# Canadian Plant Disease Survey

# Inventaire des maladies des plantes au Canada

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## Contents/Contenu



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 immediat pour les phytopathologistes.


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# Incidence and severity of downy mildew of buckwheat in Manitoba in 1979 and 1980

*R.C. Zimmer*[1] *cp12,13*

The results of surveys conducted in 1979 and 1980 show that the disease, downy mildew, was widespread in the buckwheat production areas of Manitoba. The average incidence of downy mildew in 1979 varied between production areas and was considerably greater than in 1980. Although the average incidence in 1980 was very low the incidence and the severity level in one field in the Emerson — Vita area was high. The low incidence in 1980 probably reflects unfavorable moisture-temperature conditions.

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Les résultats des inventaires effectués au cours des années 1979 et 1980 montrent que le mildiou était répandu dans les régions productrices de sarrasin du Manitoba. En 1979, l'incidence moyenne du mildiou variait entre les zones de production et fut de beaucoup supérieure à celle observée en 1980. Il est à remarquer qu'en 1980, malgré une incidence moyenne très basse due probablement aux conditions de température et d'humidité défavorables, un champ avec des niveaux d'incidence et de sévérité élevés a été inventorié dans la région Emerson-Vita.

## Introduction

Buckwheat (*Fagopyrum esculentum* Mill.) has become an important cash crop in western Canada. Since the early 1960's buckwheat production has increased due to improved exports, mainly to Japan. At the present time approximately 70% of the Canadian crop is grown in Manitoba.

Buckwheat has remained relatively free of destructive diseases. At the Morden Research Station, Morden, Manitoba, a new disease (4) was observed in 1972, which was later identified as downy mildew. The pathogen (5), appeared similar to *Peronospora ducometi* Siemaszko & Jankowska (syn. = *P. fagopyri* Elen., reported by Sidorova (1) from the U.S.S.R. and Tanaka (3) from Japan). Following the initial observation in 1972, downy mildew was observed with regularity the following years. In 1978, while on a disease survey of other special crops in southern Manitoba, ten buckwheat fields were examined. Downy mildew was found in each field. This led to implementation of disease surveys in 1979 and 1980 to determine the extent of downy mildew throughout the production areas in Manitoba. The results of these surveys are reported in this paper.

## Methods

The areas of commercial buckwheat production in 1979 and 1980 were obtained through the courtesy of companies contracting buckwheat acreage. Several growers from each region were selected at random and their consent obtained for a survey to be conducted of their fields. The locations of the fields surveyed each year are given in Figure 1. Each field was identified as to cultivar, or if this information was not obtainable it was identified as 'common'. The only cultivar identified in the survey was 'Mancan'.

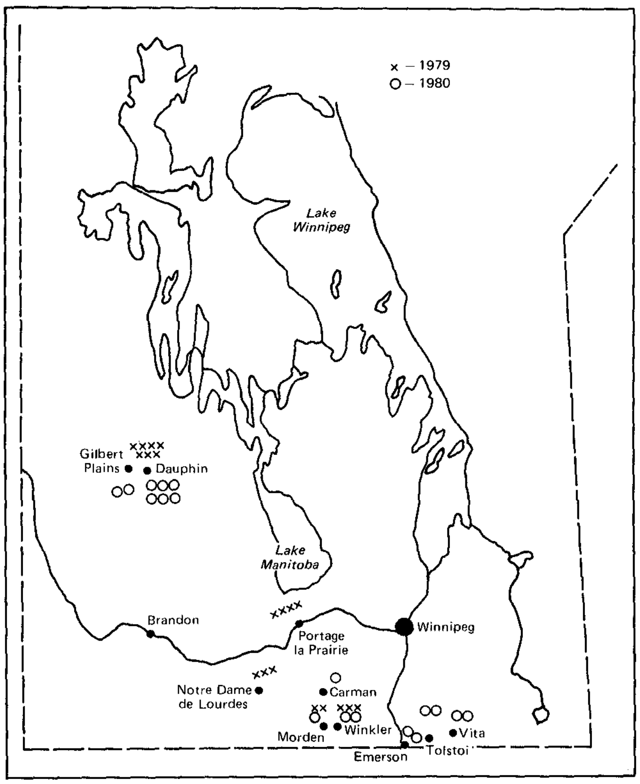


Fig. 1. Distribution of buckwheat fields surveyed in 1979 and 1980 in Manitoba.

The surveys were carried out each year during the first and second weeks of August. Each field was visually divided into quadrants. After walking 50 paces into each quadrant, samples were taken within a capital letter 'M' configuration with 50 paces between the points of the letter. Ten plants were selected at random at each point. By this method 200 plants were examined per field. Each plant was rated for the

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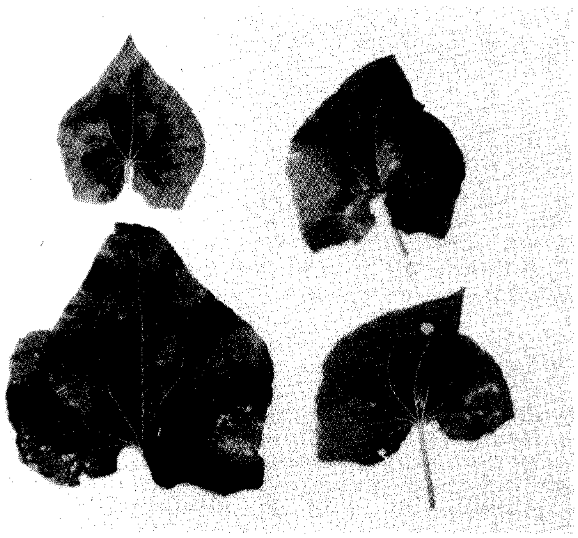

Fig. 2. Foliage symptoms of downy mildew on buckwheat.

incidence of downy mildew symptoms and the percentage leaf area infected was estimated. Foliage symptoms are portrayed in Figure 2. Ratings for downy mildew severity were based on percentage leaf area infected as follows: 0 — no infection, 1 — up to 25 percent leaf area infected, 2 — 25-50 percent leaf area infected, 3 — more than 50 percent leaf area infected.

## Results and Discussion

In 1979, 19 fields were surveyed for downy mildew (Table 1), and in 1980, 18 fields were examined (Table 2). Since there did not appear to be a significant difference in the disease levels or incidence on Mancan vs. 'common' that distinction was not made in either table. The average incidence among survey areas in 1979 ranged from a low of 63.2% in the Notre Dame de Lourdes area to 82.6 and 82.7% in the Morden-Winkler and Dauphin areas, respectively. In the Portage la Prairie area the incidence was 71.1%. The level of severity was quite low with the greatest number of infected plants occurring in disease category 1 (up to 25 percent leaf area infected). The level of infection was more severe in the following fields: No. 3 (Morden-Winkler), No. 1 (Notre Dame de Lourdes), No. 3 (Portage la Prairie) and No.'s 2, 3, 4, 5 and 7 (Dauphin).

Table 1. Incidence and severity of downy mildew of buckwheat in several buckwheat production areas in Manitoba in 1979.

| Survey Area | Field No. | | Incidence (%) | % Plants/Disease* Severity Category 0 | 1 | 2 | 3 |
|---|---|---|---|---|---|---|---|
| Morden — Winkler | 1 | | 95.0 | 5.0 | 94.0 | 1.0 | 0.0 |
| | 2 | | 81.9 | 18.1 | 77.6 | 4.3 | 0.0 |
| | 3 | | 82.6 | 17.4 | 68.9 | 13.7 | 0.0 |
| | 4 | | 88.0 | 12.0 | 80.0 | 8.0 | 0.0 |
| | 5 | | 69.9 | 30.1 | 64.5 | 5.4 | 0.0 |
| | | Ave. | 82.7 | | | | |
| Notre Dame de Lourdes | 1 | | 84.2 | 15.8 | 68.8 | 14.7 | 0.7 |
| | 2 | | 50.9 | 49.1 | 50.0 | 0.9 | 0.0 |
| | 3 | | 54.5 | 45.5 | 52.5 | 1.5 | 0.5 |
| | | Ave. | 63.2 | | | | |
| Portage la Prairie | 1 | | 70.5 | 29.5 | 69.5 | 1.0 | 0.0 |
| | 2 | | 60.5 | 39.5 | 59.5 | 1.0 | 0.0 |
| | 3 | | 73.2 | 26.8 | 49.2 | 22.8 | 1.2 |
| | 4 | | 81.5 | 18.5 | 78.5 | 3.0 | 0.0 |
| | | Ave. | 71.1 | | | | |
| Dauphin | 1 | | 66.0 | 34.0 | 56.0 | 7.0 | 3.0 |
| | 2 | | 77.7 | 26.5 | 46.2 | 26.2 | 1.2 |
| | 3 | | 92.2 | 7.8 | 62.7 | 25.4 | 1.6 |
| | 4 | | 76.0 | 24.0 | 24.0 | 40.0 | 12.0 |
| | 5 | | 89.8 | 10.2 | 62.2 | 25.5 | 2.1 |
| | 6 | | 73.0 | 27.0 | 68.0 | 5.0 | 0.0 |
| | 7 | | 84.9 | 15.1 | 61.3 | 19.7 | 3.8 |
| | | Ave. | 80.3 | | | | |

*Disease Severity Categories: 0 = no foliage infection, 1 = 1-25% leaf area infected, 2 = 25-50% leaf area infected, 3 = more than 50% leaf area infected.

Table 2. Incidence and severity of downy mildew in buckwheat in several buckwheat production areas in Manitoba in 1980.

| Survey area | Field No. | | Incidence (%) | % Plants/Disease* Severity Category 0 | 1 | 2 | 3 |
|---|---|---|---|---|---|---|---|
| Carman-Morden-Winkler | 1 | | 7.0 | 93.0 | 5.4 | 2.0 | 0.0 |
| | 2 | | 3.5 | 96.5 | 2.0 | 1.0 | 0.5 |
| | 3 | | 7.3 | 92.7 | 4.4 | 2.9 | 0.0 |
| | 4 | | 0.0 | 100.0 | 0.0 | 0.0 | 0.0 |
| | | Ave. | 4.4 | | | | |
| Emerson — Vita | 1 | | 44.4 | 55.6 | 26.8 | 15.2 | 2.4 |
| | 2 | | 11.0 | 89.0 | 8.2 | 2.8 | 0.0 |
| | 3 | | 2.1 | 97.9 | 1.5 | 0.6 | 0.0 |
| | 4 | | 6.0 | 94.0 | 4.0 | 1.5 | 0.5 |
| | 5 | | 1.9 | 98.1 | 1.4 | 0.5 | 0.0 |
| | 6 | | 2.9 | 97.1 | 2.4 | 0.5 | 0.0 |
| | | Ave. | 11.4 | | | | |
| Dauphin-Gilbert Plains | 1 | | 0.0 | 100.0 | 0.0 | 0.0 | 0.0 |
| | 2 | | 4.0 | 96.1 | 2.0 | 2.0 | 0.0 |
| | 3 | | 3.6 | 96.4 | 3.1 | 0.5 | 0.0 |
| | 4 | | 1.5 | 98.5 | 1.0 | 0.5 | 0.0 |
| | 5 | | 8.0 | 92.0 | 6.5 | 1.0 | 0.5 |
| | 6 | | 4.7 | 95.3 | 3.3 | 0.9 | 0.5 |
| | 7 | | 3.3 | 96.7 | 2.9 | 0.4 | 0.0 |
| | 8 | | 4.0 | 96.0 | 3.0 | 0.5 | 0.5 |
| | | Ave. | 3.6 | | | | |

*Disease Severity Categories: 0 = no foliage infection, 1 = 1-25% leaf area infected, 2 = 25-50% leaf area infected, 3 = more than 50% leaf area infected.

In 1980, the incidence as well as severity of infection was lower than in 1979. The average incidence of downy mildew was 4.4% for the Carman-Morden-Winkler area, 11.4% for the Emerson-Vita area, and 3.6% for the Dauphin-Gilbert Plains area. If Field No. 1 was not included the average incidence for the Emerson-Vita area was 4.8%. The incidence of infection for Field No. 1 was 44.4% and concomitantly a higher level of severity also occurred.

The results show that for both years downy mildew was widespread in the buckwheat-growing areas of Manitoba. The low incidence in 1980 and low severity in both years probably reflect the lack of rainfall and temperature patterns conducive for optimum disease development.

The severity of downy mildew development on the Morden Research Station was much higher both years than that found in the commercial buckwheat growing areas. Approximately 50% or more of the leaf area was affected. The incidence and severity levels were probably higher at Morden because the disease ratings were made later in the season and perhaps the microclimate was more favorable for disease development.

These surveys indicate that downy mildew pervades the buckwheat-growing regions in Manitoba. The widespread nature of this disease is probably due to the fact that it is seedborne (2). Investigations are underway to determine sources of resistance for incorporation into the breeding program and to study the efficacy of fungicides to control the disease.

## Acknowledgements

The assistance of the students and project leaders employed in the summer youth employment programs in 1979 and 1980 is gratefully acknowledged. The assistance of Mr. Mel Reimer in preparation of the figures and Dr. Clayton Campbell in arranging contacts with companies contracting buckwheat in Manitoba also is gratefully appreciated.

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# Phomopsis twig die-back of some woody interior ornamentals in Alberta

*K. Benschop, J.P. Tewari and E.W. Toop*[1]

Many plants of *Ficus benjamina* used for interior landscaping in Edmonton, Alberta showed a twig die-back disease. The causal agent of this disease was identified as *Phomopsis cinerescens*. *F. nitida* and *Podocarpus macrophyllus* were recognized as new hosts for this pathogen.

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De nombreux plants de *Ficus benjamina*, utilisés pour la décoration intérieure à Edmonton, Alberta, ont montré des symptômes du dépérissement des rameaux. Le pathogène causant cette maladie a été identifié comme étant *Phomopsis cinerescens*. Deux hôtes nouveaux ont été identifiés pour ce pathogène, *F. nitida* et *Podocarpus macrophyllus*.

## Introduction

Species of *Ficus* are commonly used as interior ornamentals in Alberta. In 1983 a die-back disease in *F. benjamina* L. responsible for decline and death of a significant number of plants was observed at Smith and Gordon Horticulturists, Ltd., Edmonton. A review of literature revealed that a disease with similar symptoms was first reported on *F. carica* L. by Grove (4). It was later reported on *F. benjamina* in the U.S.A. (1, 3, 6). From Canada the only report appears to be that by Hampson (5) from Newfoundland. *Phomopsis cinerescens* Trav. was identified to be the causal agent of this disease on *Ficus* spp. (1, 3-6). This article deals with the occurrence of this disease on *F. benjamina* in Edmonton, Alberta and reports two additional hosts for the pathogen.

## Materials and methods

The diseased materials of *F. benjamina* were obtained from Smith and Gordon Horticulturists, Ltd., Edmonton. They were examined by light and scanning electron microscopy (SEM). For the latter, the material was air-dried, vapour-fixed with osmium tetroxide, coated with gold and examined in a Cambridge Stereoscan 150 SEM. Pure cultures on potato-dextrose agar were established by transferring the conidia exuded from the pycnidia.

The diseased material of *Podocarpus macrophyllus* (Thunb.) D. Don was also obtained from the holding warehouses of the company mentioned above while that of *F. nitida* Thunb. was collected from a local hotel lobby.

## Results and discussion

The diseased plants of *F. benjamina* showed progressive die-back and defoliation symptoms. The bark was shrunken and the wood tissue of the twigs was discolored and showed zone lines (Fig. 1). The asexual fruiting bodies, pycnidia, were present in groups sunken in the bark. The conidia were exuded in long tendril-like cirrhi (Figs. 2-4) or in the form of droplets. The conidia were aseptate, hyaline and of two kinds (Figs. 5, 6). The $\alpha$-conidia were generally ellipsoidal, often uniguttulate and 5.9 - 9.2 $\times$ 1.8 - 3.1 $\mu$m in size. The $\beta$-conidia were filiform, mostly hamate, eguttulate and 17.9 - 31.9 $\times$ 1.0 $\mu$m. Some pycnidia contained only the $\beta$-conidia whereas the others had both types of conidia (Figs. 5, 6). Examination of the cultures on PDA indicated that the $\alpha$-conidia were formed first but as the cultures aged, the $\beta$-conidia became predominant.

Fungal structures described above were also observed on the diseased twigs of *F. nitida* and *P. macrophyllus*.

The pathogen was compared with the descriptions given by Grove (4) and Sutton (8) and identified as *P. cinerescens*. The genus *Phomopsis* consists of about 400 species. Most of the species descriptions are directly from diseased plant materials and the species have mostly been delineated based on the host. A number of species are described on gymnospermous hosts some of which (e.g. *P. araucariae*) are morphologically not too different from *P. cinerescens*. It is on this basis that the fungus on *P. macrophyllus* is tentatively identified as *P. cinerescens*. Obviously, as indicated by Sutton (8), the genus is in need of revisionary studies.

In the past various physiological parameters such as acclimatization treatments (2) and maintenance practices including the supply of water (7) have also been implicated in the leaf loss phenomenon in *F. benjamina* indoors. Plants receiving minimum light levels show a higher incidence of twig die-back caused by *P. cinerescens* (1).

These observations are consistent with the fact that *P. cinerescens* is a weak pathogen and parasitises only stressed plants (1). Benomyl and triadimefon soil drenches and benomyl foliar sprays have not proved useful in controlling this disease (1). The practical control measures at this time therefore have to be ones which help maintain clean and vigorous plants. The conidia of *P. cinerescens* are formed in mucilaginous cirrhi and are well adapted to dispersal mechanically, by splashing water or through the agency of contaminated pruning tools (1). The kind of sporogenesis mentioned above is also adapted to insect transmission of the pathogen.

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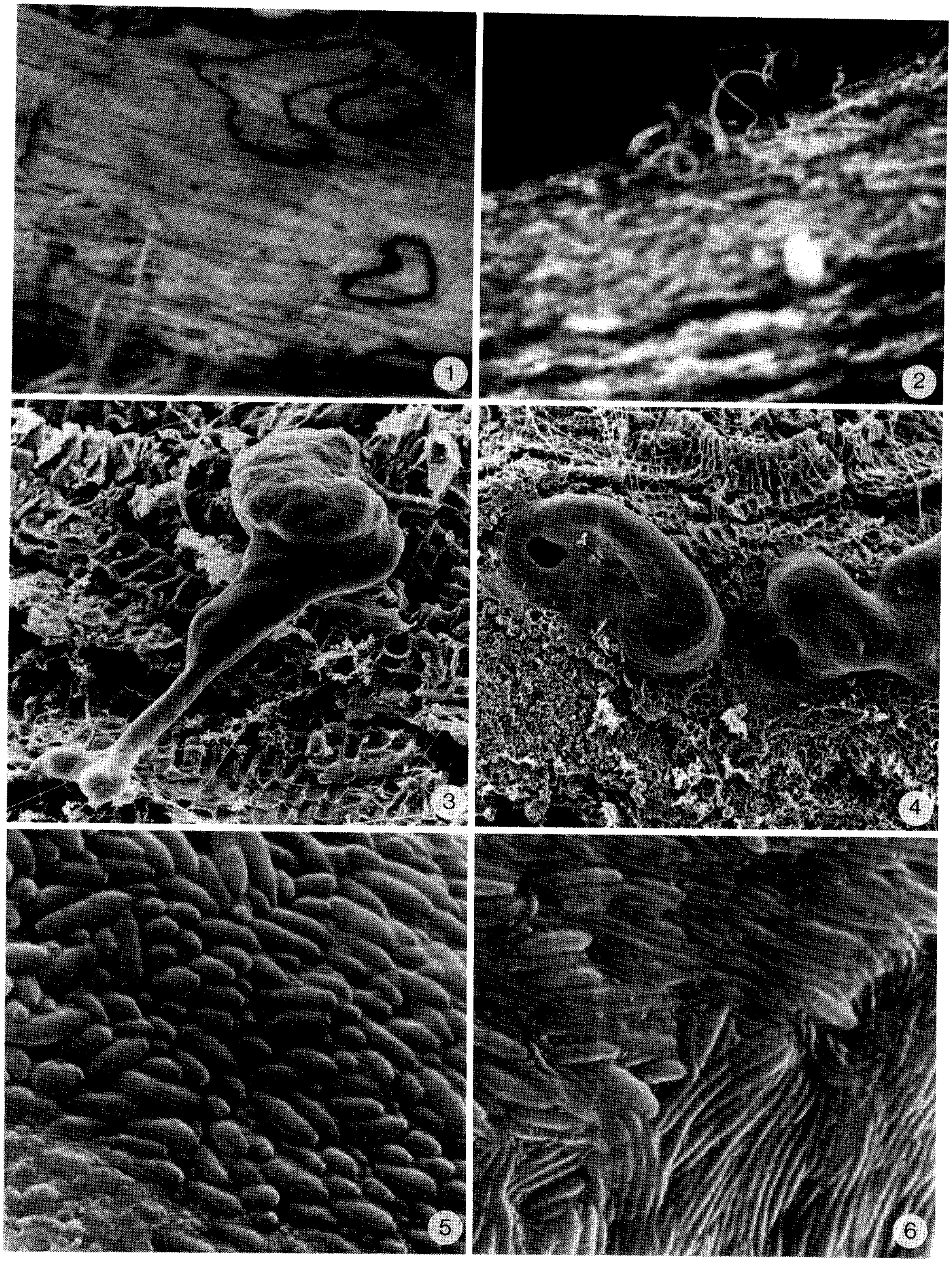


Figs. 1-6. *Phomopsis cinerescens* on *Ficus benjamina*.

1. Debarked twig showing the zone lines. × 10.

2-4. Twig with sunken pycnidia exuding conidia in cirrhi. Fig. 3,4-SEM. 2 × 12; 3 × 200; 4 × 100.

5,6. Pycnidial exudate showing $\alpha$-conidia (Fig. 5) and both $\alpha$- and $\beta$-conidia (Fig. 6). SEM. × 28,500.

Many plants of *Ficus* grown indoors in Alberta are imported from Florida where the pathogen is common outdoors (Robert DeNeve, personal communication). It is therefore possible that many of these plants may already harbour the pathogen before arrival in Alberta. The outdoor environment in Florida is quite conducive for the growth of *Ficus* spp., *Phomopsis cinerescens* being a weak pathogen, therefore, usually does not cause any appreciable disease symptoms in the Florida climate. However, according to Mr. Robert DeNeve (personal communication) the disease has become common in Florida after the 1977 freeze perhaps due to the stress injury caused by the extreme low temperatures. Upon arrival in Alberta, the weakened plants provide an ideal host for *P. cinerescens* due to suboptimal growing conditions indoors. The disease requires more study in order to develop suitable control measures. Although to date it is reported only from Newfoundland and Alberta, it would not be surprising if further studies reveal it to be common indoors all across Canada.

## Acknowledgement

Thanks are due to Smith and Gordon Horticulturists, Ltd., Edmonton for supplying the materials for study, to Mr. Robert DeNeve, Horticultural Consultant, Tropical Ornamentals, Inc., Delray Beach, Florida for background information on the disease and to Mrs. Shirley Brezden for technical assistance.

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# Cercospora leaf spot and powdery mildew of fenugreek, a potential new crop in Canada

*R.C. Zimmer*[1]

Two diseases, Cercospora leaf spot and powdery mildew, were observed on the foliage of research plots of fenugreek (*Trigonella foenum-graecum*) in 1983. The leaf spot, caused by the fungus *Cercospora traversiana*, resulted in serious defoliation and also affected the stems and pods. It appears that Cercospora leaf spot possesses the potential to be a serious constraint to the production of fenugreek in Canada. Powdery mildew was not serious.

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Deux maladies, la rayure nervale et le blanc, ont été observées sur le feuillage du fenugrec (*Trigonella foenum-graecum*) croissant sur des parcelles de recherche en 1983. La rayure nervale, causée par le champignon *Cercospora traversiana*, provoque une défoliation importante et affecte aussi la tige et les gousses. Il semble que la rayure nervale puisse gêner sérieusement la production du fenugrec au Canada. Le blanc, quant à lui, ne fait pas de dommage sérieux.

## Introduction

Fenugreek (*Trigonella foenum-graecum* L.) is a crop that is used in several ways. Some of its uses are as a spice, a tea, a vegetable, a forage, in the making of dyes and as a starter material in the production of steroidal hormones, such as cortisone.

Within the Research Branch of Agriculture Canada the evaluation of new crops for their agronomic potential in Canada is centered at the Research Station, Morden, Manitoba. Fenugreek has been evaluated at this station and other locations in the prairie provinces during the past five years. The primary objective has been to determine if the crop is able to mature and produce an acceptable yield of seed. Part of this evaluation has involved the identification of potentially serious diseases.

In late August, 1983, a foliar disease was observed which within two weeks had caused severe defoliation, plus stem and pod infection. A second disease of lesser importance also was observed on the foliage. In this paper a description and illustration of disease symptoms and causal organisms are reported.

### Cercospora Leaf Spot

Symptoms — The disease was uniformly distributed throughout a plot grown for seed increase. On individual plants only the upper few leaves remained, giving the appearance of tufts of green scattered throughout the plot (Fig. 1). On older leaves lesion size had increased significantly and sporulation was evident, sometimes giving the lesion a whitish cast. The necrotic areas were sharply defined and most lesions were surrounded by a yellowish halo (Fig. 2). Stem and pod infection also were severe (Fig. 3). Infected areas of the pod were discolored and severely infected areas were shrunken or twisted (Fig. 4). Infection of some plants was so severe that even the youngest leaves wilted and died.

Conidial Measurements — Measurements of 40 conidia, collected from leaf lesions, were made in distilled water to which a small amount of lactophenol containing cotton blue was added. The conidia varied in length from 48.1 $\mu$m — 162.8 $\mu$m with a mean of 95.4 $\mu$m. Conidial morphology is illustrated in Fig. 5. The conidia appear similar to the description by Chupp (1) for *Cercospora traversiana* Sacc. (Syns. = *Cercospora trigonellae* Maublanc, and *Cercospora traversiana* var. *trigonellae coeruleae* Savul. & Sandu-Ville), on fenugreek. They were acicular to almost cylindric, straight to curved, indistinctly multiseptate, base truncate, tip subacute to subobtuse.

Pathogenicity — Fenugreek seedlings in the 4-5 leaf stage were inoculated with a distilled water suspension of *C. traversiana* conidia. The conidial inoculum was obtained from pure cultures of fungus grown on V-8 juice agar. The inoculated plants were covered with polybags for 48 hr, after which the bags were removed and the plants were returned to the greenhouse. Lesions appeared approximately 12 days after inoculation. This pathogen possesses such a high degree of virulence that a single lesion is sufficient to kill a leaflet (Fig. 6). Conidia resembling those used to inoculate the seedlings were isolated from lesions on the inoculated plants.

Discussion of Cercospora Leaf Spot — In 1959, Leppik (2) reported that *C. traversiana*, causing leaf spot of fenugreek had reached several Eastern European countries and South America from the Near East and India. The disease was reported to affect the leaves, stems, young pods and seedlings, damaging the plants before they ripen. In 1972, Voros and Nagy (4), reported on a new destructive pathogen of fenugreek, *Cercospora traversiana*. If fenugreek is to become a viable crop in Canada knowledge about the destructiveness and control of this disease is required. Yield in 1983 was estimated to be only 20 percent that of the previous year.

### Powdery Mildew

A second disease, powdery mildew, was observed on fenugreek leaves, but was present only at an inconspicuous level

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(Fig. 7). The low severity of this disease may have been due to its late occurrence in the growing season.

Results of examination of the conidia from leaf lesions suggest that the pathogen was *Erysiphe polygoni* (Fig. 8). Prior to 1961 (3) *E. polygoni* was not reported on fenugreek. Since 1968 there have been three reports of *E. polygoni* on fenugreek. Based on this year's observations powdery mildew would not seem to be a serious problem.

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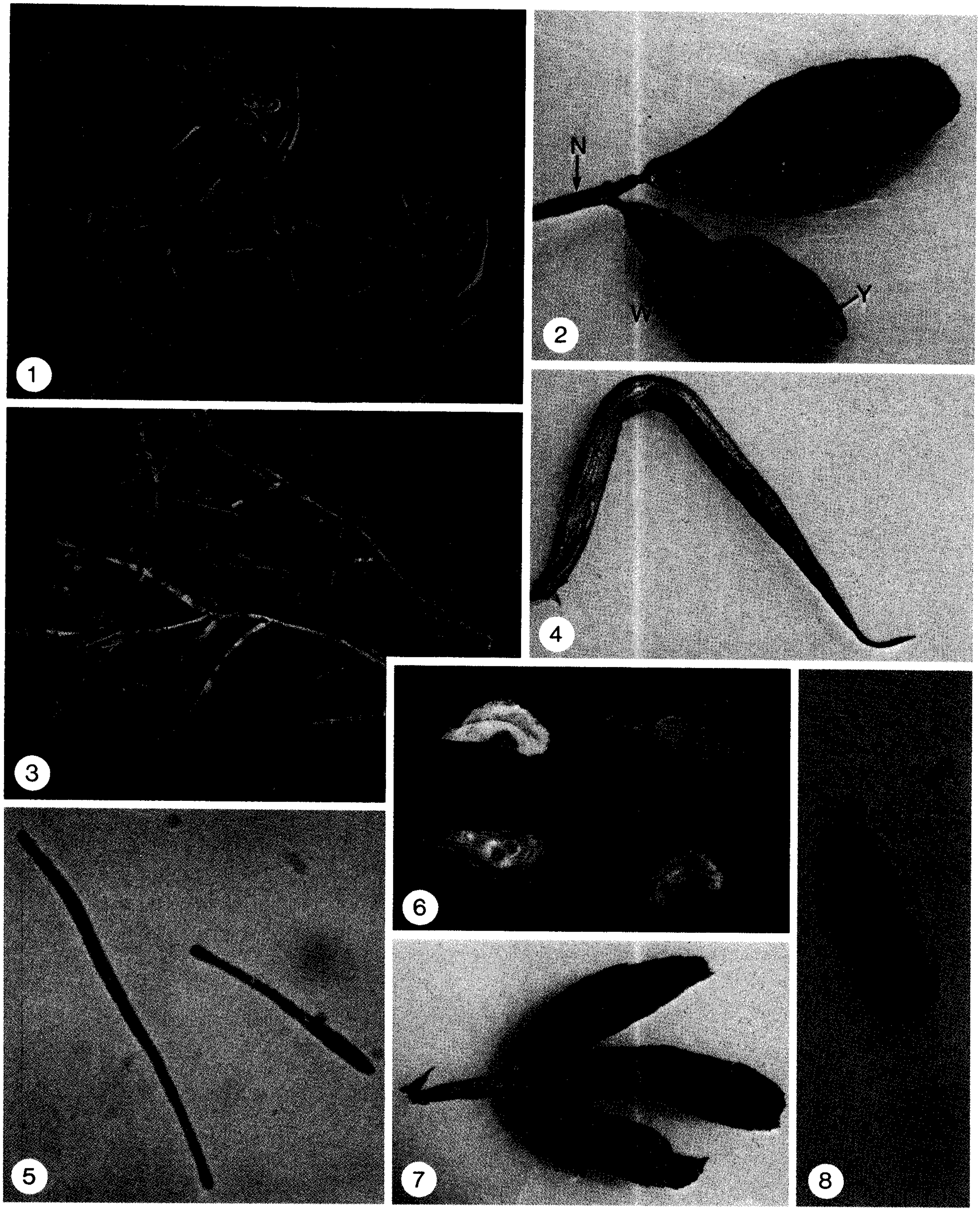

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# Predominance of race 4 of the soybean bacterial blight pathogen *Pseudomonas syringae* pv. *glycinea* in eastern Ontario, 1982

*P.K. Basu*[1]

Forty-seven isolates of *Pseudomonas syringae* pv. *glycinea* were obtained from soybean (*Glycine max*) leaves collected during the 1982 growing season from 50 fields located in 12 counties of eastern Ontario. Based on the reactions of seven differential soybean cultivars to inoculation in a growth room, 43 isolates were classed as race 4. The remaining 4 isolates closely resembled race 5 but differed from it by inducing a moderately susceptible reaction in the cv. Lindarin which is known to be resistant to race 5 of the pathogen.

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Quarante-sept isolats de *Pseudomonas syringae* pv. *glycinea* ont été isolés à partir de feuilles de fève soya (*Glycine max*) récoltées durant l'été 1982, dans 50 champs répartis dans 12 comtés de l'est de l'Ontario. En se basant sur les réactions de sept cultivars différentiels de fève soya à l'inoculation en chambre de croissance, 43 isolats ont été identifiés comme faisant partie de la race 4. Les 4 isolats restant ressemble à la race 5 mais en diffère par l'induction d'une réaction de susceptibilité modérée dans le cultivar Lindarin qui est résistant à la race 5 de ce pathogène.

Bacterial blight caused by *Pseudomonas syringae* pv. *glycinea* Young, Dye & Wilkie is a common foliage disease of soybean, *Glycine max* (L.) Merr., in Ontario and elsewhere (1,3,4), but it is not known which races (2,3) of the pathogen are prevalent in eastern Ontario.

During the 1982 growing season, samples of soybean leaves showing symptoms of bacterial blight (4) were collected from 50 fields located in 12 counties in eastern Ontario. A sample was constituted of a least 10 leaves taken from different plants from each field. Isolations were made from young lesions according to standard methods (5). Forty-seven of the isolates resembled a known culture of *P. syringae* pv. *glycinea* isolated by the author at Ottawa in 1977. For race determination, the isolates were tested on seven differential soybean cultivars: Acme, Chippewa, Flambeau, Harosoy, Lindarin, Merit and Norchief (2). Eight unifoliate leaves of potted plants of each cultivar were spray-inoculated with each isolate, using methods described previously (2,3). Plants were kept in a growth room at 22°C, 70% relative humidity, and 16 h photoperiod of 3600 ft/candle (470 micro-Einsteins) light intensity at the plant canopy. Disease reactions on the unifoliate leaves were recorded 7-10 days after inoculation. Tests were performed at least three times with adequate number of control plants sprayed with water only as well as inoculated with known races of the pathogen obtained from Dr. E.W.B. Ward, London, Ontario.

Forty-three of the isolates induced a susceptible reaction in all seven cultivars (Table 1) indicating that they belonged to race 4 of *P. syringae* pv. *glycinea*. The remaining four isolates were similar to race 5 in the reactions of six of the differential cultivars but differed from race 5 because of the production of an intermediate (moderately susceptible) reaction on cv. Lindarin which is resistant to race 5. At present it may not be justifiable to propose the existence of a new race for these four isolates before testing more isolates of this type.

Based on these results race 4 is the most prevalent form of the bacterial blight pathogen in eastern Ontario, as it is in the southwestern part of the province. Work is underway to determine the reactions of newly developed short-season soybean cultivars and lines to race 4.

The author wishes to thank Dr. E.W.B. Ward, Research Institute, Canada Agriculture, London, Ontario, for supplying available known races of the pathogen; and N.J. Brown for his excellent technical assistance in this work.

Table 1. Reactions of seven differential soybean cultivars to 47 isolates of *P. syringae* pv. *glycinea* from eastern Ontario and to a known culture of race 5.

| | Disease reaction* | | |
|---|---|---|---|
| Cultivars | 43 isolates | 4 isolates | Race 5** |
| Acme | S | R | R |
| Chippewa | S | R | R |
| Flambeau | S | R | R |
| Harosoy | S | S | S |
| Lindarin | S | I(S) | R |
| Merit | S | S | S |
| Norchief | S | R | R |

* S = susceptible, I = intermediate, R = resistant.
** Reactions of race 5 on the cultivars were similar to those reported by others (2,3).

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# Incidence of root rot in pulse crops in southern Alberta, 1978-1983

*T.A. Swanson[1], R.J. Howard[1], G.H.A. Flores[2] and S.P. Sumar[1]*

Field surveys established that root rot was a common pulse crop disease in southern Alberta from 1978 to 1983. The disease was found in nearly every field examined, and the average percentage of affected plants in the fields was: processing peas 52%, processing beans 21%, dry peas 8%, dry beans 15%, fababeans 8% and lentils 4%.

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Des inventaires aux champs ont établi que la pourriture des racines était une maladie commune chez les cultures de légumineuses dans le sud de l'Alberta de 1978 à 1983. La maladie était présente dans presque tous les champs examinés et le pourcentage moyen des plants affectés était de: 52% pois de transformation, 21% haricots de transformation, 8% pois secs, 15% haricots secs, 8% féveroles et 4% lentilles.

Pulses (edible, pod-bearing legumes) are grown in southern Alberta for processing (peas and beans), dry seed (peas, beans, fababeans and lentils), and forage (fababeans). Dry beans, and especially fababeans and lentils, are relatively new crops that have enjoyed increasing popularity with growers in recent years. This popularity is related to their use in rotation with cereals, to their value as cash crops, and to their ability to fix atmospheric nitrogen, thereby reducing the need for nitrogen fertilizer in succeeding crops. Processing peas, processing beans and dry peas are favoured crops that have supported well-established industries in southern Alberta for two to three decades. Small experimental plantings of soybeans have also been tried in southern Alberta, but this crop has not yet become established on a commercial basis.

In the early 1970's, root diseases were found to cause serious yield losses in peas grown in various areas of Canada (1-3) and North America (6). Accordingly, we have been attempting to establish the incidence of root diseases in southern Alberta pulse fields, and to estimate the resultant crop losses. We report here on the levels of root rot found during field surveys. Forthcoming reports will present crop loss data. Preliminary reports of this work have been given (4, 5, 11).

## Materials and methods

Fields were selected for survey with the assistance of contracting company representatives. No attempt was made to randomly select fields; rather, fields with and without a known history of root rot were chosen. Each year, the crops were sampled at harvest maturity (as determined by the contracting companies). Plant samples were taken at sites along a semicircular transect through each field. In 1978, 1979 and 1980, 10 plants at each of 10 sites along a transect that extended ca. 50 m into the field were dug up and rated for root rot. In 1981, 1982 and 1983, the plants in three-meter lengths of two adjacent rows were dug up at each of five sites equally spaced along a transect that spanned the field. The samples were brought to the laboratory where they were stored at 5°C until being washed and the roots rated for root rot. Roots were scored for severity as 0, 2 or 4, representing healthy, moderately rotted and severely rotted root systems, respectively.

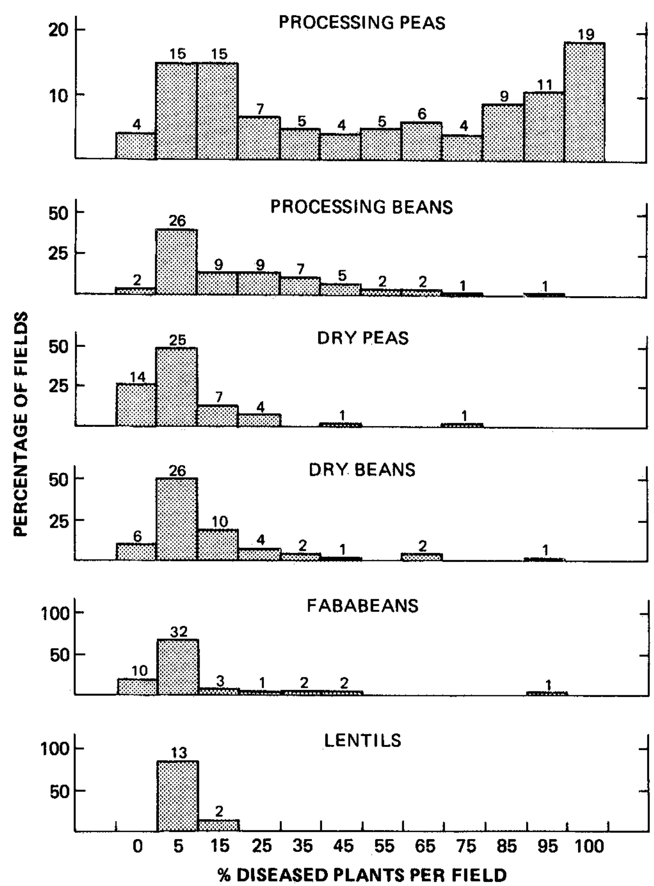


Fig. 1 Mean percentage of diseased plants in pulse fields, 1978-1983. The number of fields in each class is shown above the bar.

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Table 1. Percentages of pulse crop fields with root rot in southern Alberta, 1978-83.

| Survey year | Processing types | | | | Dry Types | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Peas | | Beans | | Peas | | Beans | | Fababeans | | Lentils | |
| | % | (n)* | % | (n) | % | (n) | % | (n) | % | (n) | % | (n) |
| 1983 | 100 | (20) | 100 | (11) | - | - | - | - | 100 | 5 | - | - |
| 1982 | 100 | (15) | 100 | (11) | - | - | 100 | 5 | 80 | 5 | 100 | 5 |
| 1981 | 94 | (20) | 94 | (17) | - | - | - | - | - | - | - | - |
| 1980 | 100 | (10) | 100 | (10) | 100 | (10) | 100 | 10 | 100 | 5 | 100 | 5 |
| 1979 | 100 | (16) | 100 | (15) | 95 | (20) | 86 | 15 | 47 | 15 | 100 | 5 |
| 1978 | 84 | (21) | -+ | - | 41 | (22) | 87 | 22 | 95 | 21 | - | - |
| All years | 96 | (102) | 99 | (64) | 79 | (52) | 93 | 52 | 84 | 51 | 100 | 15 |

* n is the number of fields sampled.
\+ – indicates crop not surveyed in this year.

Table 2. Incidence and severity of root rot in processing pea and bean fields in southern Alberta, 1978-83.

| Survey Year | Peas | | Beans | |
|---|---|---|---|---|
| | Inc. | Sev. | Inc. | Sev. |
| 1983 | 74±8(20)* | 1.8±0.2** | 29±5(11) | 0.6±1** |
| 1982 | 52±8(15) | 1.2±0.2 | 29±6(11) | 0.6±0.1 |
| 1981 | 51±8(20) | 1.2±0.2 | 6±1(17) | 0.1±0 |
| 1980 | 70±12(10) | 1.9±0.4 | 34±9(10) | 0.6±0.2 |
| 1979 | 22±6(16) | -§ | 18±5(15) | - |
| 1978 | 43±10(21) | - | - | - |
| All Years | 52±5(102) | 1.4±0.1 | 21±3(64) | 0.4±0.1 |

* Mean ± standard error of the percentage of diseased plants, with the number of fields sampled in parentheses.
** Mean ± standard error of the severity of root rot on plants in the fields, scored as healthy = 0, moderate root rot = 2, and severe root rot = 4.
§ Not determined.

Table 3. Percentages of plants with root rot in dry seed pulse fields in southern Alberta, 1978-83.

| Survey Year | Peas | Beans | Fababeans | Lentils |
|---|---|---|---|---|
| 1983 | -* | - | 30±13(5) | - |
| 1982 | - | 11±4 (5) | 32±14(5) | 5±2 (5) |
| 1981 | - | - | - | - |
| 1980 | 8±2(10)+ | 31±9(10) | 2±1 (5) | 4±1 (5) |
| 1979 | 13±3(20) | 4±1(15) | 1±0(15) | 3±1 (5) |
| 1978 | 4±1(22) | 12±3(22) | 2±1(21) | - |
| All Years | 8±1(52) | 15±2(52) | 8±1(51) | 4±1(15) |

* Not surveyed in this year.
\+ Mean ± standard error of the percentage of plants with root rot, with the number of fields sampled in parentheses.

## Results

Although root rot diseased plants were found in most fields of each pulse crop in each survey year (Table 1), the percentage of plants affected within fields (incidence) varied considerably between crops and between years. The percentages were highest in processing peas, followed by processing beans, dry beans, fababeans, dry peas and lentils (Tables 2 and 3).

The distribution of fields grouped according to the percentage of root rot diseased plants was highly skewed towards the lower percentages for all of the crops surveyed except processing peas (Fig. 1). The distribution for processing peas indicated that fields tended to contain either a low or a high percentage of diseased plants.

## Discussion

Our previous surveys of pulses in southern Alberta showed that, although several diseases affected these crops, root rot was the most important (4, 5, 11). Our most recent surveys, reported here, expand the number of observations to include more growing seasons and farms, and confirm that root rot is a widespread disease of pulses in southern Alberta, and of particular importance on the pulses that are grown for processing. Our data also illustrate the considerable variation which exists in the percentage of root rot diseased plants between fields. We are attempting to define the factors responsible for this variation (5, 12) in the hope that they can be used to develop a disease management strategy.

The incidence of root rot was highest in processing pea fields. Our current estimate of 52% (Table 2) is lower that the average of 65% reported in 1970 and 1971 (1), and higher than the average of 33% recorded in 1978 and 1979 (12). Our present findings confirm that root rot is a significant problem in pea production in Alberta. In other provinces, notably British Columbia and Ontario, a similar problem exists (1-3).

Alberta pea growers have practiced a four-year crop rotation since about 1950. Our data suggest that the current crop rotation pattern may not be effective for root rot control. For example, in 1983 we encountered one field, last cropped to peas in 1977, in which 95% of the plants were diseased.

Better methods for root rot control are urgently needed by processing pea growers in Alberta.

Except for fababeans, our estimates of root rot incidence in the other pulses we surveyed is in agreement with previous findings (11) and with similar surveys in Saskatchewan (7-10). The figure for fababeans has increased sharply since 1978. This increase is difficult to explain; it may be related to late season sampling, or it may be an indication that root rot is becoming more severe on those farms that are continuing to grow fababeans. Dry peas probably develop less root rot than processing peas because there is a greater variety and turnover of growers, and dry pea production is not concentrated on a relatively small number of farms, as is the case with processing peas.

The root rot levels in dry and processing beans were moderate, but since we have recorded yield losses of up to 35% due to the disease in some processing bean fields (Swanson *et al.*, unpublished data), these levels are probably significant. Attention needs to be given to root rot control in these two crops.

## Acknowledgements

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# Occurrence of fungi on leafy spurge in the prairie provinces from 1981 to 1983.[1]

*K. Mortensen*

Leafy spurge stands in the prairie provinces were surveyed for plant pathogens during the growing seasons of 1981, 1982 and 1983. In most sites surveyed, leafy spurge was found to be disease-free. The most frequent diseases observed were leaf spot and top dieback caused by *Alternaria* spp. and a leaf spot caused by *Septoria guepini.* Stem and root rot were observed on scattered plants from several sites. Several fungi were isolated of which *Fusarium* spp. were the most frequent. The potential of isolated fungi as biocontrol agents from leafy spurge is discussed.

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Un inventaire des phytopathogènes sur l'euphorbe ésule fut entrepris en 1981, 1982 et en 1983 dans les provinces des prairies. Dans la plupart des sites visités, aucune maladie ne fut détectée sur l'euphorbe ésule. Les maladies les plus fréquentes étaient la tache foliaire et le dépérissement causés par *Alternaria* spp. ainsi que la tache septorienne causée par *Septoria guepini.* Les pourritures de la tige et des racines furent observées sur quelques plantes éparses dans plusieurs sites. Des champignons isolés, *Fusarium* spp. fut retrouvé le plus fréquemment. Le potentiel des champignons isolés comme agent de lutte biologique pour l'euphorbe ésule est discuté.

## Introduction

Leafy spurge (*Euphorbia esula virgata* complex) is an introduced herbaceous perennial weed that occurs throughout most of the northern half of the United States and across Canada. It is a serious weed in the prairie provinces and North Dakota, where the area infested with leafy spurge doubled during the 1973 to 1982 period (Best et al. 1979, Messersmith and Lym 1982). Chemical control of leafy spurge in pasture land on a large scale is not economical because retreatment is necessary every 3 to 5 years to get adequate control (Lym and Messersmith 1983). Biological control appears to be a satisfactory long term solution. The purpose of this study was to survey and investigate the suitability of indigenous pathogens of leafy spurge as inundative biological control agents.

## Materials and methods

Surveys of leafy spurge were conducted in Saskatchewan from 1981 to 1983. The heavily infested areas at Jameson and Caronport were visited regularly during these growing seasons. Many of the leafy spurge infestations reported by Coupland et al. (1949 - 1955) in the early fifties in central and south eastern Saskatchewan were visited once (Harris, unpublished data) in 1981 and some of the sites were revisited in 1982 and 1983. A two-day survey of leafy spurge infested areas in Manitoba was conducted in each of 1982 and 1983. One leafy spurge site in Alberta was visited in 1981 and 1982. A few leafy spurge sites in interior British Columbia were surveyed in 1981 (Table 1). Leafy spurge plants with disease symptoms were brought to the laboratory and analyzed for causal organisms. Plant material with distinct lesions or symptoms was surface sterilized in 0.6% sodium hypochlorite for 10 minutes, rinsed in sterile water and plated out on potato dextrose agar (PDA). If bacteria were suspected, the diseased plant material was cut up in small sections, placed in sterile water for 15 to 20 minutes and loopfuls of that water were streaked out on nutrient agar. Pathogenicity of isolated organisms was tested by wounding a stem area slightly with a scalpel, placing mycelium and/or spores or bacteria in the wound, wrapping the treated area with wet cotton and the treated plants were kept in a mist chamber for the following 18 to 24 hours. The plants were then left on greenhouse benches (temperature: 18-24°C., daylength: 14 hours, with cool fluorescence and incandescent light) for up to one month for regular inspection. Control plants, wounded and wrapped with cotton, were included with each test. In some instances additional pathogenicity tests were made by spraying a spore suspension onto undamaged plants, to test if a pathogen could enter and infect through the unwounded epidermis. Plants treated in this manner were kept for a least 48 hours in the mist chamber then moved to greenhouse benches. If no lesion development was observed after one month, the isolated fungi or bacteria were regarded non-pathogenic. Fungi that caused discoloration and lesion development were reisolated, compared with original cultures and sent to the Biosystematic Research Institute (B.R.I.), Agriculture Canada, Ottawa, or to Commonwealth Mycological Institute (C.M.I.), Identification Services, Kew, England, for identification.

## Results and discussion

In most areas surveyed the leafy spurge population was found to be disease-free. The most prevalent disease problem observed was the *Alternaria* leaf spot and top dieback complex. The severity of the disease ranged from a few insignificant leaf spots to severe top dieback, occurring on about 10 percent of the plants. *Alternaria* spp. were consistently isolated from plants with such symptoms, although *Cladosporium*, *Fusarium* and other species of fungi were also frequently isolated. The latter were either non-pathogenic or only caused discoloration with almost no lesion development, whereas,

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Table 1. Alternaria leaf spot and top dieback observed on leafy spurge from the prairies during the three year period 1981 to 1983.

| Fungi isolated | Pathogen.* test (lab.) I | Pathogen.* test (lab.) II | Field symptoms | Location and date |
|---|---|---|---|---|
| *Alternaria alternata* (Fr.) Keissl. | + | | Irregular necrotic leaf spots | Weyburn, Sask. 7-7-83. |
| *Alternaria* sp. | (+) | | Necrotic spots on stems | Caronport, Sask. 15-7-81 |
| *Cladosporium herbarum* (Pers.) Link ex Gray | (+) | | | |
| *Alternaria tenuissima* (Kunze ex Pers) Wiltsh. | (+) | | Top dieback | Caronport, Sask. 6-8-81. |
| *Cladosporium* sp. | (+) | | | |
| *Botrytis cinera* Pers. | | + | Top dieback | Cardston, Alta. 19-8-81. |
| *Fusarium* sp. | – | | | |
| *Alternaria* sp. | – | | | |
| Bacteria | – | | | |
| *Cladosporium herbarum* (Pers.) Link ex Gray | (+) | | Stem spots, purplish black | Mortlack, Sask. 1-6-82. |
| *Alternaria* sp. | + | ++ | Leaves turning blackish mainly on upper leaf surfaces | Caronport, Sask. 1-6-82. |
| *Alternaria* sp. ? (not sporulating) | (+) | + | Stem lesions (black) | Sask. Beach, Sask. 17-6-82. |
| *Alternaria* sp. | (+) | | Flower and top dieback | Caronport, Sask. 12-7-82. |
| *Alternaria* sp. ? (not sporulating) | (+) | | | |
| *Cladosporium herbarum* (Pers.) Link ex Gray | (+) | | | |
| *Alternaria* sp. | + | | Leaf dieback and necrotic leaf spots on flower bracts | Zehner, Sask. 21-7-82 |
| *Cladosporium herbarum* (Pers.) Link ex Gray | (+) | | Irregular necrotic leaf spots | Rounthwaite, Man. 27-7-82. |
| *Alternaria* sp. | ++ | – | | |
| *Alternaria* sp. | + | | Top dieback and necrotic leaf spots | Rounthwaite, Man. 27-7-82. |
| *Fusarium sporotrichioides* Sherbakoff | (+) | | | |
| *Epicoccum purpurascens* Ehrenb. | – | | | |
| *Alternaria* sp. | ++ | – | Top dieback and necrotic leaf spots | Rounthwaite, Man. 27-7-82. |
| *Alternaria* sp. | – | | Top dieback and necrotic leaf spots | Treesbank, Man. 27-7-82. |
| *Alternaria* sp. | ++ | | Top dieback and necrotic leaf spots | Gainsborough, Sask. 28-7-82. |
| *Alternaria* sp. | – | | | |
| *Fusarium* sp. | – | | | |
| *Alternaria* sp. | ++ | – | Irregular necrotic leaf spots | Carnduff, Sask. 28-7-82. |
| *Alternaria* sp. | ++ | – | Irregular necrotic leaf spots | Estevan, Sask. 28-7-82. |
| *Alternaria* sp. | – | | Flower dieback | Moose Jaw, Sask. 9-8-82. |
| *Alternaria* sp. | – | | Necrotic leaf spots | Jameson, Sask. 18-8-82. |
| *Alternaria* sp. (or *Ulocladium* sp.) | (+) | | Flower dieback | Jameson, Sask. 18-8-82. |
| *Alternaria* sp. | + | | Top dieback | Jameson, Sask. 8-6-83. |
| *Alternaria* sp. | + | | Flower dieback | Jameson, Sask. 23-6-83. |
| *Alternaria* sp. | | | Top dieback and necrotic leaf spots | Morden, Man. 12-7-83. |
| *Alternaria* sp. | | | Flower dieback | Cypress River, Man. 13-7-83 |
| *Alternaria* sp. | | | Necrotic leaf spots | Stockton Ferry, Man. 13-7-83. |
| *Alternaria* sp. | | | Necrotic leaf spots | Treesbank Ferry, Man. 13-7-83. |
| *Alternaria* sp. | (+) | | Flower dieback | Rounthwaite, Man. 13-7-83. |
| *Alternaria* sp. | | | Leaves turning black | Caronport, Sask. 14-7-83. |
| *Alternaria* sp. | | | Leaves browning, stem and leaf petioles still green | Maxim, Sask. 19-7-83. |
| *Alternaria alternata* (Fr.) Keissler | (+) | | Lesion at base of flower branch extending half up the branch | Caronport, Sask. 27-7-83. |

* I. Wound test on stems; – = no effect; (+) = some discoloration with no or very slight lesion development in wound; + = some lesion development; ++ = plant part above wound wilting.
II. Spore suspension sprayed on plants; – = no effect; + = a few small lesions developed; ++ = severe leaf lesions developed.

most of the *Alternaria* spp. isolated were pathogenic (Table 1). All *Alternaria* spp. (except a few non-sporulating ones) produced conidia in chains. Considerable variation in amount of sporulation, color and type of mycelium was observed in cultures on PDA. Some cultures produced abundant aerial mycelium, whereas others had darker more flat mycelium. The latter usually produced more spores. Two species, *A. alternata* and *A. tenuissima*, were identified, but several, not identified to species by B.R.I. (Table 1), were distinctly different from *A. alternate* and *A. tenuissima*. *Alternaria* spp. have previously been reported from *Euphorbia* spp. in both Canada (Conners 1967) and in the United States (U.S.D.A. 1960, Krupinsky and Lorenz 1983).

*Septoria* leaf spot was widespread in Saskatchewan and was also found in Alberta and Montana, but not in Manitoba (Table 2). The severity of the disease varied from a few distinct leaf spots to larger lesions that coalesced, resulting in wilt of entire leaves. However, the attack was generally light and did little harm to the plants. Specimens sent to B.R.I. were identified as *Septoria* sp. similar to *S. jatrophae* Heald and Wolfe. Specimens sent to C.M.I. were identified as *Septoria guepini* Oudem. (Table 2). This is the first record of *Septoria* leaf spot on *Euphorbia* spp. in North America. *S. bractearum* Mont., *S. euphorbia* (Lasch.) Desm. and *S. guepini* Oudem. were reported on *Euphorbia* spp. in early literature from Europe (Harris et al. in preparation).

Powdery mildew was only detected from sites in interior British Columbia and from Jameson, Saskatchewan. Several mildew species have been reported on *Euphorbia* spp. (Harris et al. in preparation). Cleistothecia were not observed from either location and identification is difficult without the sexual stage. Powdery mildew is a serious problem under greenhouse conditions, but apparently does not do well under natural conditions on the prairies.

Stem and root rot were observed from several sites, but only on scattered plants. Plants affected showed stress and sometimes wilting of the entire plant. Several fungi were isolated of which *Fusarium* spp. were most frequent. *F. sporotrichioides* was only found in Manitoba and was the most pathogenic *Fusarium* sp. isolated. The higher pathogenicity agrees well with the more severe field symptoms observed from these sites (Table 3). Only *F. solani* and *F. acuminatum* have been reported from leafy spurge in Canada (Gordon 1959). *Rhizoctonia solani*, isolated from plants in the field as well as in the greenhouse with symptoms of root and stem rot, has previously been reported from *Euphorbia* in both Canada and the United States (Conners 1967, U.S.D.A. 1960). *Phomopsis euphorbia*, isolated from distinct lesions on stems of leafy spurge from Caronport, Saskatchewan, has not previously been reported from North America. A hyphomycete (Cypress River, Man. 13-7-83) did not sporulate and so could not be identified. A few *Alternaria*-like spores in chains were observed immediately after isolation from diseased plant material, but the culture was different in appearance from the other *Alternaria* spp. isolated (Table 1). This hyphomycete occurred on the upper part of the wilting leafy spurge stem, whereas *F. sporotrichioides* was isolated from lower parts of the stem. In wound tests this hyphomycete appeared slightly more pathogenic than the *F. sporotrichioides*. Perhaps both

Table 2. Septoria leaf spot and powdery mildew observed on leafy spurge from the prairies during the three year period 1981 to 1983.

| Fungi detected | Pathogen.* test (lab.) | Field symptoms | Location and date |
|---|---|---|---|
| *Septoria guepini Oudem.* | + | Distinct leaf spots with brown margins and brownish centers | Cardston, Alta. 22-6-81. |
| " " | + | " " | Bethune, Sask. 2-7-81. |
| " " | + | " " | Regina Beach, Sask. 2-7-81. |
| " " | | " " | Culbertson, Mont. 7-7-81. |
| " " | | " " | Caronport, Sask. 16-6-82. |
| " " | | " " | Silton, Sask. 17-6-82. |
| " " | | " " | Zehner, Sask. 21-7-82. |
| " " | | " " | Jameson, Sask. 18-8-82. |
| " " | | " " | Jameson, Sask. 23-6-83. |
| " " | | " " | Caronport, Sask. 14-7-83. |
| *Erysiphe* sp. | | Powdery mildew, in reddish brown leaf spots | Kamloops, B.C. 26-6-81. |
| *Erysiphe polygoni* ? DC.ex /st. Amans. | | Powdery mildew, from greenhouse plants | Regina, Sask. 15-12-81. |
| *Erysiphe* sp. | | Powdery mildew and necrotic leaf spots | Jameson, Sask. 19-7-82. |

*Spore suspension sprayed on leafy spurge plants; + = leaf spots developed.

fungi are involved in the cause of the disease, which occurred severely in a patch about 5-6 meters in diameter, in contrast to only scattered plants as usually observed for stem and root rot (Table 3). *Curvularia inaequalis* and *Gliocladium roseum*, which showed discoloration with very slight lesion development in the wound tests, are common fungi, as are the non-pathogenic fungi, *Epicoccum purpurascens, Acremonium* sp., *Trichoderma* sp. and others frequently isolated. None of the bacteria isolated were found to be pathogenic and consequently were not identified.

Other symptoms observed on leafy spurge, from which no disease causing organisms were detected, are shown in Table 4. In the early part of the growing season in 1981 aborting flowers and slightly wilting bracts were observed at the Jameson site. Several fungi and bacteria were isolated, but none was found to be pathogenic (Table 4). These symptoms could possibly be caused by frost or cold weather conditions in the early part of the season.

Purple to reddish leaf spots and in some cases entire reddish plants were observed frequently. No disease causing organisms were isolated from them. The phenomenon was especially common on sandy or poor soil where plants were stressed

Table 3. Stem and root rot observed on leafy spurge from the prairies during the three year period 1981 to 1983.

| Fungi and bacteria isolated | Pathogen.* test (lab.) | Field symptoms | Location and date |
|---|---|---|---|
| *Epicoccum purpurascens* Ehrenb. | – | Plant wilting, lesion at base of stem | Jameson, Sask. 10-6-81. |
| *Trichoderma* sp. | – | Lesion at base of stem | Langham, Sask. 5-6-81. |
| *Fusarium acuminatum* Ell. and Everh.<br>Bacteria (not identified) | (+)<br>– | Distinct lesion at base | Caronport, Sask. 22-6-81. |
| *Fusarium acuminatum* Ell. and Everh.<br>*Epicoccum purpurascens* Ehrenb.<br>Bacteria (not identified) | (+)<br>–<br>– | Distinct lesion starting at base of stem, extending up one side, other side green | Cardston, Alta. 22-6-81. |
| *Fusarium tricinctum* (Corda) Sacc.<br>*Gliocladium roseum* (Link) Bainer<br>Bacteria (not identified) | (+)<br>(+)<br>– | Lesion at base of stem (somewhat constricted) | Caronport, Sask. 6-8-81. |
| *Curvularia inaequalis* (Shear) Boedjin<br>*Acremonium* sp.<br>*Fusarium solani* (Mart.) Sacc. | (+)<br>(+)<br>– | Lesion at base of stem (somewhat constricted) | Caronport, Sask. 16-6-82. |
| *Fusarium tricinctum* (Corda) Sacc.<br>*Alternaria* sp.<br>*Epicoccum purpurascens* Ehrenb. | (+)<br>(+)<br>– | Plant wilting, lesion at base of stem | Zehner, Sask. 21-7-82. |
| *Alternaria* sp.<br>*Epicoccum purpurascens* Ehrenb. | (+)<br>– | Lesion at base of stem (somewhat constricted) | Caronport, Sask. 28-7-82. |
| *Fusarium sporotrichioides* Sherbakoff<br>Hyphomycete (grayish culture, not sporul.) | +<br>+ | Entire stem wilting from about 10 cm above soil level and up | Cypress River, Man. 13-7-83. |
| *Rhizoctonia solani* Kuhn | ++ | Gray stem lesion at soil level, entire plant wilting | Spruce Wood, Man. 13-7-83. |
| *Rhizoctonia solani* Kuhn | + | Rootstock rot (greenhouse) | Regina, Sask. 21-3-83. |
| *Fusarium sporotrichioides* Sherbakoff | + | Lesion at base of stem (entire plant wilting) | Stockton Ferry, Man. 13-7-83. |
| *Fusarium sporotrichioides* Sherbakoff | + | Lesion at base of stem (entire plant wilting) | Treesbank Ferry, Man. 13-7-83. |
| *Fusarium solani* (Mart.) Sacc.<br>*Fusarium equiseti* (Corda) Sacc.<br>*Fusarium oxysporum* Schlect. | (+)<br>(+)<br>(+) | Distinct lesion (light brown at base of stem of small plant) | Caronport, Sask. 14-7-83. |
| *Phomopsis euphornbiae* (Sacc.) Trav. | + | Lesion at base of stem, extending up one side (core of stem had brownish discoloration) | Caronport, Sask. 14-7-83. |

*Wound test on stem; – = no effect; (+) = some discoloration with no or very slight lesion development; + = some lesion development; ++ = plant part above wound wilted.

by drought. At some sites scattered wilting plants were observed; they did not show distinct stem lesions, rather a damaged area with a spongy appearance occurred at the base of the stem or just below soil level. No disease causing organisms were detected. At one site wilting plants occurred in an ant hill.

At one site (Dundurn, Sask. 30-6-82, Table 3) gray whitish worts or scabby symptoms appeared on a few plants in a roadside pasture. These only occurred in the epidermis, did not extend into the plant tissue, and apparently had no effect on the plants. *Alternaria* sp. and an ascomycete (not identified) were isolated but none of them caused any symptoms when tested on damaged epidermis of leafy spurge plants. The symptoms resembled oedema, which can be observed on some house plants, caused by environmental factors.

## Conclusion

Several fungi were isolated from disease symptoms on leafy spurge plants in the prairie provinces. Most of the fungi isolated from plants with stem and root rot symptoms listed in Table 3 were non-pathogenic or weakly pathogenic and probably did not individually cause the symptoms observed. Perhaps the rot was induced by a complex of several fungi together with environmental conditions. *Septoria* leaf spot and powdery mildew (Table 2) appeared to do little damage to leafy spurge plants in nature. Furthermore, they are difficult to culture in large quantities (powdery mildew is an obligate parasite and *Septoria* sp. was difficult to culture on agar media). Thus these fungi would be of little value as inundative biological control agents.

There is no doubt that *Alternaria* spp. caused the leaf spot and top dieback (Table 1). Symptoms observed at some sites

Table 4. Physiological disorders observed on leafy spurge from the prairies during the three year period 1981 to 1983.

| Fungi and bacteria isolated | Pathogen.* test (lab.) | Field symptoms and comments | Location and date |
|---|---|---|---|
| *Fusarium equiseti* (Corda Sacc.<br>*Epicoccum purpurascens* Ehrenb. | (+)<br>(+) | Aborting flowers, frost ? | Jameson, Sask. 30-5-81. |
| Bacteria (not identified) | – | Aborting flowers, frost ? | Jameson, Sask. 30-5-81. |
| *Helminthosporium* sp.<br>*Cladosporium* sp.<br>*Epicoccum purpurascens* Ehrenb. | (+)<br>(+)<br>(+) | Aborting flowers, frost ? | Jameson, Sask. 10-6-81. |
| *Cladosporium* sp.<br>*Alternaria* sp.<br>*Rhizopus* sp.<br>*Epicoccum purpurascens* Ehrenb. | –<br>–<br>–<br>– | Flowers and flower branches wilting, frost ? | Jameson, Sask. 10-6-81. |
| None | | Purple spots on leaves, physiological stress ? | Jameson, Sask. 10-6-81. |
| None | | Brownish discoloration of leaves, physiological stress ? | Caronport, Sask. 16-6-82. |
| None | | Reddish brown leaf spots, physiological stress ? | Jameson, Sask. 18-8-82. |
| None | | Purple spots on upper leaves, physiological stress ? | Jameson, Sask. 30-6-83. |
| Secondary fungi (not identified) | – | Gray whitish scabby appearances on stems, not affecting plant, cause not detected | Dundurn, Sask. 30-6-82. |
| Secondary fungi (not identified) | – | Plants wilting in a patch, epidermis somewhat damaged at base of stem, cause unknown | Silton, Sask. 17-6-82. |
| None | | Plants wilting in ant hill, stem epidermis damaged at soil level, cause unknown | Sask. Beach, Sask. 17-6-82. |
| Secondary fungi | – | Wilting tops, stem near soil level swollen, epidermis at soil level damaged, cause unknown | Jameson, Sask. 23-6-83. |

*Tested by placing bacteria or mycelium directly on flower parts and kept moist under plastic bag for 2-3 days; (+) = resulted in slight necrotic development on flower petals and bracts; – = no effect.

were severe, especially in 1983, where up to 10 percent of the plants were attacked. Some of the *Alternaria* spp. showed good pathogenicity when spore suspensions were sprayed on leafy spurge plants and kept in a mist chamber for 3-4 days (Table 1), and thus might have potential as inundative biocontrol agents. However, a spore suspension of a culture (Caronport, Sask. 1-6-82), sprayed on a field stand of leafy spurge, did not result in infection. Perhaps these *Alternaria* spp. require too much moisture to develop consistently on the prairies. This would explain why leaf spot and top dieback appeared to be more severe in 1983, when there was above average precipitation in early July, than in the two previous years.

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# Author Index to Volume 64

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