (*Rhizoctonia solani*) was not detected in any of the crops sampled. Six 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.

Three foliar diseases were observed (Table 2). Mycosphaerella blight (*Mycosphaerella pinodes*) was the most prevalent, as in previous years (McLaren et al. 2015, 2016), and was present in all crops surveyed. Disease severity ranged from 3.4 to 8.4 with a mean of 6.0. Sclerotinia disease (*Sclerotinia sclerotiorum*) was detected in twenty-one (55%) of the crops surveyed. In 2015, sclerotinia stem rot was detected in one crop only with a severity of <1.0. Environmental conditions during the latter half of the 2016 field season were more conducive to the development of sclerotinia stem rot compared with the previous year and contributed to increased disease risk. Downy mildew (*Peronospora viciae*) was detected in nine (23%) of the crops surveyed with a mean disease severity of <0.1. Powdery mildew (*Erysiphe pisi*) was not observed in any of the surveyed crops. Because all newly registered pea cultivars are required to have resistance to powdery mildew, the absence of this disease could be mainly attributed to the use of new cultivars by growers or early seeded crops escaping infection. However, powdery mildew was observed in August on a few susceptible lines at AAFC-Morden and AAFC-Brandon, which suggests that there may have been crops in which powdery mildew developed after the survey. Anthracnose (*Colletotrichum pisi*), rust (*Uromyces viciae-fabae*), septoria leaf blotch (*Septoria pisi*) and bacterial blight (*Pseudomonas syringae* pv. *pisi*) were not observed in any of the surveyed crops.

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Table 1. Prevalence and severity of root diseases in 40 crops of field pea in Manitoba in 2016.

Disease	Crops Affected (%)	Disease Severity (0-9)[1]	
		Mean	Range
Fusarium root rot	100	2.8	0.9 - 5.9
Rhizoctonia root rot	0	0	0
Fusarium oxysporum	75	2.9	0.9-5.2

[1]All 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

Table 2. Prevalence and severity of foliar diseases in 38 and 40[1] crops of field pea in Manitoba in 2016.

Disease	Crops Affected (%)	Disease Severity (0-9 or % leaf area infected)[2]	
		Mean	Range
Mycosphaerella blight	100	6.0	3.4 - 8.4
Sclerotinia stem rot	55	0.5	<0.1 - 2.9
Powdery mildew	0	0%	0%
Downy mildew	23	<0.1%	<0.1 - 0.2%
Anthracnose	0	0	0
Rust	0	0%	0%
Bacterial blight	0	0%	0%
Septoria leaf blotch	0	0%	0%

[1]Downy mildew was assessed prior to two of the 40 crops being severely damaged by hail.
[2]Powdery 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 based only on crops in which the disease was observed.

CROP / CULTURE: Flax
LOCATION / RÉGION: Manitoba / Saskatchewan

NAMES AND AGENCIES / NOMS ET ÉTABLISSEMENTS
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TITLE: DISEASES OF FLAX IN MANITOBA AND SASKATCHEWAN IN 2016

ABSTRACT: A survey of 23 flax crops in Manitoba and 58 crops in Saskatchewan revealed that pasmo was the most prevalent disease in 98% of crops surveyed in 2016, followed by alternaria blight in 31%, fusarium root rot in 27%, aster yellows in 14%, and sclerotinia stem rot in 7% of the crops surveyed. Rust was absent in all surveyed flax crops for the last 30 years. Powdery mildew was not assessed due to early maturity of the crops.

METHODS: A total of 81 flax crops were surveyed in 2016: 23 in southern Manitoba and 58 in central, southern and eastern Saskatchewan. Four crops were surveyed in the third week of August, 14 in the fourth week of August and 63 in the first week of September. Crops surveyed were selected at random along pre-planned routes in the major areas of flax production. 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 (I = very good/early, and 5 = very poor/very late).

In addition, nine 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-seven percent of the flax crops surveyed in 2016 (96% in Manitoba and 69% in Saskatchewan) had excellent stands and the rest were good to fair. Sixty-seven percent of the crops surveyed were early maturing (78% in Manitoba and 62% in Saskatchewan). Seventy-eight percent of the crops had excellent vigour and the rest were poor (83% in Manitoba and 76% in Saskatchewan). Ninety-six percent of the crops were brown seed-colour flax, and only 4% were yellow seed-colour. Weed infestation was very low in 72% of the crops surveyed in 2016 and the reminder 28% had medium to high weed infestation. The 2016 growing season was characterized by normal soil moisture conditions in Manitoba but above normal wet soils in Saskatchewan early in the season. Frequent rains occurred in Manitoba and Saskatchewan throughout the summer. Total flax area was ~400,000 ha, approximately 85% in Saskatchewan according to Statistics Canada. This disease survey showed minor differences between Saskatchewan and Manitoba; fusarium wilt/root rot, alternaria blight, and aster yellows were higher in Manitoba than in Saskatchewan. Of all crops surveyed, lodging was higher in Saskatchewan at 45% than in Manitoba at 22%.

Pasmo, the most prevalent disease in 2016, was observed in 97% of the crops surveyed in both provinces especially those surveyed in September (Table 1). The prevalence and severity on stems were generally higher than in 2015 but similar to previous years (1, 2, 3, 4), due probably to the frequent precipitation throughout the growing season. Pasmo severity was mostly at trace to 5% levels in most of the crops surveyed in August but the disease developed further towards the end of the season and reached a severity of 20-40% stem area affected in 43% of flax crops in both provinces (Table 1). Root infections and fusarium wilt were observed in 27% of the crops surveyed (44% in Manitoba and 21% in Saskatchewan). Incidence was very low (trace to 5%) even in the most affected crops (Table 1). The prevalence of this disease in 2016 was generally similar to previous years (1, 2, 3, 4).

Powdery mildew was not assessed in 2016 due to the late onset of the disease, the early maturity of the flax crops and the senescing of leaves prior to the survey. Powdery mildew was observed on the top few leaves of the late maturing crops but no precise data could be collected in 2016.

Rust was not observed in any of the crops surveyed in 2016, 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 31% of the crops surveyed (35% in Manitoba and 5% in Saskatchewan). This was more frequent than in previous years especially in Manitoba (1, 2, 3), but disease severity was very low (trace to 5% in most surveyed crops). This disease is transmitted by the aster leafhopper *(Macrosteles quadrilineatus)* that usually migrates from the south during the growing season. Alternaria blight was observed at trace to 5% levels in 31% of the crops (61% in Manitoba and 19% in Saskatchewan). Sclerotinia stem infections were observed in lodged flax crops at trace to 1% levels in 7% of the crops (13% in Manitoba and 5% in Saskatchewan), lower than in 2015 (1).

Of the nine samples submitted to the MAFRD Crop Diagnostic Centre in 2016, one was affected by pasmo, one by *Pythium* and *Rhizoctonia* spp., two by fusarium wilt, and five by herbicide injury.

ACKNOWLEDGEMENTS: Technical assistance of Tricia Cabernel and Maurice Penner.

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Table 1. Incidence and severity of fusarium wilt and pasmo in 81 crops of flax in Manitoba and Saskatchewan in 2016.

Fusarium Wilt				**Pasmo**			
Disease Class		Crops		Disease Class		Crops	
Incid.[1]	Sever.[2]	#	%	Incid.[1]	Sever.[2]	#	%
0%	0%	59	73	0%	2%	2	2
1-5%	1-5%	22	27	1-10%	1-5%	23	29
5-20%	5-10%	0	0	10-30%	5-10%	21	26
2-40%	10-20%	0	0	30-60%	10-20%	17	21
>40%	10-40%	0	0	>60%	20-50%	18	22

[1]Disease incidence = percentage of infected plants in each crop
[2]Disease severity = percentage of roots affected by fusarium wilt, and of stems affected by pasmo.

CROP / CULTURE Lentil
LOCATION / RÉGION: Saskatchewan

NAMES AND AGENCIES / NOMS ET ÉTABLISSEMENTS
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TITLE: 2016 SURVEY OF LENTIL DISEASES IN SASKATCHEWAN

ABSTRACT: A total of 50 lentil crops were surveyed in Saskatchewan in 2016. Sclerotinia and stemphylium blight were the most prevalent diseases observed in the survey, whereas anthracnose and root rot varied from field to field. Overall ascochyta blight levels remain low.

METHODS: Saskatchewan lentil crops were surveyed for disease in 2016 (50 fields). Fields were surveyed between July 19 and Aug 14th and fields ranged in staging from mid-flower to approximately 30% moisture content (desiccation stage). Regions surveyed were west-central (16), southwest (20), southeast (6) and east-central (8). Disease assessments were made qualitatively in each crop by observing several representative plants to evaluate general health and presence or absence of symptoms. In each field plants were examined to determine the presence or absence of the following diseases: root rot complex (*Fusarium* spp. / *Pythium* spp. / *Rhizoctonia solani / Aphanomyces euteiches),* anthracnose (*Colletotrichum lentis),* ascochyta blight (*Ascochyta lentis),* sclerotinia stem and pod rot *(Sclerotinia sclerotiorum*), botrytis stem and pod rot / grey mould *(Botrytis cinerea),* and stemphylium blight (*Stemphylium* spp.). Percentages of the crops surveyed showing symptoms (prevalence) of each of these diseases were calculated for each region surveyed (Tables 1-4) and for the province (Table 5); totals from the previous four years are also presented (Dokken-Bouchard et al. 2016).

RESULTS AND COMMENTS: Approximately 2.1 million hectares (5.2 million acres) of lentil were seeded in Saskatchewan in 2016, in what has been a steady increase in lentil hectares over the last 5 years (Statistics Canada 2016). Crop seeding started relatively early in 2016. Wet conditions throughout the growing season resulted in generally high levels of diseases in lentil crops, particularly in traditional lentil growing areas (brown soil zone – southwest and west-central SK). As of early November, 1.9 million hectares of lentils were harvested (Statistics Canada 2016) in Saskatchewan, with 98% of the crop combined by November 21, 2016 (Saskatchewan Ministry of Agriculture 2016). Lentil grades from submitted harvest samples (Canadian Grain Commission 2016) were 26% 1CAN, 38% 2CAN, 26% Extra 3CAN and 10% 3CAN.

At least two lentil diseases (root rot complex, anthracnose, ascochyta, sclerotinia, botrytis or stemphylium) were observed in each field of the 50 fields surveyed in 2016.

Ascochyta blight symptoms (*Ascochyta lentis)* were observed in 6% of fields surveyed in 2016. Ascochyta blight has generally decreased in prevalence over the last four years and was not observed in any fields included in the 2015 lentil survey. However it is important to note that the number of fields sampled in 2016 (50) is more than double those sampled in 2015 (18 fields) with the 2016 survey covering a larger area of the province. 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 breakdown of resistance under tight rotations and/or conditions conducive to disease development.

Anthracnose (*Colletotrichum lentis*) was observed in 74% (37 fields) of the fields surveyed in 2016. The highest prevalence was found in the east-central region (100%), followed by the west-central (88%), southeast (83%) and southwest (50%) regions.

Root rot was observed in 70% (35) of the fields included in the 2016 survey. The highest prevalence was found in the west-central region (94%), followed by the southwest (65%), east-central (63%) and southeast (33%) regions. Root rot was often observed in low lying areas prone to waterlogging. 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. No sampling or further testing was performed to confirm causal pathogens.

Botrytis stem and pod rot / grey mould (*Botrytis cinerea*) was found in 66% of the fields surveyed. The prevalence of botrytis stem and pod rot was considerably higher than recorded from 2012 to 2015, with the highest prevalence in this time period being 29% in 2012. The highest prevalence in 2016 was found in the east-central region (88%), followed by the west-central (69%), southwest (60%) and southeast (50%) regions.

Sclerotinia stem and pod rot *(Sclerotinia sclerotiorum*) was noted in 86% of fields and was the second most prevalent disease in the 2016 lentil disease survey. The highest prevalence was found in the west-central region (94%), followed by the east-central (88%), southwest (85%) and southeast (67%) regions. The prevalence in 2016 was considerable higher than from 2012 to 2015 where the highest prevalence was 56% in 2014.

Stemphylium blight (*Stemphylium* spp.) was found in 88% of lentil fields surveyed. Although the overall prevalence was high, surveyors commented that individual fields had trace levels or had a patchy distribution of the disease in most cases. This disease was observed in 100% of the fields surveyed in the southwest, southeast and east-central region, and in 63% of fields in west-central region. From 2012 to 2015, stemphylium blight has been reported to have a prevalence of 50% (2015) or less. It is not known what economic impact stemphylium blight might have on lentil and there are no commercial fungicides available to manage this disease.

Tables 1-5 include one corrected prevalence value for 2015 and should be considered an amendment to those reported by Dokken-Bouchard et al. (2016).

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Table 1. Prevalence of plant diseases in lentil crops surveyed in West-Central Saskatchewan, 2012-2016.

Year (Number of Crops)	Percentage (%) of Lentil Crops Surveyed with Disease Symptoms					
	Root Rot	Anthracnose	Ascochyta Blight	Sclerotinia Stem and Pod Rot	Botrytis Stem and Pod Rot	Stemphylium Blight
2012 (17)	76	76	24	24	24	53
2013 (12)	83	83	42	33	17	50
2014 (15)	67	80	7	67	0	40
2015 (15)	87	73	0	0	0	40
2016 (15)	94	88	0	94	69	63

Table 2. Prevalence of plant diseases in lentil crops surveyed in Southwest Saskatchewan, 2012-2016.

Year (Number of Crops)	Percentage (%) of Lentil Crops Surveyed with Disease Symptoms					
	Root Rot	Anthracnose	Ascochyta Blight	Sclerotinia Stem and Pod Rot	Botrytis Stem and Pod Rot	Stemphylium Blight
2012 (2)	0	0	100	0	0	0
2013 (16)	38	50	38	38	31	38
2014 (2)	100	100	0	0	0	0
2015 (0)	-	-	-	-	-	-
2016 (20)	65	50	0	85	60	100

Table 3. Prevalence of plant diseases in lentil crops surveyed in Southeast Saskatchewan, 2012-2016.

Year (Number of Crops)	Percentage (%) of Lentil Crops Surveyed with Disease Symptoms					
	Root Rot	Anthracnose	Ascochyta Blight	Sclerotinia Stem and Pod Rot	Botrytis Stem and Pod Rot	Stemphylium Blight
2012 (9)	80	70	30	50	40	10
2013 (9)	89	44	0	22	33	11
2014 (0)	-	-	-	-	-	-
2015 (2)*	50	100	0	50	100	100
2016 (6)	33	83	0	67	50	100

*the values for 2015 are an amendment to those published by Dokken-Bouchard et al. (2016).

Table 4. Prevalence of plant diseases in lentil crops surveyed in East-Central Saskatchewan, 2012-2016.

Year (Number of Crops)	Percentage (%) of Lentil Crops Surveyed with Disease Symptoms					
	Root Rot	Anthracnose	Ascochyta Blight	Sclerotinia Stem and Pod Rot	Botrytis Stem and Pod Rot	Stemphylium Blight
2012	-	-	-	-	-	-
2013	-	-	-	-	-	-
2014 (1)	100	100	0	0	0	100
2015 (1)	100	100	0	100	100	100
2016 (8)	63	100	38	88	88	100

Table 5. Prevalence of plant diseases in lentil crops surveyed in Saskatchewan, 2012-2016.

Year (Number of Crops)	Percentage (%) of Lentil Crops Surveyed with Disease Symptoms					
	Root Rot	Anthracnose	Ascochyta Blight	Sclerotinia Stem and Pod Rot	Botrytis Stem and Pod Rot	Stemphylium Blight
2012 (28)	75	71	32	32	29	36
2013 (37)	65	60	30	32	27	35
2014 (18)	72	83	6	56	0	39
2015 (18)	83	78	0	11	17	50
2016 (50)	70	74	6	86	66	88

CROP / CULTURE: Soybean (*Glycine max* (L.) Merr.)
LOCATION / RÉGION: Southern Alberta

NAMES AND AGENCIES / NOMS ET ÉTABLISSEMENTS

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TITLE / TITRE: THE OCCURRENCE OF SOYBEAN ROOT ROT IN SOUTHERN ALBERTA IN 2016

ABSTRACT: A survey was conducted during the period of August 17- 23, 2016, across 6 locations (Brooks, Duchess, Lethbridge, Medicine Hat, Seven Persons and Turin) in southern Alberta. The survey covered 29 soybean fields with 100 root samples collected per field. Root rot occurred at all locations with an average incidence of 90%, ranging from 25% to 100%and with an average severity of 2.0, ranging from 0.2 to 3.6. Nodulation also was assessed on a scale of 0-4 and averaged 1.9 with a range of 0-3.9 on a scale of 0-4. Species of *Fusarium* were most commonly isolated from infected root tissue (recovered from 85.5% of samples), followed by *Pythium* spp. (7.4%), *Sclerotinia sclerotiorum* (1.7%), *Rhizoctonia solani* (0.8%) and *Phytophthora* spp. (0.2%).

INTRODUCTION: Soybean (*Glycine max* (L.) Merr.) has great potential for inclusion in the cropping systems of southern areas of western Canada (4). In southern Alberta, the area seeded to soybeans has increased from 283 ha in 2008 to about 6,000 ha in 2015 (Patrick Fabian, pers. comm.), and this is expected to continue to increase as early maturing and cold-tolerant cultivars become available. Root rot is, however, a common constraint in soybean production, and its occurrence has been documented in all soybean crops surveyed in southern Alberta in the past few years (2, 3, 6, 7, Fig. 1). Root rot has deleterious effects on plant stand, directly impacting productivity, and also allows invasive weed species to outgrow the crop causing significant reductions in yield and quality (2). A survey was conducted in August 2016 across southern Alberta to assess root rot and its impact on soybean crops.

METHODS: The survey was conducted during August17- 23, 2016 when soybean crops were at the pod set to early pod filling stages. Root samples were collected from 29 soybean fields in six locations of southern Alberta: Brooks, Duchess, Seven Persons, Lethbridge, Medicine Hat, and Turin (Fig. 2). 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 were also collected outside the sampling points (primarily in low lying areas of the field) where the soybeans were observed to be severely stunted, yellowing, or dead. Soil samples were stored for future pathogen baiting experiments. Root samples were shaken gently to rid them of excess soil, sealed in plastic bags, and placed on ice in coolers in order to prevent rapid decomposition. At the end of each day, the root samples were placed in a 4°C cooler until the time of disease scoring. In the laboratory, the roots were washed gently under running water and then visually rated for root rot incidence and severity and nodulation on the 0-4 scales described by Chang et al. (2012). Microorganisms were isolated from infected root tissues using the method described by Chang et al. (2004) (1). Equal amounts of root rot tissues from soybean plants were tested for the presence of *Phytophthora sojae* using the selective medium PBNIC (5).

RESULTS AND DISCUSSION: Root rot was observed in all 29 crops sampled, at a high incidence in most fields, but disease severity varied across the locations. Mean disease severity was highest (3.3) at Medicine Hat and lowest (1.4) at Brooks (Table 1). Root nodulation varied from 0.9 (Turin) to 2.8 (Seven Persons). Overall, root rot disease incidence and severity in the surveyed locations were higher in 2016 than in 2014 and 2015 (6, 7). Rainfall was greater in the 2016 cropping season relative to the previous years, which may have created conducive soil conditions for root rot disease development in the soybean crops.

The majority of the microorganisms isolated from roots exhibiting symptoms of root rot consisted of *Fusarium* (recovered from 85.5% of samples), followed by *Pythium* spp. (7.4%), *Sclerotinia sclerotiorum* (1.7%), *Rhizoctonia solani* (0.8%) and *Phytophthora* spp. (0.2%) (Table 2). Root rot caused extensive yellowing, stunting and mortality of the soybean plants in some low-lying areas. In cases of severe disease, the plants were easily pulled from the soil.

Sclerotinia stem rot disease was observed in 12 of the 29 fields sampled, with the incidence of disease ranging from 0 to 19%. The disease was observed at 4 sites (Duchess, 19% incidence; Turin, 17.5%; Seven Persons, 14%, and Medicine Hat, 13%). No sclerotinia stem rot was observed at the Brooks or Lethbridge sites (Table 1). Nevertheless, the pathogen *S. sclerotinia* was isolated from infected roots at Brooks and Duchess (Table 2). This indicated that most of the pathogen inoculum could have originated from air-borne spores. The higher incidence of root rot and white mould in some fields in 2016 vs. 2015 was due in part to the higher accumulated precipitation (358.1 mm) during the 2016 growing season as compared with 2015 (113.5 mm). Bacterial blight also was observed in experimental plots at CDC South, but not in the fields sampled.

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Table 1. Root rot incidence, severity and nodulation, and Sclerotinia disease in 29 soybean crops in southern Alberta in 2016.

Location	No. of fields surveyed	Root rot incidence (%)		Root rot severity (0-4)		Root nodulation (0-4)		Sclerotinia incidence (%)	
		Range	Mean	Range	Mean	Range	Mean	Range	Mean
Brooks	10	25-100	80	0.2-2.7	1.4	0.0-3.9	1.3	0.0	0.0
Duchess	4	60-100	94	0.8-3.6	2.0	0.2-3.9	2.4	18-20	19
Lethbridge	1	95-100	99	1.1-2.8	2.1	0.5-2.6	1.9	0.0	0.0
Seven Persons	10	75-100	98	1.7-3.3	2.8	2.7-3.4	2.8	12-16	14
Medicine Hat	2	94-100	97	2.2-2.3	3.3	2.8-2.6	2.7	11-15	13
Turin	2	45-100	81	0.7-2.8	2.0	0.0-2.8	0.9	16-19	17.5
Total*/ Average	**29***	**25-100**	**90**	**0.2-3.6**	**2.0**	**0.0-3.9**	**1.9**	**0-20**	**8.7**

Table 2. Incidence of microorganisms isolated from diseased root tissues of soybean plants collected in southern Alberta soybean fields in 2016.

Location	No. of roots tested	Colony numbers of isolated microorganisms					
		Fusarium spp.	*Phytoph-thora* spp.[x]	*Sclerotinia sclerotiorum*	*Pythium* spp.	*Rhizoctonia solani*	Miscella-neous[y]
Brooks	500	303	0	10	31	4	11
Duchess	40	133	0	8	7	4	3
Lethbridge	10	30	1	0	11	0	2
Medicine Hat	20	69	1	0	6	0	3
Seven Persons	500	335	0	0	16	0	20
Turin	20	33	0	0	7	0	7
Total	**1,090**	**903**	**2**	**18**	**78**	**8**	**46**
Isolation (%)	**-**	**85.5**	**0.2**	**1.7**	**7.4**	**0.8**	**4.4**

[x]*Phytophthora* spp. were isolated on PBNIC medium. All other fungi were isolated using PDA medium.
[y]Miscellaneous fungi isolated included *Alternaria* spp., *Pithomyces* spp., *Rhizopus* spp. and *Stemphylium* spp.

Figure 1. Soybean plants affected by severe root rot and exhibiting premature yellowing in a field near Turin, AB, 2016.

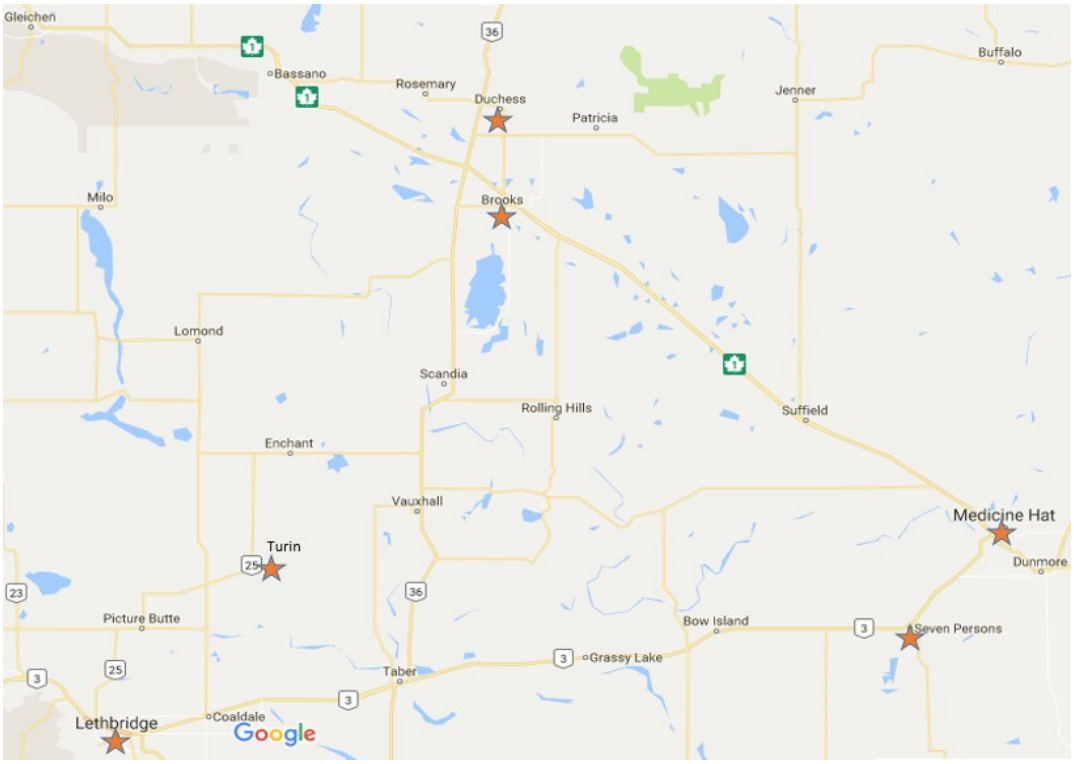

Figure 2. Map showing the approximate locations of the surveyed soybean crops in southern Alberta in 2016.

CROP / CULTURE: Soybean
LOCATION / RÉGION: Manitoba

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TITLE: SURVEY OF SOYBEAN DISEASES IN MANITOBA IN 2016

ABSTRACT: A total of 55 soybean crops at the V2 toV3 (two trifoliates/three nodes to three trifoliates/ two nodes) stage were surveyed in Manitoba for the prevalence and incidence of foliar and root diseases. A total of 82 soybean crops at the R5 to R6 (beginning seed to full seed) stage were surveyed for the prevalence and incidence of phytophthora root rot and prevalence, incidence and severity of bacterial blight, septoria brown spot, downy mildew, white mould, pod/stem blight, and anthracnose. At the later survey timing, bacterial blight and septoria brown spot were the most prevalent diseases throughout the province. Symptoms of soybean cyst nematode were not observed in the 2016 disease survey.

METHODS: A provincial soybean survey coordinated by Manitoba Agriculture and Manitoba Pulse and Soybean Growers was conducted for the first time in 2016. All results are based on visual assessment of diseases within the surveyed crops. A total of 55 fields were surveyed at the “early” stage (V2-V3 stage). Plants in these fields were given a presence/absence rating for general foliar disease and a presence/absence rating for general root disease. A total of 82 fields were surveyed at the “late” stage (R5-R6 stage). Plants at this timing weregiven incidence and severity ratings for bacterial blight, septoria brown spot, downy mildew, white mould, pod/stem blight, and anthracnose and an incidence rating for phytophthora root rot. Severity for 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 survey focused on areas with longer histories of soybean production with fewer fields being surveyed in areas newer to soybean production (Table 1).

RESULTS (EARLY SURVEY): Foliar disease was present in 91% of the fields surveyed (Table 2). The prevalence was highest in the eastern/interlake region (94%) and lowest in the southwest (75%). The provincial average incidence of foliar disease was 30%. The incidence was highest in the central region (37%) and lowest in the southwest (19%).

Root disease was present in 58% of the fields surveyed (Table 2). The prevalence was highest in the central region (70%) and lowest in the southwest (38%). The provincial average incidence of root disease was 8%. The incidence was highest in the eastern/interlake region (9%) and lowest in the southwest (2%).

RESULTS (LATE SURVEY): Bacterial blight was present in 87% of the fields surveyed (Table 3). The prevalence was highest in the southwest region (100%) and lowest in the central region (84%).The provincial average incidence of bacterial blight was 49%. The incidence was highest in the eastern/ interlake region (63%) and lowest in the southwest (24%). The average severity of bacterial blight was 1.7. The severity was highest in the central region (1.8) and the lowest in the southwest (1.4).

Septoria brown spot was present in 98% of the fields surveyed (Table 3). The prevalence was highest in the southwest and eastern/interlake regions (100%) and lowest in the central region (95%). The provincial average incidence of septoria brown spot was 57%. The incidence was highest in the eastern/interlake region (74%) and lowest in the southwest (18%). The average severity of septoria brown spot was 1.6. The severity was highest in the eastern/interlake region (1.6) and the lowest in the central and southwest regions (1.5).

Downy mildew was present in 39% of the fields surveyed (Table 4). The prevalence was highest in the central region (58%) and lowest in the southwest (11%). The provincial average incidence of downy mildew was 35%. The incidence was highest in the central region (39%) and lowest in the southwest (2%). The average severity of downy mildew was 1.5. The severity was highest in the central region (1.6) and the lowest in the southwest (1.0).

White mould was present in 33% of the fields surveyed (Table 4). The prevalence was highest in the central region (37%) and lowest in the southwest (11%). The provincial average incidence of white mould was 9%. The incidence was highest in the central region (9%) and lowest in the southwest (5%). The average severity of white mould was 2.8. The severity was highest in the southwest region (3.6) and the lowest in the eastern/interlake region (2.6).

Pod/stem blight was present in 9% of the fields surveyed (Table 5). The prevalence was highest in the eastern/interlake region (17%) and lowest in the southwest (0%). The provincial average incidence of pod/stem blight was 11%. The incidence was highest in the eastern/interlake region (15%) and lowest in the southwest (0%). The average severity of pod/stemblight was 1.5. The severity was highest in the eastern/interlake region (1.7) and did not occur in the southwest region.

Visual symptoms of anthracnose were present in 10% of the fields surveyed (Table 5). Symptomatic plant samples were not assessed in the laboratory for fungal isolation and identification to confirm the visual disease identification. The prevalence was highest in the central region (11%) and lowest in the eastern/interlake region (3%). The provincial average incidence of anthracnose was 2%. The incidence was highest in the eastern/interlake region (5%) and lowest in the central region (1%). The average severity of anthracnose was 1.7. The severity was highest in the central region (1.8) and the lowest in the southwest (1.0).

Plant samples symptomatic of phytophthora root rot (PRR) were found in 59% of the fields surveyed (Table 6). The prevalence was highest in the eastern/interlake region (73%) and lowest in the southwest (22%). The provincial average incidence of plants symptomatic of PRR was 7%. The incidence was highest in the central and southwest regions (8%) and lowest in the eastern/interlake region (7%). Severity ratings were not taken for PRR. Symptomatic plant samples were not assessed in the laboratory for fungal isolation and identification to confirm the visual disease identification. A separate survey conducted by McLaren et al. in 2016 and reported in this issue of CPDS indicated that 38% of fields surveyed were confirmed through laboratory assessment and molecular detection techniques to be positive for the presence of *Phytophthora sojae.* Visual detection of this disease can be difficult and therefore, in this report, plants symptomatic of PRR in 59% of the 82 crops surveyed may be on the high side without confirmation of the presence of the pathogen.

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ACKNOWLEDGEMENTS: This survey work was coordinated with research being conducted by Agriculture and Agri-Food Canada and Brandon University.

Table 1. Number of fields surveyed by crop reporting district in Manitoba.

Region	Early Survey	Late Survey
Central	30	43
Eastern/Interlake	17	30
Southwest	8	9
Provincial Total	55	82

Table 2. Manitoba 2016 soybean disease survey results at early-season survey timing (V2-V3 stage).

Region (No. of Crops)	Foliar Disease		Root Disease	
	Prevalence	Inc[1] (Inc[2])	Prevalence	Inc[1] (Inc[2])
Central (30)	93	37 (35)	70	8 (6)
Eastern/Interlake (17)	94	22 (21)	47	9 (4)
Southwest (8)	75	19 (14)	38	2 (1)
Provincial Total (55)	91	30 (27)	58	8 (4)

[1]Average percent incidence of disease in soybean crops infected with the given disease.
[2]Average percent incidence of disease in all soybean crops with and without the given disease.

Table 3. Manitoba 2016 soybean disease survey results for bacterial blight and septoria brown spot at late-season survey timing (R5-R6).

Region (No. of Crops)	Bacterial Blight			Septoria Brown Spot		
	Prevalence	Inc[1] (Inc[2])	Severity[3]	Prevalence	Inc[1] (Inc[2])	Severity[3]
Central (43)	84	44 (37)	1.8	95	53 (51)	1.5
Eastern/Interlake (30)	87	63 (55)	1.6	100	74 (74)	1.6
Southwest (9)	100	24 (24)	1.4	100	18 (18)	1.5
Provincial Total (82)	87	49 (42)	1.7	98	57 (56)	1.6

[1]Average percent incidence of disease in soybean crops infected with the given disease.
[2]Average percent incidence of disease in all soybean crops with and without the given disease.
[3]Average severity of disease in soybean crops infected with the given disease.

Table 4. Manitoba 2016 soybean disease survey results for downy mildew and white mould at late-season survey timing (R5-R6).

Region (No. of Crops)	Downy Mildew			White Mould		
	Prevalence	Inc[1] (Inc[2])	Severity[3]	Prevalence	Inc[1] (Inc[2])	Severity[3]
Central (43)	58	39 (22)	1.6	37	9 (3)	3.0
Eastern/Interlake (30)	27	25 (7)	1.2	33	8 (3)	2.6
Southwest (9)	11	2 (0.2)	1.0	11	5 (1)	3.6
Provincial Total (82)	39	35 (14)	1.5	33	9 (3)	2.8

[1]Average percent incidence of disease in soybean crops infected with the given disease.
[2]Average percent incidence of disease in all soybean crops with and without the given disease.
[3]Average severity of disease in soybean crops infected with the given disease.

Table 5. Manitoba 2016 soybean disease survey results for pod/stem blight and anthracnose at late-season survey timing (R5-R6).

Region (No. of Crops)	Pod/Stem Blight			Anthracnose		
	Prevalence	Inc[1] (Inc[2])	Severity[3]	Prevalence	Inc[1] (Inc[2])	Severity[3]
Central (43)	7	2 (0.1)	1.3	14	1 (0.1)	1.8
Eastern/Interlake (30)	17	15 (2)	1.7	3	5 (0.2)	1.4
Southwest (9)	0	0 (0)	n/a	11	3 (0.3)	1.0
Provincial Total (82)	9	11 (9)	1.5	10	2 (0.2)	1.7

[1]Average percent incidence of disease in soybean crops infected with the given disease.
[2]Average percent incidence of disease in all soybean crops with and without the given disease.
[3]Average severity of disease in soybean crops infected with the given disease.

Table 6. Manitoba 2016 soybean disease survey results for phytophthora root rot at late-season survey timing (R5-R6).

Region (No. of Crops)	Prevalence	Inc[1] (Inc[2])
Central (43)	56	8 (4)
Eastern/Interlake (30)	73	7 (5)
Southwest (9)	22	8 (2)
Provincial Total (82)	59	7 (4)

[1]Average percent incidence of disease in soybean crops infected with the given disease.
[2]Average percent incidence of disease in all soybean crops with and without the given disease.

CROP / CULTURE: Soybean
LOCATION / RÉGION: CROP: Manitoba

NAMES AND AGENCIES / NOMS ET ÉTABLISSEMENTS

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TITLE: SOYBEAN ROOT ROT AND PHYTOPHTHORA ROT IN MANITOBA IN 2015

ABSTRACT: In 2015, 40 soybean crops were surveyed in Manitoba for root diseases and fusarium root rot was the most prevalent root disease. Root rot was severe in low-lying areas of some fields, indicating that seed yield and quality may have been affected.

INTRODUCTION: Soybean production continues to increase with 354,000 ha (875,000 acres), 428,000 ha (1,058,000 acres), 525,700 ha (1,299,000 acres) and 526,100 ha (1,300,000 acres) seeded in Manitoba in 2012, 2013, 2014 and 2015, respectively (Manitoba Pulse Growers Association 2014; Statistics Canada 2015). This represents the eighth consecutive annual increase in soybean production in Manitoba. Root rot is a constraint in other areas of Canada where soybean production is established (Chang et al. 2013; OMAFRA 2011) and this disease complex may become more of an issue in Manitoba as soybean production continues to expand.

METHODS: Soybean crops were surveyed for root diseases at 40 different locations in Manitoba in 2015. The crops surveyed were randomly chosen from regions in south-central and southwest Manitoba where soybean is commonly grown.

The survey for root diseases was conducted during mid- to late-July when most plants were at the early flowering stage. At least ten plants were sampled by uprooting them 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). To confirm the visual disease identification, 15 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 soybean crops surveyed were frozen for future PCR analysis of root rot pathogens.

All crops that were surveyed for root rot in July were re-assessed in mid- to late August for phytophthora rot. Twenty-three additional crops were also included in the late season survey, which was conducted when most plants were at the R6 stage (APS Press 1999). Soybean plants that were symptomatic for phytophthora root and stem rot were collected for further assessment in the laboratory. Approximately 200 stems were placed on different selective media to identify *Phytophthora* spp. based on morphological characteristics (Gallegly and Hong 2008). Tissue samples from symptomatic plants were frozen for molecular detection of pathogens at a later date.

RESULTS AND COMMENTS: Favourable environmental conditions resulted in an early start to the 2015 growing season, with some early-seeded soybeans being reported (Manitoba Agriculture Food and Rural Development 2015a). Soybeans in many regions of the province responded well to good growing conditions in late June and into July and early August. Some fields that missed thundershowers in early August showed symptoms of moisture stress and premature senescence ((Manitoba Agriculture, Food and Rural Development 2015b). However crop yields were reported to be slightly above long term averages (Manitoba Agriculture, Food and Rural Development 2015c).

Root rot was observed in all soybean crops surveyed in July 2015. The microorganisms most frequently isolated from roots of infected plants belonged to *Fusarium* spp. (Table 1). Thirty-nine crops in which *Fusarium* spp. were isolated had root rot severity ratings that ranged from 1.3 to 6.7 with a mean of 4.3. Rhizoctonia root rot (*Rhizoctonia solani*) was not detected in any of the crops surveyed in 2015. The low recovery rate of *R. solani* in 2013 and lack of recovery in 2014 and 2015, suggest that in Manitoba this fungus may not be as important a root rot pathogen of soybean as are *Fusarium* spp., in contrast with other regions in western Canada (Chang et al. 2013). Pythium root rot was identified in five soybean crops with root rot ratings ranging from 2.1 to 5.9 and a mean of 3.8.

Phytophthora rot was identified in 3% (2/63) of fields surveyed in mid-August (Table 1). Each symptomatic plant that was positive for *Phytophthora* spp. had a discoloured taproot with lesions that progressed up the stem. Although symptomatic plants were collected from 16 soybean crops, many samples were not able to be processed immediately making isolation of *Phytophthora* spp. more challenging. Molecular detection methods to confirm the presence of *Phytophthora* spp. from the surveyed crops are currently in progress. This disease is more common in heavy textured soils that are subject to saturation and flooding such as those in the Red River Valley. In addition, soybeans have been grown longer in this region. Favorable weather (cool and wet) contributes to the occurrence of phytophthora rot as motile zoospores, the primary infective units, are produced under cool conditions when the soil is saturated. In late July, hot, humid weather conditions were common in many areas of soybean production (Manitoba Agriculture, Food and Rural Development 2015d) and this may have contributed to the reduced risk from this disease.

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Table 1. Prevalence and severity of root diseases in 40 crops of soybean in July and prevalence of phytophthora rot in 63 crops of soybean in August 2015.

		Disease Severity (0-9)[1]	
Disease	**No. Crops Affected**	**Mean**	**Range**
Fusarium root rot	39	4.3	1.3-6.7
Pythium root rot	5	3.8	2.1-5.9
Rhizoctonia root rot	0	0	0
Phytophthora rot	2	n/a	n/a

[1]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.

CROP / CULTURE: **Soybean**
LOCATION / RÉGION: **Manitoba**

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TITLE / TITRE: SOYBEAN ROOT ROT AND PHYTOPHTHORA ROT IN MANITOBA IN 2016

ABSTRACT: In 2016, 40 soybean crops were surveyed in Manitoba for root diseases and fusarium root rot was the most prevalent root disease. Root rot was severe in low-lying areas of some fields, indicating that seed yield and quality may have been affected.

INTRODUCTION: Soybean production continues to increase with 428,000 ha (1,058,000 acres), 525,700 ha (1,299,000 acres), 526,100 ha (1,300,000 acres) and 647,500 ha (1,600,000 acres) seeded in Manitoba in 2013, 2014, 2015 and 2016, respectively (Manitoba Pulse and Soybean Growers 2016; Statistics Canada 2016). This represents the ninth consecutive annual increase in soybean production in Manitoba. Root rot is a constraint in other areas of Canada where soybean production is established (Chang et al. 2013; OMAFRA 2011) and this disease complex may become more of an issue in Manitoba as soybean production continues to expand.

METHODS: Soybean crops were surveyed for root diseases at 40 different locations in Manitoba in 2016. The crops surveyed were randomly chosen from regions in south-central and southwest Manitoba, where soybean is commonly grown.

The survey for root diseases was conducted during mid-July when most plants were at the early pod stage. At least ten plants were sampled by uprooting them 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). To confirm the visual disease identification, 15 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 soybean crops surveyed were frozen for future PCR analysis of root rot pathogens.

All crops that were surveyed for root rot in July were re-assessed for phytophthora rot in mid-August when most plants were at the pod yellowing (R7) stage (APS Press 1999). Approximately 37 additional crops were also included in the late season survey. Soybean plants that were symptomatic for phytophthora root and stem rot were collected for further assessment in the laboratory. Approximately 250 stems were placed on different selective media to identify *Phytophthora* spp. based on its morphological characteristics (Gallegly and Hong 2008). Tissue samples from symptomatic plants were frozen for molecular detection of pathogens at a later date.

RESULTS AND COMMENTS: Cool temperatures and scattered showers delayed soybean seeding for many producers in 2016. However, in some areas, warmer, drier conditions prevailed, which led to an early start of spring seeding (Manitoba Pulse and Soybean Growers 2016). Variable weather throughout the season with warm, dry periods and sudden thunderstorms or heavy rainfall events proved challenging for crop production (Manitoba Agriculture 2016a). Higher yields were obtained in areas receiving timely precipitation, with lower yields generally a result of excess moisture or extreme weather events (Manitoba Agriculture 2016b).

Root rot was observed in all 40 soybean crops surveyed in July 2016. The microorganisms most frequently isolated from roots of infected plants belonged to *Fusarium* spp. (Table 1). Forty crops in which *Fusarium* spp. were isolated had root rot severity ratings that ranged from 3.4 to 7.7 with a mean of 5.6. Rhizoctonia root rot (*Rhizoctonia solani*) was not confirmed in any of the crops surveyed in 2016. The low recovery rate of *R. solani* in 2013 and lack of recovery in 2014, 2015 and 2016 suggest that in Manitoba this fungus may not be as important a root rot pathogen of soybean as are *Fusarium* spp., in contrast with other regions in western Canada (Chang et al. 2013). Pythium root rot was not detected in any soybean crops surveyed in 2016.

To date, phytophthora rot has been identified in 38% (15/40) of fields surveyed in mid-August for this disease (Table 1). Each symptomatic plant that was positive for *Phytophthora* spp. had a discoloured taproot with lesions that progressed up the stem. Plant samples were also obtained from an additional 37 crops, but few were symptomatic of the disease and when selected samples were processed for isolation, no phytophthora rot was detected. Molecular detection methods to confirm the presence/absence of *Phytophthora* spp. from the surveyed crops are currently in progress.

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Table 1. Prevalence and severity of root diseases in 40 crops of soybean in July and prevalence of phytophthora rot in 40 crops of soybean in August 2016.

		Disease Severity (0-9)[1]	
Disease	**No. Crops Affected**	**Mean**	**Range**
Fusarium root rot	40	5.6	3.4 - 7.7
Pythium root rot	0	0	0
Rhizoctonia root rot	0	0	0
Phytophthora rot	15	n/a[2]	n/a

[1]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.
[2]No disease severity ratings were available.

CROP / CULTURE: Sunflower
LOCATION / RÉGION: Manitoba

NAMES AND AGENCY / NOMS ET ÉTABLISSEMENTS

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TITLE / TITRE: DISEASES OF SUNFLOWER IN MANITOBA IN 2016

ABSTRACT: A survey of 40 sunflower crops in Manitoba in 2016 revealed that sclerotinia wilt/basal stem rot was the most prevalent disease in 94% of the crops followed by verticillium wilt in 78%, sclerotinia head rot in 63%, rust in 56%, septoria leaf spot in 53%, phoma stem lesions in 41%, and downy mildew in 31%. Disease severity ranged from low to moderate with no severe epidemics.

METHODS: A total of 40 sunflower crops were surveyed in 2016 in Manitoba. Fifteen crops were surveyed in the third week of August, 12 in the fourth week of August, and 13 in the first week of September. 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, eight samples of downy mildew-infected plants were submitted by the National Sunflower Association of Canada from crops surveyed early in the season for downy mildew race identification, and 11 samples of sunflower plants were submitted for analysis to the Crop Diagnostic Centre of Manitoba Agriculture by agricultural representatives and growers.

RESULTS AND COMMENTS: Ninety-seven percent of the sunflower crops surveyed in 2016 had excellent to good stands, but only 72% had good vigour, and the rest had fair to poor vigor. Only 81% of the sunflower crops were early maturing, and the remaining 19% were late to very late (Table 1). The crops surveyed were split 60:40% between confectionery and oilseed hybrids, thus showing a decrease in the confection acreage in 2016 in comparison with previous years (1, 2, 3). The 2015 growing season started with above normal soil moisture, and this contributed to the decrease in the area seeded to sunflower in Manitoba (~30,000 ha in 2016 in comparison with 41,000 ha in 2015 (Statistics Canada 2016). Growing conditions were relatively normal throughout the growing season with above normal precipitation throughout the summer. Low disease incidence and severity were observed in 2016 for rust and downy mildew in comparison with previous years (1, 2, 3).

Sclerotinia wilt/basal stem rot was present in 94% of the crops surveyed in 2016, 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 63% of infested crops. The prevalence and incidence of head rot in 2016 were high in comparison with 2015 due to the above normal soil moisture conditions in 2016 which favoured root infection by mycelia and ascospores production for head infections (1).

Rust was present in 56% of the crops surveyed, with severity ranging from trace to 5% leaf area affected in most fields but as high as 30% leaf area affected in a few crops (Table 1). Rust infections started relatively late in 2016 and did not develop rapidly in most of the crops surveyed. Preliminary analysis of the rust isolates collected indicates the prevalence of races 777, 735, 727, 357, and 377 of *P. helianthi*, which are virulent on most commercial sunflower hybrids. The predominant race of the 2016 rust population was race 777, similar to 2015 (1). Rust incidence and severity in 2016 were lower than in 2015 (1, 2), and were probably due to the late onset of infection and the normal temperatures in July and August.

Verticillium wilt was present in 78% of the crops surveyed in 2016 with traces to 5% severity in the oilseed hybrids, and 10-20% severity in the confection sunflower hybrids (Table 1). The incidence and severity of verticillium wilt were lower in 2016 than in 2015 (1).

Downy mildew was observed in 31% of the crops in 2016 close to the 29% in 2015, two years of low records of this disease (Table 1). The incidence ranged from trace to 2% at a record low in 2016, especially in the eight crops surveyed early in the season for downy mildew. Preliminary analysis of isolates collected indicates the predominance of race-group 700 (88%) followed by races 776 (38%), 732 (21%), 722 (17%), 702 (8%), and 766 (4%). A total of 43% of the downy mildew isolates collected in 2016 are either insensitive or partially insensitive to metalaxyl seed treatment, a little lower than levels reported in previous years (1, 2, 3). Downy mildew was less prevalent in 2016 and 2015 than in 2014 and was at trace levels in most crops perhaps due to normal soil moisture at the seedling stage and the wide use of downy mildew resistant hybrids (1, 2, 3).

Traces to 5% leaf area infected by *Septoria helianthi* were observed in 53% of the crops as well as some infection by *Alternaria* spp. in a few crops (Table 1) with higher severity and prevalence than previous years (1, 2, 3). Traces to 5% of stem lesions caused by *Phoma* spp. were observed in 41% of the crops and traces to 1% of *Phomopsis* spp. were present in 16% of the crops surveyed in 2016, similar to 2012-2015 but considerably lower than those prior to 2012 (1, 2, 3).

Traces to 1% infestation with the sunflower beetle (*Zygogramma exclamationis*) were observed in a few crops. Infestations at trace to 1% levels with sunflower midge (*Contarinia schulzi*) were encountered in 25% of the crops. Traces of infestation with grasshoppers were observed in a few crops. Moderate infestations by aphids were encountered in a few crops in 2016.

All the seven sunflower diseased samples submitted by the NSAC were diagnosed as having downy mildew. Of the 11 samples received by the Manitoba Agriculture Crop Diagnostic Centre in 2016, one was affected by fusarium root rot, one with Pythium root rot, two by alternaria leaf spot; two by phomopsis stem canker, one by sclerotinia head rot, one by sclerotinia stalk rot, and three with herbicide injury.

ACKNOWLEDGMENTS: The technical assistance of Tricia Cabernel and Maurice Penner is gratefully acknowledged.

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Table 1. Prevalence and index of diseases in 40 crops of sunflower in Manitoba in 2016, eight of which were surveyed early for downy mildew only.

Disease	Crops Affected		Disease Index[1]	
	No. of crops	% of crops	Mean	Range
Sclerotinia wilt/basal stalk rot	30	94%	1.3	1 - 3
Sclerotinia head rot/stem rot	20	63%	1.0	T - 1
Verticillium wilt	25	78%	1.4	T - 3
Downy mildew	10	31%	1.0	T - 1
Rust	18	56%	1.5	1 - 3
Leaf spots (*Septoria* & *Alternaria*)	17	14%	1.1	1 - 2
Phoma stem lesions	13	41%	1.1	T - 2
Phomopsis stem lesions	5	16%	1.0	T - 1
Lateness[2]	6	19%	1.8	1 - 3
Poor Stand	1	3%	1.3	1 - 3
Poor Vigour	9	28%	2.0	1 - 4

[1]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.

[2]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 / CULTURE: Wasabi (*Wasabia japonica*)
LOCATION / RÉGION: British Columbia

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TITLE / TITRE: 2016 SURVEY OF FUNGAL DISEASES OF WASABI IN BRITISH COLUMBIA GREENHOUSES

ABSTRACT: Five wasabi greenhouses in the Lower Mainland and Vancouver Island areas of British Columbia were surveyed for disease symptoms during the summer of 2016. Disease symptoms (Table 1) were observed at low to moderate levels, depending on the greenhouse sampled. Thirty-one plant samples were collected from which 8 potential fungal pathogens, as well as two oomycetes and one bacterial pathogen, were identified. Three previously unreported fungi were recovered, including *Verticillium isaacii, Fusarium solani,* and *Fusarium avenaceum*.

INTRODUCTION AND METHOD: We conducted a survey of fungal pathogens on wasabi (*Wasabia japonica*) from May to August 2016. Thirty-one plant samples were taken from 5 greenhouses in British Columbia –3 in the Lower Mainland (Abbotsford and Surrey) and 2 on Vancouver Island (Sooke and Nanoose Bay). Microbes were isolated following surface-sterilization and plating of diseased tissues onto potato dextrose agar and identified by microscopic features and sequencing of the ITS1-ITS4 barcode region. Host/pathogen associations have not yet been confirmed by Koch's postulates.

RESULTS AND COMMENTS: Moderate levels of verticillium wilt/blackening and powdery mildew were recorded at most locations except Surrey and Sooke (Table 1). Phoma leaf spot was recorded in moderate levels at all Lower Mainland locations (Table 1). Root rot caused by *Pythium* and *Fusarium* species was found at low levels across locations (Table 1).

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.

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Table 1. Summary of diseases of wasabi identified during a survey of BC greenhouses in the summer of 2016.

CROP	DISEASE/ SYMPTOM	CAUSAL/ ASSOCIATED ORGANISM	NUMBER OF SAMPLES
Wasabi (*Wasabia japonica)*	Root rot, wilt, and vascular blackening	*Verticillium isaacii*	6
	Leaf spot and vascular blackening	*Phoma wasabiae Leptosphaeria biglobosa*)	5
	Powdery mildew	*Erysiphe cruciferarum*	5
	Leaf blight	*Botrytis cinerea*	3
	White rust	*Albugo candida*	2
	Root rot	*Fusarium avenaceum*	2
	Root rot	*Fusarium solani*	1
	Anthracnose	*Colletotrichum destructivum*	1
	Root rot	*Pythium intermedium*	1
	Root rot	*Pythium irregulare*	1
	Soft rot	*Pectobacterium carvotorum*	2

CROP / CULTURE: Garlic
LOCATION / RÈGION: Manitoba

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TITLE / TITRE: THE OCCURRENCE OF STEM AND BULB NEMATODE ON GARLIC IN SOUTHERN MANITOBA, CANADA IN 2015

ABSTRACT: Stem and bulb nematode *Ditylenchus dipsaci* is known to have a significant presence in garlic crops, particularly in eastern Canada. In June 2015, we received samples of garlic bulbs with disease symptoms caused by stem and bulb nematode from two locations south of Winnipeg in the Red River Valley. Nematodes were isolated from the samples and identified as *D. dipsaci* based on morphometric and morphological characters of adult individuals. The detection was confirmed by analysing the *hsp*90 and ITS regions of rDNA using species specific primers. To our knowledge, this is the first report of *D. dipsaci* associated with garlic in Manitoba.

INTRODUCTION: *Ditylenchus dipsaci* (Kühn) Filipjev (Tylenchida: Anguinidae) is considered one of the most destructive pests of many cultivated and wild crops. It has numerous hosts and is considered as a quarantine pest in many countries. *D. dipsaci* can invade and damage garlic and onion crops throughout the world, due to its ability to adapt to different climatic conditions. However, the moderate and humid environmental conditions occurring in early spring in Canada favor the nematode development. *D. dipsaci* produces several generations per growing season which leads to severe yield loss. In Canada, the first occurrence of *D. dipsaci* on onion was reported in southwestern Ontario in 1957 (Mountain, 1957). Results of a recent survey of garlic growing fields in Ontario revealed that 73% of the samples collected were infested with *D. dipsaci* (Hughes et al., 2013). More recently, the Soil Ecology laboratory at the University of Manitoba recovered the nematode in garlic bulbs from Quebec (unpublished).

METHODS: One plant sample from a commercial garlic field and one from a home garden were delivered to the Soil Ecology Lab at the University of Manitoba. Disease symptoms visible on the infected plants were recorded. Nematode individuals were isolated from plant bulbs and identified primarily by microscopic examination of morphometric and morphological characters of males and females including body length and width, stylet length, vulva and spicule length and tail length (Tenuta et al., 2014). A PCR-based assay using species-specific primers described by Madani et al. (2015) was used with some modifications for nematode identification. Briefly, DNA was extracted from single adults from each plant sample and the species-specific primers U831 (5′-AAY AAR ACM AAG CCN TYT GGA C-3′) and Dipsaci_hsp90R (5′-GWG TTA WAT AAC TTG GTC RGC-3′) were used in the PCR reaction. The modification made in our study was in the DNA amplification temperature and time consisted of 35 cycles of 4 min at 94˚C, 30 sec at 94 ˚C and 45 s at 56 ˚C. A final step of 15 min at 72 ˚C completed the DNA amplification followed by running on a 1.2% agarose gel, stained with GelRed (Biotium, Hayward CA) dye in TAE buffer.

Population density of the nematode in the plants was determined by extracting vermiform life stages using an extraction pan, followed by enumerating the number of nematode in a counting slide under compound microscope at 40x.

RESULTS AND DISCUSSION: Disease symptoms observed on the infested plants include malformation and twisting of the leaves, blister-like areas on the leaf surface, and leaf dieback (Fig 1A & B). The bulbs were soft or spongy and no roots were observed on the bulbs (Fig 1C). Plants were generally weakened and stunted. In addition, many conidia of fusarium basal rot (*Fusarium* spp.) were observed in the extracted nematode suspension.

All nematode specimens isolated from the two samples were identified as *D. dipsaci* based on key morphological characters from females and males. Measurements of females (*n* = 5) included a body length of 1,454 to 1,585µm, maximum body width 31 to 35µm, body width at anus 21 to 22µm, stylet length 7.9 to 10.1µm, vulva length 1,161 to 1,246µm, and tail length 82-95µm. Male (*n* = 5)

measurements were body length of 1,446-1,548µm, maximum body width 31 to 34µm, body width at anus 20 to 22µm, stylet length 8.4 to 10.3µm, spicule length 30 to 32µm, and tail length 88 to 101µm. The measurements were generally similar to those reported by Tenuta et al. (2014) and other authors for *D. dipsaci*.

Our PCR test confirmed the *D. dipsaci* identification by amplification of a distinct 182-bp fragment (Fig. 2). The primer set used in our study amplified DNA of a population of *D. dipsaci* obtained from garlic bulbs in Ontario, whereas it did not amplify DNA of *D. weischeri*, a closely (morphologically) related species, obtained from *Cirsium arvense* stems from Manitoba (Fig. 2).

The number of *D. dipsaci* recovered from infested garlic plants ranged between 63 and 254 nematodes per gram of dry material. A mass of the nematode individuals was observed on the bottom surface of the infested bulbs (Fig. 3A). In addition, nematode developmental stages, including eggs, were detected inside the leaf scales of bulbs (Fig. 3B) and stem tissues.

This nematode pest has not been known to occur in Manitoba previously. We believe that the growers importing infested seed bulbs of garlic from Ontario introduced the nematode into Manitoba. Infested bulbs may easily be overlooked and become the sources of *D. dipsaci* re-infestation. The presence of *D. dipsaci* in garlic seed is of importance for spreading of the pest and may allow this nematode to cross quarantine barriers. The use of uncertified saved seed bulbs may intensify the chance of contamination of crops by *D. dipsaci*. If the nematode is present in soil, garlic cultivation should be either prohibited or subjected to phytosanitary controls. Crop rotation with nonhost crops has been recognized as a useful method for the disease management. We recently discovered that wheat and canola are nonhosts for *D. dipsaci* and can be used as rotational crops to control the nematode.

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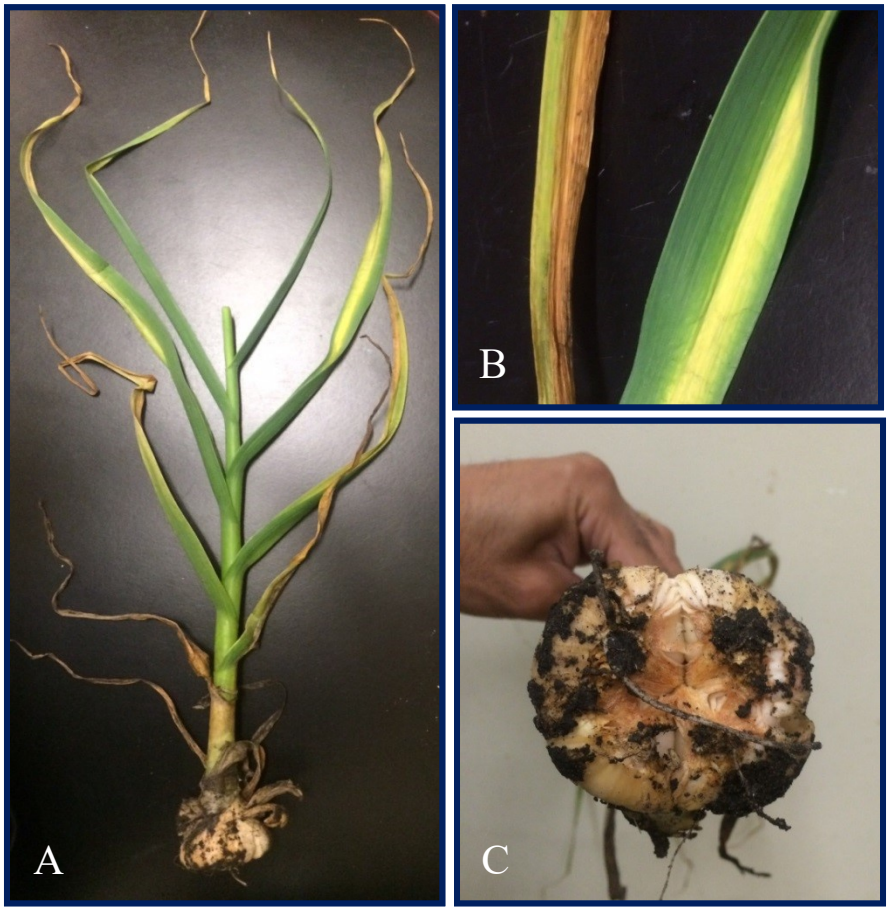

Fig. 1. A & B: Garlic plant with chlorosis symptoms on the foliage and dieback of the leaves caused by stem and bulb nematode (*Ditylenchus dipsaci*) and fusarium basal rot (*Fusarium* spp.). As the disease progresses the leaves becomes necrotic, followed by stunting and drying of the whole plant, C: Root loss and basal plate damage on the bulb due to growth of pink masses of the fungal mycelium co-infested with the nematode.

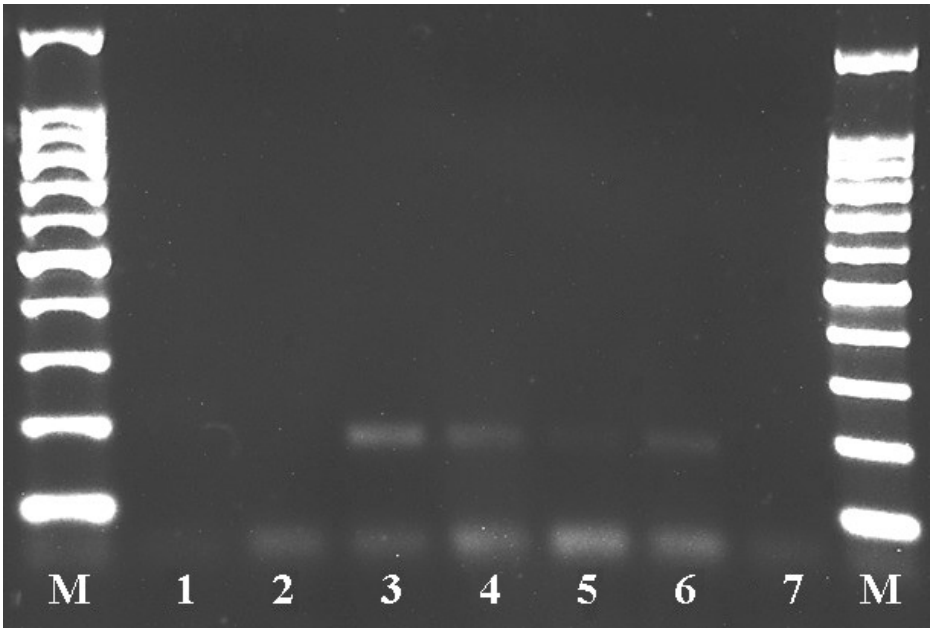

Fig. 2. Gel with specific amplicons obtained by PCR with the *D. dipsaci* species-specific primer. Lanes: M =100-bp DNA ladder; 1 and 7 = control (without DNA); 2 = *D. weischeri* from *C. arvense*; 3-5 = *D. dipsaci* from garlic, Manitoba, and 6 = *D. dipsaci* from garlic, Ontario.

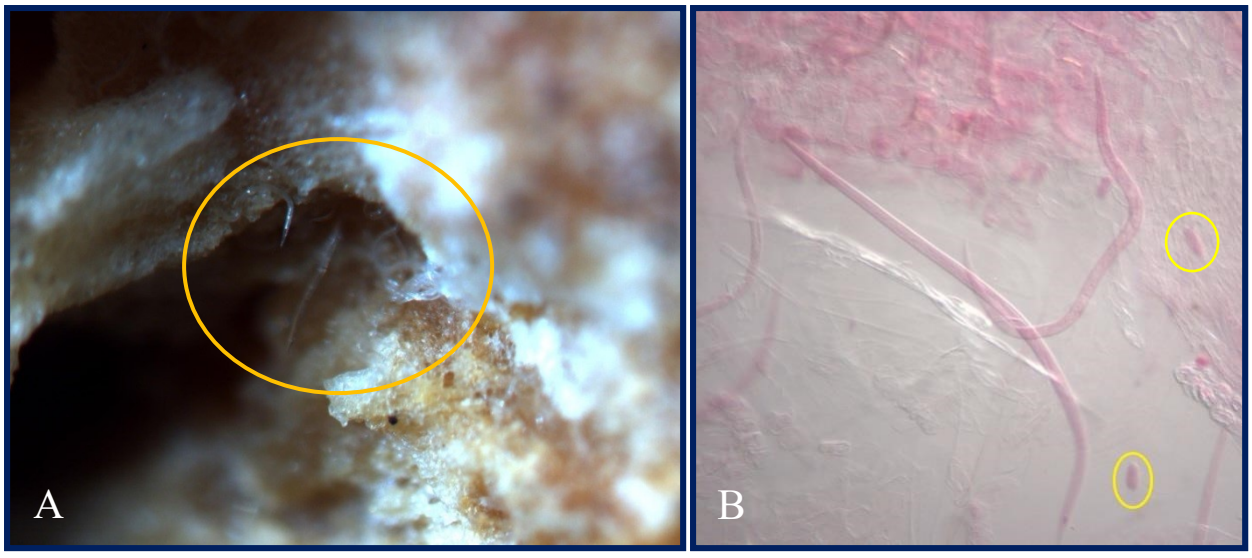

Fig. 3. A: Mass of *Ditylenchus dipsaci* individuals on the bottom surface of an infested garlic bulb, B: Stained red adults and eggs (circled) of the nematode inside a leaf scale of the bulb.

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