Canadian Plant Disease Survey

Inventaire des maladies des plantes au Canada

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CONTENTS

The *Canadian Plant Disease Survey* is a periodical of information and record on the occurrence and severity of plant diseases in Canada and on the assessment of losses from disease. Other original information such as the development of methods of investigation and control, including the evaluation of new materials, will also be accepted. Review papers and compilations of practical value to plant pathologists will be included from time to time.

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. La rédaction accepte d'autres communications originales notamment sur la mise au point de nouvelles méthodes d'enquête et de lutte ainsi que sur l'évaluation des nouveaux produits. De temps à autre, il inclut des revues et des synthèses de rapports d'intérêt immédiat pour les phytopathologistes.

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FOREWORD

A compilation of results of plant disease surveys for the 1988 crop year, and occasional reports for previous years, are included in this issue of Canadian Plant Disease Survey. This represents a continuation of a joint project undertaken by the Canadian Phytopathological Society, and Research Program Service, Research Branch, Agriculture Canada. The Society and Research Program Service recognize the need for these surveys, which are of value to federal and provincial agencies in planning appropriate research for the control of plant diseases. Such surveys are also of intrinsic value to the literature of plant pathology of Canada. This is the second annual publication of disease surveys. This year, C.P.S. has asked J.A. Matteoni to succeed R.I. Hamilton as the coordinator of this joint project.

The publication of these reports is dependent upon the voluntary contributions of many Canadian plant pathologists, and their collation by experts familiar with the diseases of the major crop categories. The list of collators is appended to the section divider for the survey. Publication of the survey is planned on an annual basis for the Spring Issue of Canadian Plant Disease Survey, with reports due to the collators by 1 December. Instructions for submissions, and forms are available from the collators.

We wish to thank all of the contributors and collators who have devoted a great amount of their time to the production of this second annual publication of disease survey results, and look forward to your future contributions.

J.A. Matteoni
Coordinator

H. Krehm and P. Beauchamp
Compilers

AVANT-PROPOS

Ce numéro de l'Inventaire des maladies des plantes au Canada contient une compilation des résultats d'études menées sur les maladies des plantes de la récolte de 1988 au Canada. Il y est aussi quelquefois question des rapports des années antérieures. C'est la continuation d'un projet conjoint entrepris par la Société canadienne de phytopathologie et le Service aux programmes de recherche, Direction générale de la recherche, Agriculture Canada. La Société et le Service aux programmes de recherche estiment qu'il existe un besoin pour ce type d'information qui peut être utile aux agences fédérales et provinciales chargées de la planification de la recherche en matière de maladies des plantes. De plus, de tels rapports ont une valeur intrinsèque pour la documentation sur la pathologie des plantes au Canada. Ce numéro est la deuxième publication annuelle des inventaires de maladies. Cette année, la Société a demandé à J.A. Matteoni de succéder à R.I. Hamilton comme coordonnateur de ce projet conjoint.

La publication de ces rapports est le fruit de la contribution bénévole de nombreux phytopathologistes canadiens et de leur compilation par des spécialistes des maladies des grandes cultures. La liste des collationneurs se trouve après la page titre de la section des rapports. Nous avons l'intention de publier cet inventaire, chaque année, dans le numéro du printemps de l'Inventaire des maladies des plantes au Canada et, pour ce faire, les rapports doivent être remis aux collationneurs avant le 1er décembre. On peut se procurer auprès des collationneurs les instructions et les formulaires pour la rédaction des rapports.

Nous remercions toutes les personnes qui ont consacré de nombreuses heures à la production de cette deuxième publication annuelle des résultats des rapports sur les maladies des plantes et nous vous encourageons à soumettre vos rapports dans les prochaines publications.

J.A. Matteoni
Coordonnateur

H. Krehm et P. Beauchamp
Compilateurs

Bacteria associated with crown and root rot of sainfoin in southern Alberta

S.F. Hwang[1], R.J. Howard[2] and L. Goatcher[1]

Thirty sainfoin fields in southern Alberta were surveyed in 1983 for the incidence and severity of crown and root rot disease. Mean incidence and severity were 87% and I.9 (on a scale of 0-3), respectively. This is the first report that strains of *Pseudomonas fluorescens, Erwinia carotovora* subsp. *carotovora* and *P. syringae* are associated with crown and root rot of sainfoin in southern Alberta.

Can. Plant Dis. Surv. 69:1, 5-8, 1989.

Trente champs de sainfoin du sud de l'Alberta ont fait l'objet d'une étude en 1983 pour déterminer la fréquence et la gravité de la pourriture du collet et des racines. La fréquence et la gravité moyennes sont de 87 % et de 1,9 (sur une échelle de 0 à 3) respectivement. C'est le premier rapport de l'existence d'une association entre des souches de *Pseudomonas fluorescens, Erwinia carotovora* sous-espèce *carotovora* et *P. syringae* et la pourriture du collet et des racines de sainfoin dans le sud de l'Alberta.

Introduction

Sainfoin (*Onobrychis viciaefolia* Scop.) is a perennial legume which has been grown as a forage crop in Europe and Asia for several centuries (7). In recent years it has received a lot of attention in southern Alberta, but it has never become a widely grown crop, despite having many merits as a forage (7). Crown and root rot disease has been considered one of the major limiting factors restricting the cultivation of sainfoin (3, 5, 6, 8).

The nature of crown and root deterioration in forage crops is very complex (5, 6, 10, 11). Previous studies have indicated that certain groups of bacteria, rather than a single fungus, are closely associated with the crown and root rot complex of sainfoin (5, 9, 12, 13). To obtain more information on crown and root rot of sainfoin in southern Alberta, a comprehensive field survey was carried out to determine the incidence and severity of crown and root rot; to isolate and identify the bacteria from discolored crown and root tissues; and to determine the pathogenicity of the isolated bacteria on sainfoin seedlings.

Materials and methods

Thirty sainfoin fields in southern Alberta were surveyed in 1983 for the incidence and severity of crown and root rot disease. Twenty-five plants dug at random using a sharpshooter shovel were shaken free of soil, placed in a paper bag, and stored in a cooler until processing. Plants were rinsed with tap water and split longitudinally to visually assess the severity of crown and root rot. Severity scores assigned were 0, no disease; 1, slight; 2, moderate; 3, severe.

For bacterial isolation, diseased sainfoin plants were randomly collected again from seven fields in the Nanton-Claresholm-Fort MacLeod area of southern Alberta in the fall of 1985 and stored at -5°C. Two g of tap-root tissue taken 4 cm below the crown from each of five plants per field were surface sterilized for 2 min in 0.6% NaOCl and rinsed three times with distilled water. The five root samples from each field were pooled and placed in a test tube containing 20 ml sterile distilled water and allowed to soak overnight.

A series of dilutions from the tissue-soaked solution was made on nutrient agar (NA) plates. Observations of the growth of bacterial colonies and subcultures of representative colony types were made after incubation for 7 days in the dark at room temperature. Purification of the isolated bacterial colonies was achieved by streaking them onto fresh NA plates. This process was repeated twice. All morphologically similar isolates were stored in sterile distilled water at 4°C, then submitted to the Microbiology Group at the Alberta Environmental Centre for identification to species level (1).

Once the isolates had been positively identified based on a range of biochemical and physiological tests, the virulence of the isolates was tested on 2.5-month-old sainfoin seedlings, cv. Melrose. Inoculum consisted of 1 ml aqueous suspension of approximately 10^8 cells/ml obtained from a 24-hr-old culture on NA. This was injected into the crown area using a sterile 23-gauge needle (4). Seedlings injected with sterile distilled water were used as a control. After inoculation, the pots were arranged randomly in the growth chamber at 20°C (16 hr day) and 15°C (8 hr night) with a light intensity of 300 $\mu em^{-2}s^{-1}$, which was provided by cool white fluorescent tubes. Five pots with four seedlings each were inoculated with bacteria or water. Symptoms were recorded 4 months after inoculation. The length of discoloration of tap roots at the inoculation site was measured and the severity of crown and root rot was assessed as previously described.

Results and discussion

Crown and root rot was found in all of the sainfoin fields surveyed in 1983. Average disease incidence and severity of crown and root rot were 87% and 1.9, respectively (Table 1). The bacteria isolated from diseased sainfoin crown and roots were classified into the following groups: *Pseudomonas fluorescens, Enterobacter agglomerans, Erwinia carotovora* subsp. *carotovora* and *P. syringae*, which accounted for 66, 25, 6, and 3% of the total isolates, respectively.

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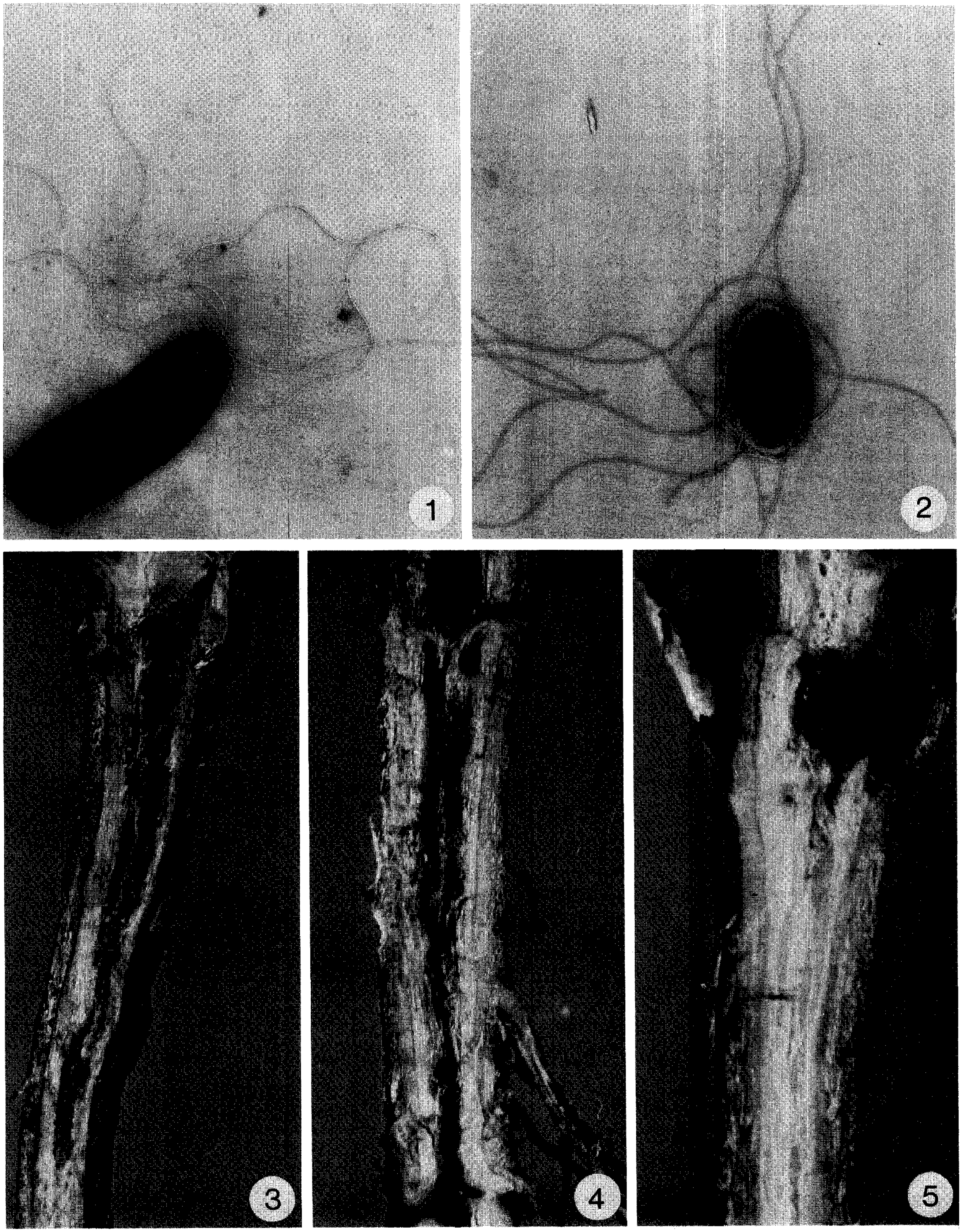
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Figure 1. Electron micrograph of *Pseudomonas fluorescens* with polar flagella (15,000×).

Figure 2. Electron micrograph of *Erwinia carotovora* subsp. *carotovora* with peritrichous flagella (15,000×).

Figure 3. Discoloration of sainfoin crown and root inoculated with a strain of *Pseudomonas fluorescens.*

Figure 4. Discoloration of sainfoin crown and root inoculated with a strain of *Erwinia carotovora* subsp. *carotovora.*

Figure 5. Sainfoin crown and root inoculated with sterile distilled water.

Table 1. Incidence and severity of crown and root rot of sainfoin in southern Alberta in 1983.

Location	No. of fields surveyed	Incidence %	Severity* rating
Brooks	1	100	2.28
Nanton	6	82	2.18
Claresholm	3	33	1.70
Spring Coulee	2	94	1.67
Kimball	4	100	1.69
Waterton Dam	2	98	2.31
Fort Macleod	2	82	1.89
Warner	2	98	2.07
Trout Creek Road	1	100	1.56
Granum	7	79	1.64
Total/average	30	87	1.90

*Crown and root rot severity rating scale: 0 = clean; 1 = slight, 1-20% of the crown and root discolored; 2 = moderate, 21-50% of the crown and root discolored; 3 = severe, 51-100% of the crown and root discolored.

Based on the length and intensity of discoloration, isolates of *P. fluorescens* (Fig. 1) and *E. carotovora* subsp. *carotovora* (Fig. 2) were the most virulent to sainfoin seedlings, followed by *P. syringae* (Table 2). A range of virulence among isolates of the same *E. carotovora* subsp. *carotovora* and *P. fluorescens* was not detected. *E. agglomerans* isolates were considered nonpathogenic to sainfoin seedlings because both length of discoloration (<5 mm) and disease severity (1.0-1.1) produced by each isolate of this bacterial species was not significantly different from those in the control.

The symptoms in sainfoin seedlings inoculated with these pathogenic bacteria and grown under artificial conditions were similar to those found in naturally infected plants. In most cases, the crown tissue became necrotic and the discolored vascular tissue extended far beyond the inoculation site (Fig. 3 and Fig. 4). Control plants had dark green leaves and grew vigorously, whereas inoculated plants became chlorotic and wilted. The crown tissues of the control plants had minor necrosis and the vascular discoloration extended not more than 4 mm (Fig. 5). The discolored roots and inoculated plants yielded bacteria similar to the original inoculum.

Table 2. The pathogenicity of the different bacterial strains on sainfoin seedlings.

Organism	Length of discoloration[x] (mm)	Disease severity[y]
Pseudomonas fluorescens		
SA-2-1	17.4 ab[z]	1.8 ab
SB-1-1	17.4 ab	1.9 ab
SC-4-1	16.0 ab	1.8 ab
SD-2-4	16.1 ab	1.7 ab
SF-2-1	17.2 ab	1.9 ab
P. syringae		
SE-3-1	12.5 b	1.5 b
Erwinia carotovora subsp. *carotovora*		
SC-4-2	23.0 a	2.0 a
SC-4-4	21.8 a	2.0 a
Enterobacter agglomerans		
SB-5-2	4.4 c	1.0 c
SE-3-2	4.9 c	1.1 c
Control	3.4 c	1.0 c

[x] The length of discoloration from the inoculation point.

[y] Severity was based on a scale of 1-3 where 1 = slight; 2 = moderate; and 3 = severe.

[z] Means within a column followed by the same letter are not significantly different using Duncan's Multiple Range Test (P = 0.05).

Most soil bacteria lack the ability to invade intact plant tissue. However, in southern Alberta, the alternate cycles of freezing and thawing within the soil can cause considerable physical stress to the roots of sainfoin and thus create avenues for the entry of non-invasive phytobacteria.

This is the first report indicating that bacteria, particularly *P. fluorescens* and *E. carotovora* subsp. *carotovora*, are closely associated with crown and root rot of sainfoin in southern Alberta. Although the presence of *P. syringae* was not consistent in our isolations, its role in the crown and root deterioration of sainfoin cannot be ignored, mainly because of its ice nucleating properties which may lead to the formation of ice in plant tissue (2, 14). This study confirms previous research (3, 5, 8, 9, 10, 11, 12, 13) that crown and root rot of forage legumes is a disease complex involving the interaction of soil-borne fungi and bacteria. A large-scale isolation of bacterial organisms based on a more extensive field survey is needed to fully determine the role of these bacteria in crown and root rot of sainfoin in other regions of Alberta.

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Crown and root rot of alfalfa in southern Alberta

S.F. Hwang[1], R.J. Howard[2] and E. Moskaluk[2]

Twenty-seven alfalfa fields in southern Alberta were surveyed in 1983 for the incidence and severity of crown and root rot disease. Mean disease incidence and severity were 61% and 0.80 (on a scale of 0-3), respectively. Four species of *Fusarium* (*F. solani, F. tricinctum, F. avenaceum* and *F. oxysporum*), *Pythium irregulare,* and two unidentified isolates of *Pythium* were found to be associated with crown and root rot of alfalfa.

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Vingt-sept luzernières du sud de l'Alberta ont fait l'objet d'une étude en 1983 pour déterminer la fréquence et la gravité de la pourriture du collet et des racines. La fréquence et la gravité moyenne sont de 61 % et de 0,80 (sur une échelle de 0 à 3) respectivement. Quatre espèces de *Fusarium* (*F. solani, F. tricinctum, F. avenaceum* et *F. oxysporum*), *Pythium irregulare,* et deux isolats non identifiés de *Pythium* s'avèrent associés à la maladie de la luzerne.

Introduction

Crown and root rot of alfalfa (*Medicago sativa* L.), a chronic and potentially devastating disease in most production areas (4, 13, 15, 19, 22), has been of major concern to alfalfa growers in southern Alberta for a number of years. This disease not only causes plants to develop asymmetrically because of the eventual death of buds and young shoots near the soil surface, but also prevents development of adequate cold tolerance in the fall, as a result of reduced food reserves in the rotted crown area (8, 17). Alfalfa stands are capable of surviving for 10 years or more, but because of this disease, the majority of the fields show a progressive deterioration after the second year (7).

Different species and strains of *Fusarium* and *Pythium* have been closely associated with crown and root rot of alfalfa in different regions of the world (1, 2, 3, 5, 6, 7, 13, 14, 19, 20). To obtain more information on crown and root rot of alfalfa in southern Alberta, a comprehensive field survey was carried out to determine its incidence and severity; to isolate and identify the species of *Fusarium* and *Pythium* associated with the disease; and to determine the pathogenicity of the organisms isolated from diseased crowns and roots of alfalfa.

Materials and methods

Twenty-seven alfalfa fields in southern Alberta were surveyed in 1983 for the incidence and severity of crown and root rot disease. Twenty-five plants dug at random with a sharpshooter shovel were shaken free of soil, placed in a paper bag, and stored in a cooler until processing. Plants were rinsed with tap water and split longitudinally to visually assess the severity of crown and root rot. Severity scores assigned were 0, no disease; 1, slight; 2, moderate; 3, severe.

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For *Fusarium* isolation, ten pieces (0.5 × 0.5 cm) of crown and upper tap root tissue were taken from each of ten randomly selected plants from each of the 27 fields sampled. The tissue pieces were surface sterilized in 0.6% sodium hypochlorite for 2 minutes, rinsed in sterile water, blotted dry, and placed on pentachloronitrobenzene (PCNB) medium (11). After incubation for one week at room temperature under fluorescent light, the hyphal tips of fungi growing out of the tissue pieces were cut and transferred to potato dextrose agar slants and carnation leaf agar plates for identification (12).

Pythium spp. could not be isolated from below-ground portions of mature plants due to loss of rootlets and necrotic root tips when the plants were removed from the soil. Therefore, rhizosphere soil samples were randomly collected from 94 alfalfa fields to estimate the number of *Pythium* and *Fusarium* propagules present in the field soils. A soil dilution series was prepared for each air-dried soil sample using 0.2% water agar, then 1 mL of the soil dilution was spread onto a PCNB plate, which is selective for *Fusarium,* and onto a pimaricin-vancomycin agar medium (MPVM) with rose bengal (0.01 g/L), which is selective for *Pythium* (10). Four plates were used for each dilution of each soil sample. The PCNB plates were incubated under fluorescent light at room temperature and the number of *Fusarium* colonies recorded after 7 days. The MPVM plates were incubated for 48 h in darkness at room temperature, then washed under a slow stream of water to remove materials other than *Pythium* colonies which had grown into the medium. The number of *Pythium* colonies was recorded and the morphologically different colony types were transferred to cornmeal agar for further study.

The pathogenicity of the *Fusarium* isolates was evaluated on 4-week-old greenhouse-grown alfalfa plants, cv. Anchor. Roots were carefully washed and immersed in spore suspensions (10^5 conidia/mL) for 5 minutes before repotting in steam-sterilized soil. Roots immersed in distilled water were used for controls. The isolates were considered to be pathogenic if the length of the vascular discoloration of the split tap root exceeded 10 mm. The pathogenicity of the *Pythium* isolates was evaluated by growing them on a cornmeal and sand mixture (15 g cornmeal, 485 g sand, 120 mL distilled water) and thoroughly mixing each inoculated mixture with steam-sterilized soil at a rate of 300 propagules/g soil. Ten

Table 1. Incidence and severity of crown and root rot of alfalfa in southern Alberta in 1983.

Location	No. of fields surveyed	Incidence %	Severity* rating
M. D. of Kneehill	1	95	0.21
Special Area No. 2	1	91	1.57
Co. of Wheatland	6	74	1.15
Co. of Mountain View	6	46	0.74
Co. of Newell	6	42	0.59
M. D. of Rocky View	4	42	0.64
Special Area No. 3	3	39	0.67
Total/average	27	61	0.80

*Crown and root rot severity rating scale: 0 = clean; 1 = slight, 1-20% of the crown and root discolored; 2 = moderate, 21-50% of the crown and root discolored; 3 = severe, 51-100% of the crown and root discolored.

surface-sterilized seeds of alfalfa, cv. Anchor, were planted in each of five 15-cm-diameter plastic pots containing each of four isolates of *Pythium*-inoculated soil. Seeds sown in pots which had received *Pythium*-free cornmeal and sand mixtures served as controls. The pots were maintained in the greenhouse at 20°C for 30 days, after which the percentage of seedling damping-off was recorded.

Results

Crown and root rot was found in all of the alfalfa fields surveyed. Average disease incidence and severity of crown and root rot were 61% and 0.8, respectively (Table 1). Soils from fields of alfalfa with crown and root rot had populations of *Fusarium* ranging from 23×10^3 to 58×10^3 propagules/g soil and of *Pythium* from 26 × 10 to 76 × 10 propagules/g soil (Table 2).

Four species of *Fusarium* were identified from crown- and root-rot-affected alfalfa plants. *F. solani* was the most abundant at 47% of the total isolates, while *F. tricinctum, F. avenaceum,* and *F. oxysporum* were found at 25, 21, and 7%, respectively. *F. tricinctum* and *F. solani* were most virulent with 82% and 60% of infected alfalfa seedlings showing vascular discoloration of the tap roots, followed by *F. oxysporum* (42%) and *F. avenaceum* (25%). Seedlings infected with *P. irregulare* AH-14 and AH-1, and unidentified *Pythium* AB-6 and AG-13 showed 41%, 54%, 62% and 33% damping-off, respectively. Control seedling damping-off was 8%.

Table 2. Populations of *Fusarium* spp. and *Pythium* spp. isolated from the rhizosphere soil of alfalfa plants in southern Alberta.

Location	No. of fields sampled	Propagules/g air-dried soil	
		Fusarium ($\times 10^3$)	*Pythium* (x10)
Co. of Newell	10	33	26
Co. of Mountain View	10	27	44
Co. of Vulcan	6	47	53
Co. of Wheatland	10	53	41
M. D. of Foothills	10	23	39
M. D. of Rocky View	10	30	76
M. D. of Starland	10	28	52
M. D. of Taber	9	58	39
Special Area No. 2	10	53	62
Special Area No. 3	9	31	32
Total/average	94	38	46

Discussion

Crown and root rot of alfalfa was widespread in southern Alberta. Mean disease severity rating was not very high, but that could increase rapidly, particularly if the plants are damaged by frost allowing fungi to enter. The isolation and infection studies showed that *Fusarium solani, F. tricinctum, F. avenaceum, F. oxysporum* and *Pythium irregulare* were the principal pathogens of crown and root rot. However, it could not be determined which of the organisms was more active in the early spring, such as was reported for *Plenodomus meliloti* and *Cylindrocladium gracile* which were found to be parasitic early in the development of crown and root of alfalfa in central Alberta (4, 18, 21). Additional work is required to assess the seasonal effect on the incidence of fungal isolation.

The ability of alfalfa to survive the winter depends, in part, on the storage of food reserves in the roots and crowns during the fall (8). Infection with *Fusarium* no doubt affects physiological processes of alfalfa and reduces its potential to achieve maximum cold hardiness (17). Unfortunately, all recommended varieties of alfalfa are susceptible to crown and root rot (9). Selection and breeding for resistance to crown and root rot will probably be difficult, mainly because the disease is associated with many causal organisms and alfalfa is predisposed to nutritional and environmental stress factors (16). Primary consideration should be given to management practices, such as selection of winter-hardy varieties and proper fertilization and cutting that promote vigorous growth of alfalfa (8).

Acknowledgements

We gratefully acknowledge Mr. H.G. Philip and Drs. L.J. Piening and B. Bolwyn for their comments on the manuscript.

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A cereal-infecting virus from orchardgrass

J.F. Peterson[1]

Extracts of orchardgrass (*Dactylis glomerata*) leaves showing mosaic symptoms in Frelighsburg, Quebec, were manually inoculated to wheat, oats, and barley, all of which developed similar symptoms. A few symptomatic orchardgrass leaves collected in Ste. Anne de Bellevue were infested with *Aceria tulipae*, an eriophyid mite vector of some viruses. Flexuous rod-shaped particles typical of other known grass viruses were associated with symptoms in experimentally infected barley and wheat, but the host range of the virus from orchardgrass, designated provisionally as "Orchardgrass mosaic virus" ('OGMV'), differentiated it from most of the other well-known grass viruses. Oat cultivars recommended for production developed fairly severe symptoms after inoculation, while symptoms were more moderate on spring and winter wheat cultivars.

Can. Plant Dis. Surv. 69:1, 13-16, 1989.

Un jus extrait de feuilles de dactyle (*Dactylis glomerata*) recueillies à Frelighsburg (Québec) et présentant des symptômes de mosaïque a été inoculé méchaniquement à du blé, de l'avoine et de l'orge, lesquels ont tous développé des symptômes. Quelques plants de dactyle, recueillis à Ste. Anne de Bellevue, étaient de plus infestés par *Aceria tulipae* une mite de la famille des "Eryophyidae" qui est un vecteur de quelques virus. Des particules flexueuses en batonnets, caractéristiques d'autres virus connus des graminés ont été associées aux symptômes observés sur l'orge et le blé inoculés. Toutefois, la gamme d'hôtes de ce virus, provisoirement nommé "virus de la mosaïque du dactyle" ('DaMV'), le distingue de la plupart des autres virus connus s'attaquant aux graminées. Les symptômes manifestés par les variétés d'avoine recommandées au Québec après inoculation ont été sévères, tandis que ceux du blé d'hiver et de printemps ont été plus légers.

Introduction

The growing of small grains fits in well with both dairying and some cash crop rotations in Quebec. Despite the importance of small grains to Quebec's agriculture, the only virus disease affecting them which has received much attention is the aphid-borne barley yellow dwarf virus. Comeau and coworkers have studied this extensively, and historically it has been the most important virus disease of cereals in Quebec (3, 4, 5).

In 1978, the writer observed virus-like symptoms on orchardgrass (*Dactylis glomerata* L.) occurring in Ste. Anne de Bellevue. During the late summer of 1984, orchardgrass plants showing typical virus-like symptoms were observed in both Frelighsburg and Ste. Anne de Bellevue. The virus was transmitted by manual inoculation to some cereals and orchardgrass. Because orchardgrass is common in the area and could represent a significant reservoir host, a greenhouse culture was established, and has been maintained for preliminary characterization by means of host range tests, determination of particle morphology, and investigations of reactions of currently recommended cereal cultivars. The virus from orchardgrass is designated provisionally as "Orchardgrass mosaic virus" ('OGMV').

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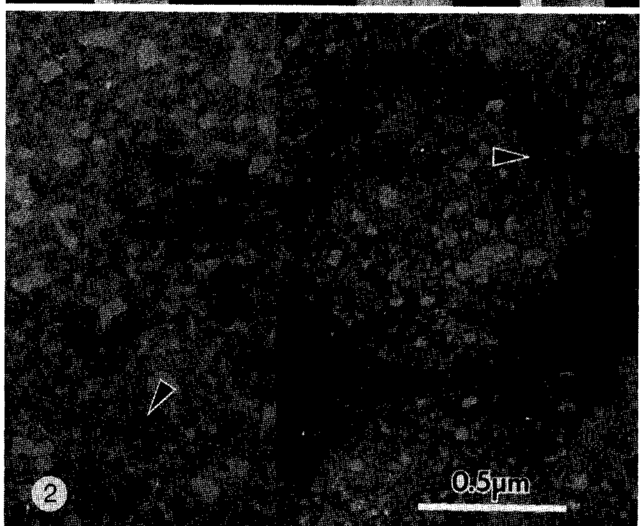
Materials and methods

Establishment of primary culture. Orchardgrass leaves collected from naturally infected plants at the Agriculture Canada research station in Frelighsburg were homogenized in 0.1M potassium phosphate buffer, pH 7, containing 0.1% 2-mercaptoethanol, and a small amount of Celite (diatomaceous earth, Johns-Manville) was added to serve as an abrasive. The extract was rubbed onto leaves of Black Hulless barley (*Hordeum vulgare* L.) in the two-leaf stage with a cheesecloth pad, and the inoculated plants were then rinsed with tap water. All test plants were grown in the greenhouse at an average temperature of 19-22°C during the winter and 25-30°C during the summer.

Additional leaves of orchardgrass were stored 4-5°C for 11 to 21 days before extracts were similarly prepared and used to inoculate Selkirk (spring) and Genesee (winter) wheat (*Triticum aestivum* L.), Roxton and Clintland oats (*Avena sativa* L.) at the two-leaf stage.

Electron microscopy. A leaf segment of experimentally inoculated Black Hulless barley was minced in a drop of water on a glass slide, and a droplet of the resulting extract was placed on an electron microscope grid, blotted, stained with neutralized 2% phosphotungstic acid, and examined in a Zeiss EM-9A electron microscope. Additional examinations were made of extracts clarified and concentrated from Genesee wheat.

Host range tests and cereal cultivar inoculations. Various graminaceous species, and some cultivars of wheat, oats, and barley recommended for Quebec (9) were inoculated as described, with extracts prepared from stock cultures maintained in either orchardgrass or Genesee wheat, which were cut back periodically to promote new growth and symptom expression.



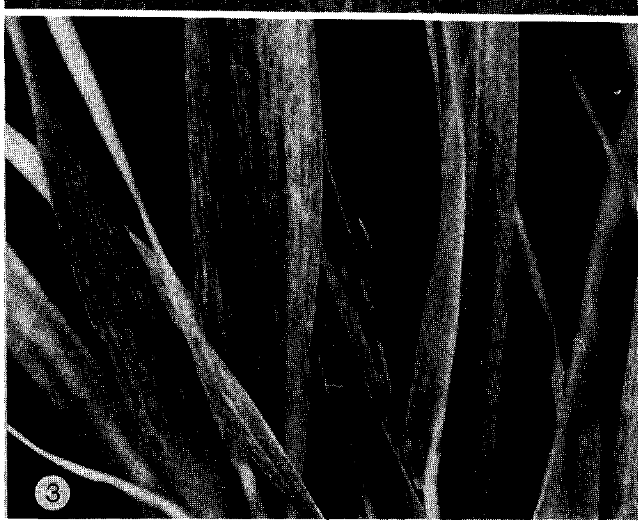


Figure 1. Leaves of experimentally inoculated orchardgrass showing typical symptoms. Healthy leaf on left.

Figure 2. Flexuous rod-shaped particles (arrowheads) in crude preparations from barley.

Figure 3. Symptoms shown by Lamar oats, 48 days after inoculation with 'OGMV'.

Forty to sixty test plants of each cereal cultivar, grown in four 10-cm pots, were inoculated with the extracts. Inoculation of plants in a fifth pot with only buffer and Celite served as a control. Counts of plants showing symptoms were made four and six weeks after inoculations. Various additional grasses and cereals were similarly inoculated.

Results

Symptoms on orchardgrass. Naturally or experimentally infected orchardgrass (Fig. 1) showed leaf markings typical of mosaics in grasses, generally consisting of light chlorotic streaking. Some naturally infected field plants, however, showed more prominent white streaking. Necrotic or brown areas usually were not present.

Primary culture establishment. Black Hulless barley, Genesee wheat, Selkirk wheat, and Roxton and Clintland oats all developed mosaic symptoms 17-21 days after inoculation with extracts from naturally infected orchardgrass leaves. Back inoculations from barley, Genesee wheat, and Roxton oats to orchardgrass resulted in symptom development after 3-4 weeks.

Electron microscopy. Examination of leaf mince preparations from Black Hulless barley revealed a low number of flexuous rod-shaped particles approximately 580-1000 nm long (Fig. 2). Similar particles were also present in partially clarified and concentrated extracts prepared from Genesee wheat leaves.

Host range and cereal cultivar reactions. The results of a series of inoculations of cereal cultivars are summarized in Table 1. Control (buffer/Celite inoculated) plants showed no symptoms. Symptoms on oats (Fig. 3) were generally more severe than those on wheat, and higher proportions of oats were infected, whether inoculum was prepared from orchardgrass or from Genesee wheat. Both wheat and oats showed typical mosaic symptoms, considerable stunting, and reduced or delayed heading (Fig. 4-6). Inoculations of barley cultivars yielded few meaningful results because of interference from a fungal pathogen, which did not appear later in the winter when Leger barley was inoculated.

Grasses which did not show symptoms after manual inoculation with extracts prepared from either orchardgrass or Genesee wheat included the following: *Agropyron repens*; *Bromus inermis*, cv. Saratoga; *Lolium multiflorum*, cvs. Merwester, Promenade; *Lolium perenne*; *Phleum pratensis*, cv. Drummond; *Secale cereale*, cv. Musketeer; *Setaria italica*; and *Triticale* × Triticosecale, cvs. Wintri, Decade.

Discussion

There are several flexuous rod-shaped viruses which infect grasses and cereals, and which are known to occur in other regions of Canada, e.g., wheat streak mosaic virus [WSMV (1)], *Agropyron* mosaic virus [AMV (11)], ryegrass mosaic virus [RMV (14)], *Hordeum* mosaic virus [HMV (13)], and oat necrotic mottle virus [ONMV (6)]. However, there are some host range differences between these viruses and 'OGMV', as

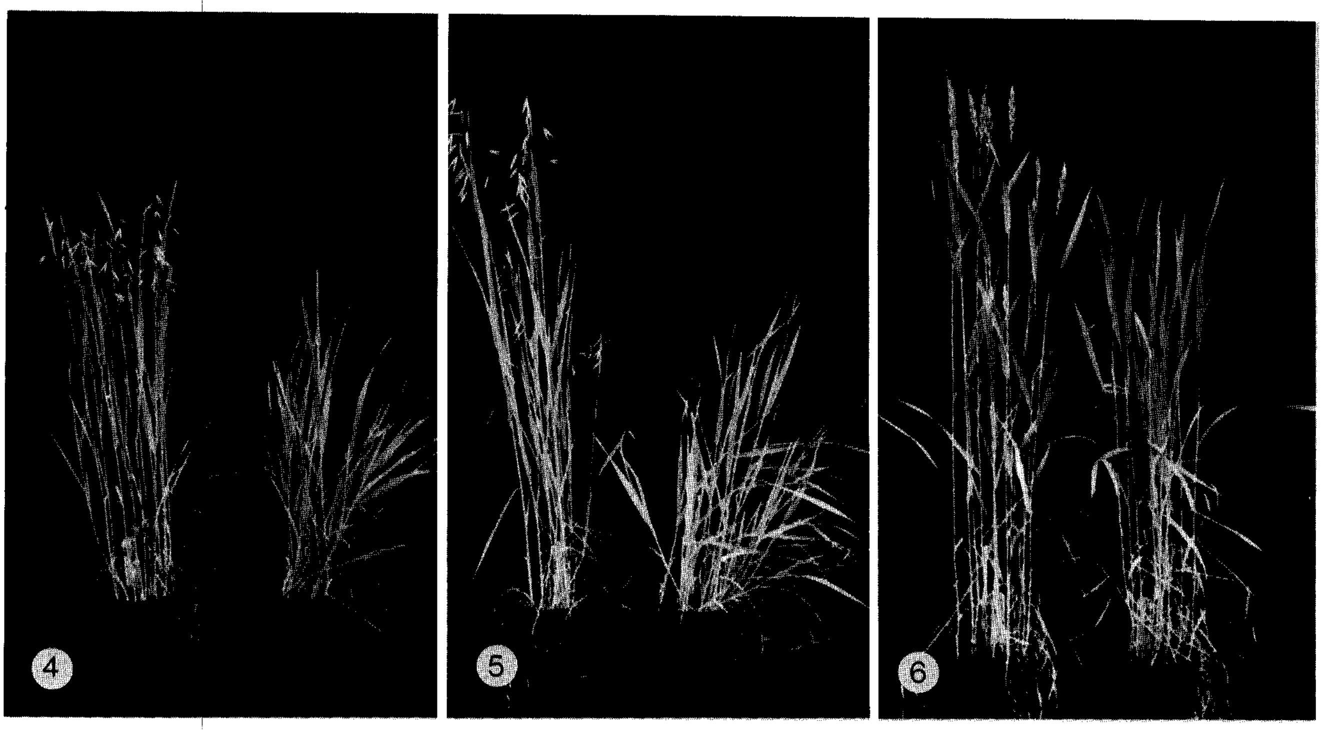


Figure 4-6. Stunting shown by oats and spring wheat, 48 days after inoculation. Left: control; Right: inoculated. 4. Lamar oats. 5. Laurent oats. 6. Laval-19 spring wheat.

Table 1. Reaction of cereal cultivars (no. plants with symptoms / no. inoculated).

Oats			*Winter wheat*		
Kamouraska	12/49*	49/49†	Frederick	36/40	29/61
Lamar	4/54	35/54	Yorkstar	40/41	32/51
Dorval	10/50	40/80	Valor	27/35	
Laurent		42/56	Lennox	39/50	
Spring wheat			*Barley*		
Columbus	22/46	20/52	Leger		14/52
Casavant	18/44	19/46			
Concorde	12/50	20/47			
Ankra	13/59	13/46			
Laval-19		33/54			
Dundas		24/58			

* Inoculum prepared from orchardgrass.

† Inoculum prepared from Genesee wheat.

shown in Table 2. AMV, HMV, and WSMV do not infect orchardgrass, and AMV does not infect oats (13). Oat necrotic mottle was originally described as not infecting wheat, barley, or orchardgrass (6), but it has been found to infect some cultivars of barley (Paliwal, *pers. comm.*). The literature is vague concerning infection of wheat by RMV; its description (14) refers to failures to infect wheat, but the description of AMV includes a statement suggesting that wheat is susceptible to RMV (II). At any rate, RMV infects *Lolium* spp., which have not shown symptoms when inoculated with 'OGMV'.

Some years ago, McKinney (8) described a virus from orchardgrass which caused symptoms resembling those seen in Quebec orchardgrass. However, the virus did not infect wheat or barley. Smith (15) implies that McKinney's virus was cocksfoot streak, but the usual British form of cocksfoot streak does not infect oats or wheat (2). Other British viruses infecting *Dactylis*, cocksfoot mottle virus and cocksfoot mild mosaic, are small spherical particles. McKinney also described a soil-borne oat mosaic virus, which does have flexuous rod-shaped particles, but infects only *Avena* spp. (7).

Whether 'OGMV' represents a potential threat to cereals in Quebec is difficult to determine at this point. Some symptomatic orchardgrass leaves found locally were infested by eriophyid mites, which were identified as *Aceria tulipae* by the Agriculture Canada Biosystematics Research Centre, but attempts to maintain a culture were unsuccessful. The association of *Aceria tulipae* with some symptomatic orchardgrass suggests a potentially hazardous virus-vector association, as this mite is known to transmit WSMV, and has been suspected as a vector of ONMV (6). However, there is as yet no evidence that it does in fact transmit 'OGMV' to other crops. Roots of naturally infected orchardgrass were not examined for presence of resting spores of *Polymyxa graminis*, which transmits some soil-borne cereal viruses (12).

Table 2. Usual host/symptom reaction of cereal viruses of similar morphology.

Host	Viruses					
	Agropyron mosaic (mi)	*Hordeum* mosaic	Wheat streak mosaic	Ryegrass mosaic	Oat necrotic mottle	'OGMV'
Agropyron repens L.	+	-	-	-	-	-
Avena sativa L.	-	+	+	+	+	+
Bromus inermis Leyss.	-	-	-		-	-
Dactylis glomerata L.	-	-	-	+	-	+
Hordeum vulgare L.	+	+	+	-	-	+
Lolium multiflorum Lam.	+	+	+	+	+	-
Lolium perenne L.	-	-	-	+	-	-
Secale cereale L.	+	+	+	-	-	-
Triticum aestivum L.	+	+	+	-	-	+
Reference:	13	13	13	14	6	present study

Virus infections of orchardgrass have not been reported previously in Quebec. Orchardgrass is recommended as a forage crop (10), and also occurs commonly in uncultivated situations. The symptoms shown by experimentally infected cereals indicate that 'OGMV' could represent a threat to their production if an efficient vector population were present. Determining whether 'OGMV' actually represents a previously undescribed virus or is simply a variant of one of the known grass viruses will require further work involving establishment of modal particle length, vector studies, and serological tests. The widespread occurrence of orchardgrass suggests that such studies could be useful.

Acknowledgements

Mr. Serge Lussier, Dr. B.E. Coulman, and Dr. A.K. Watson kindly provided seeds of currently recommended cereal cultivars and certain grasses. Danielle Mathieu, Thierry LeGros, and Josée Boisclair carried out inoculations of some cereals as portions of undergraduate projects. Drs. W.E. Sackston and R.D. Reeleder reviewed the manuscript and provided valuable suggestions for its improvement. Mrs. Roslyn James processed the words.

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Incidence and severity of snow molds on winter cereals in Saskatchewan, 1985-1988[1]

B.D. Gossen and W.W. Reiter

Fields of winter wheat and fall rye in northern and central Saskatchewan were examined for snow mold incidence and severity each spring from 1985 to 1988. *Coprinus psychromorbidus* was found throughout the area, but damage was slight. *Microdochium nivale* infection was observed at trace to slight levels in all regions. *Myriosclerotinia borealis* was found exclusively in the northeastern grainbelt. It produced severe damage in that region in the winter of 1986-87. Low-temperature and desiccation injury were much more common in central and southern regions than was snow mold injury.

Can. Plant Dis. Surv. 69:1, 17-19, 1989.

Des champs de blé d'hiver et de seigle d'automne dans le nord et le centre de la Saskatchewan ont fait l'objet d'une étude pour déterminer la fréquence et la gravité de la moisissure nivéale chaque printemps de 1985 à 1988. On a retrouvé *Coprinus psychromorbidus* dans toute la région, mais les dégâts étaient faibles. On a signalé des niveaux d'infection infimes à faibles de *Microdochium nivale* dans toute la région. En revanche, *Myriosclerotinia borealis* se retrouvait exclusivement dans la ceinture à céréales du nord-est où il a causé de lourds dégâts durant l'hiver 1986-1987. Les dommages causés par les basses températures et la dessiccation étaient beaucoup plus courants dans le centre et le sud de la province que ceux causés par la moisissure nivéale.

Introduction

In the early 1980's, there was a rapid increase in the acreage devoted to winter wheat in Saskatchewan, expanding from approximately 34,000 acres in 1980 to over 800,000 acres in 1985 and 1986 (Anon. 1980, 1985, 1986). A large proportion of this increase occurred in the northeastern portion of the grainbelt, where prolonged snow cover frequently provides conditions conducive to snow mold development. In 1974, a survey of snow mold diseases of winter cereals in Saskatchewan demonstrated that snow molds were a potential constraint to production in the north (Smith 1975). Therefore, a study was initiated to assess the extent and severity of snow mold damage on winter cereals, and to determine the relative importance of the pathogens involved.

Methods

Surveys were made in April and May of each year from 1985 to 1988. Fields were generally selected at random. The organisms responsible for snow mold damage were identified on the basis of symptoms. The presence of the distinctive sclerotia produced by *Myriosclerotinia borealis* (Bubak & Vleug.) Kohn (syn. *Sclerotinia borealis* (Bubak & Vleug.)) was used to identify that pathogen (Figure 1). *Microdochium nivale* (Fr.) Samuels & Hallett (syn. *Fusarium nivale* (Fr.) Ces., *Gerlachia nivalis* (Ces. ex Sacc.) Gams & Muller) was identified by the salmon-pink spore masses on infected leaves. *Coprinus psychromorbidus* Redhead & Traquair (the Low-Temperature Basidiomycete) was identified by its abundant mycelium and the bleached appearance of infected foliage. Disease severity was rated as None, Trace < 1%, Slight = 1-10%, Moderate = 11-25%, and Severe > 25%.

Winter cereals planted directly into standing stubble generally resume growth in the spring more slowly than those planted on fallow or tilled stubble. Therefore, fields of winter wheat seeded on conventional fallow were more noticeable from the road than those seeded into standing stubble, and were probably represented disproportionately in the survey. Thus the method of survey introduced a slight bias. This had some significance since stubble-seeded fields have the potential to trap more snow than fallow fields. As a result, crops on stubble-seeded fields may be less susceptible to low-temperature injury (Fowler 1983) but more severely affected by snow molds. As well, *M. nivale* identification was difficult on occasion. The salmon-pink sporulation was not always conspicuous and this may have led to an underestimate of the importance of *M. nivale*. However, in those areas where disease injury was significant, seeding into standing stubble was rare and there was an abundance of material for identification of the pathogens involved.

Results and Discussion

In April and May of 1985, 83 fields of winter cereals in central and northern Saskatchewan were examined. Snow mold damage was generally rated as none to trace, with damage observed only in protected areas where snow accumulation was greatest. *C. psychromorbidus* was the predominant pathogen throughout the survey area. *M. nivale* was found at trace levels in all regions. *C. psychromorbidus* caused severe damage in only one field in the survey, located in Crop District (C.D.) 5. The field was completely surrounded by bush, and had been used for alfalfa production for five of the previous eight years. Approximately 40% of the field was severely damaged. The only other significant snow mold injury occurred in the Hudson Bay region (C.D. 8), where *M. borealis* killed 5-10% of the plants in 2 of 8 fields. *M. borealis* was not observed in any other region. This level of infection was not sufficient to cause yield losses (Fowler *et al.* 1976). However, the relatively high level of infection by *M. borealis*, in a low-disease year and in a region where there was a large acreage of winter

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wheat, indicated that the potential for snow mold damage was high. Trace levels of infection by a *Typhula* spp. were noted in one field, also in the Hudson Bay area.

Low-temperature injury was observed in many fields in the spring of 1985. In the Saskatoon, Prince Albert and Tisdale regions, approximately 50% of the winter wheat fields examined suffered substantial low-temperature injury. An estimated 30% of fields in the Canora area (C.D. 5) had significant damage, while in the Hudson Bay, Nipawin and Maidstone areas (C.D. 8 & 9), 10% of the acreage examined showed injury. Damage on fall rye was substantially lower than on winter wheat.

In 1986, 31 fields of winter cereals were examined in the central and northern grainbelt. Trace amounts of snow mold damage caused by *C. psychromorbidus* were observed in seven fields. Low-temperature and desiccation injury was observed in approximately 50% of the fields examined.

In the spring of 1987, 54 fields of winter cereals were examined. Damage due to *M. borealis* was moderate to severe in 10 of 20 fields examined in the Hudson Bay area. Approximately 20% of the acreage in this area was plowed down as a result of stand reduction. Trace levels of *M. borealis* infection were found throughout the northeast (C.D. 5 & 8). Snow mold injury caused by *C. psychromorbidus* was observed at low (trace to slight) levels throughout the northern grainbelt (C.D. 8 & 9), and at trace levels in the central grainbelt (C.D. 5 & 6). No snow mold was observed in the southwest (C.D. 3 & 4).

In 1988, 35 fields were examined. In the northeastern grainbelt, snow mold damage ranged from trace to slight. Injury in low-lying areas was often severe, but damage occurred at trace levels in the open. *M. borealis* was the principal pathogen observed throughout the northeast. Low-temperature damage was apparent in most of the fields in the Saskatoon area (C.D. 6). Only two of 14 fields in this area showed even trace levels of snow mold damage. Fields south of Saskatoon were not sampled, but casual observation indicated that a combination of low-temperature injury and early-season drought had resulted in substantial stand reduction in many fields.

In summary, *Myriosclerotinia borealis* caused significant damage in one of four years. This pathogen has the potential to be an important factor limiting winter cereal production in the Hudson Bay region (C.D. 8), which is an important production area for winter cereals in Saskatchewan. It was also the most damaging pathogen observed in winter cereals in the northwest (C.D. 9) in 1974 (Smith 1975). In contrast, *Coprinus psychromorbidus* was the most important snow mold pathogen observed in a recent study in Alberta (Gaudet and Bhalla 1988), and *M. borealis* was isolated only infrequently. In Saskatchewan, *C. psychromorbidus* and *Microdochium nivale* were found at low levels (trace to slight) on winter cereals throughout the survey area, but rarely caused any significant stand loss. Low-temperature and desiccation injury were the most important factors determining survival of winter wheat in the southern and central grainbelt.

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Figure 1. *Myriosclerotinia borealis* on winter wheat. Note bleaching and prominent sclerotia (Photo by W. McFadden).

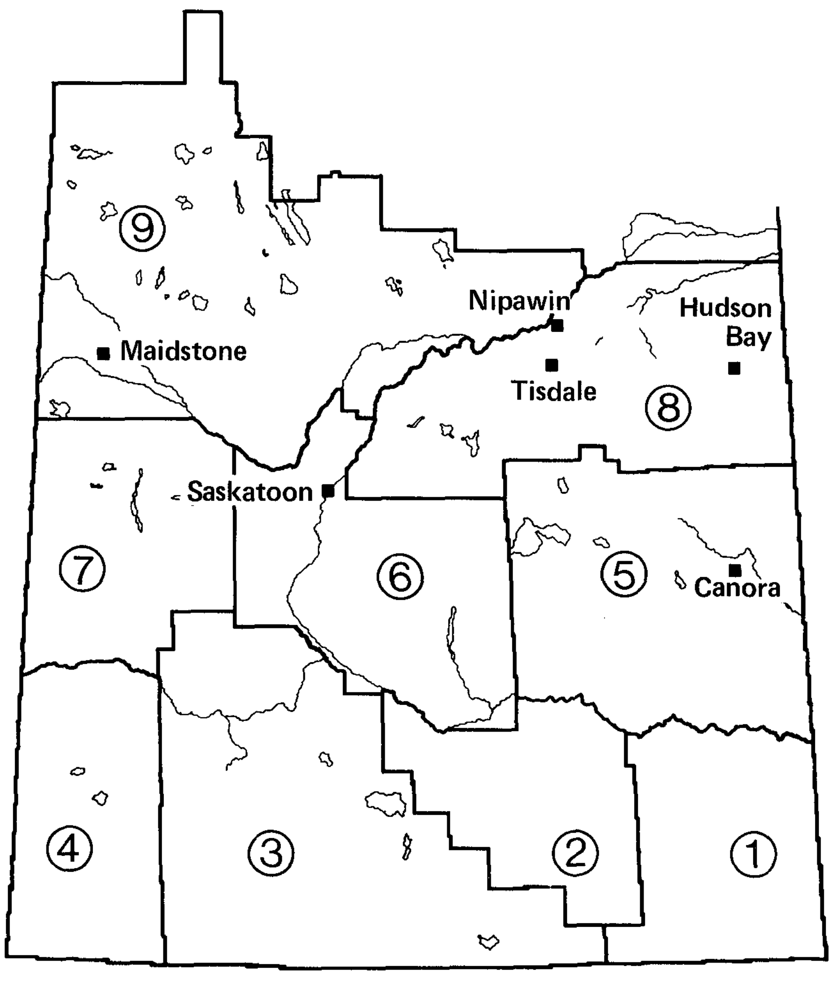

Figure 2. Crop districts in the grainbelt of Saskatchewan.

Screening of alfalfa cultivars for yield, winter hardiness and resistance to crown and root rot, common leaf spot and yellow leaf blotch in northeastern Alberta

S.F. Hwang[1] and G. Flores[2]

A field trial was conducted to evaluate alfalfa cultivars for dry matter yields, winter survival, and resistance to crown and root rot, common leaf spot and yellow leaf blotch. Significant differences were found among cultivars for dry matter yields and percent winterkill. All cultivars were affected by crown and root rot. Anik and Algonquin were the least affected, Trumpetor and Anchor the most. Anchor was the most susceptible cultivar to common leaf spot and yellow leaf blotch, whereas Trumpetor and Anik cultivars were the most resistant to common leaf spot and yellow leaf blotch, respectively.

Can. Plant Dis. Surv. 69:1, 21-23, 1989.

Un essai en plein champ a servi à évaluer des cultivars de luzerne pour les rendements de matière sèche (MS), la survie à l'hiver, et la résistance à la pourriture du collet et des racines, à la tache commune et à la tache jaune. Les cultivars diffèrent significativement pour ce qui est des rendements de MS et du pourcentage de mortalité hivernale. La pourriture du collet et des racines infecte tous les cultivars. Anik et Algonquin sont les moins touchés, tandis que Trumpetor et Anchor sont les plus atteints. Anchor est le cultivar le plus sensible à la tache commune et à la tache jaune, alors que Trumpetor et Anik sont les plus résistants à ces deux maladies, respectivement.

Introduction

Crown and root rot is a complex disease that has become a major limiting factor in the production of alfalfa (*Medicago sativa* L.) in Alberta for a number of years. The disease can predispose alfalfa to low-temperature kill and reduce a stand as a result of inadequate food reserves in the rotted crown area (7, 12). The development of resistant cultivars offers the best possibility for controlling this disease (12, 15).

Foliar diseases of forage crops are generally considered to be of minor importance (1, 2). They can, however, affect forage quality because of the reduced total nonstructural carbohydrate and crude protein in diseased leaf tissue and they can also lower yield due to premature defoliation and subsequent weakening of the plant (5, 6, 8, 13, 14, 15, 18). The severity of foliar diseases such as common leaf spot (*Pseudopeziza trifolii* f. sp. *medicaginis-sativae* Schuepp) and yellow leaf blotch (*Leptotrochila medicaginis* Schuepp) varies from year to year in Alberta. The purposes of this study were to compare the forage yield and winter survival of different alfalfa cultivars and to evaluate their resistance to crown and root rot, common leaf spot, and yellow leaf blotch.

Materials and methods

Experimental alfalfa plots were established in the spring of 1983 at the Alberta Environmental Centre, Vegreville. Eptam EC was incorporated in the soil at a rate of 4.5 L/ha as a preemergence herbicide along with 90 kg/ha of monoammonium phosphate (11-51-0), 20 kg/ha of potash (0-0-60) and 19 kg/ha of elemental sulphur (0-0-0-90). Fourteen cultivars of alfalfa were seeded in a randomized complete block design with six replications. Each plot consisted of four 6-m rows spaced 30 cm apart. There was 1 m between treatments and 2.5 m between replicates. The seeding rate was 8 kg/ha, and peat-based inoculant was used as a source of root nodule bacteria. Due to extremely dry conditions during the summer of 1983, very poor stand establishment was achieved; consequently, gaps in the rows had to be reseeded in the fall of 1983.

The middle two rows of each plot were harvested twice in the year at about 10% bloom stage and fresh-weight yields recorded. One-kg samples of fresh alfalfa were dried in an oven to determine dry-matter yields. During the spring of 1987, prior to first harvest, the degree of winterkill was determined by counting the number of plants with no green shoot development in the middle two rows of each plot. In the fall of 1987 prior to the second harvest, the severity of common leaf spot and yellow leaf blotch was rated. After the second harvest, 20 randomly selected plants from each plot were dug up and the roots bisected longitudinally to visually assess the severity of crown and root rot. Disease severity ratings were determined using the scale: 0, no disease; 1, slight; 2, moderate; 3, severe; 4, dead.

ANOVA and Duncan's Multiple Range tests were used to statistically analyze the data on dry matter yield, percent winter survival and disease severities of crown and root rot, common leaf spot and yellow leaf blotch.

Results

There were no significant differences in dry matter weights among the different cultivars of alfalfa with the exception of Anik in the first year after seeding (1984) (Table 1). Statistically significant differences for dry matter weights were observed

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Table 1. Comparative forage yield and winter survival of fourteen alfalfa cultivars.

Cultivar	Dry Weight (kg)				Winter Survival %
	1984	1985	1986	1987	
Algonquin	4.6 a[x]	2.2 abcd	2.0 cd	2.3 a	74 abc
Anchor	3.5 a	2.1 abcd	2.1 bcd	1.2 bc	21 f
Vernal	3.8 a	2.1 abcd	1.9 cd	1.4 bc	55 d
Anik	1.9 b	2.0 bcd	2.4 abc	2.3 a	86 a
Beaver	3.6 a	2.4 abcd	2.0 cd	1.8 ab	73 bc
Drylander	3.6 a	2.8 abc	2.6 abc	2.3 a	78 ab
Peace	3.5 a	2.8 abc	2.9 a	2.1 a	82 ab
Rambler	4.0 a	3.0 a	3.0 a	2.5 a	80 ab
Rangelander	3.7 a	2.6 abc	2.7 ab	2.5 a	77 ab
Roamer	3.8 a	2.9 abc	3.0 a	2.4 a	75 abc
Spredor II	3.7 a	2.6 abc	2.9 a	2.5 a	73bc
Thor	3.9 a	1.9 cd	1.6 d	1.0 bc	33 e
Trek	4.0 a	2.0 bcd	1.9 cd	1.5 b	63 cd
Trumpetor	4.0 a	1.5 d	0.8 e	0.3 d	7 g

[x]Values in a column followed by the same letter are not significantly different using Duncan's Multiple Range test (P = 0.05).

Table 2. Disease severity ratings of fourteen alfalfa cultivars to crown and root rot, common leaf spot and yellow leaf blotch[x].

Cultivar	Crown and Root Rot	Common Leaf Spot	Yellow Leaf Blotch
Algonquin	2.06 de[y]	1.56 abc	1.04 bc
Anchor	3.37 ab	2.16 a	1.60 a
Vernal	3.13 abc	1.67 abc	1.10 b
Anik	1.56 e	1.38 bc	0.79 c
Beaver	3.04 abc	1.50 bc	1.13 b
Drylander	2.85 abc	1.75 abc	1.17 b
Peace	2.89 abc	1.92 ab	1.21 b
Rambler	2.75 abc	1.67 abc	1.13 b
Rangelander	2.59 cd	1.33 bc	1.04 bc
Roamer	2.92 abc	1.38 bc	1.00 bc
Spredor II	2.64 bcd	1.67 abc	1.08 b
Thor	2.92 abc	1.46 bc	1.29 b
Trek	3.10 abc	1.75 abc	1.22 b
Trumpetor	3.40 a	1.25 c	1.00 bc

[x]Disease severity was based on a scale of 0-4 where 0 = clean; 1 = slight; 2 = moderate; 3 = severe and 4 = dead.

[y]Values in column followed by the same letter are not significantly different using Duncan's Multiple Range Test (P = 0.05).

among cultivars in each of the subsequent 3 years. Except for Thor and Trumpetor, which consistently gave the lowest yields, the ranking of the cultivars varied from year to year.

Anik, Peace, Rambler, Drylander and Rangelander had the greatest winter survival, followed by Roamer, Algonquin, Beaver and Spredor II; Trek, Vernal, Thor, Anchor and Trumpetor had the lowest survival (Table 1).

All cultivars suffered, to varying degrees, from crown and root rot (Table 2). Anik and Algonquin had the least disease with severity ratings of 1.56 and 2.06, respectively, whereas Trumpetor and Anchor had the most at 3.40 and 3.37, respectively. Overall, most cultivars evaluated had disease severity ratings between 2.59 and 3.13.

Common leaf spot and yellow leaf blotch caused progressively greater defoliation in all cultivars during September and October of 1987. Foliar disease severity ratings differed significantly among the cultivars (Table 2). Anchor had the greatest amount of diseased foliage (disease severity ratings of 2.16 and 1.60 for common leaf spot and yellow leaf blotch, respectively), while Trumpetor and Anik had the least ratings of 1.25 for common leaf spot and 0.79 for yellow leaf blotch, respectively.

Discussion

The results of this study clearly demonstrate that the severity of crown and root rot disease varies in the alfalfa cultivars evaluated. Although crown and root rot is not the only factor responsible for stand decline and yield reduction, there is increasing evidence that this disease predisposes alfalfa to winterkill (7). The impact of this disease on alfalfa plants increases with plant age and is generally irreversible (11). The damage alone may be lethal to plants in some years, but a combination of crown and root rot and winter stress factors is believed to be the more common cause for dead alfalfa in Alberta. During winter, alfalfa plants are subjected to such stress factors as freezing, ice cover, and long-lasting snow cover; hence, winter survival is a critical stage in the successful cultivation of alfalfa in Alberta (9). In our study Anik had the highest percentage of winter survival and the least crown and root rot damage 4 years after seeding. This substantiates the hypothesis that crown and root rot tolerant cultivars are more winter-hardy because of less predispositon to winterkill. Since the use of winter-hardy and crown and root rot-resistant alfalfa cultivars offers the best possibiltiy for significantly reducing winterkill and losses due to this disease, greater effort is needed to develop not only winter-hardy but also crown and root rot-resistant alfalfa cultivars suitable for cultivation in northern Alberta.

Foliar diseases are seldom important in northeastern Alberta, simply because hot and dry weather during July limits the rate of production and dissemination of secondary inocula (1, 2, 4). However, below normal temperature and above normal rainfall were recorded in July and August 1987. These abnormally cool and wet conditions not only favored infection and development of foliar diseases, but also provided an abundance of overwintering inocula since both pathogens, *Pseudopeziza trifolii* f. sp. *medicaginis-sativae* and *Leptotrochila medicaginis*, survive winter on diseased stems and leaves (10). In our study Anchor had disease severity ratings of 2.16 and 1.60 for common leaf spot and yellow leaf blotch, respectively. There is no doubt that foliar pathogens can build up quickly and spread quickly when environmental factors are favorable for their development (3, 12, 16, 17); consequently, serious outbreaks and significant crop losses may result. When foliar disease losses are added to crown and root rot losses, the loss of potential forage yield due to disease is substantial. Therefore, research efforts are also needed to breed new alfalfa cultivars with more resistance to foliar diseases.

Acknowledgements

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DISEASE HIGHLIGHTS 1988 APERÇU DES MALADIES

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CANADIAN PLANT DISEASE SURVEY - DISEASE HIGHLIGHTS

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Cereals / Céréales

Crop / Culture: Barley

Location / Emplacement: Saskatchewan (mainly), Manitoba, Alberta

Name and Agency / Nom et Organisation:
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Title / Titre: Saskatchewan Barley Leaf Disease Survey, 1988

METHODS: Kits to grow and sample 20 barley genotypes, chosen to exhibit potential disease problems, were sent to cooperators. Cooperators included School of Agriculture volunteers, public and private researchers, and pedigreed seed growers. Cooperators were asked to plant the differential varieties on barley stubble and to return 5-10 representative diseased leaves during the flag leaf and soft-dough stages. Five sites were lost to drought. Samples were returned from 24 Saskatchewan (8 from the northwest, 4 from the northeast, 5 from the east-central and 7 from the west-central region), 2 Alberta (Olds and Edmonton) and 4 Manitoba (Winnipeg and 3 near Brandon) sites. Amounts of each disease were rated as trace (some lesions), light (lesion on each selected susceptible leaf), moderate (10-30% of the area affected) and heavy (>30% of the area affected). Diseases of primary interest to the survey are listed in Table 1.

RESULTS: Disease incidence was lower than in 1987, but traces of several diseases could be found at most sites. The northwest region and one east-central site demonstrated the highest disease incidence. The pattern of each disease occurrence is affected by moisture, temperature, time, previous cropping history and aggressiveness of the pathogen. In addition to the diseases summarized in Table 1, there were signs of viral diseases, insect damage and *Fusarium* spp. Trace amounts of Halo spot (*Selenophoma donacis*) were noted at a few sites and of powdery mildew (*Erysiphe graminis*) at one location.

Table 1. Occurrence of barley leaf diseases, Saskatchewan Barley Leaf Disease Survey, 1988

	Degree of infection			
Disease	Heavy	Moderate	Light	Trace
Spot-form net blotch (*Pyrenophora teres* f. *maculata*)	2	6	17	3
Scald (*Rhynchosporium secalis*)	1	2	8	10
Net-form net blotch (*Pyrenophora teres* f. *teres*)	0	0	4	17
Spot blotch (*Cochliobolus sativus*)	0	0	3	23
Septoria (*Septoria* spp.)	0	0	4	22
Leaf rust (*Puccinia hordei*)	0	0	0	7

Crop/Culture: Barley

Location/Emplacement: Manitoba, Saskatchewan and Alberta

Title/Titre: BARLEY SMUT SURVEY, 1988

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METHODS: In July, 1988, 271 barley fields were surveyed for Ustilago hordei, U. nigra and U. nuda in Manitoba, Saskatchewan and Alberta. The northern area was covered by a route from Winnipeg-Saskatoon-Lacombe-Peace River-Prince Albert-Swan River-Winnipeg and the southern area (except for southern Alberta) in a one-day trip south of Winnipeg and a route (thanks to J. Nielsen) from Winnipeg-Arcola-Nokomis-Biggar-Melfort-Russell-Riding Mountain. Fields of barley were selected at random at approximately 15 km intervals, depending on the frequency of the crop in the area. An estimate of the percentage of infected plants (i.e. plants with sori) was made while walking an ovoid path of approximately 100 m in each field. Levels of smut greater than trace were estimated by counting plants in a 1 m^2 area at at least two sites on the path. U. nuda and U. nigra were differentiated by observing germinating teliospores with a microscope.

RESULTS: See Table 1. Smut was found in 75% of the fields examined. The average level was 0.7%. One field of six-row barley near Dunvegan, Alberta had 30% of plants with U. hordei infection.

COMMENTS: The over-all level of infection (0.7%) was less than half of that for the Manitoba-Saskatchewan survey of 1987. This probably reflects warmer, drier conditions in 1987, during the time when the seed for 1988 was infested/infected, and therefore may mean that even less smut will be observed in barley in 1989.

TABLE 1. Incidence of smut on barley, 1988

Province	Crop	% fields affected			Mean % infected plants
		U. hordei	U. nigra	U. nuda	
Manitoba	2-row	29	14	71	1.0
	6-row	23	34	74	1.1
Saskatchewan	2-row	21	10	46	0.2
	6-row	29	22	62	0.6
Alberta	2-row	13	0	75	0.1
	6-row	32	11	58	1.0

Crop / Culture: Barley

Location / Emplacement: Ontario

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Title / Titre:
WINTER BARLEY DISEASE SURVEY IN ONTARIO, 1988

METHODS: Winter barley was examined in commercial fields and cooperative trials in 1988 for damage and disease. Thirteen commercial fields of cv. OAC Halton and 19 fields of cv. OAC Acton were surveyed in southern Ontario (counties of Wellington, Waterloo, Brant, Oxford, Perth, Haldimand, Peterborough, Dufferin, Grey, Middlesex, Huron, Bruce, Halton and Kent). Cultivars Huron, OAC Acton, OAC Halton, and Elmira were rated in cooperative trials at Elora, Arkell, Woodstock, and Listowel. Damage and diseases were rated on 20 plants per field and on 3 to 6 replicate plots in cooperative trials rated on 20 plants per field and on 3 to 6 replicate plots in cooperative trials on a scale of 0 (no damage or disease) to 9 (most or all of the plant severely damaged or diseased). Winter survival and barley yellow dwarf were rated during the first week of May at Feeke's growth stage 2.0 in commercial fields and during the last week of May at Feeke's growth stage 10.0 in cooperative trials. Spot blotch, powdery mildew, scald, leaf rust, net blotch, and physiological leaf spot were rated at all locations during the last week of June at Feeke's growth stage 11.1.

RESULTS: The results are presented in Table 1. Low winter survival was characteristic of all cultivars. OAC Acton was very susceptible to powdery mildew. Scald was a major disease on all cultivars except Elmira. In the field, scald was more severe on OAC Halton than on OAC Acton, although in growthroom tests, both cultivars were equally susceptible to the seven races of scald identified in Ontario. The reaction of Huron and Elmira to Ontario races of scald has not been tested. Physiological leaf spot was especially severe on Elmira. Barley yellow dwarf was generally severe in early spring and on the lower third or more mature plants. Spot blotch, leaf rust, and net blotch were generally slightly to moderately severe on the lower third of all cultivars. Head diseases were not observed.

Table 1. Leaf damage and diseases on winter barley, Ontario, 1988.

	Commercial fields		Cooperative trials			
	Halton	Acton	Halton	Acton	Huron	Elmira
Winter survival	4.0	4.3	4.1	4.3	4.3	5.2
Barley yellow dwarf	3.0	2.6	2.0	1.7	0.9	2.7
Spot blotch	1.2	1.3	1.3	1.4	2.1	0.4
Powdery mildew	0.0	5.2	0.0	5.9	0.3	0.0
Scald	4.5	2.7	6.3	3.2	4.6	0.4
Leaf rust	1.5	1.9	1.3	2.5	1.6	0.9
Net blotch	1.6	1.6	1.3	2.0	1.3	1.3
Physiological leaf spot	0.8	0.2	2.2	0.3	2.2	6.5

Crop / Culture: Barley

Location / Emplacement: Ontario

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Title / Titre: VIRULENCE OF RHYNCHOSPORIUM SECALIS IN ONTARIO TO BARLEY

METHODS: One hundred and sixty isolates of *Rhynchosporium secalis*, cause of scald in barley, were collected from diseased barley plants from 17 counties in southern Ontario in 1987 and 1988. Pure cultures were initiated from single conidia. Virulence of the isolates was tested against the scald resistance genes Rh2 (Atlas, C.I.4118), Rh2 + Rh3 (Atlas-46, C.I.7323), Rh4 (La Mesita, C.I.7565), $Rh^2 4$ (Modoc, C.I.7566), Rh3 + Rh5 (Turk, C.I.14400), Rh4 + rh? (Trebi, C.I.936) and Rh9 (Abyssinian, C.I.668) and against cultivars OAC Acton and OAC Halton and the breeding line GW8614 which lack known genes for resistance to scald. Seedlings at the 2-leaf stage were sprayed with 0.4 mL of a suspension containing 2 x 10^5 conidia/mL, maintained in a dew chamber at 100% RH for 48 hours, and returned to the growth room for 12 days. Scald symptoms were rated on a scale of 0 (no disease) to 4 (total collapse of leaf). Disease scores of 0, 1, and 2 were classified as resistant and scores of 3 and 4 were considered susceptible.

RESULTS: All isolates were virulent to the commercial cultivars of winter barley (OAC Acton and OAC Halton) and to the advanced breeding line GW8614 (Table 1). When tested against specific genes for resistance to scald, all isolates were virulent to the $Rh^2 4$ gene and none were virulent to resistance genes Rh2, Rh4, or the combination Rh2 + Rh3. The collection of isolates were divided into seven races distinguished by their virulence to three cultivars containing resistance genes Rh9, Rh3 + Rh5, and Rh4 + rh? The most common race (61% of isolates) was avirulent to these cultivars, but the other six races had virulence to one, two, or three of these genes or gene pairs.

Table 1. Virulence of isolates of *Rhynchosporium secalis* from Ontario, 1988

Race	Atlas Rh2	Atlas -46 Rh2 Rh3	La Mesita Rh4	Turk Rh3 Rh5	Trebi Rh4 rh?	Abyss-inian Rh9	Modoc $Rh^2 4$	GW 8614	OAC Acton	OAC Halton	Isolates No.	Isolates %
1							S	S	S	S	98	61
2						S	S	S	S	S	21	13
3					S		S	S	S	S	21	13
4				S			S	S	S	S	2	1
5					S	S	S	S	S	S	9	6
6				S	S		S	S	S	S	3	2
7				S	S	S	S	S	S	S	6	4

S = susceptible reaction. Unmarked reactions were resistant.

Crop / Culture: Barley, Wheat, Ryegrass, Clover, Pea, Soybean, Potato

Location / Emplacement: Prince Edward Island

Title / Titre: SURVEY OF COMMERCIAL FIELDS FOR VERTICILLIUM DAHLIAE IN SOIL ON P.E.I.

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MATERIALS AND METHODS: Soil samples were collected early and late in the growing season from 10 x 5 m plots established in a total of 145 commercial fields across Prince Edward Island during 1986, 1987, and 1988. Fields sampled in this survey included barley, wheat, Italian ryegrass, clover, pea, soybean, and potato. All fields had been planted with potatoes at least once in the past 3 years prior to sampling. Soil was sampled by inserting a soil probe 15 cm into the soil at 1 m intervals following an X pattern through the field plots. Fifteen grams of each soil sample were analysed for the presence of *Verticillium dahliae* microsclerotia following a wet sieve direct plating technique described by Huisman and Ashworth (1974).

RESULTS AND COMMENTS: Microsclerotia of *V. dahliae* were detected in soil samples from field plots representing all crops investigated (Table 1). *Verticillium dahliae* was detected in more field plots during 1988 than 1986 or 1987; however, the number of fields with detectable microsclerotia levels varied with the crop grown in the field. In 1987, environmental conditions were warm and dry which was optimum for *V. dahliae* germination and infection of susceptible plants. The decomposition of infested crop residue ploughed down in 1987, may have increased the number of microsclerotia released in soil and therefore increase the number of fields with detectable soil population levels observed in 1988. Although only a small area of each field was sampled and may not reflect the true proportion of fields infested with *V. dahliae*, results imply that this soilborne pathogen is spreading within and possibly among commercial fields on Prince Edward Island.

Table 1. Number of commercial fields with detectable soil population levels of *V. dahliae* microsclerotia during 1986, 1987, and 1988.

Crop	1986		1987		1988	
	No. Field sampled	No. Field infested	No. Field sampled	No. Field infested	No. Field sampled	No. Field infested
Barley	11	5	12	4	11	8
Wheat	5	2	5	1	4	1
Italian Ryegrass	4	2	4	0	4	3
Clover	7	3	7	3	4	3
Pea	4	1	4	1	Na	Na
Soybean	4	3	3	2	4	2
Potato	18	6	14	6	16	11
Total	53	22	49	17	43	28

REFERENCE:

Huisman, O.C. and L.J. Ashworth, Jr. 1974. *Verticillium albo-atrum*: Quantitative isolation of microsclerotia from field soils. Phytopathology 64: 1159-1163.

Crop / Culture: Barley, Winter Wheat, Ryegrass

Location / Emplacement: Prince Edward Island

Title / Titre: SOILBORNE PATHOGENS INFECTING BARLEY, WINTER WHEAT, AND RYEGRASS IN PRINCE EDWARD ISLAND

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MATERIALS AND METHODS: The purpose of this study was to determine the incidence of crown rot and soilborne pathogens associated with crown and root tissue of barley, winter wheat, and ryegrass grown on P.E.I.. Thirty plants were sampled early, mid and late during the 1986 and 1987 growing season from 4 fields each of barley underseeded with clover, barley, underseeded with ryegrass, winter wheat, and ryegrass. Each plant was rated for crown rot (0 = healthy; 5 = crowns completely rotted causing plant death). Nematode and fungal pathogens were isolated from crown, roots, and soil of the gramineaceous crops.

RESULTS AND COMMENTS: Crown rot incidence was high in all crops sampled during this investigation. Winter wheat and ryegrass had a higher incidence of crown rot than barley. *Rhizoctonia solani* and *Fusarium avenaceum* were isolated frequently from all gramineaceous crops particularly winter wheat and ryegrass. *Bipolaris sorokiniana* and *F. crookwellense* were isolated frequently from barley, particularly in fields underseeded with clover. The incidence of *F. sambucinum* was highest in winter wheat. *Rhizoctonia cerealis* and *F. graminearum* were isolated infrequently in all crops. Root lesion nematodes (*Pratylenchus* spp.) were the predominant endoparasitic nematodes isolated from roots of the graminaceous crops, however population levels were low. Barley tended to have higher nematode population levels in roots than ryegrass or winter wheat. Stunt nematodes (*Tylenchorhynchus* spp.) were the most common ectoparasitic nematode associated with graminaceous crops with winter wheat and ryegrass fields having the highest soil population levels. The pathogens involved with the crown rot complexes of the different graminaceous crops differ with each crop. *Bipolaris sorokiniana*, *F. avenaceum*, *F. crookwellense*, *R. solani*, and root lesion nematodes were associated with the crown and root rot complex of barley. In contrast, *F. avenaceum*, *R. solani*, and the stunt nematode may be involved with crown and root rot complex of winter wheat and ryegrass. The importance and role of each organism in the disease complex of the various graminaceous crops grown on P.E.I. requires further investigation.

Crop / Culture: Oats

Location / Emplacement: Quebec

Title / Titre:

A SUMMARY OF DISEASES OF OATS IN QUEBEC IN 1988

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METHODS: Most experimental sites of cereals in Quebec were visited from 13 July to 10 August. At each site, diseases were identified and assessed in a number of lines and cultivars. Growth stages at time of assessments ranged from medium milk to soft dough.

RESULTS: Speckled leaf blotch (Septoria avenae f.sp. avenae) occurred throughout the province and was the most important disease in the oat crop this year. Its severity was moderate in most growing areas and ranged from scattered at Ste. Anne de Bellevue (southwestern Quebec) to above average at La Pocatière (Lower St. Lawrence), and Normandin (Lake Saint-Jean).

Light to moderate infections of yellow dwarf (BYDV) were observed in most areas but only traces were found at Deschambault (Central Quebec). Severe cases were not detected.

Interaction of speckled leaf blotch with yellow dwarf was noticeable at Lennoxville (Eastern Townships). It caused more pronounced darkening of the foliage than either single disease. The overall severity was moderate.

Crown rust (Puccinia coronata) was virtually absent from most areas even southwestern Quebec where it is usually highly prevalent. At La Pocatière it was however the most severe disease in the crop and the most susceptible cultivars suffered very severe damage. A late infection occurred at Pintendre (Quebec City district).

Stem rust (Puccinia graminis f.sp. avenae) was not detected at any significant level.

Fusarium head blight (Fusarium graminearum) was found to a limited extent at Lennoxville and Pintendre.

Crop / Culture: Spring Wheat and Spring Barley

Location / Emplacement: Central Saskatchewan

Title / Titre: DISEASE SURVEY OF IRRIGATED CEREALS IN SASKATCHEWAN IN 1988

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(The support of the Saskatchewan Agriculture Development Fund is acknowledged.)

METHODS: The sites studied were located along the South Saskatchewan River and associated irrigation canals from Hague to Riverhurst. Twenty-one fields of spring wheat and 4 fields of spring barley were surveyed three times during the growing season for diseases by collecting 40 plants from 10 sites in each field. All of the fields were irrigated by a center pivot system except for one field which utilized a flood system. Sampling began 10m inside the outside wheel track of the pivot and a diamond pattern was followed with each collection site being 10m apart. Individual plants were rated for foliar diseases using a 0-9 scale (Couture, L. 1980. Can. Plant Dis. Surv. 60: 8-10). Common root rot was rated by scoring the percent discoloration present on subcrown internodes using the Horsfall-Barrett Grading System. At harvest time, the same fields were visited again to collect head samples. These were used to assess head and kernel discoloration. Representative samples of internodes, leaves, glumes and seeds were saved for examination and/or plating to determine causal agents.

RESULTS: Plant samples were collected on the following dates with growth stages (Tottman, D.R. and Broad, H. 1987. Ann. Appl. Biol. 110: 441-454) given in brackets: June 13-15 (G.S. 14-24), July 11-13 (G.S. 61-77) and July 25-26 (G.S. 83-87). The average foliar disease in spring wheat for each of these periods was 0.9, 1.5 and 3.2, respectively while in spring barley it was 0.1, 1.4 and 2.2, respectively. A rating of 3.2 indicates the upper and middle leaves to be free of disease symptoms while the lower leaves show 10% symptoms. On the first sampling date only one field of wheat exhibited limited leaf mottling symptoms. These symptoms were not observed later in the season. The average rating for common root rot for spring wheat was 3.0, 8.7 and 19.5 percent, respectively for the three collection times while for spring barley it was 4.9, 7.8 and 15.9 percent, respectively. Take-all is suspected in one barley field at a level of 8% and also in two wheat fields at levels of 8 and 16%, respectively. Positive identification of the causal agent has not been done yet. The disease, however, was not severe enough to kill the affected plants. Head samples were collected Aug. 17-19 from all 21 wheat fields; however, only two barley fields could be sampled as the other two had already been harvested. The average head discoloration (glume blotch symptoms) for wheat was 2%, and 1.4% of the kernels exhibited smudge/blackpoint symptoms. Pink kernels were found only in one wheat field at a level of 1%. The average head discoloration found in the two barley fields was 0.5% with no trace of smudge/blackpoint or pink kernels. Loose smut occurred in several fields at levels less than 1% affected plants. Determination of the causal agents of disease symptoms found on internode, leaf, glume and seed samples has yet to be done.

Crop/Culture: Spring bread wheat

Location/Emplacement: Southwestern Quebec

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Title/Titre:

SURVEY OF SPRING BREAD WHEAT DISEASES IN SOUTHWESTERN QUEBEC IN 1988

METHODS: Eighteen fields of six spring bread wheat cultivars were surveyed for leaf, root, and head diseases throughout the different regions of southwestern Quebec in 1988. Foliar disease severity was assessed on 10-20 plants at 10 sites along a W transect about 100 m long across the field. Samples of about 10 plants were taken from each site to assess for root diseases in the laboratory. Leaf diseases were evaluated before heading as percentage leaf area affected on the whole plant, and after heading on only the top leaves, using the Horsfall and Barratt grading system. Root diseases were assessed by using a scale from 0-9 (0 = healthy, 9 = severe). Head blight was assessed as the percentage infected spikelets on 50 heads chosen at random at each site.

RESULTS AND COMMENTS: Table 1 gives the minimum - maximum percentage disease incidence recorded before and after heading for the diseases observed throughout the season. Before heading tan spot (Pyrenophora tritici-repentis) was observed in all fields but came earlier and with more intensity in fields where wheat stubbles from the previous year's crop remained on the surface. After heading, the spots were a mixture of tan spot and septoria leaf blotch (Septoria nodorum) very difficult to differentiate by visual observation. Powdery mildew (Erysiphe graminis) was observed in all the fields of cultivars Katepwa and Columbus before heading but not on Max. Leaf rust (Puccinia recondita) was observed only in trace amounts on cv. Max very late in the season. Take-all was observed only in two fields: a trace amount in the cv., Max and a quite severe infection in one field of cv. Columbus where up to 0.5% of the plants were affected. Fusarium head blight was observed in all fields of cv. Max and Columbus but in only two fields of cv. Katepwa. Up to 3.0% infected spikelets were recorded in one field of the cv. Max. The four fields of cv. Katepwa which escaped from head blight infection had stopped flowering after the long drought period which prevailed in June and early July. This drought period is also responsible for the low intensity of the other diseases except powdery mildew.

Table 1. % infection range of three cultivars of spring wheat at eighteen sites before and after heading in southwestern Quebec in 1988.

Growth Stages*	% minimum - maximum disease severity				
	Leaf Spots	Powdery Mildew	Head Blight	Leaf Rust	Take-All
Max					
40 - 49	0.1-0.7	0	-	0	-
75 - 83	0.2-7.5	0	0.3-3.0	0-tr.	0-tr.
Katepwa					
40 - 49	0-1.9	0.6-3.0	-	0	0
75 - 83	2.1-9.8	0.6-3.0	0-0.2	0	0
Columbus					
40 - 49	0.1-2.6	1.6-6.2	-	0	-
75 - 83	1.7-11.3	1.6-3.2	0.3-1.2	0-0.5	

*Zadoks et al. growth stages.

REFERENCES:

1. Horsfall, J.G. and R.N. Barratt, 1945. An improved grading system for measuring plant diseases. Phytopathology 35(8): 655 (Abstr.)

2. Zadoks, J.C., T.T. Chang, and C.F. Konzak, 1974. A decimal code for the growth stages of cereals, Weed Res. 14(6): 415-421.

Crop/Culture: Wheat, Oat, Barley

Location/Emplacement: Central Alberta

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Title/Titre: Cereal Disease Incidence in Central Alberta - 1988

WEATHER: Cereal crops in central Alberta suffered from poor germination; a result of the combination of low snow fall in the winter of 1987 - 1988 and almost no rainfall in April and May. The summer rains brought belated germination resulting in uneven crops and late germinating weeds. In spite of this, central Alberta recorded near normal crop yields and quality, and for barley bumper yields. Disease levels in the cereal crops were generally low.

METHODS: In early August cereal fields were selected at random in the central Alberta counties of Ponoka, Lacombe and Red Deer which form part of Census District 8. Fields were transversed in an inverted V and disease levels were noted by visible symptoms. Four categories were used based on percent leaf area of subcrown internode area diseased: trace ≤ 1%; slight < 5%; moderate 5 - 25%; and severe > 25%. In dealing with whole plant diseases (e.g. take-all) the same categories were applied to the percent of plants infected in square metre samples.

SPRING WHEAT: Fourteen wheat fields were examined which represents about 1 field per 7500 acres sown. Common root rot (*Cochliobolus sativus* and *Fusarium* spp.) appeared in all fields but there was only 1 field in each of the slight and moderate categories. Septoria leaf blotch (*Septoria* spp.) occurred in 93% of the fields examined, but only 1 field exhibited a moderate amount of lesioning on the upper leaves. Powdery mildew (*Erysiphe graminis*) appeared in 50% of the fields examined, all of them in the trace or slight categories. Leaf rust (*Puccinia recondita*) occurred in low amounts in 64% of the fields but severely infected both the lower and upper leaves of one field just east of Lacombe. This was an unusual observation for our area as leaf rust is usually of minor importance here. Take-all (*Gaeumannomyces graminis*) infected 1/3 of the fields sampled but only at trace levels. Prematurity blight (*Cochliobolus sativus* and *Fusarium* spp.) was present in one field and stem melanosis (*Pseudomonas cichorii*) was present in three. Neither of these diseases exhibited more than trace levels of severity. Glume blotch (*Septoria nodorum*) was present in 21% of the fields, again only in trace to slight amounts.

OAT: Four oat fields were examined, representing 1 field for every 26,000 acres sown in the area. Oat is a very disease-free crop in our area. Blast is the major problem, with 100% of fields usually affected. Generally blast is quite mild in its symptoms and this year was no exception. Only 1 field had over 5% of the florets blasted, the rest had 1% or less. Septoria leaf blotch (*Septoria avenae* f. sp. *avenae*) occurred in 75% of the fields but only in trace amounts on the upper leaves.

BARLEY: Twenty-nine barley fields were examined, representing approximately 1 field for every 21,000 acres sown. Common root rot (*Cochliobolus sativus* and *Fusarium* spp.) was the most frequently encountered disease but the severity was very low with only 17% of the fields examined rating slight and the remainder (83%) rating clean to trace. Net blotch (*Pyrenophora teres*) was the most commonly encountered leaf disease with 93% of the fields exhibiting symptoms. Twenty-two percent of the fields had net blotch scores of moderate on the upper leaves and 2/3 of these were two-row barleys. This level of infection at the soft dough stage of development (GS 85) would likely result in loss of grain yield. Scald (*Rhynchosporium secalis*) was observed in 72% of the fields examined; 29% of these were rated as moderately diseased on the upper leaves. Over 80% of these fields were in the northern part of the area surveyed. Bacterial blight (*Xanthomonas campestris*) was observed in 2 fields, one each in the slight and trace categories. Barley yellow dwarf was observed in only one field this year - this may be partially due to the timing of the survey. Infected specimens could not be readily distinguished from naturally senescing plants. Powdery mildew (*Erysiphe graminis*) was present in 14% of the fields examined, with one field having moderate infection on the lower leaves. Loose and covered smut (*Ustilago nuda* and *U. hordei*) were observed in 28 and 24% of the fields examined. Each disease had one field in the slight category, the remainder in the trace category.

Crop / Culture: Wheat and barley

Location / Emplacement: Southern Alberta

Title / Titre: DETECTION OF WHEAT STRIATE MOSAIC VIRUS IN FIELDS OF WHEAT AND BARLEY IN SOUTHERN ALBERTA

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METHODS: Results are based on samples submitted to the Lethbridge Research Station from 12 fields of wheat and 4 fields of barley. Diagnosis was based on leaf symptoms and a leaf dip preparation. A paired comparison of healthy and diseased plants was carried out in a late seeded field of Fielder soft white spring wheat to determine the effect of the virus on the yield components.

RESULTS AND COMMENTS: The presence of a rhabdovirus was confirmed in all the samples of wheat and barley. Examination of leaf dip preparations by transmission electron microscopy detected large numbers of rhabdovirus particles measuring 200-250 X 75 nm which corresponds to the dimensions of American wheat striate mosaic virus. Typically infected plants were often stunted and exhibited a fine, parallel, chlorotic streaking between the veins of the leaves which later developed into a general chlorosis or necrosis of the entire leaf. Observation by the authors and reports from district agriculturalists indicated that the disease was widespread throughout southern Alberta in hard red spring, soft white spring and durum wheat. In most fields the incidence of diseased plants ranged from 5 to 20%. Samples infected with the wheat striate mosaic virus were received from as far north as Drumheller. The yield of diseased plants of Fielder was only 73% of that of healthy plants. This reduction in yield was primarily due to a significant (P = 0.001) decrease in kernel weight. Other yield components such as tiller number and seed number per spike tended to be lower in diseased plants but the difference between healthy and diseased plants was not significant (P = 0.05).

Crop / Culture: Wheat and Oat

Location / Emplacement: Manitoba and eastern Saskatchewan

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Title / Titre: Occurrence of Cereal Rusts in Western Canada in 1988

METHODS: Fields of cultivated wheat and oats were examined throughout July in Manitoba and Saskatchewan for wheat leaf rust, wheat stem rust, and stem and crown rust of oats. Samples of rust were obtained from wheat, cultivated oats, wild oats, and wild barley.

RESULTS: Wheat leaf rust (causal agent *Puccinia recondita* f. sp. *tritici*) was first observed June 9 in winter wheat at Portage la Prairie, MB. By June 22, despite extremely hot and dry weather, the disease had become widespread in light amounts on spring wheat throughout southern Manitoba and parts of adjacent Saskatchewan. In fields around Dauphin, MB. leaf rust was observed in light amounts in the first week of July. In mid-July little or no leaf rust was observed in many fields in the Red River Valley which had been subjected to intense heat and drought stress. However, by the end of July heavy amounts of leaf rust were found on susceptible cultivars at Portage la Prairie, MB., Brandon, MB., Dauphin MB., Indian Head, SK., and Melfort, SK. Fields of late planted Katepwa and Neepawa cultivars near Yorkton, SK. and Dauphin, MB. were observed to have moderate amounts of leaf rust on the flag leaves. Yield losses to leaf rust in these fields may be expected as the rust infections were present before the completion of anthesis and grain filling. Wheat stem rust (*Puccinia graminis* f. sp. *tritici*) was observed in the second week of June in southern Manitoba. However the disease did not progress beyond trace amounts in western Canada due to the hot, dry weather and the use of resistant cultivars. Only trace amounts of oat crown rust (*P. coronata*) and oat stem rust (*P. graminis* f. sp. *avenae*) were observed due to the drought conditions and use of resistant cultivars.

Crop/Culture: Wheat and Barley

Location/Emplacement: Manitoba

Title/Titre: Incidence of Plant Diseases in Wheat and Barley in Manitoba in 1988

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METHODS: Results based on samples of wheat and barley submitted to the Plant Pathology Laboratory and field examinations.

RESULTS:

Wheat Wheat yields were severely reduced in much of southern Manitoba because of the drought conditions of 1988. The most severely affected area was in the Central region bordered by Plum Coulee, Altona and Morden. Yields were reduced up to 50%. The leaf diseases Septoria leaf blotch (*Septoria* spp.), and tan spot were not a problem in 1988 in most areas as a result of predominantly dry weather,(exception Dauphin area). Leaf rust developed late in July and was quite prevalent in fields near Portage, Dauphin and Swan River. Based on foliar fungicide trials in the Dauphin area yield reductions due to leaf rust were less than 10%. Barley yellow dwarf virus was found in several fields near Minnedosa and Portage. A newly described virus like disease, Flame chlorosis, was detected at low levels in several wheat fields near Portage. Common root rot(*Cochliobolus sativus* and *Fusarium* spp.) was found in 30% of samples submitted to the Manitoba Agriculture, Plant Pathology Laboratory. Environmental stress damage (ie) low soil moisture, high temperatures, was detected in 24%.

Problems Encountered on Wheat in Manitoba [1] in 1988

Disease	Percentage of Fields
Common root rot and seedling blight	30
Leaf rust	8
Septoria complex	5
Tan spot	3
Barley yellow dwarf	6
Storage fungi	5
Environmental stress	24
Herbicide injury	11
Insect damage	5

[1] Based on 102 samples submitted to Manitoba Agriculture, Plant Pathology Laboratory

BARLEY The incidence of leaf diseases on barley was less in 1988 than normal. Environmental stress was the main cause of yield loss and in the central region south of Winnipeg yields were severely reduced. The estimated yield reduction was 36%. Table 2 presents results of analysis of samples submitted to the Manitoba Agriculture, Plant Pathology Laboratory. The barley yellow dwarf virus disease was again high in 1988 but the yield reduction was less than in 1987, rapid maturation of crop reduced potential for yield loss. Flame chlorosis, a newly described virus like disease, was found in samples from 4 fields in the Minnedosa area of southwestern Manitoba in a few fields up to 20%. Net blotch (*Pyrenophora teres*) was generally low but was diagnosed in 6 samples of 13%. Yield loss from net blotch was less than 5%. Herbicide injury symptoms were diagnosed in one sample.

Table 2: 1988 Barley Disease Problems in Manitoba[1]

Disease	Percentage of Fields
Virus diseases	20
Common root rot	16
Net blotch	13
Environmental stress	42
Herbicide injury	2

[1] Based on 45 samples submitted to the Manitoba Agriculture, Plant Pathology Laboratory

Crop / Culture: Wheat

Location / Emplacement: Southern Manitoba

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Title / Titre: Incidence Of Fusarium Head Blight In Manitoba Spring Wheat In 1988

METHODS: Twenty-five wheat fields were sampled for Fusarium head blight (FHB) on August 3 and 5, 1988. One survey route extended south of Winnipeg to Rosenfeld; the second northeast of Winnipeg to Lac du Bonnet. Fields were selected at random along the survey routes. FHB was identified visually by sampling an area of about 50 x 30 m near the edge of each field. Disease levels were categorized as trace when < 0.5% of heads were infected. Heads were collected at each location for identification of any *Fusarium* spp. present.

RESULTS AND COMMENTS: Nineteen of the fields sampled were bread wheats and six were of semi-dwarf type. No durum fields were encountered along the survey routes. Crop maturity at the time of sampling ranged from late milk to hard dough. FHB at trace disease severity was detected in only one field. This was of semi-dwarf type and located at the eastern periphery of Winnipeg, near the junction of highways #100 and #15. The region northeast of Winnipeg received somewhat more rain in 1988 than the Red River Valley where drought conditions prevailed. In 1987 FHB had been most prevalent and severe in the Red River Valley south of Winnipeg. The general lack of rain likely curtailed the development of FHB in southern Manitoba in 1988. Yield loss, quality downgrading and mycotoxicological problems associated with FHB were therefore not a factor in wheat production in southern Manitoba this year. Evaluation of all *Fusarium* spp. present on (mainly) symptomless heads has not been completed at this time. *F. graminearum* was isolated from kernels and glumes from the one field where FHB was identified.

Crop / Culture: Wheat

Location / Emplacement: Province of Quebec

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Title / Titre: INCIDENCE OF WHEAT DISEASES IN QUEBEC IN 1988

The development of many of the common wheat diseases was affected this year by a long drought period in June and early July. Fusarium head blight (F. graminearum) was observed mostly on later seeded plots which flowered in July after the drought. Powdery mildew (Erysiphe graminis) was favored by the dry condition early in the season and was moderate to severe on susceptible cultivars in southwestern Quebec. Leaf spots (Pyrenophora tritici-repentis mixed with Septoria nodorum) were widespread as usual during the late dough stages in only moderate quantities. Glume blotch (Septoria nodorum) was observed in low quantities in the Eastern Townships and in trace amounts in the Quebec City area. Leaf rust (Puccinia recondita) was light to moderate only in the Eastern Townships, Deschambault, and Quebec City regions. Take-all (Gaeumannomyces graminis), ergot (Claviceps purpurea), and loose smut (Ustilago nuda) were observed in only trace amounts throughout the province.

Crop / Culture: Winter Wheat

Location / Emplacement: Saskatchewan

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Title / Titre: Foliar Disease Survey Of Winter Wheat In Saskatchewan, 1988

METHODS: In 1988, 84 winter wheat fields (cultivar Norstar) were included in a disease survey. Three sampling trips were taken across Saskatchewan, the first from 10 May to 31 May, the second from 7 June to 23 June, and the third from 30 June to 13 July. Many fields were too ripe for meaningful rating or had been harvested for grain or baled for feed by the third sampling date.

RESULTS: In fields in the brown soil zone, no disease was observed at the first two sampling dates. In the third sampling period all fields visited had moderate leaf spot and glume blotch symptoms. On average, less than 1% of the flag leaf was affected; disease was much more severe on the middle and lower leaves. Leaf rust was present in trace amounts in 25% of fields sampled in late June.

No disease was found in fields in the dark brown soil zone at first sampling. By the second sampling date, 70% of the fields had symptoms of leaf spot, mostly restricted to middle and lower leaves. Trace amounts of leaf rust were found in 25% of these fields, primarily in the extreme eastern part of the province.

Trace amounts of powdery mildew and leaf spotting diseases were found on lower leaves in 30% and 40% of the fields surveyed in the black soil zone in late May. At the second sampling date powdery mildew and leaf spotting diseases were restricted to middle and lower leaves in 45% and 100% of the fields sampled. Leaf rust was found in trace amounts in 10% of the fields.

Septoria nodorum was isolated with much greater frequency than Pyrenophora tritici-repentis from foliar lesions collected from the brown and dark brown soil zones. The reverse was true for samples from the black soil zone.

Crop / Culture: Winter wheat

Location / Emplacement: Southwestern Quebec

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Title / Titre: SURVEY OF WINTER WHEAT DISEASES IN SOUTHWESTERN QUEBEC IN 1988

METHODS: Four fields of the cultivar Augusta, two of Monopol, and two of Frederick were surveyed for leaf, root, and head diseases in eight different localities of the county of Ste. Hyacinthe in Southwestern Quebec in 1988. Foliar disease severity was assessed on 10-20 plants at 15 sites along a W transect about 200 m long across the field. Samples of about 10 plants were taken at each of the sites to assess for root and basal stem diseases in the laboratory. Leaf diseases were evaluated at the Zadoks et al. growth stages 31, 45, 59, 75, and 85. Root, stem, and head diseases were evaluated at growth stage 59. Disease levels on leaves were recorded as percentage leaf area affected on the whole plants before heading and on top leaves only after heading, using the Horsfall and Barratt grading system. Root and basal stem disease severity was assessed using a scale from 0-9 (0 = healthy, 9 = severe). Head blight was assessed as the percentage of infected spikelets on 50 heads chosen at random at each site.

RESULTS AND COMMENTS: The range of infection obtained for *Fusarium* head blight, stem necrosis due to *Bipolaris sorokiniana* or *Fusarium* sp., Take-all (*Gaeumanomyces graminis*) and at five growth stages for leaf spots (mixture of *Pyrenophora tritici repentis* and *Septoria nodorum*) and powdery mildew (*Erysiphe graminis*) are presented in Table 1. Before heading tan spot was observed in all the fields whereas afterwards the spots were a mixture of *Septoria* and *Pyrenophora* very difficult to differentiate. Heaviest and earliest infections of tan spot was observed in the three fields where wheat stubbles from last year's wheat crop remained on the soil surface. Powdery mildew was present on the three cultivars and only five fields at growth stage 31 before heading. The eight fields were infected at growth stage 45, and after heading, infection of top leaves did not go beyond 5% of the leaf surface area. Leaf rust (*Puccinia recondita*) was observed only very late in the season on the three cultivars in five fields. Head blight (*Fusarium graminearum*) was observed only in trace quantities in three fields where flowering occurred after the drought period in June. Basal stem necrosis was usually slight and superficial except in two fields of the cultivar Augusta where 1-2% stems showed a more severe infection. Take-all was observed only in trace amounts in two fields. The very long drought period in June and early July explains the low incidence of most of the diseases except for powdery mildew.

Table 1. % infection of diseases of winter wheat at eight sites and five growth stages in southwestern Quebec in 1988.

	% minimum - maximum disease severity				
Growth Stages*	Leaf Spots	Powdery Mildew	Head Blight	Leaf Rust	Stem Necrosis
Before heading**					
31	1.1-2.3	0-3.2	-	-	-
45	2.1-2.3	0.3-5.7	-	-	-
After heading***					
59	0-1.8	0-1.8	-	-	0-11.0
75	0-1.2	1.2-2.3	-	-	-
85	2.3-6.5	0.3-4.7	0-tr.	0-2.9	-

*Zadoks et al growth stages.
**Disease assessment on whole plants.
***Disease assessment on top leaves only.

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Crop / Culture: Cereals

Location / Emplacement: Southern Alberta

Name and Agency / Nom et Organisation:

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Title / Titre: CEREAL DISEASES DIAGNOSED AT THE SOUTHERN ALBERTA REGIONAL CROP LABORATORY

In 1988, the Regional Crop Laboratory at the Alberta Special Crops and Horticultural Research Center received 100 cereal specimens for disease diagnosis. The diagnoses are listed in Table 1. Note that numbers of disease within columns exceed the total number of specimens for that crop because some specimens had more than one disease. The non-pathogenic disorders affecting barley, durum, and hard red spring wheat were primarily related to drought. On winter wheat, the feeding injury of the brown wheat mite, *Petrobia latens* (Muller), was the predominant non-pathogenic disorder.

Table 1. Summary of cereal specimens diagnosed, January 1 - October 26, 1988.

	Barley	Durum	HRSW	Soft Wheat	Winter Wheat	Others	Total
Total No. of Specimens	33	12	36	5	8	6	100
Fungal Diseases	24	1	11	5	4	3	48
Glume Blotch (a)			6	1			7
Spot Blotch (b)	5		2				7
Common Root Rot (b)	4	1	2	2		2	11
Net Blotch (c)	4						4
Powdery Mildew (d)	2			1	1		4
Leaf Rust (e)	2			1	1		4
Scald (f)	2						2
Sooty Mold (g)	2						2
Covered Smut (h)	2						2
Fusarium Root Rot (i)	1		1		1		3
Take-All (j)					1		1
Ergot (k)						1	1
Viral Diseases	8	1	5	1			15
Barley Stripe Mosaic	5						5
Barley Yellow Dwarf	2						2
Wheat Streak Mosaic		1		1			2
Undetermined	1		5				6
Bacterial Diseases						2	2
Non-Pathogenic Disorders	12	13	28	2	4	3	62

(a) *Septoria nodorum*
(b) *Bipolaris sorokiniana*
(c) *Drechslera teres*
(d) *Erisyphe graminis* f.sp. *hordei*, *E. graminis* f.sp. *tritici*
(e) *Puccinia hordei*, *P. recondita*
(f) *Rhynchosporium secalis*
(g) *Alternaria* spp., *Cladosporium* spp.
(h) *Ustilago hordei*
(i) *Fusarium culmorum*
(j) *Gaeumannomyces graminis* var. *tritici*
(k) *Claviceps purpurea*

Crop / Culture: Cereals

Location / Emplacement: Prince Edward Island
New Brunswick
Nova Scotia

Name and Agency / Nom et Organisation:

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Title / Titre: CEREAL DISEASE PROFILE IN THE MARITIME PROVINCES - 1988

WEATHER CONDITIONS: In general, moisture was adequate in the early portion of the growing season. Mid to late season moisture levels significantly contributed to the development and progression of most foliar and head diseases. Temperatures were normal.

BARLEY: Scald, incited by *Rhyncosporium secalis*, was primarily associated with early seeded barley fields and was not a serious problem in 1988. Symptoms of scald tended to be restricted to the lower foliage and did not progress up the plant to any great extent.

Net blotch, incited by *Pyrenophora teres*, was the predominate foliar disease of spring barley throughout the region. The 1987 production year was very dry and resulted in the production of seed with a low incidence of *P. teres*. This may have been partially responsible for a relatively slow development and progression of net blotch symptoms in 1988, until later stages of growth when rainfall levels increased and promoted disease progression. Yield loss attributed to net blotch was more likely associated with the 2-row cultivars than with the 6-row cultivars.

Fusarium infection of barley heads, by *Fusarium graminearum*, has not been a problem in previous years, as relates to yield loss, however in 1988 a number of fields were identified in which fusarium head blight was severe. Six-row cultivars appeared to be more susceptible than 2-row cultivars.

SPRING WHEAT: While the 1987 spring wheat crop was not adversely affected by disease, with very low disease severity, as a result of unusually dry weather, the general severity of disease on the 1988 crop was more normal for the Maritime Region.

Powdery mildew, incited by *Erysiphe graminis*, was a more important disease in 1988 than in previous years. The cultivars Vernon and Max which were resistant up until 1988, were infected, in some instances to severe levels due to the overcoming of effective resistance. The overcoming of resistance occurred throughout the Maritime Region. Other cultivars such as Ketepwa which lacks resistance reported severe disease levels. Milling wheat cultivars which are produced at high nitrogen fertility levels were treated routinely with a fungicide for powdery mildew control. Under these conditions, little disease was observed due to the effectiveness of the fungicides utilized in milling wheat production.

Septoria leaf blotch and septoria glume blotch, incited by *Septoria nodorum*, were recorded at moderate to severe levels throughout the region. Reports of widespread severe septoria glume blotch in some areas of New Brunswick and Prince Edward Island were actually related to an infestation of the wheat midge which caused head discolouration similar to that of septoria glume blotch.

Fusarium head blight was the leading yield and quality reducing disease in all three provinces. The disease, incited by *Fusarium graminearum*, was particularly destructive in eastern Prince Edward Island and parts of New Brunswick where more rainfall was recorded than normal for the later part of the growing season. Yield losses were significant in some areas. Fusarium head blight resulted in lower grades for milling wheats with a large number of seed lots being downgraded as a result of tombstone kernel levels.

WINTER WHEAT: Winter wheat was subjected to the same diseases as spring wheat but the severity was lower due primarily to earlier crop maturity. The 1988 disease profile and severity was similar to previous years. Snow molds were not as severe and winter survival was good, in part a result of adequate snow cover, and the absence of the customary mid-winter thaw and associated ice sheeting. Milling winter wheat cultivars are susceptible to powdery mildew, incited by *E. graminis*, but these cultivars are produced with protection provided via foliar applied fungicides, and thus powdery mildew was not a serious yield limiting disease. In fields where foliar fungicides were not applied, the disease was yield limiting.

The severity of fusarium head blight did not approach that associated with spring wheat. While the crop was not disease free, severity was in general low.

SPRING TRITICALE: This crop was observed only in New Brunswick where fusarium head blight was very severe and resulted in high levels of mycotoxin contamination.

OATS: Speckled leaf blotch, incited by *Septoria avenae*, was the only foliar disease of any consequence on oats throughout the Maritime region. This was consistent with reports of previous years.

Forage legumes / Légumineuses fourragères

Crop / Culture: Alfalfa

Location / Emplacement: Southern Alberta

Title / Titre: SURVEY FOR VERTICILLIUM WILT OF ALFALFA

Name and Agency / Nom et Organisation:

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METHODS: From August 23-31, 1988, 29 alfalfa fields in the Vauxhall area of Southern Alberta (Fig. 1) were surveyed for Verticillium wilt (*Verticillium albo-atrum*). The majority were contracted for production of dehydrated alfalfa products. The disease was identified by visual symptoms of wilt and V-shaped yellow sectors on leaves. Each field was surveyed by entering at one corner, walking 200 paces toward the center, then exiting at 90^{o} to the closest edge of the field. Suspect plants were collected on the entry and exit transects and taken to the laboratory to confirm field diagnosis. *V. albo-atrum* was isolated from 1-cm pieces from the lower stems of suspect plants. The isolation procedure consisted of dipping stem pieces in 70% ethanol, placing them in 1% sodium hypochlorite for 3 minutes, rinsing in sterile water, and plating onto Czapek's agar amended with 200 ppm of streptomycin. The plates were incubated at 20^{o}C for 5-7 days before observation.

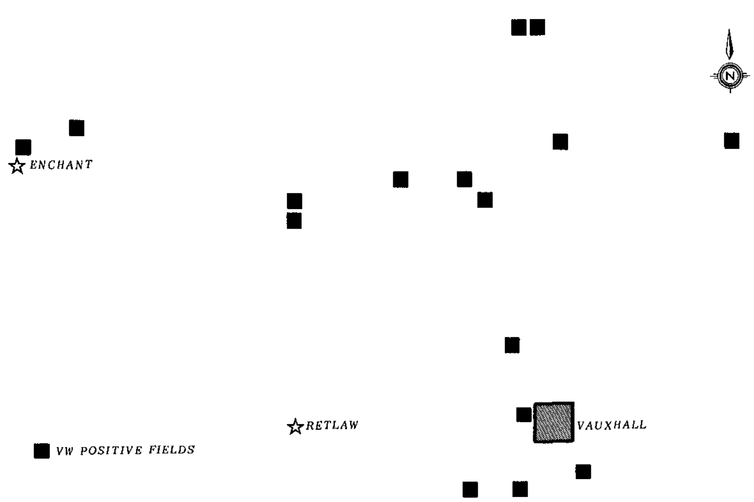
RESULTS AND COMMENTS: Verticillium wilt was found in 16 of the fields surveyed (55%) (Table 1). All but one of the fields were irrigated. Disease incidence ranged from trace (1%) to severe (>50%). The high concentration of wilt in fields contracted for dehydration suggests that custom harvesting machinery may have spread *V. albo-atrum* from field to field.

Table 1. Survey data for Verticillium wilt of alfalfa in Southern Alberta in 1988.

Field designation	No. fields surveyed	No. fields with VW
Dehydration	23	14
Hay[1]	6	2
	29	16

[1] One positive field was dryland.

Figure 1. Alfalfa fields surveyed for Verticillium wilt in 1988.



Crop/Culture: Alfalfa

Location/Emplacement: Saskatchewan

Title/Titre: FOLIAR DISEASES OF ALFALFA IN N.E. SASKATCHEWAN, 1988

Name and Agency/ Nom et Organisation:

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METHODS: Five fields of alfalfa in crop districts 8a, 8b and 9a were surveyed between August 10 and 29, 1988. Ten plants collected at ten pace intervals were rated for percentage of leaf of stem area affected (Disease Index) and losses estimated by a factor of 0.25.

RESULTS AND COMMENTS: Table 1 shows the extremely low levels of diseases, probably reduced by the serious drought in 1988. A single Red Clover field showed disease indices of 6.5 for Northern Anthracnose, 6.5 for Target Spot and 18.8 for Powdery Mildew.

Table 1. Prevalence, intensity and losses by foliar disease in Northeastern Saskatchewan.

Disease	% Fields Affected	Disease Index	% Loss
Common Leaf Spot	80	5.3	1.32
Black Stem	60	5.1	1.29
Yellow Leaf Blotch	20	10.0	0.24
Pepper Spot	40	9.6	0.16

Crop/Culture: Irrigated Alfalfa

Location/Emplacement: Saskatchewan

Title/Titre: VERTICILLIUM WILT AND FOLIAR DISEASES OF IRRIGATED ALFALFA IN SASKATCHEWAN IN 1988

Name and Agency/ Nom et Organisation:

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METHODS: Thirty irrigated alfalfa fields in the southwestern and central portions of the grainbelt in Saskatchewan (crop districts 3, 4 and 6) were examined for the presence of Verticillium wilt (*Verticillium albo-atrum*) between July 20 and August 5, 1988. All fields in the survey were used for forage production. Second growth was examined and suspect plants were taken to the laboratory for pathogen identification. Leaf disease identification was based primarily on field characteristics, and occasionally by collecting samples and isolating cultures.

RESULTS AND COMMENTS: Samples were taken from eight fields. Verticillium infection was confirmed in only two fields, both adjacent to the South Saskatchewan River near the Alberta border in crop district 4. *Verticillium* had not been found previously in either of these fields. This indicates that the disease may be spreading, albeit slowly.

Spring black stem (*Phoma medicaginis* var. *medicaginis*) was the most prevalent leaf pathogen in southern areas, but common leaf spot (*Pseudopeziza medicaginis*) was predominant in central areas. Downy mildew (*Peronospora trifoliorum*) infection was noted in several fields in the southern area. A *Colletotrichum* sp. was isolated from stems of wilted plants from several fields in the south. Leaf spot severity was very low throughout the survey area until late in the summer when some regions received precipitation after prolonged drought. However, severity never exceeded moderate levels.

This work was supported in part by a grant from the Agriculture Development Fund, Saskatchewan Agriculture.

Crop / Culture: Alfalfa

Location / Emplacement: Prince Edward Island

Title / Titre: FIRST OCCURRENCE REPORT OF VERTICILLIUM WILT OF ALFALFA ON PRINCE EDWARD ISLAND

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INTRODUCTION: Verticillium wilt of alfalfa (*Medicago sativa*), incited by *Verticillium albo-atrum*, has, since its reintroduction into Canada in 1977, become widespread. In 1981 surveys, infected plants were found in fields in British Columbia, Alberta, Saskatchewan, Ontario, and Nova Scotia (1). A survey in 1986 identified the presence of Verticillium wilt in the southern agricultural areas of Québec (3). Recent surveys of both Ontario and Québec have indicated that in both provinces Verticillium wilt incidence is increasing (2,4). With the exception of one field in Nova Scotia (1), Verticillium wilt has not been reported from the Atlantic Provinces.

METHODS: *Verticillium albo-atrum* was recovered from stem sections of alfalfa which exhibited symptoms of Verticillium wilt. The stem sections were surface sterilized in 10% Javex, plated on water agar, and incubated at room temperature for 3 to 5 days.

RESULTS AND COMMENTS: In September of 1988, after regrowth had occurred, several fields of alfalfa on Prince Edward Island were identified which exhibited symptoms of Verticillium wilt. The most severely infected fields were located at the Charlottetown Research Station of Agriculture Canada. A commercial field was also identified as being positive for Verticillium wilt. The severely infected fields at the Research Station were 3-year old and had not exhibited any symptoms of Verticillium wilt prior to September of 1988. Distribution of diseased plants was fairly even throughout these fields. Several small plot experiments also exhibited symptoms but in general at lower severity level.

The progression of Verticillium wilt in the worst fields was rapid. In mid-September, approximately 10% of the plants were displaying symptoms. By late October to early November, approximately 80 to 90% of the plants were displaying advanced symptoms.

The exact origin of contamination of the primary infected fields is unknown. However from the even distribution pattern in the severely infected fields, it would appear that the source of introduction may have been the seed. Infection of the plot experiments was probably as a result of contaminated harvest equipment used in the main infected fields.

ACKNOWLEDGMENT: The authors gratefully acknowledge the assistance of P. Basu and L. Seaman of the Plant Research Centre, Agriculture Canada, Ottawa, Ontario, for their assistance in confirming our identification of Verticillium wilt.

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1. Atkinson, T.G. 1981. Verticillium wilt of alfalfa: Challenge and opportunity. Can. J. Plant Pathol. 3: 266-272.

2. Basu, P.K., N.J. Brown, et al. 1988. Incidence of Verticillium wilt of alfalfa in Eastern Ontario. Can. Plant Dis. Surv. 68: 65-67.

3. Nicholls, H., C. Richard, and J.G. Martin. 1987. Verticillium wilt of alfalfa in Québec. Can. Plant Dis. Surv. 67: 17-21.

4. Richard, C. and H. Nicholls. 1988. Survey of Verticillium wilt of alfalfa in Québec, 1986-87. Can. Plant Dis. Surv. 68: 72-73.

Crop/Culture: Forage Legumes

Location/Emplacement: Saskatchewan

Title/Titre: SNOW MOLD AND WINTER INJURY ON ALFALFA AND OTHER FORAGE LEGUMES IN SASKATCHEWAN IN 1988

Name and Agency/ Nom et Organisation:

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METHODS: In May of 1988, 67 fields of dryland alfalfa, 7 of red clover and 3 fields of sweetclover were examined in the central and northern grainbelt areas of Saskatchewan to determine the extent and severity of snow mold diseases and winter injury. The sampling was stratified in that protected areas where snow would accumulate, and exposed areas where snow accumulation would be minimal, were examined in each field. Disease severity was rated on a five point scale; None, Trace <1% of plants killed, Slight = 1-10%, Moderate = 11-25%, Severe >25%. Identification of injury was based primarily on field symptoms, and occasionally by collecting specimens and isolating cultures.

RESULTS AND COMMENTS: Cottony snow mold (*Coprinus psychromorbidus*) of alfalfa was found at low levels throughout the survey area. Affected plants occurred most frequently around foci in areas where snow accumulated in the winter. Disease levels were very low (None - 26, Trace - 8) throughout the central grainbelt area (Saskatoon, Canora, Tisdale). Damage was somewhat higher (None - 7, Trace - 4, Slight - 2, Moderate - 1, Severe - 1) in the northwest (Meadow Lake, Glaslyn). In the northeast (Nipawin, Hudson Bay), disease severity levels were generally low (None - 6, Trace - 5, Slight - 5, Moderate - 3), except in and adjacent to patches where the disease had been severe in 1986-87. Damage was very severe in these areas, presumably because inoculum levels were high. *C. psychromorbidus* was the only snow mold pathogen observed on alfalfa. There was little or no low-temperature or desiccation injury on alfalfa in the survey area, and 65% of the fields examined were rated as good to excellent.

Seven fields of red clover were examined in the northeastern region. Snow mold injury caused by *Phoma sclerotioides* was higher than normal (None - 2, Slight - 1, Moderate - 2, Severe - 1), especially in the Nipawin area.

The three fields of sweetclover examined were all in the central grainbelt. They were in very good condition, with no visible snow mold or winter injury.

This work was supported in part by a grant from the Agriculture Development Fund, Saskatchewan Agriculture.

Crop/Culture: Forage Legumes

Location/Emplacement: Manitoba

Title/Titre: INCIDENCE OF PLANT DISEASES IN ALFALFA IN MANITOBA IN 1988

Name and Agency/ Nom et Organisation:

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METHODS: Results are based on alfalfa samples submitted to the Plant Pathology Laboratory and field examinations.

RESULTS: Winter injury to alfalfa was not a major problem in 1988. A few fields of alfalfa in the Central region were found to be infected with brown root rot (*Plenodomus sclerotioides*) but this problem was not widespread and losses were less than 10%. Verticillium wilt was not detected in alfalfa in Manitoba in 1988. Leaf and stem diseases were generally very low. Moisture and heat stress were the major causes of poor alfalfa yields in Manitoba in 1988.

Oilseeds and special crops / Oléagineux et cultures spéciales

Crop / Culture: Dry Bean

Location / Emplacement: Southern Alberta

Name and Agency / Nom et Organisation:
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Title / Titre: SURVEY OF DRY BEAN FOR SCLEROTINIA WHITE MOLD IN SOUTHERN ALBERTA IN 1988

METHODS: The survey was carried out during August 4-10 in five fields in the County of Lethbridge. Ten sites of 3-m row samples, with approximately 18 m between samples, were selected and surveyed in each field following a U-shaped pattern. The number of plants with symptoms of white mold (Sclerotinia sclerotiorium) and the total number of plants at each site were recorded. The disease incidence in each field was calculated based on average percent of infected plants from the 10 sites.

RESULTS AND COMMENTS: White mold was found in three fields. The average number of plants infected in the three fields was 8.1, 15.1, and 13.0%, respectively. The cultivars in the three diseased fields were Viva in one and Red Mexican in the other two.

Crop / Culture: Field pea and field bean

Location / Emplacement: Manitoba

Name and Agency / Nom et Organisation:
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Title / Titre:

INCIDENCE OF PLANT DISEASES IN PULSE CROPS IN MANITOBA IN 1988

METHODS: The results are based on samples of pulse crops submitted to the Plant Pathology Laboratory and on field examinations.

RESULTS:

Field Pea: The incidence of plant diseases in field pea in 1988 was less than in 1987. Mycosphaerella blight (Mycosphaerella pinodes) was much reduced in severity from 1987 because of dry weather. The most conspicuous problem was powdery mildew (Erysiphe polygoni). Three fields in the Portage area showed heavy development of mildew in August. Other diseases observed were bacterial blight (Pseudomonas pisi) in one field, and low levels of root rot and damping off (Fusarium spp. and Pythium spp.) in seven fields. The environmental stress of moisture deficiency and high temperatures was the major cause of yield loss in field pea in 1988.

Field Bean: Dry weather during the growing season prevented many of the normal problems in field bean. Sclerotinia white mould (Sclerotinia sclerotiorum) was not a significant problem. Root rot (Fusarium spp.) was detected in four fields south of Winnipeg in the central region. Bacterial blight, (Xanthomonas phaseoli) was found in three fields at low levels. In the area bounded by Carman, Plum Coulee and Winkler, yield loss from drought was in excess of 50%. In the other field bean growing areas around Portage and Whitemouth, normal to slightly above normal crops were harvested with very little disease loss.

Crop/Culture: Canary Grass

Location/Emplacement: Saskatchewan

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Title/Titre: CANARY GRASS DISEASE SURVEY IN N.E. SASKATCHEWAN, 1988

METHODS: Five fields of canary grass were surveyed for diseases between August 10 and 29, 1988, in crop district 8a. Fields surveyed were selected at random and sampled by collecting ten plants from each field at ten pace intervals. Diseases were identified by symptoms, and the severity of each disease recorded as an estimate of the percentage of leaf, stem or root area affected. Results for each disease were averaged over the total number of samples, and fields surveyed to give the disease index. Number of fields affected over total number of fields surveyed gave % fields affected.

RESULTS AND COMMENTS: Three diseases were found affecting canary grass. Root rot and spot blotch (Bipolaris sorokiniana) and a septoria leaf spot (Septoria triseti) are shown in Table 1 with their severity and frequency of occurrence.

Table 1. Prevalence and severity of diseases of Canary Grass in North East Saskatchewan

Disease	% Fields Affected	Disease Index
Root Rot	40	3.4
Septoria Leaf Spot	60	21.8
Spot Blotch	20	7.0

Crop / Culture: Canola

Location / Emplacement: Alberta

Title / Titre: BLACKLEG OF CANOLA SURVEY IN ALBERTA - 1988

Name and Agency / Nom et Organisation:

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METHODS: Two surveys of blackleg of canola, caused by the highly virulent strain of *Leptosphaeria maculans*, were carried out during the summer of 1988. In one survey, canola fields were surveyed by individual pathologists in particular Census Divisions (Table 1). Each field was sampled by traversing the path of an inverted V and examining canola plants at 5 spots about 30 meters apart. At each spot, 10 plants were examined visually and plants suspected to be infected with blackleg were collected for laboratory testing. The virulent nature of blackleg was confirmed by cultural methods (1). Blackleg severity was assessed from low to very severe based upon the depth and size of stem lesions: healthy = no lesion; low = small basal lesion; moderate = lesion up to several cm long; severe = stem girdled but not severed at base; very severe = stem severed, plant lodged.

The second survey was done in August by agricultural fieldmen throughout the province using the same sampling method. To confirm the disease, canola samples suspected of blackleg infection were forwarded to one of the cooperating plant pathologists at Brooks, Fairview, Olds, or Vegreville.

RESULTS: The results are summarized in Tables 1 and 2. The area in Alberta found infested with virulent blackleg is shown in Figure 1.

COMMENTS: Blackleg incidence and severity were higher in 1988 than in any of the years since 1983 when the disease was first recorded in Alberta. The disease was found at several new locations, and was particularly severe around Paradise Valley, Viking and Sedgewick. In Census Division 10, severely infested fields were detected as early as June. The disease was found in 90% of the fields surveyed, mostly in the southern half of this Census Division, and was severe in 25%. The average yield loss in this area is estimated to be about 10%; however, in one field it was more than 60%. In Census Division 7 the disease was confirmed in 45% of the fields surveyed.

In the survey conducted by agricultural fieldmen, a total of 821 fields were examined throughout the province. All fields found infested (Table 2) are located in either Census Divisions 10 or 7.

In southern Alberta, a virulent blackleg-infested field was located near Lyalta. This field, however, was not a part of the organized survey reported here. It is the most southern location where the disease has been found so far.

REFERENCE: 1. McGee, D.C. and G.A. Petrie. 1978. Variability of *Leptosphaeria maculans* in relation to blackleg of oilseed rape. Phytopathology 68:625-630.

TABLE 1. BLACKLEG OF CANOLA SURVEY BY PLANT PATHOLOGISTS IN ALBERTA - 1988.

Census Divisions	Acreage (Thousands)	No. of fields surveyed	Surveyors	Fields infested with highly virulent blackleg
1 + 4	36	13	Huang	0
2 + 5	282	14	Kaminski	0
3 + 6 + 9	207	11	Kaminski	0
7	496	24	Slopek	11
8 + 11	335	18	Evans	0
10	661	37	Kharbanda	33
12 + 13 + 14	279	11	Tewari	0
15	1,241	120	Harrison	0

TABLE 2. BLACKLEG OF CANOLA SURVEY CONDUCTED BY AGRICULTURAL FIELDMEN IN ALBERTA - 1988

A. Virulent blackleg of canola confirmed

Locality	Number of fields surveyed	Number of fields with virulent blackleg
County of Flagstaff #29	35	5
County of Minburn #27	20	5
County of Paintearth #18	10	1
M.D. of Provost #52	2	2
M.D. of Wainwright #61	10	2
County of Vermilion River #24	19	2

B. Virulent blackleg of canola not found

Locality	Number of fields surveyed	Locality	Number of fields surveyed
M.D. of Acadia #34	1	County of Smoky Lake #13	11
County of Athabasca #12	9	M.D. of Smoky Lake #130	32
County of Beaver #9	10	M.D. of Spirit River #133	12
County of Camrose #22	29	M.D. of Starland #47	8
M.D. of Clearwater #99	10	County of Stettler #6	17
M.D. of Fairview #136	16	County of Strathcona #20	7
M.D. of Foothills #31	10	M.D. of Taber #14	9
County of Forty Mile #8	5	County of Thorhild #7	10
County of Grande Prairie #1	26	M.D. of Westlock #92	10
M.D. of Kneehill #48	13	County of Wheatland	20
County of Lac Ste Anne #28	10	M.D. of Willow Creek #26	5
County of Lacombe #14	11	I.D. #16 (Valleyview)	18
County of Leduc #25	10	I.D. #17 E (Slave Lake)	12
County of Lethbridge #26	11	I.D. #17 W (Peace River)	19
County of Parkland #31	10	I.D. #18 (Bonnyville)	10
M.D. of Peace #135	15	I.D. #19 (Spirit River)	18
County of Ponoka #3	11	I.D. #20 (Spirit River)	15
County of Red Deer #23	19	I.D. #21 (Worsley)	54
M.D. of Rockey View #44	10	I.D. #22 (Peace River)	30
County of St. Paul #19	10	I.D. #23 (High Level)	22
		S.A. #4 (Consort)	10

C. Virulent blackleg survey not done

County of Barrhead #11	County of Two Hills #21
* M.D. of Bighorn #8	*County of Vulcan #2
M.D. of Bonnyville #87	*County of Warner #5
*M.D. of Cardston #6	County of Wetaskiwin #10
M.D. of Cypress #1	I.D. #14 (Evansburg)
County of Lamont #30	I.D. #15 (Fort Assiniboine)
County of Mountain View #17	I.D. #18 (Lac La Biche)
County of Newell #4	SA #2 (Hanna)
M.D. of Pincher Creek #9	SA #3 (Oyen)
M.D. of Sturgeon #90	

* Not much canola grown this year.

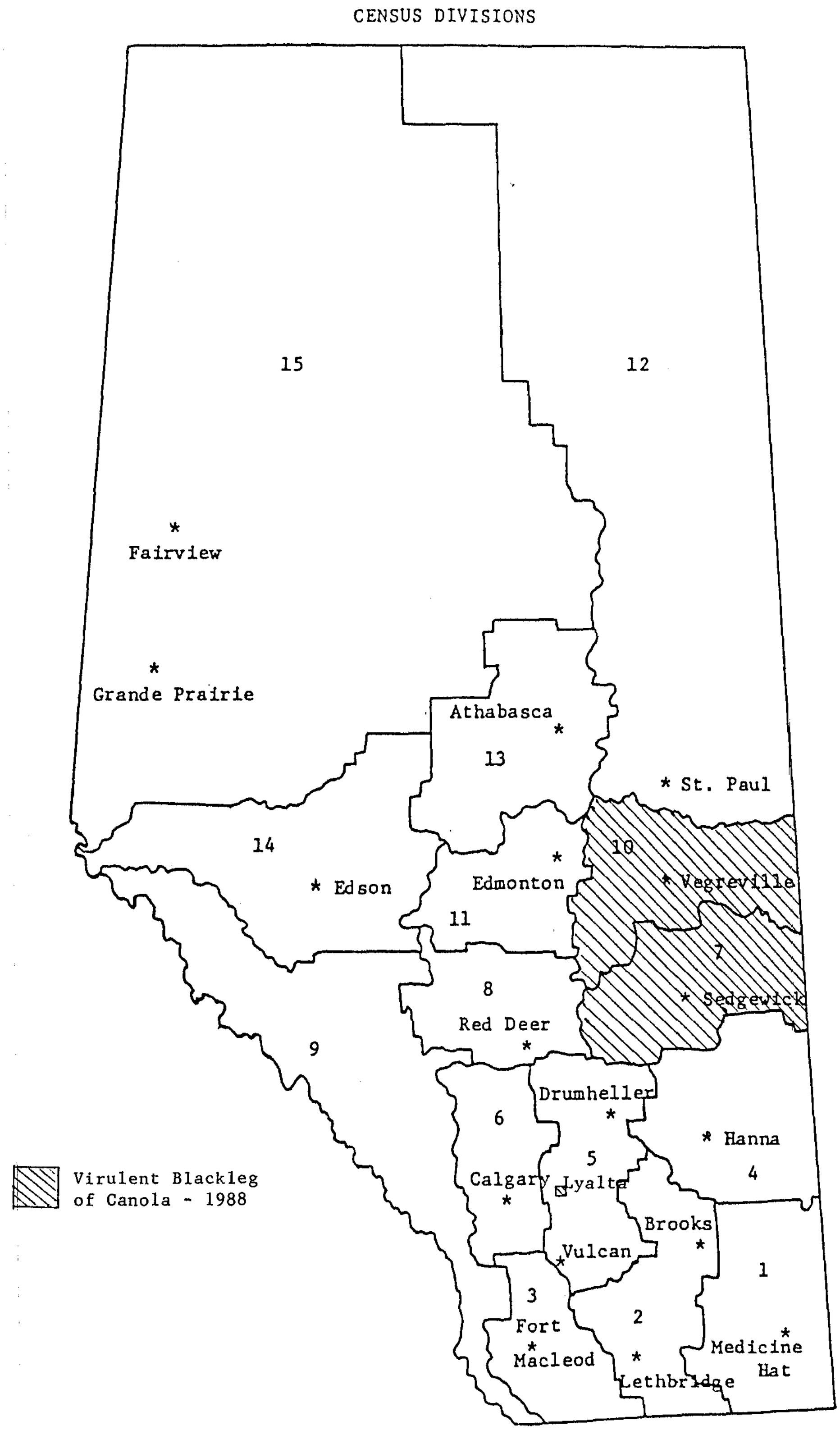

FIGURE 1. Distribution of highly virulent blackleg of canola in Alberta, 1988.

Crop / Culture: Irrigated Canola

Location / Emplacement: Southern Alberta

Title / Titre:

Name and Agency / Nom et Organisation:

H.C. HUANG[1], L.M. PHILLIPPE[1] and P.D. KHARBANDA
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SURVEY OF IRRIGATED CANOLA FOR BLACKLEG DISEASE IN SOUTHERN ALBERTA IN 1988

METHODS: Irrigated canola fields were surveyed for incidence of blackleg (Leptosphaeria maculans) during August 30-31, 1988 in the Counties of Lethbridge, Forty Mile, Warner and Vulcan and the Municipal District of Taber. Canola plants were examined for symptoms on stems by inspecting five sites in each field, with two 1-meter rows at each site, and recording the numbers of diseased and healthy plants. Range and average percent infection were determined for each field.

RESULTS AND COMMENTS: Of the 13 fields surveyed, blackleg was found in only one crop of Brassica napus located in the County of Warner. The disease incidence varied from 0 to 10%, averaging 1.4%. Isolation from plant samples showed that the disease was caused by the avirulent strain of L. maculans. This is the first report of blackleg disease on irrigated canola in southern Alberta.

Crop / Culture: Irrigated Canola

Location / Emplacement: Southern Alberta

Name and Agency / Nom et Organisation:

H.C. HUANG and L.M. PHILLIPPE
Agriculture Canada Research Station
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Title / Titre: SURVEY OF IRRIGATED CANOLA FOR SCLEROTINIA STEM ROT IN SOUTHERN ALBERTA IN 1988

METHODS: Irrigated canola fields were surveyed for incidence of sclerotinia stem rot (Sclerotinia sclerotiorum) during August 30-31, 1988, in the Counties of Lethbridge, Forty Mile (Bow Island) and Warner and the Municipal District of Taber. Canola plants were examined for symptoms on stems, leaves and/or pods by inspecting five sites in each field, with two 1-meter rows at each site, and recording the number of diseased and healthy plants. Range and average percent infection were determined for each field.

RESULTS AND COMMENTS: Twelve fields, two Brassica campestris and ten B. napus, were surveyed. Of the 12 fields surveyed, sclerotinia stem rot was found in three fields in the County of Lethbridge and Municipal District of Taber (see Table below). The disease incidence in the positive fields varied with sites, ranging from 0 to 20% and the average number of plants infected was 1.1% in each field. Disease was found in both fields of B. campestris.

In 1988, there were fewer fields with sclerotinia stem rot than in 1986 and 1987, and the disease incidence was light. This low level of disease may be due to the severe drought in southern Alberta in 1988.

Table. Survey of irrigated canola for sclerotinia stem rot in southern Alberta in 1988.

Districts	No. fields		% infected plants	
	Surveyed	Diseased	Range	Average
County of Forty Mile	5	0	0	0
County of Lethbridge	3	1	0-4	0.5
Municipal District of Taber	3	2	0-20	1.6
County of Warner	1	0	0	0
Total	12	3	0-20	1.1

Crop / Culture: Rapeseed/Canola

Location / Emplacement: Alberta

Name and Agency / Nom et Organisation:
HARRISON, L.M.
Alberta Agriculture
Regional Crops Laboratory
Fairview, Alberta TOH 1LO

Title / Titre: CANOLA DISEASE SURVEY IN THE PEACE RIVER REGION IN 1988

METHODS: In August 1988, a disease survey was conducted on rapeseed/canola fields in the Peace River Region of Alberta. The total area of canola production in the region in 1988 was approximately 1.2 million acres. The total number of fields included in this survey was 115. The diseases included in the survey were root rot, foot rot, sclerotinia stem rot, black spot and blackleg.

Fields were sampled by walking into each one in a V pattern and collecting the first plants at a site 50 paces from the edge of the field. Ten plants were selected at random at each of five sites along the V pattern for a total of 50 plants per field. Disease incidence was recorded on every plant. Root rot ratings were recorded using a 0-4 scale, where 0 = no lesions on taproot, 1 = light brown lesions on taproot but no girdling, 2 = coalesced brown lesions on taproot but no girdling, 3 = dark brown lesions girdling taproot above main laterals (wirestem appearance), 4 = severe necrotic lesions on taproot, roots rotted off and plant dead.

RESULTS: The results are given in Tables 1 and 2.

COMMENTS: The root rot complex was the most prevalent disease affecting 100% of the 115 fields sampled with 99.1% of the sampled plants infected (Table 1). The average severity of root rot was 2.4 (Table 2). Incidence of sclerotinia stem rot was high for this area with 35% of fields infected. Incidence of black spot and foot rot was high with 49.9% and 28.5% respectively.

Table 1. Prevalence and incidence of root rot, foot rot, sclerotinia stem rot, blackleg and black spot of canola in the Peace River Region in 1988.

Disease	% fields infected	% plants infected
Root Rot (*Rhizoctonia*, *Pythium*, *Fusarium*)	100	99.1
Black Spot (*Alternaria* spp.)	97	49.9
Foot Rot (*Rhizoctonia*, *Fusarium*)	84	28.5
Sclerotinia (*Sclerotinia sclerotiorum*)	35	5.0
Avirulent Blackleg (*Leptosphaeria maculans*)	17	1.2

Table 2. Incidence and severity of root rot in canola fields in the Peace River Region in 1988.

Crop	number of fields	% root rot	root rot rating
canola	115	99.1	2.4

Crop/Culture: Canola

Location/Emplacement: Saskatchewan

Name and Agency/
Nom et Organisation:
G.D.JESPERSON
Saskatchewan Agriculture
Soils and Crops Branch
Regina, Saskatchewan

Title/Titre: SURVEY OF BLACKLEG, SCLEROTINIA AND FOOTROT IN SASKATCHEWAN CANOLA CROPS, 1986

METHODS: Two hundred and fifty-seven canola fields were surveyed after swathing during August and September, 1986. The majority were sampled by agricultural representatives according to instructions provided to them. Twenty-five stem bases per field were collected by pulling up 5 plants every 25 paces while walking a diagonal from the edge of the field. All samples were mailed to a central location for disease assessment and culturing. Isolations were made from a maximum of 6 stems per field for determination of blackleg virulence, according to the method of McGee and Petrie (1978).

RESULTS AND COMMENTS: Results broken down by crop district are shown in the table. The majority of agricultural representatives in canola growing areas participated in the survey. However, some areas were sampled more heavily than others (see table).

The virulent strain of blackleg (*Leptosphaeria maculans*) was found in 65% of fields sampled. The mean percentage of infected plants per field was 29% for all fields or 45.5% for fields where blackleg was detected. Blackleg was most damaging in crop district 8B and was generally severe through most of north central Saskatchewan. Virulent blackleg was not detected in crop district 1B.

Blackleg levels were higher than those reported in the past. In 1984 and 1985, virulent blackleg was found in 28.5% and 43% of canola fields respectively (Petrie, 1986). The increase in incidence in 1986 may be partly explained by the later sampling time and partly by the continued natural spread of the pathogen.

Sclerotinia stem rot (*Sclerotinia sclerotiorum*) was found in 31.1% of fields surveyed at a mean incidence of 3.9% of plants per field. Incidence was highest in crop district 9B followed by 5B. Incidence of Sclerotinia appeared to be limited by dry weather early in the season.

Footrot (*Rhizoctonia solani*, *Fusarium* spp.) was found in 35.8% of fields at a mean incidence of 3.1% of plants per field. The highest disease incidence was found in crop districts 1B and 9B. Incidence was generally light.

REFERENCES:

(1) McGee, D.C. and Petrie, G.A. 1978. Variability of *Leptosphaeria maculans* in relation to blackleg of oilseed rape. Phytopathology 68:625-630.

(2) Petrie, G.A. 1986. Blackleg and other diseases of canola in Saskatchewan in 1984 and 1985. Can. Plant Dis. Surv. 66(2):51-53.

Table. Incidence of blackleg, Sclerotinia and footrot of canola in Saskatchewan, 1986

Crop District	Number of Fields Surveyed	BLACKLEG* % Fields Affected	BLACKLEG* Mean % Incidence	SCLEROTINIA % Fields Affected	SCLEROTINIA Mean % Incidence	FOOTROT % Fields Affected	FOOTROT Mean % Incidence
1b	7	0	0	0	0	57.1	9.1
5a	17	47.1	3.2	23.5	2.2	47.1	3.2
5b	33	63.6	22.0	36.4	7.7	12.1	0.6
6a	13	76.9	42.3	7.7	0.2	15.4	1.0
6b	9	88.9	53.3	22.2	4.0	22.2	7.1
7b	10	100.0	51.2	30.0	2.4	40.0	3.2
8a	57	49.1	14.0	22.8	2.2	42.1	2.4
8b	49	96.0	58.0	24.5	1.9	34.7	2.3
9a	33	54.5	25.9	36.4	3.6	30.3	1.7
9b	29	58.6	21.8	72.4	10.8	58.6	8.5
Total or Average	257	65.0	29.0	31.1	3.9	35.8	3.1

* virulent strain

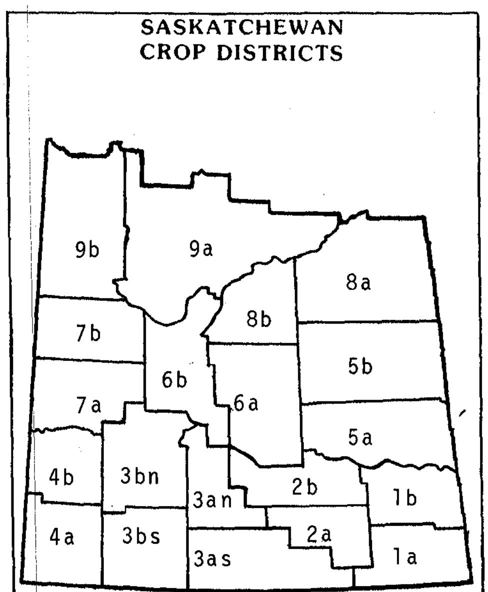

Figure 1. Saskatchewan crop districts and sub districts

Crop / Culture: Canola

Location / Emplacement: Saskatchewan

Name and Agency / Nom et Organisation:
B. Berkenkamp and C. Kirkham
Agriculture Canada Research Station
Melfort, Saskatchewan
SOE 1A0

Title / Titre: CANOLA DISEASE SURVEY IN N.E. SASKATCHEWAN, 1988

METHODS: Forty canola fields were surveyed between August 10 and 29, 1988, in crop districts 5b, 8a, 8b, and 9a. Fields surveyed were selected at random in each crop district, and sampled by collecting ten plants from each field at ten pace intervals. Diseases were identified by symptoms, and the severity of each disease recorded as an estimate of the percentage of leaf or stem area affected. Results for each disease were totaled and averaged over the total number of samples and fields surveyed, to give the disease index (DI). Number of fields affected over total number of fields surveyed gave % fields affected (%FA).

RESULTS AND COMMENTS: No root rot phase and only very low levels [0.05 DI/0.5 %FA] of the foot rot phase of the root rot complex (Rhizoctonia sp., Fusarium spp.) were found in 1988. Low levels were also found of the staghead phase of white rust (Albugo candida) [0.015 DI/0.2 %FA] and aster yellows (Aster yellows mycoplasma-like organism) [<0.01 DI/0.2 %FA]. No downy mildew (Peronospora parasitica) was observed. The other diseases, blackleg (Leptosphaeria maculans), black spot (Alternaria sp.), white rust and sclerotinia stem rot (Sclerotinia sclerotiorum) were above 1987 levels (Table 1).

Table 1. Severity and Prevalence of Canola Diseases

Crop District	No. Fields	Disease Index/% Fields Affected			
		Blackleg	Black Spot	White Rust	Sclerotinia
5b	8	6.4/100	1.8/63	<.1/13	0/0
8a	15	6.3/100	5.6/80	1.5/33	.3/7
8b	9	12.7/100	4.9/89	2.6/33	0/0
9a	8	12.7/100	12.6/100	1.7/50	.2/25
Total or Avg.	40	9.0/100	6.2/83	1.5/33	<.1/1

Crop / Culture: Canola

Location / Emplacement: Manitoba

Title / Titre: SURVEY OF PLANT DISEASES OF CANOLA IN 1988

Name and Agency / Nom et Organisation:

R. G. PLATFORD
Manitoba Agriculture, and
C. G. A. VAN DEN BERG
Department of Plant Science
University of Manitoba
Winnipeg, Manitoba

METHODS: Results are based on a survey during the third week of August of 73 fields distributed throughout southern Manitoba. Sixty-nine fields of *Brassica napus* (Argentine canola) and four fields of *Brassica campestris* (Polish canola) were included. Prevalence and incidence of diseases were recorded (Table 1).

RESULTS: Disease reaction was similar in both types of canola. Disease loss was generally less than in previous years. For the first time since the canola survey was initiated in 1970 no sclerotinia stem rot (*Sclerotinia sclerotiorum*) was detected. The absence of this disease can be attributed to the very dry weather that prevailed over most of the season and in particular in the later part of June and the first few weeks of July. Most of the fields surveyed in the central and eastern regions were free of disease. Blackleg (*Leptosphaeria maculans*) was the most prominent disease, occurring in 29% of fields surveyed at an average incidence within infested fields of 25%. Blackleg caused an estimated 5% yield loss in Manitoba in 1988 and was the only disease that caused losses above 1%. There were two areas where blackleg was a severe problem. In the southwest region, particularly near Elgin and Souris, the percentage of infected fields was 62% with an average incidence of 30% and losses about 10%. Severe blackleg was also detected in the northwest region, north of Dauphin and near Gilbert Plains. Infested fields were also detected near Russell, Roblin, Benito and Kenville, just south of Swan River. In the northwest region 31% of fields were infested with an average disease incidence of 24% within fields. Losses were determined to be in the range of 10-15%. Blackleg was detected in the central region only in one field near Portage la Prairie and was not detected in the eastern region. A sample from a field near Arborg in the Interlake region sent to the Plant Pathology Laboratory was also found to be affected by blackleg. Other diseases detected in the survey were alternaria black spot (*Alternaria* sp.), foot rot (*Rhizoctonia solani*), gray stem (*Pseudocercosporella capsellae*) and downy mildew (*Peronospora parasitica*) (Table 1).

Although the canola crop in most areas escaped the effects of plant diseases, it was severely damaged by heat and moisture stress. It has been estimated that average Manitoba canola yields were reduced about 30% from 1987.

Table 1: Prevalence and Incidence of Diseases of Canola (*B. napus* and *B. campestris*) in Manitoba in 1988.

Disease	PREVALENCE (Percentage of fields affected)	DISEASE INCIDENCE (Percentage of plants affected within infested fields)	Estimated Yield loss %
Blackleg	29	25	5
Foot rot	8	<5	trace
Black spot	17	10	trace
Stem rot	0	0	trace
Gray stem	5	<5	trace
Downy mildew	5	<5	trace
Aster yellows	4	<1	trace

[1]Based on 73 fields surveyed

Crop / Culture: Flax and Sunflowers

Location / Emplacement: Manitoba

Name and Agency / Nom et Organisation:
K.Y. RASHID,
Agriculture Canada Research Station,
P.O. Box 3001, MORDEN, Manitoba, ROG 1J0
R. G. PLATFORD,
Manitoba Agriculture

Title / Titre:
SURVEY OF FLAX AND SUNFLOWER DISEASES IN MANITOBA IN 1988

FLAX

METHODS: A total of 51 flax fields were surveyed south of Highway No. 1 in southern Manitoba. Twelve fields were surveyed on July 20, 20 fields on July 27, 8 fields on August 4 and 11 fields on August 22. In addition 8 samples submitted to the Manitoba Agriculture Plant Pathology Laboratory were analysed.

RESULTS: Poor emergence and heat canker were very common especially in areas severely affected by drought, where thousands of hectares had to be reseeded. Most of the fields had high weed populations, were moderate to poor in vigour and had two to three stages of plant growth due to non-uniform emergence. Only one field showed a trace (<1% disease incidence) of wilt (*Fusarium oxysporum* f. sp. *lini*) and seven fields showed a trace of aster yellows (Aster yellows mycoplasma-like organism). Pasmo (*Septoria linicola*) was observed only in the eastern region of the province late in the season. Disease incidence was 10% in two fields and up to 5% in five other fields. Rust (*Melampsora lini*) was not encountered in any of the fields surveyed, nor on the flax differential sets planted at Morden and Portage la Prairie. The samples of flax submitted to the Manitoba Agriculture Plant Pathology Laboratory mainly exhibited heat canker resulting from environmental stress. Heat canker was particularly severe on samples from the central region, south of Carman.

SUNFLOWER

METHODS: A total of 35 sunflower fields were surveyed in Southern Manitoba (4 confectionery and 31 oilseed sunflower). Ten fields were surveyed on July 20, 13 on July 27, 4 on August 4, 2 on August 22 and 6 on September 1. A disease index was estimated for each field based on disease incidence [DI] or disease severity [D.S.] (Table 1).

RESULTS: Rhizopus head rot (*Rhizopus* spp.) was the most common and widespread disease (trace to 40% DI in 75% of fields surveyed after August 1st). This could be attributed to the high incidence of insect and grasshopper damage to the heads early in the season. The first signs of this disease were observed during the first week of August. The second most common disease was sclerotinia wilt (*Sclerotinia sclerotiorum*) which was observed during and after flowering and ranged from trace to 40% DI in 63% of the fields surveyed. Rust (*Puccinia helianthi*) showed 80-100% DS values in the western part of the province (predominantly race 3, still under investigation). Values of trace - 10% occurred in the eastern part of the province and predominantly race 1 was involved. Verticillium wilt (*Verticillium* spp.) was observed in 54% of fields surveyed and ranged from trace to 50% DI in various fields. Traces of downy mildew (*Plasmopara halstedii*) and septoria leaf spot (*Septoria helianthi*) were observed only in two fields. Phoma (*Phoma* spp.) was observed at low levels towards the end of the season and, combined with the drought conditions, might have contributed to the premature ripening of some fields. Three samples of sunflower submitted to the Plant Pathology Laboratory were found to be affected by rhizopus head rot and two were affected by sclerotinia wilt.

Table 1. Sunflower fields affected and disease severity.

Disease or Vigour	Prevalence (% of fields infested)	Mean disease index*	Range of disease index
Rhizopus head rot	75%	1.9	1-3
Sclerotinia wilt	63%	1.6	1-3
Verticillium wilt	54%	1.4	1-4
Rust	57%@	1.9	1-5
Downy mildew	6%	1.0	0-1
Sclerotinia head rot	0	0	0
Botrytis head rot	0	0	0
Septoria leaf spot	6%	1.5	1-2
Vigour**	100%	1.6	1-3

* Disease index is based on a scale of 1-5 (1= trace to 5%, 2= 5% to 20%, 3= 20% to 40%, 4=40% to 60% and 5= >60% disease). Index is based on disease incidence for all except rust, which is based on disease severity (i.e. leaf area diseased).

** Vigour index is based on a 1-5 scale (1= very high vigour and 5= very poor vigour)

@ Most of the rust-infected fields were in the western part of the province and were predominantly affected by race 3 of the rust.

Crop/Culture: Flax

Location/Emplacement: Saskatchewan

Name and Agency/ Nom et Organisation:

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Title/Titre: FLAX DISEASE SURVEY IN N.E. SASKATCHEWAN, 1988

METHODS: Twenty three flax fields were surveyed between August 10 and 29, 1988, in crop districts 5b, 8a, 8b and 9a. Fields surveyed were selected at random in each crop district, and sampled by collecting ten plants from each field at ten place intervals. Diseases were identified by symptoms, and the severity of each disease recorded as an estimate of the leaf, stem or root area affected. Results for each disease were totaled and averaged over the total number of samples and fields surveyed to give the disease index. Number of fields affected over total number of fields surveyed gave % fields affected.

RESULTS AND COMMENTS: Very low levels of disease were found in 1988. Pasmo (Septoria linicola) was present in 33% of the fields with a disease index of 0.79, i.e. at about one fifth the levels in 1987. Root rot (Fusarium sp.), rust (Melampsora lini) and aster yellows (aster yellows mycoplasma-like organism) were not found in any of the fields sampled.

Crop / Culture: Lentil

Location / Emplacement: Manitoba

Title / Titre: ANTHRACNOSE AND OTHER DISEASES OF LENTIL IN MANITOBA IN 1988

Name and Agency / Nom et Organisation:

R.A.A. MORRALL[1], B.D. McCALLUM[2] and C.C. BERNIER[2]
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Saskatoon, S7N 0W0 and
[2]Department of Plant Science, University of Manitoba,
Winnipeg, R3T 2N2

METHODS: Because of the discovery in Southern Manitoba in 1987 of a new anthracnose disease of lentil caused by _Colletotrichum truncatum_ (1), a survey of crops in all major areas of lentil production in Manitoba was undertaken in 1988. Some fields were visited twice or more during the summer, others only once, usually in July. During visits a semi-quantitative assessment of anthracnose was made by walking at least 100 m through the crop and rating disease severity as none, slight, moderate or severe. Percentage heat canker, the presence of other diseases and the density and height of the crop were also noted. In most cases the owner of the field was contacted and background information on cultivar, seed source, crop history and agronomic practices was collected. In a few cases samples of the seed planted or harvested were obtained. Subsamples of 400 seeds were surface disinfected in dilute NaOCl and plated on Difco-Bacto potato dextrose agar to assess incidence of seed infection with _C. truncatum_.

RESULTS AND COMMENTS: The regions where lentil crops were inspected are shown in Fig. 1. Anthracnose was found in 18 fields out of 65 inspected, but mostly at low levels (Table 1). Crops with more than slight disease severity were observed only in regions where anthracnose had been reported in 1987 (1), and severity was generally lower than in 1987. However, anthracnose is clearly widely distributed in Manitoba, including in regions close to the border with Saskatchewan, which is the major producer of lentil in Canada. A survey of lentil crops throughout Saskatchewan in 1988 (R.A.A.M., unpublished data) failed to detect anthracnose, even in the regions closest to the Manitoba border.

In the present survey anthracnose was detected on three lentil cultivars, Eston (9/35 fields) French Green (5/19 fields) and Laird (4/9 fields). However, no relationship of disease severity could be demonstrated with cultivar, crop history or agronomic practices, probably because of the low levels of disease. Isolation from seed samples showed incidences of infection of planted seed from 0 to 0.2% and of harvested seed from 0 to 1.9%. The value of 1.9% coincided with the one crop that was severely diseased.

During the survey anthracnose symptoms were found on wild _Vicia_ sp. in lentil crops and on faba bean in three fields in the Portage area. A fungus identical in morphology to _C. truncatum_ isolated from lentil in 1987 (1) and during the present survey was isolated from these hosts. In greenhouse tests isolates of _C. truncatum_ from lentil were pathogenic on several cultivars of faba bean and pea as well as lentil. Thus, it appears that anthracnose of lentil is caused by a pathogen with a relatively wide host range.

Many lentil crops in Manitoba in 1988 were in poor condition due to drought and extreme heat, especially in early June. One reflection of this was a very high incidence of heat canker (Table 1); in addition many crops were very short and matured early. The weather probably resulted in the low severity of anthracnose in the Portage, St. Jean and St. Joseph areas, as well as the fact that other lentil diseases were found at only trace levels.

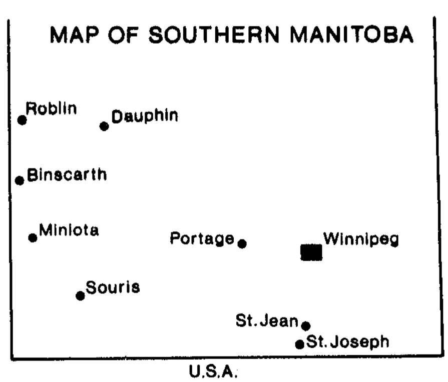
Reference: 1) Morrall R.A.A. 1988. A new disease of lentil induced by _Colletotrichum truncatum_ in Manitoba. Plant Dis. 72:994.

Table 1. Number of lentil crops in relation to anthracnose and heat canker in eight regions* of Manitoba in 1988

Region	Severity of Anthracnose				Incidence of heat canker**		
	None	Slight	Moderate	Severe	5-10%	15-20%	>25%
St. Jean	7	4	2		4	5	4
St. Joseph	4	2	1			2	5
Portage	12	3	1	1	12	3	1
Souris	2	2			3		1
Miniota	4	1			2	2	1
Binscarth	7				2	2	2
Dauphin	10				6	4	
Roblin	1	1			1	1	

* See Fig. 1 for locations. ** Missing data for 2 crops.

Fig. 1



Crop / Culture: Pea

Location / Emplacement: Saskatchewan

Name and Agency / Nom et Organisation:

B. Berkenkamp and C. Kirkham
Agriculture Canada Research Station
Melfort, Saskatchewan S0E 1A0

Title / Titre: PEA DISEASE SURVEY IN N.E. SASKATCHEWAN, 1988

METHODS: Twenty fields of pea were surveyed from August 10 to 29, 1988, in crop districts 5b, 8a and 8b. Fields surveyed were selected at random in each crop district, and sampled by collecting ten plants from each field at ten pace intervals. Diseases were identified by symptoms, and the severity of each disease recorded as an estimate of the percentage of leaf or stem area affected. Root rot and foot rot severity was assessed on a scale where 0 = healthy, 2 = trace, 5 = moderate, and 10 = severe. Results for each disease were totaled and averaged over the total number of samples and fields surveyed to give the disease index. Number of fields affected over total number of fields surveyed gave % fields affected.

RESULTS AND COMMENTS: The drought in 1988 probably reduced some diseases, but not powdery mildew, as it was the most prevalent disease (Table 1). Mycosphaerella blight was more prevalent and severe than in 1987, but ascochyta leaf spot (A. pisi) and septoria leaf blotch (Septoria pisi) were not found this year. Anthracnose was found at very low levels in 1988.

Table 1. Severity and prevalence of pea diseases

Disease	Disease index	% Fields affected
Mycosphaerella Blight (M. pinodes)	12.9	100
Foot Rot (Ascochyta spp.)	1.8	80
Root Rot (Fusarium spp.)	1.9	90
Powdery Mildew (Erysiphe polygoni)	33.0	100
Downy Mildew (Peronospora viciae)	0.7	5
Anthracnose (Colletotrichum pisi)	0.1	5

Crop/Culture: Spring and Winter Rapeseed

Location/Emplacement: Ontario

Name and Agency/ Nom et Organisation:
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Title/Titre: INCIDENCE AND SEVERITY OF BLACKLEG IN SPRING AND WINTER RAPESEED IN ONTARIO, 1988.

METHODS: The incidence and severity of blackleg [Leptosphaeria maculans] in spring and winter rapeseed in Ontario was determined during the period July 5 to August 16, 1988. Twenty-six winter and 45 spring rapeseed fields were examined in Middlesex, Wellington, Huron, Perth, Bruce and Grey counties. Sampling and crop loss assessment methods were as described by Peters and Hall (Can. Plant Dis. Surv., this issue).

RESULTS: Blackleg was observed in 20 fields of winter rapeseed (77%) and 14 fields of spring rapeseed (31%). The mean incidence of diseased plants was 29.5% in winter rapeseed and 2.2% in spring rapeseed. The mean disease severity was 0.6 for winter rapeseed and 0.03 for spring rapeseed. The maximum incidence and severity values recorded were 80% and 1.6 in winter rapeseed and 20% and 0.4 in spring rapeseed. Average and maximum crop losses were estimated to be 2.7% and 23.1% in winter rapeseed and 1.2% and 15.7% in spring rapeseed.

Crop/Culture: Winter Rapeseed

Location/Emplacement: Ontario

Name and Agency/ Nom et Organisation:
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Title/Titre: INCIDENCE AND SEVERITY OF BLACKLEG IN WINTER RAPESEED IN ONTARIO, 1986 AND 1987.

METHODS: The incidence and severity of blackleg [Leptosphaeria maculans] in winter rapeseed in Ontario was determined during the period 1-23 July. Seventy-two fields in 1986 and 49 fields in 1987 were examined in Huron, Perth, Bruce, Middlesex and Wellington counties. A diamond-shaped sampling pattern with sides 20 m long was initiated 30 m from the edge of each field. Single plants were collected at 2-m intervals for a total of 40 plants per field. Severity of blackleg symptoms on the crown was rated on a scale of 0 (no disease) to 4 (crown completely girdled). The presence of the causal agent was confirmed by plating crown pieces onto agar media. Crop loss was assessed from the relationship between seed yield and disease severity of 250 plants collected from each of 5 fields in each year.

RESULTS: Blackleg was observed in 66 fields (92%) in 1986 and 49 fields (100%) in 1987. The mean incidence of diseased plants was 31.8% in 1986 and 69.1% in 1987. The mean disease severity was 0.7 in 1986 and 1.5 in 1987. The maximum incidence and severity values recorded were 82.5% and 2.5 in 1986 and 100% and 3.6 in 1987. Average and maximum losses in seed yield were estimated to be 5.0% and 29.2% in 1986 and 7.5% and 27.3% in 1987.

Crop/Culture: Safflower

Location/Emplacement: Southern Alberta

Name and Agency/ Nom et Organisation:

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Research Center, Bag 200, BROOKS, AB, TOJ 0J0

Title/Titre: SURVEY FOR SEEDLING BLIGHT OF SAFFLOWER

METHODS: From June 2-15, 1988, 10 safflower fields in southern Alberta (Fig. 1) were surveyed for disease when crops were at the seedling stage. The survey procedure consisted of walking through each field in a teardrop pattern and stopping at 200-pace intervals a total of 10 times. At each stop, plants within a 1 m^2 area were counted, carefully dug to preserve the roots intact, bagged, and returned to the laboratory. Plants were washed, examined for disease symptoms, and rated for disease severity. Samples of diseased tissue were assayed for fungal pathogens by surface sterilizing in 1% sodium hypochlorite, rinsing in sterile water, and plating onto selective media. Plates were incubated at 20°C for 5-7 days before observation. Prevalent fungal species were subcultured for pathogenicity tests, which are pending.

RESULTS AND COMMENTS: Root rot and/or stem canker were found in all fields. These were collectively termed seedling blight, and disease incidence and severity ratings were made accordingly (Table 1). No leaf diseases were observed. Plant density ranged from 20.6 to 83.3/m^2. A stand of 40-70 plants/m^2 is considered optimum under Alberta conditions. Seedling blight incidence varied from 5.8 to 53.3%. In field #1, the crop was disced under because of disease. The disease severity index ranged from 2.0 to 16.7. In general, seedling blight incidence and severity were low in safflower fields in 1988. The predominant fungi isolated and average % tissue pieces colonized by each were: *Alternaria* spp. - 44%, *Fusarium* spp. - 37%, and *Pythium* spp. - 9%. *Rhizoctonia solani* was isolated in only one case. Some stem cankers were caused by high temperatures at the soil line (heat canker).

Table 1. Safflower survey data, 1988.[1]

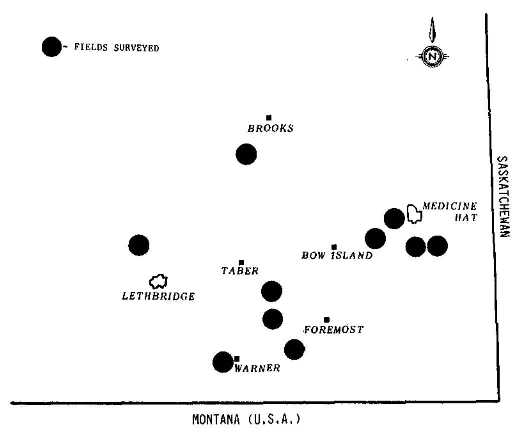
Field No.	Stand (plants/m^2)	Seedling blight Incidence (%)	Seedling blight Severity[2]
1	24.2	53.3	16.7
2	83.3	16.3	7.3
3	32.2	6.2	3.0
4	45.3	13.5	5.7
5	23.9	12.1	5.8
6	24.0	5.8	2.0
7	37.5	11.5	6.9
8	28.3	12.4	4.7
9	21.9	13.7	5.7
10	20.6	12.6	4.4
Avg.	34.1	15.7	6.2

[1] Figures in this table are averages of 10 sampling sites/field.

[2] Severity Index = $\left[\frac{(S_1 \times 1)+(S_2 \times 2)+(S_3 \times 3)}{T \times 3}\right] \times 100$

Where S_1 = No. of plants with 1-25% of stem/root blighted.
S_2 = No. of plants with 26-75% of stem/root blighted.
S_3 = No. of plants with 76-100% of stem/root blighted.
T = Total no. plants examined, including healthy ones.

Figure 1. Safflower fields surveyed in 1988.



REFERENCE: Mundel, H.-H., Roth, B., and Kubik, J.J. 1987. Safflower production in Alberta. Agri-Fax factsheet, Alberta Agriculture, Edmonton, AB.

Crop / Culture: Soybean

Location / Emplacement: Ontario

Name and Agency / Nom et Organisation:
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Title / Titre: STRAINS OF SOYBEAN MOSAIC VIRUS IN SOUTHWESTERN ONTARIO, 1979-81.

METHODS: The incidence of soybean mosaic was surveyed in the summers of 1979, 1980 and 1981 in the eight southwestern Ontario counties (Essex, Kent, Elgin, Lambton, Oxford, Middlesex, Perth and Huron (3). A total of 100 samples were collected each year for a period of 3 years. Of the 300 samples, 265 were successfully transferred to Amsoy 71 seedlings in a 21 ± 3°C greenhouse by mechanical inoculation. They were subsequently assayed on a set of differential hosts for the identification of soybean mosaic virus (SMV). The differential hosts included NN tobacco, Haro Nova tobacco, *Chenopodium amaranticolor*, crimson clover, soybean (Harosoy, Amsoy and Columbia), cucumber, bean (Bountiful, Fleetwood and Black Turtle Soup), pea and cowpea.

Isolates initially identified as SMV were further examined by electron microscopy for the presence of flexuous rods in cell sap of infected plants. Reaction to SMV antiserum was determined to confirm the SMV identity.

Strains of SMV were determined based on a series of differential soybean cultivars (Table 1).

RESULTS AND COMMENTS: Based on the test results (Table 1) two additional SMV strains were found in Ontario in addition to those reported by Cho and Goodman (1). One of the strains (H1) found in Ontario causes severe tip necrosis to several cultivars of soybean and was similar to strain C14 reported by Lim (2). This strain was frequently found in Essex county and was particularly prevalent in the breeders' nursery at the Harrow Research Station.

Table 1. Response of differential soybean cultivars to SMV isolates from soybean in southwestern Ontario

Soybean	SMV Strain								
	G1	G2	G3	G4	G5	G6	G7	H1[a]	H2[a]
Williams	S(M)[b]	S(M)	S(M)	S(M)	S(M)	S(M)	S(M)	S(M)	S(M)
Franklin	S(M)	S(M)	S(M)	S(M)	S(M)	S(M)	S(M)	S(M)	S(M)
PI 96983	R	R	R	R	R	R	S(N)	R	S(M)
PI 483.084	R	R	R	R	R	R	R	S(N)	S(M)
PI 486.355	R	R	R	R	R	R	R	R	R

[a] An unclassified SMV isolated in southwestern Ontario.
[b] R = resistant (no symptom) and S = susceptible with mosaic (M) or necrotic (N) symptoms; based on reactions of 10 soybean plants for each SMV isolate.

REFERENCES:

1. Cho, E.K. and R.M. Goodman. 1982. Evaluation of resistance in soybeans to soybean mosaic virus strains. Crop Sci. 22: 1133-1136.

2. Lim, S. M. 1985. Resistance to soybean mosaic virus in soybeans. Phytopathology 75: 199-201.

3. Tu, J. C. 1986. Incidence of soybean mosaic virus and tobacco ringspot virus in southwestern Ontario. Can. Plant Dis. Surv. 66: 49-50.

Vegetables / Légumes

Crop / Culture: Celery

Name and Agency / Nom et Organisation: MAGED SAID AND D.J. ORMROD. B. C. Ministry of Agriculture and Fisheries. 17720-57th Avenue, SURREY, B. C. V3S 4P9

Location / Emplacement: Cloverdale, British Columbia.

Title / Titre: FIELD SURVEY FOR FUSARIUM YELLOWS (*Fusarium oxysporum* f. sp. *apii*, race 2) OF CELERY IN CLOVERDALE, BRITISH COLUMBIA.

METHODS: Twenty farms in 1987 and seventeen in 1988 were surveyed once or twice during the growing season for the presence of Fusarium yellows of celery. Every five to ten beds of celery were walked and notes were taken on the appearance of yellows and other disorders. Fields were scored as having yellows if areas of stunted plants were found and roots planted onto SBM selective medium produced *F. oxysporum* cultures.

RESULTS AND COMMENTS: Results of the two years' surveys are given in Table 1. Yellows was not as severe in 1988 as it was in 1987, possibly due to the cooler growing season. It is widespread throughout the celery growing area, however, and growers must utilize resistant cultivars to avoid serious losses.

TABLE 1. Incidence of Fusarium Yellows of Celery in the Cloverdale Area.

Farm No.	Cultivars Grown * 1987	Cultivars Grown * 1988	Distribution of Yellows 1987	Distribution of Yellows 1988	Other Disorders 1987	Other Disorders 1988
1.	TU 52-70 HK	--	small area	--	--	--
2.	Florida 683 TU 52-70 HK	TU 52-70 HK	widespread	small areas	pink rot petiole lesions	pink rot blackheart petiole lesions
3.	TU 52-70 HK Napoleon	--	small area	--	blackheart	
4.	?	TU 52-70 R	not seen	small areas	--	--
5.	TU 52-70 HK	TU 52-70 R	small area	not seen	pink rot	--
6.	Florida 683	--	not seen	--	--	
7.	?	Bishop, Deacon, Napoleon	not seen	not seen	--	--
8.	TU 52-70 HK TU 52-70 R	Bishop, Deacon, Napoleon	small area	not seen	black heart	pink rot petiole lesions
9.	TU 52-70 R TU 52-70 HK	TU 52-70 R TU 52-70 HK	widespread	widespread	--	--
10.	Florida 683	TU 52-70 R	not seen	not seen	blackheart	--
11.	TU 52-70 HK	TU 52-70 HK	widespread	small areas	pink rot	--
12.	TU 52-70 R TU 52-70 HK Napoleon	TU 52-70 HK Napoleon	scattered	large area in Napoleon	pink rot	pink rot bolting
13.	Deacon, Bishop	?	scattered	not seen	pink rot bacterial soft rot	--
14.	TU 52-70 R	TU 52-70 HK	small area	not seen	--	
15.	?	TU 52-70 R	scattered	not seen	pink rot	--
16.	TU 52-70 HK	TU 52-70 HK Napoleon	not seen	not seen	blackheart	--
17.	TU 52-70 HK Napoleon	Napoleon	small area	not seen	blackheart	petiole lesions
18.	?	Florida 683 Deacon	scattered	scattered	pink rot	--
19.	TU 52-70 HK Florida 683	Florida 683 Deacon	not seen	small areas	pink rot bolting	--
20.	Florida 683	?	widespread	widespread	pink rot	--

* TU 52-70 HK, Deacon and Bishop are considered to be resistant; TU 52-70 R is highly susceptible; Florida 683 and Napoleon are intermediate.

Crop / Culture: Greenhouse Cucumber

Location / Emplacement: British Columbia

Title / Titre: 1988 Greenhouse cucumber disease survey in British Columbia

Name and Agency / Nom et Organisation:
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METHODS: A survey of greenhouses for cucumber powdery mildew (*Sphaerotheca fuliginea* and *Erysiphe cichoracearum*) was carried out in the Fraser Valley, May, 1988 in response to increasing concern over the early siting of powdery mildew. Cucumber growers were interviewed and crops in commercial greenhouses were visually assessed for powdery mildew and other diseases. Greenhouse cucumber samples, submitted by extension specialists and growers, were diagnosed throughout the year at the provincial plant diagnostic clinic. Greenhouse long English cucumber varieties grown in B.C. are predominantly Corona and Farona with a very limited amount of Farbiola and Mustang.

RESULTS AND COMMENTS: Cucumber powdery mildew in 1988 developed unusually early in the season in February to April. Growers were concerned because in previous years the disease occurred late in the season with little effect on yield. The May, 1988 survey recorded 13/25 greenhouses with a 1-5% level of powdery mildew infection. Three other greenhouses had such severe powdery mildew, exceeding a 40% level of infection, that replanting was necessary at substantial cost to the growers. One of the severely affected greenhouses produced a winter cucumber crop under lights which may have led to the early incidence of powdery mildew in 1988. Cucumber crops planted later in the year and greenhouses which were relatively isolated and had limited visitor access appeared to escape the early and severe development of powdery mildew.

Pythium crown rot is a persistent problem occurring in 7/25 cucumber greenhouses. One greenhouse reported a problem with Phomopsis black root rot (*P. sclerotiodes*) and four others had difficulty controlling gummy stem blight (*Didymella bryoniae*). Zucchini yellow mosaic virus infected 500 plants in one greenhouse.

Crop/Culture: Cucumber, European Seedless

Location/Emplacement: Southern Alberta

Title/Titre: SURVEY FOR STEM ROT AND CANKER DISEASES OF GREENHOUSE-GROWN CUCUMBERS

Name and Agency/ Nom et Organisation:

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METHODS: Twenty commercial greenhouses in the Medicine Hat - Redcliff area were surveyed in September and October, 1988. Approximately 5% of the plants in each house were visually examined for rot and canker symptoms on the lower stems. Plants were selected at equally spaced intervals down each row according to the number/row required to be sampled. Disease incidence data were recorded. Presence of fungal pathogens was confirmed by isolation. This involved surface sterilizing pieces of infected stem tissue in 1% sodium hypochlorite for 1 minute, rinsing in sterile water, and plating onto selective media. Plates were incubated at 20°C for 4-7 days before observation. Subcultures of representative isolates were made for pathogenicity tests. Results are pending.

RESULTS AND COMMENTS: Of the 58,864 m^2 surveyed, approximately one-third was covered with polyethylene and two-thirds with glass. Artificial mixes were the most common growing media, followed by soil, rockwool and sawdust, respectively (Table 1). Corona was the most frequently grown cultivar (90% of greenhouses). Stem rot and canker diseases were very high in incidence ($\bar{x}$ = 82.8%). A number of crops were pulled early because of this disease. *Pythium* spp. were most commonly isolated (100% of greenhouses), followed by *Fusarium* spp. (90%), *Didymella bryoniae* (45%), and *Rhizoctonia solani* (25%). Poor sanitation and the failure to use pasteurized growing media were the major factors which favored outbreaks in greenhouses with stem rot and canker diseases.

Table 1. Greenhouse cucumber production and disease survey data, 1988.

Greenhouse No.	Medium[1] type	Crop age (wk)	No. Plants examined	Stem rot/ canker (%)	Fungi isolated from diseased stems			
					Pythium	*Fusarium*	*Didymella*	*Rhizoctonia*
1	A	9	150	56	+	+	-	-
	R	9	170	96	+	+	-	-
	A	7	225	55	+	+	-	+
2	S	9	300	85	+	+	-	-
	A	10	270	24	+	+	-	-
3	S	9	126	41	+	+	-	-
	S	15	126	94	+	-	-	+
4	D	8	150	0	N/A	N/A	N/A	N/A
	R	8	50	94	+	-	-	-
	R	8	90	75	+	+	-	+
5	A	8	120	76	+	+	+	+
6	R	9	105	96	+	-	-	-
	A	8	90	97	+	-	-	-
7	S	13	135	14	+	+	-	+
8	D	10	300	48	+	+	+	-
9	A	10	140	85	+	+	+	-
10	A	10	140	97	+	+	+	-
11	A	13	112	90	+	+	+	-
12	A	10	451	27	+	-	+	-
13	A	10	156	16	+	+	-	-
14	A	13	124	25	+	+	+	-
15	S	13	84	28	+	+	+	-
16	A	11	120	93	+	+	-	-
17	S	9	120	50	+	+	-	-
18	A	11	145	96	+	+	+	-
19	A	28	215	94	+	+	-	-
20	S	11	180	87	+	+	-	-

[1] Medium type: A = Artificial (Metro, Grace or homemade mix), D = Sawdust, R = Rockwool, S = Soil.

Crop / Culture: Potatoes

Location / Emplacement: Manitoba

Title / Titre: 1988 Survey of Manitoba Potato Fields Affected by Early Senescence Caused by Verticillium Wilt and Other Diseases.

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METHODS: Thirty-four fields of Russet Burbank and 16 fields of other varieties were surveyed for symptoms of early senescence in the Carman, Carberry and Winkler areas during the last two weeks of August, 1988. Stem pieces of plants showing symptoms were plated onto Potato Dextrose Agar and Sorbose Agar (2 g sorbose, 20 g agar, 100 ppm streptomycin sulphate and 1 liter distilled water). Plates were incubated at 25 C and examined after 7 days. Based on the recovery of pathogens, the incidence of fields with Verticillium dahliae (Verticillium wilt), Fusarium spp. (Fusarium root rot and wilt, Colletotrichum atramentarium (black dot) and Rhizoctonia solani (Rhizoctonia disease) was determined.

RESULTS: The survey results are presented in Table 1. On average, the incidence of fields of Russet Burbank potatoes in the Carman, Carberry and Winkler areas with Verticillium, Fusarium, Colletotrichum, and Rhizoctonia was 59%, 41%, 41% and 6%, respectively. In 6% of the fields, no pathogens were recovered. Fields of the varieties Norland, Pontiac, Norchip, Norkotah and Viking were also surveyed in the Winkler area. The isolation results for these varieties were combined as only a few fields of each variety were sampled. The incidence of fields with Verticillium, Fusarium, Colletotrichum, and Rhizoctonia was 69%, 27%, 27% and 0%, respectively. It is likely that the overall incidence of Rhizoctonia in Manitoba potato fields is much higher than detected in the survey. Isolations were made from the above ground portions of wilted plants, which are ideal for isolating Vericillium, Fusarium, and Colletotrichum, but not Rhizoctonia. Rhizoctonia is more commonly associated with stolons and tubers.

Verticillium, Fusarium, and Colletotrichum, are often isolated in combination from potato plants showing symptoms of early senescence and are the cause of a disease complex known as early dying. Verticillium and Fusarium are considered more serious pathogens of potatoes than is Colletotrichum, but Colletotrichum has been reported to play a role in accelerating the early senescence of potato plants.

Early dying has been observed in Manitoba potatoes in previous years, but it appeared to be much more common in 1988 than had been previously observed. It is difficult to establish what effect Verticillium, Fusarium and Colletotrichum or the complex of these organisms had on potato yields in 1988 as many of the fields sampled were also under severe heat and moisture stress. In nonirrigated fields of Russet Burbank near Carman, early senescence was very pronounced by mid August whereas irrigated fields of this variety in the same area were not as severely affected.

Results of the 1988 survey are compared to a similar survey conducted in 1987 in Table 2. The 1987 survey was conducted primarily in fields of Russet Burbank in the Winkler area. Verticillium was detected in 72% of the fields in 1987 and 67% in 1988. In the past two years, the higher than normal temperatures during the growing season have been favorable for this pathogen. Fusarium was detected in 28% of the fields in 1987 and 50% in 1988. The higher incidence of Fusarium in 1988 may be attributed, in part, to drier soil conditions. The incidence of black dot was similar in both 1987 and 1988 at 17% and 11%, respectively. Varieties other than Russet Burbank were also sampled in both years and Verticillium was found in 58% and 69% of the fields in 1987 and 1988, respectively. The incidence of Fusarium was similar in 1987 and 1988 at 25% and 27%, respectively. Black dot was not found in any fields in 1987, but was detected in 27% of fields in 1988. Black dot attacks potato plants under heat stress, which was a much more widespread problem in 1988 than in 1987.

Table 1. 1988 Potato disease survey results.

Variety	Location	Number of fields	Pathogens * % Vert.	% Fus.	% Coll.	% Rhiz.
Russet Burbank	Carman	11	82	28	28	9
Russet Burbank	Carberry	11	27	45	82	0
Russet Burbank	Winkler	12	67	50	17	8
Varieties other than Russet Burbank	Winkler	16	69	27	27	0
Russet Burbank	Provincial average	34	59	41	41	6

* Vert. = *Verticillium dahliae*, Fus. = *Fusarium* spp., Coll. = *Colletotrichum atramentarum*, and Rhiz. = *Rhizoctonia solani*.

Table 2. Potato disease survey results Comparison 1987 - 1988.

Variety	Location	Year	Number of fields	Pathogens * % Vert.	% Fus.	% Coll.	% Rhiz.
Russet Burbank	Winkler	1987	18	72	28	11	6
	Winkler	1988	12	67	50	17	6
Varieties other than Russet	Winkler	1987	12	58	25	0	0
	Winkler	1988	16	69	27	27	0

* Vert. = *Verticillium dahliae*, Fus. = *Fusarium* spp., Coll. = *Colletotrichum atramentarum*, and Rhiz. = *Rhizoctonia solani*.

Crop / Culture: Greenhouse Tomato

Location / Emplacement: British Columbia

Title / Titre: 1986 Greenhouse Tomato Disease Survey in British Columbia

Name and Agency / Nom et Organisation:
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METHODS: A disease survey of greenhouse tomato was carried out in the Fraser Valley, October, 1986. Growers were interviewed and crops visually assessed for diseases. Samples of tomato stem cankers were collected for detailed microscopic examination and pathogen isolation on selective agar. The predominant greenhouse tomato variety grown in B.C. in 1986 was Dombito with some production of Caruzo, Dombello, Jumbo, Larma, Perfecto, Vedetto and 86-32.

RESULTS AND COMMENTS: Gray mold (Botrytis cinerea) stem cankers and leaf mold (Cladosporium fulva) were prevalent diseases late in the season when the 1986 survey was carried out. Two greenhouses grew Perfecto and Vedetto which are resistant to leaf mold. Maintaining proper night temperatures and improving air circulation and sanitation are important in reducing gray mold and leaf mold. Pruning techniques must ensure complete removal of the petiole without any stub which could become an infection court for gray mold. One grower used bamboo stakes to lift layered tomato stems off the ground, improve air circulation around the stems and reduce gray mold stem infection.

Four suspected isolates of Didymella stem rot sent to Biosystematics proved not to be D. lycopersici.

Fusarium crown and root rot (Fusarium oxysporum f. sp radicis-lycopersici) occurred in 9/15 greenhouses surveyed in 1986. An annual loss estimated at 10-15% is attributed to Fusarium crown and root rot which is the industry's major concern. Larma has resistance to Fusarium crown and root rot but is susceptible to Botrytis stem canker. Two greenhouses that continue to produce greenhouse tomatoes in soil and four others using sawdust culture had no apparent Fusarium crown and root rot problem. Competitive microorganisms could explain the absence of Fusarium crown and root rot in the soil grown crops. One tomato crop grown in sawdust culture was planted late and may have escaped early Fusarium infection. Lettuce interplanted with tomato in the sawdust bags reduced Fusarium crown and root rot in four greenhouses. One grower found no reduction in crown and root rot with lettuce but may have planted the lettuce too late. Low light levels in early spring make it difficult to establish the lettuce crop. Lettuce can develop gray mold and harbour insect pests. One grower cut off the lettuce tops in mid-season and still had a reduction in Fusarium crown and root rot.

Dandelions have a longer grower season and compact growth habit and were used instead of lettuce for interplanting with tomatoes in 1987. Growers have not been satisfied with interplanting lettuce or dandelion to control Fusarium crown and root rot because of the labour, management and pest problems. A control of Fusarium crown and root rot is urgently needed until resistant varieties become available.

Crop / Culture: Tomato

Location / Emplacement: Southern Alberta

Title / Titre: SURVEY FOR CORKY ROOT (PYRENOCHAETA LYCOPERSICI) IN GREENHOUSE-GROWN TOMATOES

Name and Agency / Nom et Organisation:

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METHODS: Six commercial greenhouses in the Calgary-Medicine Hat area were surveyed between June and October, 1988. Approximately 5% of the plants in each house were dug and visually examined for symptoms of corky root rot. Plants were selected at equally spaced intervals down each row according to the number/row required to be sampled. Incidence and severity ratings were made for each diseased plant. Presence of the pathogen was confirmed by isolation. This involved surface sterilizing small pieces of infected root tissue in 1% sodium hypochlorite for 1 minute, rinsing in sterile water, and plating onto potato dextrose agar amended with penicillin (100 ppm) and tetracycline (50 ppm). The plates were incubated at 20°C for 5-7 days before observation. Isolates of *P. lycopersici* were induced to sporulate by transferring to potato dextrose agar for 5 days, then to water agar for 2-3 days, and finally to ¼-strength V-8 juice agar. The V-8 plates were incubated under continuous fluorescent light for 30 days before spores were collected and observed. Subcultures of *P. lycopersici* were retained for pathogenicity tests. Results are pending.

RESULTS AND COMMENTS: Three of the six greenhouses surveyed had corky root rot (Table 1). In two, disease incidence was 98% or more, severity ranged from moderate (index = 66) to high (85), and crop vigor was poor. Greenhouses 2 and 4 had a previous history of tomato production, whereas, #1 was growing its first crop in virgin prairie soil. In #1, it is believed that *P. lycopersici* was introduced via soil amendments. In greenhouses 1 and 2, Dowfume MC-2 (98% methyl bromide + 2% chloropicrin LI) was applied at 1 and 2 lb/100 ft^2 (49-98 g/m^2) to half of a single bay at each house after the crops had been removed. Followup sampling of the new plantings in September, 1988, revealed that the fumigant had only slightly reduced corky root rot incidence. A similar result was observed in an area of #2 where the sand had been given a solarization treatment.

Table 1. Greenhouse tomato production and disease survey data, 1988.

Greenhouse No.	Growing medium	Cultivar	Age (wk)	No. plants examined	Corky root rot[1] Incidence (%)	Severity
1	Soil	Laura, Caruso	30	145	98	85.0
2	Sand	Dombito	32	46	100	81.9
3	Soil	Caruso	28	100	0	0
4	Soil	Terrific	24	17	100	66.7
5	Soil	Laura	47	248	0	0
6	Soil	Tropic, Caruso, Capello	40	80	0	0

[1] Severity Index = $$\left[\frac{(S_1 \times 1) + (S_2 \times 2) + (S_3 \times 3)}{T \times 3}\right] \times 100$$

Where S_1 = No. of plants with 1-25% of roots rotted.
S_2 = No. of plants with 26-75% of roots rotted.
S_3 = No. of plants with 76-100% of roots rotted.
T = Total No. plants examined, including healthy ones.

Crop / Culture: Vegetables

Location / Emplacement: Manitoba

Title / Titre: Incidence of Vegetable Diseases in Manitoba in 1988

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ALLEN, L.
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METHODS: Results are based on samples of vegetables submitted to the Plant Pathology Laboratory and field examinations.

RESULTS:

Lettuce: Commercial lettuce fields in the Portage area were surveyed for disease. In fields not sprayed, aster yellows caused about a 4% plant loss in leaf lettuce and 13% in Romaine lettuce. Where insecticides were sprayed regularly throughout the season, the incidence of aster yellows in leaf lettuce was less than 2% and in Romaine 6%. There were no other diseases detected in either the leaf or Romaine lettuce.

Tomatoes: The incidence of blossom end rot, caused by a calcium deficiency, was higher than normal in tomatoes. Septoria leaf spot (*Septoria lycopersici*) was detected in five samples of tomatoes submitted from the Winnipeg area.

Cabbage: Internal tip burn caused by a calcium deficiency was a problem for a commercial grower of cabbage in the Winnipeg area. Loss from this problem was about 10% but restricted to varieties that produce very large heads. A field of cabbage, grown in a commercial field near Winnipeg was found to be affected by Fusarium yellows (*Fusarium oxysporum*) causing a yield loss close to 50%.

Onions: A basal root rot caused by *Fusarium oxysporum* was a problem in two fields of commercial dry bulb onions near Winkler and Portage. These fields were under severe moisture stress. Loss from this disease was difficult to separate from moisture stress damage, but probably accounted for about a 15% loss. Slippery skin (*Pseudomonas alliicola*) caused a storage problem in commercial spanish onions grown in the Winkler area in the 1987 harvested crop. Loss was estimated at 5%. Slippery skin was not detected in commercial onions in 1988.

Carrots: Disease levels in commercial carrot fields were very low in 1988. The major disease detected was aster yellows caused by a mycoplasma-like organism. Two fields in the Portage area were monitored for the effect of insecticide sprays on disease incidence. One field had 6 sprays and the other 12 sprays between May 27 and August 15. Aster leaf hoppers were monitored on yellow card sticky traps at 2-day intervals. Aster leaf hoppers were first detected May 18 and peak populations occurred around July 11. Populations remained fairly high for several weeks and then declined to low levels. Trapping was discontinued August 19, at which time there were relatively few aster leaf hoppers present on the traps. The effect of insecticide sprays was evaluated by sampling fields at harvest and determining the percentage of roots showing symptoms of aster yellows. In one field, the incidence of infected roots in the untreated area was 3.2%, but significantly (P-0.05) reduced to 0.7% in the portion of the field which was sprayed six times. Similarly, in the second field, the incidence of infected roots in the untreated area was 2.1%, but significantly (P-0.05) reduced to 1.0% in the portion of the fields which was sprayed 12 times.

Tree fruits and nuts / Arbres fruitiers et noix

Crop / Culture: Apple

Location / Emplacement: Ontario

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Title / Titre: DISEASE SURVEY OF COMMERCIAL APPLE ORCHARDS IN SOUTHERN ONTARIO

METHODS: Fruit harvest assessments were carried out in Southern Ontario in 96 different commercial orchards. Four hundred fruit were examined from each orchard with 11 exceptions as noted below. Fruit from four trees per orchard were sampled at/or just prior to harvest maturity. From standard-sized trees, 33 fruit from the top, skirt inside and skirt outside were checked. One extra apple was checked from each tree to bring the sample total to 100 apples per tree.

From dwarf sized trees, 33 fruit from each of the top, middle and bottom portions of the tree were checked. One extra apple was picked from each tree to bring the sample size to 100 apples per tree.

In one orchard in each of Essex-Kent, Durham and Northumberland, a sample of 100 apples was taken. Two hundred apples were sampled from one orchard in each of Middlesex, Durham and Hastings. In Kemptville, 300 apples were sampled from each of three orchards. In Prince Edward County, 434 apples were examined at one orchard.

Forty apples from an abandoned orchard in Durham were sampled for comparison.

Fruit was checked for apple scab (Venturia inaequalis (Cke.) Wint.), fly speck (Leptothyrium pomi (Mont. and Fr.) Sacc.), sooty blotch (Gloeodes pomigena (Schw.) Colby) and insect injury. These were reported by area as to the presence or absence of disease or insect injury. Observations on blister spot (Pseudomonas syringae pv papulans (Rose) Dhanvantari), fire blight (Erwinia amylovora (Burr.) Winsl. et al.) and powdery mildew (Podosphaera leucotricha Ell. & Ev.) were made during the growing season.

RESULTS AND COMMENTS: Fruit damage from disease was considerably less than injury from insects in all areas surveyed in 1988.

The incidence of apple scab, fly speck, and sooty blotch was low in 1988. See table below.

Precipitation in most parts of southern Ontario was below the 10-year normal during the growing season.

Blister spot and fire blight were not reported as severe in 1988. Powdery mildew, however, was prevalent in 1988, especially in the Georgian Bay area (Simcoe and Grey counties).

Powdery mildew infections were severe on the terminals and were present on varieties not typically prone to severe infections, such as McIntosh. There was no economic loss of fruit due to russetting, however. In the Essex-Kent area mildew was prevalent on terminals, but did not cause significant fruit infection.

Incidence of apple scab, flyspeck and sooty blotch in apple orchards in southern Ontario, 1988.

Area	Number of Orchards	Number of Apples	Scab	Fly Speck	Sooty Blotch
Essex, Kent	9	3300	33	0	0
Elgin	6	2400	27[a]	0	0
Middlesex	2	600	0	0	0
Norfolk, Brant	34	13600	42	7	2
Niagara	10	4000	30	0	0
Halton, Peel	4	1600	2	0	0
Simcoe, Grey	7	2800	13	0	0
Durham (Commercial)	8	2700	4	6	0
Durham (Abandoned)	1	40	12	9	25
Northumberland	6	2100	6	13[b]	2
Hastings	1	200	0	0	0
Prince Edward	4	1634	47[c]	1	0
Kemptville	5	1700	12	0	0
TOTAL [1]	96	36634	216	27	4

[1] Does not include abandoned site
[a] 26 apples from 1 orchard
[b] 13 apples from 1 orchard (Red Delicious)
[c] 45 apples from 1 orchard

Crop / Culture: Hazelnut

Location / Emplacement: British Columbia

Name and Agency / Nom et Organisation:
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Title / Titre: SURVEY FOR EASTERN FILBERT BLIGHT (*Anisogramma anomala*) IN BRITISH COLUMBIA

METHODS: A survey of hazelnut orchards for Eastern filbert blight (caused by *Anisograma anomala*) was conducted in the fall in the lower Fraser Valley of British Columbia. Hazelnut production in B.C. is centered in the Langley, Chilliwack, Agassiz and Rosedale area, and totals 283 ha (700 acres). Agriculture Canada and the B.C. Hazelnut Growers Association cooperated in the survey to visually inspect hazelnut orchards. Orchards were surveyed by walking along transects (rows) representing 10 % of the total acreage. Hazelnut trees were checked for branch dieback and close inspection was made to determine the cause of damage. Hazelnut trees infected with Eastern filbert blight develop perennial cankers distinguished by relatively large (3 x 6 mm) black, oval-shaped perithecia that protrude in rows along the canker surface.

RESULTS AND COMMENTS: Eastern filbert blight is not known to occur in British Columbia, and this was substantiated by the 1988 survey. Limited branch die-back observed during the survey was caused by tent caterpillars, Lecanium scale, winter injury and shading. A low incidence of bacterial blight (tentatively identified as *Pseudomonas syringae*) was also recorded. Other minor pests included aphids, leafhoppers, leafrollers and powdery mildew (*Phyllactinia corylea*). Deer damage was severe in one, newly planted hazelnut orchard.

British Columbia hazelnut growers are concerned that Eastern filbert blight could be introduced on imported hazelnut planting stock from Washington and Oregon. Currently, there is no effective control for Eastern filbert blight. Hazelnut growers in B.C. strongly support implementation of a ban against further importation of hazelnut planting stock.

Small fruits / Petits fruits

Crop / Culture: Blueberry

Location / Emplacement: British Columbia

Title / Titre: BLUEBERRY DISEASES SUBMITTED TO THE DIAGNOSTIC LAB IN 1988

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RESULTS AND COMMENTS:

Galls: Galls on stems, crowns and one root were observed on cuttings purchased by three growers fron one source. Forty to 50% of Bluejay and 10% of Bluecrop planting stock purchased by one grower had severe galls. Ten percent of Bluecrop and Rancoccas cuttings planted by another grower were galled; galls on Rancoccas were smaller than Bluecrop galls on plants of similar age. The third grower lost 2,000 of 10,000 Bluecrop planting stock from girdling by galls and unthriftiness. Most galls were found in two year old cuttings although some one year old cuttings had galls. The cause is under investigation.

Godronia Canker: There were no submissions of canker which is representative of the low incidence of the disease in B.C. during 1988.

Mummyberry: There were three cases of shoot blight caused by *Monilinia vacinii-corymbosi*, although the problem was widespread in B.C.

Bacterial Blight: *Pseudomonas syringae* caused minimal damage at two sites which were marginal for blueberry production due to late frosts.

Crop/Culture: Fruit Crops

Location/Emplacement: Manitoba

Title/Titre: INCIDENCE OF PLANT DISEASES IN FRUIT CROPS IN MANITOBA IN 1988

Name and Agency / Nom et Organisation:

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METHODS: Results based on samples of fruit crops submitted to the Plant Pathology Laboratory and field examinations.

RESULTS AND COMMENTS:

Apples: The main problem encountered on commercial apples in 1988 was a winter injury problem at a large nursery in the Carman area. Close to forty thousand apple rootstock seedlings, mainly variety Antanovka of open pollinated origin, from Montana, that had been planted in the spring of 1987 and budded in August of 1987 were lost. Examination of the rootstock revealed a root rot. The area above ground was initially not affected but leaves wilted during the month of June because of lack of viable roots. Isolations from the roots indicated an infection of Fusarium acuminatum and Fusarium oxysporum. The consensus was that the variety Antanovka was not sufficiently hardy for Manitoba. The seedlings were in a large open field with poor snow cover. Other problems encountered based on 58 apple samples, mainly from home gardens, submitted to the Plant Pathology Laboratory, were fireblight (Erwinia amylovora) 21 %, Cytospora canker (Cytospora spp.) 9%, iron chlorosis 16%, physiological problems including winter injury and sunscald 27%. Problems encountered in a few samples only were silver leaf (Stereum purpureum), crown gall (Agrobacterium tumefaciens), Black rot (Physalospora obtusa), water core apple storage disorder, and herbicide injury.

Manitoba Apple Problems[1] in 1988

Disease	Percentage of Samples
Fireblight	21
Cytospora canker	9
Black rot	2
Crown gall	2
Silver leaf	3
Verticillium	2
Physiological problems	27
Herbicide injury	3
Fruit breakdown	7
Iron chlorosis	16
Insect injury	7
Miscellaneous	2

[1]Based on 58 samples received by Manitoba Agriculture, Plant Pathology Laboratory.

Strawberries: Fifteen samples of strawberries were analysed. In 30% of samples winter injury and associated crown and root invasion by Fusarium sp. was the cause of plant death. Multiplier disease caused by an unidentified mycoplasma like organism (MLO) was detected in a commercial field in Southeastern Manitoba near Sprague. There are numerous wild strawberries in the area around this field which may have been the source of the MLO infection. Verticillium wilt (Verticillium sp.) was found to be a severe problem causing up to 70% plant loss in one commercial field near Winnipeg necessitating destruction of the field. The previous crop in this field was potatoes. Fruit rot was found in several fields but was not generally a problem in 1988 in most fields.

Raspberries: Twenty-four samples of raspberries were analysed. In 54% of samples either cane blight (Leptosphaeria coniothyrium) or spur blight (Didymella applanata) was found to be the cause of injury. Fruit rot was not a significant problem in 1988.

Plums: A mid May frost caused loss of fruit set in many plum trees in the Winnipeg area. Plum pocket (Taphrina communis) was submitted from Brandon.

Crop / Culture: Saskatoon, Amelanchier alnifolia

Location / Emplacement: Alberta

Title / Titre: SURVEY FOR DIEBACK AND CANKER DISEASE OF SASKATOON CAUSED BY CYTOSPORA SP.

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METHODS: Twelve saskatoon orchards in the south central, north central and Peace River regions of Alberta were surveyed in the summer of 1988. A systematic sampling technique was used in which every tenth bush was examined and rated as having the disease based on symptoms of dieback, exfoliation, canker, shrivelled bark, flagging and/or the presence of pycnidia. Disease severity was rated numerically according to the number of main branches affected: 0 = no disease; 1 = 1% to 25%; 2 = 26% to 50%; 3 = 51% to 75%; 4 = 76% to 100%. Random samples from each site were collected and returned to the laboratory for isolation and identification of the pathogen.

RESULTS AND COMMENTS: In 1988 there were approximately 142 ha. of saskatoons under cultivation in Alberta with another 120 ha. projected in the near future (1). Dieback and canker disease was found in all orchards surveyed. Disease incidence was higher in central Alberta than in the Peace River region, occurring most frequently in the north central area (Figure 1). The most severe infections were observed in north central Alberta where 23% of diseased bushes had 25% to 50% of the main branches affected. In the south central and Peace River regions infection was less severe, generally involving 25% or less of the main branches (Table 1). The most common symptoms observed were branch tip dieback and cankers with pycnidia. Cytospora sp. was isolated from all samples collected and microscopic examination revealed hyaline, allantoid spores 4.5 to 7.5 um. x 1.5 um. in size.

Table 1. Incidence and severity of dieback and canker disease in Alberta in 1988.

Area Surveyed in	Incidence (%)	Severity (% bushes per category)				
		0	1	2	3	4
S. Central	30	72	21	4	1	2
N. Central	37	63	9	23	1	4
Peace River	14	86	11	1.4	.5	1.1

REFERENCES:

1. Hausher, L. 1988. Personnal Communication. Alberta Special Crops and Horticulture Research Station. Edmonton, Alberta.

Ornamentals / Plantes ornementales

Crop / Culture: Geranium

Location / Emplacement: British Columbia

Title / Titre: Xanthomonas bacterial blight of geranium in British Columbia

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METHODS: Zonal and ivy geranium, (*Pelargonium* x *hortorum* Bailey and *P. peltatum* L.) submitted to the provincial plant diagnostic lab were tested for bacterial blight (*Xanthomonas campestris* pv. *pelargonii*) in view of widespread outbreaks the previous year. Bacterial identification was based on symptoms and the presence of bacterial streaming from petiole and stem vascular tissue, isolation of yellow, mucoid, convex colonies with entire margins on nutrient agar and yeast dextrose calcium carbonate agar, negative gram reaction and oxidase reaction, lack of fluorescence on King's B medium, hypersensitive reaction on tobacco cv. White Burley and positive reaction on reinoculation into *P.* x *hortorum* cv. Yours Truly.

RESULTS AND DISCUSSION: Geranium growers submitted samples of imported cuttings and their own stock to check for *Xanthomonas* bacterial blight infection. Six out of 14 greenhouses in 1988 had *Xanthomonas* bacterial blight which was traced to the use of infected, imported cuttings or the carry over of old, infected mother stock. There has been some reduction in the incidence of *Xanthomonas* bacterial blight which occurred in 10/27 greenhouses in 1987 and 4/6 greenhouses in 1986. An educational program involving newsletters, surveys, field calls and a special geranium seminar (November, 1987) alerted growers to the problem and its control through strict sanitation and the use of disease-free stock.

Crop / Culture: Greenhouse crops

Location / Emplacement: Manitoba

Title / Titre: Incidence of plant diseases in greenhouse crops in Manitoba in 1988.

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METHODS: Results based on samples of greenhouse crops submitted to the Plant Pathology Laboratory and field examinations.

RESULTS: Root rot caused by *Pythium* spp. and *Fusarium* spp. was diagnosed in several greenhouses that produce geraniums + begonias. *Fusarium* spp. was found to be causing a problem in hydroponically-produced lettuce. A greenhouse in Winnipeg submitted impatiens plants showing a ring-spot symptom. This was identified by the Agriculture Canada Research Station in Vancouver as Tomato ring spot virus. About 5% of the plants were affected. *Botrytis cinerea* was found to be a problem on fuchsia cuttings in one greenhouse in April, 1988. Phyllosticta (*Phyllosticta* sp.) leaf spot was detected on dracaena plants.

Crop / Culture: Ornamentals

Location / Emplacement: British Columbia

Title / Titre: DIAGNOSTIC LAB REPORT FOR DISEASES OF NURSERY CROPS IN B.C. DURING 1988

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METHODS: Diseased ornamentals were submitted to the Cloverdale diagnostic lab by growers, extension personnel and sales representatives. Fungal diseases were identified by observation in plant tissue or from pure cultures of isolations. Pathogenicity and biochemical tests were used to identify bacterial pathogens (Lelliott and Stead, 1987). Dr. R. Stace-Smith identified carnation latent virus by sap inoculation to indicator plants and ELISA. Only noteworthy diseases are described.

RESULTS AND COMMENTS: See Table 1. Most Andromeda in Fraser Valley nurseries was infected with red leaf spot caused by Exobasidium vaccinii. Kabatina infected 100% of the Chamaecyparis pisifera 'Cyanoviridis' and Thuja occidentalis 'Reingold' at one nursery, and several T. occidentalis at another. Cheiranthus (wallflower) 'Orange Bedder' seedlings, infected with Xanthomonas campestris, exhibited wilt, leaf yellowing and collapse. Cheiranthus 'Primrose Monarch' adjacent to C. 'Orange Bedder' and other cvs. appeared healthy. Carnation latent virus was detected in red flowering perennial Dianthus spp. having symptoms of white flower break and purple-black leaf streaks and spots in two nurseries. Symptoms had been observed for two years. Phomopsis sp. dieback of Juniperus spp. occurred in two nurseries. Junipers died within two weeks of symptom expression at one nursery with a resultant crop loss of 30% through the summer. Thelephora sp. smothered 10 cm tall Pinus mugo mughus seedlings grown in a shady, damp location.

REFERENCES: Lelliott, R.A. and D.E. Stead. 1987. Methods in Plant Pathology Volume 2. Methods for the Diagnosis of Bacterial Diseases of Plants. Blackwell Scientific Publication, Palo Alto, U.S.A.

TABLE 1. Significant nursery crop diseases diagnosed in B.C. during 1988

CROP	DISEASE	CROP LOSS
Andromeda polifolia (Bog Rosemary)	Exobasidium vaccinii	$4000+
Azalea (Rhododendron sp.)	Crown gall symptoms	several plants
Chamaecyparis pisifera 'Cyanoviridis;	Kabatina sp. dieback	n.a.
Cheiranthus (Wallflower) cv 'Orange Bedder'	Xanthomonas campestris wilt	1400 of 2000 plants
Cornus mas 'Elegantissima' and C. stolonifera	Pseudomonas syringae leaf spot and stem canker	n.a.
Cotoneaster dammeri	Erwinia amylovora Phomopsis sp. dieback	20% 100% of one block
Dianthus plumarius and D. caesius (Red cvs.)	Carnation latent virus	n.a.
Juniperus spp.	Phomopsis sp. dieback	30% at one nursery
Pinus mugo mughus	Smothering by Thelephora sp.	n.a.
Thuja occidentalis	Kabatina sp. dieback	n.a.

n.a. = not available

Crop / Culture: Greenhouse Ornamentals

Location / Emplacement: British Columbia

Title / Titre: NOTEWORTHY DISEASES OF GREENHOUSE ORNAMENTALS DIAGNOSED IN B.C. DURING 1988

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METHODS: Diseased ornamentals were submitted to the Cloverdale diagnostic lab by growers, sales representatives, and extension personnel. Fungi were identified in pure culture from isolations and *Phytophthora* spp. were confirmed by reaction with a polyclonal antibody developed by Dr. H. Pepin, Agriculture Canada Vancouver Research Station. Bacteria were identified from pure cultures by various biochemical and pathological tests (Lelliott and Stead, 1987). Viral diseases were identified by Dr. R. Stace-Smith, Agriculture Canada Vancouver Research Station, through sap inoculation onto indicator plants and election microscopy. Herbicide residue was detected by the B.C. Ministry of Environment and Parks Environmental Laboratory, 3650 Westbrook Mall, Vancouver, B.C. V6S 2L2.

RESULTS AND COMMENTS: The following table includes some diseases which caused significant damage to B.C. growers. Geranium diseases and infections caused by tomato spotted wilt virus are discussed elsewhere within this commodity area.

Carnation mottle virus (CarMV) caused flower breaking of carnations grown during February and March in two Fraser Valley greenhouses. Both infections appeared to originate in the red cv. 'Jack' which had been purchased from the same supplier. It is believed the cooler temperatures, due to time of year and latitude, promoted symptom development because CarMV infections are usually not serious (Baker *et. al.*, 1985). CarMV quickly spread by cutting knives and one grower lost his entire crop. White flowers of 'Starlight' developed pink patches as a result of infection; discoloured tissue in both cvs. was leathery in texture, and eventually collapsed.

Phytophthora heart rot of *Cymbidium* propagated by tissue culture was restricted to plants grown in 10-inch pots or smaller. Most infected plants were 10 years old and more recently-developed cultivars seemed to be more susceptible to heart rot.

Dinoseb top-killer applied to potatoes adjacent to a rose greenhouse burned rose foliage and young tissues when drift entered through the ventilation fans. Yellow line patterns also developed on some leaves. The cvs. 'Scarlett O'Hara' and 'Oragami' were most sensitive to dinoseb spray drift. Plants recovered after two weeks.

TABLE 1. Noteworthy diseases of B.C. greenhouse ornamentals during 1988.

CROP	DISEASE	CROP LOSS	NO. OF GREENHOUSES
Anemone	*Phytophthora* crown rot	10% +	1
Carnation cvs. Winsome and Juanita	*Fusarium* wilt	20%	1
Carnation cv. Jack cv. Starlight	Carnation mottle virus	90%*	2 1
Cyclamen (4" pots)	*Erwinia* soft rot	500 plants	2
Cymbidium 10 years old	*Phytophthora* heart rot	10%	2
Rose	Dinoseb burn	2 weeks' production	1

* Damage in one greenhouse, no figures for other greenhouse.

REFERENCES: Baker, R.R., P.E. Nelson, and R.H. Lawson. 1985. Carnation. pp. 554-563 in: Chapter 16, Diseases of Floral Crops Vol. 1. D.L. Strider, ed. Praeger. Toronto. 638 pp.

Lelliott, R.A. and D.E. Stead. 1987. Methods in Plant Pathology. Vol. 2. Methods for the Diagnosis of Bacterial Diseases of Plants. Blackwell Scientific Publications, Palo Alto, U.S.A.

Crop / Culture: Greenhouse Ornamentals

Location / Emplacement: South Coastal British Columbia

Title / Titre: INCIDENCE OF TOMATO SPOTTED WILT VIRUS IN BRITISH COLUMBIA

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METHODS: The tomato spotted wilt virus (TSWV) was identified in greenhouse ornamentals on the bases of visual symptoms on specimens and on inoculated indicator plants, by particle characteristics observed in the electron microscope, and by ELISA. With umbrella tree, the causal relationship was confirmed by thrips-transmission of the virus to healthy plants of the species. Greenhouse ornamentals in the Lower Mainland of British Columbia were surveyed to determine the incidence of TSWV. Virus methodology has been reported (Allen and Broadbent 1986; Allen and Matteoni 1988).

RESULTS AND COMMENTS: TSWV was first detected in British Columbia in April 1987 in florist's chrysanthemum cv. Polaris. In May 1988, TSWV was detected in a new host, *Brassaia actinophylla* (*Schefflera actinophylla*, Araliaceae), in which severe concentric ring patterns were induced. TSWV-infected cyclamen and begonia were found in the same greenhouse. Subsequently, TSWV was found in 11 of 14 other greenhouses in the Lower Mainland, in a total of 8 ornamental crops (Table 1), suggesting that the virus had been present in B.C. for at least several years prior to 1987. The origin of the virus was not determined with certainty for any of the greenhouses due to extensive movement of plant material from areas known to have the virus. The earliest record of the predominant vector, the western flower thrips (*Frankliniella occidentalis*), in B.C. greenhouses was 1983. Losses from the TSWV, in many cases, have been attributed to other causes due to difficulty in isolating and identifying the virus (Allen and Matteoni 1988).

REFERENCES: Allen, W.R. and A.B. Broadbent. 1986. Transmission of tomato spotted wilt virus in Ontario greenhouses by *Frankliniella occidentalis*. Can. J. Plant Pathol. 8:33-38.

Allen, W.R., and J.A. Matteoni. 1988. Cyclamen ringspot: Epidemics in Ontario greenhouses caused by the tomato spotted wilt virus. Can. J. Plant Pathol. 10:41-46.

Table 1. Greenhouse ornamentals infected with tomato spotted wilt virus in British Columbia in 1987 and 1988.

Crop	No. of Greenhouses	Diagnostic Criteria**
Cyclamen _Cyclamen persicum_	7	Visual, IP, ELISA
Rieger begonia _Begonia_ X _hiemalis_	3	IP, ELISA
Umbrella tree _Brassaia actinophylla_	2	IP, EM, TT, ELISA
Tree schefflera _Schefflera arboricola_	1	Visual, ELISA
Florist's chrysanthemum _Chrysanthemum_ X _morifolium_	1	IP, EM, ELISA
Gloxinia _Sinningia speciosa_	1	Visual
New Guinea Impatiens _Impatiens wallerana_	1	Visual, IP, ELISA
Ornamental pepper _Capsicum_ sp.	1	ELISA, IP
Purple velvet plant _Gynura aurantiaca_ 'Sarmentosa'	1	IP, ELISA

* Based on a total of 14 greenhouses surveyed in the Lower Mainland. ** Diagnostic criteria: symptoms on specimens (visual) and on indicator plants (IP); electron microscopy (EM); thrips transmission (TT); and ELISA.

Crop/Culture: Ornamentals

Location/Emplacement: Manitoba

Title/Titre: INCIDENCE OF PLANT DISEASES IN ORNAMENTALS IN MANITOBA IN 1988

Name and Agency/ Nom et Organisation:

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METHODS: Results based on 846 samples of ornamentals submitted to the Plant Pathology Laboratory and field examinations.

RESULTS: The Plant Pathology Laboratory analysed 846 samples of ornamentals in 1988. Cytospora canker (*Cytospora* spp.) was found on dogwood, cotoneaster, willow and mountain ash. Fireblight (*Erwinia amylovora*) was detected on cotoneaster. Powdery mildew (*Microsphaera penicillata*), was found on lilac; zinnia, (*Erysiphe cichoracearum*); virginia creeper, (*Uncinula necator*). Aster yellows was present in marigold, but to a lesser extent than normal. Marginal leaf scorch caused by low soil moisture and, in some cases, high soil salt level was a common problem for many ornamental shrubs and trees including willow, mountain ash, apple, elm, Manitoba maple and dogwood. A leaf spot (*Septoria caraganae*) was observed on several samples of caragana. Needle browning, beginning in mid September, was present on most of the ornamental white cedar in Winnipeg and other places in southern Manitoba. A large amount of the browning was just normal old - needle senescence, but it appeared to be more pronounced in 1988 because of the effect of the prolonged spring and summer drought. Black spot of roses (*Diplocarpon rosae*) was less severe than normal because of the dry weather. Root knot nematodes, (*Meloidogyne* spp.) were found to be a problem on a sample of French marigold.

Crop / Culture: Ornamentals

Location / Emplacement: Ontario

Name and Agency / Nom et Organisation:
J.A. MATTEONI, W.R. ALLEN, B. TEHRANI
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Title / Titre: DISEASES OF ORNAMENTALS: DIAGNOSTIC SUMMARY, VINELAND RESEARCH STATION

METHODS: Diseased plant samples were sent to the Research Station, particularly when the plant or disease related to ongoing research programs, or when diagnosis required either virus identification or complicated isolation and identification. In 1988, 67 (61% of 110 samples total) came from extension personnel, 26 samples (24%) came directly from growers, 13 samples (12%) came from allied industry personnel, 3 samples (<3%) came from other Agriculture Canada branches, and 2 samples (<2%) came from other diagnostic labs. Four of the samples came from British Columbia, and the remainder were from Ontario. There were 92 samples (84%) from floricultural crops, 15 (14%) from nursery crops, and three from related vegetables. Most samples (79 plants, 72%) were from production stages; 20 samples (11 floricultural and 9 nursery, 18%) were from propagation stages; and 11 samples (10%, all floricultural samples) were from stock plants. Of the floricultural samples, 34 (37%) were potted plants, 32 (35%) were bedding plants (including geraniums), 21 (23%) were cut flowers, and 5 (5%) were foliage plants. Of the nursery samples, 11 were woody plants and 5 were herbaceous perennials.

Bacterial diagnoses followed standard practices (Schaad 1980). Bacteria were identified to species or pathovar only when necessary. Virus identification involved one or more of the following: immunosorbent transmission electron microscopy, indicator plants, ELISA, or transmission by the western flower thrips (Frankliniella occidentalis). Specific procedures were followed for identification of tomato spotted wilt virus (TSWV) (Allen and Matteoni 1988). Abiotic disorders were diagnosed on the bases of symptoms, and the plant history which was supplied with each sample.

RESULTS AND COMMENTS: The most common diagnosis was tomato spotted wilt virus (21 positive identifications) in a variety of potted, cut, foliage, and bedding plants (Table 1); and from one greenhouse tomato crop. This represents continuing spread of TSWV in floricultural crops since 1983 (Matteoni 1988). The other two vegetable samples were field tomato plants, one with early blight and the other with herbicide injury. TSWV has not been detected recently in field tomatoes from Ontario.

Botrytis cinerea was frequently isolated from a variety of crops, and was a common secondary invader in lesions caused by TSWV. The number of samples with botrytis blight was low because it can be readily diagnosed in the field. Xanthomonas campestris pv. pelargonii remained a serious problem on florist's geranium. There were few large economic losses, because of early detection and eradication of infected plants. Diseases caused by Fusarium spp. were numerous, and affected a wide range of floricultural hosts as well as nursery crops. There were no samples of powdery mildew on rose, although it is still one of the most important problems in commercial cut rose production.

The number of nursery samples was low (Table 2), and consisted primarily of junipers with phomopsis blight. Samples with phomopsis blight were from field specimens as well as from propagation beds.

References: Allen, W.R. and J.A. Matteoni. 1988. Cyclamen ring-spot: epidemics in Ontario greenhouses caused by the tomato spotted wilt virus. Can. J. Pl. Pathol. 10:41-46.

Matteoni, J.A. 1988. Diseases of florist's chrysanthemum in Ontario from 1983-1987. Can. Pl. Dis. Survey 68:85-86.

Schaad, N.W. 1980. Laboratory guide for the identification of plant pathogenic bacteria. Amer. Phytopathol. Soc. St. Paul, MN. 72 pp.

Table 1. Disease diagnoses of floricultural crops, including greenhouse ornamentals, foliage plants, and field ornamentals grown for cut flowers -- Vineland Station 1988.

Number of samples	Plant species	Diagnoses: Pathogens*	Diagnoses: Frequency
21	Florist's geranium *Pelargonium* X *hortorum* L.H. Bailey	Abiotic	7
		Xanthomonas campestris	7
		Botrytis cinerea	3
		Virus**	2
		Pythium sp.	1
16	Florist's chrysanthemum *Chrysanthemum* X *morifolium* Ramat.	Tomato spotted wilt virus	4
		Fusarium solani	3
		Abiotic (pesticide)	2
		MLO ***	2
		Pythium sp.	2
		Erisiphe cichoracearum	1
		Fusarium oxysporum	1
		Pseudomonas cichorii	1
		Rhizoctonia solani	1
7	Impatiens *Impatiens wallerana* Hook.f.	Tomato spotted wilt virus	4
		Botrytis cinerea	1
6	Cyclamen *Cyclamen persicum* Mill.	*Botrytis cinerea*	3
		Tomato spotted wilt virus	3
		Erwinia sp.	1
		Gloeosporium cyclaminis	1
		Fusarium oxysporium	1
4	Carnation *Dianthus caryophyllus* L.	Carnation mottle virus	2
		Fusarium roseum	1
		Fusarium solani	1
		Rhizoctonia solani	1
4	Gloxinia *Sinningia speciosa* (Lodd.) Hiern.	Tomato spotted wilt virus	3
		Phytophthora sp.	1
3	Gerbera *Gerbera jamesonii* H. Bolus ex Hook.f.	*Fusarium solani*	2
		Tomato spotted wilt virus	1
3	Kalanchoe *Kalanchoe blossfeldiana* Poelln.	*Myrothecium roridum*	2
		Oidium sp.	1

Table 1. Disease diagnoses of floricultural crops, including greenhouse ornamentals, foliage plants, and field ornamentals grown for cut flowers -- Vineland Station 1988. (cont'd)

Number of samples	Plant species	Diagnoses Pathogens*	Frequency
3	Poinsettia Poinsettia pulcherrima Willd. ex Klotzsch	Abiotic (high temperature) Erwinia sp. Pythium sp.	1 1 1
2	Christmas cactus Schlumberga Lem. sp.	Fusarium sp.	2
2	Florist's azalea Rhododendron obtusum (Lindl.) Planch.	Pestalotia macrotricha Cylindrocladium sp.	1 1
2	Fuschia Fuschia X hybrida Hort. ex Vilm.	Tomato spotted wilt virus	2
2	Bells-of-Ireland Moluccella laevis L.	Virus (Nepo group) ***	2
2	Regal geranium Pelargonium X domesticum L.H. Bailey	Botrytis cinerea	2
2	Rieger begonia Begonia X hiemalis Fotsch.	Tomato spotted wilt virus Cylindrocladium sp. Xanthomonas campestris	2 1 1
2	Rose, cuttings Rosa odorata (Andr.) Sweet	Cylindrocladium sp. Pythium sp. Fusarium solani	1 1 1
2	Tree Schefflera Brassaia actinophylla Endl.	Tomato spotted wilt virus Abiotic	1 1
1	Cinerea Senecio X hybridus (Willd.) Regel.	Alternaria senescionis Botrytis cinerea	1 1
1	Daffodil Narcissus pseudonarcissus L.	Botrytis sp. Fusarium oxysporum Penicillium sp.	1 1 1

Table 1. Disease diagnoses of floricultural crops, including greenhouse ornamentals, foliage plants, and field ornamentals grown for cut flowers -- Vineland Station 1988. (cont'd)

Number of samples	Plant species	Diagnoses Pathogens*	Frequency
1	Dieffenbachia Dieffenbachia maculata (Lodd.) G. Don.	Fusarium solani	1
1	Exacum, Persian violet Exacum affine Balf.f.	Botrytis cinerea	1
1	Freesia Freesia X hybrida L.H. Bailey	Fusarium roseum	1
1	Gynura, purple velvet Gynura aurantiaca (Blume) DC.	Tomato spotted wilt virus	1
1	Ivy geranium Pelargonium peltatum (L.) L'Her. ex Ait	Abiotic (oedema), thrips	1
1	Lipstick plant Aeschynanthus pulcher (Blume) G. Don.	Normal cultivar colouring	1
1	Yucca, cane Yucca elephantipes Regel.	Abiotic (cold temperature) Fusarium solani	1 1

* More than one pathogen was isolated from many samples, parti- cularly when many plants were included in the sample. Secondary pathogens or invaders are not reported.

** The virus was not specifically identified, but was visualized by electron microscopy, and was demonstrated through symptoms on inoculated indicator plants.

*** Mycoplasmalike organisms determined as the cause on the bases of symptoms and by the lack of other pathogens isolated.

Table 2. Disease diagnoses for nursery crops, and herbaceous perennials -- Vineland Station 1988.

Number of samples	Plant species	Diagnoses: Pathogens*	Diagnoses: Frequency
7	Juniper *Juniperus chinensis* L.	*Phomopsis juniperova*	7
2	Euonymous *Euonymous fortunei* (Turcz.) Hand.-Mazz.	*Gloeosporium* sp.	2
1	Apple *Malus sylvestris* Mill.	Abiotic (drought)	1
1	Forthysia *Forsythia* X *intermedia* Zab.	Abiotic (drought)	1
1	Garden chrysanthemum *Chrysanthemum* X *morifolium* Ramat.	Abiotic	1
1	Hollyhock *Alcea rosea* L.	*Puccinia malvacearum*	1
1	Strawberry *Fragaria* X *ananassa* Duchesne	*Phytophthora* sp. *Fusarium* sp.	1 1
1	Yew (cuttings) *Taxus cuspidata* 'Hicksii' Siebold. & Zucc.	*Fusarium solani*	1

* More than one pathogen was isolated from many samples, particularly when many plants were included in the sample. Secondary pathogens or invaders are not reported.

Turf / Gazon

Crop / Culture: Turf grasses

Location / Emplacement: Saskatchewan

Name and Agency / Nom et Organisation:
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Title / Titre: SNOW MOLD AND WINTER INJURY ON TURF GRASS IN SASKATCHEWAN IN 1988.

Methods: In May of 1988, 12 golf courses in the central and northern grainbelt areas of Saskatchewan were examined to determine the extent and severity of snow mold diseases and winter injury. Disease severity was rated on a five point scale; None, Trace < 1% of plants killed, Slight = 1-10%, Moderate = 11-25%, Severe >25%. Identification of injury was based on field symptoms.

Results and Comments: Ten of the 12 courses examined had at least slight cottony snow mold damage on greens and surrounds, and damage was moderate to severe on 7 courses. Damage was significantly lower on fairways, where 1 course was None, 9 were rated Trace, 7 were rated Slight and 2 were rated Moderate. Casual observation of domestic turf in the survey area indicated that there was little or no snow mold damage on lawns. Microdochium nivale (cause of pink snow mold) was noted at trace to slight levels on two courses. Desiccation/low-temperature damage was noted on greens and surrounds of only three courses. Winter injury was probably much more important in southern areas, where inadequate snow cover resulted in injury to many perennials. Cottony snow mold (caused by Coprinus psychromorbidus) continues to be an important disease of fine turf in Saskatchewan where intensive management is used.

Crop/Culture: Turf, Lawn grass, *Poa* spp.

Location/Emplacement: Manitoba

Title/Titre: Incidence of Plant Diseases in Turf, Lawn grass and *Poa* spp. in Manitoba in 1988

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METHODS: Results based on 145 samples of turf and lawn grass submitted to the Plant Pathology Laboratory and field examinations. The majority of the samples were from the Winnipeg area.

RESULTS: The Plant Pathology Laboratory analysed 145 samples of lawn and turf grass in 1988. The main disease problems were anthracnose (*Colletotrichum graminicola*) found in 41% of samples, melting out (*Dreschlera poae*) in 37% of samples, Ascochyta (*Ascochyta* spp.) in 20% of samples. Other diseases identified were Fusarium blight (*Fusarium* spp.) in 10% of samples. Septoria leaf spot (*Septoria* spp.), Leptosphaerulina leaf blight (*Leptosphaerulina australis*) and flag smut (*Urocystis agropyri*) in 3% of samples. Fairy ring (*Marasmius oreades*) occurred in 2% of samples. Pythium blight (*Pythium* spp.) and powdery mildew (*Erysiphe graminis*) both occurred in 1% of samples. In about 12% of samples insect injury and drought were the main cause of damage.

Table 1: 1988 Manitoba Lawn and Turf Grass Problems[1]

Disease	Percent Of Samples
Melting out	37
Ascochyta	20
Anthracnose	41
Fusarium blight	10
Fairy ring	2
Flag smut	3
Leptosphaerulina leaf blight	3
Septoria leaf spot	3
Pythium blight	1
Powdery mildew	1
Drought	6
Miscellaneous	4

1 Based on 145 samples submitted to the Manitoba Agriculture, Plant Pathology Laboratory

Forest trees / Arbres forestiers

Crop / Culture: Conifer Wood Chips

Location / Emplacement: British Columbia

Name and Agency / Nom et Organisation: Sarah Sheffield
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Title / Titre: SURVEY FOR PINEWOOD NEMATODE IN BRITISH COLUMBIA.

METHODS: Fresh wood chip samples were collected by B.C. Ministry of Forests field staff from approximately 10 sawmills in each of the six B.C. forest regions during 1986 and 1987. Mills were chosen so as to cover as much of each region as possible. Chips were also collected from rail cars and from chip piles.

Nematode extraction and identification were carried out by Plant Health's Ottawa Lab. Identification of pinewood nematode (Bursaphylenchus xylophilus) specimens was confirmed by Dr. Roger Anderson of the Ottawa Biosystematics Lab.

Except as noted, chip samples were pure pine or a mixture of pine, spruce, and/or subalpine fir.

RESULTS AND COMMENTS: Pinewood nematode (PWN) was found in samples from all B.C. forest regions except Kamloops (Table). The much higher recovery of PWN from the Fiberco samples was expected since chips from various interior B.C. sources are bulked when rail cars are loaded at the mills, and bulked again when piled at the Fiberco premises. Also, population levels of PWN in such piles appear to increase over time.

This project was part of a national PWN survey. Actual and threatened embargoes on Canadian softwood products by European importers concerned about PWN made it imperative to determine the distribution of PWN in Canada. Two PWN forms, the "r" (round-tailed) and the "m" (mucronate-tailed), occur in North America. The two are closely related, although the exact nature of the relationship has not been determined. The devastating pine wilt epidemic in Japan is caused by the "r" form. In North America the "m" form is generally found in non-pine hosts, where it appears to cause little damage.

These survey results indicate that the "r" form is widely distributed in B.C.

Actual population levels of PWN in B.C. cannot be estimated from such a limited number of samples. However, in the light of current information, it would not be possible to declare any part of B.C. free of either the "r" or the "m" form. The condition of the trees from which the chips were made cannot be determined, but there is no evidence that either the "r" or the "m" form of PWN causes significant damage in B.C. forests.

Table. Results of PWN Chip Sampling Survey 1986-87

Forest Region	Samples: Type	Samples: No.	Samples Positive for PWN: No. and Origin		Form
Cariboo	Mill	12	1	100 Mile House	r
	Rail car	6	5		m, r
Kamloops	Mill	9	0		
Nelson	Mill	9	1	Kinbasket	r
Prince George	Mill	16	1	Fort St. John	r
	Rail car	3	1	Fort Nelson	r
Prince Rupert	Mill	8	2	Kispiox Dist.	m
				Burns Lake	m
Vancouver	Mill	4	1	Campbell River	r
	Chip piles	6*	0		r
	Fiberco	4	3	Interior B.C.	r

*Of six chip piles sampled in the Vancouver Forest Region, two were pure Douglas-fir, two hemlock, and two cedar species not considered hosts of PWN.

Crop / Culture: Plantations of Douglas-fir, interior spruce, lodgepole pine, western larch

Location / Emplacement: Southern Interior, British Columbia

Name and Agency / Nom et Organisation:
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Title / Titre:

RHIZINA ROOT DISEASE IN NEW CONIFER PLANTATIONS.

METHODS: In the Nelson Forest Region in September-November 1988, 80 newly planted cutblocks were examined for rhizina root disease, caused by the fungus *Rhizina undulata*. Infected seedlings were identified by the occurrence of *Rhizina* sporocarps. Blocks were burned in 1987 and planted in 1988. In Tree Farm License (TFL) 23, an additional 13 blocks that were burned in 1986 and planted in 1987 were also examined. In the Golden and Revelstoke Timber Supply Area (TSA) and in TFL 23, walk-through surveys were made to estimate disease occurrence. In Cranbrook, Boundary, and Kootenay Lake TSA, 10 to 20 standard regeneration survey plots were placed in each block in a zig-zag pattern, and infected seedlings were recorded.

RESULTS AND COMMENTS: Of the 93 blocks examined, 39 had evidence of rhizina root disease (Table A), and on 29 of these blocks, mortality from the root disease was 30% or more, thus necessitating replanting to achieve the target 1200 seedlings per hectare. Based on a regional total of 305 blocks (3500 ha) burned in 1987 and planted in 1988, losses from rhizina root disease in 1988 were estimated at $1,000,000 for the Nelson Region.

Tree mortality was generally evenly distributed in groups of 1, 2 or 3-5 trees. Up to 70% of trees were killed by the disease in some areas. Douglas-fir, interior spruce (*engelmann* x *glauca*), lodgepole pine, and western larch were infected. Prior to the survey, mortality of seedlings was attributed to poor stock or poor handling.

Occurrence of rhizina root disease was associated with the intensity of burning. Generally most infection occurred on blocks that were moderately burned (as judged by the amount of the soil litter layer removed), and very little on blocks or portion of blocks that were rated as a low or high intensity of burn. Potentially the rhizina root disease could be prevented by burning under suitable conditions for either hot or cool, but not moderate burns.

Examination of 13 blocks burned in 1986 and planted in 1987, indicated that five had 35 to 50% of the tree seedlings killed by *Rhizina*, and eight did not have the root disease. Apparently recent burning history, not climatic changes, have led to the current outbreak of the root disease. Areas surveyed will be re-examined in future years to determine if disease losses will subside, as expected. Further work is needed to determine the characteristics of forest sites and intensity of prescribed burning that result in disease outbreaks.

Table A. Occurrence of rhizina root disease in Nelson Forest Region, 1988

Timber Supply Area	Number Examined	Rhizina occurrence High	moderate	low	nil
Golden	21	2	5	2	12
Revelstoke	21	5	3	3	10
TFL 23 (87 burn)	6	2			4
TFL 23 (86 burn)	13	5			8
Cranbrook	11	2			9
Boundary	5	1	1		3
Kootenay Lake	16	3		5	8

Crop / Culture: Elm

Location / Emplacement: Manitoba

Title / Titre: INCIDENCE OF DUTCH ELM DISEASE IN MANITOBA IN 1988

Name and Agency / Nom et Organisation:

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METHODS: Results are based on 1799 samples of American elm, Ulmus americana and 75 Siberian elm Ulmus pumila, submitted to the Plant Pathology Laboratory from a survey conducted by the Manitoba Department of Natural Resources. Trees were selected for sampling and submission to the laboratory on the basis of presence of wilted, brown leaves and internal, brown staining of the cambium. All samples submitted were cultured on potato dextrose agar medium and incubated for 7 days at 20°C. Fungal identifications were done after 7 days.

RESULTS: There were 1874 elm trees sampled in Manitoba in the 1988 survey, 1799 American elm (Ulmus americana) and 75 Siberian elm (Ulmus pumila). Branch samples were taken to the Manitoba Agriculture Plant Pathology Laboratory and from 1799 samples of American elms 1633 (90.8%) were found to be infected with Dutch Elm Disease (DED) (Ophiostoma ulmi, Ceratocystis ulmi). DED was not detected in any of the samples of Siberian elm.

Dothiorella wilt, (Dothiorella ulmi) was found in 1% of sampled trees. One hundred and five samples or 12% were found to be negative for any elm pathogens. The survey results are presented in Table 1. Tree removals are also included as these data indicate the real impact of DED in the area sampled. In many areas where DED is prevalent, only a few samples are taken to confirm presence of DED, and surrounding elms with similar symptoms or trees with more than 50% of the crown dead are marked for removal. The sampling results do not give a full indication of the impact of the disease in Manitoba, as sampling and tree removals are concentrated in cities, towns and municipal parks-areas which have agreed to a cost-sharing agreement with the Manitoba Department of Natural Resources. The number of trees confirmed with DED in Winnipeg was less than in 1987: 911(1988) vs. 1643 in 1987. However, a total of 5129 trees were marked for removal including trees along the Red, Assiniboine and Seine River banks. There was no major expansion of DED into residential areas within the centre of the city. In 1987 there were 117 trees found to have DED in the Winnipeg Centre/Fort Rouge area and in 1988 only 60 trees were found to be affected by DED. The City of Winnipeg control program of infected tree removal, pruning and basal spraying of living elms with chlorpyrifos for elm bark beetle control has kept the loss from DED to less than 2% based on 273,000 elm trees within the City of Winnipeg boundary. There are still large numbers of trees being removed in the buffer zone around Winnipeg. In 1988, 2809 trees were designated for removal in the rural municipality (RM) of Richot which is adjacent to the Red River south of Winnipeg. This compared to 4367 elm trees marked for removal in the same municipality in 1987. Other areas with high numbers of trees marked in 1988 for removal were the RM of St. Francois Xavier with 420, RM of Cartier-927, both on the Assiniboine River just west of Winnipeg and the RMs of West and East St. Paul along the Red River North of Winnipeg, with a total of 1340 trees.

The results of the survey in the regions of Southern Manitoba are also presented in Table 1. The largest concentrations of diseased trees are in the Central region with 428 trees identified having DED and 6160 trees marked for removal, of which 2809 were in Richot municipality. The Interlake region had 219 trees identified as having DED and 2149 identified for removal; about 1300 of the removal total are trees within the Winnipeg buffer zone. Dutch elm disease was also a problem in the Interlake area in locations where it has occurred over the past 10 years, such as in the town of Selkirk, and the municipalities adjacent to Lake Winnipeg. The infected tree numbers (53) and tree removals (432) in the Eastern region do not reflect the severity of the disease in this area because mainly trees within towns were sampled. There are many more infected trees in wild areas along rivers and streams that are not within the control zones. The major concentration of hazard and diseased trees designated for removal was near the town of St. Anne and the surrounding municipality of Tache, which is situated on the Seine River about 50 km east of Winnipeg. These trees accounted for 78% of the trees marked for removal in the Eastern region. In the Western region there were 128 trees identified as having DED and 1464 trees marked for removal. The majority of the trees identified as having DED and trees marked for removal were near Souris with 29 trees found to have DED and 736 marked for removal. There was no major westward expansion of DED toward Saskatchewan. One tree was found to have DED in the town of Virden which is about 40 km east of the Saskatchewan border. Separate survey totals were kept for Brandon. The number of trees identified with DED was 38 and 1817 trees were marked for removal. The majority of the marked trees were on the outskirts of Brandon along the Assiniboine River.

DED continues to be a problem in Manitoba, however in areas where a control program is being undertaken the losses are relatively low and there is no immediate threat of all the elms disappearing.

Table 1. Dutch Elm Disease Survey for Manitoba

AREA	TREES SAMPLED	TREES DISEASED[a]	PERCENT INFECTED	TREES REMOVED
Wpg. Centre/ Fort Rouge	72	60	83	213
Wpg. St. James/ Assiniboia	60	51	85	379
Wpg. Lord Selk./ West Kildonan	105	87	82	565
Wpg. East Kildonan/ Transcona	231	211	91	692
Wpg. St. Boniface/ St. Vital	206	186	90	1232
Wpg. Assiniboine Pk./ Fort Garry	234	216	92	2048
Brandon	45	38	84	1817
Interlake[1]	260	219	84	2149
Central[2]	475	428	89	6160
Eastern[3]	58	53	91	432
Western[4]	128	82	64	1464

[a] Based on confirmation of presence of Ophiostoma ulmi (Ceratocystis ulmi) in laboratory cultures

[1] Interlake region includes the City of Selkirk and all area north of Winnipeg between Lake Manitoba and Lake Winnipeg.

[2] Central region includes the town of Portage la Prairie and the area south to the United States border and east to the Red River.

[3] Eastern region includes all area east of the Red River to the Ontario border.

[4] Western region includes area west of Portage la Prairie to the Saskatchewan border excluding the City of Brandon.

Instructions to authors

Articles and brief notes are published in English or French. Manuscripts (original and one copy) and all correspondence should be addressed to Dr. H.S. Krehm, Research Program Service, Research Branch, Agriculture Canada, Ottawa, Ontario K1A 0C6.

Manuscripts should be concise and consistent in style, spelling, and use of abbreviations. They should be typed, double spaced throughout, on line-numbered paper. All pages should be numbered, including those containing abstract, tables, and legends. For general format and style, refer to recent issues of the *Survey* and to *CBE Style Manual* 3rd ed. 1972. American Institute of Biological Sciences, Washington, D.C. Whenever possible, numerical data should be in metric units (SI) or metric equivalents should be included. Square brackets may be used to enclose the scientific name of a pathogen, following the common name of a disease, to denote cause.

Titles should be concise and informative providing, with the Abstract, the key words most useful for indexing and information retrieval.

Abstracts of no more than 200 words, in both English and French, if possible, should accompany each article.

Figures should be planned to fit, after reduction, one column (maximum 84 × 241 mm) or two columns (maximum 175 × 241 mm), and should be trimmed or marked with crop marks to show only essential features. Figures grouped in a plate should be butt-mounted with no space between them. A duplicate set of unmounted photographs and line drawings is required. Figures should be identified by number, author's name, and abbreviated legend.

Tables should be numbered using arabic numerals and have a concise title; they should not contain vertical rules; footnotes should be identified by reference marks (* † § # ¶ ** ††) particularly when referring to numbers.

Literature cited should be listed alphabetically in the form appearing in current issues; either the number system or the name-and-year system may be used. For the abbreviated form of titles of periodicals refer to the most recent issue of *Biosis List of Serials* published by Biosciences Information Service of Biological Abstracts or to the *NCPTWA Word Abbreviation List*, American National Standards Institute.

Recommandations aux auteurs

Les articles et les communiqués sont publiés en anglais ou en français. Les manuscrits (l'original et une copie) et toute la correspondance qui s'y rapporte doivent être envoyés à D[r] H.S. Krehm, Service des programmes de recherche, Direction de la recherche, ministère de l'Agriculture du Canada, Ottawa, (Ontario) K1A 0C6.

Les manuscrits doivent être concis et faire preuve de suite dans le style, l'orthographe et l'emploi des abréviations. Ils doivent être dactylographiés à double interligne, de préférence sur des feuilles à lignes numérotées. Toutes les pages doivent être numérotées y compris celles portant le résumé, les tableaux et les légendes. Pour plus de renseignements sur le format des feuilles et le style, prière de consulter nos dernières publications et le *CBE Style Manual* (3e ed. 1972) de l'American Institute of Biological Sciences, Washington (DC). Dans la mesure du possible, les données numériques doivent être exprimées en unités métriques, (SI) ou être suivies de leur équivalent métrique. L'emploi de crochets est autorisé pour l'identification du nom scientifique d'un micro-organisme pathogène après le nom commun de la maladie dont il est l'agent causal.

Les titres doivent être courts et révélateurs en contenant, avec le résumé, les mots clés les plus utiles pour le classement et l'extraction de l'information.

Chaque article doit être accompagné d'un *résumé* d'au plus 200 mots en anglais et en français, si possible.

Les figures doivent pouvoir, après réduction, remplir une colonne (maximum 84 × 241 mm) ou deux colonnes (maximum 175 × 241 mm) et devraient être taillées ou montrer les parties essentielles à garder. Les figures groupées sur une même planche doivent être montées côte à côte, sans intervalle. L'article doit être accompagné d'un double des photographies non montées et des graphiques. Les figures doivent être numérotées, porter le nom de l'auteur et une légende abrégée.

Les tableaux doivent être numérotés en chiffres arabes et avoir un titre concis. Ils ne devraient pas avoir de lignes verticales. Les renvois doivent être identifiés par un signe typographique particulier (* † § # ¶ ** ††) surtout lorsqu'il s'agit de nombres.

Les références bibliographiques devraient être citées par ordre alphabétique comme dans les livraisons courantes. On peut utiliser le système de numération ou le système nom-et-année. Pour l'abrégé du titre des périodiques, on suivra l'édition la plus récente de *Biosis List of Serials* publiée par les Biosciences Information Services de Biological Abstracts ou la *NCPTWA Word Abbreviation List* et l'American National Standards Institute, Standards Committee Z39.