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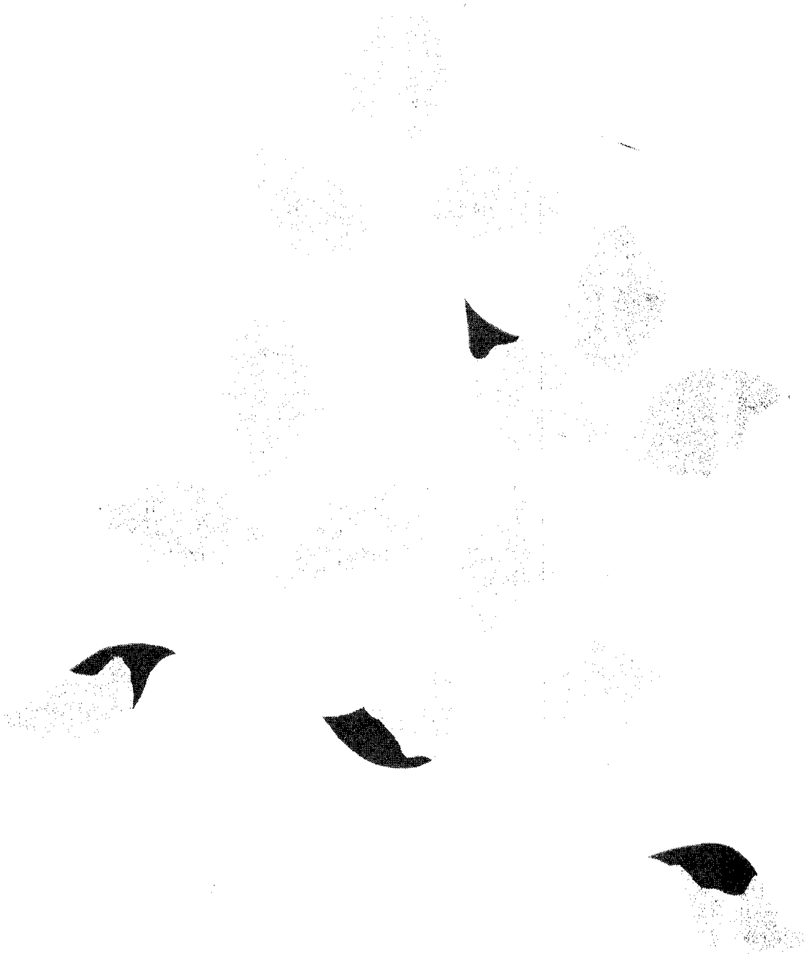

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The *Canadian Plant Disease Survey* is a periodical of information and record on the occurrence and severity of plant diseases in Canada and on the assessment of losses from disease. Other original information such as the development of methods of 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

Included in this issue of Canadian Plant Disease Survey is a compilation of the results of plant disease surveys in Canada for the 1987 crop year, with occasional reports for previous years. The compilation and consequent publication of these survey reports is a project recently undertaken by the Canadian Phytopathological Society and the Research Program Service, Research Branch, Agriculture Canada. The Society recognized the need for publication of plant disease surveys, which all-too-often were not prepared for publication, because it firmly believes that survey results are of value to federal and provincial agencies in planning appropriate research for the control of plant diseases. Moreover, such surveys are of intrinsic value to the literature of plant pathology in Canada. This first annual publication was authorized by the Society in 1987 and R.I. Hamilton was asked to coordinate the project. Succeeding editions are planned for the years ahead.

The publication of these reports is dependent upon the voluntary contributions of many Canadian plant pathologists (federal, provincial, university and private practitioners) and their collation by experts familiar with the diseases of the major crop categories. The list of collators is appended. It is planned to increase the scope of the surveys to include those of diseases of forage grasses and grapes in forthcoming issues of the Canadian Plant Disease Survey.

We wish to thank all the contributors and collators who have devoted a great amount of their time to the production of this first annual publication of disease survey results sponsored by the Canadian Phytopathological Society and Agriculture Canada.

R.I. Hamilton
Coordinator

H. Krehm and P. Beauchamp
Compilers

AVANT-PROPOS

Ce numéro de l'Inventaire des maladies des plantes au Canada est une compilation des résultats d'études menées sur les maladies des plantes de la récolte de 1987 au Canada. Il y est aussi quelquefois question des rapports des années antérieures. La Société canadienne de phytopathologie et le Service aux programmes de recherches, Direction générale de la recherche, Agriculture Canada sont convenus récemment de travailler de concert pour la compilation et la publication de ces rapports. La Société estime qu'il existe un besoin pour ce type d'information, car dans la plupart des cas les résultats des rapports sur les maladies des plantes ne sont pas publiés. Elle juge que ces résultats sont utiles pour les 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. La Société a autorisé la première publication annuelle en 1987 et a demandé à R.I. Hamilton de coordonner le projet. Elle prévoit publier d'autres éditions dans les années à venir.

La publication de ces rapports est le fruit de la contribution bénévole de nombreux phytopathologistes canadiens (des administrations fédérales et provinciales, des universités et du secteur privé) et de leur compilation par des spécialistes des maladies des grandes cultures. La liste de ces personnes se trouve ci-jointe. Nous avons l'intention de publier dans les prochains numéros de l'Inventaire des maladies des plantes du Canada les résultats des rapports sur les maladies des graminées de fourrage et des raisins.

Nous remercions toutes les personnes qui ont consacré de nombreuses heures à la compilation des résultats des rapports sur les maladies des plantes. La Société phytopathologique canadienne et Agriculture Canada, qui parrainent le projet, désirent en faire l'objet d'un numéro annuel.

R.I. Hamilton,
Coordonnateur

H. Krehm et P. Beauchamp
Compilateurs

Change in the *Rhizoctonia solani* index on the stems and stolons of four potato cultivars during the growing season

R.C. Zimmer[1]

A survey, for the incidence of *Rhizoctonia solani* infection of stems and stolons, was taken on 12 commercial potato fields from June to August in 1982. In general the number of stems decreased during the survey period, while the Rhizoctonia Index (R.I.) increased markedly from June to July and levelled off from July to August. The levelling off of the R.I. on the stems may have been influenced by the amount of girdling and pruning. Although stolon pruning increased from July to August the number of stolons and tubers also increased.

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Douze champs de pommes de terre commerciaux ont été examinés entre juin et août 1982 afin d'établir la fréquence d'infection des tiges et des stolons par *Rhizoctonia solani*. En général, le nombre de tiges a diminué au cours de la durée de l'enquête, tandis que l'indice d'infection par *Rhizoctonia* a augmenté de façon notable de juin à juillet et s'est stabilisé de juillet à août. La stabilisation de l'indice d'infection des tiges par *Rhizoctonia* pourrait être attribuable à l'ampleur de l'émondage et à la quantité d'incisions annulaires. Même si l'émondage des stolons a pris de l'ampleur de juillet à août, le nombre de stolons et de tubercules a également augmenté.

Introduction

Numerous field studies have been carried out on various aspects of Rhizoctonia disease of potatoes. Recent investigations indicate that stem canker originates early in the development of the shoots and once the shoots have emerged the stems become less susceptible (6), whereas stolons become increasingly susceptible throughout growth (2). Other research has shown that stem canker as well as stolon infection increased between successive samplings during July and September (4). Hide *et al.* (5) showed that only severe infection by *Rhizoctonia solani* Kühn. decreased the number of main stems per plant in cv. Majestic, however, disease assessments were not made over a period of time during the growing season. Hide and Bell (3) found that shoot emergence and stem population were not usually affected, although in one experiment, inoculating with *R. solani* decreased numbers of stems/plant at one location but not at another.

To determine the incidence of *R. solani* infection of stems and stolons at different growth stages on four potato cultivars, a survey of twelve commercial potato fields in Manitoba was made in 1982 during the period, June to August.

Methods

Twelve fields of two large potato producers in southern Manitoba, comprising four cultivars, were selected for survey in 1982. The fields were assessed on June 4, July 14 and August 12. Twenty plants were collected from each field on each date by selecting five consecutive plants from each of four widely spaced locations. The degree of *R. solani* infection on stems (Table 1) and stolons (Table 2) included the number of healthy stems or stolons and the stems or stolons cankered, girdled or pruned. A Rhizoctonia Index (R.I.) was calculated using the formula (1):

$$\text{R.I.} = \frac{\Sigma(\text{Class}^2 \times \text{number of stems or stolons per infection class})}{\text{Total number of stems or stolons}}$$

Since stolon development was not far enough advanced by June 4, assessments of stolons were made only on July 14 and August 12. Because production practices varied amongst fields no attempt was made to make statistical comparisons of cultivars.

Results and discussion

In general, the results of this survey indicate that the number of stems decreased during the period June to August across all cultivars, while the R.I. increased markedly from June to July and then levelled off from July to August. The levelling off of the R.I. from July to August may have been influenced by the amount of girdling and pruning of stems. The amount of girdling and pruning remained level in Russet Burbank and Pontiac and decreased in Norland and Norchip.

It may be that the increase in R.I. from June to July caused some reduction of stem numbers. It also may be that other factors affected stem production. Toosey (7) reported that spacing between plants should be taken into account in attempting to explain numbers of main stems that develop. In this study plant spacing did not seem to be important as it varied amongst cultivars and a decrease in stem number occurred for all cultivars.

Although stolon pruning had increased from July to August in all cultivars the number of stolons and tubers also had increased except for Norland. In cultivars Norland and Pontiac stolon production appeared to correlate somewhat with change in the R.I., whereas in Norchip and Russet Burbank as R.I. increased stolon numbers increased. Because of the diversity of production practices such as crop rotation, fungicide treatment of mother tubers, row spacing, date of seeding, and fertilizer and herbicide application by the producers in this survey, comparison of cultivars is difficult. Similar trends occurred on plants from similar mother tubers planted in 1982 in plots at the Morden Research Station in which potatoes had not previously been grown.

[1] *Agriculture Canada, Research Station, Morden, Manitoba, R0G 1J0.*
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Table 1. Mean index of *Rhizoctonia solani* infection (± SEM) on stems of potato cultivars under commercial production in southern Manitoba in 1982[1].

	Rhizoctonia Index			Total No. of Stems /Mother Tuber		
Cultivar	June	July	August[2]	June	July	August
Norland	1.9±0.1	3.5±0.8	3.8±0.4	6.4	6.0	4.5
Norchip	1.7±0.2	3.3±1.1	3.2±0.6	4.7	3.7	3.9
Russet Burbank	1.7±0.8	4.2±1.1	3.8±1.2	4.7	4.3	4.0
Pontiac	1.7±0.4	2.6±1.4	2.3±0.9	5.2	3.8	3.7

[1] Number of plants sampled per cultivar: Norland - 80, Norchip - 80, Russet Burbank - 40, Pontiac - 40

[2] Sampling dates: June 4, July 14, August 12

Table 2. Mean index of *Rhizoctonia solani* infection (± SEM) on stolons of four potato cultivars under commercial production in southern Manitoba in 1982[1].

	Rhizoctonia Index		Total No. of Stolons /Mother Tuber	
Cultivar	July	August	July	August
Norland	3.3±0.8	4.8±0.6	35.6	33.9
Norchip	2.0±0.1	2.8±0.2	14.6	20.6
Russet Burbank	3.4±0.1	3.8±0.4	10.2	28.7
Pontiac	5.2±0.1	4.2±0.3	23.4	25.5

[1] Number of plants sampled per cultivar: Norland - 80, Norchip - 80, Russet Burbank - 40, Pontiac - 40

[2] Sampling dates: July 14, August 12

Acknowledgement

The author thanks the students of the Summer Youth Job Corps Program for their assistance in collecting the data.

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Development of *Rhizoctonia solani* on four fungicide-treated potato cultivars grown in virgin potato soil

R.C. Zimmer[1]

None of the fungicides consistently reduced the Rhizoctonia index (R.I.) or altered the number of stems produced over the growing season. Regardless of seed source, cultivar or fungicide treatment of the mother tubers, the number of stems per mother tuber decreased from late June to early August. The R.I. remained relatively constant over the growing season. The incidence of sclerotial infection on harvested tubers generally was reduced by fungicide treatment of the mother tubers. The incidence of sclerotial infection appeared to decrease during the storage period on daughter tubers from untreated mother tubers but not on daughter tubers from fungicide-treated mother tubers.

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Aucun des fongicides utilisés n'a réduit de façon constante l'indice d'infection par *Rhizoctonia* ni modifié le nombre de tiges produites pendant la saison de croissance. Sans égard à la source de semences, au cultivar ou au traitement fongicide des tubercules-mères, le nombre de tiges par tubercule-mère a fléchi de la fin de juin au début d'août. L'indice d'infection par *Rhizoctonia* est demeuré relativement constant pendant la saison de croissance. Le traitement fongicide des tubercules-mères a entraîné en général une diminution de la fréquence de l'infection par les sclérotes chez les tubercules récoltés. La fréquence d'infection par les sclérotes a semblé diminuer pendant l'entreposage chez les tubercules-filles issus de tubercules-mères non traités mais non chez les tubercules-filles provenant de tubercules-mères traités avec le fongicide.

Introduction

Numerous studies exist on the effect of *Rhizoctonia solani* Kühn on potato production (1-7, 9-12, 14, 15). Much of the research covers the effect of fungicide treatment of mother tubers on: emergence, stem canker, stolon canker, tuber size, yield, and sclerotia on tubers. The data generally have been collected once only and do not reflect changes occurring during the growing season.

The data presented in this report are from a test conducted in 1982 in which fungicide-treated tubers with sclerotia of *R. solani* were planted in soil, at the Morden Research Station, in which potatoes apparently had never been grown. Information on several canker severity categories were gathered on stems and stolons twice before harvest; sclerotial incidence on tubers in storage was monitored over time.

Materials and methods

Tubers of cultivars Norchip, Norland, Russet Burbank and Pontiac were obtained from two producers whose commercial fields were surveyed in 1982 for Rhizoctonia development (16). Some of the tubers had already been treated by the producers with one of the following fungicides: captan (Orthocide), thiophanate-methyl (Easout), mancozeb (Dithane M-45), or metiram (Polyram 7). Untreated tubers of the above cultivars were obtained from the same producers and treated with either benomyl (Benlate) or thiabendazole (Mertect), or included as the untreated control treatment. Each treatment, a single row approximately 10 m in length, was replicated four times. Data, collected June 28 and August 10, 1982, included the number of healthy stems and stolons, and stems and stolons cankered, girdled or pruned. A Rhizoctonia Index (R.I.) was calculated (Table 1) using the formula (4):

$$\text{R.I.} = \frac{\Sigma(\text{Class}^2 \times \text{number of stems or stolons per infection class})}{\text{Total number of stems or stolons}}$$

The tubers were harvested September 9, graded and placed into storage at 4-10°C. On October 15, 1982, February 1, 1983 and April 26, 1983, 20 tubers from the 5.7 - 8.9 cm (2.5 - 3.5 in.) size category were selected from each treatment and assessed for presence of sclerotia (Table 2).

Results and discussion

Stems. Regardless of producer, cultivar or mother tuber treatment, the number of stems per mother tuber decreased from late June to early August. In general, fungicide treatment June 28 seemed to cause an increase in the number of stems. By August 10, the beneficial effect of fungicides on stem production was apparent for both mancozeb and captan in Norchip and for metiram in Norland; however, a rather large drop in stem production occurred with captan in Norland and Russet Burbank. Hide and Cayley (8) found that between July and September the number of stems per plant decreased on plants from seed treated with 2% thiabendazole; as was apparent in this study.

Fungicide × cultivar interactions appeared to occur. In Norland, both June 28 and August 10, stem production from thiabendazole-treated mother tubers was similar or better than from the untreated controls, while, in Russet Burbank it was reduced considerably both dates. Captan increased stem production both dates in Norchip, reduced it both dates in Russet Burbank and in Norland increased it in June and decreased it in August. There appeared to be no correlation between stem number and Rhizoctonia Index. In many instances as the stem number dropped between assessments the Rhizoctonia Index also dropped.

[1] *Agriculture Canada, Research Station, Morden, Manitoba, ROG IJO.*

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Table 1. Stem and stolon production, and Rhizoctonia Index on four cultivars planted in virgin soil with fungicide-treated tubers[1].

Cultivar	Seed Source	Mother Tuber Treatment	No. Stems/ Mother Tuber June	No. Stems/ Mother Tuber August	No. Stolons/ Mother Tuber August	Rhizoctonia[2] Index Stems June	Rhizoctonia[2] Index Stems August	Rhizoctonia[2] Index Stolons August
Norchip	A	Untreated	6.1	3.2	15.6	4.0	3.2	3.5
		Mancozeb	7.3	4.4	28.4	2.2	4.5	2.9
	B	Untreated	5.8	3.3	27.5	2.1	1.9	1.8
		Captan	6.2	4.2	31.2	2.4	2.2	2.6
Norland	A	Untreated	4.6	3.7	15.7	3.8	3.2	2.9
		Thiabendazole	5.5	3.7	26.8	3.9	3.5	2.8
		Metiram	6.6	4.3	30.4	3.2	2.3	2.5
		Captan	6.1	2.4	18.0	2.7	2.8	1.9
		Benomyl	5.5	4.1	24.3	3.6	4.9	2.7
	B	Untreated	5.9	3.7	22.5	2.4	3.2	2.9
Russet Burbank	A	Untreated	6.0	4.3	27.6	4.2	4.2	2.9
		Thiabendazole	3.6	1.9	11.3	4.8	3.1	2.9
		Captan	4.5	2.6	18.7	2.5	2.7	1.8
		Benomyl	5.7	3.0	20.1	4.4	2.3	1.9
Pontiac	B	Untreated	5.4	3.6	27.7	2.8	2.7	2.3
		Thiophanate -methyl	5.7	2.6	14.8	3.3	2.7	1.6

[1] The data are the means of 40 plants

[2] $\text{Rhizoctonia Index} = \frac{\Sigma\ (\text{Class}^2 \times \text{number of stems or stolons per infection class})}{\text{Total number of stems or stolons}}$

[3] Sampling dates - June 28 and August 10, 1982

Stolons. Fungicide treatment of mother tubers decreased the number of stolons produced by Russet Burbank and Pontiac. Captan enhanced stolon production only slightly in Norland compared to thiabendazole, metiram and benomyl.

A cultivar × fungicide interaction appeared to occur. Benomyl and thiabendazole enhanced stolon production in Norland, but suppressed it in Russet Burbank; captan enhanced it only slightly in Norland and also suppressed it in Russet Burbank. As with the stems there was no definite correlation between the Rhizoctonia Index and the number of stolons produced. Stolon production also appeared to be affected by the tuber source. Stolon production from untreated mother tubers in Norchip and Norland was higher for Producer B in both instances. A factor, such as seed size, may have caused such an effect.

Post harvest development of sclerotia on tubers. Observation of the harvested daughter tubers on October 15, 1982, showed that sclerotial incidence generally was reduced by fungicide treatment of the mother tubers before planting, in cultivars Norchip, Russet Burbank and Pontiac. Sclerotial incidence in Norchip was reduced 35% by mancozeb and 25% by captan; in Russet Burbank it was reduced 20% by captan and 30% by benomyl; in Pontiac sclerotial incidence was reduced 30% over the untreated controls by thiophanate-methyl. In the cultivar Norland none of the fungicides reduced sclerotial incidence except thiabendazole.

In some instances a cultivar × fungicide interaction appeared to occur. Thiabendazole reduced sclerotial incidence 40% in Norland, but in Russet Burbank sclerotial incidence was 40% greater than for the untreated control. With benomyl there was no reduction in sclerotial incidence in Norland but in Russet Burbank it was reduced 30%. Captan reduced sclerotial incidence in all cultivars treated, but little reduction occurred in Norland. The variability of the results may have been due in part to fungicide application to the mother tubers; the treated tubers were obtained from three separate sources. Sclerotial incidence on the mother tubers planted ranged from 73 - 93%, but coverage was light.

Table 2. Incidence and change of sclerotial infection on harvested tubers.

Seed Source	Cultivar	Seed Tuber Treatment	% Tubers with Sclerotia[1,2]		
			Oct. 15, 1982	Feb. 1, 1983	April 26, 1983
A	Norchip	Untreated	60	40	35
		Mancozeb	25	25	35
B		Untreated	65	55	40
		Captan	40	60	40
A	Norland	Untreated	70	30	20
		Thiabendazole	30	25	25
		Metiram	70	60	60
		Captan	60	50	55
		Benomyl	75	80	70
B		Untreated	75	60	45
A	Russet Burbank	Untreated	45	50	55
		Thiabendazole	85	80	80
		Captan	25	40	30
		Benomyl	15	20	10
B	Pontiac	Untreated	90	80	65
		Thiophanate-methyl	60	65	40

[1] Twenty tubers were assessed per treatment per date.
[2] Tubers were stored in a potato storage at 4 - 10°C at the Morden Research Station.

A surprising effect on the incidence of tubers with sclerotia appeared to occur in storage. Sclerotial incidence on daughter tubers from 'untreated' mother tubers decreased over time for all cultivars except Russet Burbank. The sclerotial incidence on tubers from fungicide-treated mother tubers tended to remain relatively constant over the storage period. Again a cultivar × fungicide interaction appeared to occur. In Norland sclerotial incidence was low for thiabendazole relative to the other treatments while in Russet Burbank it was high for thiabendazole and low for captan and benomyl.

Acknowledgement

The author thanks the students of the Summer Youth Job Corps Program for their assistance in collecting the plot data and Mr. Ike Wolfe for collecting storage data.

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White mold of dry bean (*Phaseolus vulgaris* L.) in southern Alberta, 1983-87

H.C. Huang, M.J. Kokko and L.M. Phillippe[1]

Surveys in 1983-1987 revealed that white mold caused by *Sclerotinia sclerotiorum* (Lib.) de Bary is a serious disease of dry beans (*Phaseolus vulgaris* L.) in southern Alberta. The disease was found in 13 of the 17 fields surveyed in 1983, in all the 21, 31, and 33 fields surveyed in 1984, 1985, and 1986, respectively, and in 24 of the 25 fields surveyed in 1987. The percentage of infected plants in each field varied from 0 to 90%. The disease was distributed throughout the entire dry bean growing region of southern Alberta, but was most concentrated in the area between Grassy Lake and Bow Island.

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Selon des enquêtes menées entre 1983 et 1987, la pourriture sclérotique causée par *Sclerotinia sclerotiorum* (Lib.) de Bary est une grave maladie du haricot sec (*Phaseolus vulgaris* L.) dans le sud de l'Alberta. La présence de la maladie était visible dans 13 des 17 champs inspectés en 1983, dans la totalité des 21, 31 et 33 champs examinés en 1984, 1985 et 1986 respectivement et dans 24 des 25 champs inspectés en 1987. Le pourcentage de plants infectés dans chaque champ variait entre 0 et 90%. La maladie était répandue dans toute la région de culture du haricot sec du sud de l'Alberta mais était plus fréquente dans la région située entre Grassy Lake et Bow Island.

Introduction

Dry beans (*Phaseolus vulgaris* L.) are one of the important irrigated specialty crops in southern Alberta. Production is concentrated in an area south of the Bow and South Saskatchewan Rivers and the acreage was 970 ha in 1974, 3440 ha in 1981, 4980 ha in 1986, and 8300 ha in 1987 (B. Roth, personal communication). Both white and colored beans are grown including cultivars of Red Mexican, Pink, Pinto, Great Northern, and navy beans.

White mold caused by *Sclerotinia sclerotiorum* (Lib.) de Bary is the most important disease of dry beans in southern Alberta. A survey carried out in 1982 showed that the average incidence of white mold in bean fields was 29.2% (Howard and Huang 1983). The disease is incited by infection from airborne ascospores released from the apothecia produced on sclerotia in the soil (Abawi and Grogan 1975, Cooke *et al.* 1975). Secondary spread of the disease is due to direct contact between diseased and healthy tissue (Abawi and Grogan 1979). Infected plants develop pale white or tan-colored lesions on leaves, petioles, stems, and/or pods, sometimes with white mycelial mats or black sclerotia on the infected tissue. Severe infection often results in the premature death of plants.

This paper reports the results of a 5-year survey on the distribution and incidence of white mold of dry beans in southern Alberta.

Materials and methods

Surveys of dry bean fields for white mold were carried out in southern Alberta during early to mid-September 1983-1987. Prior to the survey in 1983 the field production supervisor of the Alberta Wheat Pool Bean Plant, Bow Island, Alberta, was consulted for information on the bean production area and the distribution of bean fields in Alberta. Fields were randomly selected from the entire bean production area and were surveyed for incidence of white mold. 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 (Howard and Huang 1983). The number of plants with white mold symptoms and the total number of plants in each site were recorded. The disease incidence in each field was calculated based on average percent of infected plants from the 10 sites. The disease incidence was divided into six categories based on percent of infected plants in each field: (1) no disease, (2) trace (<1%), (3) light (1-10%), (4) moderate (11-25%), (5) severe (26-50%), (6) very severe (>50%).

Results

White mold was found in 13 of 17 bean fields surveyed in southern Alberta in 1983, in all 21, 31 and 33 fields surveyed in 1984, 1985 and 1986, respectively, and in 24 of the 25 fields surveyed in 1987 (Table 1). The frequency of the surveyed fields with moderate to very severe disease was 29, 62, 52, 45 and 44% for 1983, 1984, 1985, 1986 and 1987, respectively. The disease occurred on cultivars of Red Mexican, Pink, Great Northern, and Pinto. Disease incidence varied among years and fields, 0.7-19% (avg. 9%) of infected plants in 1983, 1-73% (avg. 23%) in 1984, 0.2-80% (avg. 19%) in 1985, 0.2-90% (avg. 17%) in 1986, and 0.2-64% (avg. 18%) in 1987. Despite the difference in disease incidence among fields, it appears that all these cultivars were susceptible to white mold.

The disease was distributed throughout the entire bean production area in southern Alberta (Fig. 1). The highest concentration of diseased fields was in the area south of Grassy Lake and Bow Island (Fig. 2). In this area, more than 35% of the fields surveyed had a disease incidence ranging from moderate, 11 to 25% of infected plants, to very severe, more than 50% of infected plants in the field. Although the disease was

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Table 1. White mold of dry bean (*Phaseolus vulgaris* L.) in southern Alberta (1983-1987)

	1983				1984				1985			
	No. fields		% infected plants		No. fields		% infected plants		No. fields		% infected plants	
Cultivar	Surv.	Dis.	Range	Avg.	Surv.	Dis.	Range	Avg.	Surv.	Dis.	Range	Avg.
Red Mexican	7	4	0.8-17	8	12	12	2-73	21	13	13	0.2-45	14
Pink	5	4	0.7-13	7	4	4	7-59	36	7	7	0.3-80	32
Great Northern	5	5	4-19	11	4	4	1-27	10	3	3	24-62	38
Pinto	—	—	—	—	1	1	46	46	8	8	0.6-36	9

	1986				1987			
	No. fields		% infected plants		No. fields		% infected plants	
	Surv.	Dis.	Range	Avg.	Surv.	Dis.	Range	Avg.
Red Mexican	12	12	0.2-66	17	10	10	3-64	18
Pink	9	9	1-37	12	5	4	2.5-55	23
Great Northern	9	9	1-90	23	6	6	0.4-54	24
Pinto	3	3	1-28	14	4	4	0.2-7	3

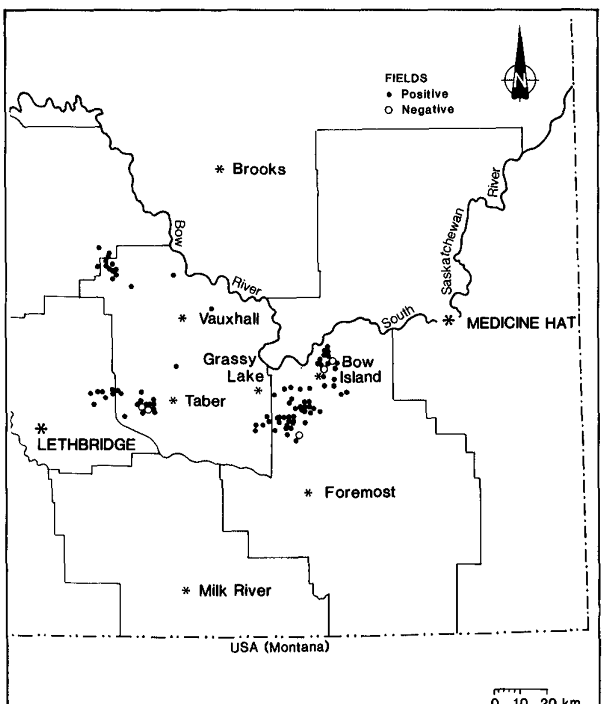

Figure 1. Distribution of white mold of dry bean fields surveyed in southern Alberta (1983-1987). ● - fields with the disease; o - fields without the disease.

found in most of the surveyed fields west of Taber and northwest of Vauxhall (Fig. 1), the disease incidence in these areas was generally lighter than in the Grassy Lake - Bow Island area (Fig. 2).

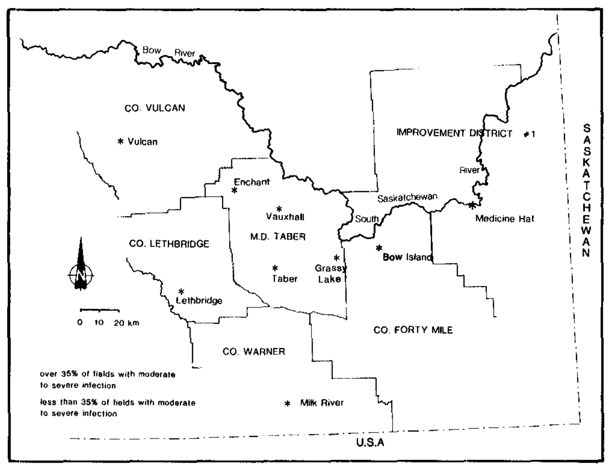

Figure 2. Severity of white mold of dry bean in southern Alberta in 1983-87. Note the disease in the area between Grassy Lake and Bow Island area was more severe than in the areas west of Taber and northwest of Vauxhall.

Discussion

The results of the survey in 1983-1987 indicate that white mold is a serious disease of field beans in southern Alberta. The disease is not only widespread but also severe in many of the bean fields. The most devastated area is from Grassy Lake to Bow Island. The widespread nature of the disease in this area may be related to heavy concentrations of dry beans and other host crops such as canola, sunflowers, field peas, and lentils.

Irrigation is a major factor in the development and severity of white mold of dry beans in southern Alberta. Hunter *et al.* (1984) reported that in New York State, an outbreak of white mold on snapbeans in a *S. sclerotiorum*-infested field is likely to occur whenever the average soil matric potential (Ψ_m) is equal to or greater than -30 kPa for 1- to 2-week periods just prior to or during bloom. Le Tourneau (1979) reported that sclerotia of *S. sclerotiorum* germinated carpogenically when cool, moist conditions existed for several weeks. Irrigation of bean fields in southern Alberta provided soil moisture conditions conducive to the production of apothecia and release of ascospores from sclerotia of *S. sclerotiorum*. This allowed white mold to become serious on irrigated crops such as dry beans in southern Alberta in 1984 and 1985 despite a serious drought in the region in those two years.

Acknowledgements

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Survey for snow mold diseases of winter cereals in central and northern Alberta, 1983-87

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A survey for the incidence and distribution of snow molds on winter cereals in central and northern Alberta and northeastern British Columbia was conducted in early spring from 1983-87. The non-sclerotial form of cottony snow mold (*Coprinus psychromorbidus*) (LTB) was the most prevalent snow mold fungus and was responsible for severe reductions in winter survival of winter cereals, particularly in the south and north Peace River District of Alberta. The sclerotial form of *C. psychromorbidus* (SLTB) was infrequently recovered from diseased plants, but was commonly observed on decaying leaves of deciduous trees in the Peace River District. Snow scald (*Sclerotinia borealis*) and pink snow mold (*Gerlachia nivalis*) were also infrequent. *Plenodomus meliloti* and *Pythium* spp. were commonly isolated from diseased plants but the role of these fungi in reducing survival of winter cereals is unclear.

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Au début du printemps de 1983 à 1987, on a enquêté sur la fréquence et la distribution des moisissures des neiges qui affectent les céréales d'hiver dans le centre et le nord de l'Alberta, et dans le nord-est de la Colombie-Britannique. La forme non sclérotique de la moisissure cotonneuse des neiges (*Coprinus psychromorbidus*) (LTB) était le champignon le plus courant auquel on attribuait une grave diminution de la survie hivernale des céréales d'hiver, en particulier dans le sud et le nord du district de la Rivière-de-la-Paix en Alberta. On trouvait très rarement des sclérotes de *C. psychromorbidus* (SLTB) chez les plantes atteintes, mais on en trouvait souvent sur les feuilles en décomposition des arbres décidus dans le district de la Rivière-de-la-Paix. La brûlure des neiges (*Sclerotinia borealis*) et la moisissure rose des neiges (*Gerlachia nivalis*) étaient également peu fréquentes. Il était courant d'isoler *Plenodomus meliloti* et *Pythium* spp. des plantes atteintes mais le rôle joué par ces champignons dans la diminution de la survie des céréales d'hiver n'est pas défini.

Introduction

Current winter cereal varieties possess sufficient freezing resistance to survive in the Parkland regions of central and northern Alberta provided that the snow cover is sufficient to insulate the crop against low ambient temperatures. However, there are fewer than 10,000 ha seeded to winter cereals in these regions, annually. Lack of adequate snow cover is responsible for soil temperatures below -15°C at the crown level in less than one year out of ten (12); however, sublethal temperatures between -10 and -15°C were recorded in 28-45% of the winters examined. Exposure of winter cereals to these temperatures for prolonged periods will reduce survival and yields (13). Conversely, if a deep snow cover arrives early or persists in the spring, a frequent event in central and northern Alberta, snow mold caused by psychrophyllic fungi can virtually eliminate the winter cereal crop. Poor winter survival necessitates re-seeding to spring cereals.

A number of different snow mold diseases have been reported on winter cereals in the northwestern United States and western Canada (2, 3, 11, 15). They include cottony snow mold caused by the non-sclerotial (LTB) and sclerotial (SLTB) forms of *Coprinus psychromorbidus* Redhead and Traquair (15, 16), snow scald caused by *Sclerotinia borealis* Bub. and Vleug., pink snow mold caused by *Gerlachia nivalis* (Ces. ex Sacc.) W. Gams and E. Muller, grey snow mold caused by *Typhula incarnata* Lasch ex. Fr., and speckled snow mold caused by *T. ishikariensis* Imai var. *ishikariensis*, *T. ishikariensis* var. *idahoensis* Arsvoll and Smith, and *T. ishikariensis* var. *canadensis* Smith and Arsvoll (15). Other psychrophillic fungi associated with winter injury in grasses and legumes in North America are *Acremonium boreale* Smith and Davidson, *Plenodomus meliloti* Dearn. and Sanford (14) and *Pythium iwayamai* Ito (10).

The only practical control for snow molds is through the development of resistant crop varieties. A survey of winter cereal fields in central and northern Alberta was conducted in early spring from 1983-87 to determine the incidence and distribution of snow molds associated with winter injury in winter wheat and fall rye. The results of this survey will serve as a basis for initiating a breeding program to develop winter wheat and fall rye varieties resistant to snow molds.

Materials and methods

A survey to establish the incidence and distribution of snow mold fungi in winter wheat and fall rye fields was conducted in April from 1983-87. The province was subdivided into three regions, central, southern Peace River, and northern Peace River (Fig. 1). The southern Peace River region included the northeastern portion of the British Columbia Peace River District. Because of the paucity of winter cereal fields in the survey area, district agriculturalists and regional crop specialists were asked to identify fields within their region.

Fields were surveyed by walking along one edge and to the centre of each field. Plants exhibiting chlorosis, discoloration, or signs of fungal activity were sampled. Leaf, stem, crown, and root sections were excised, surface-sterilized in 0.05% sodium hypochlorite for 3 minutes, plated on acidified Potato

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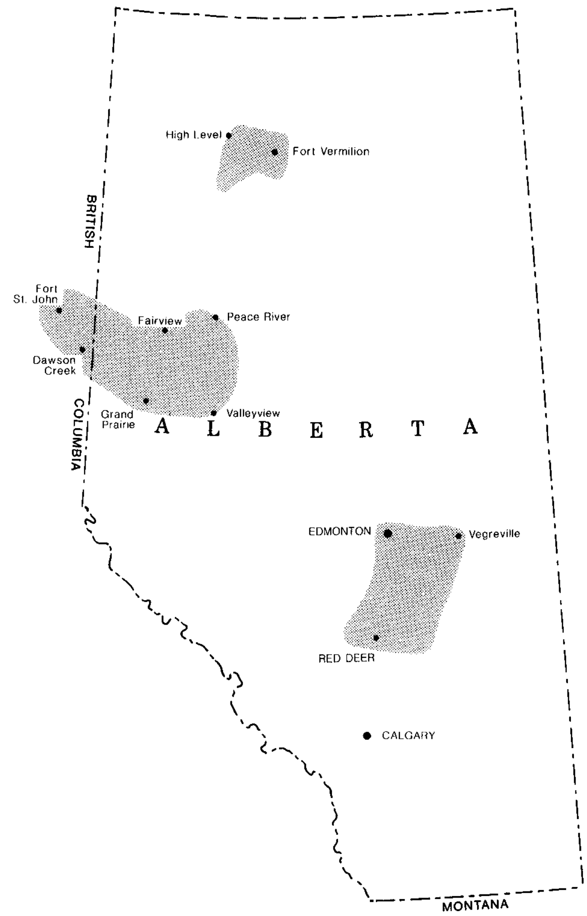

Figure 1. Map of Alberta showing the areas in central Alberta, southern and northern Peace River Districts surveyed for snow mold diseases of winter cereals.

Dextrose Agar (+HPDA) or acidified Corn Meal Yeast Extract Agar (+HCMMY), and incubated at 0.5°C for 4 weeks. The identity of fungi was confirmed by microscopic examination, or by the presence of characteristic structures such as sclerotia or protopycnidia on affected plant parts.

Results and discussion

The majority of the winter wheat or fall rye fields surveyed were seeded into fallow or worked forage fields. The practice of underseeding winter cereals by simultaneously planting it with barley, wheat, or canola in the spring, harvesting the spring crop in the late summer, and harvesting the winter wheat the following crop year, was common in the latter years of the survey. Fields in which winter wheat was seeded into standing stubble were infrequently encountered.

The non-sclerotial form of *C. psychromorbidus*, the low temperature basidiomycete (LTB), was the most prevalent snow mold encountered in isolations from diseased winter wheat seeded into fallow fields (Table 1). It was observed in all three regions but was most prevalent in the Peace River Districts. The disease was often characterized by a white cottony mycelium which covered the leaves after snow melt (Fig. 2). When the outer leaf sheaths were removed from the plant, white plaques were often visible along the length of the stem (Fig. 3). When the disease was especially severe, crowns disintegrated and plants were easily pulled from the soil without attached roots. In a winter wheat field east of High Level, circular white mycelial mats were scattered over the soil surface (Fig. 4); similar mats have been observed in the same region on red fescue (*Festuca rubra* L.). Smaller, denser mats were observed in winter wheat and fallow fields, and appeared independent of the presence of plant material. In light infestations, the cottony mycelium was visible on small groups of plants scattered throughout the field, whereas in severe infestations, the groups coalesced and the disease became generalized throughout the field. Circular patches of infected plants were sometimes visible. The disease was usually most severe in those areas where snow accumulated near windrows of trees, or where the snow became compacted such as under tire tracks.

The cottony mycelium was not always present on diseased plants; isolations on artificial media were necessary to confirm the presence of the LTB fungus. Occasionally, plants that appeared green and healthy soon after snow melt subsequently turned yellow and died. LTB was the predominant fungus isolated from the stems and crowns of these plants.

Cottony snow mold infection appeared closely associated with mortality of the plants sampled during the survey. This disease was especially destructive in the Peace River Districts where 30-50% of the winter wheat fields surveyed were subsequently ploughed under. Fall rye appeared to be more resistant to cottony snow mold infection than winter wheat, but plant mortality exceeding 50% was observed. The disease was common in fields which had been continuously cropped to spring cereals and oilseeds; however, a field which had recently been cleared of trees and had no history of crop production also had damaging levels of cottony snow mold in the fall rye crop. The LTB fungus was observed on annual, biennial, and perennial weeds and grasses (Fig. 5), and on canola, wheat, and grass stubble. Cormack (3, 4) demonstrated that numerous weed, ornamental, and native plant species were susceptible to the cottony snow mold fungus. The prevalence of LTB in surveyed fields which had never been cropped to winter cereals or forages may be due to its wide host range. Consequently, control of this disease through rotation to a spring crop may not be effective.

The presence of the cottony mycelium was not characteristic of winter cereal plants infected with the SLTB form of *C. psychromorbidus*. Symptoms of SLTB infection consisted of yellow or brown discoloration of the crown, and the presence of small dark spherical or elongate sclerotia embedded in leaf sheath and crown tissues (Fig. 6).

The SLTB fungus was infrequently recovered from diseased plants and it caused slight mortality in winter cereals in central Alberta (Table 1). In the Peace River Districts, SLTB sclerotia were commonly observed on decaying leaves (Fig. 7) of deciduous trees sampled from fields, seeded to winter wheat or left fallow, and on lawn grasses; subsequent isolations confirmed the presence of the SLTB form. However, SLTB was isolated only once from diseased winter cereals (Table 1) in the Peace River Districts.

Table 1. Summary of survey results for snow molds on winter wheat and fall rye during April, 1983-87.

Region	No. fields surveyed	Number of fields with LTB	SLTB	*S. borealis*	*Plenodomus meliloti*	*Pythium* spp.
1983						
Central Alberta	2	0	0	0	2	1
Southern Peace River	7	6	0	0	6	2
Northern Peace River	0	—	—	—	—	—
1984						
Central Alberta	1	1	0	0	1	0
Southern Peace River	2	1	0	0	2	1
Northern Peace River	6	4	0	0	6	5
1985						
Central Alberta	11	1	2	0	5	2
Southern Peace River	14	9	0	1	3	1
Northern Peace River	6	4	0	1	2	1
1986						
Central Alberta	7	1	2	0	5	3
Southern Peace River	10	8	0	3	1	1
Northern Peace River	6	4	0	1	2	1
1987						
Central Alberta	19	9	2	0	10	7
Southern Peace River	10	7	0	2	2	2
Northern Peace River	7	6	1	0	7	0
1983-87						
Central Alberta	40	12(30)*	6(15)	0	23(57)	13(37)
Southern Peace River	43	31(72)	0	6(13)	14(30)	7(16)
Northern Peace River	25	20(80)	0	2(8)	17(68)	7(28)
All Regions (1983-87)	108	63(58)	6(5)	8(7)	54(50)	27(25)

* Figures in brackets represent the percentage of fields in which the fungus was observed.

Traquair and Smith (16) reported the occurrence of SLTB on leaves and twigs of deciduous trees from central Alberta and on winter wheat and grasses. The reason for the common occurrence of SLTB on leaf and tree litter but not on winter cereals in the central and northern Peace River Districts is unknown but may be due to the weak pathogenicity of SLTB isolates to winter cereals at the low soil temperatures which prevail in northern Alberta. Traquair and Smith (16) and Gaudet (7) reported that SLTB isolates exhibited lower pathogenicity than LTB isolates. Gaudet (7) demonstrated that the optimal temperature for some SLTB isolates was above 0.5°C whereas LTB isolates were highly pathogenic at temperatures between -8 and -3°C. McBeath (11) observed the SLTB form of *C. psychromorbidus* on winter cereals in Alaska.

Plants infected with *S. borealis*, the snow scald pathogen, were bleached in appearance with a white appressed mycelium covering the leaves and stems. Conspicuous black sclerotia were common on the leaf surface (Fig. 8). This pathogen was not encountered in central Alberta and was infrequently observed on winter cereals, but was prevalent on golf greens throughout the Peace River District. Snow scald was frequently observed on winter cereals in central and northern Alberta prior to 1983 (L. Piening, J.G.N. Davidson, personal communication). Low incidence of snow scald in the last 5 years may be due to the relatively low average snow fall during this period. Snow scald develops best under a deep and persistent snow cover (8).

Pink snow mold, caused by *G. nivalis*, was only observed in two winter cereal fields in 1986 located east of Fort St. John, B.C., although the fungus was commonly observed on grasses in all years throughout the survey area. Damage attributed to this fungus was light. Distinct salmon-pink circular patches were visible (Fig. 9). Pink snow mold has been reported previously to cause damage on winter cereals in Alberta (9) and Alaska (11).

Plenodomus meliloti, which causes a root and crown rot in sweet clover and alfalfa (14), was frequently isolated from winter cereals (Table 1). The occurrence of protopycnidia on the surface of the roots and crown was also diagnostic for *P. meliloti* (Fig. 10). Results from experiments conducted under controlled environmental conditions have failed to demonstrate pathogenicity of *P. meliloti* on healthy winter wheat plants (Gaudet, unpublished). Possibly, this fungus develops in plants which have been injured or killed by environmental stresses such as low temperature or ice encasement.

The *Pythium* species commonly isolated from the crown regions of winter cereals were *P. ultimum* Trow and *P. volutum* Vanderpool and Truscott. Neither species was associated with a characteristic symptom on winter cereals. *Pythium iwayamai* causes a snow rot of winter wheat in the northwestern United States (9). *Pythium ultimum* has been reported nonpathogenic to winter wheat but may invade root and leaf tissues without causing a snow rot (10). *Pythium volutum* has been associated with a root rot of wheat in Ontario (1). However, fungicides specific to water mold fungi have been shown to be effective in increasing winter wheat yields (5). These fungi may play a role in reducing winter survival and yields of fall sown cereals and require further investigation.

Underseeded winter cereals. The stems and crowns of winter wheat or fall rye which had been underseeded with spring cereals or canola, appeared soft and decayed when examined the following spring. Estimates of plant mortality based on reports from district agriculturalists and producers ranged from 10 to 80%. In 14 fields surveyed in 1986 and 1987, incidences of the LTB fungus, *P. meliloti*, and *Pythium* spp. were all less than 20%. *Cochliobolus sativus* (Ito and Kurib.) Drechs. and *Fusarium* spp. were more frequently isolated from decayed plant parts. Consequences of early planting of winter wheat include the increase of snow mold resistance (2), and the decrease of freezing resistance (6). The lower incidence of snow mold fungi may be due to enhanced snow mold resistance which develops in older plants. The practice of underseeding winter wheat would also be conducive for the buildup of large populations of the wheat curl mite, *Aceria tulipae* Kiefer, the vector of wheat streak mosaic virus. It is possible that the winter mortality was due to the lower levels of freezing resistance which developed in underseeded winter wheat and that the fungi isolated from decayed plant parts were saprophytes or weak parasites invading damaged or dead tissues. Further studies are required to identify the role of plant parasites and winter injury in the poor winter survival of underseeded winter wheat.

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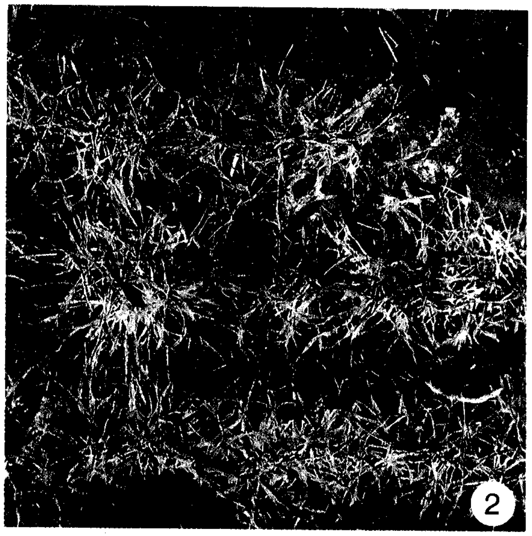


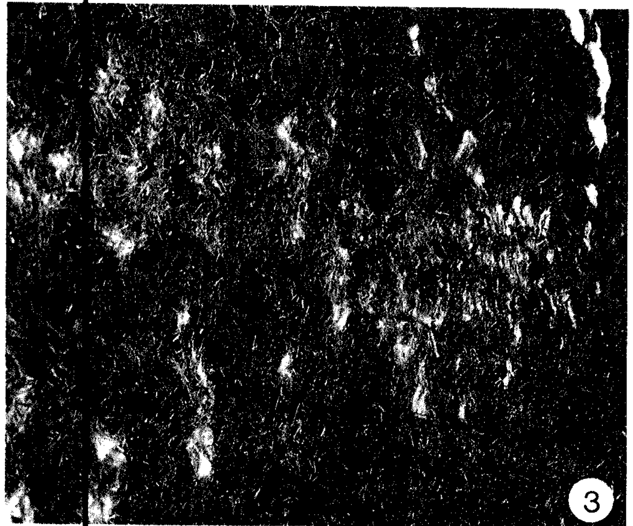
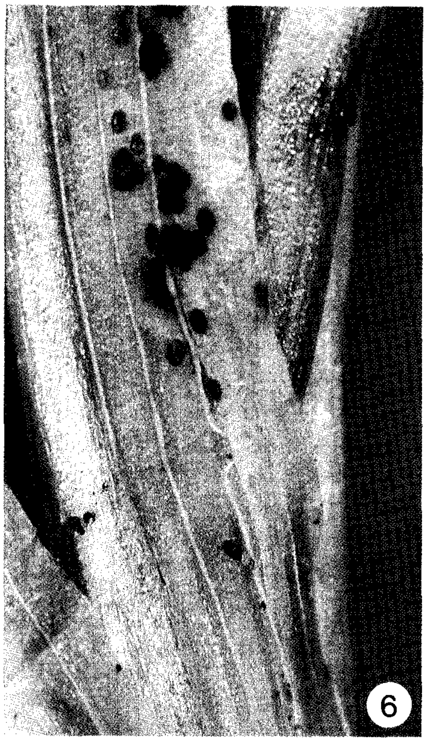
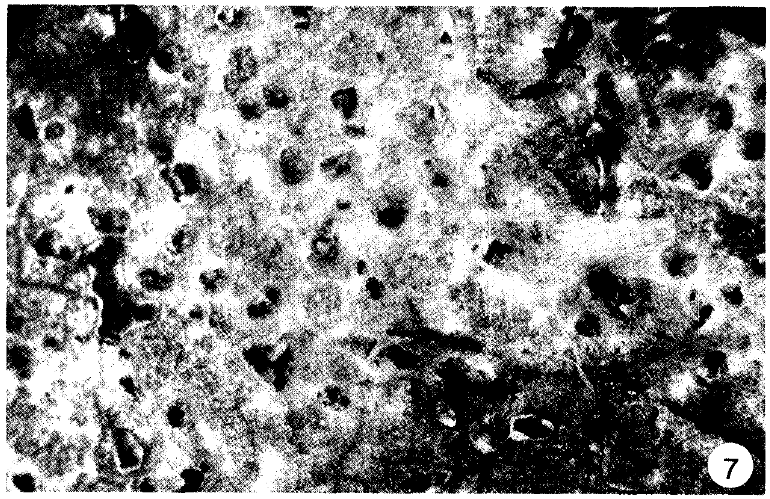


Figure 2. Winter wheat plants infected with the LTB form of cottony snow mold.
Figure 3. Mycelial mats of the LTB form of cottony snow mold in a winter wheat field.
Figure 4. Mycelial plaques of the LTB form of cottony snow mold in a fall rye stem.
Figure 5. Dandelion (*Taraxacum officinale* Weber) infected with the LTB form of cottony snow mold.





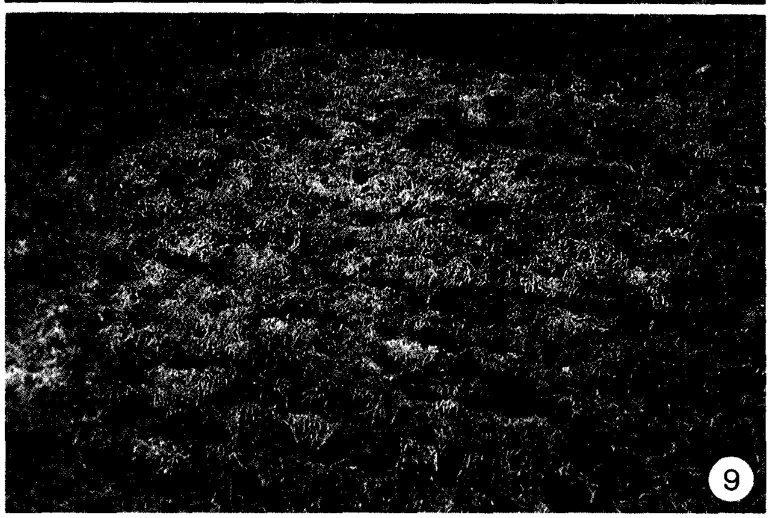


Figure 6. Sclerotia of the SLTB form of cottony snow mold on the leaf sheath of a winter wheat plant.
Figure 7. Sclerotia of the SLTB form of cottony snow mold on a poplar leaf.
Figure 8. Sclerotia of *S. borealis* on fall rye.
Figure 9. A pink snow mold patch in a field of fall rye.
Figure 10. Protopycnidia of *P. meliloti* on the crown and roots of winter wheat.

Relationship between Phytophthora root rot severity index and the percentage of resistant alfalfa plants

P.K. Basu[1]

Six named cultivars and several unnamed lines of alfalfa (*Medicago sativa*) were inoculated under greenhouse and field conditions with *Phytophthora megasperma* f.sp. *medicaginis*, the cause of root rot, over a 3-year period. Plants were rated for disease severity three and 12 weeks after inoculation in the greenhouse and field plots, respectively. Disease severity was divided into six categories (1 = no disease, 2 = very slight .... 6 = dead). The percentage of resistant plants (%R) was obtained by combining categories 1 and 2 and a disease severity index (DSI) was calculated from all plants in an experiment. A high degree of correlation (r = 0.78** to 0.97**) and a consistent linear relationship between %R and DSI were found in both greenhouse and field trials. Results indicated that %R values alone can be used for disease assessment to save time. The correlation between greenhouse and field tests was significant ($P \leq 0.01$) in all but one trial.

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Pendant 3 ans, six cultivars et plusieurs lignées de luzerne (*Medicago sativa*) ont été inoculés en serre et au champ avec *Phytophthora megasperma* f. sp. *medicaginis*, la cause du pourridié phytophthoréen. La gravité de la maladie chez les plantes a été évaluée trois semaines après l'inoculation dans le cas des plantes de serre et 12 semaines plus tard dans le cas des plantes au champ. Il y a six catégories pour définir la gravité de la maladie (1 = aucune maladie, 2 = plante très légèrement atteinte ... 6 = plante morte). On a obtenu le pourcentage de plantes résistantes (% R) en combinant les catégories 1 et 2 et calculé un indice de gravité de la maladie (IGM) à partir de toutes les plantes d'une expérience. On a trouvé une corrélation élevée (r = 0,78** à 0,97**) et une relation linéaire constante entre le pourcentage de plantes résistantes et l'indice de gravité de la maladie dans les essais en serre et au champ. Les résultats donnent à penser que l'on peut se servir uniquement des pourcentages de résistance pour évaluer la gravité de la maladie afin d'épargner du temps. La corrélation entre les tests en serre et ceux effectués au champ était significative ($P \leq 0,01$) dans le cas de tous les essais à l'exception d'un seul.

Introduction

There is general agreement among plant pathologists and breeders that field trials are more desirable than greenhouse tests for evaluating disease resistance in field crops. For the evaluation of alfalfa (*Medicago sativa* L.) root rot caused by *Phytophthora megasperma* f.sp. *medicaginis*, Kuan and Erwin (10), Frosheiser and Barnes (5) described both field and greenhouse screening methods and reported that there was a good correlation between the two methods. The field method requires about 17 weeks to complete and has been widely used. As reviewed by Heisey (7), several greenhouse methods (6, 7, 8, 9) have been developed for screening alfalfa for Phytophthora root rot (PRR). Among these methods, however, there are considerable differences in the type of plant growth medium, containers, seedling age, amount of inoculum, and periods of incubation and soil saturation.

Since 1983 various alfalfa cultivars and breeding lines have been evaluated for resistance to PRR at Ottawa on behalf of the Ontario Forage Crop Committee that has the responsibility to recommend lines for use in Ontario (1). With respect to PRR resistance, alfalfa lines are usually classified on the basis of the percentage of resistant plants (%R) along with some information on the disease severity index (DSI). Field tests were conducted routinely using the method outlined by Frosheiser and Barnes (5). Their greenhouse 'sand tank' method was also tested twice but disease ratings of the small seedlings presented some difficulties. A greenhouse method (pot test) developed at Ottawa (3,4) will be described here in greater detail. The main objective of the present work was to determine a relationship between the percentage of resistant plants (%R) and the disease severity index (DSI) under both field and greenhouse conditions.

Materials and methods

Field test. Frosheiser and Barnes (5) described the method used in Minnesota field trials but additional details are provided for the Ottawa test. At the Central Experimental Farm a field which had previous outbreaks of Phytophthora root rot (PRR) was chosen. It has a clay-loam soil with poor drainage but no mineral deficiencies as determined by soil tests. Each spring (May) after seedbed preparation, scarified alfalfa seeds of various lines were planted by hand in 1.5 m rows, 0.6 m apart in a randomized complete block design with 4 replications. At least 120 seeds were sown in each row. A stand count (emergence) was made 2-3 weeks after seeding (this count was used to determine the number of dead or missing plants at a later date). When seedlings were 4-wk-old, they were inoculated by pouring a mycelial suspension of three virulent *P. megasperma* f.sp. *medicaginis* (Pmm) isolates (3,4) at their base at the rate of ca. 0.9 g wet mycelium per row (dry weight 0.16 g). The suspension was prepared from mycelial mats grown in liquid medium in flasks for two weeks as described earlier (3,4). Plots were kept wet by sprinkler irrigation (1-2 h per day) for the next two weeks. In the following week the soil was allowed to dry for necessary weeding and cultivating.

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Plots were, alternately, kept saturated for two weeks and allowed to dry for one week until plants were 16-17 wk-old when they were dug and rated for root rot according to Frosheiser and Barnes' description of six disease severity categories (5). The percentage of resistant plants: %R = number of plants in categories 1 and 2 times 100 divided by total number of plants, and the disease severity index: DSI = [Σ(number of plants × category value) / total number of plants] were calculated. Dead or missing plants were included in the category 6, based on the previous stand count. Data were analysed by using available computer programs (11) on correlation and regression (12).

Greenhouse test. A uniform potting soil mixture containing 1:2:3:1 parts by volume of garden soil, peat, sand and perlite with additional 0.15% superphosphate and 0.08% lime was used in all experiments. The soil was distributed evenly in 10 cm plastic pots. Scarified alfalfa seeds were germinated on moist filter paper in 9 cm petri plates (24-48 h) and then 22 seedlings per pot were uniformly distributed over the moistened soil and lightly covered with finely screened (3 mm mesh) soil, which was then dampened with a mist of water. Pots were placed on greenhouse benches receiving a 14 h photoperiod with ca. 200 μmol $m^{-2} s^{-1}$ at the plant surface. When the seedlings emerged, they were thinned to 20 per pot and allowed to grow for the next three weeks. These seedlings were inoculated by pouring a mycelial suspension of the same three isolates of Pmm (described previously) on the soil surface (ca. 0.9 g/pot). Pots were placed on 5 cm plastic saucers and from this time the soil was kept at field capacity (by adding small amounts of water to each pot until it just started to drain into the saucer) for the next 10 days. During the following 11 days, the saucers were removed and the pots were watered every other day to avoid overwatering. In preliminary flooding trials with uninoculated seedlings, no abnormality was noted until 12 days, although it has been recently reported that anatomical and physiological changes in the tap roots can be detected even after four days of flooding (2,13). After the incubation period of 21 days, plants (6-wk-old) were rated for root rot using the 1-6 severity categories (5). The %R and DSI were calculated and analysed.

Results and discussion

Relationship between % resistant plants and disease severity. A high degree of correlation and consistent linear relationship between the percentage of resistant plants (%R) and disease severity index (DSI) were found in all groups of alfalfa lines, large (e.g. 66) or small (e.g. 8), tested in the field during 1983-1986 (Table 1). The correlation coefficients (r) were greater than -0.9, all significant at $P \leq 0.01$ (12) and the linear regression equations were very similar each year. Log (natural) transformation of either %R or DSI or both did not alter the results but actual (raw) values are presented in the tables 1-3. A strong relationship between %R and DSI (r = -0.78 to -0.97, significant at $P \leq 0.01$) and similar linear regression equations were found in the greenhouse tests also (Table 2). Examination of six individual cultivars (tested twice in the greenhouse) also led to the same conclusions. Results were similar in both field and greenhouse tests and all data pairs (%R and DSI) were plotted to illustrate their relationship (Fig. 1). It is noteworthy that the two measurements (%R and DSI) are not independent as they are based on the same alfalfa population. Therefore it was not surprising that the two were correlated. It is clear however that either %R or DSI can be used as a measurement for evaluating PRR resistance in alfalfa lines. Since the DSI has a narrow, discrete range (1-6) but %R

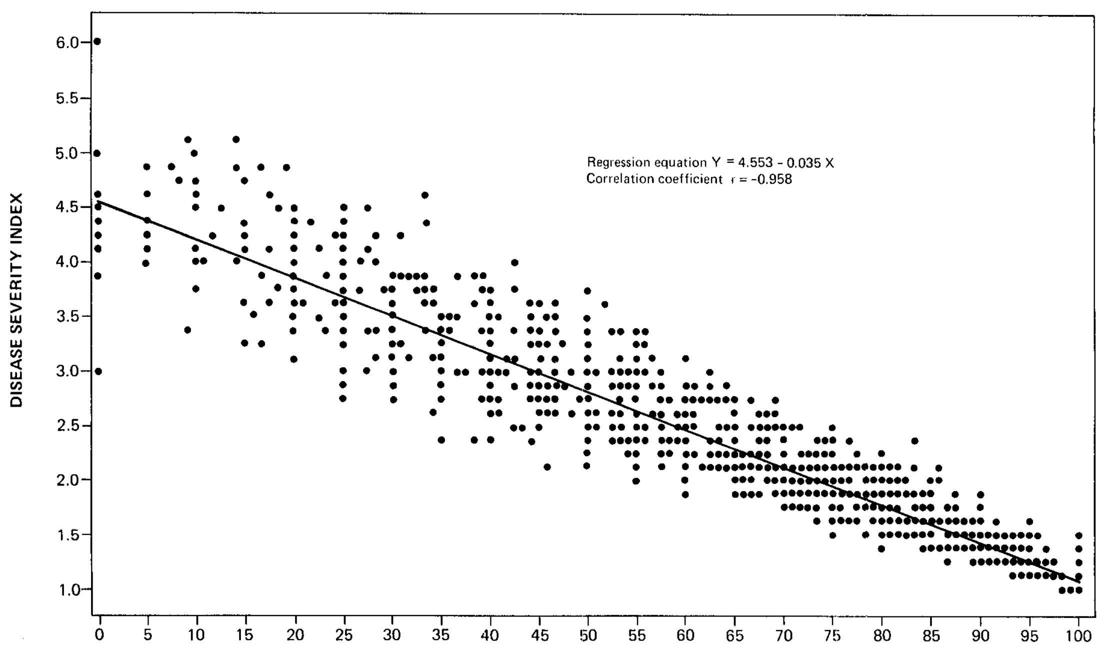

Figure 1. Relationship between percent resistant plants and disease severity index (of a total of 2394 pairs of data points from all tests combined, 515 are shown and the remaining 1879 coincided).

Table 1. Correlation coefficients (*r*) and regression equations (Y = a + bX) for the percent resistant plants (% R = X) and the disease severity index (DSI = Y) and their ranges in a number of alfalfa lines under field conditions during 1983-1986.

No. of Lines	*r* Values[a]	Regression Equations	Ranges of % R	Ranges of DSI
25 (1983)	-0.94	Y = 5.10 - 0.038 X	34 - 99	1.3 - 1.8
37 (1984)[b]	-0.96	Y = 4.47 - 0.035 X	14 - 100	1.2 - 4.2
29 (1984)	-0.95	Y = 4.33 - 0.033 X	24 - 100	1.3 - 3.8
8 (1984)	-0.97	Y = 4.72 - 0.038 X	14 - 90	1.2 - 4.2
66 (1985)	-0.94	Y = 4.71 - 0.036 X	9 - 100	1.0 - 5.1
61[c] (1985)	-0.93	Y = 4.92 - 0.037 X	0 - 100	1.0 - 3.7
30 (1986)	-0.96	Y = 4.97 - 0.039 X	27 - 97	1.2 - 4.0

[a] All *r* values significant at $P \leqslant 0.01$ (see ref. 12, p. 174)

[b] These 37 lines were divided into two groups: 29 unnamed and 8 named (Answer, Apollo, Iroquois, Peak, Saranac, Trident, Turbo and Vernal) for separate analysis.

[c] These 61 lines had 2 instead of the usual 4 replications, each containing more than 60 plants at the time of emergence.

Table 2. Correlation coefficients (*r*) and regression equations (Y = a + bX) for the percent resistant plants (% R = X) and the disease severity index (DSI = Y) and their ranges in a number of alfalfa lines under greenhouse conditions.

No. or Names of Lines X Reps[a]	*r* Values[c]	Regression Equations	Ranges of % R	Ranges of DSI
28 (1984) X 10	-0.96	Y = 4.38 - 0.033 X	7 - 100	1.1 - 4.9
66 (1985) X 10	-0.96	Y = 4.35 - 0.032 X	0 - 100	1.1 - 4.9
81 (1985) X 2	-0.96	Y = 4.05 - 0.030 X	0 - 100	1.0 - 4.5
30 (1986) X 10	-0.97	Y = 4.82 - 0.038 X	0 - 100	1.1 - 5.1
Answer (1st run)[b] X 20	-0.96	Y = 5.60 - 0.047 X	0 - 100	1.1 - 6.0
Answer (2nd run) X 20	-0.94	Y = 3.78 - 0.026 X	50 - 90	1.5 - 2.6
Apollo (1st run) X 20	-0.88	Y = 4.28 - 0.030 X	30 - 81	1.4 - 3.4
Apollo (2nd run) X 20	-0.94	Y = 3.57 - 0.023 X	60 - 100	1.3 - 2.3
Iroquois (1st run) X 20	-0.94	Y = 4.63 - 0.034 X	0 - 100	1.5 - 4.6
Iroquois (2nd run) X 20	-0.88	Y = 4.23 - 0.031 X	20 - 55	2.7 - 3.9
Saranac (1st run) X 20	-0.87	Y = 4.79 - 0.037 X	0 - 100	1.3 - 6.0
Saranac (2nd run) X 20	-0.78	Y = 4.07 - 0.024 X	25 - 65	2.5 - 3.9
Trident (1st run) X 20	-0.97	Y = 4.50 - 0.034 X	18 - 100	1.1 - 3.7
Trident (2nd run) X 20	-0.95	Y = 3.84 - 0.028 X	55 - 100	1.0 - 2.6
Vernal (1st run) X 20	-0.85	Y = 4.84 - 0.036 X	20 - 82	1.9 - 4.5
Vernal (2nd run) X 20	-0.96	Y = 4.47 - 0.036 X	5 - 55	2.6 - 4.4
Above 6 cvs (1st run) X 20	-0.92	Y = 4.90 - 0.038 X	0 - 100	1.0 - 6.0
Above 6 cvs (2nd run) X 20	-0.97	Y = 4.35 - 0.033 X	5 - 100	1.0 - 4.4

[a] A replication is a pot of alfalfa seedlings.

[b] Individual named cultivars were tested two times (runs) in the same greenhouse.

[c] All *r* values significant at $P \leqslant 0.01$ (see ref. 12, p. 174).

has a wide range (0-100), the use of %R would seem more appropriate for separating or grouping of alfalfa lines despite the fact that within individual lines the range may be large (Table 1 and 2). Furthermore, evaluation of lines by %R is simple, objective and time-saving as noted by other workers (8).

Correlation between field and greenhouse tests. Since the number of replications in the field and greenhouse varied, the mean %R and DSI values for each corresponding alfalfa lines were used for obtaining correlation coefficients (*r*) and regression equations (Table 3). In all, except the test with 61 lines with two replications, the *r* values were significant at $P \leq$

Table 3. Correlation coefficients (*r*) and regression equations (Y = a + bX) for field (Y) and greenhouse (X) tests using the mean[a] values of percent resistant plants (% R) and disease severity index (DSI) of corresponding alfalfa lines during 1984-1986.

No. of Lines	*r* values for		Regression Equations for	
	% R	DSI	% R	DSI
6 (1984)	0.95**[b]	0.95**	Y = -0.98 + 0.83 X	Y = 0.87 + 1.14 X
25 (1984)	0.58**	0.57**	Y = 16.49 + 0.58 X	Y = 1.26 + 0.56 X
66 (1985)	0.58**	0.44**	Y = 62.63 + 0.32 X	Y = 1.06 + 0.27 X
61 (1985)[c]	0.13ns	0.12ns	Y = 83.58 + 0.07 X	Y = 1.40 + 0.08 X
30 (1986)	0.77**	0.70**	Y = 46.51 + 0.51 X	Y = 0.70 + 0.47 X

[a] The mean values of %R and DSI of each line were derived from 4 reps. in the field and 20 reps. in the greenhouse.

[b] ** indicate significance at $P \leqslant 0.01$; ns = non-significant.

[c] These 61 lines had only 2 reps. in both field and greenhouse.

0.01 but they varied from 0.58 to 0.95 for %R, and from 0.44 to 0.95 for DSI. The regression equations for field (Y) on greenhouse (X) differed between years, indicating a lack of consistency in their relationship. It was generally observed that variability in greenhouse data was less than in field data. The greater variability in field tests was likely due to several (unknown or unavoidable) biotic and environmental factors affecting disease development. Results indicate that in order to increase accuracy and consistency in the evaluation of alfalfa lines, greenhouse tests should also be used in addition to field trials for determining resistance to Phytophthora root rot.

Conclusions

There is a strong linear correlation between the percentage of resistant alfalfa plants (%R) and Phytophthora root rot severity index (DSI) both under field and greenhouse conditions. To simplify the disease assessment procedure only %R values can be used for evaluating alfalfa lines, and field trials should be supplemented with greenhouse tests to confirm PRR resistance.

Acknowledgements

The author wishes to thank N.J. Brown for technical assistance.

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Black point incidence in soft white spring wheat in southern Alberta and Saskatchewan between 1982 and 1987

R.L. Conner and A.D. Kuzyk[1]

Analysis of results from a 6-year survey of irrigated fields of soft white spring wheat determined that the annual percentage of fields in southern Alberta that would have been downgraded because of black point ranged between 19 and 54%. In 1982 and 1984, disease incidence was substantially higher in Saskatchewan and would have caused downgrading in almost every field sampled. Regional differences in black point incidence were apparent each year and usually were related to differences in amount of precipitation received during the last week in July and the first two weeks in August, which corresponds to the time when kernel development occurred in most fields. Large differences in black point incidence were observed between fields in the same area, which suggested that disease incidence was also being influenced by differences in irrigation and cultural practices. No consistent relationship was found between type of irrigation system and disease incidence. Isolations from infected kernels indicated that black point was caused primarily by *Alternaria alternata* and that *Cochliobolus sativus* was of only minor importance.

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D'après l'analyse des résultats d'une enquête de 6 ans sur les champs irrigués de blé blanc tendre de printemps, le pourcentage annuel de champs dans le sud de l'Alberta qui auraient été classés à la baisse en raison de l'infection par le point noir s'établissait entre 19 et 54 %. En 1982 et 1984, la fréquence de la maladie était nettement supérieure en Saskatchewan et aurait entraîné une baisse de classement dans presque tous les champs échantillonnés. Chaque année, il y avait des différences régionales dans la fréquence de point noir qui étaient habituellement liées aux différences dans la quantité de précipitations au cours de la dernière semaine de juillet et des deux premières semaines d'août, soit pendant le développement du grain dans la plupart des champs. On a observé de grandes différences dans la fréquence de point noir entre les champs d'une même région, ce qui donne à penser que les différences dans l'irrigation et les pratiques culturales peuvent également influer sur la fréquence de la maladie. On n'a pas trouvé de relation constante entre le type de système d'irrigation et la fréquence de la maladie. D'après la fréquence d'isolement des divers organismes pathogènes dans les grains infectés, le point noir était causé surtout par *Alternaria alternata* et très rarement par *Cochliobolus sativus*.

Introduction

Black point is a leading cause of downgrading in soft white spring wheat grown in western Canada (2). In North America, black point is caused primarily by *Alternaria alternata* (Fr.) Keisler = (*A. tenuis* Nees.) or *Cochliobolus sativus* (Ito and Kurib.) Dreschl. ex Dastur, conidial state *Bipolaris sorokiniana* (Sacc. in Sorok.) Shoem., syn. *Helminthosporium sativum* Pammel, King and Bakke. (1,6,7,9,10). The relative importance of these fungi in causing black point varies between years and with location (1,6,7,9). Fielder and Owens, the soft white spring wheat cultivars currently grown in western Canada, are susceptible to *A. alternata* (5).

Black point is characterized by a brown to black discoloration of the germ end of the kernel. Grain containing more than 10, 15 or 35% black point kernels is downgraded to grades C.W.S.W. 2, 3 and Canada Western Feed, respectively (3). The nutritional properties of the flour are not impaired by the disease but the discolored appearance of the flour is regarded unfavorably by the consumer (2).

Black point incidence is strongly influenced by environmental conditions. The disease is most serious under irrigation or in areas receiving heavy rainfall during kernel development (4,7). It is therefore frequently a problem in soft white spring wheat which is grown exclusively under irrigation. Timing of irrigation has a major effect on black point incidence (4). In areas where air-borne spores of the pathogens are not limiting, heavy irrigation during the milk or mid-dough stages (Growth stages 11.1 and 11.2 respectively, Feekes scale) (7) results in a sharp increase in black point incidence. In western Canada, the crop is grown under either a flood-, pivot- or wheel move-irrigation system. The influence of the type of irrigation on black point incidence has not been reported.

The objectives of this study were to survey commercial fields of soft white spring wheat to determine the extent of downgrading caused by this disease, determine the influence of type of irrigation system on disease incidence, and identify the fungi responsible for the disease.

Materials and methods

Field survey. Between 1982 and 1987, soft white spring wheat fields throughout the irrigated region of southern Alberta were surveyed for black point at the end of the growing season. In Alberta, 75 fields were examined in 1982, 107 in 1983, 110 in 1984, 111 in 1985, 79 in 1986, and 72 in 1987. In Saskatchewan, samples were received from 17 fields in 1982 and 14 fields in 1984. Fields were randomly selected but an attempt was made to sample fields in the same vicinity that were grown under flood-, pivot- and

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wheelmove-irrigation systems. Only ripe fields were sampled and areas with high numbers of late fields were left for sampling at a later date. In each field, approximately 30-40 spikes were collected from sites well into the irrigated portion of each field. Between 1982 and 1985, samples from different sites within each field were combined into a single sample. In 1986 and 1987, three samples taken at 50-m intervals from each field were collected separately and used to determine black point incidence. Field samples were air-dried for a week or more before they were threshed and examined for black point symptoms. The incidence of black point in a field was determined based on the average percentage of black point kernels in 200-kernel samples from each site. Information on precipitation during each growing season was obtained from weather stations located in Lethbridge, Taber, Vauxhall, Brooks, Bow Island, Medicine Hat, and Outlook. Weather information was used to explain any obvious regional differences in disease incidence.

Identification of causal organisms. The identity of the fungi infecting the kernels was determined from a 100-kernel sample containing healthy and black point kernels. The kernels were surface-sterilized in a 1:1 mixture of 6% sodium hypochlorite and 95% ethanol for 45 seconds. Then the kernels were aseptically transferred on to moistened filter paper in sterile petri dishes and were placed in the dark at 21°C for 5 days after which they were examined under the stereomicroscope. A small percentage of the fungi did not sporulate and could not be identified in this manner. The non-sporulating fungi were induced to sporulate by plating surface-sterilized seed on potato dextrose agar. Two weeks later, the identity of the fungi growing from each infected seed was determined.

Each year, a paired comparison was made of the percentage of kernels infected by *A. alternata* in samples of healthy and black point kernels from 10 fields. Thirty healthy and black point kernels from each field were surface-sterilized, plated on moist filter paper and later examined for colonization by *A. alternata*. A paired *t*-test was used to determine whether the black point samples differed significantly from the healthy samples for number of kernels infected by *A. alternata*.

Results and discussion

Each year, black point incidence in an area was influenced by the amount of precipitation received in the last week in July and first two weeks in August (Table 1). This coincided with the period when most crops were at the milk and dough stages, which are the stages most prone to the disease (4). Dry conditions during the early stages of kernel development always resulted in a low disease incidence but it was also noted in several instances that substantial rainfall during this period did not result in a high black point incidence.

In 1982 and 1984, disease incidence was substantially higher in Saskatchewan than in Alberta (Table 2). In both years, the high disease incidence appeared to be due to heavier precipitation in the Lake Diefenbaker area in July and August. Only one field out of the 31 fields surveyed in Saskatchewan during 1982 and 1984 would not have been downgraded because of high black point incidence.

Regional differences in black point incidence were apparent in Alberta in each year of the study. In 1982, dry conditions resulted in a low black point incidence in most Alberta fields (Fig. 1). Only the area southeast of Brooks had a high incidence of black point and this area received the heaviest rainfall during the last week of July and the first two weeks of August (Table 1). In 1983, black point incidence was highest in fields near Taber and Brooks, which also had heavy rainfall during kernel development (Fig. 2). In 1984, frequent showers at the end of July and in early August appeared responsible for a higher disease incidence than in the two previous years (Fig. 3). The major exceptions were the Bow Island-Medicine Hat areas where dry conditions generally kept black point incidence low. In 1985, the extremely dry conditions around Lethbridge kept black point incidence low (Fig. 4). Medicine Hat and Bow Island received a heavy shower at the middle of August but this did not offset the effect of dry conditions prior to this and did not result in a high black point incidence. The occasional shower in the other areas resulted in higher levels of disease. Conditions in Alberta during 1986 and 1987 were generally conducive for disease development (Fig. 5-6). However, disease incidence was low around Lethbridge and Taber in 1986 because of low rainfall in July and August. In 1987, high black point incidences in the Lethbridge area appeared to be related to a heavy rainfall (46 mm) on July 23-24, which resulted in heavy dew formation during the early stages of kernel development. Other locations did not receive heavy precipitation on this date but subsequent rainfalls during early kernel development (Table 1) were responsible for high incidences of black point.

Table 1. Amount of rainfall received in the last week of July and first two weeks in August at locations surveyed between 1982 and 1987*.

Year	Rain (mm) received at:						
	Lethbridge	Taber	Vauxhall	Brooks	Bow Is.	M. Hat	Outlook
1982	10.8	10.2	22.6	20.0	17.4	11.1	31.4
1983	15.2	22.9	17.6	36.5	0.5	5.8	**
1984	30.9	51.2	24.2	51.6	13.4	10.9	58.0
1985	7.0	31.5	21.8	26.0	21.8	25.0	**
1986	9.1	18.9	21.2	33.1	26.5	26.7	**
1987	19.8	38.8	26.6	77.0	82.8	14.2	**

Bow Is. = Bow Island, M. Hat = Medicine Hat.

* Based on data from the Daily Weather Bulletin issued by Climate Services — Central Region, Environment Canada.

** Area not sampled.

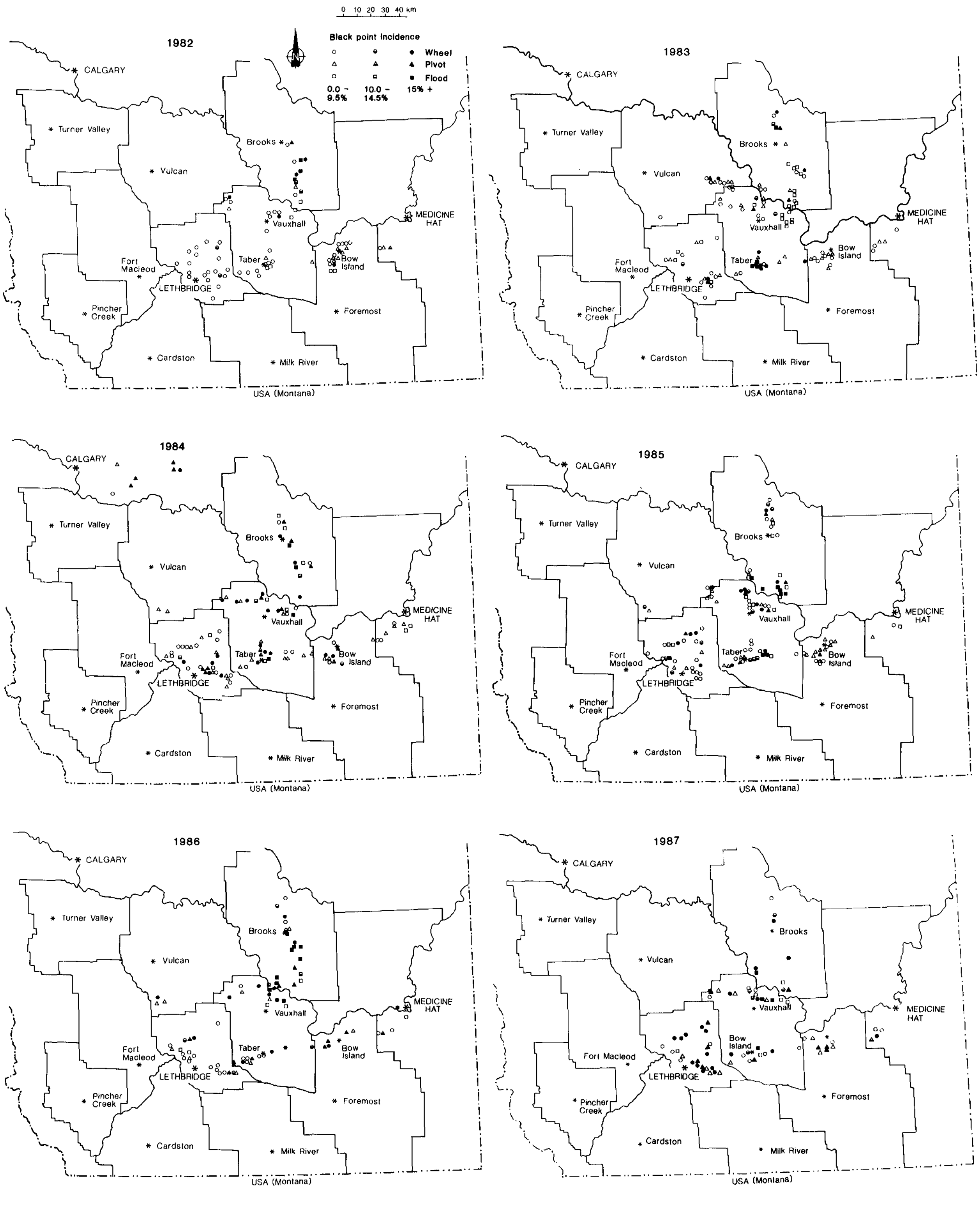
Table 2. Distribution of black point incidence in soft white spring wheat fields under different irrigation systems between 1982 and 1987.

Type of irrigation and year	Average black point incidence	Number of fields with black point incidence (%) :				Total field number
		0.0–9.5	10.0–14.5	15.0–35.0	35.0 +	
1982 Alta.*						
Flood	9.7 ± 2.5†	6	2	3	0	11
Pivot	3.0 ± 1.3	11	2	0	0	13
Wheelmove	5.0 ± 1.0	44	2	5	0	51
1982 Sask.						
Flood	25.2 ± 6.0	0	1	2	1	4
Pivot	19.1 ± 2.0	0	5	6	0	11
Wheelmove	37.0 ± 1.0	0	0	0	2	2
1983 Alta.						
Flood	6.0 ± 1.4	21	1	4	0	26
Pivot	6.3 ± 1.0	27	3	1	0	31
Wheelmove	7.5 ± 1.1	39	3	8	0	50
1984 Alta.						
Flood	8.1 ± 1.8	12	3	3	0	18
Pivot	11.0 ± 1.7	27	5	11	2	45
Wheelmove	13.4 ± 1.9	26	1	17	3	47
1984 Sask.						
Flood	21.0 ± 10.0	1	0	1	1	3
Pivot	25.5 ± 3.3	0	1	7	1	9
Wheelmove	14.5 ± 3.5	0	1	1	0	2
1985 Alta.						
Flood	11.5 ± 2.0	11	2	9	0	22
Pivot	6.8 ± 1.4	22	5	2	1	30
Wheelmove	9.4 ± 1.2	39	9	8	3	59
1986 Alta.						
Flood	14.4 ± 3.0	7	3	5	3	18
Pivot	13.3 ± 2.2	10	5	6	1	22
Wheelmove	11.2 ± 1.5	20	5	14	0	39
1987 Alta.						
Flood	14.8 ± 3.8	7	1	4	1	13
Pivot	18.1 ± 3.9	11	2	6	3	22
Wheelmove	18.9 ± 2.9	15	4	12	6	37

* Alta. = Alberta, Sask. = Saskatchewan. † Mean ± standard error of the mean.

It was observed in dry years that irrigation in many fields continued until quite late in the growing season and might have increased disease incidence. In most years, the low black point incidence in the area north and west of Lethbridge appeared to be due to a combination of dry conditions and the early curtailment of irrigation caused by a lack of sufficient water reserves in the irrigation district.

No consistent relationship was found between disease incidence and type of irrigation system (Table 2). Each year, high disease incidences were found in at least a few fields grown under each type of irrigation system. During the study, the type of irrigation system associated with the highest average black point incidence was evenly split between wheelmove- and flood-irrigation with 3 years each. However, the apparent



Figs. 1-6. Maps showing black point incidence and the approximate location of the fields of soft white spring wheat surveyed between 1982 and 1987.

Table 3. Identity of the fungi infecting samples of soft white spring wheat from Alberta and Saskatchewan between 1982 and 1987.

Year	Prov.*	Percentage of kernels infected with :					
		Black Point**	*Alternaria*	*C. sativus*	*Fusarium*	Other†	Healthy
1982	AB	5.3 ± 0.8 ††	30.9 ± 1.7	0.6 ± 0.1	2.1 ± 0.2	5.1 ± 0.4	61.4 ± 2.0
1982	SK	22.7 ± 2.3	38.6 ± 2.9	0.9 ± 0.2	1.1 ± 0.2	2.2 ± 0.4	57.1 ± 3.0
1983	AB	6.8 ± 0.7	24.3 ± 0.8	0.6 ± 0.1	4.4 ± 0.3	9.0 ± 0.4	61.6 ± 1.2
1984	AB	11.6 ± 1.1	23.0 ± 1.2	0.8 ± 0.1	2.1 ± 0.2	6.5 ± 0.4	67.7 ± 1.4
1984	SK	23.0 ± 3.0	51.6 ± 3.2	0.6 ± 0.3	1.9 ± 0.4	3.6 ± 3.6	42.4 ± 3.7
1985	AB	9.2 ± 0.9	42.0 ± 1.6	0.8 ± 0.1	2.6 ± 0.2	9.3 ± 0.5	45.0 ± 1.7
1986	AB	12.5 ± 1.2	50.6 ± 1.3	0.2 ± 0.1	3.3 ± 0.2	26.1 ± 0.9	19.3 ± 1.3
1987	AB	17.9 ± 1.9	57.0 ± 1.7	0.3 ± 0.1	2.0 ± 0.2	6.0 ± 0.5	34.7 ± 1.6

* AB = Alberta, SK = Saskatchewan.

** Black Point = black point incidence.

† Other = mainly *Cladosporium* spp., *Penicillium* spp. and *Aspergillus* spp.

†† Mean ± standard error of the mean.

differences between irrigation systems often appeared to be due to differences in disease incidence between areas where certain irrigation systems were more common. For example, black point incidence in flood-irrigated fields tended to be higher in certain years because flood irrigation was concentrated primarily in areas where disease incidence tended to be high in all irrigated fields (Figs. 1-6).

During the 6 years of the study, the annual percentage of fields that would have been downgraded by at least one grade ranged from 19-54%. Even in extremely dry years, black point incidence was still high in a number of fields. Variation in disease incidence between fields in the same area was at least partially due to differences in irrigation and cultural practices. Factors such as time of irrigation and seeding date could have directly influenced black point incidence. Differences in seeding date would result in exposure to different environmental conditions at critical stages of development such as the milk and mid-dough stages. It was observed in 1985 that late-seeded fields had substantially higher incidences of black point; this was likely due to exposure to heavy rainfall just prior to harvest. The same year, it was also noted in partially swathed fields which had been exposed to a prolonged period of heavy rainfall after swathing that a higher disease incidence occurred in samples taken from the swath than in samples taken from the standing crop in the same fields.

When isolations were made from seed samples, a large percentage of apparently healthy kernels were infected with *Alternaria* spp. (Table 3). Several other studies (6,10) have also reported that a high percentage of healthy kernels were also infected with *Alternaria* spp. It appears that in many cases infection occurred either too late or under unfavorable conditions for further disease development. However, each year there was a significant ($P = 0.05$) correlation ($r = 0.5 - 0.7$) between black point incidence and the percentage of kernels infected with *A. alternata*. A paired comparison of samples of healthy and black point kernels indicated that a significantly higher percentage of kernels from the black point samples were infected with *Alternaria*. Each year, *C. sativus* infected only a low percentage of seed. These results clearly indicate that *C. sativus* is of only minor importance as a cause of black point in the irrigated areas of southern Alberta and Saskatchewan.

Acknowledgements

The authors thank L.T. Bohrson for providing us with seed samples from fields in Saskatchewan. We also thank N. Nakahama for preparing the figures in this paper.

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DISEASE HIGHLIGHTS 1987 APERÇU DES MALADIES

CANADIAN PHYTOPATHOLOGICAL SOCIETY/ CANADIAN PLANT DISEASE SURVEY - DISEASE HIGHLIGHTS

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Cereals

CROP: Barley

LOCATION: Central Alberta

NAME AND AGENCY:
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TITLE: BARLEY DISEASE SURVEY IN CENTRAL ALBERTA, 1987

METHODS: Twenty-four barley fields were surveyed in early August 1987 in the counties of Ponoka, Lacombe, and Red Deer, which form part of Census Division 8. This was one field surveyed per 25,000 acres sown. Each field was traversed in an inverted V and sampled at five sites about 20 paces apart. Diseases were identified by visual symptoms. In addition unusual conditions were noted.

Disease severity was assessed as follows:

trace	=	$\leq$ 1%
slight	=	$\leq$ 5%
moderate	=	5-25%
severe	=	25-100%

RESULTS: Common root rot (*Cochliobolus sativus* and *Fusarium* spp.) was the most prevalent disease with 100% incidence. Levels were low this year with 30% of the fields in the slightly diseased category and the rest with only trace amounts. Loose and covered smut (*Ustilago nuda*, *U. nigra* and *U. hordei*) continue to be common, each infecting 33% of all fields in trace amounts. Leaf diseases were very wide spread this year after a cool, wet July. Net blotch (*Pyrenophora teres*) was the leaf disease most often observed with 91% of the fields infected, versus 67% for scald (*Rhyncosporium secalis*). But scald symptoms were more severe with 33% of all fields rating moderately diseased on the upper leaves (5-25%) in comparison to 25% for net blotch. Septoria leaf blotch (*Septoria passerinii*) was present on 25% of the fields with 1 field in the moderate category. About 12% of the fields surveyed had BYD symptoms in low amounts.

COMMENTS: In addition to the survey results there were several reports of Diamond barley exhibiting small heads with very light kernels. Examination of these plants showed evidence of common root rot on the above ground crown tissue. This may be a previously unnoticed characteristic of Diamond to be on the lookout for.

CROP: Barley

LOCATION: Saskatchewan

NAME AND AGENCY:
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Melfort, Saskatchewan SOE 1AO

TITLE: DISEASE SURVEY OF BARLEY FIELDS IN N.E. SASKATCHEWAN

METHODS: Forty seven barley fields were surveyed between June 29, 1987 and July 27, 1987 in crop districts 5b, 8a, 8b and 9a in N.E. Saskatchewan. The fields surveyed were selected at random in each crop district. One plant was selected every ten paces ten times in each field. Diseases were identified according to visual symptoms expressed on the plants and findings were recorded on a standard format sheet. Root rot severity was assessed as for wheat, according to the lesions of the subcrown internode where 0 = Healthy, 2 = Trace, 5 = Moderate, and 10 = severe (1, 2). All other diseases were assessed on the basis of percentage of leaf or stem area affected (3). Results for each disease were totaled and averaged over the total number of samples and fields surveyed to give the Disease Index. Percentage of fields affected was calculated by dividing the number of fields in which the disease was noted by the total number of fields surveyed. Any symptoms that were not recognized in the field were returned to the lab for incubation and identification if possible. Diseases listed as trace (T) were found in the field but not in the sampled plants.

RESULTS AND COMMENTS: In the table below loose smut (Ustilago nuda) disease index is the result of observations of percentage of heads infected over entire fields, rather than over the ten sampled plants in a field. This resulted from the disease being easily noted in the field, but never being in among the 10 randomly selected plants. The table also shows that net blotch (Drechslera teres) was the most severe disease found in a high percentage of fields and the spot biotype (4) was the most prevalent. Root rot (Bipolaris sorokiniana) followed in severity, but was found in every field surveyed. Scald (Rhynchosporuim secalis) was found in low levels in approximately two thirds of the fields surveyed. Other diseases such as Speckled leaf blotch (Septoria passerinii), loose smut (U. nuda), covered smut (Ustilago hordei), and spot blotch (Bipolaris sorokiniana) were found in low levels in a few fields.

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Can. J. Plant Sci. 54(4):731-734.

Table. Barley Disease Survey in N.E. Saskatchewan, 1987

	Fields Assessed	Disease Index/% Fields Affected						
C.D.	Number of Fields	Root Rot	Net Blotch	Scald	Speckled Leaf Blotch	Loose Smut	Covered Smut	Spot Blotch
5B	10	3.32/100.0	8.12/100.0	0.19/50.0	0.11/50.0	*1.00/20.0		
8A	14	2.81/100.0	6.04/85.7	0.98/64.3	0.27/57.1	*0.35/50.0	*T/14.3	
8B	12	3.68/100.0	10.79/100.0	0.74/66.7	0.39/25.0	*0.17/35.3		0.68/33.3
9A	11	3.11/100.0	5.77/100.0	1.20/72.7	*T/9.1	*0.27/36.4		
Total or Avg.	47	3.23/100.0	7.68/96.4	0.78/63.4	0.19/30.3	*0.44/34.9	<.1/3.6	0.17/8.3

*Disease found in the field, but not in the sampled plants

CROP: Barley

LOCATION: Saskatchewan

NAME AND AGENCY:
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TITLE: SASKATCHEWAN BARLEY LEAF DISEASE SURVEY, 1987

METHODS: Kits to grow and sample 25 (at 20 locations) or 40 (at 7 locations) barley genotypes, chosen to exhibit differential disease infection were mailed to co-operators to be planted in fields where barley had been grown in 1986. Co-operators included School of Agriculture volunteers, previous co-operators, pedigree seed growers and other barley researchers. The 27 locations were well distributed over the N.W., N.E. and S.E. portions of Saskatchewan. Leaf samples were obtained from 22 of the 27 locations and 5 additional sites.

RESULTS AND COMMENTS: The primary objective was to assess the relative prevalence of the spot and net forms of net blotch (**Pyrenophora teres**). The spot form was the most prevalent. Varieties had different reactions at different sites indicating more than one biotype of the spot form exists. Additional results are summarized in Table 1.

Table 1. Occurrence of barley leaf diseases, Saskatchewan, 1987

Disease	Number of locations		Comments
	Heavy infection	Trace infection	
Spot form net blotch (**Pyrenophora teres** f. **maculata**)	16	11	- found at all sites
Net form net blotch (**Pyrenophora teres** f. **teres**)	6	11	- more prevalent in the eastern regions
Spot blotch (**Cochliobolus sativus**)	1	17	- heavy infection at one location near Regina
Scald (**Rhynchosporium secalis**)	9	7	- heaviest in the northern region
Leaf rust (**Puccinia hordei**)	4	7	- heaviest in the southeast region
Septoria (**Septoria** spp.)	0	15	- more evident at the northern locations

CROP: Barley

LOCATION: Manitoba

TITLE: Incidence of Plant Diseases in Barley in Manitoba in 1987

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Plant Pathology Laboratory
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R3T 2N2

METHODS: Results are based on 73 samples of barley submitted to the Plant Pathology Laboratory and field examinations.

RESULTS: Barley yellow dwarf was present at high levels in the Eastern and Central regions. Some fields examined in the Eastern region near Steinbach had close to a 100% level of infection. Barley yields on clay soils were 3200-3800 kg/ha which indicates a 10-20% yield loss that could be attributed to barley yellow dwarf virus. On sandy soils south of Steinbach the affect of BYDV was much greater. Many of these fields showed an obvious drought stress in early July which was accentuated by the BYDV infection. The average yield in these fields was 1600-2200 kg/ha. Yield losses appeared to be in the range of 20-30%.

Flame chlorosis virus disease was identified in the Russell area of the Northwest region. This newly reported virus disease was first detected in 1985 in the Minnedosa area. Leaf diseases in most cases were less prevalent than in 1986 on account of the drier conditions especially during June and early July.

The incidence of leaf rust and speckled leaf blotch or Septoria of barley was also higher than the previous year. There are indications that speckled leaf blotch, a stubble borne disease is increasing in occurrence and severity within Manitoba.

CROP: Barley

LOCATION: Manitoba

TITLE: LEAF DISEASES OF BARLEY IN MANITOBA IN 1987

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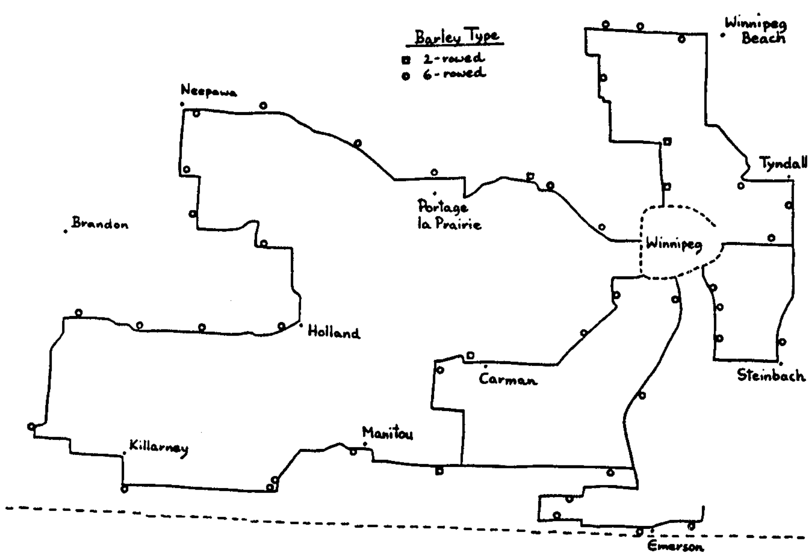
METHODS: 45 barley fields in south-central Manitoba were surveyed for leaf diseases from 15 to 31 July 1987 (Fig 1). Fields were selected at random along the survey routes. An inverted V transect about 100m long was sampled in each field and disease levels were assessed on 20-30 plants. Four categories were used: trace (<5% leaf area diseased); slight (5-15%); moderate (16-37%); and severe (38-100%). Ratings were given to both upper (flag and penultimate) and to lower leaves. Diseases were identified visually and/or subsequently in the laboratory.

RESULTS AND COMMENTS: The main leaf diseases were net blotch (*Pyrenophora teres*), spot blotch (*Cochliobolus sativus*), speckled leaf blotch (*Septoria passerinii*) and leaf rust (*Puccinia hordei*). Five fields (all in the eastern half of the surveyed area) were of two-rowed barley, but no distinctive pattern of disease incidence or severity was apparent between two-rowed and six-rowed barley types. Excluding leaf rust, leaf spot damage to upper leaves was rated as trace in 51% of fields, slight - 47%, moderate - 2% and severe - 0%. Damage was generally enhanced on lower leaves with 50% of fields having moderate or severe leaf spotting. Based on disease severity on lower leaves, leaf spots of barley were most prevalent in a band running south-east from Winnipeg to Steinbach, and one running north-south from east of Neepawa to the US border. The relatively low disease levels on upper leaves at the time of sampling (early to mid-dough, Zadoks' scale 83 - 86) suggest that yield losses due to leaf spots were generally minimal. Exceptions may have been the few fields that were rated as having moderate to severe leaf rust in addition to leaf spots. The incidence of speckled leaf blotch appears to be increasing.

Fig. 1



CROP: Barley

LOCATION: Manitoba and Saskatchewan

NAME AND AGENCY:
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TITLE: Barley Smut Survey, 1987

METHODS: In July, 1987, 217 barley fields were surveyed for *Ustilago hordei*, *U. Nigra* and *U. nuda* in Manitoba and Saskatchewan (Fig. 1). 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 81% of the fields examined. The average level of infection was 1.6%. One field in north-western Manitoba had 40% covered, 8% false loose and 2% loose smut.

COMMENTS: The level of infection was the highest found in the last 25 years. Weather conditions appeared to favour infestation of seed and therefore high levels of smut again in 1988.

ACKNOWLEDGEMENT: The south-western loop (Fig. 1) was surveyed by J. Nielsen.

Table 1. Incidence of smut on barley, 1987

Province	Crop	% fields affected: U. hordei	U. nigra	U. nuda	Mean % infected plants
Manitoba	2 row	21	29	50	1.7
	6 row	26	43	67	2.0
Saskatchewan	2 row	32	16	29	0.4
	6 row	37	21	83	1.6

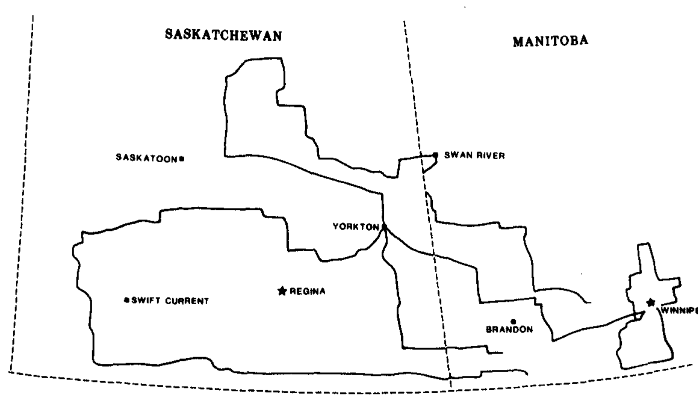

Figure 1.
Barley smut survey routes, 1987

CROP: Oats

LOCATION: Central Alberta

NAME AND AGENCY:
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Agriculture Canada
LACOMBE, Alberta TOC 1S0

TITLE: OAT DISEASE SURVEY IN CENTRAL ALBERTA, 1987

METHODS: Four oat fields were surveyed in August 1987 in the counties of Ponoka, Lacombe and Red Deer, which form part of Census District 8. This was approximately one field surveyed per 26,000 acres sown. Each field was traversed in a inverted V and sampled at 5 sites about 20 paces apart. Diseases were identified by visual symptoms. In addition, unusual conditions were noted.

RESULTS AND COMMENTS: Oats continues to be the most disease free cereal in Central Alberta. Blast was, as usual, the most common disease with 75% of all surveyed fields infected. Levels were generally < 1% with the exception of one field with 5% of the florets blasted. Septoria leaf blotch (Septoria avenae) was noticed in 2 of the surveyed fields with levels less than 5%.

CROP: Oats

LOCATION: Manitoba and Saskatchewan

TITLE: OAT CROWN RUST SURVEY, 1987

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METHODS: The occurence and severity of oat crown rust in Manitoba and eastern Saskatchewan was determined by frequent examination of commercial oat fields or stands of wild oats (Avena fatua L.), beginning in Manitoba in late June, 1987. The extent of the infections was determined in twenty-eight commercial oat fields in Manitoba in July and August, and four in Saskatchewan in August. Rust samples were collected from wild oats and from susceptible cultivars grown in farm fields and uniform rust nurseries for race identification in the greenhouse. The rust nurseries were located near Woodmore, Brandon, Morden, and Dauphin, Manitoba, and Regina, Indian Head, and Scott, Saskatchewan.

RESULTS AND COMMENTS: Crown rust was first found in trace amounts in Manitoba on June 26, 1987. The inoculum arrived about two weeks earlier than usual, but the development of the rust following the initial infections was slow and uneven because of dry conditions. By early August crown rust was widespread on wild oats in Manitoba, with the heaviest infections occurring in the southern part of the Red River Valley. However, most of the commercial oats grown in Manitoba in 1987 are highly resistant to the prevalent races of the rust. Only three of the twenty-eight commercial oat fields examined were found to have infections and these were light. Trace to light infections were found in two of the four commercial oat fields in eastern Saskatchewan. The race identification study is under way.

CROP: Oats

LOCATIONS: Manitoba, Saskatchewan, Alberta

TITLE: OAT STEM RUST SURVEY IN THE PRAIRIE PROVINCES, 1987

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METHODS: The extent of oat stem rust (*Puccinia graminis* f.sp. *avenae*) infection in the prairie provinces was determined by inspection of stands of wild oats (*Avena fatua* L.) and where possible, commercial oat fields. Most oat cultivars planted in Manitoba and eastern Saskatchewan are resistant to the prevailing western races of *P. graminis avenae*, thus most information was derived from wild oat infections and from nurseries planted in Woodmore, Brandon, Morden and Dauphin, Manitoba and Regina, Indian Head and Scott, Saskatchewan. A survey into Alberta was made in late September where late fields of cultivated oats and wild oats were inspected. Surveys in Manitoba began in late June and continued through August, and in Saskatchewan in August and September. About 450 samples were collected for physiologic race analysis.

RESULTS AND COMMENTS: Oat stem rust was first found in trace amounts in southern Manitoba on July 23, and increased gradually until the second week of August, when the disease began to increase rapidly. However, most commercial oats in Manitoba were not affected due to their resistance, and most crops of susceptible cultivars ripened before extensive damage occurred. Some late fields of susceptible cultivars likely suffered some damage due to the sudden increase of stem rust, brought on by warm and humid weather. By September oat stem rust occurred continuously from Manitoba to southern Alberta, but infections through Saskatchewan and Alberta were light to moderate, and most fields had been harvested. No oat stem rust was found in central Alberta.

The analysis of the occurrence and distribution of physiologic races is currently in progress.

CROP: Spring Wheat

LOCATION: Saskatchewan

TITLE: LEAF DISEASES OF SPRING WHEAT IN SASKATCHEWAN IN 1987

NAME AND AGENCY:
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METHODS: Disease assessment was made on experiments conducted at Saskatoon, Shellbrook, Paddockwood and Weirdale. The experimental design was a randomized complete block with six replications. Each replication consisted of eight cultivars: Neepawa, Kenyon, Park, Oslo, Pembina, Wildcat, Potam and Columbus. Ten random plants from each plot were sampled on August 4 at Paddockwood and Weirdale, August 5 at Shellbrook and August 11 at Saskatoon. Flag leaves of these plants were rated for leaf-spotting diseases, using the Horsfall-Barratt scale. Pathogens causing the leaf-spotting diseases were identified. On July 30, a soft white spring wheat yield trial at Outlook was rated for leaf-spotting diseases. The disease assessment was made on two replications. Each replication consisted of 25 genotypes. A random sample of leaves were collected for the identification of pathogens causing the leaf-spotting diseases.

RESULTS AND COMMENTS: Occurrences of leaf diseases in spring wheat at five sites are presented in Table 1. At the time of disease assessment, septoria nodorum blotch was the predominant leaf disease at Outlook, Saskatoon, Paddockwood and Weirdale. At Shellbrook, both septoria nodorum blotch and tan spot were the main leaf diseases. At Paddockwood, Shellbrook and Weirdale, tan spot was the predominant leaf disease in early summer. Septoria tritici blotch started to appear in July and by mid-August was as prevalent as septoria nodorum blotch at Shellbrook. Leaf rust appeared in late summer at Outlook, Saskatoon and Weirdale.

At all sites, the plants were severely infected with leaf-spotting diseases, resulting in premature senescence of leaves. Severity of the leaf-spotting diseases was higher at the northcentral sites than at Saskatoon and Outlook. Head infection (average severity 10-25%) by **Leptosphaeria nodorum** was common throughout northcentral Saskatchewan.

Table 1. Occurrences of wheat leaf diseases at five sites in Saskatchewan in 1987.

Site	Disease
Outlook	SNB, TS and LR
Paddockwood	SNB, TS, STB and PM
Saskatoon	SNB, TS, STB, SAB and LR
Shellbrook	SNB, TS and STB
Weirdale	SNB, TS, STB, PM and LR

SNB = Septoria nodorum blotch; TS = tan spot; LR = leaf rust;
STB = Septoria tritici blotch; PM = powdery mildew;
SAB = Septoria avenae blotch.

CROP: Wheat

LOCATION: Saskatchewan

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TITLE: DISEASE SURVEY OF WHEAT FIELDS IN N.E. SASKATCHEWAN

METHOD: Sixty five wheat fields were surveyed for disease between June 29, 1987 and July 27, 1987 in Crop districts 5b, 8a, 8b and 9a in N.E. Saskatchewan. Fields surveyed were selected at random in each crop district. One plant was selected every ten paces, ten times in each field. Diseases were identified according to visual symptoms expressed on the plant and findings were recorded on a standard format sheet. Root rot severity was assessed based on a scale where 0 = Healthy, 2 = Trace, 5 = Moderate, and 10 = Severe according to the lesions found on the subcrown internode. (1, 2) All other diseases were assessed on perecentage of leaf or stem area affected (3). Results for each disease were totalled and averaged over the total number of samples and fields surveyed to give the Disease Index. Percentage of fields affected was calculated by dividing the number of fields in which the disease occurred by the total number of fields surveyed. Any symptoms that were not recognized in the field were returned to the lab for incubation and identification if possible. Diseases listed as trace (T) were found in the field, but not in the sampled plants

RESULTS AND COMMENTS: Septoria blotch (*Septoria* sp.) was the most severe and widespread disease followed by Tan spot (*Drechslera tritici-repentis*) and Root rot (*Bipolaris sorokiniana*). Although Tan spot was found in fewer fields than Root rot, it had a higher disease index. Other diseases such as Powdery mildew (*Erysiphe graminis*), leaf rust (*Puccinia recondita*) and loose smut (*Ustilago tritici*) were found in a few fields, but in very low amounts.

Table. Percentage of Fields Affected and Severity of Diseases

C.D.	Field Assessed: Number of Fields	Disease Index/% Fields Affected: Root Rot	Septoria	Tan Spot	Powdery Mildew	Leaf Rust	Loose Smut
5B	17	1.57/100	9.07/100	1.12/82.4			*T/5.9
8A	12	1.43/83.3	11.75/83.3	1.64/75.0	0.82/8.3		
8B	15	2.90/93.3	14.62/100.0	7.27/86.7	0.51/6.7	0.08/20.0	
9A	21	2.27/100	5.47/100	5.68/61.9	1.37/28.6		*T/14.3
Total or Avg.	65	2.04/95.4	10.23/96.9	3.93/7.54	0.68/12.3	<0.1/4.6	<0.1/6.2

*T Disease found in the field, but not in the sampled plants

REFERENCES:

(1) Ledginham, R.J. et. al. 1973
Wheat losses due to common root rot in the Prairie Provinces of Canada, 1969-71.
Can. Plant Dis. Surv. 53(3):113-122

(2) Tinline, R.D. 1986
Agronomic pratices and common root rot in spring wheat. Effect of depth and density of seeding on disease.
Can. J. Plant Pathol. 8(4):429-436

(3) James, C. 1971
A Manual of Assessment Keys for Plant Diseases
Canada Dept. of Agriculture #1458

CROP: Spring Wheat and Spring Barley

LOCATION: Central Saskatchewan

TITLE: DISEASE SURVEY OF IRRIGATED CEREALS IN SASKATCHEWAN IN 1987

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

METHODS: From Riverhurst to Warman along the South Saskatchewan River and associated irrigation canals, 20 fields of spring wheat and four 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 fields were being irrigated with a center pivot system. Sampling began inside the outside wheel track of the pivot and a diamond pattern was used with each collection site being 10 m 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 on subcrown internodes by scoring percent discoloration using the Horsfall-Barratt system. At harvest time, the same fields were visited again to collect head samples. These were used to assess for head discoloration and after threshing, kernel discoloration. Representative samples from leaves, crowns and heads were saved for detailed observation and/or plating to determine casual agents.

RESULTS: Plant samples were taken on the following dates with growth stages according to Zadoks et al. given in brackets: June 17, 18 (G.S. 20-31) then again on July 8, 10 (G.S. 45-69) then again on July 28, 30 with two fields on August 5 and one each on August 16 and 17 (G.S. 71-88). For these three times the average rating for foliar diseases in barley was 0.7, 2.3 and 6.7, respectively, and for wheat ratings were 1.0, 3.2, and 6.7, respectively. A 6.7 rating indicates 10-25% symptoms on upper leaves and greater than 50% symptoms on middle and lower leaves. On the first dates in wheat, 12 fields had plants showing leaf mottling symptoms affecting about 10% of the leaf area and up to 25% of the leaf area in one field. This symptom was not observed later in the season. The average ratings for common root rot on barley were 3.0, 9.8 and 18.0, respectively, and 4.2, 10.0 and 15.6, respectively, on wheat. Prematurity blight was observed in low levels in two wheat fields. Take-all occurred in six wheat fields with an average of 8% of plants affected but the disease was not severe in that plants were not killed. Head samples were collected on August 25 and September 02 from only 18 wheat fields. All the other fields had been combined. The average head discoloration (glume blotch symptoms) was 2%, and 3% of kernels showed smudge/black point symptoms. Tombstone and pink kernels occurred in five fields of wheat but with less than 2% affected kernels. Loose smut occurred in three wheat fields at levels less than 2% affected plants. Determination of the causal agents of disease symptoms on foliage, crown and heads has not been done yet.

CROP: Wheat

LOCATION: Central Alberta

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TITLE: WHEAT DISEASE SURVEY IN CENTRAL ALBERTA, 1987

METHODS: Twelve wheat fields were surveyed in early August 1987 in the counties of Ponoka, Lacombe and Red Deer, which form part of Census District 8. This was one field surveyed per 9,000 acres sown. Each field was traversed in an inverted V and sampled at five sites about 20 paces apart. Diseases were identified by visual symptoms. In addition, unusual conditions were noted.

Disease severity was assessed as follows:

trace	=	$\leq$ 1%
slight	=	$\leq$ 5%
moderate	=	5-25%
severe	=	25-100%

RESULTS: Common root rot (*Cochliobolus sativus* and *Fusarium* spp.) was present in every field surveyed but only in trace amounts. Septoria leaf blotch (*Septoria* complex) was also present in every field with 42% of the fields showing moderate (5-25%) leaf damage. As well, 42% of all fields had septoria glume blotch with 40% of them moderately diseased. Both take-all (*Gaeumannomyces graminis*) and stem melanosis (*Pseudomonas cichorii*) were seldom observed and leaf rust (*Puccinia recondita*) occurred only rarely in the southern portions of the region. Stripe rust (*Puccinia striiformis*) was not observed at all. Powdery mildew (*Erysiphe graminis*) was common (42%) in trace amounts.

COMMENTS: The cool, wet July undoubted contributed to the amount of septoria leaf and glume blotch encountered.

CROP: Winter wheat

LOCATION: Saskatchewan

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TITLE: FOLIAR DISEASE SURVEY OF WINTER WHEAT IN SASKATCHEWAN, 1987

METHODS: From mid-May to mid-July, 96 winter wheat fields across Saskatchewan were surveyed for foliar diseases in 1987. Each field was sampled once early in the season (plants at Zadoks growth stage 18-38) and again after flag leaf emergence (Zadoks G.S. 54-71). For each sample from each field, 40 plants were collected in a diamond-shaped pattern (about 0.4 ha) and individually rated for foliar diseases present. Disease in the early sample was recorded as % plants with trace symptoms. For the second sample Couture's rating scale was used. The effect of the previous year's crop on development of leaf spotting diseases was examined.

RESULTS AND COMMENTS: Leaf spot was present in most fields in trace amounts in the first sample. Crop District 5 had the highest average number of plants infected per field, with 45%, followed by C.D. 3 (29.3%), C.D. 8 (25%), C.D. 2 (18.9%), C.D. 6 (16.3%), C.D. 1 (12.9%) and C.D. 4 (1.25%). In C.D. 8, an average of 28.2% of the plants sampled per field had trace amounts of powdery mildew in the early sample. Leaf spot incidence increased to close to 100% by the second sample and its severity also increased. C.D. 5 had the highest average severity (a rating of 6) (5% of the upper leaf area diseased). C.D.'s 1, 2, 3, 6, and 8 had average leaf spot severity ratings in the range of 4-5 (2-10% of the middle leaf area diseased) and C.D. 4 had the lowest (2.5) (5% of lower leaf area diseased). Powdery mildew was present with high severity in some fields in C.D.'s 5 and 8. Leaf rust was found in trace amounts in C.D.'s 5 and 8. Powdery mildew and take-all were considerably less prevalent and severe due to very dry conditions in the northeastern part of the province where these diseases are commonly a problem. Fields seeded into canola stubble or summerfallow had fewer plants with leaf spot symptoms in the early sample but no significant differences were found in leaf spot severity among fields with different previous crops in the second sample. Data are currently being gathered to determine the effect of 2- and 3-year previous cropping history on initial disease development. Determination of the causal agents of the leaf spotting diseases has yet to be completed.

REFERENCE: Couture, L. 1980. Assessment of severity of foliage diseases of cereals in cooperative evaluation tests. Can. Plant Dis. Surv. 60: 8-10.

CROP: Wheat, barley and oats

LOCATION: Manitoba, Saskatchewan and Alberta

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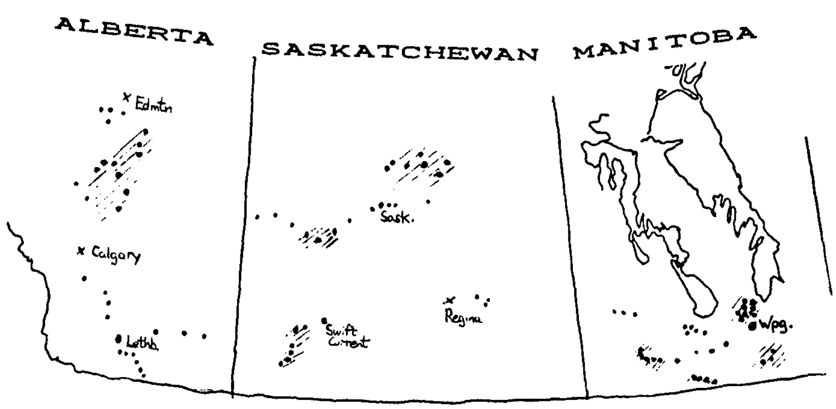
TITLE: BARLEY YELLOW DWARF SURVEY IN WESTERN CANADA

METHODS: Ninety-four cereal grain fields were surveyed from mid-June to mid-July, 1987 in locations as shown by dots on the map below. Barley yellow dwarf (BYD) was first tentatively identified in stands of bread- and durum wheat, barley and oats by visual symptoms, and representative samples of transplants and detached leaves with and without symptoms were collected for later analysis by aphid transmission and serological assay (ELISA). At 49 locations, representing all the regions examined in the survey, fields were traversed along the paths of diagonals and 50-100 leaf samples collected at random for later analysis of individual leaves by ELISA.

Initial estimates of severity were based on visual assessment of the proportion of visibly afflicted plans and the degee of stunting and loss of vigor of afflicted plants compared to escapes from the same field.

RESULTS AND COMMENTS: BYD incidence and severity were at historically high levels for cereal-growing regions of western Canada. In 'hot spot' areas (shaded areas on map) of southeastern Manitoba and north central Saskatchewan, as high a proportion as 100% of plants in a field were infected. Losses attributable to BYD ranged from 10-15% for crops on clay soils (Red River Valley) where drought stress was not severe, through 20-30% on sandy soils (south of Steinbach, Manitoba), to 80-90% for some durum wheat fields (near Domremy, Saskatchewan) where BYD infection at early plant growth stages had predisposed crops to potentiated drought stress and foliar fungal infections.

The principal factor that probably accounted for the much higher incidences of BYD in 1987 than in any of the previous three years was the arrival earlier than usual of aphid inoculum on strong southerly winds in late May and early June when many crops were at vulnerable early plant growth stages. In the Calgary area, snow in early June led to replanting of some fields, and these were almost completely free of BYD.



CROP: Wheat

LOCATION: Manitoba - Saskatchewan

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TITLE: INCIDENCE AND SEVERITY OF LEAF AND STEM RUST OF WHEAT IN THE EASTERN PRAIRIES IN 1987

METHODS: We examined more than 90 commercial fields of winter and spring wheats for severity and incidence of leaf and stem rust of wheat. Readings and samples were also collected at specially planted wheat nurseries throughout the eastern prairies.

RESULTS AND COMMENTS: Initial and secondary spread of leaf rust was easily found on winter wheat at Morden and Portage la Prairie, Mb. in early June, indicating that initial infection had occurred in mid-May. Leaf rust was widespread by early August, reaching high levels of infection in winter wheat and susceptible hard red spring cultivars in Manitoba and Saskatchewan. Neepawa and Katepwa were moderately resistant to moderately susceptible when examined in commercial fields in early August. Yield in these cultivars was not affected, however, as grain filling in the heads occurred before infection reached high levels. There was no or little leaf rust on cultivars Columbus, Roblin, Kenyon and durum varieties. Yield reduction due to leaf rust was minimal in 1987. Preliminary virulence studies indicate increasing levels of virulence on *Lr*24 and traces of virulence on *Lr*26.

Stem rust was first found on winter wheat at Moosomin, Saskatchewan, July 2nd, several weeks earlier than usual. Infections reached trace to light amounts on winter wheat and susceptible spring wheat cultivars over all of Manitoba and eastern Saskatchewan. Crop loss due to stem rust was minimal, even in susceptible winter wheat. Preliminary virulence studies indicate race C53, the dominant race in the prairies for many years, still comprises 90% of the stem rust population.

CROP: Wheat

LOCATION: Manitoba

TITLE: FUSARIUM HEAD BLIGHT OF SPRING WHEAT IN MANITOBA IN 1987

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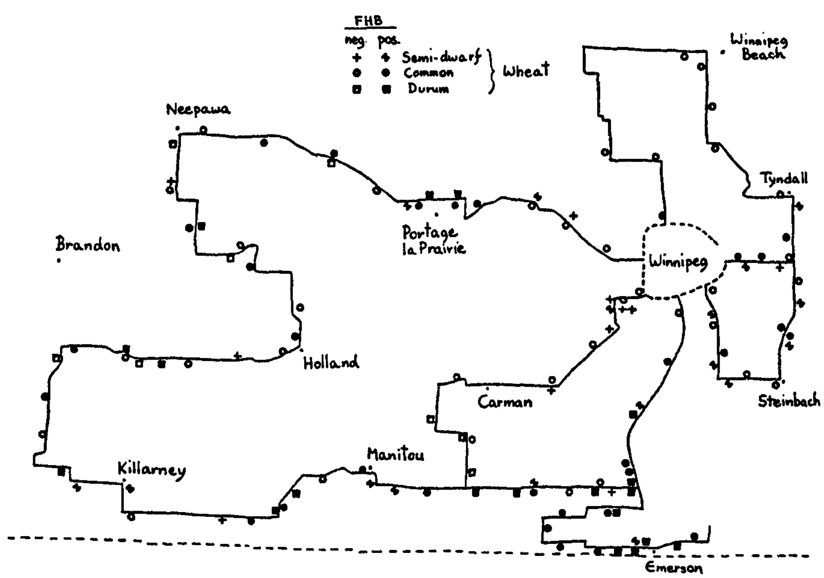
METHODS: 122 fields of common, durum and semi-dwarf wheats in south-central Manitoba were surveyed for Fusarium head blight (FHB) from 15 to 31 July 1987 (Fig. 1). Fields were selected at random along the survey routes. FHB was identified visually by sampling an area of about 50 x 30m at the edge of each field. When disease was evident at higher than trace levels four samples of at least 50 adjacent wheat heads were examined for FHB. Disease levels were categorized as: trace (tr - 0.5% heads infected); slight (0.5 - 5.0%); moderate (6 - 20%); and severe (>20%). Diseased heads were collected for pathogen identification.

RESULTS AND COMMENTS: The incidence of FHB in all fields was 55%. It was found in 46% (32 of 69) of common, 72% (18 of 25%) of durum, and 61% (17 of 28) of semi-dwarf wheat fields. FHB was widespread but was most concentrated in the area south of Winnipeg near the US border and was least common in the Interlake north of the city (Fig. 1). Most fields had FHB at only trace levels. The others, 10 durum and 2 common wheat fields, had FHB at slight (7 fields), moderate (4) or severe (1) levels. The latter two categories comprised only of durum types. Most fields with higher than trace disease were in the region directly south of Winnipeg and within 40km of the US border. The exception was of one durum field south of Neepawa with 10% FHB. Severity of infection on individual heads ranged from a single spikelet to the entire head. The higher proportions were found in durum wheat. Species of *Fusarium* isolated from FHB-infected spikelets included *F. graminearum* (most common), *F. sporotrichioides*, *F. acuminatum* and *F. culmorum*.

Fig. 1



CROP: wheat

LOCATION: Manitoba

TITLE: Incidence of Plant Diseases in Wheat in Manitoba in 1987

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METHODS: Results are based on 150 samples of wheat submitted to the Plant Pathology Laboratory and field examinations.

RESULTS: Thirty-four percent of samples were analysed for seed borne diseases, primarily *Fusarium* sp. on 1986 harvested seed, from the Central region adjacent to the Red River Valley. The highest levels of *Fusarium* occurred on Durum. Some seed lots showed as much as 60% level of *Fusarium* mainly a combination of *F. graminearum* and *F. sporotrichioides*. The average percentage of *Fusarium* was 23.3%. The *Fusarium* toxins, vomitoxin and HT2 were detected in some durum samples. Twenty-seven percent of samples showed *Septoria* sp. but the levels were less than 1986. An additional 6% of samples had glume blotch. The incidence and severity of tan spot and septoria in wheat in 1987 was much lower than in 1986. There has been a trend however in the past 2 years towards an increased incidence of *Septoria*, whereas tan spot now accounts for about two thirds of the leaf disease problems observed. Fourteen percent of samples showed root and crown rot. Five percent showed rust, primarily on winter wheat, but levels were much lower than 1986. Four percent of wheat samples were diagnosed as having barley yellow dwarf. Yield loss was less than 10%. Three percent of samples were affected by Fusarium head blight and three percent were affected by head moulds. Leaf rust was found at only trace levels on susceptible cultivars of spring wheat but was present at quite high levels on winter wheat in southern Manitoba. Loss from leaf rust in winter wheat was less than in 1986 because of the slower rate of development. Stem rust was not a problem on winter wheat in 1987.

CROP: Wheat

LOCATION: Manitoba

TITLE: LEAF DISEASES OF SPRING WHEAT IN MANITOBA IN 1987

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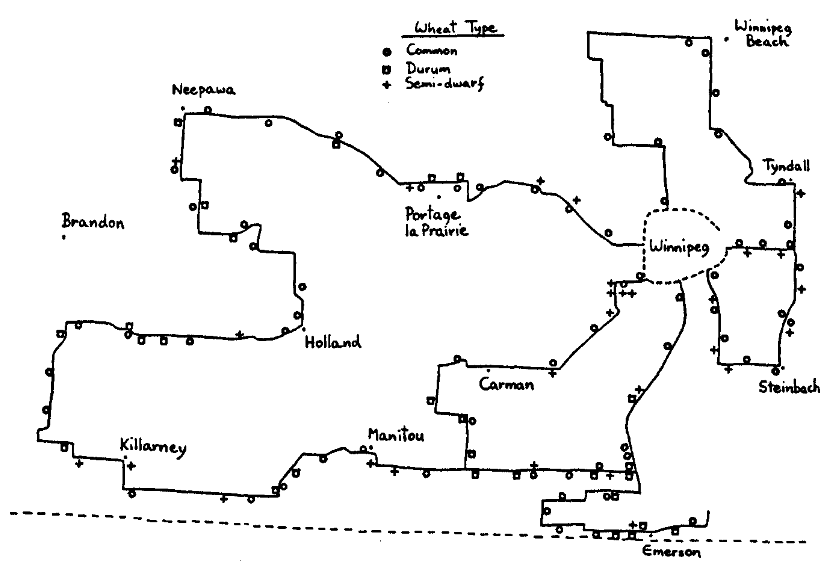
METHODS: 122 fields of common, durum and semi-dwarf wheats in south-central Manitoba were surveyed for leaf diseases from 15 to 30 July 1987 (Fig. 1). Fields were selected at random along the survey routes. An inverted V transect about 100m long was sampled in each field and disease severity was assessed on 20-30 plants. Disease levels were categorized as: trace (<5% leaf area diseased); slight (5 - 15%); moderate (16 - 37%); and severe (38 - 100%). Ratings were done on both the upper (flag) and lower leaves. Samples were collected for identification of the disease-causing pathogens.

RESULTS AND COMMENTS: The main diseases were septoria avenae blotch (*Leptosphaeria avenaria* f.sp. *triticea*) and tan spot (*Pyrenophora tritici-repentis*). Septoria nodorum blotch (*Leptosphaeria nodorum*) and septoria tritici blotch (*Mycosphaerella graminicola*) were found occasionally. These could not be differentiated with certainty on the basis of visual symptoms. Leaf spot severity was at trace levels in 32% of fields, slight - 49%, moderate - 18% and severe - 0%. The proportion of common, durum and semi-dwarf wheats with moderate disease severity was 17%, 32% and 7%, respectively. Damage was enhanced on lower leaves with 75% of fields rated in the moderate or severe category. Fields with severe leaf spot levels on lower leaves were scattered throughout the surveyed area. The relatively low disease levels on the flag leaf when sampled (late milk to early dough, Zadoks' scale 77-83) suggests that yield losses due to leaf spots were generally minimal. Septoria avenae blotch was more common than tan spot (3:1 ratio), the opposite to that found previously.

Fig. 1



CROP: Cereals

LOCATION: Ontario

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TITLE: CEREAL DISEASES IN ONTARIO, 1987

WEATHER: A relatively mild winter was followed by an early spring and an unusually warm summer; in most areas low precipitation in spring and early summer resulted in drought stress and reduced yield and test weight of most spring cereals. Foliar diseases were present early in the season but their development in most areas was suppressed by hot dry weather. Weather at harvest was generally excellent with no problems from sprouting or vomitoxin in soft white winter wheat.

Notable disease problems included dwarf bunt in winter wheat; powdery mildew in 6-row barley cultivars, including susceptibility of cv. Léger; and crown rust in oats, with the development and spread of a virulent race on formerly resistant OAC Woodstock and the appearance of other potentially dangerous new races in buckthorn-infested areas.

WINTER WHEAT: The acreage of winter wheat was much lower than usual because of unfavorably wet seeding conditions in the fall of 1986. Many fields were broadcast-seeded, and late-seeded crops were poorly established before winter. However, a combination of adequate snow cover, mild temperatures, and absence of a January thaw resulted in unexpectedly good survival. Snow molds caused light to moderate losses, with less plow-down than usual. *Typhula incarnata* *T. ishikariensis*, *T. phacorrhiza*, *Microdochium nivale*, and *Myriosclerotinia borealis* were involved. In Simcoe Co. survival was higher in drilled than in broadcast-seeded fields and desiccation stress in spring resulted in poor tillering and slow development. Late seedings and broadcast fields in several eastern counties also suffered from drought stress in early spring. Wheat spindle streak mosaic [WSSMV] was suppressed by the warm spring in the southwest, although symptoms were prominent in test plots at Ottawa. Powdery mildew [*Erysiphe graminis*] developed early and spread rapidly but was arrested by hot weather in most western counties; development was reported heaviest in fields that had been seeded to susceptible spring wheat in 1986. Manganese deficiency was widespread in dryer, lighter soils in the southwest. Leaf rust [*Puccinia recondita*] was light-moderate in most areas but moderate on upper leaves late in the season. Overwintered *Septoria tritici* infections were common in southwestern and eastern counties and in Perth-Huron, but development was slowed by dry, hot weather. Tan spot [*Drechslera tritici-repentis*] was generally light. Septoria glume blotch [*S. nodorum*] was widespread and moderate to severe in Perth-Huron and York-Simcoe. Take-all [*Gauemannomyces graminis*] was reported widely but was not severe in most fields. Yellow-dwarf [BYDV] was relatively light in all areas, although individual fields in Victoria and Northumberland showed up to 30% infected plants. Fusarium head blight [*Fusarium graminearum*] was light in most areas and no problems with mycotoxin levels were experienced in harvested grain.

Cocksfoot mild mosaic [CMMV] was detected in 18 of 26 fields of winter wheat in 16 counties in southern Ontario, but levels of infection were low (less than 12%). This disease is not regarded as potentially threatening at present, but inoculation tests have shown that while Fredrick is highly resistant or tolerant, newer cultivars are moderately susceptible (Augusta) or highly susceptible (Harus).

In a cooperative survey of winter wheat throughout southern Ontario, dwarf bunt was detected in 42 of 288 fields of pedigreed seed wheat in three counties but in only 1 of 308 commercial fields. Counties affected were Huron, Perth, and Simcoe.

SPRING WHEAT: The feed wheat Laval 19 and the western milling wheats Fielder, Katepwa, and Columbus were heavily infected by powdery mildew [*Erysiphe graminis*], but only a few pustules were noted on Max. Fungicide applications were considered cost-effective in some areas but not in others where mildew developed late on upper leaves. Septoria glume blotch and fusarium head blight were widespread and of moderate severity in fields east of Ottawa, especially in durum. In two adjacent fields of cv. Max, glume blotch was tr-light in the fall-plowed field and severe in the spring-plowed field. Leaf rust was not observed on resistant western cultivars, and incidence was late and generally light on susceptible cultivars. Septoria leaf spot and tan spot were moderate, especially on Max, and tan spot was most severe in second-year wheat crops. Take-all also was moderate in second-year wheat fields. Agropyron mosaic was detected in 5 of 8 spring wheat fields examined in the area east of Ottawa. This virus overwinters in *Agropyron* and is transmitted by windblown mites to wheat, causing infection about mid June. Warm dry weather in 1987 favored a buildup of mite populations. This disease is regarded as relatively minor, although in one field infection levels were high (17% visible symptoms) in late tillers produced from plants flattened by tractor wheels.

BARLEY: Relatively mild winter conditions resulted in good survival of winter barley crops in the main growing area. Yellow dwarf [BYDV] generally was less prevalent than usual, but moderate to severe levels were observed in two fields of winter barley in Middlesex Co. In spring barley, yellow dwarf levels were higher than usual in the Thunder Bay area, but elsewhere levels were generally low, reflecting low aphid populations in early summer and probably a low incidence of fall infection in winter cereals. Powdery mildew [*Erysiphe graminis*] was not a problem in winter barley or in 2-row barley, but it developed to moderate-severe levels on all 6-row barley crops in most areas, especially the south-central counties. The loss of resistance in the high-yielding cv. Léger is of concern. Scald [*Rhynchosporium secalis*] also was reported at moderate levels in Perth-Huron, Bruce-Grey, and York-Peel-Simcoe areas, especially in early-sown 2-row cultivars. Net blotch (*Pyrenophora teres*) was also reported in Bruce-Grey and some eastern counties; generally light infections of the spot form of net blotch were found on 2-row barleys. Manganese deficiency was noted in Norfolk-Brant-Wentworth-Elgin and in the New Liskeard area. In the northeast, scald was common, especially in second-year barley crops, other leaf diseases were prominent in late-seeded fields, and scab [Fusarium spp.] was widespread. In the northwest, loose smut [Ustilago nuda], scald, and net blotch were reported by late June, and a high incidence of common root rot and head blight occurred in late August, especially on lighter soils. Pyrenophora leaf stripe [Pyrenophora graminea] continues to be of concern in test plots and nurseries, but a field survey was not conducted.

OATS: In general, yield and test weight of oats were disappointing. Heat and drought stress resulted in high levels of blasting in the southwest. Red leaf (barley yellow dwarf virus) incidence and aphid populations were relatively low in most areas, except in Perth and Huron counties, where levels were moderate in some fields. Septoria leaf blotch and black stem (Septoria avenae) was light to moderate in some fields in the Niagara, central, and eastern areas where precipitation and high humidity occurred late in the season. The most important disease development in oats was the widening of the area in which the formerly resistant cv. OAC Woodstock was affected by crown rust. In 1986, isolates of Puccinia coronata virulent on OAC Woodstock were detected in trace amounts in localized areas of eastern Ontario. In 1987 light to moderate infections occurred at several locations in the eastern counties, and a moderate infection also was found in the Niagara-Haldimand area. In addition, other new races of P. coronata were detected in eastern Ontario that threaten all new rust-resistant cultivars now grown in western Canada. The continual development of new races of both stem rust and crown rust as a result of sexual recombination on alternate hosts in Ontario poses a serious threat to cereal production both in Ontario and elsewhere in North America where resistant cultivars are deployed. This situation will undoubtedly continue until efforts to control the populations of barberry and buckthorn are renewed.

CROP: Cereals

LOCATION: Quebec

NAME AND AGENCY: COUTURE, L., DEVAUX, A. and DOSTALER, A.
Agriculture Canada, Research Station
Ste. Foy, M.A.P.A.Q., Saint Hyacinthe, and
Universite Laval, Quebec

TITLE: HIGHLIGHTS OF CEREAL DISEASES IN QUEBEC IN 1987.

Weather conditions in southwestern Quebec up to the end of June were favourable for *Fusarium* head blight (*F. graminearum*) infections in spring wheat. Infections were observed in all regions and varied from 10 to 33% infected heads (average 19% heads and 5% spikelets) in cultivar Max in the Saint Hyacinthe region. Spring wheat Katepwa, as well as winter wheat cultivars which flowered earlier, were much less infected. Traces were also noticed in barley in southwestern Quebec.

From early July until the end of the season, very severe drought conditions in the Saint-Hyacinthe region caused a premature ripening of the heads (more than 30% in some fields of cv. Max) with symptoms much like those of take-all (*Gaeumannomyces graminis*). Take-all varied from less than 1% to 10% (average 8%) in surveyed winter wheat fields and from less than 1% to 8% (average 3%) in surveyed spring wheat fields in the Saint-Hyacinthe region. It occurred also at light levels in barley in southwestern Quebec.

Leaf spot (*Pyrenophora tritici-repentis* mixed with *Septoria nodorum*) were observed in significant amounts (up to 19% necrosis on upper leaves) only late in the season when wheat plants were at the soft dough stage. Glume blotch (*Septoria nodorum*) was observed in slight quantities (less than 5% infected glumes) only in the Quebec City region and in the Eastern Townships.

Leaf rust of wheat (*Puccinia recondita*) prevailed at the late soft dough stage in significant quantities on susceptible cultivars in southwestern Quebec.

Early infection of powdery mildew (*Erysiphe graminis*) occurred in susceptible wheat cultivars like Katepwa (spring) and Yorkstar (winter) in southwestern Quebec. It was also light to moderate in barley in the same region.

Ergot (*Claviceps purpurea*) was widespread in barley fields in the Saguenay-Lac-Saint-Jean region. Its severity was such that it caused a large number of crops to be rejected or downgraded. It was also observed affecting about 0.1% heads in a field of Katepwa wheat at Saint Hyacinthe.

Net blotch (*Pyrenophora teres*) and scald (*Rhynchosporium secalis*) were widespread. Net blotch was moderately severe to heavy from southwestern Quebec to Lac-Saint-Jean; scald was fairly heavy in the Quebec City region. Spot blotch (*Bipolaris sorokiniana*) was light to moderate in southwestern Quebec. Bacterial blight (*Xanthomonas campestris translucens*) was found in some barley research plots.

Crown rust (leaf rust), caused by *Puccinia coronata*, was highly conspicuous west of Montreal where it was the most severe disease of oats. Elsewhere in the province, its severity was very slight except in the Lower St. Lawrence and in the Saint Hyacinthe regions where it reached light to moderate levels.

Speckled leaf blotch, caused by Septoria avenae, was widely distributed in oat crops over the province. Its severity ranged from average to above average depending on regions.

Yellow dwarf, caused by the barley yellow dwarf virus (BYDV), was on the increase this year except in Abitibi where there was little. Its severity in oats was at least equal to the one of speckled leaf blotch and sometimes higher. It was most noticeable in eastern Quebec, in the Eastern Townships, and in the Lac-Saint-Jean region.

Various snow mould agents were detected in experimental plots and fields of winter cereals: Gerlachia nivalis, Sclerotinia borealis, and Typhula ishikariensis in wheat, triticale, and barley and Typhula incranata in wheat and triticale.

Smuts (Ustilago spp.) were usually very low in all crops.

CROP: Cereals

LOCATION: Prince Edward Island
New Brunswick
Nova Scotia

NAME AND AGENCY:
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TITLE: CEREAL DISEASE DISTRIBUTION AND SEVERITY IN THE MARITIME PROVINCES

WEATHER CONDITIONS: The 1987 growing season was considerably drier than normal during mid-summer and this contributed to a general lowering of disease severity. Rainfall at Charlottetown during July and August amounted to 7 mm and 40 mm compared to a 78 year average of 78 mm and 86 mm, respectively. This weather pattern was widespread throughout the Maritime Provinces excepting north-western New Brunswick which had more rainfall.

SPRING WHEAT: Spring wheat crops were not subjected to the normal disease pressures and little septoria glume and leaf blotch was detected on early seeded crops. All isolations from leaf blotch lesions on spring wheat yielded isolates characteristic of Septoria nodorum. Glume blotch symptoms were much reduced from previous years in all areas of the Maritimes with the exception of north-western New Brunswick. In north-western New Brunswick, glume blotch and fusarium head blight were more severe on spring wheat than in any other area of the Maritimes. This was attributed to the moist weather occurring in this area in July and early August. Fusarium head blight surveys indicated that the most frequently isolated species from spring wheat heads were Fusarium poae, F. avenaceum, and F. sporotrichiodes. In north-western New Brunswick the moist environment favoured F. graminearum and F. avenaceum isolations from seed.

Powdery mildew, incited by Erysiphe graminis, was not a serious disease on spring wheat in 1987 with the exception of the cultivar, Katepwa.

Loose smut, incited by Ustilago tritici, was a more noticeable disease on spring wheat than in previous years although the level remained below 0.05% in field observations.

WINTER WHEAT: Winter wheat, like the spring wheat, was observed to have very low levels of septoria glume and leaf blotch. Levels of fusarium head blight were in general lower on winter wheat than spring wheat. Powdery mildew levels on the susceptible cultivars, Monopol and Absolvent were very low in fields in Nova Scotia where these cultivars are mainly produced. This was due to the widespread use of foliar fungicides, however disease levels on these and similar cultivars in untreated plot trials remained very high. Feed winter wheats were not affected by powdery mildew regardless of resistance levels since most of this crop is produced at much lower nitrogen fertility levels than cultivars destined for the milling trade.

Root diseases were more prevalent in 1987 than previous years and this may have been exacerbated by the dry weather. Take-all was particularly severe in research plots of winter wheat in the Truro area but to a much lesser extent in commercial fields.

Snow molds were not severe and winter survival throughout the Maritime Provinces was good. Where snow mold did occur, it was due primarily to Gerachia nivalis and to a lesser extent Typhula and Sclerotinia spp.

BARLEY: Spring barley production was enchanced by the low levels of leaf diseases recorded in all areas of the Maritime Provinces. Scald, incited by Rhyncosporium secalis was at relatively low levels and in general did not progress to the upper foliage. Net blotch, incited by Pyrenophora teres, was the predominant foliar disease on barley in the Maritimes. In general, however, impact on yield was not great with significant levels of disease only occurring during late stages of crop development, shortly before harvest. This was primarily due to low moisture levels in July and August when disease progression is usually greatest.

Common root rot was noticeably severe in fields of barley following barley in both New Brunswick and Prince Edward Island. This severity was not recorded when barley was planted following a non-cereal crop.

OATS: This species produced a healthy crop through out the Maritimes due to the reduction in severity of speckled leaf blotch incited by Septoria avenae. This was the only disease of consequence affecting the oat crop.

Forage legumes

CROP: Alfalfa

LOCATION: Saskatchewan

NAME AND AGENCY:
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TITLE: SNOW MOLD OF ALFALFA IN SASKATCHEWAN, 1985-87

METHODS: Thirty-six alfalfa fields in the northern and central portions of the grain belt in Saskatchewan (crop districts 5-9) were examined for winter injury and snow mold damage between April 22 and May 23, 1985. Forty-nine dryland alfalfa fields were surveyed from May 6 to May 28, 1987. Disease severity was assessed on the basis of stem and crown symptoms (Trace <1% of plants affected, Slight = 1-10%, Moderate = 11-25%, Severe >25%). Cottony snow mold (Coprinus psychromorbidus) identification was based on comparison with symptoms in inoculated field plots. Brown root rot (Phoma sclerotioides), characterized by circular, sunken, dark-brown root lesions, was also identified from symptoms. Five fields of red clover and five fields of yellow sweet clover were also examined in 1987.

RESULTS AND COMMENTS: In 1985, traces of cottony snow mold injury could be found in low-lying areas throughout the survey area, but no significant snow mold damage was observed. Low-temperature damage was generally slight, but several fields in the central portion of the grainbelt showed moderate to severe damage. In 1987, snow mold incidence in the northern portion of the grainbelt (Hudson Bay, Melfort and Meadow Lake regions, crop districts 8 and 9) was high, but disease severity was slight. However, in the Nipawin and Carrot River region (crop district 8), 5 of 10 alfalfa fields surveyed were severely damaged by cottony snow mold (Coprinus psychromorbidus), with several fields exhibiting 80-90% damage. Moderate levels of brown root rot (Phoma sclerotioides) damage were observed on alfalfa in the Nipawin area. Brown root rot damage was very severe on red clover and yellow sweet clover fields in that region. P. sclerotioides was also noted on sweet clover near Watrous (crop district 6). No winter injury or snow mold damage on alfalfa was observed in the southern and central portions of the grainbelt. The unusually mild winter of 1986-87 was probably responsible for the severity of the snow mold outbreak on alfalfa, because snow mold fungi requires soil temperatures near 0°C for optimum disease development. No survey of snow molds on forage legumes was made in 1986 because highly susceptible crops e.g. turfgrasses, showed little or no snow mold injury. However, low-temperature damage on alfalfa and other forage legumes was widespread and severe.

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

CROP: Irrigated alfalfa

LOCATION: Saskatchewan

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TITLE: SURVEY OF IRRIGATED ALFALFA IN SASKATCHEWAN

METHODS: Fifty irrigated alfalfa fields in the south-western and central portions of the grain belt in Saskatchewan (crop districts 3, 4 and 6) were examined for the presence of Verticillium wilt (*Verticillium albo-atrum*) between July 6 and July 20, 1987. 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.

RESULTS AND COMMENTS: Samples were taken from 23 fields. Verticillium infection was confirmed in only two fields; one in the Chesterfield Flats irrigation project on the South Saskatchewan River near the Alberta border in crop district 4, and the other less than 15 km from the first, in a separate irrigation project. Verticillium wilt was previously isolated from alfalfa in the Chesterfield Flats project (A. Frowd, personal communication). This is the first report of Verticillium wilt of alfalfa in Saskatchewan since 1984. Spring black stem (*Phoma medicaginis* var. *medicaginis*) was observed in almost every field examined, and disease severity ranged from slight to moderate. Downy mildew (*Peronospora trifolium*) infection was moderately severe in three fields examined in the Outlook area.

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

CROP: Alfalfa

LOCATION: Saskatchewan

NAME AND AGENCY:
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TITLE: FOLIAR DISEASES OF ALFALFA IN NORTHEASTERN SASKATCHEWAN

INTRODUCTION: Fourteen alfalfa fields in crop districts 5b, 8a, 8b and 9a were surveyed between June 29 and July 22, 1987. Ten plants from each field were rated for percentage of leaf, or stem, area affected (Disease index) and losses calculated by the method of Berkenkamp 1971. Diseases listed as trace (T) were found in the field, but not in the sampled plants.

RESULTS AND COMMENTS: The table below shows that there were low levels of disease found in northeastern Saskatchewan this year, probably due to a very dry spring and the early survey. Common Leaf Spot (Pseudopeziza medicaginis) was the most widespread and severe, followed by Black Stem (Ascochyta imperfecta) and Yellow Leaf Blotch (Leptotrochila medicaginis). Stagonospora Leaf Spot (Leptosphaeria pratensis) was present in about half the fields, and with Pepper Spot (Leptosphaerulina briosiana) and Downy Mildew (Peronospora trifoliorum) caused essentially no loss.

Table. Prevalence, intensity and losses of foliar diseases of alfalfa in northeastern Saskatchewan.

Disease	% fields affected	Disease index	% loss
Common leaf spot	100	13.46	3.36
Black stem	79	5.60	1.40
Yellow leaf blotch	71	1.61	0.40
Stagonospora leaf spot	43	<0.1	
Pepper spot	7	<0.1	
Downey mildew	7	T	

Reference: Berkenkamp, B. 1971. Losses from foliage diseases of forage crops in central and northern Alberta in 1970. Can. Plant Dis. Surv. 51: 96-100.

CROP: Alfalfa

LOCATION: Southern Alberta

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TITLE: SURVEY OF VERTICILLIUM WILT OF ALFALFA IN SOUTHERN ALBERTA

METHODS: In July and August 1987, 111 fields of alfalfa in southern Alberta were surveyed for Verticillium wilt in the counties of Forty Mile, Newell, Letnbridge, Warner, Wheatland, and Vulcan, in the municipal districts of Taber, Cardston, Pincher Creek, Willow Creek, and Foothills, and in the improvement district no. 1 (Figure 1). The disease was identified by visual symptoms of wilt and V-shaped lesions on leaves of the plants. The fields were surveyed by entering the field at one corner, walking 200 paces towards the center of the field, and then exiting at 90° to the side of the field on which you came in (Figure 2). Suspect plants were noted on the entry transect and counted and collected at twenty-pace intervals on the exit transect. The suspect plants collected were brought back to the laboratory for isolation and identification of the pathogen.

RESULTS AND COMMENTS: Verticillium wilt of alfalfa caused by *Verticillium albo-atrum* was found in 8 of the 111 fields surveyed (Table). The 8 positive fields were all irrigated alfalfa distributed in the counties of Forty Mile, Newell, and Wheatland, and the municipal district of Taber (Figure 1). These positive fields are new in addition to those found in the 1986 survey of the Verticillium wilt of alfalfa.

Table. Survey of Verticillium wilt (VW) of alfalfa in southern Alberta, 1987.

Census division	County or municipality	No. fields Surveyed	No. fields With VW
1	Improvement district no. 1	4	0
2	Co. Forty Mile	3	1
2	Co. Newell	27	3
2	Co. Lethbridge	4	0
2	MD Taber	5	1
2	Co. Warner	4	0
3	MD Cardston	6	0
3	MD Pincher Creek	3	0
3	MD Willow Creek	3	0
5	Co. Wheatland	42	3
5	Co. Vulcan	3	0
6	MD Foothills	7	0
Totals		111	8

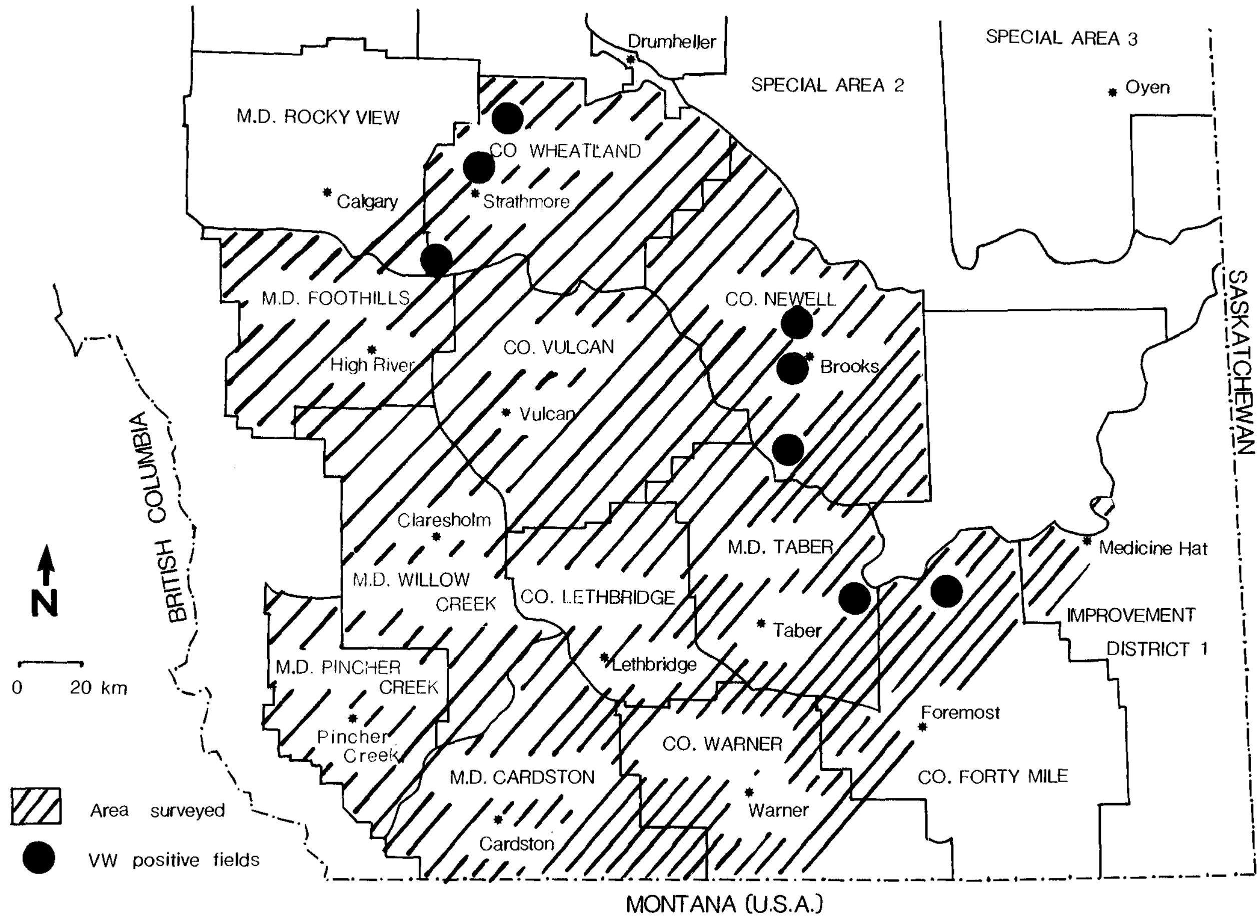

Figure 1. Area surveyed for Verticillium wilt of alfalfa and location of disease positive fields in southern Alberta, 1987.

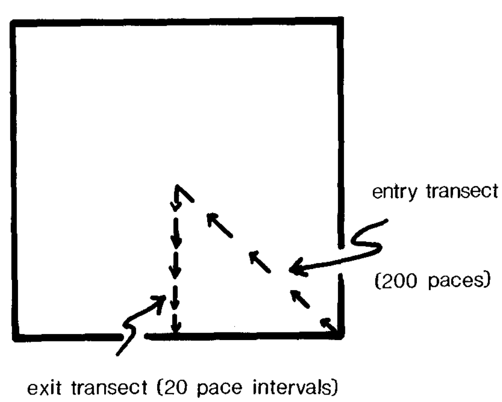

Figure 2. A diagram showing the method of conducting the survey in each field.

CROP: Alfalfa

LOCATION: Manitoba

NAME AND AGENCY:
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TITLE: INCIDENCE OF PLANT DISEASES IN ALFALFA IN MANITOBA

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

RESULTS AND COMMENTS: Winter injury of alfalfa was very low in 1987 because of the early snowfall in November 1986 that persisted until spring. There were a few samples of alfalfa sent into the laboratory infected with brown root rot caused by *Plenodomus meliloti*. Spring black stem and common leaf spot of alfalfa were not a problem in the first spring cut in most areas of Manitoba because of the very dry spring conditions but samples were received from alfalfa fields in the Eastern, Interlake and Northwest regions in August and September following periods of moist weather that showed a high amount of leaf disease. A sample of alfalfa infected with *Sclerotinia* sp. was received from the Portage la Prairie area in the Central region. There was no verticillium wilt of alfalfa detected in 1987 from samples submitted. There was no special survey of alfalfa carried out in Manitoba in 1987.

CROP: Alfalfa

LOCATION: Eastern Ontario

NAME AND AGENCY:
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TITLE: INCIDENCE OF VERTICILLIUM WILT OF ALFALFA IN EASTERN ONTARIO

INTRODUCTION: Since 1981, Verticillium wilt (VW) of alfalfa caused by *Verticillium albo-atrum* has been reported from most of the western and southwestern counties of Ontario (4). In 1981, this disease was not detected in eastern Ontario (2). However, during 1982-86, sporadic reports of VW were obtained from Dundas and Stormont counties but no systematic surveys were made recently. Hence, this study was initiated in 1987 in order to determine the incidence of this disease in eastern Ontario.

METHODS: At least two alfalfa fields were selected at random from each township of Russell, Prescott, Glengarry, Renfrew, Lanark, Ottawa-Carleton, Dundas, Stormont, Grenville and Leeds in order to distribute the sample fields widely. However, when growers sent alfalfa samples through agricultural representatives for disease diagnosis, these were also included in this study. Fields were inspected during May 12 to

October 5, 1987. Plants, within a 3-m wide W-shape sampling path (2) in each field were examined for symptoms of Verticillium wilt (3) and the pathogen, V. albo-atrum, was isolated from stems to confirm (PKB) disease diagnosis. If there were no visible symptoms or when the pathogen was not recovered, a field was considered negative for Verticillium wilt. When a typically wilted plant was found in a field, it was marked as positive. No attempt was made to quantify the disease incidence or its severity in order to save time.

RESULTS AND COMMENTS: The distribution of Verticillium affected and non-affected fields is shown in Fig. 1, and the percentage of affected fields is given in Table below. Fields in Russell, Prescott and Renfrew were free of Verticillium wilt this year. The overall incidence for the 10 counties was 21.8. Relatively higher incidence values in Ottawa-Carleton, Stormont and Dundas may be partly attributable to the fact that 27 samples were sent by the growers and these were added to the initial random samples. Consequently, the incidence values in these three counties might have been over-estimated. However, since the disease was present in most counties, it is only a matter of time that it will appear in all. Control strategies (1) and the mode of spread of the disease (4) need to be investigated urgently.

Table. Numbers and percentage of Verticillium wilt affected alfalfa fields in 10 counties of eastern Ontario.

County	Fields sampled	Fields affected	% affected
Russell	5	0	0.0
Prescott	4	0	0.0
Glengarry	11	1	9.1
Renfrew	19	0	0.0
Lanark	16	1	6.3
Ottawa-Carleton	19	6	31.6
Dundas	13	6	46.2
Stormont	28	15	53.6
Grenville	11	1	9.1
Leeds	16	1	6.3
TOTAL	142	31	21.8

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

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3. Christen, A.A., and R.N. Peaden. 1981. Verticillium wilt in alfalfa. Plant Dis. 65: 319-321.

4. Christie, B.R., L.V. Busch, and G.J. Boland. 1986. Verticillium wilt of alfalfa. 1986 Annual Report, pages 158-170, Department of Crop Science, University of Guelph, Guelph, Ontario.

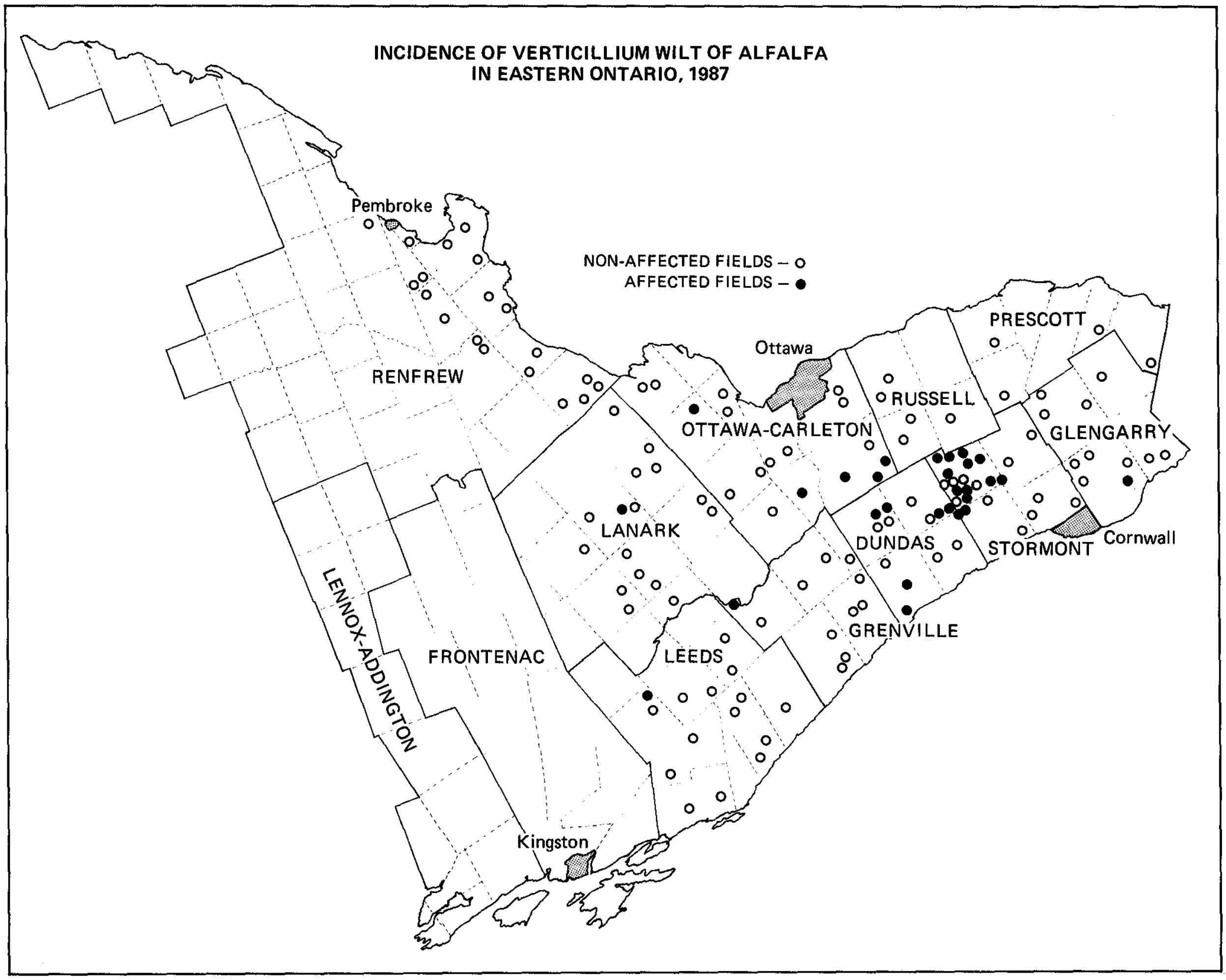

Figure 1. Distribution of Verticillium wilt affected alfalfa fields in 10 eastern Ontario counties out of 142 examined; a few fields could not be shown in the map because of their close proximity.

CROP: Alfalfa

LOCATION: Ontario

NAME AND AGENCY:
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TITLE: SURVEY OF VERTICILLIUM WILT OF ALFALFA IN SOUTHERN ONTARIO

METHODS: In 1981-2 L.V. Busch surveyed six counties and collected samples from 33 fields that exhibited typical wilt symptoms. In 1983 field samples were collected from 215 fields representing 25 counties by personnel of the Ontario Ministry of Agriculture and Food (Plant Industry Branch) augmented by the Department of Environmental Biology. Samples were taken only from fields that had typical symptoms of Verticillium wilt and were sent to L.V. Busch, University of Guelph, for laboratory confirmation. Every tonwship in the counties of southern Ontario were surveyed, with the exception of Prescott, Russell, Glengary, Carleton, Leeds, Grenville, Dundas, Stormont, Essex, Kent and Lambton.

RESULTS AND COMMENTS: Verticillium wilt was found only in Perth county in 1981, where 80% of the sampled fields were positively diagnosed (Table). Eighty-three percent of the fields surveyed in Perth were positive in 1982. In 1983, when all the counties in southern Ontario were sampled, 37.6% of the samples were positive for Verticillium wilt. Sixteen additional fields were questionable. Frontenac, Halton, Lambton, Leeds, Peel and Victoria counties were negative. All townships in the following counties of central southwestern Ontario: Perth, Wellington, Waterloo, Oxford, Brant and Hamilton-Wentworth had disease in at least one field. Townships in the counties of Bruce, Grey, Huron, Haldimand-Norfolk and Middlesex, adjacent to those mentioned above, also yielded positive diagnoses of Verticillium wilt.

Table. Number and location of alfalfa fields with Verticillium wilt of alfalfa in southern Ontario in 1981-82 and 1983.

County	No. fields sampled	% positive diagnoses	% questionable diagnoses
1981-1982			
Perth	17	87.5	0.0
Bruce	4	0.0	0.0
Grey	4	0.0	0.0
Simcoe North	3	0.0	0.0
Simcoe South	3	0.0	0.0
Wellington	2	0.0	0.0
1983			
	8	87.5	0.0
Bruce	15	13.3	13.3
Dufferin	15	9.9	13.3
Essex	1	0.0	100.0
Frontenac	1	0.0	0.0
Grey	14	21.4	7.1
Haldimand	12	33.3	16.6
Halton	1	0.0	0.0
Hastings	4	0.0	0.0
Huron	19	36.8	0.0
Lambton	1	0.0	0.0
Leeds	1	0.0	0.0
Middlesex	13	38.5	7.7
Niagara North	7	0.0	28.6
Niagara South	4	50.0	25.0
Norfolk	4	25.0	0.0
Northumberland	2	0.0	0.0
Oxford	15	73.3	13.3
Peel	1	0.0	0.0
Perth	12	66.6	0.0
Simcoe North	14	0.0	7.1
Simcoe South	3	0.0	0.0
Waterloo	18	61.1	11.1
Wellington	22	68.2	0.0
Wentworth	3	100.0	0.0
York	4	50.0	0.0
Victoria	1	0.0	0.0

CROP: Alfalfa

LOCATION: Ontario

NAME AND AGENCY:
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TITLE: FOLIAR DISEASE SURVEY OF ALFALFA IN SOUTHWESTERN ONTARIO

METHODS: Seventy alfalfa fields in 18 counties were surveyed for foliar diseases in September and October 1986. Observations of diseases were made in each field and 50 plants were collected in a V-shaped pattern. Plants were returned to the laboratory for evaluation and pathogen identification.

The presence of all diseases was assessed in each field to determine disease prevalence. Disease severity was determined for most diseases by rating the two lowest mature leaves on each stem for the percentage of leaf area diseased in total, and for each symptom (James 1971). The lower 20 cm of each stem also was rated for the percentage of stem area diseased. Most symptoms were then associated with the causal agents and representative samples were cultured for positive identification.

RESULTS AND COMMENTS: Cool, wet conditions during autumn 1986 resulted in leaf and stem diseases being present in all fields surveyed (Table). Common leaf spot, yellow leaf blotch, Leptosphaerulina leaf spot, spring black stem and anthracnose had the highest disease incidences and/or severities. Verticillium wilt was found on 17% of the farms surveyed. Stem diseases occurred as a complex of pathogens and mean disease severities for individual diseases were not evaluated.

Table. Incidence and severity of foliar diseases of alfalfa in south-western Ontario during September and October 1986

Disease	# fields with disease	% fields with disease	Mean disease severity (all fields)
Foliar diseases (total)	70	100.0	11.8
Common leaf spot	59	84.3	7.7
Yellow leaf blotch	32	45.7	3.8
Leptosphaerulina leaf spot	27	38.6	4.3
Rust	22	31.4	-
Spring black stem	7	10.0	5.2
Downey mildew	17	24.3	-
Verticillium wilt	12	17.1	-
Stemphylium leaf spot	13	18.6	0.04
Alfalfa mosaic virus (symptoms)	4	5.7	-
Unidentified	51	72.9	1.8
Stem diseases (total)	70	100.0	9.4
Spring black stem	48	68.6	-
Anthracnose	41	58.6	-
Summer black stem	16	22.9	-
Rhizoctonia	10	14.3	-
Stemphylium leaf spot	3	4.3	-

James, C. 1971. A manual of assessment keys for plant diseases. Can. Dept. Agric., Pub. 1458.

CROP: Alfalfa

LOCATION: Québec

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TITLE: OBSERVATIONS ON DISEASES OF ALFALFA

METHODS: Results are based upon observations made sporadically on the occasion of visits to producers or upon examination of samples received from agronomists.

RESULTS AND COMMENTS: Leaf spot diseases were general throughout the growing season. More specifically, Common Leaf Spot (*Pseudopeziza trifolii* f.sp. *medicaginis-sativae*) was observed in Lévis county, Lepto Leaf Spot (*Leptosphaerulina briosiana*) and Spring Black Stem (*Phoma medicaginis* var. *medicaginis*) in Saint-Hyacinthe, Yellow Leaf Blotch (*Leptotrochila medicaginis*) and Lepto Leaf Spot in Lac-Saint-Jean-Ouest, Sclerotinia Crown and Stem Rot in Kamouraska, and Downy Mildew (*Perenospora trifoliorum*) in Sherbrooke. Fusarium Crown and Root Rot is general while Phytophthora Root Rot was observed in Portneuf.

CROP: Alfalfa

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TITLE: SURVEY OF VERTICILLIUM WILT OF ALFALFA IN QUEBEC, 1986-87

INTRODUCTION: Verticillium wilt of alfalfa caused by *Verticillium albo-atrum* was found at ten locations in Québec in 1986. It was the first report of the disease in Québec since it had been discovered in North America in 1976. The purpose of this survey is to determine the extent of the disease in the province.

METHODS: Sixty-six alfalfa fields were surveyed in September 1987 in 46 municipalities over 26 counties. Sampling, isolation and identification of the pathogen were done by the Plant Health Division. Plants, within a 2-m wide, 100-pace long sampling path were examined for symptoms of Verticillium wilt and samples were taken to confirm the presence of the disease. A field was considered positive only when the presence of *V. albo-atrum* was confirmed in samples. Alfalfa samples received from growers through agronomists in 1986 and 1987 and examined by the Laboratoire de diagnostic, ministère de l'Agriculture, des Pêcheries et de l'Alimentation du Québec, are also included in the survey.

RESULTS AND COMMENTS: See Table below. Verticillium wilt was detected in eight counties in 1986 and sixteen counties in 1987. Of the 66 surveyed fields in 1987, only 12 samples were positive because of the long delay between sampling and isolation. Seventeen samples received from agronomists were positive. Although spread over the agronomic area of Québec, the disease is concentrated in the Eastern townships where most of the positive counties are located.

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

Table. Counties of Québec where Verticillium wilt was found in 1986 and 1987.

County	1986	1987
Bagot	x	x
Beauce		x
Bellechasse	x	
Chicoutimi		x
Compton	x	x
Frontenac		x
Ile-de-Montréal	x	
Labelle		x
Lac Saint-Jean est	x	
Lac Saint-Jean ouest		x
Missisquoi		x
Napierville		x
Richmond		x
Rouville	x	x
Sherbrooke	x	x
Stanstead	x	x
Témiscamingue		x
Yamaska		x

CROP: Clover

LOCATION: Saskatchewan

NAME AND AGENCY:
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TITLE: DISEASES OF CLOVER IN NORTHEASTERN SASKATCHEWAN

A limited number of clover fields were examined and the following diseases found : Black Stem (Phoma trifolii), Stagonospora Leaf Spot (Leptosphaeria pratensis), Powdery Mildew (Erysiphe polygoni), and Northern Anthracnose (Kabatiella caulivora) on red clover; Sooty Blotch (Cymadothea trifolii), Stagonospora Leaf Spot and Powdery Mildew on alsike clover; Stagonospora Leaf Spot and Plenodomus Root Rot on sweet clover.

Forest trees

CROP: Ash

LOCATION: Manitoba

TITLE: Incidence of Plant Diseases on Ash in Manitoba in 1987

NAME AND AGENCY:
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METHODS: Results are based on ash samples submitted to the Plant Pathology Laboratory and field examinations.

RESULTS: Dieback of green and black ash was widespread in Winnipeg area in the spring. No pathological cause could be determined. Unusual winter conditions may have resulted in dieback. The sudden and early onset of winter conditions following November 8th 1986 snowfall may have been a factor in increased amount of winterkill.

CROP: Birch

LOCATION: Manitoba

TITLE: Incidence of Plant Diseases in Birch in Manitoba in 1987

NAME AND AGENCY:
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METHODS: Results are based on birch samples submitted to the Plant Pathology Laboratory and field examinations.

RESULTS: There were fewer samples of birch dieback reported in 1987 in Manitoba. The lower incidence of dieback could be related to a diminishing population of mature weeping birch in Winnipeg and a greater awareness of the need to water birch trees during periods of dry weather.

CROP: Conifer Plantations

LOCATION: Southern Interior British Columbia

NAME AND AGENCY:
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TITLE: ROOT DISEASE SURVEY IN BACKLOG AREAS AND PLANTATIONS IN SOUTHERN INTERIOR BRITISH COLUMBIA

METHODS: In 1986 - 87, 18 areas either planted or naturally stocked with conifers or scheduled for rehabilitation treatment under the backlog reforestation program of the Forest Resources Development Agreement (FRDA) were examined for root diseases by M. Curran and J. Schulting, Pathocon Consulting. The work was conducted under contract (FRDA Backlog Research project 3.8) jointly funded by the Province of British Columbia and the Government of Canada. Trees, vegetation, stumps, and adjacent mature forest stands were examined using systematically placed transects approximately 100m apart. Identification of root disease fungi was based on field characteristics, and occasionally by collecting specimens and isolating cultures.

RESULTS AND COMMENTS: Root diseases were present in 17 of the 18 areas. From 2 to 18% of the planted or most common trees per site were infected. Trees infected - both planted and naturally established - included Douglas-fir, lodgepole pine, western white pine, interior spruce, western hemlock and western red cedar. With one exception, all young trees were infected by Armillaria root disease (pathogen: *Armillaria obscura*). Laminated root rot (pathogen: *Phellinus weirii*) was found only on one young tree but often in stumps or in adjacent stands at five areas.

On the unstocked backlog sites, root diseases were found attacking young conifers in four areas. Root diseases were found in all of the nearby, mature stands, and on stumps in two areas. On four areas, armillaria root disease was found on hardwood trees and brush species.

On the 12 stocked areas, armillaria root disease was found on young trees that had been planted as recently as 1984, with only one site completely free of any signs of *Armillaria* or *Phellinus*. The fungi were also found in the adjacent stands (6 areas), on stumps (3) and hardwoods (6).

The occurrence of root disease in most of the backlog areas and plantations was a major concern. In backlog unstocked areas, root disease could be the major reason for the chronic, unsatisfactory stocking. In several of the stocked plantations, tree mortality due to root disease was so severe that these areas might soon become poorly stocked. Mature stands scheduled for harvest and backlog, non-satisfactorily restocked areas should be examined for root diseases, and an appropriate root disease treatment applied in most instances.

Plantings of tree species less susceptible to armillaria root disease, or mechanical removal of infected stumps and roots, could re-establish or even enhance productive forests on infested sites.

CROP: Oak

LOCATION: Manitoba

TITLE: Incidence of Plant Diseases on Oak in Manitoba in 1987

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

RESULTS: Dieback of bur oak was reported from Winnipeg, Morden, Stonewall and other areas. Site examination of several cases indicated the problem was likely cultural rather than pathological. Removal of underbrush from native oak stands, change in soil grade and soil compaction are major contributing factors to oak decline. In a few cases Armillaria root rot was also observed but this is usually only a problem in trees weakened by environmental conditions.

CROP: Poplar

LOCATION: Manitoba

TITLE: Incidence of Plant Diseases in Poplars in Manitoba in 1987

NAME AND AGENCY:
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METHODS: Results are based on poplar samples submitted to the Plant Pathology Laboratory and field examinations.

RESULTS: Septoria canker is a common problem in shelterbelts of hybrid poplars. Septoria leaf spot caused premature leaf fall of poplar in August in Winnipeg. Efforts to retain native poplar in home landscapes in new land developments in Winnipeg invariably result in eventual death of the trees by hypoxylon canker.

CROP: Elm

LOCATION: Manitoba

TITLE: Incidence of Dutch Elm Disease in Manitoba in 1987

NAME AND AGENCY:
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METHODS: Results are based on 3,002 samples of American elm, Ulmus americana 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 3,002 elm trees sampled in Manitoba in 1987 of which 2,778 (92.5%) were found to be affected by Dutch Elm Disease (DED), caused by Ophiostoma ulmi (Ceratocystis ulmi). The Dothiorella wilt, caused by Dothiorella ulmi and Verticillium wilt caused by Verticillium spp.

The results of the 1987 DED survey for Manitoba are presented in Table 1. The results of the Winnipeg survey are divided into 6 regions. The highest number of DED infected trees occurred in the Assiniboine Park, Fort Garry area, 608 trees or 93.3% of trees sampled. The majority of infected trees were found in the southern part of this area along the Red and La Salle Rivers. There was also a high number of infected trees in the St. Boniface, St. Vital regions, mainly in trees adjacent to the Red and Seine Rivers. The number of infected trees in the other regions of Winnipeg is presented in Table 1. A measure of the full extent of DED severity within Winnipeg can be obtained by examining tree removal records of the Manitoba Department of Natural Resources and the City of Winnipeg. There were 4,362 trees tagged for removal in the City of Winnipeg area (Figure 1). The areas of highest DED incidence were the southern portions of St. Boniface-St.Vital (1,234) and St. Norbert-Fort Garry (1,296). Most of the infected trees were in native stands along the Red, Seine and La Salle rivers. There were also numerous trees identified for removal in North Winnipeg. Infected trees were found in the Kildonan Park area and other areas adjacent to the Red River along the west side of the river and Henderson Highway on the east side of the river (1,273). There were 4,367 trees designated for removal in the Ritchot municipality, which were within the Winnipeg buffer zone. This also applied to the large number of trees designated for removal in the RM of Cartier (828) and RM of St. Francois Xavier (604) which border on the west side of Winnipeg along the Assiniboine River. There were 177 infected trees detected in Brandon but high concentrations of dead trees, most of which on the basis of sampling likely died from DED, were evident in the Brandon area north of the city adjacent to the Assiniboine river (3,169) Figure 2. Within the City of Brandon, only 203 trees were marked for removal. The incidence of DED is particularly severe in Eastern Manitoba where 707 infected trees were detected or 97% of all elm trees sampled in this area. There were fewer infected trees detected in Western Manitoba, 36 or 80% of elm trees sampled. In the entire province of Manitoba 17,266 trees have been identified for removal because of being infected by DED or having sufficient dead wood to be a risk as a potential brood tree for elm bark beetles.

The survey did not accurately reflect the large numbers of trees that have been killed by DED in the Eastern and Interlake regions, because sampling and tree removal primarily takes place within the boundaries and buffer zones of cities, towns and villages and not in rural areas.

There was no major expansion in the geographic limits of DED, westward along the Assiniboine adjacent to the Saskatchewan border in 1987. Infected trees were again observed in 1987 near St. Lazare on the Assiniboine River but no dead or diseased trees were observed along the Saskatchewan border. The Souris river had DED infected elms from its junction with the Assiniboine east of Brandon until the river enters the United States in the Southwest corner of Manitoba, south of Melita.

Table 1. Dutch Elm Disease Survey for Manitoba

AREA	TREES SAMPLED	TREES DISEASED[a]	PERCENT DISEASED
Wpg. Centre/ Fort Rouge	136	117	86.0
Wpg. St. James/ Assiniboia	35	32	91.4
Wpg. Lord Selk./ West Kildonan	138	122	88.4
Wpg. East Kildonan/ Transcona	321	295	91.9
Wpg. St. Boniface/ St. Vital	512	469	91.6
Wpg. Assiniboine Pk./ Fort Garry	652	608	93.3
Brandon	74	67	90.5
Interlake[1]	147	139	94.5
Central[2]	212	186	87.7
Eastern[3]	730	707	96.8
Western[4]	45	36	80.0

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

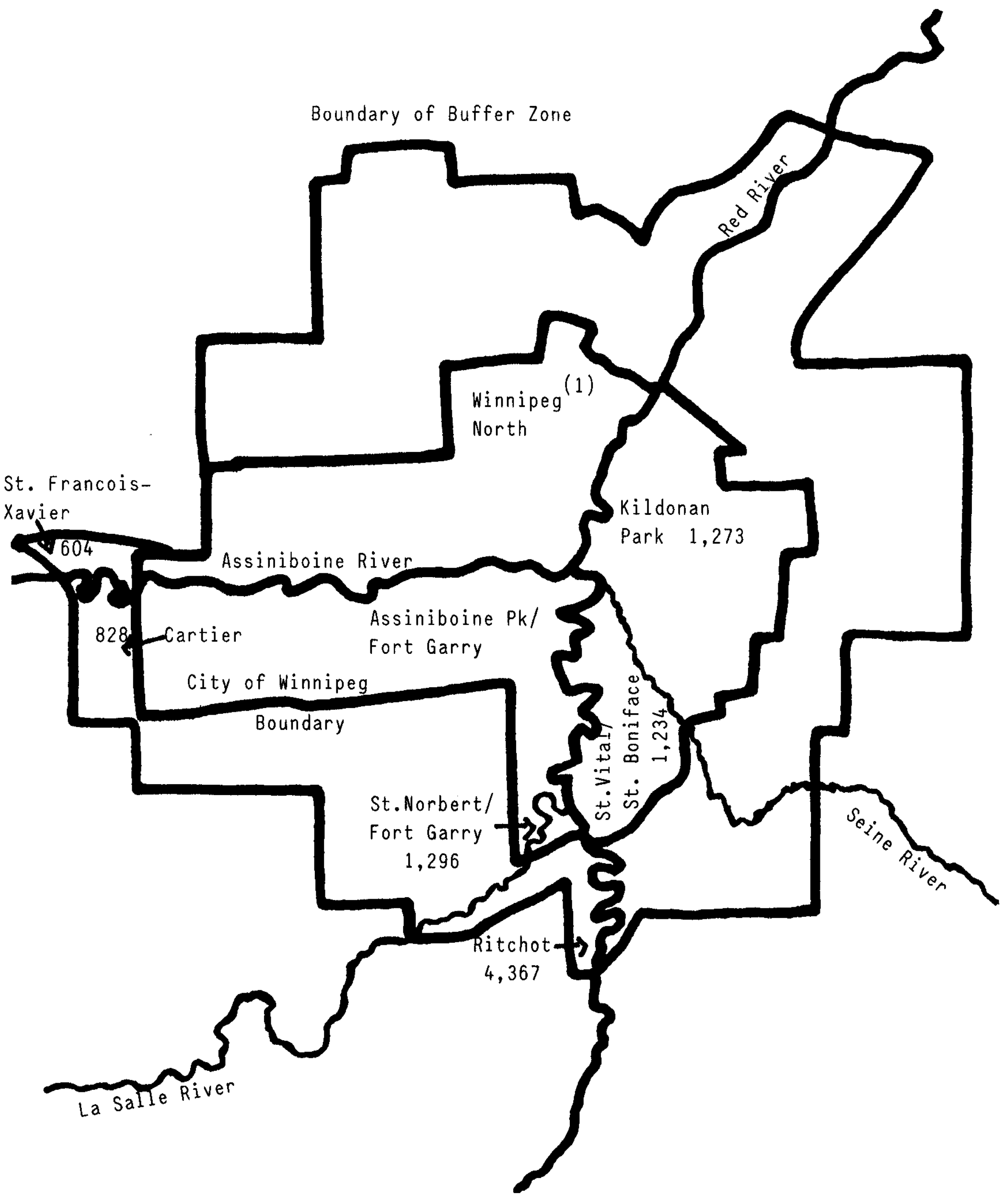
[1] Interlake region includes the City of Selkirk and all area north of Winnipeg between Lake Manitoba and Lake Winnipeg

[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

FIGURE 1: Distribution of Dutch Elm Disease Within City of Winnipeg and Buffer Zone.



(1) Trees marked for removal-diseased and hazard, over 50% dead

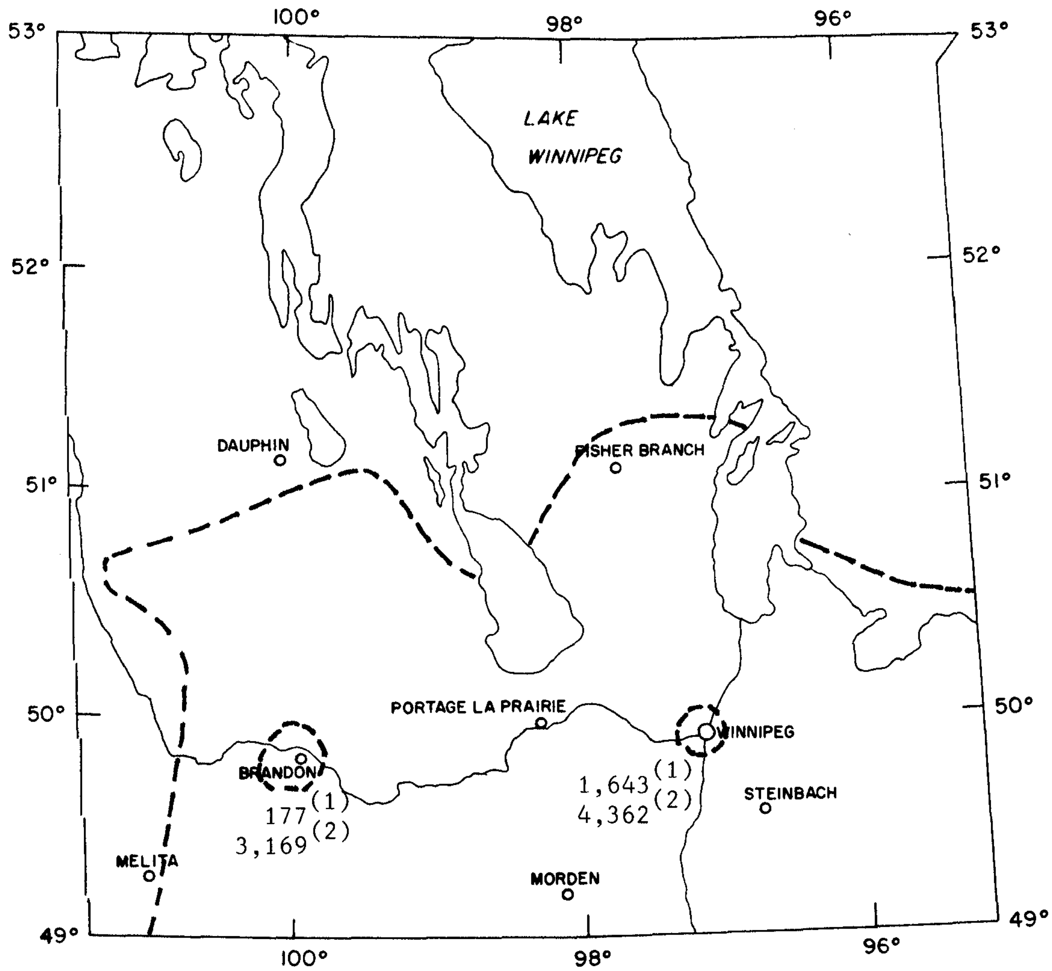


Figure 2: Distribution of Dutch Elm Disease in Manitoba in 1987

--- geographical limit of Dutch Elm Disease in Manitoba as of 1987

(1) Elm trees confirmed to have Dutch Elm Disease

(2) Elm trees marked for removal - diseased and hazard, over 50% dead

CROP: Spruce

LOCATION: Manitoba

TITLE: Incidence of Plant Diseases on Spruce in Manitoba in 1987

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

RESULTS: Cytospora canker was found as a common problem on mature blue spruce.

Needle casts caused by *Lirula* sp. were detected from samples submitted from Eastern Manitoba. Rhizosphaera needle cast is commonly observed on spruce particularly from western Manitoba. This disease has caused considerable damage to spruce in International Peace Garden plantings.

Ornamentals

CROP: Ornamentals

LOCATION: Manitoba

TITLE: Incidence of Plant Diseases in Ornamentals in Manitoba in 1987

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METHODS: Results based on 1,033 samples of ornamentals submitted to the Plant Pathology Laboratory and field examinations.

RESULTS: Common disease problems were: fireblight of cotoneaster; corm rot of gladioli caused by *Penicillium* spp; leaf spot anthracnose) of dogwood; silver leaf and fireblight of mountain ash; black spot, powdery mildew and rust of roses, *Gymnosporangium* sp. gall of junipers.

Cytospora sp. canker was a common problem on ornamental crabapples especially in the early spring. It is closely associated with winter damage. There were only a few samples of fireblight on crabapples received. Many of the samples showed evidence of environmental and nutritional disorders such as winter sunscald of crabapples, leaf scorch of dogwood related to spring drought conditions and iron chlorosis of spirea and roses.

CROP: Greenhouse crops

LOCATION: Manitoba

TITLE: Incidence of Plant Diseases in Greenhouse Crops in Manitoba in 1987

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

RESULTS: *Pythium* root rot and seedling blights were the major disease problems of greenhouse producers in Manitoba. Other problems detected were powdery mildew of begonias. Root rot of poinsettias was caused by complex of *Pythium* and *Fusarium* and occasionally *Thielaviopsis*. Nutrient and environmental disorders were observed in several greenhouses in the Winnipeg area. High soil and water conductivity was a common problem. Geranium diseases include ringspot virus disease, *Pythium* blackleg, *Botrytis* gray mould affecting new transplants, and oedema.

CROP: Cyclamen

LOCATION: Ontario

NAME AND AGENCY:
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TITLE: DISEASES OF CYCLAMEN IN ONTARIO FROM 1983 TO 1987

METHODS: Diseased cyclamen (*Cyclamen persicum*) were sent to the research station by growers, extension personnel, and by diagnostic laboratories for isolation of plant pathogens. Fungi were identified in plant tissues or in pure cultures from isolation. Soft rotting bacteria were identified only to the genus level (Schaad, 1980). Virus infection was detected using the methods of Allen and Matteoni (1988). All but one of the 40 samples were from Ontario.

RESULTS AND COMMENTS: Bacterial corm rot, caused by *Erwinia spp.* was the most prevalent disease (30% of all samples), but was associated with other diseases in 8 samples. Fusarium wilt, caused by *Fusarium oxysporum* f. sp. *cyclaminis*, affected almost 28% of the samples; cyclamen ringspot, caused by tomato spotted wilt virus was identified from at least 22%; and Botrytis blight, caused by *B. cinerea*, affected nearly 18% of the samples. Other diseases included cyclamen stunt, caused by *Ramularia cyclaminicola* (5%), and leaf spot caused by *Gloeosporium cyclaminis* (5%). Physiological factors such as high soluble salts in the potting medium, and pesticide phytotoxicity were implicated in 13% of the samples. *Thielaviopsis*, *Cylindrocarpon*, and *Pythium* were never isolated from affected plants.

Of the *Fusarium* cultures isolated, 18% showed some level of resistance to the fungicide benomyl in preliminary tests. This may substantiate reports from growers of reduced effectiveness of benomyl for the control of Fusarium wilt.

Although other viruses can infect cyclamen (McCain, 1985), only tomato spotted wilt virus was isolated. The estimate of 22% of the samples may be conservative because the technology for enhancing detection of this virus in cyclamen was only recently developed.

REFERENCES: Allen, W.R., and J.A. Matteoni. 1988. Cyclamen ringspot: epidemics in Ontario greenhouses caused by the tomato spotted wilt virus. Canad. J. Plant Pathol. (in press).

McCain, A.H. 1985. Cyclamen. pp. 3-8 *in*: Chapter 18 Diseases of Floral Crops Vol. 2. D.L. Strider, ed. Praeger. Toronto. 579 pp.

Schaad, N.W., ed. 1980. Laboratory Guide for the Indentification of Plant Pathogenic Bacteria. American Phytopathol. Soc., St. Paul, MN. 72. pp.

CROP: Florists' Chrysanthemum

LOCATION: Ontario

NAME AND AGENCY:
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TITLE: DISEASES OF FLORISTS' CHRYSANTHEMUM IN ONTARIO FROM 1983 TO 1987

METHODS: Diseased chrysanthemums (Chrysanthemum morifolium) were sent to the research station by growers, extension personnel, and by diagnostic laboratories for isolation of plant pathogens. Bacteria isolated by dilution plating of macerated tissues, were identified by gram reaction (Suslow et al., 1980), and by several biochemical and pathological tests (Schaad, 1980). Fungi were identified in plant tissues or in pure culture from isolation. Viral infections were detected by bioassay with indicator plants, and viroid infection was diagnosed on the bases of grafting on idicator plants and symptoms. To distinguish between the physiological disorder, Marble fleck; the genetic disorder, chrysanthemum slow decline; and the disease associated with infection by mycoplasmalike organisms, phloem necrosis, graft transmissibility tests and epifluorescent microscopy with DNA-specific fluorochromes were used. Seventy four samples were diagnosed. Some plants were affected by more than one disease.

RESULTS AND COMMENTS: See Table 1. Bacteria were isolated from about 25% of the plants, with bacterial leaf spot and black stem necrosis caused by Pseudomonas cichorii the most frequent diagnosis (18% of the samples). P. cichorii is becoming less of a problem with improved control in large propagation greenhouses, but under conditions conducive to disease, losses have been significant.

Fusarium root and stem rot and Fusarium wilt were diagnosed in 20% of the samples. Approximately 75% and 15% of isolates of F. solani and F. oxysporum, respectively, were resistant to benomyl. Pythium root rot was present in 10% of the samples, primarily from growers who did not pasteurize soil media, or who neglected preventation fungicide drenches.

Chrysanthemums at five locations were infected with tomato spotted wilt virus. The virus has also been identified in cut chrysanthemums in British Columbia. Because of the presence of the vector, the western flower thrips (Frankliniella occidentalis), serious losses could occur the susceptible varieties.

REFERENCES: Schaad, N.W., Ed. 1980. Laboratory Guide for the Indentification of Plant Pathogenic Bacteria. American Phytopathol. Soc., St. Paul, MN. 72 pp.

Suslow, T.V., M.N. Schroth, and M. Isaka. 1982. Application of a rapid method for gram differentiation of plant pathogenic and saprophytic bacteria without staining. Phytopathol. 72:917-918.

Table 1. Diseases of florists' chrysanthemum in Ontario from 1983 to 1987.

Pathogen	Disease or Disorder	Frequency of Isolation (%)
Pseudomonas chichorii	Bacterial leaf spot and black stem necrosis	18
Fusarium solani	Fusarium root and stem rot	12
Pythium	Pythium root rot	10
*Fusarium oxysporum**	Fusarium wilt	9
Erwinia	Bacterial soft rot	6
Viruses**	Various	6
Physiological	Marble fleck	6
Phytotoxicity	Pesticides or growth regulators	6
Rhizoctonia solani	Rhizoctonia root rot	6
Viroid	Chrysanthemum stunt	4
Micosphaerella ligululicola	Ascochyta ray blight	4
Physiological	Various	4
Sclerotinia sclerotiorum	Sclerotinia stem rot	3
Oidium chrysanthemi	Powdery mildew	3
Botrytis cinerea	Botrytis leaf and flower blight	1
Aphelenchoides	Foliar nematode	1
Genetic	Chrysanthemum slow decline	1
Mycoplasmalike organism	Chrysanthemum phloem necrosis	0
Total		100%

* The *forma specialis* was not determined, although isolates were pathogenic upon reinoculation

** Specific viruses are not reported, however, 5 samples were tomato spotted wilt virus

CROP: Florists' Geranium

LOCATION: Ontario

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TITLE: DISEASES OF FLORISTS' GERANIUM IN ONTARIO FROM 1983 TO 1987

METHODS: Diseased geraniums were sent to the research station by growers, extension personnel, and by diagnostic laboratories for isolation of plant pathogens. Bacteria isolated by dilution plating of macerated tissues, were identified by gram reaction (Suslow et al., 1982), and by several biochemical and pathological tests (Schaad, 1980) including fluorescence on King's B medium, oxidase reaction, growth on nutrient agar and YDC media, potato soft rot test, tobacco hypersensitivity tests, and reinoculation into *Pelargonium* X *hortorum* cv. Crimson Fire. Fungi were identified in plant tissues, or from pure cultures. Viral infections were detected by bioassay with indicator plants, but specific viruses were not identified. Over the four year period 118 samples were diagnosed, primarily florists' geranium (*P.* X *hortorum*), but also ivy geranium (*P. peltatum*), and regal geranium (*P.* X *domesticum*). Most samples were from Ontario.

RESULTS AND COMMENTS: Diagnoses included nonpathological problems of high salts in the potting medium, oedema, pesticide or growth regulator phytotoxicity (18% of total), Pythium blackleg (12%), viruses (7%), Botrytis (3%), fasciation caused by *Corynebacterium fasciens* (2%), southern bacterial wilt; caused by *Pseudomonas solanacearum* (2%), leaf spot caused by *Pseudomonas cichorii* (1%), cottony stem rot caused by *Sclerotinia sclerotiorum* (1%), and stem rot caused by *Myrothecium roridum* (1%). The most important disease of florists' geranium was bacterial blight caused by *Xanthomonas campestris* pv. *pelargonii* (57%). (Four samples were affected by both bacterial blight and another disease.)

From the majority (83%) of the questionnaires submitted with samples, the likely source of *Xanthomonas* infection was determined. Over half (55%) of the new infections were probably started from infected, prefinished pots sold for growing-on. Infected geranium cuttings imported from outside of Canada accounted for over 11% of the new infections, and 6% was from putatively culture-virus indexed plant material. Greater than 11% of the new infections was started from infected stock plants purchased at the end of the growing season. When major propagating greenhouses had infected geraniums, dissemination of the bacterium was great and accounted for over 80% of the new infections.

In situations conducive to development and spread of bacterial blight, estimates of infection rates were between 0.1 and 0.2% of the plants per day, in spite of regular roguing of infected plant material. Losses for Ontario during 1986 were estimated at over $300,000 -- about 5% of the crop.

REFERENCES: Schaad, N.W., ed. 1980. Laboratory Guide for the Identification of Plant Pathogenic Bacteria. American Phytopathol. Soc., St. Paul, MN. 72 pp.

Suslow, T.M., M.N. Schroth, and M. Isaka. 1982. Application of a rapid method for gram differentiation of plant pathogenic and saprophytic bacteria without staining. Phytopathol. 72:917-918.

CROP: Geranium

LOCATION: British Columbia

NAME AND AGENCY:
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TITLE: SURVEY FOR BACTERIAL BLIGHT (XANTHOMONAS CAMPESTRIS PV. PELARGONII) OF GERANIUM IN BRITISH COLUMBIA

METHODS: In the spring of 1986 bacterial blight (*Xanthomonas campestris* pv. *pelargonii*) on zonal and ivy geraniums (*Pelargonium* x *hortorum* Bailey and *P. peltatum* L.) occurred in four greenhouses in the Lower Fraser Valley of British Columbia. Infections were confirmed in the plant diagnostic laboratory by tissue isolations onto nutrient agar or potato dextrose agar followed by tests for pigment formation and colony morphology on King's medium B and yeast-dextrose calcium carbonate agar as outlined by Schaad, 1980. An oxidase test was also performed. Koch's postulates were confirmed for two isolates.

Newsletters alerted growers to the bacterial blight problem and a survey of greenhouse geraniums was conducted in the spring of 1987. Wilted plants showing necrotic leaf spots, V-shaped lesions or darkened stems were sampled and tested in the laboratory for bacterial blight infection.

RESULTS AND COMMENTS: See Table 1 below. Xanthomonas bacterial blight was identified in 10/27 greenhouses or in twice as many greenhouses in 1987 compared to 1986. A special geranium workshop held in November and continued extension efforts will hopefully curb the spread of the disease. The origin of the pathogen is unknown but contaminated imported cuttings are suspected. Pythium blackleg is the second most common disease resulting in substantial losses where infected imported cuttings were used. Botrytis stem rot, Rhizoctonia root rot, Fusarium root rot and Verticillium wilt were of minor occurrence in geraniums.

REFERENCES: Schaad, N.W. 1980. Laboratory Guide for Identification of Plant Pathogenic Bacteria. American Phytopathol. Soc. St. Paul, MN. 72 pp.

Table 1. Number of greenhouses with geraniums affected by Xanthomonas bacterial blight, Pythium blackleg, Botrytis stem rot and Rhizoctonia and Fusarium root rots based on a 1986 and 1987 disease survey in British Columbia

Diseases	Number of Greenhouses* in Years 1986	1987
Xanthomonas bacterial blight	4	10
Pythium blackleg	1	8
Botrytis stem rot		5
Rhizoctonia root rot	1	2
Fusarium root rot		1
Verticillium wilt		1
Healthy plants		5

* Several greenhouses had more than one of the geranium disease problems listed.

CROP: Pears and junipers

LOCATION: Lower Mainland and Vancouver Island, British Columbia

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TITLE: PEAR TRELLIS RUST SURVEY IN SOUTH COASTAL BRITISH COLUMBIA

METHODS: In order to ship junipers or pear trees to the Okanagan or Eastern Canada, nurseries in the B.C. Coastal area must be certified free of pear trellis rust (*Gymnosporangium fuscum*). Beginning in 1989, this requirement also applies to junipers and pears destined for the prairie provinces.

To facilitate this, a survey of pear trees within 1 km or more of each juniper producing nursery is carried out annually. If infections are found on pear, the junipers in the vicinity are checked for infections the following spring and, if found to be diseased, they are destroyed. In 1987, two students carried out the work on the Lower Mainland while one student, aided by the local nurseries, worked on Vancouver Island, particularly the Saanich Peninsula, where the disease is well established.

RESULTS AND COMMENTS: See Table 1. As a result of the 1987 work, 28 nurseries out of 46 that applied, were certified to ship junipers and/or pears.

Table 1. Results of pear trellis rust survey in south coastal British Columbia.

Area	Number of Junipers Examined	Number of Junipers Removed	Pear Trees Examined	No. Pear Infections >5/tree	No. Pear Infections >50/tree
LOWER MAINLAND					
Abbotsford	14	1	102	30	21
Aldergrove	15	0	382	0	0
Bradner	1	0	210	6	2
Chilliwack	5	0	29,657*	13	8
Hatzic	18	17	40	39	31
Langley	0	0	1,171	40	3
Matsqui	0	0	131	11	1
Mission	226	73	97	24	9
Pitt Meadows	0	0	160	4	0
Richmond	303	265	370	58	15
Surrey	25	0	406	198	64
Yarrow	0	0	8,000*	0	0
VANCOUVER ISLAND					
Saanich Peninsula	1,337	315	1,321	497	212
Saltspring Isl.	400	0	76	0	0
Central Vancouver Island	0	0	197	0	0
TOTAL	2,344	617	42,320	920	366

* Includes one and two year old trees in nurseries

Small fruits

CROP: Blueberries

LOCATION: British Columbia

NAME AND AGENCY
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TITLE: SURVEY FOR BLUEBERRY SCORCH VIRUS AND TOMATO RINGSPOT VIRUS IN HIGHBUSH BLUEBERRY IN B.C., WASHINGTON AND OREGON

METHODS: A survey for blueberry scorch virus (BBScV)(Martin and Bristow, in press) and tomato ringspot virus (TomRSV) in highbush blueberry (Vaccinium corymbosum) was carried out in the Fraser Valley of B.C., Washington and Oregon during the summer of 1987.

Five thousand samples were tested for each virus by ELISA. Of several grinding buffers tested to keep the pH of the homogenized leaf tissue near neutrality 0.1M borate (pH 8.2) with 0.5% nicotine, 2% PVP, 0.1% non-fat dried milk and 0.5ml/l Tween-20 gave the best results with blueberry tissue and this buffer was used for the survey. Standard ELISA protocol (Clark and Adams, 1977) was used except for the different grinding buffer.

A sample was made up of three leaves taken from different branches on a single bush as BBScV does not appear to be equally distributed throughout a plant. Normally samples were tested the day after collection but could also be kept for several weeks at 4 C with no apparent loss in efficiency of detection.

RESULTS AND COMMENTS: TomRSV was found in only one 40 year old field in Whatcom County, Washington and the grower has since removed the infected bushes. BBScV was found in hundreds of plants but all were located in the Puyallup Valley, Washington. Field infections with BBScV were detected in 13 cultivars of highbush blueberry with varying response to infection. The cultivars \`Atlantic', \`Berkeley', \`Collins', \`Dixie', \`Herbert', \`Pemberton', and \`Weymouth' showed blossom blight and marginal chlorosis of leaves produced on older wood; \`Olympia' and \`Eberhardt' showed marginal chlorosis of older leaves; \`Jersey', \`Stanley', \`Bluecrop', and \`N15G' did not show symptoms.

A disease with symptoms similar to bushes infected with BBScV has been found in the Fraser Valley of B.C. and in Whatcom and Clark Counties of Washington and western Oregon. These bushes did not react with BBScv antiserum. Electron microscopy of ultrathin sections cut from fixed leaf tissue revealed long, flexous rod-shaped virus-like particles and numerous vesicles associated with these particles. This cytopathology is quite distinct from the large bundles of virus particles and lack of vesiculation observed in thin sections from bushes infected with BBScV and is similar to some features of Sheep Pen Hill disease in New Jersey.

Reference: Clark, M.E. and Adams, A.N. 1977.Characteristics of the micro-plate method of enzyme-linked immunosorbent assay or the detection of plant viruses. J. Gen. Virol. 34:475-483.

Martin, R.R. and Bristow, P.R. 1988. A carlavirus associated with blueberry scorch disease. Phytopathology (in press)

CROP: Blueberry

LOCATION: Manitoba

TITLE: Incidence of Plant Diseases in Blueberries in Manitoba in 1987

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

RESULTS: Commercial production of a lowbush, highbush blueberry cross is being undertaken by a few growers in Manitoba. The main disease problems encountered were cankers caused by *Fusicoccum* sp and *Pestalotia* sp.

CROP: Raspberries

LOCATION: British Columbia

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TITLE: SURVEY OF VIRUSES IN RASPBERRRIES IN B. C. AND WASHINGTON

METHODS: A survey of virus diseases of raspberries in British Columbia and Washington was carried out during the summer of 1986. Three methods of analysis; mechanical transmissions to *Chenopodium quinoa*, double-stranded RNA analysis, and a serological test (ELISA, specific for raspberry bushy dwarf (RBDV) and tomato ringspot (TomRSV) viruses) were used to test each of 450 samples collected. Samples of 15-20 g were collected and brought to the laboratory for analysis. Three leaflets, 1/2 tp 3/4 expanded, from each sample were used for mechanical transmissions to *C. Quinoa*. Another three young leaflets were used for the ELISA and 10 g from each sample were used for the dsRNA analysis (Kurppa and Martin, 1986).

RESULTS: In the early summer (May and June) there was an excellent correlation between RBDV and TomRSV detection in all three tests. Two RBDV and one TomRSV positive sample by mechanical transmission and dsRNA were negative by ELISA, whcih may be due to uneven distribution of these viruses in some raspberry plants. Later in the season the mechanical transmission tests were very unreliable.

To test for uneven distribution of RBDV within raspberry plants six leaves on each of 20 primocanes from one known infected plant of the varieties Trent and Creston were assayed for RBDV by ELISA. In 'Creston' each of the 6 leaves on all 20 canes indexed positive while in 'Trent', 4 canes indexed negative for RBDV and 16 indexed positive. All 6 leaves on canes indexing negative were negative and all leaves on infected canes were positive. The uneven distribution was between canes rather than within canes.

Of the 450 samples surveyed tobacco streak virus (TSV), RBDV, TomRSV and an ilar-like virus (ILV) were detected in 7, 8, 22, and 65 samples respectively. The ILV was detected only by dsRNA analysis and thought to be raspberry leaf spot virus based on symptoms in *Rubus occidentalis* and 'Norfolk giant'. However, RLSV infected leaves obtained from A. T. Jones (Scottish Crops Research Institute) did not give dsRNA bands and therefore these dsRNA bands are referred to as ILV since the number and position of the bands is similar to what we see with TSV another ilarvirus. The ILV is aphid transmitted and not transmitted mechanically whereas TSV is transmitted mechanically and not aphid transmitted.

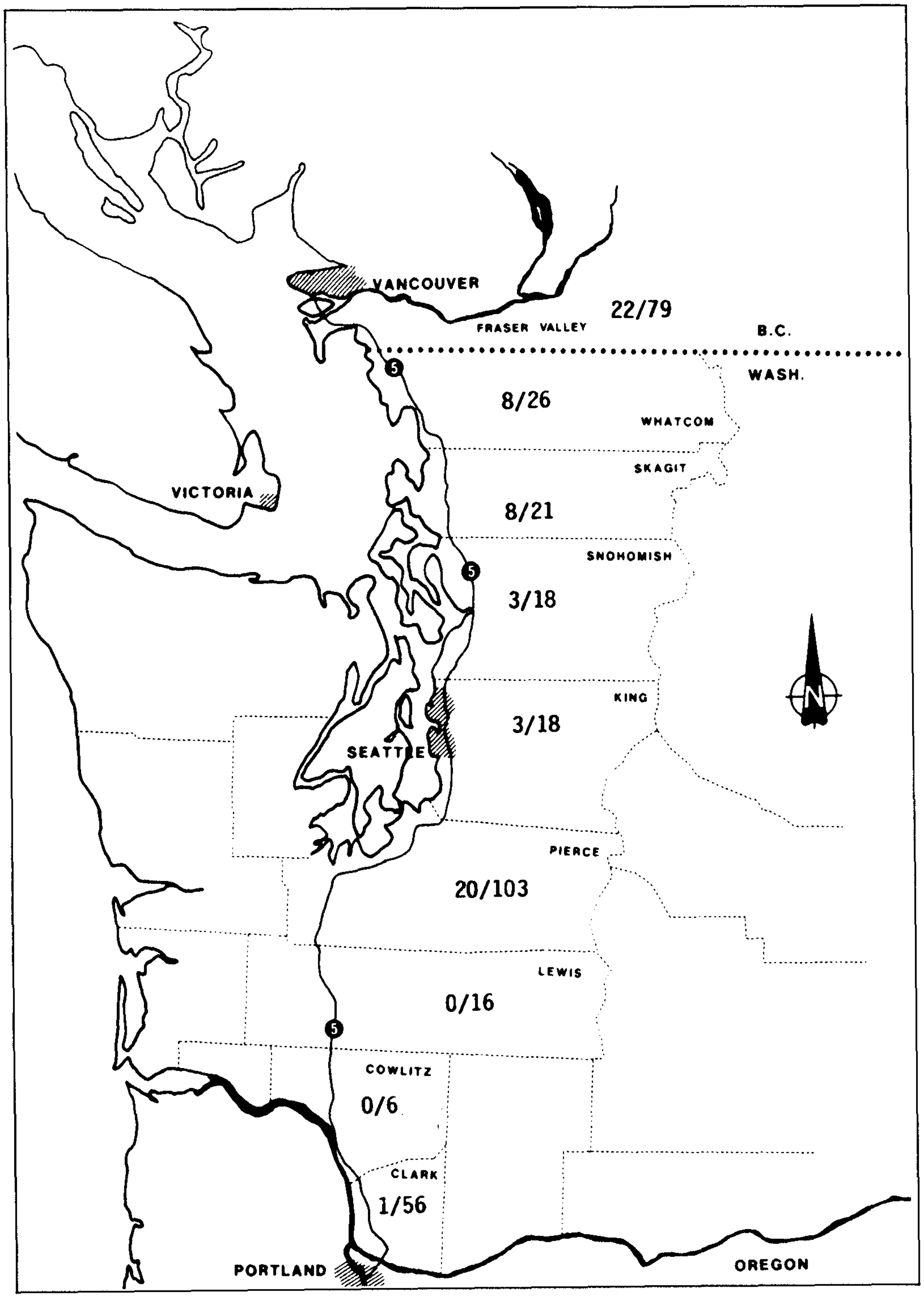
The TSV, RBDV and TomRSV were distributed evenly throughout the sampling area, whereas the ILV was found primarly along Puget Sound and in the Fraser Valley (Fig.). Aphid populations were also noted while collecting samples. During the summer of 1986 populations of the raspberry aphid *Amphorophora agathonica* were in excess of 100/cane on susceptible varieties from the southern end of Puget Sound north into the Fraser Valley but were very rare south of Puget Sound. This was thought to be due to the unseasonably cold winter of 1985-86 with the moderation of temperatures near the Sound responsible for higher aphid populations. The winter of 1986-87 was very mild followed by a warm spring and summer. High aphid populations were expected in the summer of 1987 but instead the raspberry aphid was difficult to find until autumn. It is now thought that the populations of raspberry aphids observed in raspberry fields is a function of the overwintering and early buildup of predators rather than how well the aphids survive the winter.

The most common virus in this survey was the ILV which is aphid-borne. Use of aphid-resistant varieties gives excellent control of this virus in the field. None of over 100 samples of aphid resistant varieties tested indexed positive for this virus. Several of the newer varieties released from the small fruit breeding program at Agriculture Canada in Vancouver are resistant to aphids (Daubney 1980, 1987) and should help limit the spread of this virus.

References: Daubeny, H.A. 1987. Chilliwack and Comox red raspberries. HortScience 22: (In Press).

Daubeny, H.A. 1980. Red raspberry cultivar development in British Cloumbia with special reference to pest response and germplasm exploitation. Acta Hort. 112: 59-67.

Kurppa, A. and Martin, R.R. 1986. Use of double-stranded RNA for detection and identification of virus diseases of Rubus species. Acta Hort. 186: 51-62.



Distribution of Aphid-Borne Rubus Virus

CROP: Raspberry

LOCATION: British Columbia

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TITLE: TOMATO RINGSPOT VIRUS DISEASE SURVEY OF RED RASPBERRY

METHODS: Tomato ringspot virus (TomRSV) has been isolated in previous years from a few commercial red raspberry plantings in the Fraser Valley. In 1987, a more detailed survey was undertaken, involving 20 commercial raspberry plantings located in the Fraser Valley and southern Vancouver Island. Approximately, 50 samples of each cultivar at each location were indexed by the ELISA technique. In order to optimize detection, the many variables of the double antibody sandwich technique were investigated. Most indexing was done during the period May to July using leaves from primocanes as the virus source. Some known infected plants were indexed at intervals from February through to October to determine seasonal variability of test results.

RESULTS:

(a) Occurrence and distribution: TomRSV was not detected in any of the 7 plantings on Vancouver Island nor in 11 of the 13 plantings on the mainland. The two exceptions were a 4-hectare planting of cv. Willamette near Chilliwack and a 3-hectare planting of Willamette and Chilcotin near Sumas. Both of these plantings were extensively infected although infection was in localized patches, with some areas of the planting being completely virus-free and other areas being totally infected. The average infection was 20 percent in the Sumas planting and 35 percent in the Chilliwack planting. Many plants showed varying degrees of interveinal chlorosis of the leaves of fruiting canes but few of the plants showed distinctive symptoms in current year canes.

(b) Effect of virus on growth and yield: Growth and yield records were taken on a 10-plant block of 'Willamette' raspberries infected with TomRSV, and an adjacent 10-plant block from a healthy portion of the same field. The diseased plants, which had probably been infected for at least four years, were stunted and had fewer fruiting canes, and bud break was 2-3 weeks later than on healthy plants. Fruit weight and the number of berries was recorded twice a week for the five-week picking season. The virus-free plants yielded an average of 2011 g of fruit per plant; infected plants yielded an average of 655 g per plant. The average number of berries on healthy plants was 879; on infected plants it was 473. Thus, two factors contributed to the yield reduction on the infected plants: the number of berries per plant and the berry size. Despite the 2-3 week delay in bud break on infected plants in the spring, peak berry production was delayed only four days.

(c) Seasonal variation in ELISA detection: Testing for tomato ringspot virus was done at intervals from February through to October on field grown raspberry plants to determine seasonal variability of test results. Polyclonal antibodies were used to coat the microtiter plates and monoclonal antibodies were used for conjugate in ELISA tests. Sap was extracted from the raspberry tissue by means of the Pollahne leaf press. These ELISA tests demonstrated that infected plants could be reliably detected in the spring of the year, but the reliability of the test decreased as the season progressed. Bark tissue and dormant buds constituted good test material during the winter and early spring. Leaf tissue was material test tissue from bud break through to leaf drop. High background readings occasionally encountered in mid-summer were avoided by using tissue:buffer ratios in the order of 1:100.

(d) Optimizing ELISA detection: To optimize detection of tomato ringspot virus in red raspberry, the many variables in the double antibody sandwich ELISA technique were investigated. G-globulin from a high quality polyclonal antiserum was used at a dilution of 1:2000, followed by a conjugate prepared from monoclonal g-globulin at 1:2000 dilution. Microtiter wells were coated overnight or longer, followed by incubation of test antigen for 16 hours, conjugate for 6 hours and subtrate for 24 hours, all steps at 20°C. Under the above conditions, infected leaf tissue gave an absorbance reading of 2.0 to 3.0 at sap dilutions ranging from 1:125 to 1:1000, whereas healthy controls gave readings of less than 0.1. Leaf tissue was the standard source of virus inoculum that was used to test variables, but virtually any tissue from an infected plant (bark, roots, fruit, petals, etc.) proved to be a suitable inoculum source.

COMMENT:

TomRSV does not appear to be extensively distributed in raspberry plantings in the Fraser Valley and southern Vancouver Island. It is probably confined to those soils in which there is a moderately high population to those nematodes belonging to the genus *Xiphinema* that are capable of vectoring the virus. It was originally thought that the only vector was *X. americanum* but several closely related species may be involved (Stace-Smith, 1984). The fact that the virus does not appear to be present in the native vegetation adjacent to the raspberry plantings suggest that it was introduced in the infected sucker plants that were used to establish the planting. This circumstantial evidence points to the value of using planting stock obtained from certified virus-free sources.

Reference: Stace-Smith, R. 1984. Red raspberry virus diseases in North America. Plant Dis. 68: 274-279.

CROP: Raspberry

LOCATION: Manitoba

TITLE: Incidence of Plant Diseases in Raspberries in Manitoba in 1987

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METHODS: Results are based on 53 samples of raspberries submitted to the Plant Pathology Laboratory and field examinations.

RESULTS: Fifty percent showed cane blight and/or spur blight. Several samples were affected by anthracnose. Nutrient deficiencies mainly iron chlorosis was the problem diagnosed in 9% of samples. Other diseases identified were Botrytis fruit rot and mosaic virus.

CROP: Red Raspberries

LOCATION: Nova Scotia

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TITLE: SURVEY OF SPUR BLIGHT AND CANE BOTRYTIS IN COMMERCIAL RED RASPBERRY PLANTINGS IN NOVA SCOTIA

METHODS: Fifteen commercial red raspberry plantings in seven counties were surveyed in 1987 for spur blight, caused by *Didymella applanata* (Niessl) Sacc., and cane botrytis, caused by *Botrytis cinerea* Pers. ex Fr. A random sample of 50 second-year canes was collected from each cultivar in each planting in April, May or June and brought back to the laboratory for examination. Spur blight and cane botrytis were identified by visual inspection of lesions on the canes. Disease incidence was expressed as the percentage of canes showing symptoms in each 50-cane sample. Distribution of disease on individual canes was assessed by marking each cane off into consecutive 15-cm sections and recording the presence of lesions in each section.

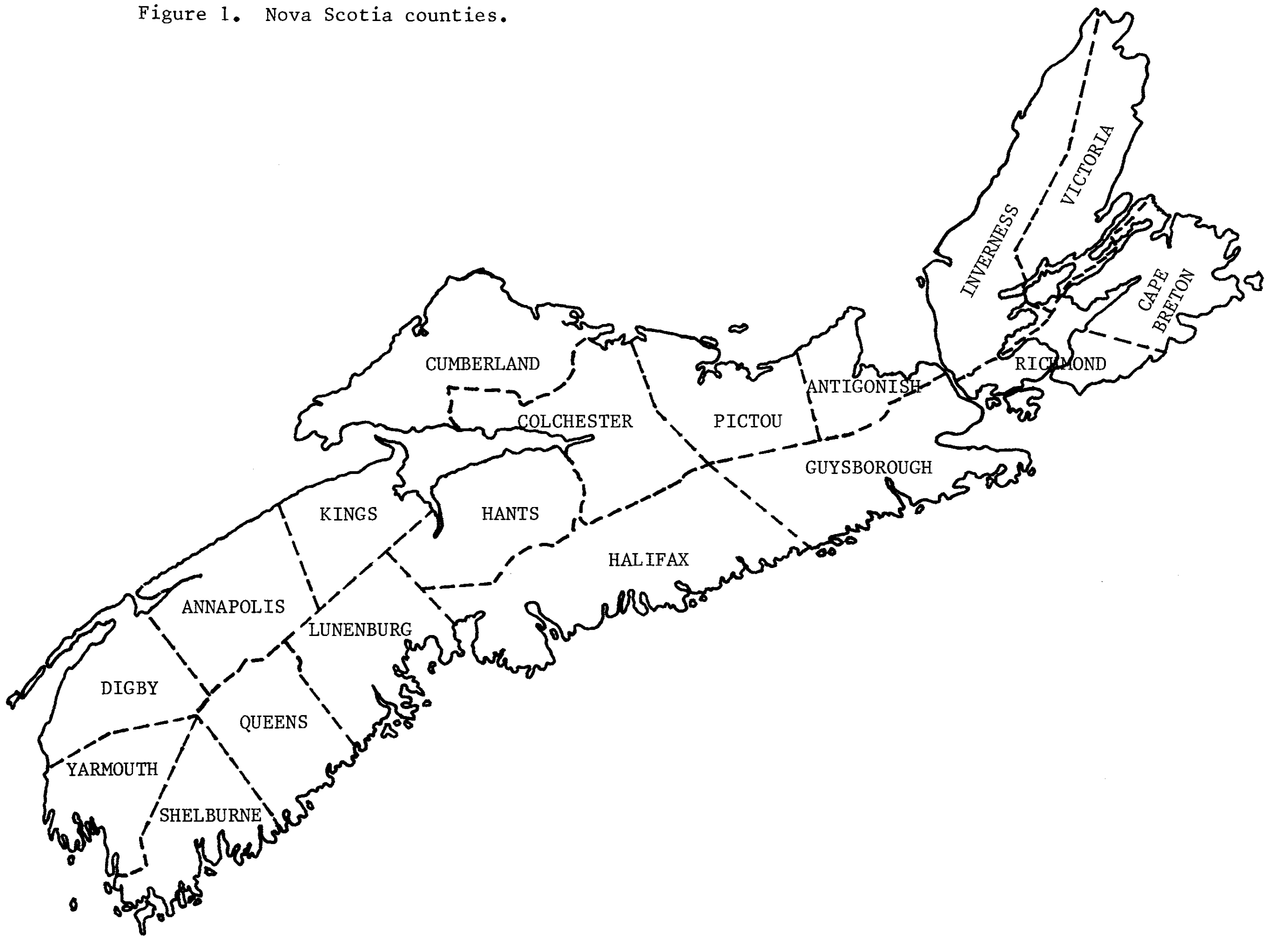
RESULTS AND COMMENTS: See Table 1 and Fig. 1. The higher levels of spur blight were usually found in plantings where recommended spray schedules had not been followed and/or where cane density was unusually high, resulting in poor air circulation. The incidence of cane botrytis was highest near commercial strawberry fields, which probably served as sources of inoculum. The number of samples of cultivars other than Festival was too small for a meaningful comparison of cultivar disease ratings, but in mixed plantings there was some evidence that Carnival and Comet were more resistant to both diseases than Festival. In all cultivars the incidence of both diseases was highest on the lower one-third to one-half of the canes.

Table 1. Incidence of spur blight and cane botrytis in 15 commercial red raspberry plantings in Nova Scotia

Planting	County	Cultivar	Disease Incidence (%)*	
			Spur Blight	Cane Botrytis
1	Annapolis	Festival	96	2
2	Colchester	Festival	30	44
3	Colchester	Comet	0	0
3	Colchester	Festival	2	10
4	Hants	Festival	94	0
5	Kings	Festival	2	52
6	Kings	Festival	8	26
7	Kings	Festival	22	12
8	Kings	Festival	28	2
9	Kings	Festival	94	0
10	Kings	Festival	100	0
11	Kings	Boyne	92	0
11	Kings	Carnival	68	0
11	Kings	Festival	98	2
12	Lunenburg	Carnival	72	4
13	Pictou	Comet	16	2
13	Pictou	Festival	48	12
13	Pictou	Nova	32	0
14	Pictou	Festival	60	16
15	Yarmouth	Carnival	54	2
15	Yarmouth	Nova	84	2
		Mean	52.5	9.0

*50 canes of each cultivar in each planting were rated for disease.

Figure 1. Nova Scotia counties.



CROP: Strawberry

LOCATION: British Columbia

NAME AND AGENCY:
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TITLE: SURVEY FOR COLLETOTRICHUM ACUTATUM IN STRAWBERRY FIELDS IN THE LOWER FRASER VALLEY

METHODS: Twenty seven commercial strawberry fields were surveyed in early September for disease caused by Colletotrichum acutatumin the lower Fraser Valley from Westham Island in the west to Rosedale in the east. Plants were examined along a transect in the form of a modified inverted W pattern in each field. Petioles or runners showing typical lesions were collected, taken back to the laboratory an cultured for the presence of the fungus.The number of plants sampled per field depended on the number of diseased plants found.

RESULTS AND COMMENTS: C. acutatum causes a serious disease of strawberry under the hot, humid conditions of the irrigated strawberry culture systems used in California where many of our certified planting stock comes from. The disease had not been recorded in B.C. on strawberries and is unlikely ever to be important with our cooler, drier conditions. However, this organism has a wide host range, including seedlings of many of our important tree species, particularly hemlock and Douglas fir. The organism was isolated from hemlock seedlings growing in a seedling nursery in the Aldergrove area of the central Fraser valley in 1985. As the nursery is next to a strawberry field planted with certified plants from California it was assumed that the disease came in with the plants. However, the nursery also contained seedling trees brought in from New Zealand where the disease is also prevalent. The purpose of the survey was to determine if C. acutatum was being brought into B.C. with the certified strawberry plants from California.

Typical symptoms were found in most of the fields surveyed but only one isolate of C. acutatum was obtained from the Langley area. Both Botrytis cinerea, Rhizoctonia solani and Gloeosporium spp. cause similar symptoms and were isolated a number of times; B. cinerea was isolated from 18 fields, R. solani from 6 and Gloeosporium spp. from 8. Isolations were random throughout the sampling area with no significant clustering of any one organism. Although C. acutatum was found, the extremely low incidence coupled with the lack of evidence as to the source of the original infestation would indicate that importation of California planting stock is unlikely to pose any threat to the forest tree nursery industry.

CROP: Strawberry

LOCATION: Manitoba

TITLE: Incidence of Plant Diseases in Strawberries in Manitoba in 1987

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METHODS: Results are based on 61 samples of strawberries submitted to the Plant Pathology Laboratory and field examination.

RESULTS: Crown rot was a major problem in older stands. Wilt symptoms were particularly evident following hot dry weather in mid June. The fungi isolated from dead roots and crowns were usually *Fusarium* sp. and *Cylindrocarpon destructans*. Occasionally plants were received that were infected with *Rhizoctonia solani*. In one field near Teulon in the Interlake region plants showing wilt were found to be affected by *Pythium* sp. Hot, dry weather in May and June prevented the widespread development of fruit rot on June bearing varieties. Moist weather in late July and August was very favorable for a heavy development of leaf spot caused mainly by *Mycosphaerella fragariae*. In some cases leaf spot was due to *Diplocarpon* sp. In a field near Beausejour the variety Kent was heavily infected with *Mycosphaerella* leaf spot while an adjacent planting of the variety Gorella showed only a trace amount of leaf spot.

Special crops

CROP: Canola, cv. Tobin (Brassica campestris L.)

LOCATION: Alberta

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TITLE: INCIDENCE OF THE BLACKSPOT OF CANOLA CAUSED BY ALTERNARIA BRASSICAE (BERK.) SACC. DURING 1987.

METHODS: Twenty-five randomly selected fields were surveyed in central Alberta during August, 1987. Additional information and materials were obtained through Mr. C. Loessin and Mr. L. Turner, both of Alberta Agriculture, Innisfail, and Mr. L.J. Lee of Saskatchewan Agriculture, Nipawin. The disease was confirmed by isolation of the pathogen on V8 juice agar supplemented with rose bengal.

RESULTS: All the fields surveyed revealed the presence of blackspot. Each silique (fruit) had up to numerous blackspot lesions. Alternaria brassicae was isolated from most of the diseased plant samples collected or received from the various provincial government agriculture personnel. In the severely affected fields, many siliques were undeveloped (or underdeveloped) indicating initiation of infection during the green silique stage. The fungus, in many cases, had penetrated the fruit wall and colonized the developing seed. In 5 fields in the Nipawin, SK, area, the estimated yield of canola ranged from 17-25 bushels/acre with higher than usual dockage in the heavily infected fields (Mr. L.J. Lee, personal communication). A few of these fields had some variable hail damage as well. In Innisfail, Alberta, a heavily infected field had an estimated yield of 15-20 bushels/acre with about 16% dockage (Mr. L. Turner, personal communication). Several heavily infected fields were located on sandy soils. This association has to be studied further, but could have been due to early maturity of the crop and/or due to some nutritional interactions.

CONCLUSIONS: It appears that the blackspot disease was more severe this year than in the previous few years, and was, perhaps, the most economically important disease of canola across the prairies during 1987. In heavily infected fields, the yield losses are estimated to be about 30% with significantly higher-than-normal dockage.

CROP: Irrigated Canola

LOCATION: Southern Alberta

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TITLE: SURVEY FOR SCLEROTINIA STEM ROT OF IRRIGATED CANOLA IN SOUTHERN ALBERTA IN 1984

METHODS: Irrigated canola (Brassica napus and Brassica campestris) fields in southern Alberta were surveyed for Sclerotinia stem rot (Sclerotinia sclerotiorum) August 1-15, 1984. The survey covered all the major areas of production of irrigated canola, including Counties of Vulcan, Lethbridge, and Forty Mile, Municipal District of Taber, and Improvement District No. 1 (Medicine Hat). In each field, five random spots of at least 25 m from the edge of the field were selected. The distance between any two spots was approximately 20 m. At each spot, two 1-m rows were marked off and the plants were examined to determine the numbers of diseased and healthy plants. Average percent infection in each field and range of infection were determined.

RESULTS AND COMMENTS: There were about 25,000 ha of canola grown under irrigation in southern Alberta in 1984 (A. M. Harvey, personal communication). Sclerotinia stem rot was found in 46 out of the 68 fields surveyed (See Table below). Of the 46 fields with the disease, the incidence was trace to light in 24 fields but was severe in six fields which had over 50% of the plants infected. The growth stage of the crop surveyed varied with fields, ranging from mid-bloom to early maturity.

The survey indicates that Sclerotinia stem rot of canola is widespread in most of the irrigated areas in southern Alberta. Due to the severe drought in 1984, Sclerotinia stem rot was not found in dryland canola in central Alberta (I. Evans, personal communication). The high incidence of the disease in the irrigated region suggests that Sclerotinia stem rot will remain a serious problem in irrigated crops even in years when it is not present on dryland crops because of weather conditions.

Table. Survey of irrigated canola for Sclerotinia stem rot in southern Alberta in 1984

Census Division	County or Municipal District	No. fields*		% infected plants	
		Surveyed	Diseased	Range	Average
1	Co. Forty Mile	19	15	0.4 - 65.0	22.9
2	MD Taber	35	24	0.6 - 66.1	15.9
2	Co. Lethbridge	5	1	9.7	9.7
5	Co. Vulcan	7	4	3.4 - 23.7	12.6
Total		66	44	0.4 - 66.1	17.8

*Two canola fields in Improvement District No. 1 (south of Medicine Hat) also had Sclerotinia stem rot but notes on percent infected plants were not taken.

CROP: Irrigated Canola

LOCATION: Southern Alberta

NAME AND AGENCY:
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TITLE: SURVEY FOR SCLEROTINIA STEM ROT OF IRRIGATED CANOLA IN SOUTHERN ALBERTA IN 1985

METHODS: Irrigated canola (Brassica napus and Brassica campestris) fields were surveyed for Sclerotinia stem rot (Sclerotinia sclerotiorum) between August 20 and September 17, 1985. the survey covered the Counties of Forty Mile and Vulcan and the Municipal District of Taber. In each field, five random spots at least 25 m from the edge of the field were selected. The distance between any two spots was approximately 20 m. At each spot, two 1-m rows were marked off and the plants in the marked areas were examined to determine the numbers of diseased and healthy plants. Average percent infection in each field and range of infection were determined.

RESULTS AND COMMENTS: There were about 30,300 ha of irrigated canola in southern Alberta in 1985 (A. M. Harvey, personal communication). Sclerotinia stem rot was observed in 16 out of the 23 irrigated fields surveyed (See Table below). The average percent of plants infected in each field was 8.2 with a range from 0.8 to 29.7. The maturity of the crop surveyed varied with fields, ranging from early seed set to completely ripe.

Due to the severe drought in 1985, Sclerotinia stem rot was not found in the traditional Sclerotinia problem area for dryland canola in central Alberta (I. Evans, personal communication). The survey suggested that despite the drought conditions in central and southern Alberta in 1985, Sclerotinia stem rot was still a devastating disease of canola grown under irrigation.

Table. Survey of irrigated canola for Sclerotinia stem rot in southern Alberta in 1985

Census Division	County or Municipal District	No. fields		% infected plants	
		Surveyed	Diseased	Range	Average
1	Co. Forty Mile	5	4	2.4 - 29.7	15.1
2	MD Taber	14	9	0.8 - 28.7	5.4
5	Co. Vulcan	4	3	6.4 - 9.1	7.7
Total		23	16	0.8 - 29.7	8.2

CROP: Irrigated Canola

LOCATION: Southern Alberta

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TITLE: SURVEY FOR SCLEROTINIA STEM ROT OF IRRIGATED CANOLA IN SOUTHERN ALBERTA IN 1986

METHODS: Twenty-two irigated fields and three non-irrigated fields of either *Brassica napus* or *Brassica campestris* were surveyed between August 19 and August 26. The area of souther Alberta surveyed included Counties of Forty Mile, Lethbridge, and Vulcan, and the Municipal District of Taber. Canola plants were examined for symptoms of the Sclerotinia disease by inspecting five sites in each field, with two 1-meter rows at each site, and recording the number of diseased and healthy plants. Average percent infection for each field and average percent infection for each County or Municipal District were determined.

RESULTS AND COMMENTS: There were about 16,000 ha of irrigated canola in southern alberta in 1986 (K. Parker, personal communication). The Sclerotinia disease (*Sclerotinia sclerotiorum*) was observed in 21 out of the 25 fields surveyed (See Table below). The average percent plants infected in each field varied from 0.3 to 20.4%, averaging 5.3%. The disease occurred on cultivars of both *B. napus* and *B. campestris*.

Table. Survey of irrigated canola for Sclerotinia stem rot in southern Alberta in 1986

Census Division	County or Municipal District	No. fields*		% infected plants	
		Surveyed	Diseased	Range	Average
1	Co. Forty Mile	11	10	0.6 - 20.4	5.5
2	Co. Lethbridge	9	7	0.3 - 16.2	5.4
3	MD Taber	4	3	1.2 - 5.4	3.5
5	Co. Vulcan	1	1	7.2	7.2
Total		25	21	0.3 - 20.4	5.3

*Three of the fields surveyed were dryland canola located one in each of the Counties of Lethbridge, Vulcan, and the Municipal District of Taber.

CROP: Irrigated Canola

LOCATION: Southern Alberta

NAME AND AGENCY:
H. C. HUANG and L. M. PHILLIPPE
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LETHBRIDGE, Alberta T1J 4B1

TITLE: SURVEY FOR SCLEROTINIA STEM ROT OF IRRIGATED CANOLA IN SOUTHERN ALBERTA IN 1987

METHODS: Irrigated canola fields were surveyed for incidence of Sclerotinia stem rot (*Sclerotinia sclerotiorum*) between August 28 and September 9 in the Counties of Lethbridge, Forty Mile (Bow Island), and Vulcan, and the Municipal District of Taber. Canola plants (*Brassica napus*) 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 numbers of diseased and healthy plants. Range and average percent infection were determined for each field.

RESULTS AND COMMENTS: There were about 12,000 ha of irrigated canola in southern Alberta in 1987 (B. Roth, personal communication). Sclerotinia stem rot was found in 18 out of the 19 fields surveyed (See Table below). Of the 18 positive fields, the disease incidence varied from 0.7-35%, averaging 10.8% of infected plants in each field.

The crops in the survey fields varied from early seed set stage to completely ripe. The weather conditions for the survey period were generally cool and rainy. Due to lateness of the survey, half of the canola fields examined were already swathed and the disease was determined by the examination of stubble for characteristic lesions of stem blight.

Table. Survey of irrigated canola for Sclerotinia stem rot in southern Alberta in 1987

Census Division	County or Municipal District	No. fields		% infected plants	
		Surveyed	Diseased	Range	Average
1	Co. Forty Mile	3	3	4.9 - 23	13.6
2	Co. Lethbridge	11	10	0.7 - 35	11.1
3	MD Taber	1	1	10.3	10.3
4	Co. Vulcan	4	4	0.7 - 15	8.0
Total		19	18	0.7 - 35	10.8

CROP: Irrigated Canola

LOCATION: Southern Alberta

NAME AND AGENCY:
H. C. HUANG, L. M. PHILLIPPE, M. J. KOKKO and A. K. TOPINKA
Agriculture Canada Research Station
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TITLE: DISTRIBUTION OF SCLEROTINIA STEM ROT OF IRRIGATED CANOLA IN SOUTHERN ALBERTA, 1984-87

METHODS: Canola (*Brassica napus* and *Brassica campestris*) grown under irrigation in southern Alberta was surveyed for Sclerotinia stem rot from 1984 to 1987. The survey in each year covered the major production areas of irrigated canola, including Counties of Vulcan, Lethbridge and Forty Mile, Municipal District of Taber and Improvement District No. 1.

RESULTS AND COMMENTS: The numbers of fields surveyed in 1984, 1985, 1986, and 1987 were 66, 23, 25, and 19, respectively. *Brassica napus* was found in more than 87% of the fields surveyed each year. *Brassica campestris* was found in less that 13% of the fields surveyed.

Sclerotinia stem rot of canola was found in most of the irrigated areas in southern Alberta, including Counties of Vulcan, Lethbridge, and Forty Mile, Municipal District of Taber and Improvement District No. 1 (See Figure 1). The highest concentration of diseased fields was in the M.D. of Taber and County of Forty Mile in the area between Grassy Lake and Bow Island.

Results of the 4-year survey suggest that irrigated conditions are conducive to the development of Sclerotinia stem rot of canola. The prevalence of the disease in the Grassy Lake-Bow Island region suggests that the heavy infestation of *S. sclerotiorum* is due to the growth of canola and other irrigated host crops such as field beans and sunflower in that area.

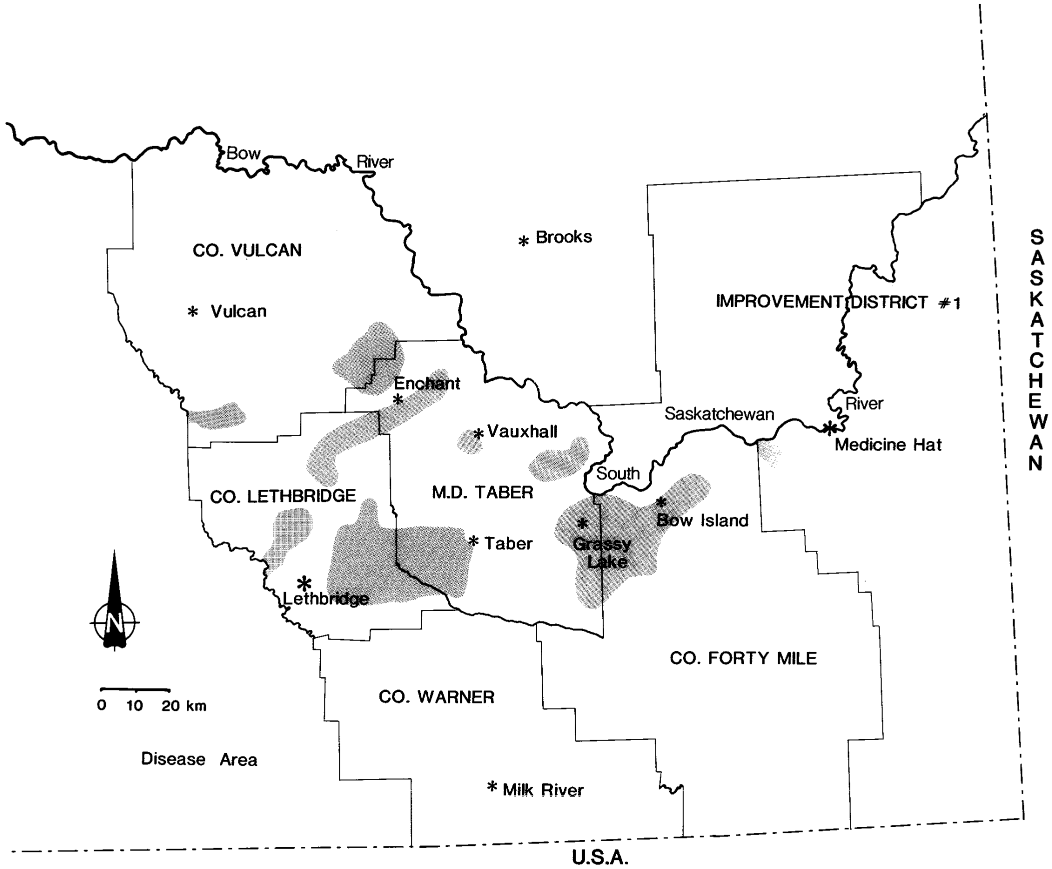


Figure 1. Distribution of Sclerotinia stem rot of irrigated canola in southern Alberta, 1984-87.

CROP: Rapeseed/Canola

LOCATION: Alberta

NAME AND AGENCY:
HARRISON, L.M.
Alberta Agriculture
Regional Crop Laboratory
Fairview, Alberta, TOH 1L0

TITLE: RAPESEED/CANOLA DISEASE SURVEY IN THE PEACE RIVER REGION IN 1987.

METHODS: A disease survey was conducted in August on 54 rapeseed/canola fields in the Peace River Region of Alberta. The total area of canola in the region in 1987 was about 900,000 acres. Forty-three fields were planted with Tobin (Brassica campestris) and 11 fields with Westar (B. napus).

Fields were sampled by walking into each one in a V pattern and collecting the first plants at a site 30 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, and the incidence of root maggot damage was also noted.

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

COMMENTS: The root rot complex was the most prevalent disease affecting 96% of fields observed (Table 1). Disease incidence averaged 48.7% of plants observed in each field.

Incidence of root rot and maggot was compared in Tobin and Westar fields (Table 2). Tobin was more susceptible than Westar. The cultivar Tobin is prevalent in the Peace Region, comprising approximately 85% of the total acreage. Its susceptibility is one of the factors accounting for the high root rot incidence.

Table 1. Prevalence and incidence of diseases of canola in the Peace River Region in 1987.

Disease	% fields infected	% plants infected
Root Rot (Rhizoctonia, Pythium, Fusarium)	96	48.7
Foot Rot (Rhizoctonia, Fusarium)	83	13.9
Staghead (Albugo candida, Peronospora parasitica)	54	5.3
Sclerotinia (Sclerotinia sclerotiorum)	1	0.3
Blackleg (Leptosphaeria maculans)	0	0.0
Aster Yellows (mycoplasma)	0	0.0
Gray Stem (Pseudocercosporella capsellae)	96	31.6
Black Spot(Alternaria spp.)	94	24.6

Table 2. Incidence of root rot and root maggot in Tobin and Westar fields in the Peace River Region in 1987.

Cultivar	No. of fields	% root rot	% root maggot
Tobin	43	57.4	61.0
Westar	11	15.5	2.4

CROP: Canola

LOCATION: Alberta

NAME AND AGENCY: KHARBANDA, P.D., Alberta Environmental Centre, Vegreville, Alberta,TOB 4L0; EVANS, I.R., Plant Industry Division, Alberta Agriculture, Edmonton, Alberta, T6H 5T6; SLOPEK, S., Regional Crop Laboratory, Alberta Agriculture, Olds, Alberta, TOM 1P0; HOWARD, R.J., Alberta Special Crops and Horticultural Research Center, Brooks, Alberta, TOJ 0J0; HARRISON, L., Regional Crop Laboratory, Alberta Agriculture, Fairview, Alberta, TOH 1L0; TEWARI, J.P., Plant Science Department, University of Alberta, Edmonton, Alberta, T6G 2P5; HUANG, H.C., Research Station, Agriculture Canada, Lethbridge, Alberta, T1J 4B1.

TITLE: BLACKLEG OF CANOLA SURVEY IN ALBERTA - 1987

METHODS: Canola fields were surveyed by individual cooperators as indicated in the table below. Approximately one field per 20,000 acres of canola grown in each Crop District was surveyed. Blackleg was identified by visual symptoms in the field, however, the virulent nature of blackleg (Leptosphaeria maculans) was confirmed by laboratory tests (1). Each field was traversed along the path of an inverted V and sampled at 5 spots, about 100 meters apart. In swathed fields, 50 stem stalks and the corresponding adjacent swath were examined for blackleg. In standing crops, 25 plants were checked for the disease. Observations on stem rot (Sclerotinia sclerotiorum), root rot/basal stem rot (Rhizoctonia solani), black spot (Alternaria spp.), and staghead (Albugo candida) were also taken.

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.

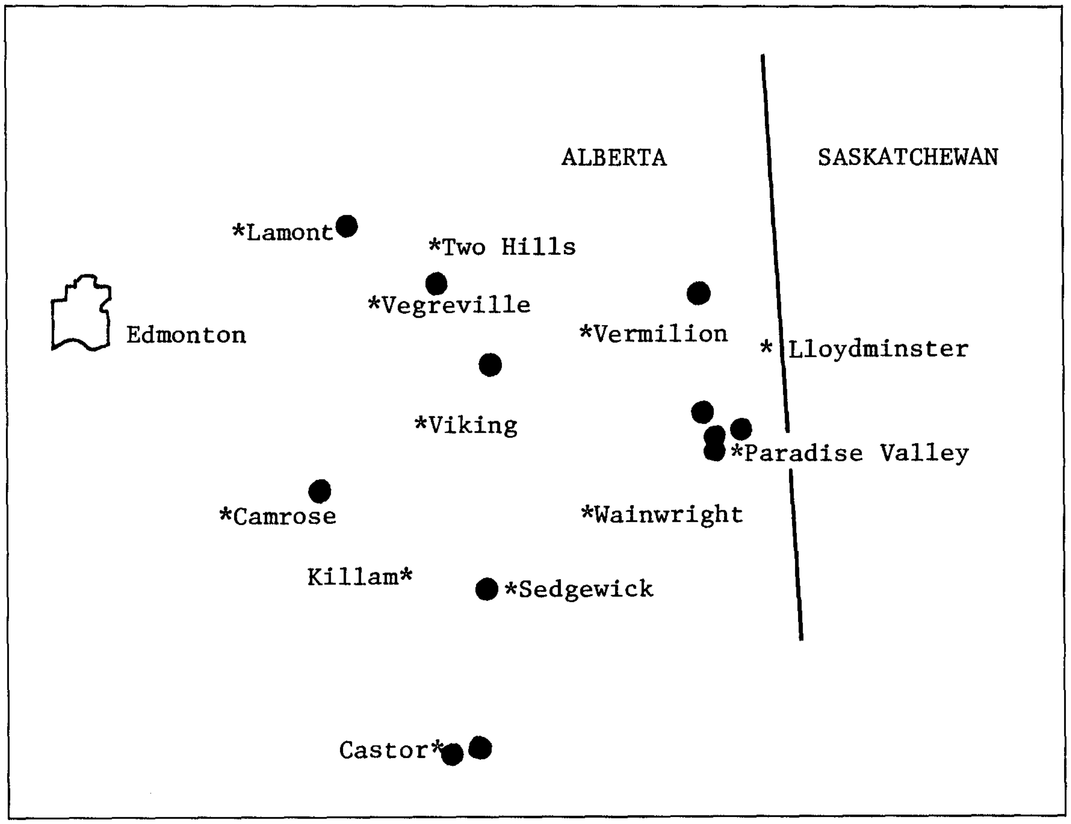
RESULTS AND COMMENTS: See Table below. Blackleg severity was generally low. Highly virulent blackleg was identified in north-central Alberta as indicated on the map below. The incidence and severity of black spot, in general, and staghead in cv. Tobin was higher than in 1986. By contrast, the occurrence of other diseases was considerably lower.

Census Divisions	Acreage (Thousands)	No. of fields surveyed	Surveyors	Fields infested with highly virulent blackleg
1 + 4	35	19	Huang	0
2 + 5	222	12	Howard	0
3 + 6	166	13	Howard	0
7	460	24	Slopek	3
8 + 11	358	26	Evans	0
10	621	36	Kharbanda	9
12 + 13	248	9	Tewari	0
15	837	54	Harrison	0

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.

1987 BLACKLEG OF CANOLA SURVEY

INCIDENCE OF THE VIRULENT STRAIN



CROP: Canola

LOCATION: South-Central Alberta

PEST: Blackleg, *Leptosphaeria maculans*, Stem rot, *Sclerotinia sclerotiorum*, Grey Stem, *Pseudocercosporella capsellae*, Powdery mildew, *Erysiphe communis*, Blackspot, *Alternaria* spp., Crown borer, unidentified

NAME AND AGENCY:
SLOPEK, S.W. and S. PETERS
Regional Crops Laboratory
Alberta Agriculture
Olds, Alberta
TOM 1PO

TITLE: A SURVEY OF CANOLA DISEASES IN SOUTH CENTRAL ALBERTA, 1987

METHODS: Fifty-one canola fields were surveyed on September 8 and 11 in the counties of Red Deer and Mountainview and the municipal district of Kneehill. Fields were surveyed after swathing but prior to combining. Twenty-five plants were examined at each of ten sites. Each site was 15-30 feet apart, depending upon the width of swath. For blackleg and stem rot, only plants that were girdled were counted as diseased. Diseased stems were collected and further examined in the laboratory. Isolations were made from the blackleg lesions and virulence was determined using the methods described by McGee and Petrie (1978, Phytopath. 68:625-30). The severity of grey stem and powdery mildew was established by estimating the percentage of infected plants. The following categories (Ellis, 1983, M.P.M. Thesis, SFU) were used, 0 = no plants with lesions, 1 = Trace 5% of plants with lesions, 2 = Slight 6-25%, 3 = Moderate 26-75%, 4 = Severe >75%. Apart from the formal surveys, some observations were made in regards to other field visits and specimens which were received by the Regional Crops Lab, Olds.

RESULTS: The results of the survey are summarized in the figure and tables below. This is the first year in which powdery mildew of canola has been reported in Alberta. Canola plants infected with powdery mildew were received by both the Regional Crops Laboratory in Olds and by R. Howard in Brooks. Apart from the survey two fields in the Innisfail area were found to have very damaging levels of blackspot. It was estimated that yield losses would exceed 50% due to pod damage and seed shrivelling and the inevitable increased losses due to shattering. Blackspot levels appeared to be generally higher than in other years. It was noticed during the survey that an insect of some sort had burrowed into the crown of the plants. Affected plants at the time of the survey were brownish in colour and brittle. Root maggot damage was very common in all fields surveyed. The virulent strain of blackleg was not found.

COMMENTS: The objective of this survey was to provide both quantitative and qualitative estimates of disease severity levels and distributions. Although it is impossible to produce estimates of yield losses from the survey results, they provide an indication of whether disease levels are increasing from one year to the next. Although this is the first report of powdery mildew of canola in Alberta, it appears that the pathogen is widely distributed (42% of fields with infections). Overall stem rot levels were low at 2.3%. The field with 13.2% stem rot had a very bad infestation of hemp-nettle which was also heavily infected with stem rot. Poor weed control has undoubtedly contributed to the stem rot probably in this field. It is felt that the damage caused to crowns by an as of yet unidentified insect may be causing significant yield losses.

Pest	No. of Fields Rated	% of Fields with Infections	Mean % Incidence per field	Range in % Incidence
Blackleg	51	23.5	0.3	0-4.0
Stem Rot	51	80.0	2.3	0-13.2
Powdery Mildew	40	42.0	-	-
Grey Stem	40	45.0	-	-
Crown borers	15	93.0	8.0	0-21.2

Table 1. Percentage of fields infected with canola diseases and the mean incidence per field.

Pest	Severity Category				
	0	1	2	3	4
Powdery Mildew	24	11	0	3	2
Grey Stem	23	12	4	0	1

Table 2. Distribution of severity categories for powdery mildew and grey stem.

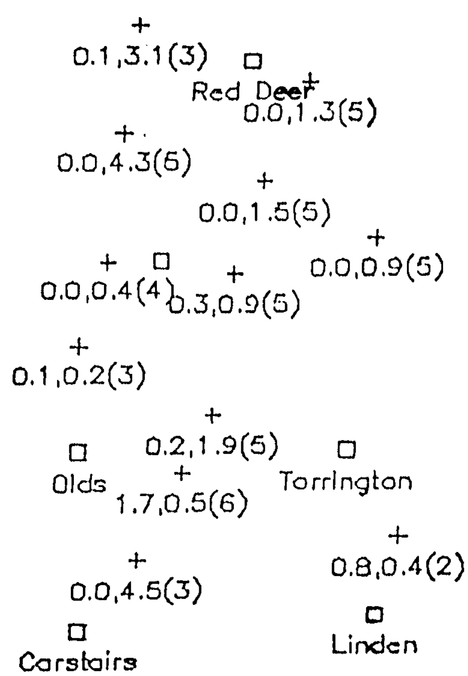


Fig. 1. Disease distribution of blackleg and stem rot. The first number refers to the percentage of blackleg, the second to stem rot and in brackets, the number of fields surveyed.

CROP: Canola

LOCATION: Saskatchewan

NAME AND AGENCY:
B. Berkenkamp and C. Kirkham
Agriculture Canada Research Station
Melfort, Sask. S0E 1A0

TITLE: DISEASE SURVEY OF CANOLA IN N.E. SASKATCHEWAN

METHODS: Forty four canola fields were surveyed between June 25 and August 12, 1987 in crop districts 5b, 8a, 8b and 9a in N.E. Saskatchewan. Fields surveyed were selected at random throughout each crop district. One plant was selected every ten paces, ten times in each field. Diseases were identified according to the visual symptoms expressed on the plants. Root rot severity was assessed according to the lesions on the roots where 0 = Healthy, 2 = Trace, 5 = Moderate, and 10 = Severe, similar to that of Petrie in 1972 (1). All other diseases were assessed on the basis of percentage of leaf or stem area affected. Results for each disease were totalled and averaged over the total number of samples and fields surveyed to give the Disease Index. Percentage of fields affected was calculated by dividing the number of fields in which the disease was noted by the total number of fields surveyed.

RESULTS AND COMMENTS: The severity and distribution of diseases of canola in the four crop districts surveyed are shown in the table below. The early survey dates probably had an effect on the intensity and percentage of fields affected by the diseases (2, 3).

Blackleg (*Leptosphaeria maculans*) was found to be the most prevalent disease. The disease was most severe in crop district 8b, as was found in 1984 and 1985 (2). The symptoms were noted mainly on the leaves, but during August surveys it was found on the stems as well. Overall this disease was found in greater than 70 percent of the fields surveyed.

Blackspot (*Alternaria* spp.) was found in low levels in all crop districts surveyed. It was more prevalent, however, in crop district 8b as it was found in every field surveyed. The low severity levels were probably due to the early survey.

White rust (*Albugo candida*) was uncommon, occurring in only three out of forty four fields surveyed. Staghead symptoms were only noted in one of these three fields.

Downey mildew (*Peronospora parasitica*) and Root rot (several fungi) were also uncommon, occurring in less than 5 and 16 percent of the fields respectively.

Stem blight (*Sclerotinia sclerotiorum*) was found only in crop district 8b. Again the survey in July was too early to properly assess this disease (2, 3, 4). It did, however, occur in 25% of the fields in crop district 8b with a disease index of 0.83.

Table. Disease Survey of Canola in N.E. Saskatchewan, 1987

C.D.	Fields Assessed Number of Fields	Disease Index/% Fields Affected					
		Root Rot	Blackleg	Blackspot	White Rust	Downey Mildew	Sclerotinia
5B	8	0/0	1.28/87.5	0.41/37.5	<0.1/12.5	0/0	0/0
8A	8	0/0	1.57/50.0	1.85/62.5	0/0	T/12.5	0/0
8B	12	0.13/16.7	7.34/100.0	1.49/100.0	0/0	0/0	0.83/25.0
9A	16	0.23/31.3	1.08/50.0	0.34/68.8	0.91/12.5	<0.1/6.3	0/0
Total or Avg.	44	0.10/15.9	2.82/70.5	1.02/70.5	0.23/6.8	<0.1/4.5	0.21/6.8

*Disease found in the field, but not in the sampled plants

REFERENCES:

(1) Petrie, G.A. 1973
Diseases of Brassica Species in Saskatchewan, 1970-72 III. Stem and Root rots
Can. Plant Dis. Surv. 53(2):88-92

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

(3) Morrall, R.A.A., J. Dueck, D.L. McKenzie and D.C. McGee. 1976
Some aspects of Sclerotinia sclerotiorum in Saskatchewan, 1970-75
Can. Plant Dis. Surv. 56(2):56-62

(4) Petrie, G.A. 1985
Saskatchewan rapeseed/canola disease survey, 1983
Can. Plant Dis. Surv. 65(2):47-49

CROP: Canola

LOCATION: Manitoba

TITLE: Survey of Plant Diseases of Canola in Manitoba in 1987

NAME AND AGENCY:
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Manitoba Agriculture
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R3T 2N2

METHODS: Results are based on a survey of 65 fields distributed throughout southern Manitoba during the third week of August 1987. Fifty-nine fields of *Brassica napus* and six fields of *Brassica campestris* type canola were included in the survey.

RESULTS: The incidence of disease in *Brassica napus* type canola is presented in Table 1. Sclerotinia stem rot was found in the highest percentage of fields 64% at an average level of occurrence of 5.77% and an estimated overall severity of 3.72%. However in only a few areas such as in the central region near Elm Creek, Carman and Rosebank, in the northwest region near Benito and Swan River and the eastern region near St. Anne was stem rot a major problem . In the above areas individual fields with up to 30% loss from stem rot were detected. In the majority of the province only low levels of stem rot occurred. Blackleg caused in most cases by the virulent strain of *Leptosphaeria maculans* was found in 54% of fields surveyed at an average level of incidence of 17.7% and caused an estimated overall loss of 9.6%. The high loss attributed to blackleg is a reflection of the severe problem in the southwest region south of Souris, and the northwest region near Grandview, Gilbert Plains and Roblin. In the eastern area of Manitoba only trace levels of blackleg were detected. Black spot caused by *Alternaria* sp. was found in 35% of fields but the disease was of very low incidence 0.5% and only caused a trace level of damage 0.17%. Foot rot caused mainly by *Rhizoctonia solani* was found in 22% of fields at an average level of incidence of 7.15% and it caused an overall loss of 1.6%. The areas affected most severely by foot rot were in the southwest region near Killarney and Neepawa and the northwest region near Swan River. In all of these areas the affected fields had received higher than normal amounts of precipitation during July and early August. Other diseases detected were aster yellows in 10% of fields and ringspot or white leaf spot caused by *Pseudocercosporella capsellae* in 1% of fields. Both of these diseases caused losses less than .2%.

The level of disease in *Brassica campestris* type canola was similar to that caused by *B. napus* and is presented in Table 2. The majority of *B. campestris* fields included in the survey were in the northwest region. Blackleg and foot rot were the most prevalent disease problems and were detected in 83% of fields surveyed, causing overall losses of 10.8 and 9.83% respectively. Sclerotinia stem rot and ringspot were both found in 66% of fields surveyed. Sclerotinia rot caused an estimated loss of 2.5%. Ringspot although rated at an overall level of severity of 9.25% did not in most cases cause severe yield loss as the disease occurs very late in the growing season. Aster yellows and white rust were not found in any fields surveyed.

Table 1. Results of Disease Survey in *B. napus* Fields in Manitoba (Total number of fields = 59)

DISEASE	FIELD %	MEAN %[1] INCIDENCE	MEAN %[2] SEVERITY
Sclerotinia	64	5.77	3.72
Blackleg	54	17.70	9.60
Black spot	35	.50	0.17
Foot rot	22	7.15	1.60
Aster Yellows	10	2.33	0.23
Ringspot	1	10.00	0.16
White rust - staghead	0	0	0

Table 2. Results of Disease Survey in *B. campestris* Fields in Manitoba (Total number of fields = 6)

DISEASE	FIELD %	MEAN %[1] INCIDENCE	MEAN %[2] SEVERITY
Blackleg	83	12.10	10.08
Foot rot	83	11.80	9.83
Ringspot	66	13.87	9.25
Sclerotinia	66	3.75	2.50
Black spot	50	.55	0.27
Aster Yellows	0	0	0
White rust - staghead	0	0	0

[1] based on disease level within infected fields only

[2] average level of infected plants based on all fields surveyed

CROP: Fababeans

LOCATION: Manitoba

TITLE: Incidence of Plant Diseases in Fababeans in Manitoba in 1987

NAME AND AGENCY:
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METHODS: Results are based on 14 samples of fababeans submitted to the Plant Pathology Laboratory and field examinations.

RESULTS: The most commonly encountered disease problem was chocolate spot caused by Botrytis fabae. Sclerotinia was detected from plants submitted from Swan River. Root rot caused by Fusarium sp. was recorded from Altona. Five seed samples were analysed all showed Botrytis sp. at an average level of occurrence of 6%. Fusarium was detected on 80% of seed samples at an average level of 5%. Ascochyta was not detected on any fababean plants or seed samples submitted in 1987.

CROP: Flax

LOCATION: N.E. Saskatchewan

NAME AND AGENCY:
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Agriculture Canada Research Station
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METHODS: Nineteen flax fields were surveyed between June 29, 1987 and August 21, 1987 for disease in Crop districts 5b, 8a, 8b and 9a of N.E. Saskatchewan. One plant was selected every ten paces, ten times in each field. Diseases were assessed according to the visual symptoms expressed on the plants. Root rot was assessed based on a scale where 0 = Healthy, 2 = Trace, 5 = Moderate, and 10 = Severe, according to lesions found on the roots. All other diseases were assessed for percentage of leaf or stem area affected (1). Results were recorded for each plant on a standard format sheet, 1 sheet per field. Disease index was calculated by totalling results for each disease and then averaging it over the number of samples and total number of fields surveyed. Percentage of fields affected was calculated by dividing the number of fields in which the disease occurred by the number of fields surveyed.

RESULTS AND COMMENTS: The table below shows that there were very low levels of disease found in N.E. Saskatchewan this year. Pasmo (Septoria lincola) was by far the most prevalent disease, occurring in the majority of the fields. Low levels of root rot (several fungi) and traces of Aster yellows (Mycoplasmalike organism) were found in less than 6 and 20 percent of the fields respectively. No evidence of Rust (Melampsora lini) was found in any of the fields surveyed. On the whole most of the fields surveyed showed low levels of disease, with the exception of the late August samples which ranged up to 30% leaf and stem areas affected with Pasmo.

Table. Percentage of Fields Affected and Severity of Diseases

Disease	Disease Index	% Fields Affected
Pasmo	4.94	84.2
Root Rot	<.1	5.2
Aster Yellows	*T	15.8

*T Disease found in the field, but not among the sampled plants

REFERENCES:

(1) James, C. 1971
A Manual of Assessment Keys for Plant Diseases
Canada Department of Agriculture #1458

CROP: Flax

LOCATION: Manitoba

TITLE: Incidence of Plant Diseases in Flax in Manitoba in 1987

NAME AND AGENCY:
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METHODS: Results are based on 21 samples of flax submitted to the Plant Pathology Laboratory and field examinations.

RESULTS: Early in the season heat canker and damping off were quite common particularly from fields in the Central and Eastern regions. Pasmo appeared on flax late in July and August but did not cause significant loss. A sample of flax from the Swan River area in the Northwest region was found to have a flower and stem blight caused by *Alternaria* sp. but it did not cause appreciable loss.

CROP: Lentils

LOCATION: Manitoba

TITLE: Incidence of Plant Diseases in Lentils in Manitoba in 1987

NAME AND AGENCY:
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METHODS: Results are based on 42 samples of lentils submitted to the Plant Pathology Laboratory and field examinations.

RESULTS: There were 28 samples of seed, 17 from 1986 crop and 11 from 1987. *Ascochyta* sp. was present on 82% of 1986 seed samples at an average level of 3.5%. *Botrytis* sp. was found on 65% at the 1.6% level. The incidence of *Ascochyta* found on 1987 harvested seed was 82% at a level of 1.5%. *Botrytis* sp. was found on 73% of samples at a level of .8%. *Colletotrichum* sp. was detected on plant samples submitted from St. Jean in southern Manitoba adjacent to the Red River. It has not yet been determined if the *Colletotrichum* sp. is causing an actual plant disease problem. An isolation of *Colletotrichum* from lentil stems in 1983 was identified by the Commonwealth Mycological Laboratory as *Colletotrichum detructivum*.

CROP: Peas

LOCATION: N.E. Saskatchewan

NAME AND AGENCY:
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Agriculture Canada Research Station
Melfort, Saskatchewan SOE 1A0

TITLE: DISEASE SURVEY OF PEA FIELDS IN N.E. SASKATCHEWAN

METHODS: Sixteen fields of peas were surveyed from June 29, 1987 to August 21, 1987 for diseases in four crop districts of N.E. Saskatchewan, (5b, 8a, 8b, and 9a). Diseases were identified according to visual symptoms on the plant and then recorded on a standard format sheet. One plant was selected at ten pace intervals ten times in each field. Any symptoms that were not recognized on the plants were returned to the lab and incubated until identification of the pathogen was possible.

Root rot severity was assessed according to amount of discoloration on the roots based on a scale where 0 = Healthy, 2 = Trace, 5 = Moderate, and 10 = Severe. All other diseases were assessed on the basis of percentage of leaf area covered, to estimate the disease index over all fields.

RESULTS AND COMMENTS: Blight (*Mycosphaerella pinodes*) was the most widespread followed by Root rot (several fungi) and foot rot (*Ascochyta* sp.). Ascochyta leaf spot (*Ascochyta pisi*), and Powdery mildew (*Erysiphe polygoni*) were found in less than half the fields while Downy mildew (*Peronospora viciae*) and Septoria leaf blotch (*Septoria pisi*) were found in a few fields, but in very small amounts.

Table. Percentage of Fields Affected and Severity of Diseases.

Disease	Disease Index	% Fields Affected
Mycosphaerella Blight	19.56	81.3
Root Rot	0.66	62.5
Foot Rot	0.76	56.3
Ascochyta Leaf Spot	0.94	37.5
Powdery Mildew	3.21	25.0
Downy Mildew	<.1	12.5
Septoria Leaf Blotch	<.1	6.3

CROP: Field Peas

LOCATION: Manitoba

TITLE: Incidence of Plant Diseases in Field Peas in Manitoba in 1987

NAME AND AGENCY:
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WINNIPEG, Manitoba
R3T 2N2

METHODS: Results are based on 31 samples of field peas submitted to the Plant Pathology Laboratory and field examinations.

RESULTS: Ten of the samples submitted were of seed. The seed showed an average of 3.3% *Mycosphaerella* sp. *Botrytis* was generally trace in most samples but was present at a 21% level in one sample. Heat canker was evident in samples submitted in June following a week of 30°C average temperature. *Mycosphaerella pinodes* leaf and stem blight was present in most pea fields prior to harvest in September but it appears to have developed late in the season and did not cause major loss. Sclerotinia stem rot was observed in a field near Winnipeg causing about 5% level of damage. Root rot attributed to *Fusarium* sp. was diagnosed from 6 samples.

CROP: Soybeans

LOCATION: Eastern Ontario

NAME and AGENCY:
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TITLE: SOYBEAN DISEASE INCIDENCE IN GROWERS' FIELDS, 1987

INTRODUCTION: Since the 1979 soybean disease survey (1), the soybean acreage in Eastern Ontario has expanded. Hence, this survey was conducted to obtain current information on soybean diseases (3).

METHODS: With guidance from the Agriculture Representatives (Ontario Ministry of Agriculture and Food) to locate soybean growers, 75 fields in 9 counties (see Table) in Eastern Ontario were visited during the month of August. In each field, within an area of 0.04 ha., disease incidence was recorded and, based on a 1-5 visual rating scale (2), disease severity was estimated. The approximate field size was determined using a range finder.

RESULTS AND COMMENTS: Three foliage diseases, brown spot (*Septoria glycines*), bacterial blight (*Pseudomonas syringae* pv. *glycinea*), and downy mildew (*Peronospora trifoliorum*) were distributed in the 75 fields (see Table) with a total area of 710 ha. Disease severity was usually low (visual rating of 2-3) except in two fields where brown spot rating was more than 3.

REFERENCES:

1. Basu, P.K. 1980. Occurrence of soybean foliage diseases in Eastern Ontario, 1979. Can. Plant Dis. Surv. 60: 23-24.

2. Basu, P.K. and G. Butler. 1986. An evaluation of soybean bacterial blight assessment methods. Can. J. Plant Pathol. 8: 459-463.

3. Sinclair, J.B. and M.C. Shurtleff. (ed). 1975. Compendium of soybean diseases. American Phytopathol. Soc., St. Paul, Minn., U.S.A. 69 pp.

TABLE. Number of fields affected by brown spot (BS), bacterial blight (BB), and downy mildew (DM).

County	Fields	BS	BB	DM
Lanark	5	5	3	3
Leeds	5	5	0	1
Grenville	8	7	4	1
Ottawa-Carleton	15	13	5	10
Dundas	11	9	8	3
Russell	15	13	7	8
Stormont	7	5	5	3
Prescott	4	4	1	1
Glengarry	5	2	4	5
TOTAL	75	63	37	35

CROP: Sunflower

LOCATION: Southern Alberta

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TITLE: SURVEY OF SCLEROTINIA WILT AND HEAD ROT OF SUNFLOWER IN SOUTHERN ALBERTA, 1983

METHODS: Six sunflower (*Helianthus annuus* L.) fields in the County of Forty Mile near Bow Island were surveyed for Sclerotinia wilt and head rot (*Sclerotinia sclerotiorum*) on September 1, 1983. This was done by randomly selecting four rows in the field, with about 20 paces between the rows surveyed. One hundred plants in each row were examined for symptoms of Sclerotinia wilt by the presence of bleached lesions on basal stem of wilted plants and symptoms of Sclerotinia head rot by the presence of sclerotia on rotted head. The severity of Sclerotinia wilt and head rot was determined by the average percent infection in each field.

RESULTS AND COMMENTS: Sunflower was a new crop grown under contract with the Alberta Sunflower Company Ltd. There were about 730 ha of sunflowers in southern Alberta in 1983 (B. Roth, personal communication). Almost all the varieties were confectionary type.

All the six fields surveyed were confectionary type of sunflower. Sclerotinia wilt was found in all the fields, and the disease incidence was trace or less than 1% of wilt in three fields, light or less than 5% of wilt in two fields, and moderate or 20% of wilt in one field. Sclerotinia head rot was found in three fields, two with trace infection, and one with 10% of head rot.

Three of the six fields had hail damage. Insect infestation was found in two fields, one with aphids and the other with aphids and grasshoppers.

CROP: Sunflower

LOCATION: Southern Alberta

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TITLE: SURVEY OF SCLEROTINIA WILT AND HEAD ROT OF SUNFLOWER IN SOUTHERN ALBERTA, 1986

METHODS: Fourteen fields of sunflower (*Helianthus annuus* L.) in the County of Forty Mile and the Municipal District of Taber were surveyed from September 18-23, 1986. In each field six rows of 25 plants per row were rated for incidence of Sclerotinia wilt and head rot.

RESULTS AND COMMENTS: Sclerotinia wilt was found in six of the seven fields surveyed in the County of Forty Mile near Bow Island area and in one of the seven fields surveyed in the Municipal District of Taber (Table 1). The disease ranged from light, or 1.3% of wilt, to severe, or 42-78% of wilt.

Sclerotinia head rot was found in three of the seven fields surveyed in the County of Forty Mile and two of the seven fields surveyed in the Municipal District of Taber. The disease incidence was generally light, ranging from 1-4.8% of infection (Table 1).

Table 1. Survey of Sclerotinia wilt and head rot of sunflower in southern Alberta, 1986.

County or Municipality	Field Number	Sclerotinia disease (%)	
		Wilt	Head rot
Co. Forty Mile	1	0	2.7
	2	2.4	4.8
	3	1.3	2.0
	4	78.0	0
	5	45.3	0
	6	53.0	0
	7	42.0	0
M.D. Taber	8	14.5	0
	9	0	0
	10	0	1.0
	11	0	0
	12	0	0
	13	0	1.3
	14	0	0

CROP: Sunflower

LOCATION: Southern Alberta

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TITLE: SURVEY OF SCLEROTINIA WILT AND HEAD ROT OF SUNFLOWER IN SOUTHERN ALBERTA, 1987

METHODS: Twenty-nine sunflower fields in the County of Forty Mile and the Municipal District of Taber were surveyed from October 14-19, 1987. In each field, six rows of 25 plants per row were rated for incidence of Sclerotinia wilt and head rot.

RESULTS AND COMMENTS: There were 1420 ha of sunflowers in southern Alberta in 1987 (B. Roth, personal communication). Of the 29 fields surveyed, 5 were oilseed type and 24 were confectionary type of sunflower. The Sclerotinia wilt was found in 18 fields and the Sclerotinia head rot was found in 16 fields (Table 1). The severity for Sclerotinia wilt varied with fields, ranging from trace, or less than 1% of infected plants, to moderate, or 31.3% of infected plants. The severity for head rot ranged from trace to light infection. Both wilt and head often occurred in the same field in the County of Forty Mile and the Municipal District of Taber (Figure 1).

Table 1. Survey of Sclerotinia wilt and head rot of sunflower in southern Alberta, 1987.

Disease severity and incidence	No. fields	
	Sclerotinia wilt	Sclerotinia head rot
None	11	13
Trace (< 1%)	4	12
Light (1-10%)	10	4
Moderate (11-40%)	4	0
Severe (41-80%)	0	0
Very Severe (> 80%)	0	0
Total	29	29

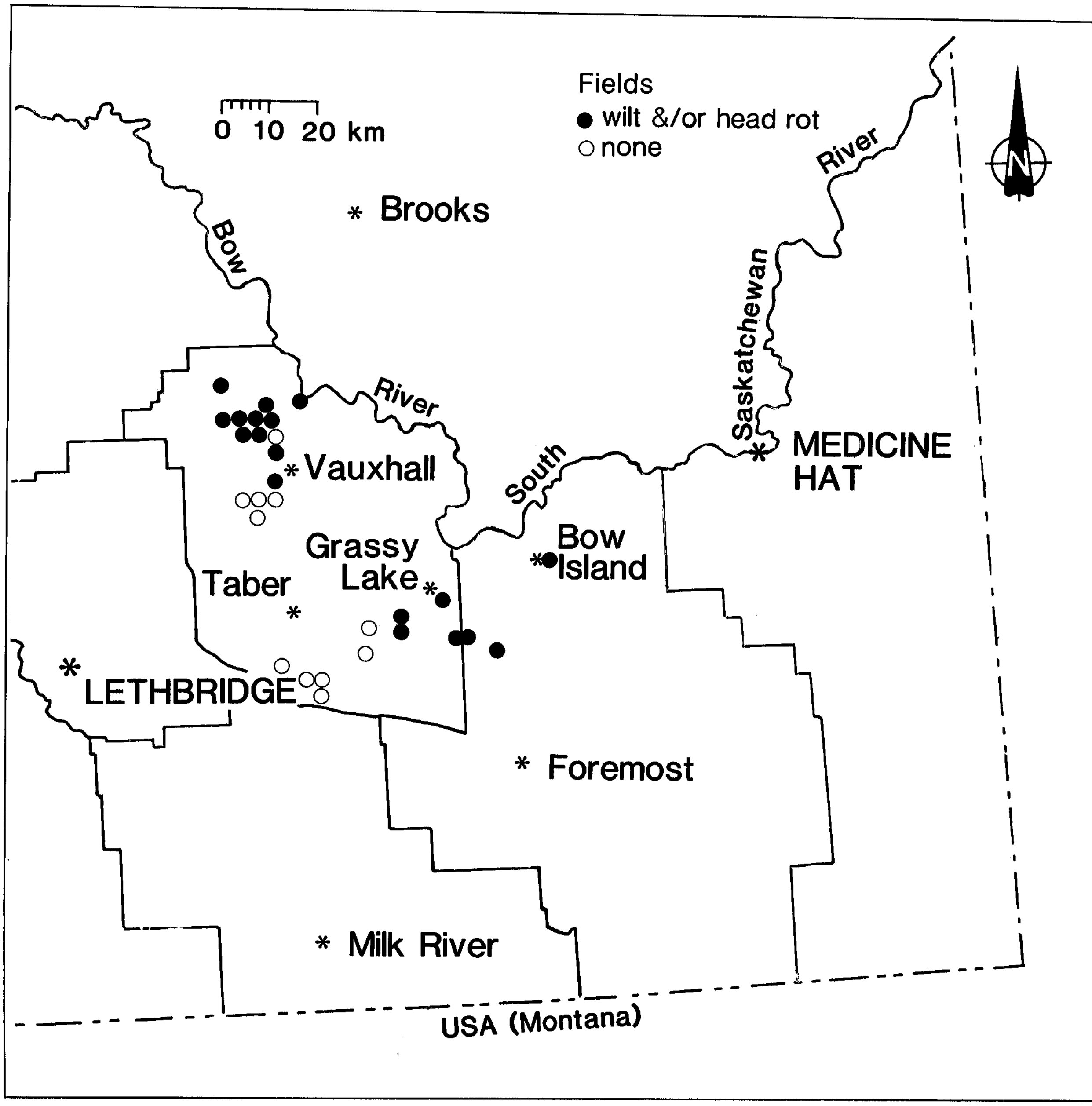

Figure 1. Distribution of fields with Sclerotinia wilt and head rot in southern Alberta, 1987.

CROP: Sunflower

LOCATION: Manitoba

TITLE: Incidence of Plant Diseases in Sunflowers in Manitoba in 1987

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

RESULTS: Sunflowers, with a few exceptions, were not severely affected by diseases in 1987. Five replicated variety trials were examined in the Eastern, Central and Southwest regions. Sclerotinia head rot was most severe in the Eastern region ranging from trace to 70%. Phoma was common on most varieties of sunflowers when examined on September 2 and when the same plot was re-examined on September 24 there was evidence of premature ripening on most varieties. Botrytis head rot was present at a low level in 2 commercial fields examined in the Eastern region. In the Central region the variety trial at Altona showed less disease damage than the Eastern region trial. The level of head rot varied from trace to 20%. Phoma was present but at a low level. The trial at Morden showed low levels of sclerotinia stem or head rot from trace to 10%. Phoma was present but at low levels on most varieties. Sclerotinia head rot was severe at the Holland site in the central region ranging from trace to 50% loss. In the southwest region disease incidence was generally lower than in the central and eastern region fields. Rust was very evident in the trial at Waskada in the extreme southwest. Damage due to rust was in all cases low as most varieties have at least moderate resistance to rust. Rust was very heavy on wild sunflowers, *Helianthus annuus* which were very common along the margins of the field at Waskada.

Tree fruits

CROP: Apples

LOCATION: Manitoba

TITLE: Incidence of Plant Diseases of Apples in Manitoba in 1987

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METHODS: Results based on 101 samples of apples submitted to the Plant Pathology Laboratory and field examinations.

RESULTS: Samples submitted were mainly from home gardens. The main problems detected were: cytospora canker (*Cytospora* sp.), frogeye spot (*Physalospora obtusa*), fireblight (*Erwinia amylovora*), silver leaf (*Stereum purpurea*) and apple scab (*Venturia inaequalis*). Many of the samples received in the early spring showed evidence of sunscald and winter injury. Fireblight was not a major problem in 1987 because of the very dry weather in May and June. Iron chlorosis is very common in apple trees from the Winnipeg area. A severe problem from a canker disease occurred in a nursery near Carman. All of the isolations from this material indicated *Fusarium* sp. Leaves on infected plants turned a purple color before wilting. Most of the cankers were at ground level.

CROP: Apple cv McIntosh and Delicious

LOCATION: Ontario

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TITLE: DISEASE SURVEY OF COMMERCIAL APPLE ORCHARDS IN SOUTHERN ONTARIO.

METHODS: Fruit harvest assessments were carried out in southern Ontario in 108 different commercial orchards. 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. In two orchards (one from the St. Lawrence Valley, one from Prince Edward) which had a light crop load 300 apples were checked.

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.

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. Disease data from the Norfolk-Haldimand, Brant area from 1979 to 1987 was included for comparison. Observations on blister spot (*Pseudomonas syringae* pv papulans van Hall), 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 diseases was considerably less than injury from insects in all areas surveyed in 1987. Apple scab and fly speck was less prevalent in the Norfolk-Haldimand, Brant area during 1987 than in previous years due to dry weather in 1987. In the Durham region in 1987, 45 of the scab infested fruit were from one orchard where a high inoculum pressure was present from the previous year. Sooty blotch has only shown up in large, poorly managed trees. The sooty blotch reported in the St. Lawrence Valley all occurred in one orchard.

In all areas of Southern Ontario, blister spot and fireblight were less severe, while foliar powdery mildew was more prevalent during 1987 than in 1986. Powdery mildew did not cause any economic loss of fruit due to russetting in 1987.

CROP: Apples and Pears

LOCATION: Nova Scotia

NAME AND AGENCY:
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TITLE: COLLAR ROT SURVEY OF APPLE AND PEAR ORCHARDS IN NOVA SCOTIA.

METHODS: Fifteen apple orchards and two pear orchards were surveyed for collar rot in the fall of 1986 and the summer of 1987 in the Annapolis Valley and Lunenburg County. Soil samples were collected from trees with visual symptoms of collar rot or trees in the same orchard showing poor growth located mainly in low or wet areas of orchards.

The presence of collar rot organism *Phytophthora cactorum* (Leb. & Cohn) Schroet in the soil was determined by the cotyledon method of Jeffers 1986 (Personal Communication). Pathogencity tests were conducted by dipping the roots of two week old McIntosh and/or Beautiful Arcade seedlings in the infected cotyledon soil water cultures.

RESULTS AND COMMENTS: See Table below. *Phytophthora cactorum* was identified in seventy-three per cent of the soil samples collected from around apple trees and in one hundred per cent of the pear trees showing poor growth. The pathogencity tests were positive. It is to be noted that the trees showing poor growth or collar rot symptoms were located in low or wet areas of orchards and it is suspected that the previous loss of trees may have been due to collar rot. Yield losses due to *P. cactorum* are estimated at less than 0.5 per cent.

Disease	Number of Orchards	Collar Rot Incidence (per cent)
Phytophthora cactorum	15 (Apple)	73
	2 (Pear)	100

CROP: Peaches

LOCATION: Ontario

NAME AND AGENCY:
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TITLE: DISEASE SURVEY OF COMMERCIAL PEACH ORCHARDS IN SOUTHERN ONTARIO.

METHODS: A total of 49 samples from 37 different grower farms representing various regions of southern Ontario were surveyed. Each sample consisted of 50 L of peach fruit which the grower had graded as seconds and/or culls at the time of first pick. The fruit were classified into the categories as listed below in the table. Other information such as the amount of fruit graded out and packed out was collected from the grower. This was used to determine the percent of the overall crop which was culled out and the subsequent percent of overall crop affected per category.

RESULTS AND COMMENTS: See Table below. Taking samples over a wide range of varieties, locations and growers with varying perceptions of grading standards contributed greatly to the variation in the survey. The reported damage from bacterial spot, brown rot, and birds may under estimate the true disease level in the population because pickers of some growers throw away such fruit in the field rather than bringing the fruit to the packing house where the sample was taken. On the other hand, reported damage from some insects and physical damage may over estimate the true population level of these categories, because fruit affected in these ways tend to ripen first, thus biasing the first pick to have a greater cull out rate than the over all crop.

	Number of Samples	Per Cent Fruit With Injury					
		Brown Rot		Bacterial Spot		Powdery Mildew	
		Ave.	Range	Ave.	Range	Ave.	Range
Harrow	5	tr[1]	0-0.1	0.1	0.1-0.3	0.1	0-0.3
Jordan	15	0.1	0-1.1	2.9	0-18.4	0.1	0-0.9
Niagara-on-the Lake	18	0.1		0-0.7	0.1	0-0.6	0
Vineland	11	0.9	0-9.1	0.1	tr-0.6	tr	0-tr

[1]tr = trace (less than 0.05%)

	Per Cent Fruit With Injury					
	Bird		Physical		Total Insect	
	Ave.	Range	Ave.	Range	Ave.	Range
Harrow	0.2	0-0.6	4.5	1.8-7.1	5.3	2.1-8.4
Jordan	tr	0-0.1	9.8	0.9-43.3	6.1	0.6-21.6
Niagara-on-the Lake	tr	0-0.1	8.0	0.8-23.6	5.1	0.6-18.6
Vineland	0.1	0-0.5	5.5	0.2-11.7	9.5	0.3-22.3

Turf

CROP: Turf

LOCATION: British Columbia

NAME AND AGENCY:
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TITLE: TURF GRASS DISEASES ON CULTIVARS AT AGASSIZ RESEARCH STATION IN 1987

Stripe rust (*Puccinia striiformis*) incidence was high on some of the 72 cultivars of *Poa pratensis* rated in early spring and late fall. Traces only were noted on the cultivars Sydsport, Bristol and America while it was abundant on Midnight, Merion and Victa and severe on Dormie.

Red thread disease (*Laetisaria fuciformis*) was abundant on most cultivars of *Lolium perenne* and fine-leaved *Festuca* spp., except on the hard fescues (*F. ovina* L. ssp. *duriuscula*) which were nearly disease-free.

Fusarium patch and pink snow mold diseases (*Microdochium nivale*) were abundant on all bentgrasses (*Agrostis* spp.). Following 3 weeks of snow cover in February all bentgrasses not protected by fungicide were heavily damaged.

CROP: Turf

LOCATION: British Columbia

NAME AND AGENCY:
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TITLE: TURF DISEASES DIAGNOSED IN SAMPLES IN 1987

In 18 turf specimens examined for disease in the Cloverdale diagnostic laboratory, 4 showed pythium blight, 2 *Rhizoctonia* spp., 2 algae, 2 fusarium blight (one *Fusarium poae*) and 2 *Drechslera* spp. There were single samples showing slime mold and root rot caused by *Pythium* sp. In other samples damage was ascribed to poor cultural conditions. In the remainder of the samples no pathogen could be associated with the damage.

CROP: Turf grasses

LOCATION: Saskatchewan

NAME AND AGENCY
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Saskatoon, Sask. S7N 0X2

TITLE: NOTES ON SNOW MOLD OF RECREATIONAL TURF IN SASKATCHEWAN, 1985-87

METHODS: Golf courses in central Saskatchewan were examined in late April and May each year. Five courses were examined in 1985, four in 1986 and three in 1987. In addition, three golf courses from widely separated locations in northern Saskatchewan were included in 1987. Domestic lawns were also examined. Disease diagnosis was made on the basis of symptoms. Disease severity estimates were made using four categories: Trace < 1%; Slight 1-10%; Moderate 11-25%; Severe > 25%.

RESULTS AND COMMENTS: In Saskatchewan, Kentucky bluegrass (*Poa pratensis*) is widely used for fairways and surrounds, and bentgrass (*Agrostis stolonifera*) is used for putting greens. In general, greens are treated with fungicides in fall to limit snow mold damage. Fairways are not managed as intensively as greens and green surrounds, and are not as susceptible to snow mold damage. Green surrounds are generally the area most severely affected by snow molds. In the winter of 1984-85, an unusually early snow fall kept soil temperatures higher than normal throughout the winter. In 1985-86, the winter was severe, snow fall was minimal, and soil temperatures were low. The winter of 1986-87 was one of the mildest on record. However, a cold snap in November drove soil temperatures down before a snow cover developed.

In the spring of 1985, snow mold damage was generally moderate to severe on golf greens in central Saskatchewan. Damage was particularly severe (80%) at one course where the early snowfall had interrupted the fungicide spray program. Damage was generally slight to moderate on fairways and severe on green surrounds. *Coprinus psychromorbidus* was the most important pathogen observed. *Microdochium nivale* was equally important on bentgrass, but not bluegrass, turf. Trace levels of *Typhula* spp. were noted on bluegrass turf at Saskatoon. Damage to domestic lawns was moderate and recovery was rapid.

In 1986, low-temperature and dessication injury on golf greens was severe. Many greens were reseeded, or did not recover until well into summer. Snow mold damage on putting greens and fairways was estimated as trace to slight. *M. nivale* infection on bentgrass had been initiated early the previous fall, and it was the principal pathogen observed on greens. Snow mold injury on surrounds, due primarily to *C. psychromorbidus*, was highly variable (slight to severe). Snow mold damage on domestic lawns ranged from trace to slight.

In 1987, damage to golf greens and fairways in central and northern Saskatchewan was generally slight, with moderate to severe damage on green surrounds. On one course in north-eastern Saskatchewan, the fairways were moderately affected, but there was no damage on the greens. This was a clear example of the efficacy of the fungicide application program. *C. psychromorbidus* was the principal snow mold pathogen, with *M. nivale* a distant second. Damage on domestic turf was slight.

CROP: Turf

LOCATION: Saskatchewan and Alberta

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TITLE: BLACK LAYER IN INTENSIVELY MANAGED AMENITY TURF

Symptoms of black layer, a soil condition where dark horizons high in sulphides of iron and/or manganese and other micronutrients develop in the soil profile, were noted on eight golf courses in Saskatchewan and two in Alberta in 1987. The soil condition was associated with yellowing, thinning, and in severe cases, death of turfs of *Agrostis* and *Poa* spp., particularly on golf greens. Surrounds and collars were also affected. Turf growing in sand, sand/soil and soil root zones showed symptoms.

METHODS: The frequency of black layer formation was recorded for golf greens on each course. The range of severity of turf injury (0 to 3 where 0 is no symptoms to 3 death of large patches) was noted on greens. Surrounds or fairways at each location were also examined. In some of the cases, core samples and samples from different soil horizons were analysed chemically for major and minor nutrients at the University of Saskatchewan Soil Testing Laboratory.

RESULTS AND COMMENTS:

Saskatchewan: On six courses the number of greens showing black layer(s) in the soil profile is given, followed (in brackets) by sa = sand or so = soil mix rootzone and severity, 0-3.
(1) 18/18 (sa, 0-3). (2) 5/18 (sa, 1-3). (3) 4/18 (so, 1-2). (4) 3/18 (sa, so, 1-2). (5) 2/9 (sa, 1-2). (6) 1/9 (so, 0). A further two courses showed black layer profiles and in collars or surrounds to greens. One of these with a very high soil iron (460 µg/g) showed severe yellowing of *Poa annua* turf.

Alberta: Black layer in the soil profile was noted on greens on two golf courses in the Calgary area. In neither case were symptoms of grass injury seen.

Micronutrient Analyses:
Sample soil cores to 10 cm depth showed analyses for iron ranging from 37 to 460 µg/g and for manganese from 8 to 249 µg/g. In sand greens, when chemical analyses were made where the black layer could be clearly partitioned from the soil above and below it showed increased (up to 10X) amounts of iron in the black layer than in the soil below or above it.

Reference

Berndt, W.L., Vargas, J.M. Jr., Detweiler, A.R., Rieke, P.E. and Branham, B.E. 1987. Black layer in highly maintained turfgrass soils. Golf Course Management. 55(6): 106-112.

Vegetables

CROP: Turf

LOCATION: Manitoba

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TITLE: DISEASES AFFECTING TURF AND LAWN GRASS IN MANITOBA IN 1987

Seventy samples of turf and lawn grass were examined for disease. The most common disease problem was anthracnose, caused by Colletotrichum graminicola, found in 27% of the samples. Melting out caused by Drechslera spp. was found on 16% of the samples and 10% had root rot attributed to Pythium and Fusarium spp. while powdery mildew (Erysiphe graminis) accounted for 9% and fairy ring for 7%. Only a few samples showed rust, snow mold, red thread and septoria leaf spot. Twenty-six percent of the samples showed damage due to causes other than pathogens. Most of the lawn samples were of peat base sod composed of bluegrasses favouring heavy thatch and leaf disease.

CROP: Green Beans

LOCATION: Manitoba

TITLE: Incidence of Plant Diseases in Green Beans in Manitoba in 1987

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

RESULTS: In a commercial field near Portage la Prairie, bacterial blight caused close to 70% loss of green and yellow snap beans. Applications of copper fungicides were not effective in preventing loss. The disease problem occurred mainly in August. Sclerotinia white mould also caused some loss but was kept under control by applications of fungicides.

CROP: Carrots

LOCATION: Manitoba

TITLE: Incidence of Plant Diseases in Carrots in Manitoba in 1987

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

RESULTS: The incidence of aster yellows in commercial fields was monitored in the Portage la Prairie area. Aster yellows caused about 7% damage in fields sprayed up to 10 times for leaf hoppers, and 10% damage in unsprayed sections of the field. Leaf blight caused by *Alternaria* was common, but of low severity.

CROP: Celery

LOCATION: Manitoba

TITLE: Incidence of Plant Diseases in Celery in Manitoba in 1987

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

RESULTS: The major problem detected in commercial celery fields was aster yellows. In a field near Portage la Prairie the incidence of aster yellows was determined to be 10% in both sprayed and unsprayed sections of the field. Late blight caused by *Septoria* was present in the field but at low levels.

CROP: Cucurbits

LOCATION: Manitoba

TITLE: Incidence of Plant Diseases in Cucurbits in Manitoba in 1987

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

RESULTS: Cucumber mosaic virus was detected in a market garden planting near Winnipeg, on cucumbers and squash. The virus disease was restricted to only a small portion of the field. Scab was detected on 4 cucumber samples from the Central, Interlake and Northwest regions. Bacterial wilt was found in a commercial field of cucumbers in the Portage la Prairie area. No yield loss estimate was made.

CROP: Onions

LOCATION: Manitoba

TITLE: Incidence of Plant Diseases in Onions in Manitoba in 1987

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

RESULTS: A severe outbreak of downy mildew occurred in a commercial field in the area of south central Manitoba causing up to 50% loss in green bunching onions. *Botrytis* blast was common on bunching and cooking onions in the Portage la Prairie area but did not cause significant loss.

CROP: Potato

LOCATION: Manitoba

TITLE: Incidence of Plant Diseases in Potato in Manitoba in 1987

NAME AND AGENCY:
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METHODS: Results are based on 197 samples of potatoes submitted to the Plant Pathology Laboratory and field examinations.

RESULTS: The problems most commonly encountered were early blight, bacterial soft rot, Fusarium rot and Verticillium wilt. Early blight was less severe than normal. Verticillium wilt caused by *Verticillium dahliae* was diagnosed from 22 fields primarily in the Central region near Portage la Prairie, Gretna, Plum Coulee and Winkler. Early dying related to Verticillium wilt was quite widespread during the later half of August and early September. Bacterial soft rot became a major concern in September particularly on Norland new crop table potatoes. Higher than normal soil temperatures at harvest may have been a contributing factor to the high losses caused by soft rot. There was only 1 sample of ring rot received by the laboratory in 1987 and this was from 1986 harvested commercial potatoes. Ring rot was not detected in any samples of seed potatoes in 1987.

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

RESULTS: Septoria leaf spot and early blight were very common on garden tomatoes late in the season, mid August and September. Defoliation was caused by leaf diseases. No commercial fields were examined.

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.

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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.