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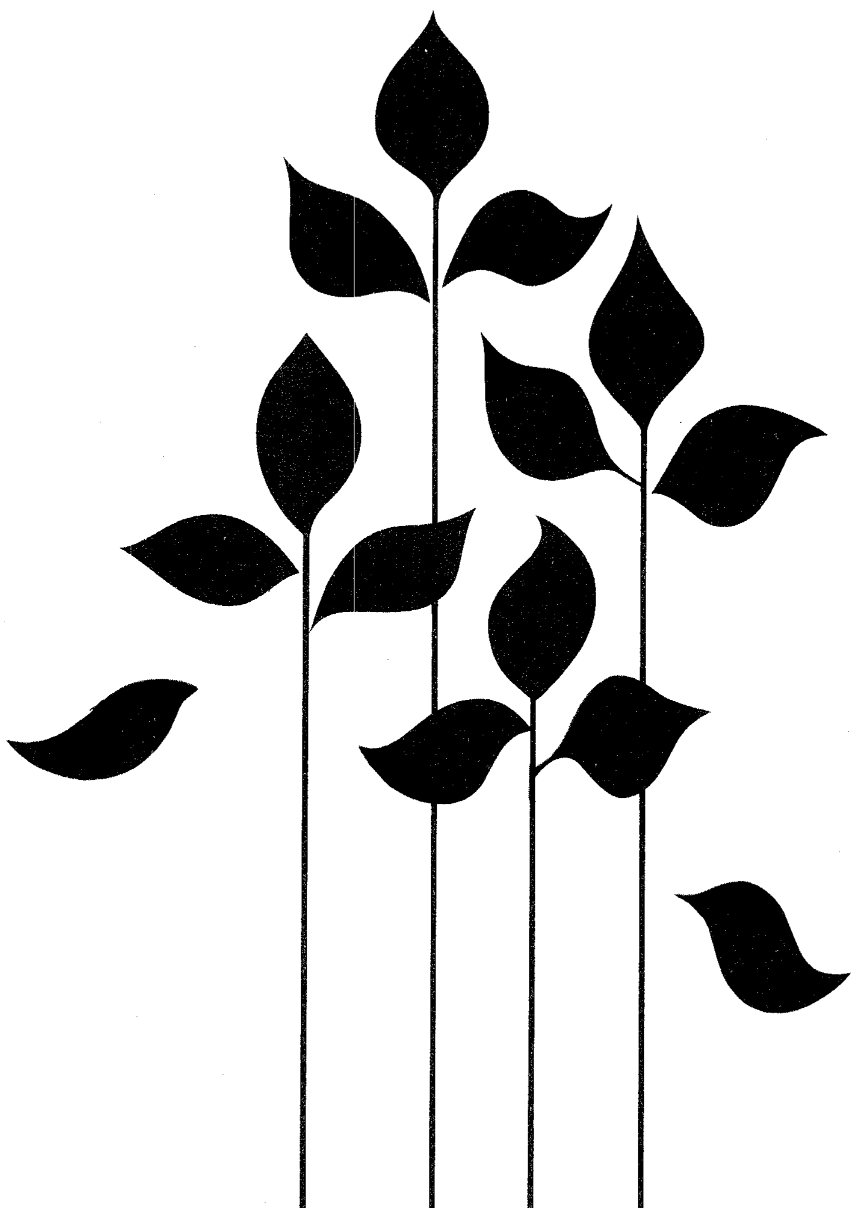

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Contents

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

L'Inventaire des maladies des plantes au Canada est un périodique d'information sur la fréquence des maladies des plantes au Canada, leur gravité, et les pertes qu'elles occasionnent. La rédaction accepte d'autres communications originales notamment sur la mise au point de nouvelles méthodes d'enquête et de lutte ainsi que sur l'évaluation des nouveaux produits. De temps à autre, il inclut des revues et des synthèses de rapports d'intérêt immédiat pour les phytopathologistes.

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Incidence of green petal disease in strawberry in Prince Edward Island, 1976[1]

J.A. Cutcliffe and L.S. Thompson

Following 5 years of low incidence of green petal disease in strawberries in Prince Edward Island, growers reported increased prevalence at the beginning of the 1976 harvest season. A survey conducted on 14 farms showed a mean of 6.2% infection in plantings of the cultivar Bounty and a much lower incidence in the cultivars Redcoat and Veestar. It appears that Bounty is more susceptible than Redcoat and that the incidence of green petal increases in Prince Edward Island during periods when "susceptible" cultivars are included in commercial plantings.

Can. Plant Dis. Surv. 57: 1-2. 1977

Après 5 ans de faible incidence du pétale vert dans les fraisières de l'Ile-du-Prince-Edouard, les producteurs ont signalé une recrudescence de la maladie au début de la saison de récolte de 1976. Une enquête réalisée dans 15 fermes a révélé un taux moyen d'infection de 6.4% dans les fraisières du cultivar Bounty et une fréquence beaucoup plus faible dans celles des cultivars Redcoat et Veestar. Il semble que Bounty soit plus sensible que Redcoat et que le fréquence d'apparition du pétale vert augmente dans l'Ile-du-Prince-Edouard au cours des périodes d'inclusion de "cultivars sensibles" dans les fraisières commerciales.

Green petal disease of strawberries was apparently first observed in Prince Edward Island in 1961 (4). Losses from green petal were severe in some fields from 1961 to 1967 (3, 5), but the disease occurred only sporadically in commercial strawberry plantings from 1968 to 1970 (4). A survey of first-crop plantings conducted in 1971-72 indicated averages of 1.9%, 2.4%, and 9.0% infected plants in the cultivars Cavalier, Redcoat, and Sparkle, respectively (1). There was subsequently a marked reduction in the planting of Sparkle and the authors noted very little green petal during the years 1973 to 1975, inclusive. However at the beginning of the 1976 harvest season, some growers reported that green petal was prevalent, particularly in the cultivar Bounty, which was not extensively fruited in Prince Edward Island prior to 1976.

Materials and Methods

A survey was conducted during the 1976 harvest season of strawberry plantings in all the major producing areas of Prince Edward Island. In keeping with the reports by producers, Bounty was the main cultivar surveyed. Redcoat and Veestar were also examined on farms where they were grown adjacent to Bounty in an attempt to establish the susceptibility of Bounty in relation to these cultivars. Only first-crop plantings were examined at all locations, and the source of plants determined. Within a planting of each cultivar, 10 sampling sites, each consisting of 3 linear metres of matted row, were selected at random on a line running diagonally across the planting. The number of infected plants was counted at each of the 10 sampling sites, and the total number of plants was counted at two of the sites to provide an average number of plants per site for each planting. Plantings ranged in size from 0.1 to 2 hectares. A total of 8 hectares, representing about 40% of the total area planted to Bounty in Prince Edward Island was surveyed. The incidence of green petal was determined as a mean percentage for each planting.

Results and discussion

The mean ratings or percentages of green petal for each of the 14 locations surveyed are shown in Table 1. Green petal was found in all plantings of Bounty that were examined, and the incidence varied from 0.6% to 15.0%. At five of the seven locations where Redcoat was examined, the incidence of green petal was greater in Bounty than in Redcoat, while the difference between these cultivars was very slight at the other two locations. The mean incidence of green petal in Bounty and Redcoat at the seven locations was 4.7% and 2.5%, respectively. At the three locations where both Veestar and Bounty were examined, the mean incidence of green petal was 1.2% and 10.0%, respectively. Since the plantings of Bounty that were surveyed were propagated from three different sources of plants, and since the incidence of green petal varied considerably within plantings from each source, it is unlikely that the green petal observed in Bounty could be attributed to the source of plants.

The low levels of green petal observed in Redcoat and Veestar, 2.5% and 1.2%, respectively, suggest that this disease was not of major importance in the production of

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Table 1. Incidence of green petal disease in three straw-berry cultivars in Prince Edward Island in 1976

Location	% infection (first crop)		
	Bounty	Redcoat	Veestar
Alexandra	0.6		
Tea Hill	1.7	0.2	
Tea Hill	8.0	2.1	
Tea Hill	9.3	6.7	
Cross Roads	3.3	3.6	
Cross Roads	2.6		
Fort Augustus	11.4		2.8
Fort Augustus	3.6		0.3
Blooming Point	15.0		0.4
Vernon	8.2		
Ten Mile House	3.7	1.0	
Parkdale	3.4	0.3	
Tryon	12.1		
Fairview	3.4	3.5	
Mean	6.2	2.5	1.2

these cultivars in P.E.I. in 1976. Observations by the authors also indicate that green petal has not caused serious losses in these cultivars during the past 3 years. It is of interest to note that others (2, 5) have observed lower levels of green petal infection in the cultivar Redcoat than in the cultivar Sparkle in commercial plantings throughout the Maritime provinces. Chiykowski et al. (1) speculated that the change in cultivars grown, from Sparkle to Redcoat, may have contributed to a lower disease incidence in Quebec and the Maritimes in 1971 and 1972. The extensive use of Redcoat by growers in Prince Edward Island from 1970 to 1975 possibly has been the main reason for the low incidence of green petal during this period.

The high incidence of green petal in the cultivar Bounty confirms our earlier observation (4) that Bounty, or K64-436, along with some other cultivars and selections, exhibited a high incidence of green petal infection. The results of the 1976 survey also support our suggestion (4) that certain strawberry cultivars have some resistance or tolerance to green petal, or that there is a leafhopper vector preference for one cultivar over another. Certainly strawberry growers in Prince Edward Island, and possibly throughout the Maritimes and Quebec, should be cautioned about the susceptibility of Bounty to green petal when they are selecting cultivars for new plantings. Also, it appears that new or potential cultivars for the Maritime Provinces and Quebec should be screened for susceptibility to green petal and only those expressing a high level of resistance be recommended for commercial planting.

Acknowledgment
The assistance of Mrs. Lenore Andrew in conducting the survey is gratefully acknowledged.

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Distribution of stylet-bearing nematodes associated with raspberries and strawberries in British Columbia

F.D. McElroy[1]

In the Fraser Valley of British Columbia stylet-bearing nematodes of 16 genera were isolated from raspberry soils, and of 11 genera from strawberry soils. *Pratylenchus penetrans* was the most widely distributed, occurring in nearly 90% of the samples. *Xiphinema bakeri* also occurred frequently but only in loam soils. Both species were associated with direct plant damage. *X. americanum* was restricted to silty clay loam soils and was associated with tomato ringspot virus in raspberry. *Longidorus elongatus* was found in less than 5% of the samples but caused considerable damage to strawberries. The other genera occurred less frequently and caused no plant damage.

Can. Plant Dis. Surv. 57: 3-8. 1977

On a prélevé 16 et 11 genres de nématodes de sols à framboisiers et à fraisiers respectivement dans la vallée du Fraser en Colombie-Britannique. *Pratylenchus penetrans* était le plus répandu, étant représenté dans 90% environ des échantillons. *Xiphinema bakeri* était également abondant, mais seulement dans les loams. Ces deux espèces étaient directement responsables des dégâts causés aux végétaux. *X. americanum* se limitait à des loams argileux limoneux et était associé au virus de la tache annulaire de la tomate chez le framboisier. Moins de 5% des échantillons contenaient *Longidorus elongatus*, lequel a causé des dégâts considérables aux fraisiers. Les autres genres étaient moins répandus et n'ont causé aucun dégât.

More than 2300 acres of the Fraser Valley of British Columbia are devoted to raspberries, which gave a return of about 4 million dollars in 1975. Under optimum growing conditions, disease-free plantings remain productive 10-15 years and should yield at least 4-5 tons per acre. In recent years, however, plantings have begun to decline. Yields in many fields are down by 40-50% and plantings are becoming unproductive after only 7-8 years.

Strawberry also is an important crop in this area with 1200 acres returning almost 3 million dollars a year. Plants normally remain in the ground for 3-4 years and yield an average of 4 tons per acre. However, many plantings fail to become established while others suffer from patchy areas of poor growth. These plantings often become uneconomical after the second year and are usually plowed out.

Many species of plant parasitic nematodes have been found associated with raspberry and strawberry throughout the world (12). Several of these have been reported from British Columbia (1, 2, 3, 4, 13, 18), some associated with decline, but the extent of their occurrence and the amount of damage they cause were unknown. To assess their importance, a nematode survey was conducted of the berry plantings in the Fraser Valley of British Columbia. The results of this survey are reported here.

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Materials and methods

The nematode survey was conducted during May through September from 1969 to 1971. In this paper the terms 'unhealthy' or 'unthrifty' refer to plants that lack vigor, are stunted, off color, or produce lower yields than other plants in the same field. Where large areas of unhealthy plants were encountered, samples were taken from the margin, where preliminary sampling showed nematode populations were highest.

A total of 636 samples was taken from soil around the roots of red raspberry (*Rubus ideaus* L.) and strawberry (*Fragaria chiloensis* L.). For each sample, six soil cores, 2.5 cm in diameter, 15-30 cm deep, were taken from each of the root zones of both unthrifty and apparently healthy plants and placed in a polyethylene bag. The samples were carried to the laboratory in an insulated box, and either processed immediately or stored at 5°C for not longer than 48 hours.

After thorough mixing of the soil a 200 cc subsample was processed by the Christie-Perry (6) and modified Flegg (9) methods to recover the nematodes. Freshly extracted nematodes were counted and identified to genus under a dissecting microscope. Species identifications were made under a compound research microscope from specimens mounted in glycerine.

Determination of *Meloidogyne* species was made from mature females obtained by growing tomato (*Lycopersicum esculentum* L. cv. Rutgers) for 8 weeks in soil from which *Meloidogyne* larvae had been recovered.

Composite nematode samples from each farm were preserved in TAF fixative (8) and stored as a permanent record. All samples were cross-indexed according to location, associated crop and nematode genus. A map

Table 1. Distribution of stylet–bearing nematode genera associated with raspberry in the berry growing municipalities of the Fraser Valley

	Municipality								
Nematode genus	Chilliwack (156)*	Kent (2)	Langley (27)	Matsqui (85)	Mission (10)	Richmond (37)	Sumas (24)	Surrey (8)	Total (349)
Aphelenchoides	2.6†	0	43.6	9.4	0	8.1	4.2	25.0	10.0
Aphelenchus	2.6	0	36.0	14.1	0	2.7	8.3	37.5	10.3
Criconema	0.6	0	0	1.2	0	0	0	0	0.5
Criconemoides	1.9	0	0	3.5	0	0	0	0	1.7
Ditylenchus	7.1	0	34.4	8.2	0	2.7	0	0	9.2
Helicotylenchus	8.3	0	0	12.9	0	0	0	0	6.8
Heterodera	10.9	0	7.7	3.5	0	18.9	0	0	8.5
Longidorus	1.3	0	0	0	0	0	0	0	0.5
Meloidogyne	0	0	2.6	0	0	0	8.3	0	0.8
Paratylenchus	33.3	0	3.3	8.2	40.0	2.7	0	0	18.6
Pratylenchus	88.5	0	92.3	75.3	100	86.4	100	100	89.3
Rotylenchus	0	0	2.7	0	0	0	0	0	0.3
Trichodorus	0	0	0	0	0	0	50.0	0	3.4
Tylenchorhynchus	3.2	0	0	0	0	0	0	0	1.4
Tylenchus	25.6	50.0	41.0	20.0	40.0	45.9	66.6	50.0	32.9
Xiphinema	58.9	50.0	15.4	41.1	10.0	0	12.5	0	10.8

* Total number of samples taken from raspberry fields in the municipality.
† Percentage of samples containing the genus.

Table 2. Distribution of stylet–bearing nematode genera associated with strawberry in the berry growing municipalities of the Fraser Valley

	Municipality						
Nematode genus	Delta (38)*	Kent (30)	Langley (105)	Matsqui (40)	Mission (10)	Richmond (64)	Total (287)
Aphelenchoides	13.2†	0	35.2	5.0	10.0	12.5	18.5
Aphelenchus	21.1	23.3	22.8	22.5	0	20.3	21.2
Ditylenchus	21.1	16.7	8.6	5.0	0	3.1	9.0
Helicotylenchus	0	10.0	0	2.5	0	0	4.5
Heterodera	15.8	0	8.6	15.0	30.0	20.3	12.9
Longidorus	0	40.0	2.5	0	0	0	4.5
Paratylenchus	21.1	3.3	10.5	22.5	0	18.8	14.3
Pratylenchus	84.2	13.3	82.8	95.0	60.0	90.5	88.8
Rotylenchus	0	0	2.9	0	0	0	1.0
Tylenchus	10.6	6.7	31.4	20.0	0	26.6	22.2
Xiphinema	60.0	0	4.8	20.0	10.0	0	11.1

* Total number of samples taken from strawberry fields in the municipality.
† Percentage of samples containing the genus.

was made for each farm showing the source of each sample as a reference for future samplings.

Results and discussion

Stylet-bearing nematodes of 16 genera were isolated from raspberry soils (Table 1) and 11 from strawberry soils (Table 2) in the Fraser Valley. Figures 1, 2, and 3 show the nematode distribution in the Fraser Valley with the associated soil textures. For convenience soil textural classes have been grouped into families as follows: fine (heavy clay, clay, silty clay, sandy clay); medium fine (silty clay loam, loam, clay loam); medium (silt, silty loam, loam); coarse (sandy loam, loamy sand, sand); organic (>30% organic matter).

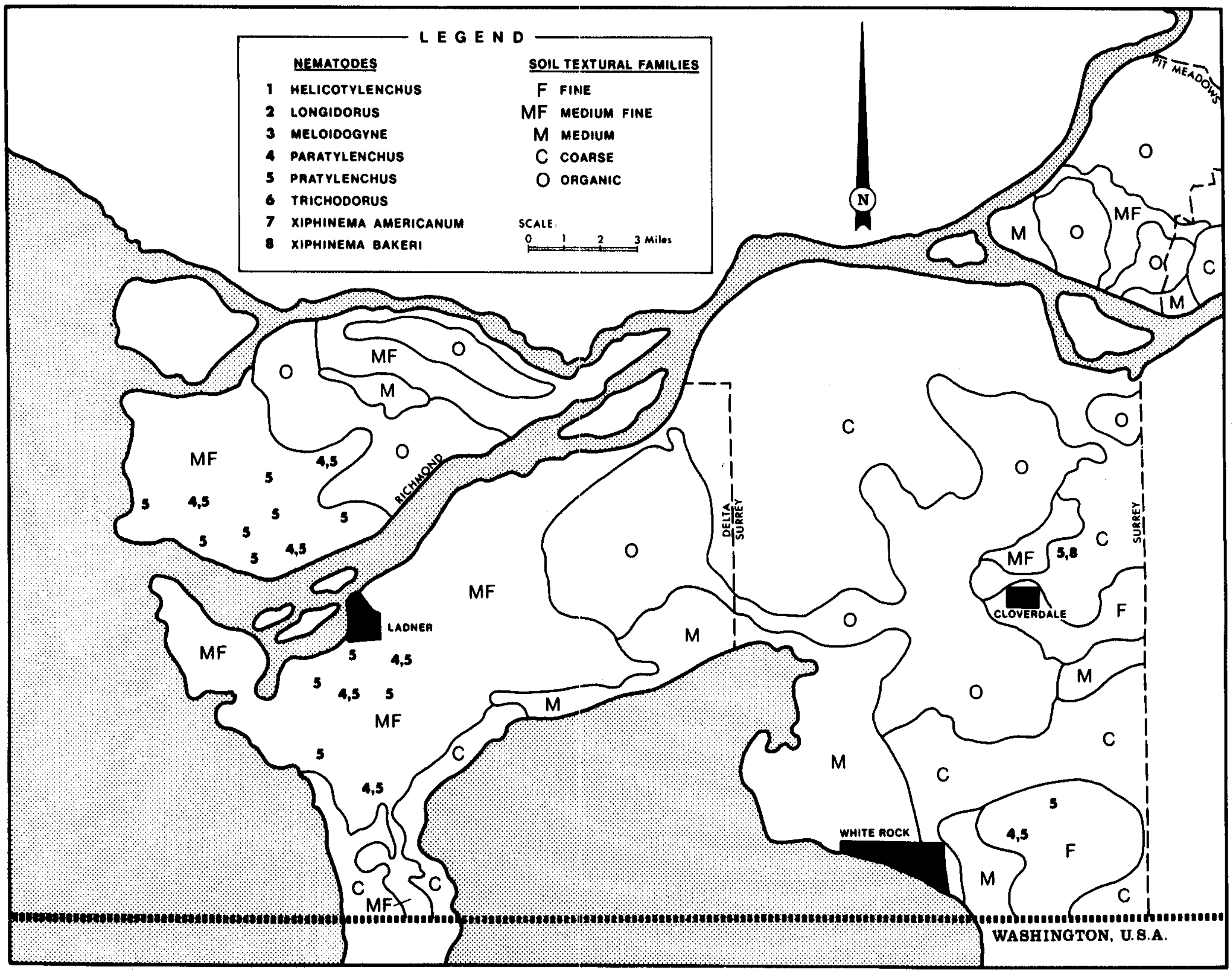

Figure 1. Distribution of stylet-bearing nematode genera and the associated soil textures in the western Fraser Valley.

Pratylenchus penetrans (Cobb) Chitwood and Oteifa was the species most frequently recovered from beneath both of these crops. In several municipalities it was recovered from every sample taken. While this species was usually present in samples from both healthy and unhealthy plants, populations were consistently and significantly greater under the unhealthy plants. Soil type appeared to have little influence on presence or absence of the species (Fig. 1, 2, 3) but populations were usually higher and caused greater damage in the medium textured soils.

Two species of *Xiphinema* were recovered, *X. americanum* Cobb and *X. bakeri* Williams. The first was confined to the raspberry fields in the medium fine textured soils of the municipality of Chilliwack (Fig. 3). This is also the only area in the Fraser Valley where tomato ringspot virus (TmRSV) occurs in raspberry, and it is consistently associated with *X. americanum*. Populations were usually low (20-50/200 cc of soil) and not associated with direct plant damage.

X. bakeri was more widely distributed in the medium textured soils of all raspberry and strawberry growing areas from the municipalities from Langley to Kent (Fig. 2, 3). It was never recovered from any of the heavier soils (containing more than 25% clay). When it occurred in large numbers plants were unthrifty and swollen, curled root tips indicated root feeding. The pathogenic effect of this species has been reported elsewhere (11). In the field *X. bakeri* occurred with *Pratylenchus* in 52% of the raspberry samples and 53% of the strawberry samples. The two nematodes together were associated with considerable plant damage.

Longidorus elongatus (deMan) Thorne and Swanger was first reported from British Columbia in 1971 (10). It occurred in only a few of the samples (Table 1, 2; Fig. 2, 3), but it was consistently associated with stunted and dying strawberry plants. *L. elongatus* has been shown to be a pathogen of strawberry in other parts of the world (14, 15) and observations here confirm a similar behavior in B.C. It was also recovered from two

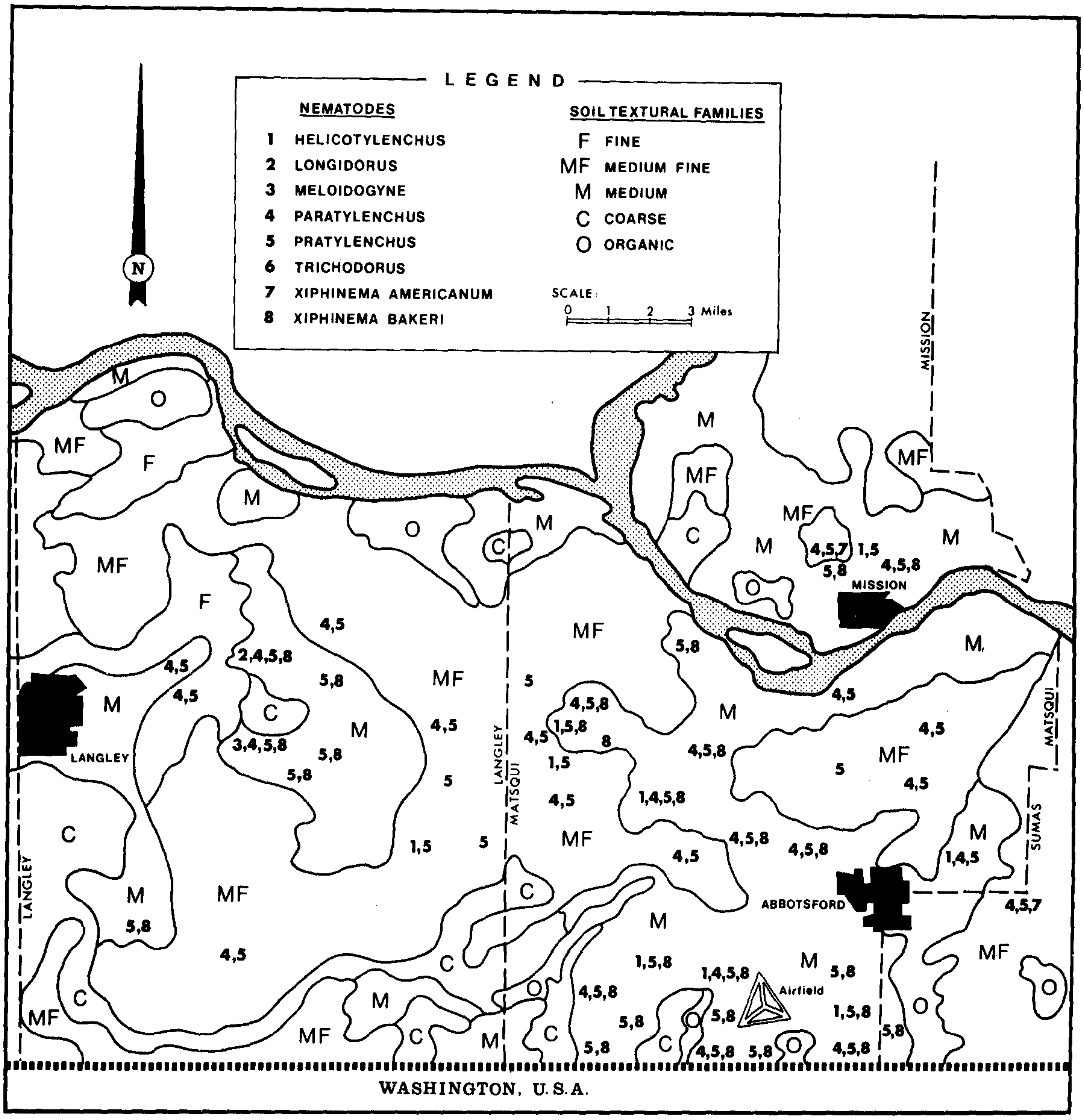

Figure 2. Distribution of stylet-bearing nematode genera and the associated soil textures in the central Fraser Valley.

raspberry soil samples in the Chilliwack area (Fig. 3) where it was associated with *X. americanum, X. bakeri* and *P. penetrans*. Because of this association it was difficult to ascertain its involvement in plant damage. Raspberry is not normally a host of this species (16) so it may have had a weed host. A similar situation has been reported from Scotland (17) where *L. elongatus* multiplies on virus infected weed hosts and feeds on raspberry only sufficiently to transmit the virus. No virus was found to be associated with this nematode in British Columbia.

The four genera mentioned above have all been recovered from virgin, forested areas in several locations in the Fraser Valley (Fig. 2, 3). Several native weeds also serve as hosts for *P. penetrans* and *X. americanum*. *X. bakeri* has been found associated with native trees, especially red cedar (*Thuja plicata* D. Don), red alder (*Alnus rubra* Bong.) and broadleafed maple (*Acer macrophyllum* Pursh.). *L. elongatus* was also found under the native broadleafed maple. These recoveries point to the importance of preplant sampling and fumigation even in newly cleared land.

None of the other genera found were associated with plant damage except in combination with those already mentioned. Most of the *Aphelenchoides* species were *A. subtennis* (Cobb) Steiner and Buhrer. Neither *A. fragariae* (Ritzema Bos) Christie nor *A. ritzema-bosi* (Schwartz) Steiner were found in this survey. *A.*

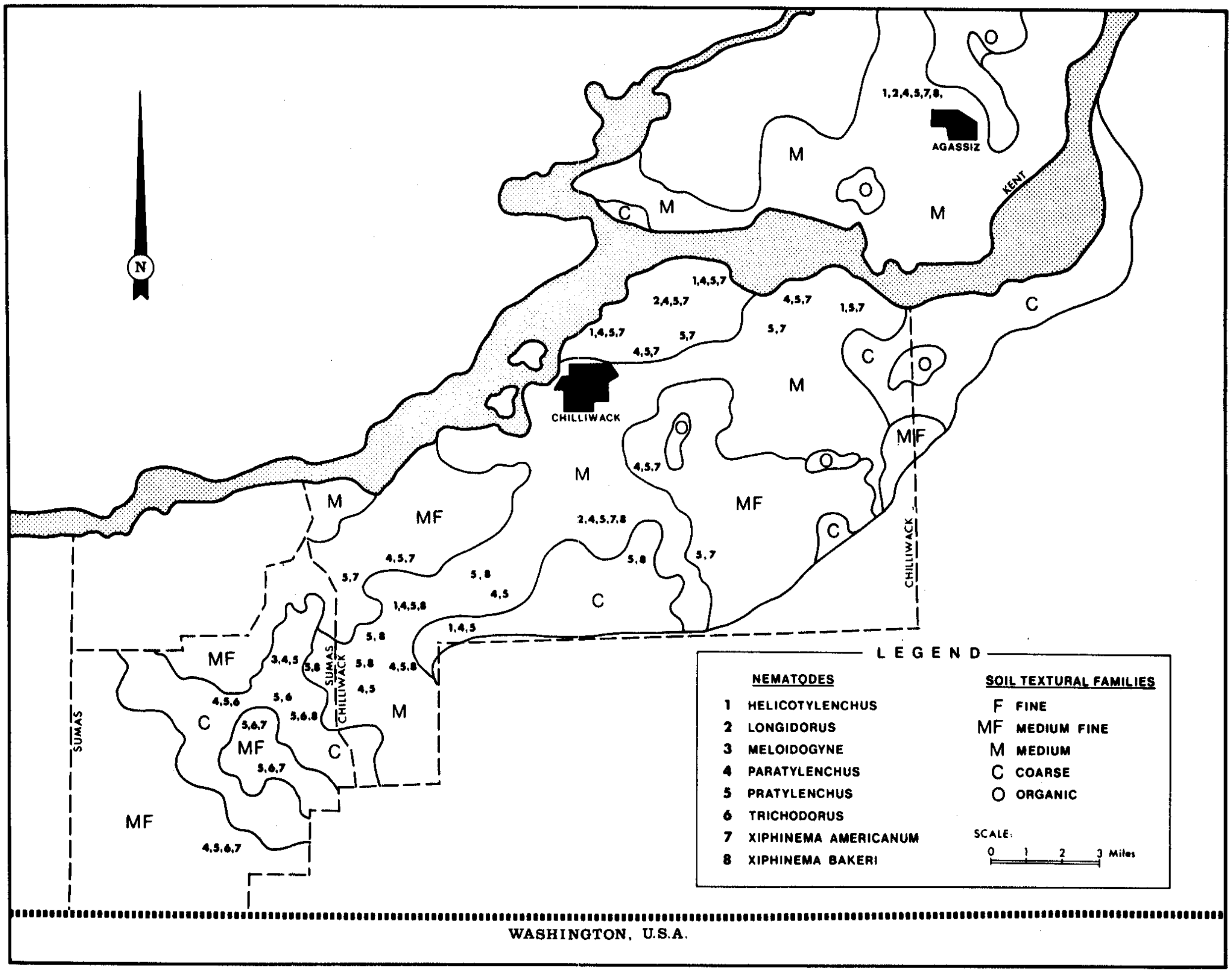

Figure 3. Distribution of stylet-bearing nematode genera and the associated soil textures in the eastern Fraser Valley.

fragariae has been reported in British Columbia (18) but not from strawberry.

Ditylenchus dipsaci (Kühn) Filipjev, has been reported as a strawberry pest in Washington (5, 7), and is an economically important pest of bulb crops in British Columbia but, while present, it was not associated with damaged strawberry or raspberry.

Meloidogyne hapla Chitwood was the only root knot species found. Root galling was not evident on raspberry. It was not recovered from strawberry in this survey, although it has been reported on this host in the Fraser Valley (13). It does not appear to be a serious pest on either crop in the valley.

Heterodera trifolii Goffart was the only cyst nematode species recovered from raspberry and strawberry soils. This is a ubiquitous species in British Columbia and has been reported from raspberry here (18). In this survey it was never associated with damaged raspberry or strawberry plants.

The remainder of the genera found occurred less frequently, were less widely distributed, and did not appear to be associated with any plant damage. It appears therefore that *P. penetrans* and *X. bakeri* are the main nematode pests causing direct damage to raspberries and strawberries in British Columbia. While *X. americanum* is important as a vector of TmRSV its restricted distribution and apparent lack of direct pathogenic effect limit its importance in berry production. *L. elongatus* can be a serious pathogen on strawberry but it too is of minor importance because of its limited distribution.

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Resistance to naturally and artificially induced fire blight in the Harrow pear collection

H. A. Quamme[1]

Ratings of the severity of fire blight [*Erwinia amylovora*] are reported on 51 cultivars in the Harrow pear collection during an epidemic period 1972 to 1975. This collection included cultivars of *Pyrus communis* grown commercially in Ontario and others used in the Harrow breeding program. In 1975, succulent shoots of 22 of the cultivars were inoculated with the disease organism using a hypodermic needle, microsyringe, and dispensing attachment. A significant correlation (r -0.737) was found between the percentage length of infected shoot after artificial inoculation and average ratings of natural infection on the whole tree (USDA rating system 1 to 10 with increasing numbers indicating greater resistance). The inoculation technique appeared to be reliable for distinguishing cultivars in which fire blight develops mainly in succulent shoots from those in which fire blight penetrates deeply into the woody parts of the tree. The procedure allowed the removal of infected shoots and prevented loss of susceptible cultivars after the measurements were made.

Can. Plant Dis. Surv. 57: 9 - 12, 1977

L'auteur présente les cotes de gravité de la brûlure bactérienne (*Erwinia amylovora*) sur 51 cultivars de poirier faisant partie de l'assortiment conservé à Harrow au cours d'une épiphytie (1972 à 1975). Cet assortiment comprenait des cultivars de *Pyrus communis* cultivés commercialement en Ontario et d'autres servant au programme d'amélioration de Harrow. En 1975, on a inoculé des pousses herbacées de 22 de ces cultivars avec l'agent pathogène au moyen d'une aiguille hypodermique, d'une microseringue et des accessoires de distribution. On a constaté une corrélation positive (r -0.737) entre la longueur relative de pousse infectée après inoculation artificielle et les cotes moyennes d'infection naturelle de l'arbre en entier (système de notation du ministère de l'Agriculture des Etats-Unis de 1 à 10, l'ordre croissant indiquant une résistance accrue). La technique d'inoculation semble convenir pour distinguer les cultivars où l'infection touche les pousses herbacées de ceux ou elle pénètre les parties ligneuses profondes de l'arbre. La technique a permis l'enlèvement des pousses infectées et a prévenu la perte de cultivars sensibles, une fois les mesures effectuées.

Fifty-one pear cultivars were grown at the Research Station, Harrow, to determine their commercial value and use in the breeding program. This planting was comprised mostly of *Pyrus communis* L. cultivars but some hybrids of *P. communis* with *P. pyrifolia* (Burm.) Nak. were also included. When the trees reached bearing age, a severe fire blight outbreak caused by *Erwinia amylovora* (Burr.) Winslow et al. occurred which allowed evaluation of cultivar resistance. The reaction of many of these cultivars has been reported previously following fire blight outbreaks in other pear collections (2, 3). One purpose of this study was to evaluate fire blight resistance of these and several new cultivars in southwestern Ontario. Another purpose of the study was to determine the correlation between natural infection and that produced by artificial inoculation.

Materials and methods

One to nine trees of each pear cultivar, sport, or numbered selection, were propagated on seedling rootstocks or grafted on Old Home interstocks. They were planted at a spacing of 4.6 by 5.5 m in one location of the orchard. They were pruned, fertilized, and sprayed according to commercial practice in Ontario. No sprays were applied to control fire blight.

The fire blight epidemic began in 1972 when the trees were 6 to 8 years old. Each fall, during the period from 1972 to 1975, the trees were rated individually using the rating system of van der Zwet et al. (7). In this system trees are rated from 1 (100% infection) to 10 (no infection) on the basis of the number of twigs infected, age of the wood penetrated, and the percentage of the tree infected.

During June 1975, healthy current-season shoots of 22 cultivars representing a range of fire blight resistance, based on previous ratings, were inoculated with the fire blight organism when they were in a succulent stage of growth. Six isolates of *E. amylovora* from pear orchards near Harrow were grown individually on slants of nutrient-yeast dextrose agar. Each of twenty succulent shoots (20 to 30 cm long) was inoculated with 10 to 20 ul of the aqueous suspension of a composite (1×10^7 cell/ml) of these strains. The inoculum was injected into the plant through a 26 gauge hypodermic needle with a microsyringe and dispensing attachment (Hamilton Co., Reno, Nevada). The inoculation was made at the first or second node below the shoot apex.

Fire blight resistance was determined by measuring the length of the infected shoot and expressing it as a

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Table 1. Fire blight reaction of cultivars in the Harrow pear collection as determined by rating the trees in the orchard during an epidemic 1972 to 1975 and by measuring percentage length of current season shoots infected after artificial inoculation

Cultivar	No. trees	Mean USDA score*	Mean percentage † § length of infected shoot after artificial inoculation
A. Classes 7.9 to 10 (blight mainly in current season shoots; required no or little surgical pruning)			
Maxine	4	10.0	18.9 (1.3)
Old Home	4	9.9	15.5 (0.7)
Surecrop	3	9.6	14.9 (2.0)
Star	2	9.5	
Moonglow	6	9.4	
Mac	2	9.3	37.4 (5.9)
Seckel	3	9.3	13.4 (0.7)
Mericourt	3	9.0	
Miney	3	9.0	
Moe	3	9.0	20.5 (2.4)
Pierre Cornielle	3	9.0	
Clara Fris	3	8.6	
Barseck	3	8.5	38.9 (4.0)
Louise Bonne de Jersey	2	8.5	
Anjou (tetraploid)	2	8.4	
Ewart	2	8.4	28.7 (4.5)
Kieffer	3	8.3	24.6 (3.1)
Starking Delicious	5	8.3	16.5 (0.5)
NY8760	6	8.2	39.2 (7.7)
B. Classes 6.0 to 7.9 (fire blight penetrated little beyond 3—year—old wood; required major cuts to save the tree)			
Anjou	5	7.7	70.9 (4.3)
Parburton (tetraploid Bartlett)	2	7.7	52.0 (5.2)
Yakima (tetraploid Bartlett)	2	7.3	38.0 (5.5)
Enie	3	7.0	
Fondante d'Autumne	1	7.0	
Clairgeau	3	6.9	
Giffard	4	6.7	20.5 (3.6)
Russett Bartlett (Bartlett sport)	1	6.5	
Stewart's Bartlett (Bartlett sport)	8	6.2	
Wilder	2	5.8	
Laxton's Progress	2	5.7	38.8 (6.5)
Maxred (Bartlett sport)	4	5.5	
Menie	3	5.4	
Buerré Superfin	3	5.0	

percentage of the total current season growth. Infected shoots were removed to spare the tree further infection after the infection ceased to advance or after the infection penetrated into 1-year-old wood.

Results and discussion

In most cultivars infection usually began in succulent shoots and spread into older wood. A few infections spread from blossom infections. The cultivar Magness was an exception. Fire blight developed directly in the mainstem and not in the shoots and blossoms. This observation agreed with that of van der Zwet et al. (5), who reported that Magness was trunk-susceptible but shoot-resistant.

The average fire blight scores are presented in Table 1. An average score was used instead of the lowest score (2,3) because infected branches were removed from the trees during the course of annual pruning. Some trees became progressively infected from one year to another while others appeared to recover.

Table 1. (Cont.)

Cultivar	No. trees	Mean USDA score*	Mean percentage † § length of infected shoot after artificial inoculation
C. Classes 1.0 to 4.9 (fire blight penetrated trunk and scaffold limbs; productivity severely affected)			
Bosc	5	4.9	56.6 (4.4)
Aurora	4	4.5	57.3 (5.7)
Buerré Henri Courcelle	2	4.5	
V25021	2	4.5	55.6 (3.1)
Magness	9	4.5	
Merton Pride	3	4.4	
Souvenir du Congress	3	4.3	
Fertility	3	3.8	
Flemish Beauty	3	3.8	55.6 (5.4)
Highland	4	3.7	51.0 (3.1)
Precose de Trevoux	2	3.5	
Santa Maria	3	3.4	
Devoe	3	3.2	
President Devoilaine	2	3.0	
Sheldon	3	2.8	
President Barabe	2	2.5	
Bartlett	6	2.2	53.9 (4.6)
Doyenne d'Ete	3	2.2	
Dr. Jules Guyot	3	1.6	
Starkcrimson (Clapp's Favorite sport)	5	1.5	
Clapp's Favorite	2	1.5	
Gorham	2	1.4	
Buerré Hardy	2	1.3	
Dessertina	2	1.3	
Phileson	2	1.0	
Mean of:			
11 inoculated cultivars, mean scores 10.0–8.0 (A)		9.0	24.4
5 inoculated cultivars, mean scores 7.9–6.0 (B)		7.0	44.0
6 inoculated cultivars, mean scores 5.9–1.0 (C)		3.9	55.1

* USDA Fire Blight Scoring System: 10 = no blight; 9 = 1–3%, current season wood only; 8 = 4–6%, 1– to 2–year–old wood; 7 = 7–12%, 1– to 3–year–old wood in upper 1/8 of tree; 6 = 13–25%, 2– to 3–year–old or older wood and in upper 1/4 of tree; 5 = 26–50%, 3–year–old or older wood and in upper 1/2 of tree; 4 = 51–75%, older wood in lower 1/2 of tree; 3 = 76–88%, old wood in lower 1/4 of tree; 2 = 89–99%, base of trunk and 1 = 100%, tree dead.

† The measurements of percentage length of infected shoot is significantly correlated with the field ratings (r = 0.737).

§ The standard error of the mean is presented in the brackets.

Maxine was the only cultivar that remained free of fire blight. Maxine is not immune because infection in it has been reported previously (2, 3). Cultivars with a score of 8.0 or greater were considered resistant. In this class fire blight infection was limited mainly to current season shoots, although some infection penetrated as far as 2-year-old wood. Minimal surgical pruning was required to remove fire blight and maintain fruit production. Seckel, Kieffer, and Moonglow were the only cultivars grown commercially in Ontario that fell into this class. Old Home is a resistant cultivar that is used as a parent for seedling rootstock production, but the fruit is of no commercial worth. Cultivars in Table 1 with a rating of 7.9 or greater are being used as sources of fire blight resistance in the Harrow breeding program.

Fire blight penetrated 3-year-old wood of cultivars scoring 6.0 to 7.9. Major surgical pruning was required to remove diseased branches. Production was maintained at commercial levels in the pruned trees. Anjou, Giffard, Stewart's Bartlett, and Russett Bartlett were cultivars of commercial importance in Ontario that fell in this class.

Fire blight penetrated 4-year-old and older wood of cultivars scoring 5.9 or less. Commercial production could not be maintained by surgical pruning and whole trees were frequently killed.

Reaction ratings of cultivars in the Harrow collection were similar to those in other collections (2, 3) with few exceptions. Reaction of several new cultivars, including Aurora, Barseck, Doyenne d'Ete, Highland, V-25021, N.Y. 8760, Mac, Mericourt, and Merton Pride, are reported which did not appear in these previous reports.

All inoculated shoots showed fire blight symptoms. The percentage infection in current season shoots was significantly correlated with ratings of natural fire blight (r -0.737) (Table 1).

Analysis of variance on the mean percentage infected shoots was not carried out because of wide differences in variance among cultivars (significantly different at the 1% level by Bartlet's test of homogeneity). The standard errors of the mean are presented in Table 1.

On the average, cultivars in which natural fire blight penetrated little beyond current season shoots (USDA score 8.0 to 10.0) were more resistant to artificial inoculation than cultivars in which natural fire blight penetrated into 3-year-old wood (USDA score 6.0 to 7.9), and these latter cultivars in turn were more resistant to artificial inoculation than cultivars in which natural fire blight penetrated beyond 3-year-old wood (USDA score 1.0 to 5.9). All cultivars that which were rated 8.0 or higher ranked greater in resistance to artificial inoculation than cultivars that ranked 5.9 or less. The artificial inocualtion technique appeared to be reliable for distinguishing cultivars in which fire blight developed no further than succulent shoots from those in which it deeply penetrated the woody parts of the tree. Magness, which is trunk-susceptible and shoot resistant, is an exception, but this type of cultivar is rare and can be identified by a trunk inoculation technique (6).

Inoculation techniques have been used previously for measuring fire blight resistance of pear cultivars (1, 4, 6), but with this method the infection was removed when it reached 1-year-old wood and further spread of the disease was prevented. This allowed susceptible cultivars to be spared for fruit evaluation and for breeding purposes.

Acknowledgments
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Outbreak of tomato late blight in Ontario

A. A. Reyes, J. G. Metcalf, J. T. Warner, and L. W. Matheson[1]

A serious outbreak of tomato late blight caused by *Phytophthora infestans* is reported in Ontario in 1976 for the first time in 16 years.

Can. Plant Dis. Surv. 57: 13-14. 1977

On signale la première apparition en 16 ans d'un grave foyer de mildiou de la tomate (*Phytophthora infestans*) en Ontario.

Early in August 1976, a serious disease was noted on field tomatoes (*Lycopersicum esculentum* Mill.) cultivars Heinz 1350 and Rideau in Prince Edward County, Ontario (Fig. 1). It was diagnosed as late blight caused by *Phytophthora infestans* (Mont.) de Bary. The symptoms observed were dark, water-soaked spots on the leaves and stems and dark olivaceous, greasy-appearing spots on the fruits. Downy-white mycelial growth was easily located on the lower surfaces of lesions on the leaves and sporangia and sporangiophores of *P. infestans* were readily obtained.

Of five fields ranging from 20 to 40 ha. visited in Prince Edward County on August 10, 1976, two were severely affected by *P. infestans* (more than 50% infected plants); the others were only mildly affected.

During the first week of August in Prince Edward County the weather was generally warm (max. 26°C) during the day and cool (min. 9°C), humid, and very foggy at night. These conditions favor late blight (1) and we believe they were responsible for the severity of the outbreak this year.

In 1940 an outbreak of late blight was reported for the first time in Ontario when *P. infestans* caused serious rot on tomato fruits during the early part of the canning season (2). According to Conners and Savile (3), tomato late blight was again epidemic in 1946. The last late blight outbreak in Ontario occurred in 1960 (4).

Acknowledgment

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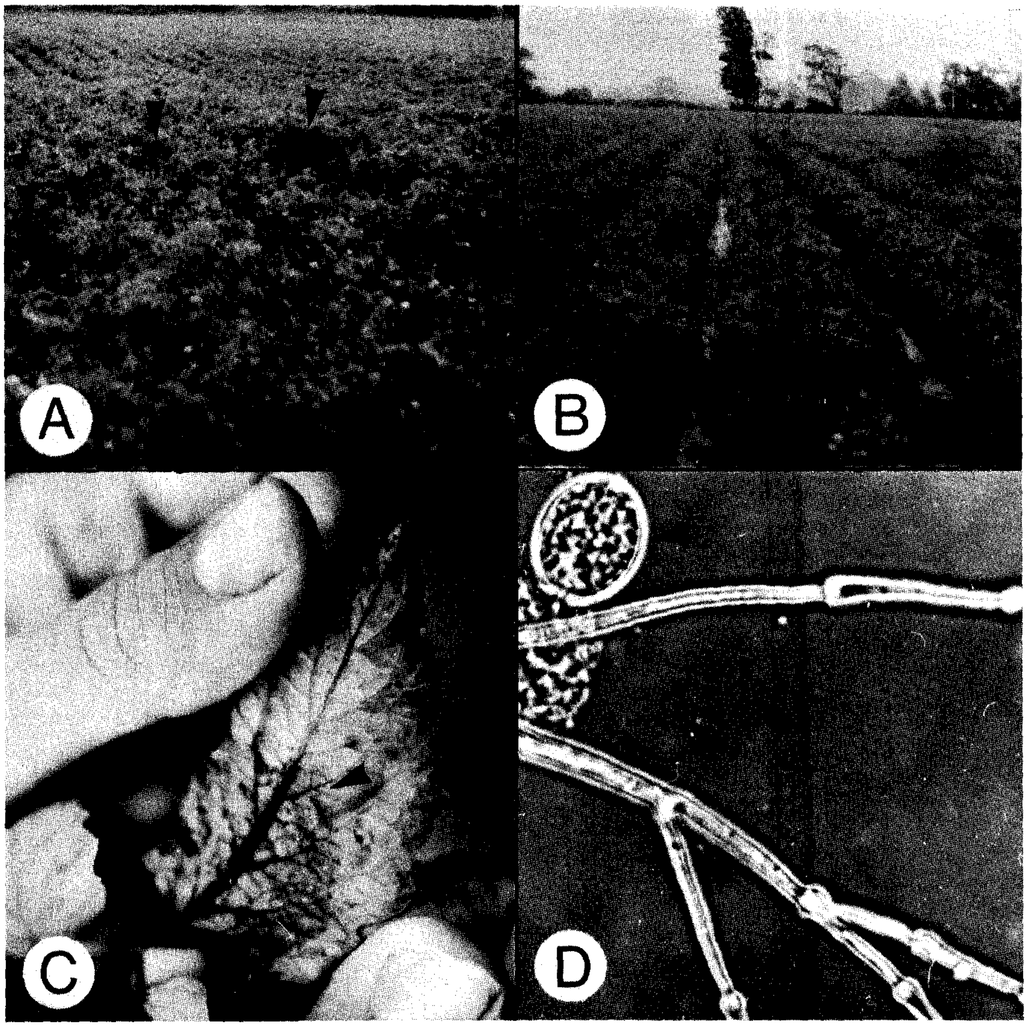

Figure 1. Tomato late blight. A) A spot in a field of 'Heinz 1350' tomatoes (arrows) severely affected by *P. infestans*. B) Normal, symptomless field tomatoes. C) Dark, water-soaked lesion (arrow) caused by *P. infestans* on a tomato leaf. D) Sporangium (arrow) and sporangiophore of *P. infestans*.

Pertes dues aux maladies chez la luzerne au Québec en 1976[1]

C. Richard et C. Gagnon

A third annual survey of alfalfa diseases in Quebec was performed in 1976. Three types of root rot, five foliar diseases, and alfalfa blotch leaf miner were observed. The latter was estimated to be ten times more destructive than in 1975. Total losses were assessed at $5 million.

Can. Plant Dis. Surv. 57: 15-17. 1977

Un troisième inventaire des maladies de la luzerne au Québec a été effectué en 1976. Trois types de pourriture de racine, cinq maladies du feuillage et la mineuse virgule ont été observées. Cette dernière maladie fut dix fois plus importante que l'année précédente. Les pertes totales sont estimées à $5 millions.

Le présent inventaire fait suite à ceux de 1974 et 1975 (3, 4). Non seulement avons-nous augmenté encore l'intensité de l'échantillonnage mais nous avons aussi amélioré considérablement sa représentativité.

Matériel et méthodes

L'échantillonnage couvre 44 comtés répartis dans onze des douze régions agricoles du Québec. Trois régions supplémentaires ont donc été échantillonnées. Seule la région 9 n'a pas été visitée en raison de son éloignement et du peu de luzerne qui y est cultivée.

L'intensité de l'échantillonnage a été d'une luzernière visitée par 4000 acres de luzerne par comté.

L'échantillonnage, l'évaluation des indices et le calcul des pertes dues aux maladies du feuillage, y compris la mineuse virgule (*Agromyza frontella* Rondami, Agromyze de la lucerne), ont été effectués comme précédemment (4). Quant aux pourritures de racines, elles ont été divisées selon les types décrits par McKenzie & Davidson (2). La pourriture interne (pourridié fusarien) a été évaluée selon l'échelle déjà utilisée en 1974 et 1975 (3 et 4). L'échelle d'évaluation de la pourriture externe de la couronne est basée sur le pourcentage de la couronne atteinte (1 à 5 = 0 à 100 pourcent), tandis que la pourriture racinaire externe a été évaluée selon une échelle établie par Hine *et al.* (1) et dont les critères sont les suivants: 1 racine saine; 2 pas de lésions sur les racines, radicelles détruites et point noir au point d'attachement; 3 lésions sur la racine principale; 4 plusieurs lésions allongées sur la racine principale; 5 presque toute la racine est atteinte de pourriture.

La valeur commerciale du foin de luzerne pour l'ensemble des mois de janvier à octobre 1976 a été de $50 selon le Bureau de la Statistique du Québec (communication personnelle).

Resultats

La distribution de l'échantillonnage, le nombre de champs affectés et les indices de maladie pour les pourritures et les maladies du feuillage sont indiqués au tableau 1 et 2. Les pertes dues aux maladies du feuillage sont tabulées au tableau 3. Les renseignements sur l'échantillonnage, la distribution et les pertes dues à la mineuse virgule sont rassemblés au tableau 4.

L'indice du pourridié fusarien a été plus élevé pour 1976 que pour les deux années précédentes (1.60 par rapport à 1.47 et 0.93). Les trois plus importantes maladies du feuillage ont vu leur indice diminuer par rapport à 1975; ce sont la tache commune [*Pseudopeziza medicaginis* (Lib.). Sacc.], la tache leptosphaerulinienne [*Leptosphaerulina briosiana* (Poll.) Graham & Luttrell] et la tige noire [*Phoma medicaginis* Malbr. & Roum. var. *medicaginis*] avec respectivement 3.67, 3.44 et 3.67 comparativement à 6.62, 5.33 et 4.08 pour 1975. Les pertes totales dues aux maladies du feuillage ont été moins élevées: $2.6 millions comparativement à $2.9 millions en 1975.

Le plus grand changement fut du coté de la mineuse virgule dont les dommages s'élèvent à $2.9 millions, soit plus de 10 fois les dommages de 1975.

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Tableau 1. Fréquence et gravité des pourritures de racine au Québec en 1976

Région	Superficie (acres)*	Nombre de champs échantillonnés	Nombre de champs/Indice de maladie: Pourridié fusarien	Pourriture externe de la couronne	Pourriture racinaire externe
1	43,000	10	10/1.28	10/1.63	10/1.81
2	42,323	8	8/1.22	8/1.26	8/2.12
3	5,000	1	1/2.2	1/1.80	1/2.20
4	59,000	15	15/1.75	15/1.27	15/1.70
5	13,208	2	2/1.85	2/1.65	1/1.30
6	130,000	29	27/1.71	25/1.13	27/2.07
7	29,900	7	7/1.56	7/1.96	6/1.63
8	28,675	8	8/2.17	7/1.45	8/2.09
10	39,500	9	9/1.42	7/0.77	9/2.00
11	12,908	3	3/0.94	3/0.13	3/1.23
12	7,350	2	2/1.4	2/1.25	2/1.40
Total	411,364	94	92/1.60	87/1.28	90/1.90

*1 acre = 0.405 hectare.

Tableau 2. Fréquence et gravité des maladies du feuillage de la luzerne au Québec en 1976

Région	Superficie (acres)	Nombre de champs échantillonnés	Nombre de champs/Indice de maladie: Tache commune	Tige noire	Tache leptos—phaerulinienne	Mildiou	Tache stemphylienne
1	43,000	10		7/8.73	5/1.67		
2	42,323	8	6/2.11	8/1.10	5/2.87		4/0.18
3	5,000	1		1/1.40	1/4.80		
4	59,500	15	12/8.10	14/2.64	13/5.28	1/0.01	4/0.09
5	13,208	2	2/0.40	2/4.80	2/2.93		
6	130,000	29	17/6.39	25/3.05	24/3.90		6/0.08
7	29,900	7	2/1.03	7/13.59	6/4.70		
8	28,675	8	8/8.39	8/1.68	7/0.57	7/0.27	7/0.32
10	39,500	9	9/6.55	8/1.05	9/2.95	2/0.15	1/0.01
11	12,908	3	1/1.0	3/0.16	3/1.71	3/0.57	2/0.15
12	7,350	2		2/0.32	2/2.60		
Total	411,364	94	57/3.67	85/3.67	77/3.44	13/0.30	24/0.17

Tableau 3. Pertes dues aux maladies du feuillage chez la luzerne*

Région	Nombre de champs échantillonnés	Superficie (acres)	Rendement (tonnes/acre)**	Perte %	Production ('000 tonnes)†		Pertes ('000 tonnes)	Pertes ('000 dollars)
					Actuelle	Potentielle		
1	10	43,000	3.92	2.60	168.560	173.06	4.50	225.75
2	8	42,323	3.88	1.57	164.213	166.83	2.62	129.69
3	1	5,000	3.74	1.55	18.700	18.99	0.29	14.36
4	15	59,500	4.02	4.03	239.190	249.23	10.04	496.98
5	2	13,208	3.74	2.03	49.397	50.42	1.02	50.49
6	29	130,000	4.45	3.36	578.500	598.61	20.11	995.45
7	7	29,900	4.45	4.83	133.055	139.81	6.76	334.62
8	8	28,675	3.96	2.81	113.553	116.84	3.29	162.86
10	9	39,500	3.96	2.68	156.420	160.73	4.31	213.35
11	3	12,908	3.96	0.90	51.115	51.58	0.47	23.27
12	2	7,350	3.19	0.73	23.446	23.62	0.17	8.42
Total	94	411,364	3.93	2.81	1696.15	1749.72	49.08	2655.24

* Excluant les pertes dues à la mineuse virgule

† 1 tonne = 2000 livres

** 1 tonne/acre = 2.242 tonnes métrique/hectare

Tableau 4. Fréquence, gravité et pertes dues à la mineuse virgule chez la luzerne

Région	Nombre de champs échantillonnés	Superficie (acres)	Rendement (tonnes/acre)*	Nombre de champs/ Indice de maladie	Perte %	Production ('000 tonnes)†		Pertes ('000 tonnes)	Pertes ('000 dollars)
						Actuelle	Potentielle		
1	10	43,000	3.92	10/18.02	4.51	168.560	176.521	7.96	394.02
2	8	42,323	3.88	8/8.09	2.02	164.213	167.60	3.39	167.81
3	1	5,000	3.74	1/2.60	0.65	18.700	18.82	0.12	5.94
4	15	59,500	4.02	15/17.27	4.32	239.190	249.99	10.80	534.60
5	2	13,208	3.74	2/8.98	2.25	49.397	50.53	1.13	55.94
6	29	130,000	4.45	24/3.90	3.55	578.500	599.79	21.29	1053.86
7	7	29,900	4.45	6/4.70	6.24	133.055	141.91	8.86	438.57
8	8	28,675	3.96	8/2.73	0.68	113.553	114.33	0.78	38.61
10	9	39,500	3.96	9/10.44	2.61	156.420	160.61	4.19	207.41
11	3	12,908	3.96	3/5.08	1.27	51.115	51.77	0.66	32.67
12	2	7,350	3.19			23.446			
Total	94	411,364	3.93	90/13.48	3.42	1696.15	1731.87	59.18	2929.43

* 1 tonne/acre = 2.242 tonnes métriques/hectare

† 1 tonne = 2000 livres

LTB snow mold is probably not a graminicolous Typhula species[1]

J. Drew Smith

Mating tests using dikaryotic isolates of the low-temperature basidiomycete (LTB) and monokaryotic isolates of four species of *Typhula* failed to establish a genetical relationship between the LTB and the common graminicolous *Typhula* spp. in western Canada.

Can. Plant Dis. Surv. 57: 18, 1977

Des essais de fécondation par des isolats dicaryotiques du basidiomycète psychrophile et des isolats syncaryotiques de quatre espèces de *Typhula* n'ont pas réussi à établir un rapport génétique entre le champignon et les espèces graminicoles courantes de *Typhula* dans l'ouest du Canada.

A sterile, low-temperature-tolerant, nonsclerotial basidiomycete, LTB, the cause of extensive damage to grasses and alfalfa in Alberta (1), was later reported from grasses, cereals and forage legumes in all the western provinces of Canada, and Alaska (3, 5). Attempts to induce the production of sclerotia, fruiting bodies, and spores have failed; (1, 5, and Dr. M. W. Cormack, personal communication 13 September 1976; Smith unpublished). Characteristic clamp connections which are frequent in rapidly growing mycelium indicate that the fungus is a basidiomycete. Broadfoot and Cormack (1) suggested that the LTB might be related to *Typhula* but since there were no sclerotia it was not one of the *Typhula* spp. that had been studied by Remsberg (4). However, some isolates of a typhula snow mold, common in western Canada, designated at present *Typhula* FW (5) and considered (Arsvoll and Smith unpublished) to be a new, morphologically distinct variety of *Typhula ishikariensis* Imai produce abundant fluffy, near-white aerial mycelium like that of the LTB. Some isolates of *T. ishikariensis* Imai, *T. idahoensis* Remsberg, and especially *T. incarnata* Lasch ex Fries found in North America are shy sclerotium producers especially after repeated subculturing (Smith unpublished). Their mycelium may turn gray on diseased plants like that of the LTB. Therefore it seemed possible that the LTB might be a *Typhula* sp. which, in the course of evolution in geographical and climatic isolation in western Canada, had lost the ability to sporulate or produce sclerotia.

Attempts were made to establish a genetical relationship between the LTB and *Typhula* spp. found in western Canada. Monokaryotic testers of graminicolous *Typhula* species used in other genetical studies were paired with dikaryotic isolates of the LTB from various hosts using the "di-mon" mating technique of Bruehl et al. (2). Five dikaryotic isolates of the LTB, two from turfgrass, two from rye, and one from alfalfa, were paired with each of four tester monokaryotic isolates of one isolate of *T. ishikariensis*, one isolate of *T. idahoensis*, two isolates of *Typhula* FW, and two isolates of *T. incarnata*.

In no case did any mating occur, as indicated by the absence of clamp formation in the monokaryotic testers. It seems unlikely that the LTB is related to the common graminicolous *Typhula* spp. in western Canada.

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Genera of plant parasitic nematodes associated with soybeans on the heavier textured soils of Essex, Kent, and Lambton counties in southwestern Ontario

P.W. Johnson[1]

Nine genera of plant parasitic nematodes, *Criconemoides, Helicotylenchus, Heterodera, Meloidogyne, Paratylenchus, Pratylenchus, Trichodorus, Tylenchorhynchus*, and *Xiphinema* were found associated with soybeans in the heavier textured soils of Essex, Kent, and Lambton counties in southwestern Ontario. Most frequently encountered were *Helicotylenchus* species, present in 61% of the samples collected, *Pratylenchus* species, present in 59% of the samples, and *Paratylenchus* species, present in 25% of the samples. *Heterodera*, represented only by *H. weissi*, and *Meloidogyne*, represented only by *M. hapla*, were found in 3% and 1% of the samples respectively.

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On a constaté la présence de neuf genres de nématodes phytoparasites *Criconemoides, Helicotylenchus, Heterodera, Meloidogyne, Paratylenchus, Pratylenchus, Trichodorus, Tylenchorhynchus* et *Xiphinema*) associés au soja dans les sols lourds des comtés d'Essex, de Kent et de Lambton du sud-ouest de l'Ontario. Le plus fréquent était *Helicotylenchus* (61% des échantillons prélevés) suivi, dans l'ordre, par *Pratylenchus* et *Paratylenchus* avec 59% et 25% des échantillons respectivement. *Heterodera*, représenté uniquement par *H. weissi*, et *Meloidogyne*, représenté seulement par *M. hapla*, ne constituaient que 3% et 1% respectivement des échantillons prélevés.

Soybean (*Glycine max* (L.) Merr.) is a crop of increasing economic importance in southwestern Ontario. Numerous reports (2, 3, 4) exist concerning nematode problems of soybeans in the United States and many other countries around the world. There is a lack of relevant information concerning the nematodes associated with soybeans in southwestern Ontario. In the summer of 1975, as part of a survey on the incidence of phytophthora root rot of soybeans on the heavier textured soils of Essex, Kent, and Lambton counties of southwestern Ontario, soil samples were collected from surveyed fields for nematode analysis. This paper deals with the results of the nematode analysis of these samples.

Materials and methods

During July and August of 1975 a survey was conducted on the incidence of phytophthora root rot of soybean in southwestern Ontario. A total of 76 soybean fields were checked. Soil samples for nematode analysis were obtained from the root zones of both healthy and diseased plants when they occurred in the same field. Individual samples were thoroughly mixed, passed through a 4-mesh screen to remove large debris particles, and a 50 g subsample extracted using a modified Baerman pan technique (7). Plant parasitic nematodes in the extract were counted, identified to genus, and expressed as number of nematodes per kg of soil. All *Meloidogyne* species recovered were cultured on tomato (*Lycopersicum esculentum* Mill.) and identified to species. In the case of *Heterodera* sp., samples of larvae and cysts were identified by R. H. Mulvey of the Biosystematics Research Institute in Ottawa.

Since nematode occurrence and population density were the same in samples around healthy and root rot affected plants, results reported here are based on the average nematode count from affected and nonaffected sites in a field, or on an individual samples from fields in which diseased plants were not observed.

Results

Nine plant parasitic nematode genera, *Criconemoides* Taylor, 1936; *Helicotylenchus* Steiner, 1945; *Heterodera* Schmidt, 1871; *Meloidogyne* Goeldi, 1887; *Paratylenchus* Micoletzky, 1922; *Pratylenchus* Filipjev, 1936; *Trichodorus* Cobb, 1913; *Tylenchorhynchus* Cobb, 1913; and *Xiphinema* Cobb, 1913; were found associated with the roots of soybean in this survey. The frequency of occurrence and population density (range and mean) of the nine nematode genera are presented in Table 1.

The distributions of these nematodes within the soybean growing areas of Essex, Kent, and Lambton counties are given in Figures 1-3. It is interesting to note that only the three most frequently occurring nematodes in the survey, *Helicotylenchus* sp., *Pratylenchus* sp., and *Paratylenchus* sp., were found on Pelee Island.

The *Meloidogyne* species encountered during the survey was identified as *M. hapla* Chitwood, 1949, and the

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Table 1. Genera of plant parasitic nematodes, their frequency of occurrence and population densities, associated with soybeans in Essex, Kent, & Lambton counties

Nematode genus	Samples (+/t)*	Percent occurrence	Population density (no./kg soil) Mean	Range
Helicotylenchus	46/76	61	478	20–5800
Pratylenchus	45/76	59	951	20–7000
Paratylenchus	19/76	25	849	40–7800
Tylenchorhynchus	13/76	17	115	20–400
Heterodera	2/76	3	270	240–300
Criconemoides	2/76	3	70	20–120
Xiphinema	2/76	3	70	20–120
Meloidogyne	1/76	1	260	
Trichodorus	1/76	1	40	

* +/t: number of positive samples over the total number of samples.

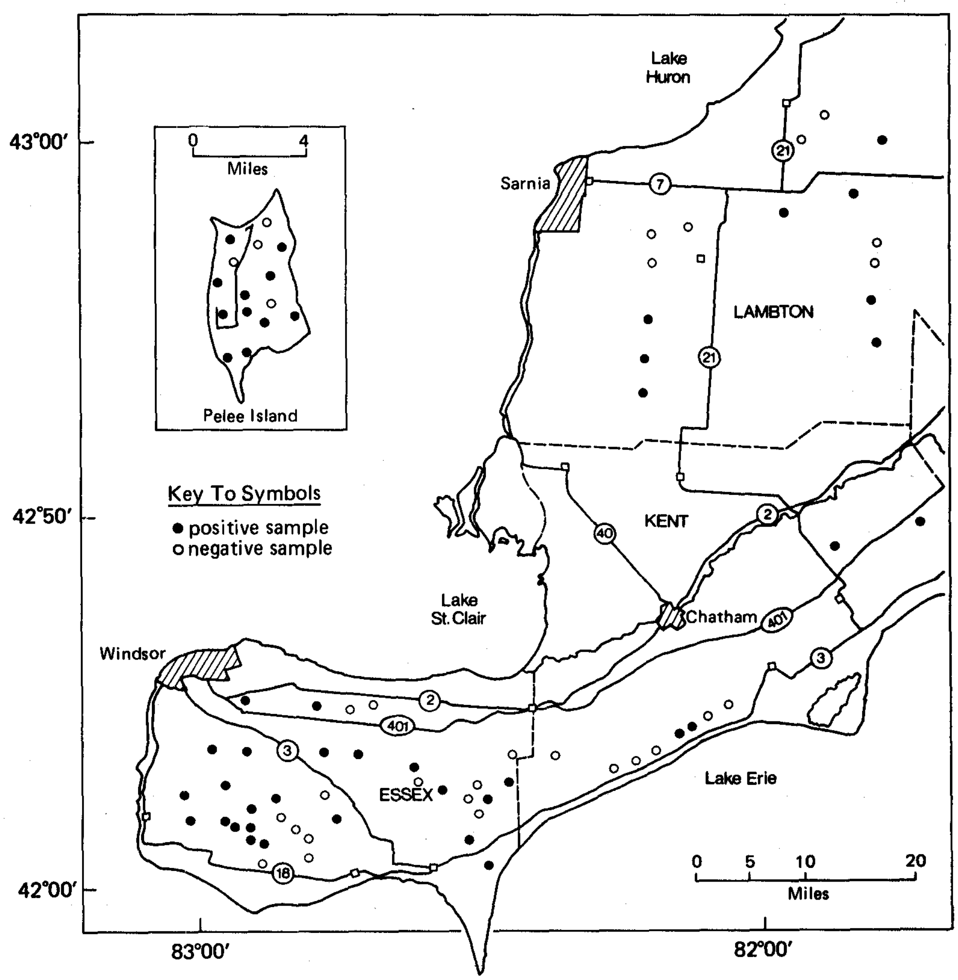

Figure 1. Distribution of *Helicotylenchus* species in soybean fields in southwestern Ontario, 1975.

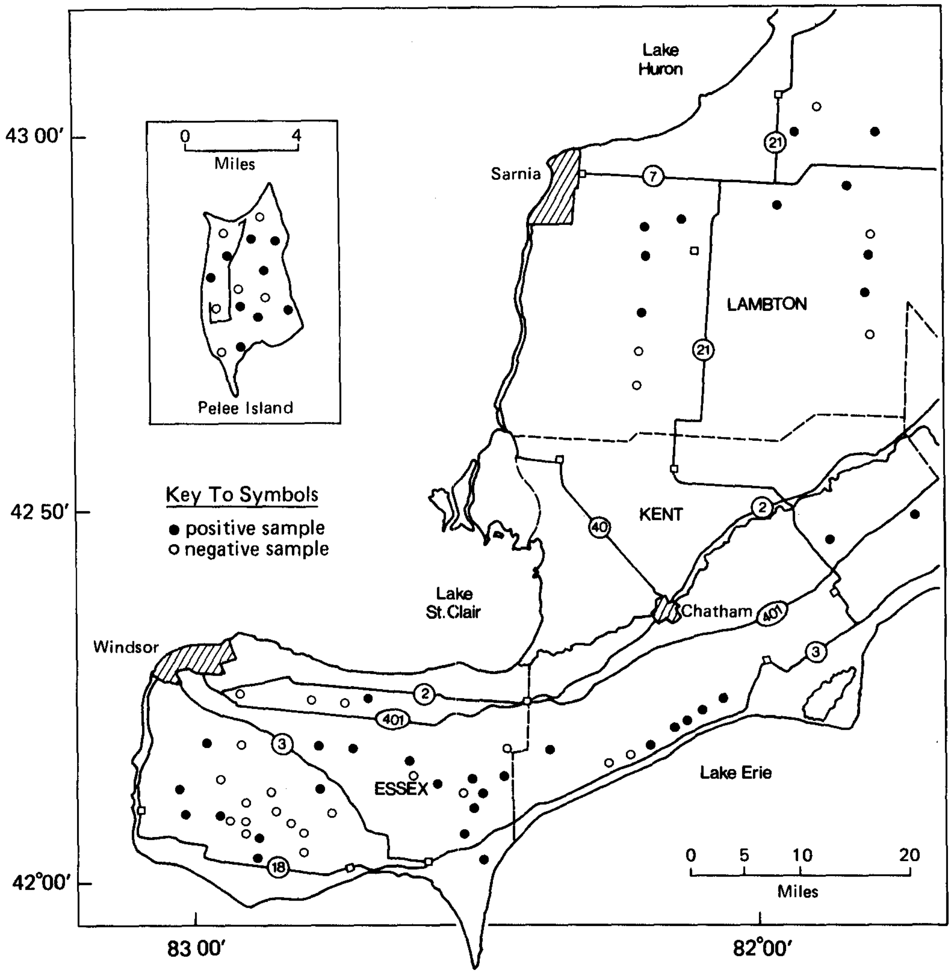

Figure 2. Distribution of *Pratylenchus* species in soybean fields in southwestern Ontario, 1975.

Heterodera species was identified as *H. weissi* Steiner, 1949.

Two other stylet bearing genera, *Aphelenchus* Bastian, 1865, and *Tylenchus* Bastian, 1865, predominantly known as fungus feeding genera and of little economic importance, were both frequently observed in the samples.

Discussion

Although nine genera of plant parasitic nematodes were found to be associated with soybean in Essex, Kent, and Lambton counties, the two nematode species, *Heterodera glycines* Ichinohe, 1952, and *Meloidogyne incognita* (Kofoid and White, 1919) Chitwood, 1949, that are of major economic concern in many soybean growing areas in the United States, were not found. In Essex County, *M. incognita* is a major problem in tomato and cucumber greenhouses (5), but it is not known as a field problem since it is unable to survive winter conditions in the field (1, 6). The soybean cyst nematode, *H. glycines*, has not been recorded from Canadian soil and its potential for winter survival in this area is not known.

Pratylenchus, Helicotylenchus, Paratylenchus, and *Tylenchorhynchus* species occurred in population densities high enough in some fields to suggest that some loss in soybean yield might be occurring; however, additional research is required to determine if any of these nematodes are of real economic concern in soybeans in southwestern Ontario.

Acknowledgements

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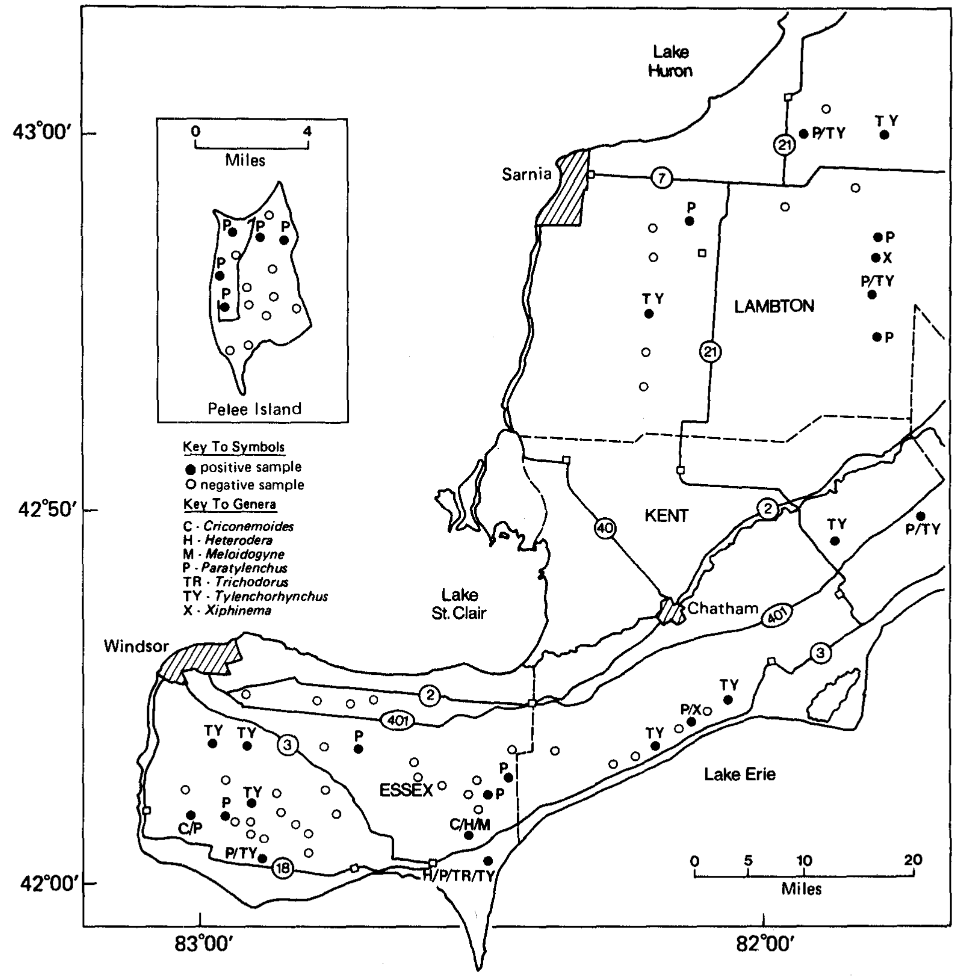

Figure 3. Distribution of *Criconemoides, Heterodera, Meloidogyne, Paratylenchus, Trichodorus, Tylenchorynchus*, and *Xiphinema* species in soybean fields in southwestern Ontario, 1975.

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Etiological and pathogenicity studies on the bacterial pod spot of rape

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The bacterial pod spot of rape first reported from southern Alberta in 1973 has since been found in central Alberta and appears to be quite widespread. The brown lesions produced on the pods by some isolates of the pathogen may be bordered by chlorotic haloes. All varieties of Polish rape (*Brassica campestris*) and Argentine rape (*B. napus*) tested have proved susceptible. Wounding in various ways seems to predispose rape to infection. The causal bacterium is seed borne and has been identified as a strain of *Pseudomonas syringae*. Five isolates of the bacterium from rape reacted identically in biochemical and physiological tests and were very similar to one of *P. syringae* from lilac that produced symptoms on inoculated pods of rape resembling those of the pod spot isolates.

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Signalée pour la première fois dans le sud de l'Alberta en 1973, la tache des siliques du colza a depuis été observée dans le centre de la province et semble très répandue. Il peut arriver que les lésions brunes produites sur les siliques par certains isolats du microbe soient entourées de halos chlorotiques. Toutes les variétés de navette (*Brassica campestris*) et de colza (*B. napus*) testées se sont révélées sensibles. Les blessures semblent prédisposer la culture à l'infection. La bactérie responsable, transmise par la semence, semblerait être une souche de *Pseudomonas syringae*. Cinq isolats de la bactérie provenant du colza ont réagi de la même façon à des tests biochimiques et physiologiques et ressemblaient étroitement, après inoculation sur des siliques de colza, à un isolat du lilas manifestant des symptômes qui ressemblent à ceux des isolats de la tache des siliques.

Bacterial pod spot was first reported from southern Alberta affecting crops of Span rape on two farms near Rockyford in 1973 (3). The causal organism, a species of *Pseudomonas*, infects its host most readily through wounds. Further studies on the identity and pathogenicity of the causal bacterium are reported here.

Though as yet no thorough survey of the distribution of bacterial pod spot has been made in Alberta we know now that it is not confined to southern Alberta. Judging from specimens received and from field examinations, we believe that the disease is widespread and that it may develop wherever and whenever conditions favorable for its development occur. The disease has been found at a number of points in central Alberta including the Edmonton and Edgerton areas; there, and no doubt in other parts of Alberta besides the southern part, conditions often favor the incidence of the disease and the spread of the causal bacterium. While rape has been the principal host found affected in the field there is reason to suspect that other hosts, including several horticultural plants, may be affected.

Materials and methods

The pathogen was isolated from affected rape pods and seeds grown in pure culture on nutrient agar, potato sucrose agar, and other media, where it produced grayish white, shiny colonies. Dried exudates of the bacterium that developed on lesions were scraped off with a sterile scalpel, dispersed in sterile water, and the suspension streaked on agar plates; colonies were allowed to develop for a few days, as suggested by Dowson (2). If no exudates were present lesions were cut out with a sterile scalpel and allowed to soak overnight in a few ml of sterile water, which was then streaked on agar plates; the same procedure was followed with whole seeds suspected of being infected or infested. Single colony isolates were established on nutrient agar.

Isolates of the pathogen from two main sources have been studied. The original ones were obtained in 1973 from infected pods of Span rape (*Brassica campestris* L.) from two farmers' fields at Rockyford in southern Alberta. The isolates from the second source were obtained in 1975 from lightly frosted seed of Tower rape (*B. napus* L.)grown at Edgerton in the east central part of Alberta.

Plants of several varieties of *B. campestris* and *B. napus* were grown in the greenhouse from seed kindly supplied by Dr. Z.P. Kondra, University of Alberta. Fresh well developed green pods from these plants were then inoculated by a standardized procedure to determine the relative pathogenicity of different isolates of the pathogen and the comparative reactions of different rape varieties to them. The use of detached freshly harvested green pods was more convenient and more rapid than a similar procedure using attached pods and appeared to give similar results. Inoculum was applied to small wounds made in the pod wall with a sterile steel needle dipped in an artifical culture of the pathogen on nutrient or other agar. Two punctures for inoculation purposes,

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one toward each end of the pod, were made and a third one in the center between inoculation points was made with a sterile needle to serve as a wounded check (3). Another method of inoculation that proved effective consisted of the immersion of pods similarly wounded in a suspension of the bacterium in sterile water for several hours. Following inoculation the pods were immediately placed on the surface of sterile water agar in petri plates and incubated for 1-2 weeks at 20°C or at room temperature.

Observations and results

Isolates of the pathogen from different sources have been found to be similar in many of their characters. This constancy is quite remarkable in view of the different environments to which these isolates were exposed. But as might be expected this pathogen like many others exhibits variability in several characters; particularly important are those of pathogenicity and toxin production.

Variability in pathogenicity of rape isolates of *Pseudomonas* sp. has been observed in our studies not only when rape has been inoculated but also when other hosts, e.g. bean, have been inoculated with rape isolates. Though high pathogenicity was more commonly found in isolates from central than in those from southern Alberta many more isolates need to be studied before conclusions on distribution can be drawn. Toxin production, indicated by the formation of pale chlorotic haloes around brown pod lesions, occurred with certain isolates of *Pseudomonas*, but with others haloes were absent or poorly developed. Variability in halo production by *Pseudomonas* species has been observed in other bacterial plant diseases, e.g. of beans caused by *Pseudomonas phaseolicola* and of oats caused by *Pseudomonas coronafaciens*. In bacterial pod spot of rape we so far have observed halo production more commonly in rape inoculated with isolates of *Pseudomonas* from central Alberta (Fig. 1A) than with those from southern Alberta (Fig. 1B).

Attention was drawn in a previous article (3) to the fact that pre-disposition of the host by wounding is important in encouraging infection by the bacterium. This has been supported by further observations, especially of factors operating in the field. Two which appear worthy of special attention and which were not mentioned specifically in our previous paper are frost and insect wounding. Both probably play significant roles in the development of bacterial pod spot of rape in Alberta and no doubt account in part for the occurrence and severity of the disease.

The comparative pathogenicity of isolates of *Pseudomonas* was tested on varieties of rape using green pods of approximately the same stage of maturity. These pods were wound inoculated and incubated as described, and severity of infection was judged by the size and character of the lesions. All isolates were treated in the same way. Similar results were obtained for all varieties inoculated with the isolates tested. The isolates from southern Alberta were in general less pathogenic than those from east central Alberta as was judged by the severity of infection produced. For example, on pods of Span rape, isolates from Span pods from southern Alberta produced less severe symptoms than isolates from Torch seed from central Alberta. There was also less tendency for the southern isolates to produce haloes around their lesions than was true of isolates from east central Alberta. This probably indicates differences in toxin production. It cannot be said however from the limited observations made to date that pathogenicity is directly related to toxin production. It would seem however that varietal differences in both exist but especially in respect to pathogenicity the differences so far observed have not been particularly sharp and consistent. It appears from preliminary tests however that certain differential noncruciferous hosts may be found useful in distinguishing isolates with respect to pathogenicity.

The bacterial pod spot disease of rape was first reported in 1973 affecting fields of Span rape, a Polish variety. Soon after, it was found affecting another Polish variety, Torch, in the field. It seemed important to determine if the disease was confined to Polish varieties or if it might affect Argentine varieties as well. A preliminary test in which the Polish variety Torch and the Argentine variety Midas were inoculated with two isolates of *Pseudomonas* from southern Alberta showed the two varieties to be equally susceptible; both isolates produced definite dark lesions on pods of both varieties.

In a second test four Polish varieties and four Argentine varieties representing different types of rape grown in Alberta were inoculated with a highly pathogenic seed isolate of *Pseudomonas* from Tower rape grown in central Alberta. The results of this test (Table 1) showed that all eight varieties are susceptible and that the Argentine varieties are as susceptible as the Polish varieties. Unfortunately no marked resistance was detected in any variety.

Studies undertaken to determine the specific identity of the causal organism consisted mainly of biochemical and physiological tests. In addition a few comparisons with isolates of *Pseudomonas* affecting noncruciferous plants were made.

The bacterial isolates under study all proved to be fluorescent pseudomonads and to be oxidase negative and arginine dehydrolase negative (Table 2). Hence according to the eighth edition of Bergey's Manual (1) they belong to the "Pseudomonas syringae" group. Using methods outlined in papers by Hildebrand et al. (4), Lelliott et al. (5), Misaghi et al. (6), and Stanier et al. (8), five isolates from rape were shown to be identical. An isolate of *Pseudomonas* from lilac reacted similarly to those from rape in all tests except gelatin liquefaction, for which rape isolates were negative and the lilac isolate positive (Table 2). It should be noted that such variability

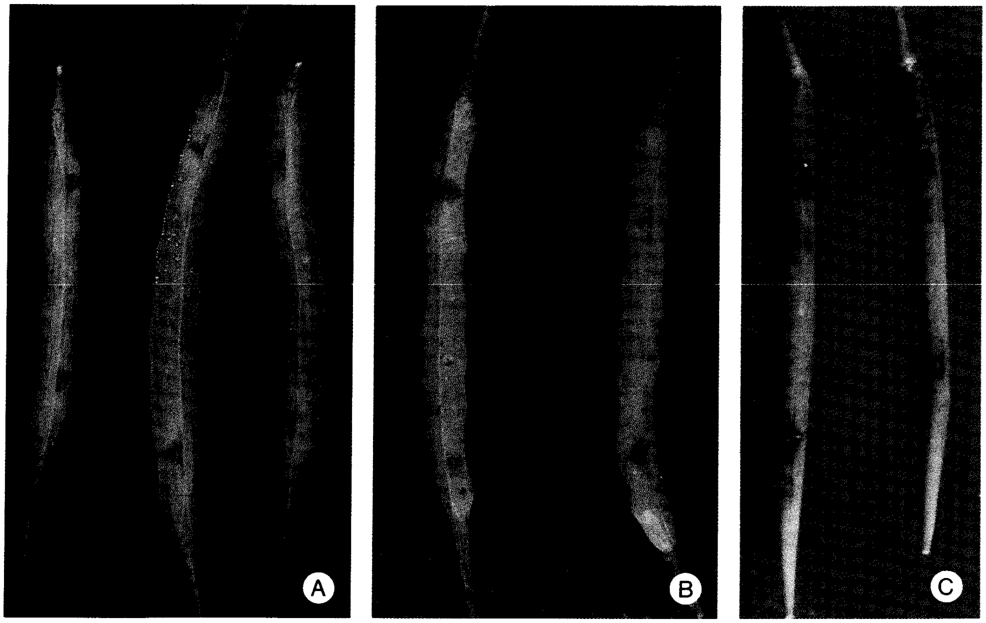

Figure 1. Detached pods of rape inoculated with isolates of *Pseudomonas syringae*. A) Lesions with chlorotic haloes on pods of Midas rape inoculated with an isolate from central Alberta. B) Lesions lacking haloes on pods of Midas rape inoculated with an isolate from southern Alberta. C) Definite dark lesions on pods of Span rape inoculated with an isolate from lilac. Pods were inoculated through a wound near each end; a wound near the center of each pod was not inoculated.

Table 1. Reactions of eight rape varieties to a seed isolate of *Pseudomonas syringae* from Tower rape

Species and variety	Severity on inoculated pods
Brassica campestris (Polish rape)	
Span	light
Torch	medium
R–500	heavy
Arlo	medium
Brassica napus (Argentine rape)	
Midas	heavy
Tower	medium
Target	medium
Nugget	medium

Table 2. Biochemical and physiological comparisons of five isolates of *Pseudomonas* from rape with an Alberta isolate of *Pseudomonas syringae* from lilac

Biochemical and physiological tests	*Pseudomonas* isolates from rape					*Pseudomonas syringae*
	OS73–9 BII	OS73–9 XXC	OS75–51 I	OS75–51 VI	OS75–51 VIII	DP74–98, Lilac
Nitrite reduction	–	–	–	–	–	–
Arginine dihydrolase	–	–	–	–	–	–
Oxidase	–	–	–	–	–	–
Fluorescent pigment	+	+	+	+	+	+
Reducing substances (sucrose)	+	+	+	+	+	+
Gelatin liquefaction	–	–	–	–	–	+
Indole production	–	–	–	–	–	–
Levan	+	+	+	+	+	+
Acid from lactose	–	–	–	–	–	–
Acid from maltose	–	–	–	–	–	–
Acid from glucose (aerobically)	+	+	+	+	+	+
Acid from glucose (anaerobically)	–	–	–	–	–	–
Pectate liquefaction	–	–	–	–	–	–
Pathogenicity on green rape pods	+	+	+	+	+	+

is commonly found among isolates of *P. syringae*. On the basis of these tests therefore the rape isolates are not distinguishable from the *P. syringae* isolate from lilac.

As noted above, an isolate from lilac that we consider to be *Pseudomonas syringae* proved pathogenic to rape, affecting green rape pods as severely as several rape isolates. It is noteworthy that van Hall originally isolated *P. syringae* from lilac in 1902 (1). Another host which has been found to harbour a *Pseudomonas* capable of attacking rape, though less severely than the lilac isolate, is the raspberry. Among leguminous plants, beans have been reported as susceptible to *P. syringae*. Patel et al. for instance have found *P. syringae* to be the cause of bacterial brown spot of beans in Wisconsin (7). The symptoms of this disease are in several respects similar to those of the disease of rape which we have called bacterial pod spot. Moreover certain of our rape isolates have infected green bean pods producing definite brown lesions on them.

It is concluded from the results reported here that strains of *P. syringae* can cause bacterial pod spot of rape and that several noncruciferous plants may serve as additional hosts. Though the five rape isolates studied here appear identical, it is recognized that considerable variability in the causal agent of this disease exists and that further work may uncover other strains of the pathogen.

Acknowledgments
For photographic and other technical assistance gratitude is extended to Mr. Marion Herbut.

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Blister smut in Kentucky bluegrass at Agassiz, B.C.[1]

S.G. Fushtey[2] *and D.K. Taylor*[3]

Blister smut (*Entyloma dactylidis*) was found in abundance in some cultivars of Kentucky bluegrass (*Poa pratensis*) in turfgrass plots at Agassiz, B.C., in February 1977. No smut was found on the cultivars Merion, Nugget, and Sydsport and only a trace on Fylking, indicating the existence of substantial cultivar resistance.

Can. Plant Dis. Surv. 57: 29-30. 1977

En février 1977, on a constaté le présence d'une grave infestation de charbon des feuilles (*Entyloma dactylidis*) en parcelles de gazon composées de quelques cultivars de pâturin du Kentucky (*Poa pratensis*), à Agassiz (Colombie-Britannique). Les cultivars Merion, Nugget, et Sydsport étaient exempts de charbon et Fylking ne manifestait qu'une infestation négligeable, ce qui prouve le haut niveau de résistance de ces cultivars.

Blister smut [*Entyloma dactylidis* (Pass.) Cif.] in Kentucky bluegrass (*Poa pratensis* L.) was found in turfgrass plots at the Agriculture Canada Research Station at Agassiz, B.C., in February 1977, immediately after Gould reported an outbreak of this disease at the Western Washington Research and Extension Center in Puyallup, Washington (personal communication, C.J. Gould, 1977). As far as can be determined this is the first report of this disease occurring on turfgrass in Canada.

The disease was positively identified by comparing symptoms and microscopic features with descriptions published by Fischer (1,2).

Blister smut sori were found in leaves only. They were not found in leaf sheaths as described by Fischer (2). Sori were roughly circular to oval, with the surface raised to give a blister-like appearance but with the epidermis intact; sori were greenish black on green leaves to grayish- or brownish-black on leaves that were severely chlorotic. Some sori had lighter-colored centers. Most sori occupied up to one half the width of the leaf (about 1 mm diam) and occurred in two rows, one on either side of the midrib. Other sori were smaller and were more or less randomly distributed in the leaf.

The disease is apparently peculiar to mild winters. The 1976-77 winter at Agassiz was one of the mildest on record. Fischer (1) reported the disease occurring in epidemic form on his home lawn in Pullman, Washington, on January 1 and stated that the winter weather in the Pacific Northwest so far that season had been unusually mild.

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An interesting feature of the Agassiz occurrence is that the disease was not found in fescue and bentgrass plots adjacent to the bluegrass plots and that the disease was severe in some of the cultivars but absent in others. Disease severity ratings were made on cultivar test plots mowed at 1.9 and 3.8 cm. The results are given in Table 1. All cultivars in the test were rated but only the named ones are reported here.

Table 1. Incidence of blister smut in bluegrass cultivars, Agassiz, B.C., 24 February 1977

Cultivar	Disease rating* at two mowing heights (cm) 1.9	3.8
Baron	2	3
Barzan	0	0
Fylking	1	1
Galaxy	3	3
Majestic	0	0
Merion	0	0
Nugget	0	0
Onar	0	0
Sydsport	0	0
Victa	3	3

* 0 = No disease found
1 = Trace, very few spots on very few leaves
2 = Moderate, spots abundant but damage slight
3 = Severe, leaves severely chlorotic due to abundance of blister smut

The plots that rated severe could be picked out at a distance due to a grayish-brown cast as compared to the normal green color of the healthy grass. When the plots were examined again in early April no evidence of the disease could be found. Apparently diseased leaves had broken down and new infections did not occur on new growth.

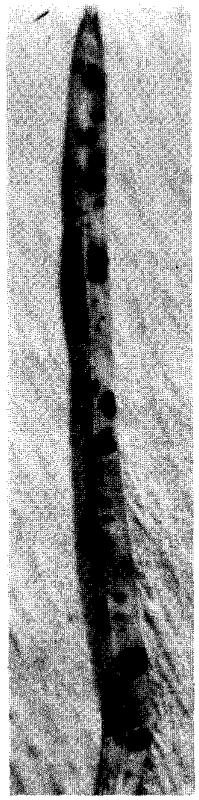

Figure 1. Blister smut sori on leaf of Kentucky bluegrass.

The disease seems to have the potential to do appreciable damage because leaves bearing numerous sori in an advanced stage of development were virtually dead. However, the period of disease activity seems to be limited to midwinter when the grass is dormant or nearly so and the damage is quickly repaired when active growth is resumed. Such a disease is not likely to present a major problem but no information on the biology and control of this disease could be found in the literature. The fact that no disease was found in six cultivars while three cultivars growing in adjacent plots were severely affected (Table 1) indicates the presence of a high degree of cultivar resistance. This information is significant since the popular cultivars Merion, Nugget, and Sydsport are among those which showed this resistance. Possibly the use of such cultivars will be enough to keep this disease from becoming a problem.

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Studies on the biology and control of Ascochyta fabae on faba bean[1]

V.R. Wallen and D.A. Galway

The optimum temperature for radial growth of *Ascochyta fabae* mycelium on agar and for fungal infection of Erfordia faba bean (*Vicia faba*) was 20°C. *A. fabae* did not survive over winter in field plots in which infected plants had been p·oughed down the previous year. Less than 3% of internally infected faba bean seed produced infected seedlings in greenhouse and field trials. In the field, seed treatment trials with captan, benomyl, and thiram did not significantly affect the amount of seedling or adult plant infection. Infection levels of 4% to 10% in field plots caused no significant loss in yield.

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La température optimale pour la croissance radiale de *Ascochyta fabae* sur gélose et à l'infection fongique du cultivar de féverole Erfordia (*Vicia faba*) était de 20°C. *A. fabae* n'a pu survivre à l'hiver dans les parcelles dont les plants infectés avaient été enfouis d'année précédente. Moins de 3% des semences de féverole infectées (infection par la semence) ont produit des plantules infectées lors d'essais en serre et en plein champ. Des essais de traitement des semences au captane, bénomyl et thirame n'ont pas influé significativement sur le taux d'infection des plantules ou des plants adultes en plein champ. Des taux de 4 à 10% en parcelles n'ont causé aucune baisse significative de rendement.

Two seed-borne diseases, chocolate spot caused by *Botrytis fabae* Sard. and leaf and pod spot caused by *Ascochyta fabae* Speg., were reported in Nova Scotia in 1970 (2). *A. fabae* caused higher incidences of seed infection and it was suggested that this organism might be a greater threat to faba bean production than the chocolate spot disease. In 1972, the acreage of faba bean increased dramatically as a new crop in Canada, and it was apparent that diseases known to cause damage in Europe should be investigated for their potential destructiveness in Canada.

The present work was initiated because of concern about the effects of leaf and pod spot on faba bean, since large quantities of seed were being imported from Europe for planting in Canada. A number of experiments were conducted: temperature effects on growth and infectivity of *A. fabae* and of the closely related fungus *Ascochyta pisi*, the cause of leaf and pod spot of pea (*Pisum sativum* L.); infection experiments with *A. fabae* and three *Ascochyta* pathogens of pea; survival of *A. fabae* in soil; fungicide seed treatments to control the seed-borne phase of the faba bean disease; and the relationship of seed infection to subsequent infection in the crop and to yield.

Methods and materials

Isolates of *A. fabae* were obtained from diseased seed samples submitted to Plant Products Division, Agriculture Canada, for examination. Isolates of *Ascochyta pisi* Lib., *Ascochyta pinodes* L.K. Jones, and *Ascochyta pinodella* L.K. Jones (*Phoma medicaginis* var. *pinodella* (L.K. Jones)Boerema) were from stock collections maintained at the Ottawa Research Station.

The effect of temperature on radial growth of mycelium of *A. fabae* and *A. pisi* were studied using agar discs (6 mm) from petri dish cultures of the fungi placed on the center of pea, faba bean, and Difco malt agars in 90 mm petri dishes. The pea and faba bean media were prepared as follows: 360 g of seed in 2.2 litres of water were autoclaved for 2 h at 121°C; and the resulting mash was strained through two layers of cheesecloth, the volume made up to 3 liters and 45 g of Difco agar added. The medium was dispensed into 1 litre flasks and sterilized 20 min at 121°C. The colonies were incubated in darkness at constant temperatures (10°C - 35° ± 1°C, 5°intervals) with 5 replicates per temperature. The radial growth (mm) was recorded daily for 14 days.

Three methods of inoculating 16-day-old Erfordia faba bean plants with an aqueous spore suspension (0.5 X 10^6 spores/ml) of *A. fabae* containing two drops of Tween 80 per 100 ml were compared at temperatures of 15°, 20°, and 25°C in growth chambers using a 16-h day and a relative humidity of 95-100%. Spore suspension was sprayed to run-off on 1) unwounded leaves, 2) leaves abraded with no. 600 emery paper, and 3) plants wounded by the addition of no. 600 (medium sharp) silicon carbide to the spore suspension. Disease severity on leaves and stems was determined 14 days after inoculation using a method described previously (4) to rate disease severity of *A. pisi* on peas. Similarly the infectivity of *A. fabae* on Improved Laxton's Progress peas and of *A. pinodella, A. pinodes*, and *A.*

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[1] *Contribution No. 510, Ottawa Research Station, Agriculture Canada, Ottawa, Ontario K1A 0C6*

pisi on Erfordia faba bean was studied with 11-day-old seedlings.

Soil samples from field plots that had been planted to infected seed in 1974 and 1975 were assayed to determine if the fungus could overwinter at Ottawa. These plots contained debris from infected plants that had been ploughed into the soil. Composite soil samples were taken to a depth of 5 cm from each of 16 plots in the fall of 1974 and in the spring and fall of 1975. The samples were heated in a forced-air oven at 50° ± 1°C for 12 h. Surviving propagules were isolated from serial dilutions of the soil samples on rose bengal agar as described previously (5).

For seed treatment studies Erfordia seed containing 13% *A. fabae* was used in greenhouse and growth chamber (20°C) tests with four fungicides, benomyl (50%), captan (75%), thiram (75%), and carbathiin (75%) at rates of 4.2 g and 6.25 g of fungicide formulation per kg of seed. Four replicates each of 100 seeds were used in two greenhouse trials and in one growth chamber trial. Based on results from those tests, field trials were conducted using the 4.2 g rate only of benomyl, captan, and thiram. Four replicates of each treatment and an untreated control, each containing seven rows 17.5 cm apart and 5 m long, were sown in duplicate blocks in each of the years 1974 and 1975. In all experiments emergence counts were taken and some seedlings were removed from the soil and examined for symptoms of *A. fabae* infection 27-30 days after seeding. Sections from infected plants were plated on malt agar to verify the identity of the causal organism. Plants from the center row of the unsampled block were assessed for disease symptoms at 14-day intervals. At maturity the center row of each treatment in the unsampled block was harvested, weighed, and (100 X 4) seeds plated on malt agar in petri dishes to determine the amount of seed infection.

Results and discussion

Temperature

The optimum temperature for the growth of both *A. fabae* and *A. pisi* was 20°C on all media tested over the 14-day period. Radial growth was parallel on both faba bean agar (Fig. 1A) and pea agar (Fig. 1B), although *A. pisi* outgrew *A. fabae* slightly at all temperatures; however, colony diameters after 14 days were 5-15 mm less on faba bean agar than on pea agar. Radial growth of the two organisms on malt agar was similar at all temperatures for both organisms (Fig. 1C and D). It was found that *A. fabae* had the greatest radial growth after 14 days on malt agar, and hence malt agar was used as the culture medium throughout all subsequent experiments.

Infectivity

In preliminary tests it was found that disease symptoms were produced at temperatures of 15°, 20°and 25°C, with the optimum at 20°C. At 20°C well defined fruiting lesions were produced on leaves and stems 14 days after inoculation (Fig. 2 A, B). As there was little difference in efficiency among the three methods of inoculation in most tests, all subsequent tests used spore suspension sprayed directly onto unwounded leaves.

Cross-infection tests were negative; isolates of *A. pisi* from pea did not infect faba bean and *A. fabae* from faba bean did not infect pea. In England Beaumont (1) was successful in 2 of 25 attempts to inoculate *A. fabae* onto pea and in 2 of 13 attempts to inoculate *A. pisi* onto faba bean; he reported that sporulation occurred rarely but that typical *A. fabae* cultures were isolated from lesions on pea plants.

Survival in soil

A. fabae was not detected in any of 16 composite soil samples collected in the fall of 1974, after harvest or in the spring and fall of 1975. The inability of the fungus to survive even a few months in field soil is important, and indicates that in this area there is little danger of soil contamination from infected seed. Like *A. pisi, A. fabae* is probably distributed chiefly by infected seed.

Seed treatment

Although 13% of the seed used in these tests was infected, only 1-3% of the seedlings grown from that seed in the greenhouse or growth chambers became infected. This transmission rate was lower than the 4-8% transmission reported by Hewett (3). In one greenhouse trial, only 3 of 400 seedlings were infected in the control. One infected seedling was present in the carbathiin treatment and no infected seedlings were found in the captan, benomyl, or thiram treatments. In the second greenhouse trial, 1.75% of the seedlings were infected in the carbathiin and 0.5% in the thiram treatments, and no infected seedlings were found in the benomyl, captan, and control treatments. In growth chambers, the control contained 1.5% infected seedlings and all treatments had some infection but less than 0.5%.

In the 1974 field trial, initial infection levels in seedlings ranged from 0.4% with benomyl to 2.5% in the control (Fig. 3A). The highest plant infection level occurred in the captan treatment where 5% of the plants showed symptoms by August 1. By August 14 diseases plants were difficult to identify because of senescence accompanied by defoliation, and at harvest on September 16 no infected plants could be identified.

In the 1975 field trial (Fig. 3B), the initial infection level in seedlings was highest in the control at 1.7%. Once again infection levels reached a peak by the end of July (4-10%), although the plots had been seeded 21 days earlier than in 1974. Because of senescence and early defoliation, identifiable infection fell to zero on August 14. No significant differences occurred in the total yield or in 1000 kernel weight among treatments either year.

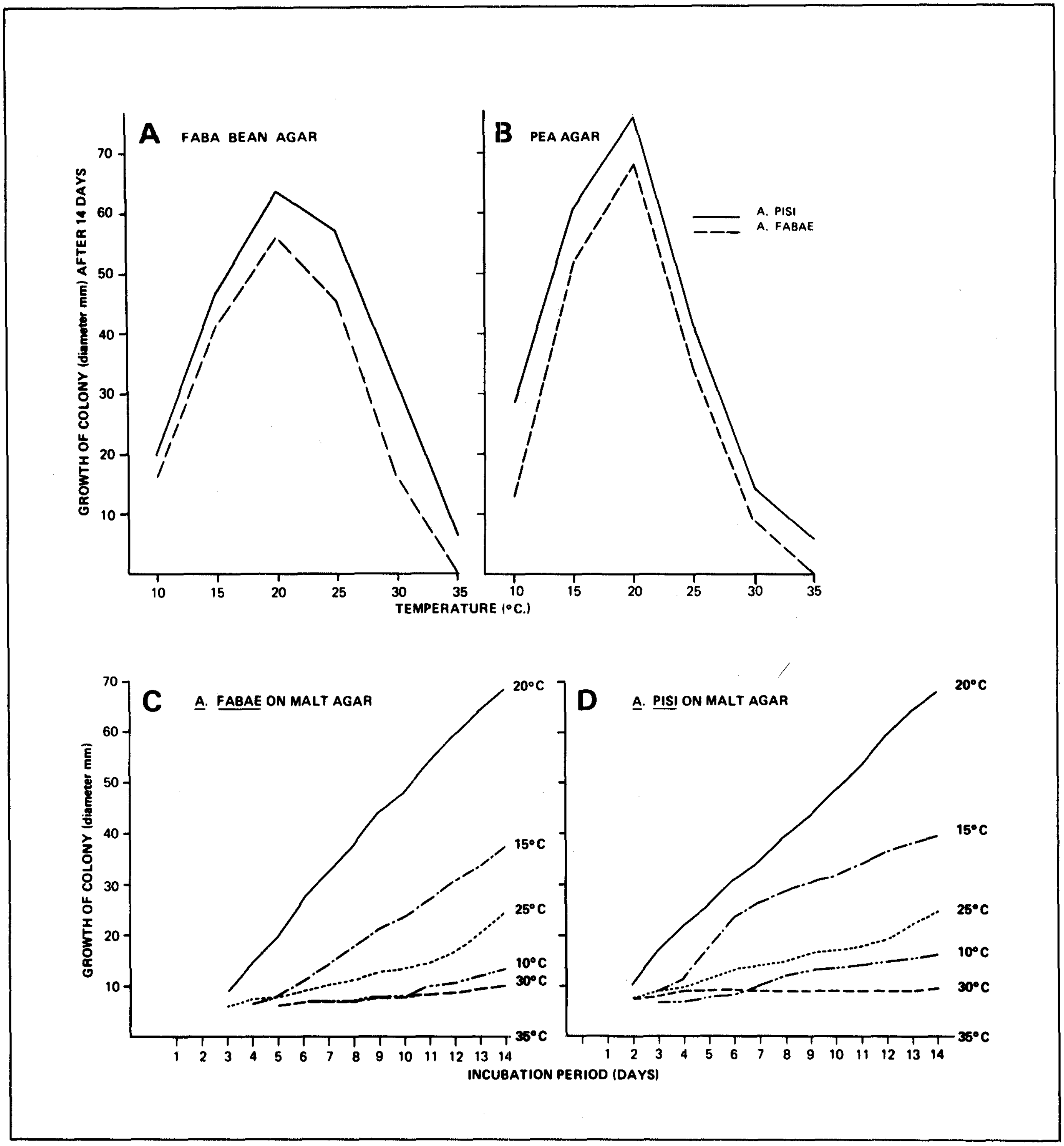

Figure 1. Radial growth of *Ascochyta fabae* and *A. pisi* colonies after 14 days at various temperatures on (A) faba bean agar and (B) pea agar; and effect of temperature on the radial growth of (C) *A. fabae* and (D) *A. pisi* on malt agar.

In 1974 *A. fabae* was isolated from 0.25% of the seed from the control and from 0.5% of the seed from the thiram-treated plots. No cultures of *A. fabae* were isolated from the seed of the captan- or benomyl-treated plots. In 1975, no cultures of *A. fabae* were isolated from the seed from any of the plots.

From these results it is apparent that for this disease to reach epiphytotic proportions, more favorable conditions would have to be present than occurred at Ottawa in 1974 and 1975. Despite an original seed-borne infection level of 13%, less than 3% of the seedlings became infected in the field, and the seed progeny from

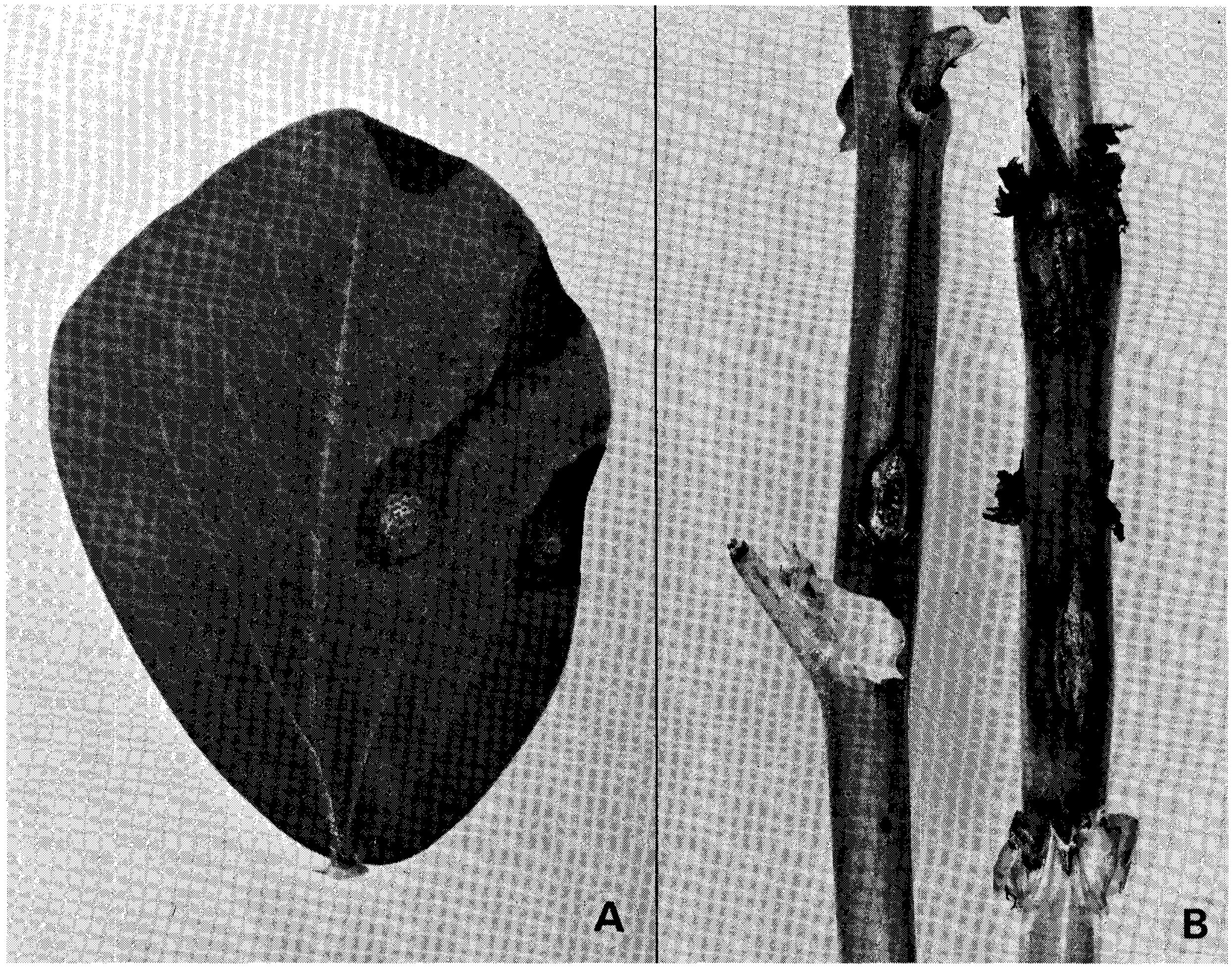

Figure 2. Lesions with pycnidia of *Ascochyta fabae* on inoculated Erfordia faba bean, A) leaf, B) stems.

the 1974 and 1975 trials contained considerably less than 1% diseased seeds. Surveys conducted from 1972 to 1975 on faba bean seed grown at various locations across Canada showed that of 471 samples examined only 11 (2.3%) contained more than 5% infected seeds (unpublished results). This low rate of seed infection is not consistent with an agressive disease pattern. However in England a severe outbreak of the disease coincided with an increased acreage of faba bean (3). There it was found that above-average rainfall in May and/or June was necessary for successful infection of the developing seedlings and it was usual for only 4-8% of the infected seeds in seed lots to produce diseased seedlings when sown in the field. The normal summer conditions in Ontario and the western provinces of Canada are not conducive to the buildup of this disease. None of the fungicide treatments gave complete control of seed borne infection.

Acknowledgment
The authors thank A.B. Ednie, Plant Products Division, Production and Marketing Branch, Agriculture Canada, for providing the seed samples of Erfordia faba bean.

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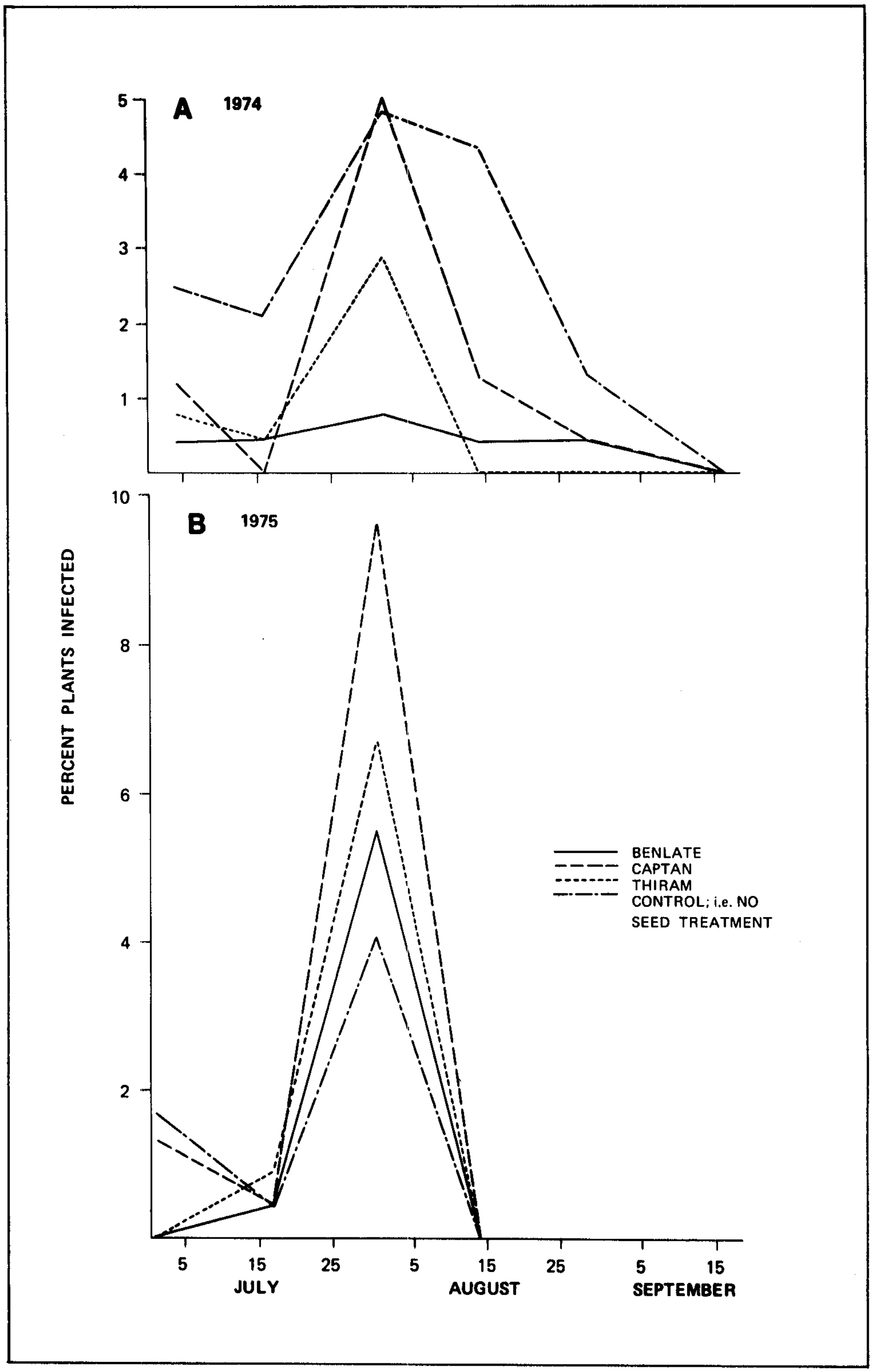

Figure 3. Effect of seed treatment on the control of seed-borne *A. fabae* and the progression of disease from uncontrolled seed-borne infection.

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