Canadian Plant Disease Survey

Inventaire des maladies des plantes au Canada

Vol. 59, No. 2, 1979

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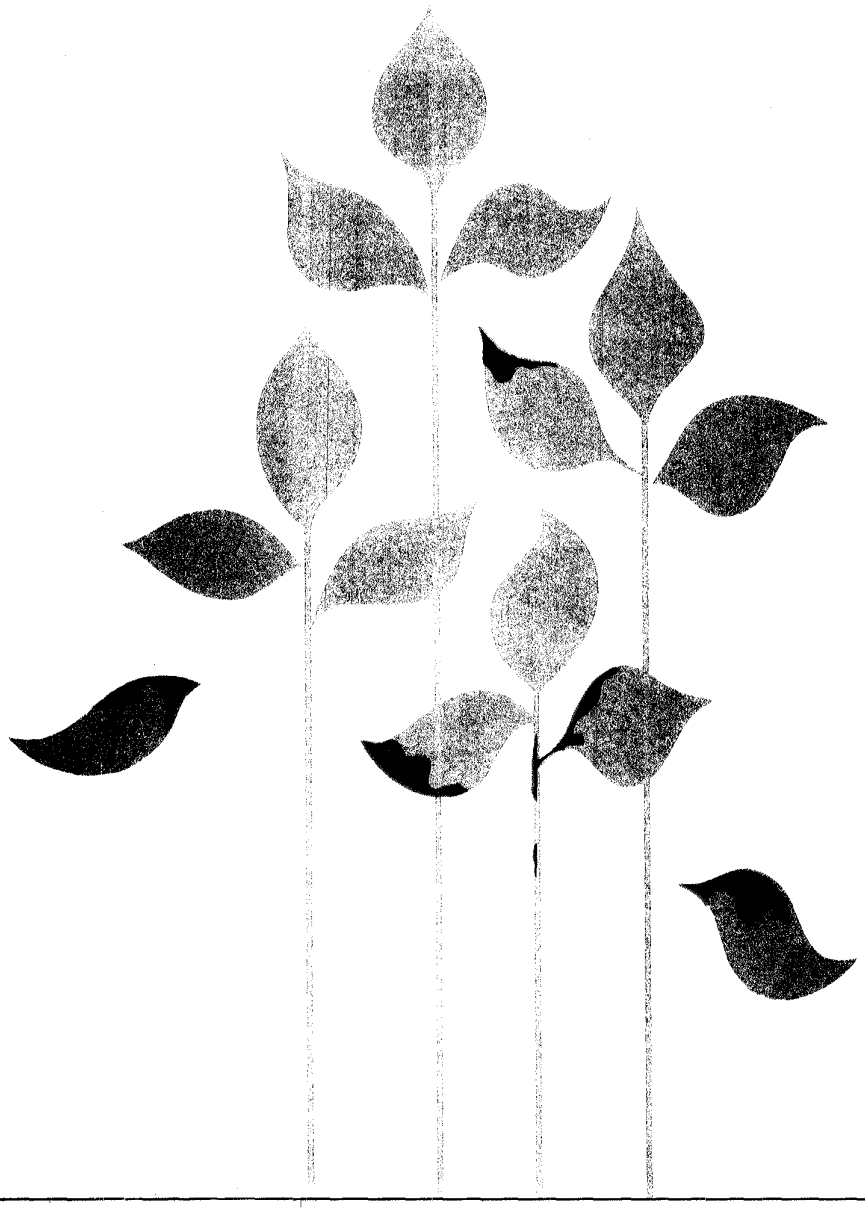

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Contents/Contenu

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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Barley leaf spots in Prince Edward Island, 1978[1]

K. S. Clough and K. R. Sanderson

In Prince Edward Island net blotch (*Pyrenophora teres*) was found in 100% of the fields of barley surveyed in 1978. Spot blotch (*Bipolaris sorokiniana*) was found in 71% of the fields. Net blotch was more severe than spot blotch in most fields. Scald (*Rhyncosporium secalis*) and a *Selenophoma* leaf spot were also recorded. Non-parasitic brown spot was found in 13% of the fields.

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À l'Île du Prince Edouard, la rayure réticulée (*Pyrenophora teres*) a été trouvée dans 100% des champs d'orge, échantillonnées en 1978. La tache helminthosporienne (*Bipolaris sorokiniana*) a été trouvée dans 71% des champs. La rayure réticulée était plus grave que la tache helminthosporienne dans la plupart des champs. La tache pâle (*Rhyncosporium secalis*) et la tache ocellée (*Selenophoma donacis* var. *stomaticola*) ont aussi été enregistrée. La moucheture brune a été trouvée dans 13% des champs.

Two principal parasitic fungi are associated with leaf spot symtoms of barley in Prince Edward Island. They are *Pyrenophora teres* (Died.) Drechs. causing net blotch (2) and *Bipolaris sorokiniana* Sacc. in Sorok. (Shoem) causing spot blotch (4). The severity of infection by these fungi varies from year to year. There is evidence that disease severity is related to factors such as seed source and treatment (5, 8), seeding date (8), crop management practices, and weather (1, 3), but no clear picture of their relative importance was evident from these studies. Casual observations in 1976 and 1977 suggested that net blotch was more prevalent and more severe than spot blotch. Therefore in 1978 this survey was carried out to establish the frequency and severity of these two diseases in Prince Edward Island barley fields. Observations on the presence or absence of other foliar symptoms in barley were also made.

Methods

Forty-five barley fields were selected in Prince Edward Island (Fig. 3). The following information was obtained: a) cultivar, date, and rate of seeding; b) fertilizer and herbicide application; c) crops in field for up to 5 years preceding 1978.

The fields were surveyed in late July when plants were between growth stages 70 and 76 (10). First and second leaves were examined on plants along a diagonal traverse starting 10 m from the edge of the field. Disease severity ratings were made according to the criteria shown in Table 1. Since the symptoms of spot and net blotch are sometimes difficult to separate, leaves from each of the fields were collected for subsequent reference and symptom confirmation.

To confirm the causal agent of leaf spots, leaves were incubated in moisture chambers at 16°C and 24°C. Sporulation of *P. teres* is favoured at the lower temperature while *B. sorokiniana* sporulates at higher temperatures. Results of these tests were used to confirm field observations.

Table 1. Number of fields in each disease severity category for spot blotch and net blotch in 1978

Category	Explanation	Spot blotch	Net blotch
Absent	no disease	13	0
Trace	when number of lesions averages less than one per leaf	11	2
Slight	lesions cover up to 5% of leaf area	16	14
Moderate	lesions cover up to 10% of leaf area	5	23
Severe	lesions cover more than 10% leaf area	0	6

Results and discussion

The symptoms of spot blotch and net blotch are shown in Figures 1 and 2. Although typical symptoms of both diseases appear quite distinct there are often similarities (7, 9) which may confuse the assessor. In this survey, laboratory tests indicated that all net blotch symptoms sporulated to produce conidia typical of the imperfect stage of *P. teres*. Most of the spot blotch symptoms produced conidia of *B. sorokiniana*. However few spot blotch symptoms produced only *P. teres* conidia. Field assessments were modified according to these results. None of the 45 fields surveyed were free from leaf spot symptoms. Net blotch symptoms were present in all fields (Table 1, Fig. 3). Twenty-three fields (51%) had moderate symptoms and 6 fields (13%) were severely infected. There were no fields in the severe category for spot blotch and only 5 fields (11%) in the moderate category. The remaining 40 fields had few or no spot blotch symptoms (Table 1).

Net blotch was therefore more frequent in occurrence and more severe than spot blotch in 1978. This confirms casual observations made in 1976 and 1977. Aerial spore populations of *P. teres* were 10 to 20 times greater than those of *B. sorokiniana* in 1977 and 1978.

[1] *Contribution No. 411. Charlottetown Research Station.*

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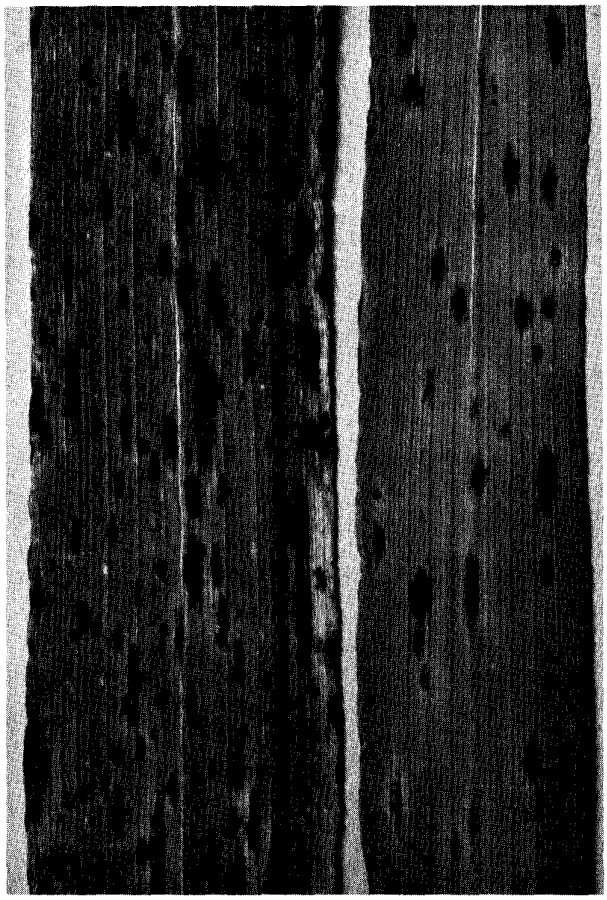

Fig. 1. Symptoms of spot blotch (*Bipolaris sorokiniana*) on Loyola barley.

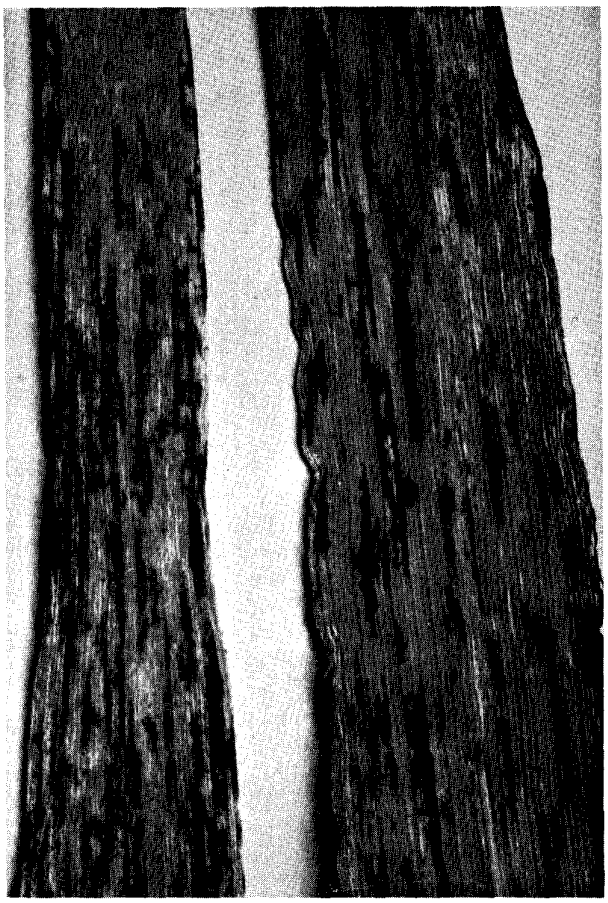

Fig. 2. Symptoms of net blotch (*Pyrenophora teres*) on Loyola barley.

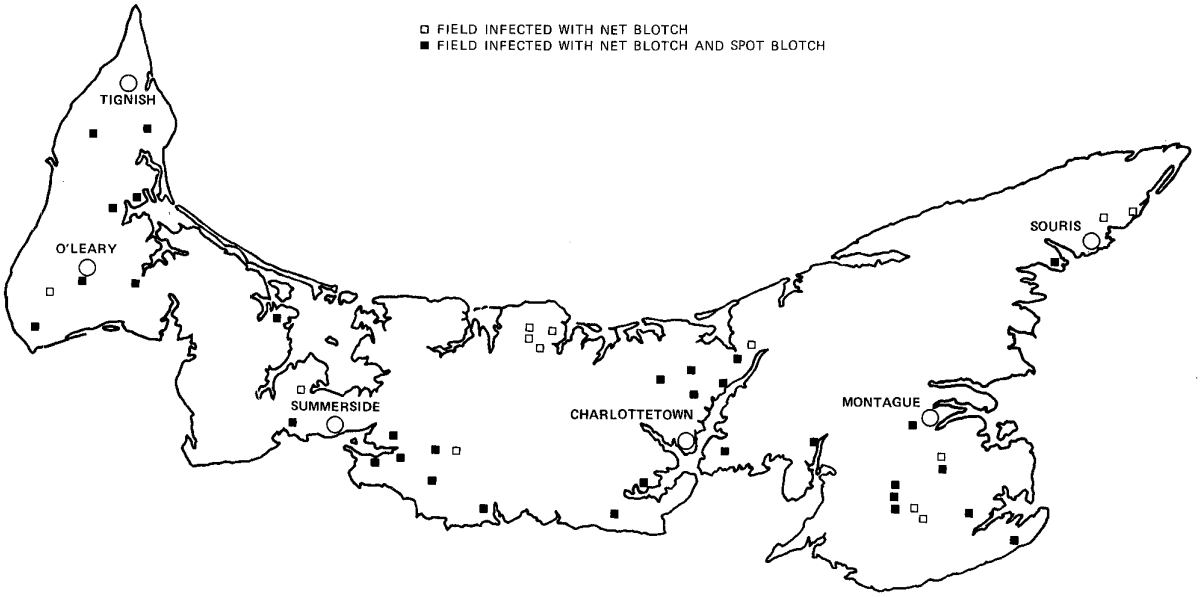

Fig. 3. Map of Prince Edward Island showing fields surveyed and diseases present.

There was no clear relationship between disease and cultivar or disease and management practices. Nine of the fields surveyed had been in barley for two years. Disease was not greater in these fields than in fields which were in potatoes, forage, or another cereal the previous year.

Other diseases noted were scald caused by *Rhynocosporium secalis* (Oudem) J. J. Davis in 32 (71%) fields, *Selenophoma donacis*, var. *stomaticola* (Bäuml.) Sprague, A. G. Johnson (6) in 3 (7%) fields and non-parasitic brown spot in 5 (13%) fields.

These results indicated that a variety of leaf spotting fungi are responsible for symptom production and in Prince Edward Island barley fields. Net blotch appears to be the most significant disease, however, more surveys are needed to confirm this.

Literature cited

1. Clough, K. S. 1978. Unpublished data.
2. Connors, I. L. 1936. Can. Pl. Dis. Survey Ann. Rep., p. 20.
3. Couture, L. and J. C. Sutton. 1978. Relation of weather variables and host factors to incidence of airborne spores of *Bipolaris sorokiniana*. Can. J. Bot. 56:
4. Creelman, D. W. 1958. Can. Pl. Dis. Survey Ann. Rep., p. 5.
5. Nass, H. G., H. W. Johnston, J. A. MacLeod, and J. D. E. Sterling. 1974. Effects of seedling date, seed treatment, and foliar sprays on yield and other agronomic characters of wheat, oats, and barley. Can. J. Plant Sci. 55:41-47.
6. Sampson, G. and K.S. Clough. *Selenophoma* leaf spot on cereals in the Maritimes. (in preparation).
7. Smedegard-Petersen, V. 1976. Pathogenesis and genetics of net spot blotch and leaf stripe of barley caused by *Pyrenophora teres* and *Pyrenophora graminea*. Copenhagen 1976. 176 pp.
8. Sterling, J. D. E., H. W. Johnston, and D. C. Munro. 1976. Effects of seed source and seed treatment on barley emergence, yield, and kernel weight. Can. J. Plant Sci. 57:251-256.
9. Tekauz, A. and J. T. Mills. 1976. New types of virulence in *Pyrenophora teres* in Canada. Can. J. Plant Sci. 54:731-734.
10. Zadoks, J. C., T. T. Chang, and C. F. Konzak. 1974. A decimal code for the growth stages of cereals. Weed Research 14:415-421.

New or noteworthy plant diseases in coastal British Columbia 1975 to 1977

Z.K. Punja[1] *and D.J. Ormrod*[2]

During the summer months of 1975 to 1977 inclusive, over 2000 specimens were examined at the B.C. Ministry of Agriculture Plant Clinic at Surrey, B.C. This paper lists and illustrates a number of new or noteworthy diseases encountered on a wide range of host plants.

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Au cours des étés 1975 à 1977 inclusivement, au-delà de 2 000 spécimens végétaux ont été examinés au Plant Clinic de Surrey (Colombie-Britannique) tenue sous l'égide du ministère provincial de l'Agriculture. Le présent rapport énumère et illustre une série de maladies nouvelles ou importantes décelées chez une grande variété de plantes hôtes.

The British Columbia Ministry of Agriculture provides a plant diagnostic service for the general public at Surrey, Kelowna, and Victoria, B.C. The Surrey Plant Clinic receives the largest number of submissions and is now staffed year round. The senior author operated the Surrey Plant Clinic during the months of May, June, July and August in each of the 3 years 1975 to 1977. During those 3 summers approximately 2000 specimens were received and examined. This paper records some of the previously unrecorded or more unusual diseases found during diagnosis and also illustrates in 24 photographs some of the more striking symptoms observed.

A number of specimens submitted to the Biosystematics Research Institute have been retained in the National Mycological Herbarium. These are identified with DAOM (Department of Agriculture, Ottawa, Mycology) accession numbers in the text.

DISEASES

***Agropyron repens* (L.) Beauv. - couchgrass**
***Phyllachora graminis* (Pers. ex. Fr.) Fckl., tar spot. Vancouver, B.C. DAOM 162792. Fig. 1.**
This pathogen has been reported numerous times on couchgrass and other *Agropyron* spp. across Canada. There is a previous collection from British Columbia in the National Mycological Herbarium from the year 1962 by R.J. Bandoni 2691 (DAOM 91111).

***Cornus canadensis* L. - dwarf cornel**
***Puccinia porphyrogenita* Curt., rust. Surrey, B.C. DAOM 164610, 162732. Fig. 2.**
Stage III has been reported numerous times on this host in Canada (1). It is recorded here for purposes of symptom illustration.

***Cornus nuttalli* Audub. - flowering dogwood**
***Septoria cornicola* Desm, leaf spot. Surrey, B.C. DAOM 162791. Fig. 3.**
This disease was seen only once out of numerous cultivated dogwood specimens submitted. The pathogen is reported on other *Cornus* spp. throughout Canada but this is the first published report for British Columbia (1). In DAOM there are 3 additional B.C. collections on *C. pubescens*: 5953 Cowichan Lake Wm. Newton 23 July 1939; 118596 W. Saanich W. Jones 19 Aug. 1948 SBC 1144; 39891 N. Saanich W. Jones 17 Aug. 1949; and one on *Cornus* sp.: 155668 Sidney, Vancouver Island, Macoun 6, 11 Sept. 1916.

***Cucumis sativus* L. - cucumber**
***Mycosphaerella citrullina* (C.O. Sm.) Gross (*M. melonis* (Pass.) Chiu and Walker), gummy stem blight. Burnaby, B.C., Surrey, B.C.**
Serious losses due to fruit rot in greenhouse cucumbers led to the identification of this disease in several commercial greenhouses in the Lower Fraser Valley in 1975. Leaf and stem infections were also extensive. The use of maneb brought the disease under control. There is one additional B.C. collection of *Mycosphaerella citrulina* in DAOM on *Cucurbita pepo* vegetable marrow (greenhouse), 118313 Saanichton I.M. 12 Dec. 1941.

***Cytisus scoparius* (L.) Lk. - Scotch broom**
***Alternaria alternata* (Fr.) Keissler, foliage blight. Langley, B.C. Fig. 4.**
In the spring of 1977, about 10% of the plants in an unheated polyethylene propagation house containing 9000, 1-gallon size, plants were destroyed by a foliar blight. The gross symptoms resembled a typical *Botrytis* disease but examination of numerous plants revealed only *Alternaria* spp. and *Stemphylium* spp. The disease was brought under control by improving ventilation and applying chlorothalonil.

There are no known published reports of *Alternaria* or *Stemphylium* on *Cytisus* in North America (1, 2).

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***Daucus carota* L. - carrot**
***Thielaviopsis basicola* (Berkeley & Broome) Ferraris, black root rot. Surrey, B.C. Fig. 5.**
The early harvested carrots from 4 separate farms in the Cloverdale area encountered problems when superficial blackening developed in the market place after carrots had been washed and packaged in perforated polyethylene bags. Examination showed that the discoloration was due to extensive fruiting of the fungus. The problem did not persist into the late crop which is harvested under cooler conditions. This is the first known natural infection of carrot by this fungus in British Columbia.

***Fraxinus velutina* Torr. var. *glabra* Rehd. - Modesto ash**
***Discula quercina* (West.) Arx. (*Gloeosporium aridum* Ell. & Holw.), anthracnose. Vancouver, B.C. DAOM 162789. Fig. 6.**
This disease appears to be well established in all Vancouver city street plantings of Modesto Ash. The extent of early summer leaf infection and shedding is proportional to the rainfall received in April, May and June. This is a new report for British Columbia.

***Ilex aquifoluim* L. - English holly**
***Phytophthora ilicis* Buddenhagen & Young, leaf and twig blight. Delta, B.C.; Duncan, B.C. Fig. 7, 8.**
Phytophthora is a perennial problem in many holly plantations. It causes leaf, twig, and fruit infections and may cause post-harvest defoliation. Control involves pruning of lower branches, fungicide applications to the trees and post-harvest dips of 30 ppm copper ion (D.L. Coyier, personal communication).

***Juniperus* spp. - junipers**
***Gymnosporangium fuscum* DC (G. sabinae Dicks ex. Wint.), pear trellis rust. Fig. 9, 10.**
An intensive pear trellis rust survey and eradication program has seen over 1000 infected junipers removed in the Fraser Valley since 1975. Figure 9 illustrates the contrast between the appearance of dry telia on juniper and the same telia 15 minutes after being wetted. Figure 10 illustrates rarely observed pear fruit infections.

***Lycopersicum esculentum* Mill. - tomato**
***Stemphylium botryosum* Wallr. and *Alternaria* spp., leafspot. Fig. 11.**
An extensive greenhouse tomato leafspot problem in the Fraser Valley in the early summer of 1976 led to a survey which showed the disease to be present in 19 of 32 houses. Only *S. botryosum* was isolated from some houses while others yielded *A. alternata* or *A. solani*. It appeared that the fungi were only weakly pathogenic. Factors which appeared to predispose leaves to infection were high humidity, temperatures of 25–27°C, phosphorus deficiency, and approaching senescence.

***Mahonia aquifolium* (Pursh.) Nutt. - mahonia**
***Cumminsiella mirabilissima* (Pk.) Nannf. (*C. sanquinea*) Arth., rust. DAOM 164613-617; 162731. Fig. 13, 14, 15.**
Rust is very common in *Mahonia* in British Columbia. Both *C. mirabilissima* and *Puccinia koeleriae* Arth. have been identified in the past. A survey of nurseries was carried out in 1977 to determine the distribution and identity of the rust now present in the Fraser Valley. Of 38 nurseries carrying the shrubs, 33 had infected stock. In all cases *C. mirabilissima* was the fungus present. No evidence of *Puccinia* spp. was found.

***Malus pumila* Mill. - apple and *Pyrus communis* L. - pear**
***Nectria galligena* Bres., European canker DAOM 164806. Fig. 17, 18.**
European canker has long been known in British Columbia. Previous B.C. collections on *Malus* in DAOM are: 118307 Vancouver W. Jones June 1935 SBC 174; 118306 Alberni W. Jones 27 Feb. 1939 SBC 408. Positive diagnoses were carried out on 20 apple branch specimens and 5 pear branch specimens from various parts of the Fraser Valley. This is presently the most serious canker disease on these hosts in the coastal area.

***Oemleria (Osmaronia) cerasiformis* (Torr. & A. Gray ex Hook & Arn.) Landon. - Osoberry, Indian plum**
***Cylindrosporium nuttallii* (Harkn.) Dearn., leafspot Surrey, B.C. DAOM 165273. Fig. 19, 20.**
This disease appears to be very common on this host where it is grown on the Pacific coast of North America (1, 2). It is included here as the symptoms are unique and it is doubtful that photographs have been published previously. Additional records on *O. cerasiformis* from B.C. in DAOM are: Vancouver Island. J. Macoun 933 18 July, 1916; 3960 Sannichton, B.C. W. Newton. 22 September 1936; 25166 Duncan, V.I. M.K. Nobles. 4 June 1949; 129576 Ivy Green Park N. of Ladysmith. M.C. Melburn P. 305 6 August 1969.

***Paeonia lactiflora* Pall. - peony**
Peony ringspot virus. Fig. 21.
Peony ringspot is frequently encountered in the Fraser Valley as it is elsewhere in Canada (1). The virus has yet to be characterized beyond the fact that it is a spherical partical (R. Stace-Smith, personal communication).

***Pinus sylvestris* L. - Scots pine**
***Lophodermium pinastri* (Schrad. ex Fr.) Chev., needle cast. Fig. 21, 22.**
L. pinastri on *P. sylvestris* from B.C. is represented by DAOM 138809 Straiton D.J. Ormrod, 17 March 1972. As noted in a previous paper, *Lophodermium* needle cast is now a major disease of Scots pine in nursery and Christmas tree plantations in the Fraser Valley (3). Protectant sprays using maneb or benomyl have been effective in controlling the disease.

***Polygonum scabrum* Moench. - green smartweed**
Septoria polygonorum on *Polygonum persicaria* L. in B.C. is represented in DAOM by: 118619 Aldergrove W. Jones 4 Aug. 1942 SBC 700; 118618 Agassiz W. Jones 2 July 1942 SBC 663; and on *Polygonum* sp. by: 118619 Surrey W. Jones 8 Aug. 1933. *Ustilago reticulata* Liro (*U. utriculosa* (Nees) Ung.), Smut Burnaby, B.C.; Richmond, B.C. DAOM 162733. *Ustilago reticulata* is not represented in DAOM by a B.C. collection but is recorded from most other provinces.

***Raphiolepis indica* (L) Lindl. - Indian hawthorn**
***Diplocarpon maculatum* (Atk.) Jorst (*Entomosporium mespili* (DC. ex Duby) Sacc.). Burnaby, B.C. DAOM 162790.**
Indian hawthorn is not a common outdoor shrub in British Columbia, being hardy only in the most sheltered

locations. The host genus is not listed in Canada (1) and the pathogen is not listed on this host in the U.S.A. (2). There are numerous collections of the pathogen on other hosts in DAOM.

***Rheum rhaponticum* L. - rhubarb**
Virus. Fig. 23.
Turnip mosaic virus is fairly common in commercial rhubarb plantings in the Fraser Valley. It causes stunting and various leaf mosaic symptoms. Infected plants must be rogued but fortunately the virus appears to spread slowly (4). At least one other virus is also present in plants which may or may not be infected with turnip mosaic virus. It is believed that this additional virus may be responsible for the definite ring spot symptoms which are frequently seen (R. Stace-Smith, personal communication).

***Thuja plicata* Donn. - western red cedar**
***Didymascella thujina* (Durand) Maire, keithia blight. Fig. 24.**
Keithia blight is the most serious disease of ornamental cultivars of *T. plicata* in coastal nurseries. Damage is frequently so severe as to render thousands of shrubs unsaleable each year. Control measures include a spray program and increasing plant spacing in nurseries. There are numerous collections of this fungus on native *Thuja plicata* from B.C. in DAOM.

Acknowledgement
The authors wish to thank Dr. R.A. Shoemaker and the staff of the Biosystematic Research Institute, Agriculture Canada, Ottawa for confirmation and indentification of submitted diseases specimens and review of the manuscript.

Literature cited
1. Conners, I.L. 1967. An annotated index of plant diseases in Canada. Can. Dep. Agric. Publ. 1251. 381 pp.
2. Crops Research Division, USDA, 1960. Index of plant diseases in the United States. Agr. Hdbk. 165. 531 pp.
3. Ormrod, D.J. 1976. Control of *Lophodermium* needle cast of Scots pine Christmas trees in British Columbia. Can. Plant. Dis. Surv. 56: 69-72.
4. Stace-Smith, R., and G.G. Jacoli. 1967. A virus disease of rhubarb in British Columbia. Can. J. Bot. 45: 1059-1061.

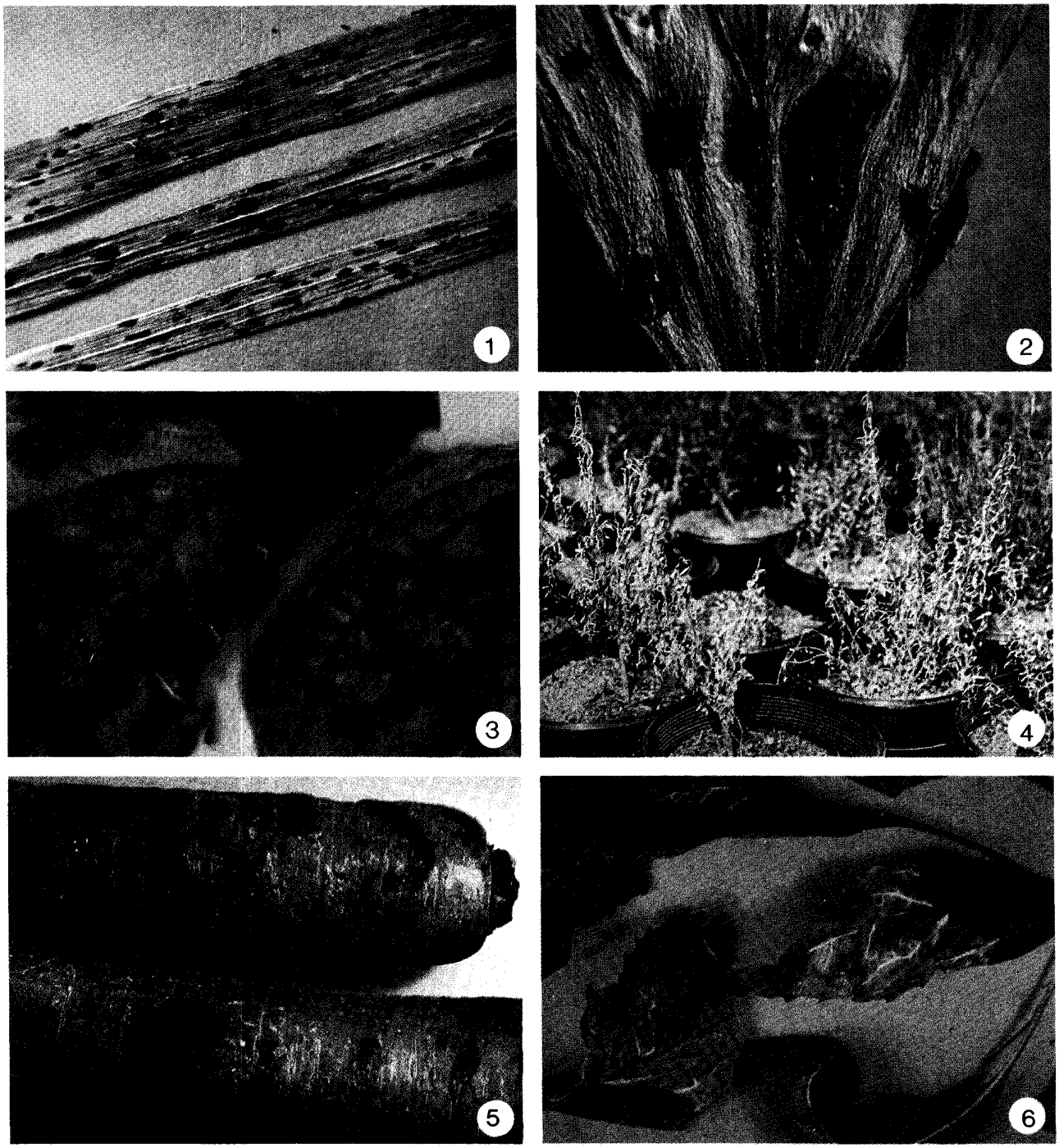
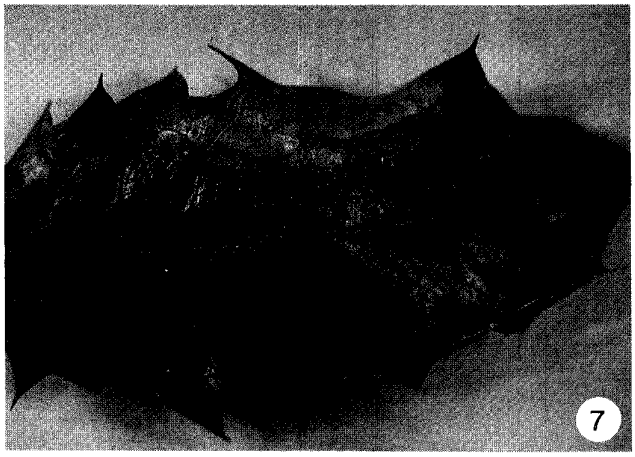
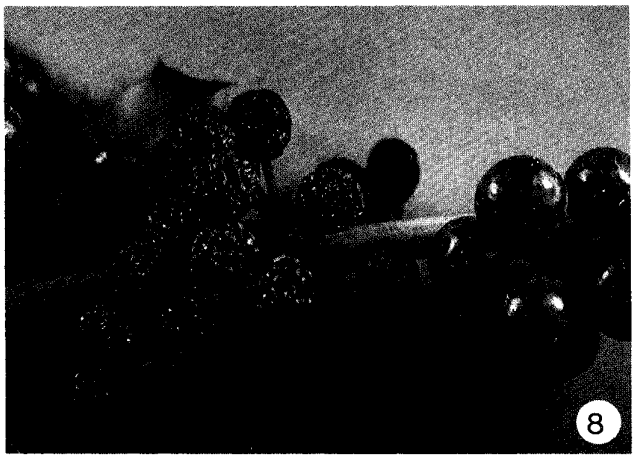
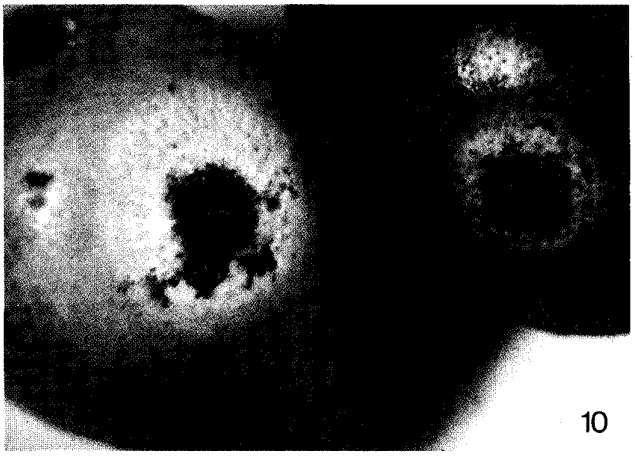


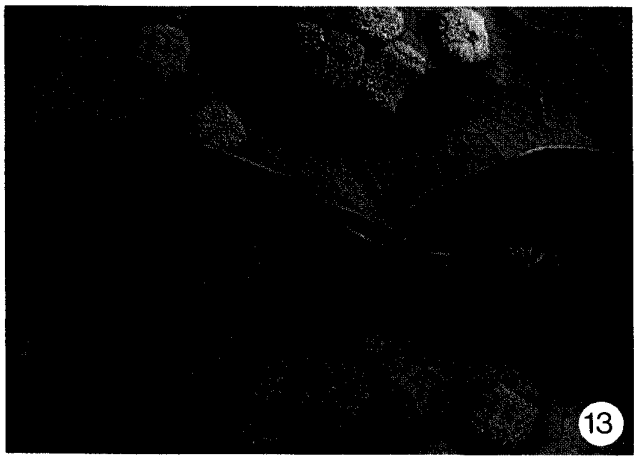
Fig. 1. *Phyllachora graminis* on *Agropyron repens* showing hard, black fungus stroma. Fig. 2. *Puccinia porphyrogenita* on *Cornus canadensis* showing sori containing telia. Fig. 3. *Septoria cornicola* on *Cornus nuttalli.* Fig. 4. *Alternaria* blight of *Cytisus scoparius.* Fig. 5. Fruiting of *Thielaviopsis basicola* on surface of carrot roots. Fig. 6. Leaves of *Fraxinus velutina* var *glabra* infected with *Discula quercina.*
**Gloeosporium* spp. Conners 1967 Ed.

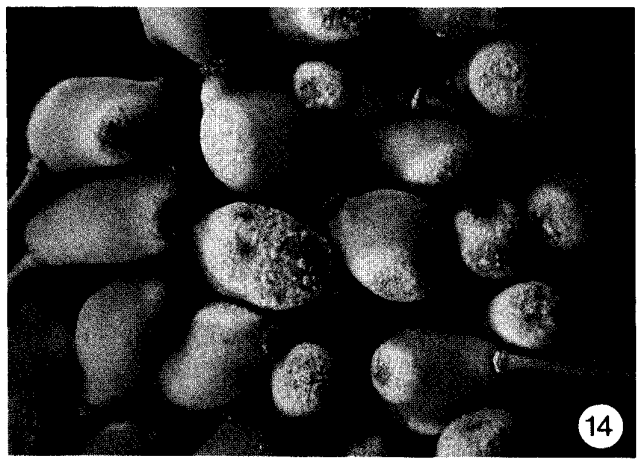


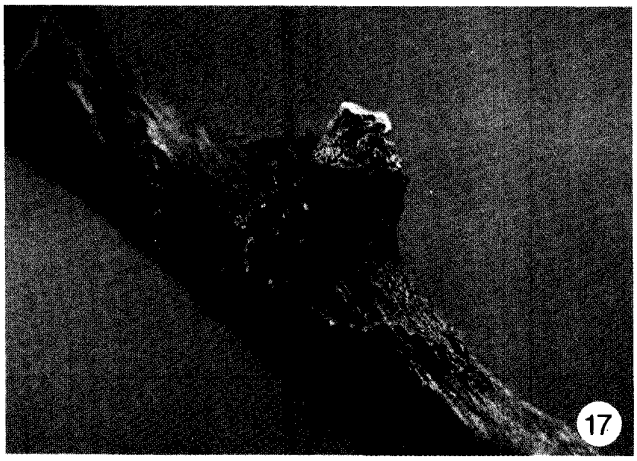


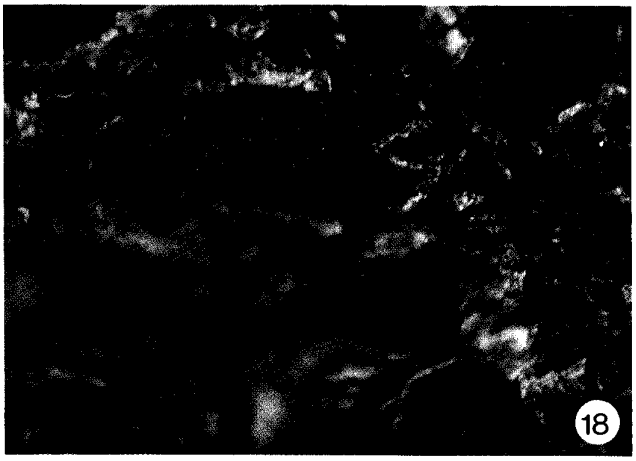


Figs. 7 and 8. Leaf and fruit cluster infections of *Ilex aquifolium* by *Phytophthora ilicis.* Fig. 9. Comparison of dry *Gymnosporangium fuscum* telia from *Juniperus* sp. (bottom) with telia wetted for 15 minutes (top). Fig. 10. Pycnia of *gymnosporangium fuscum* on pear fruit. Fig. 11. *Stemphylium botryosum* leaf spot on leaves of *Lycopersicum esculentum.* Fig. 12. Ringspot virus symptoms in leaves of *Paeonia lactiflora.*

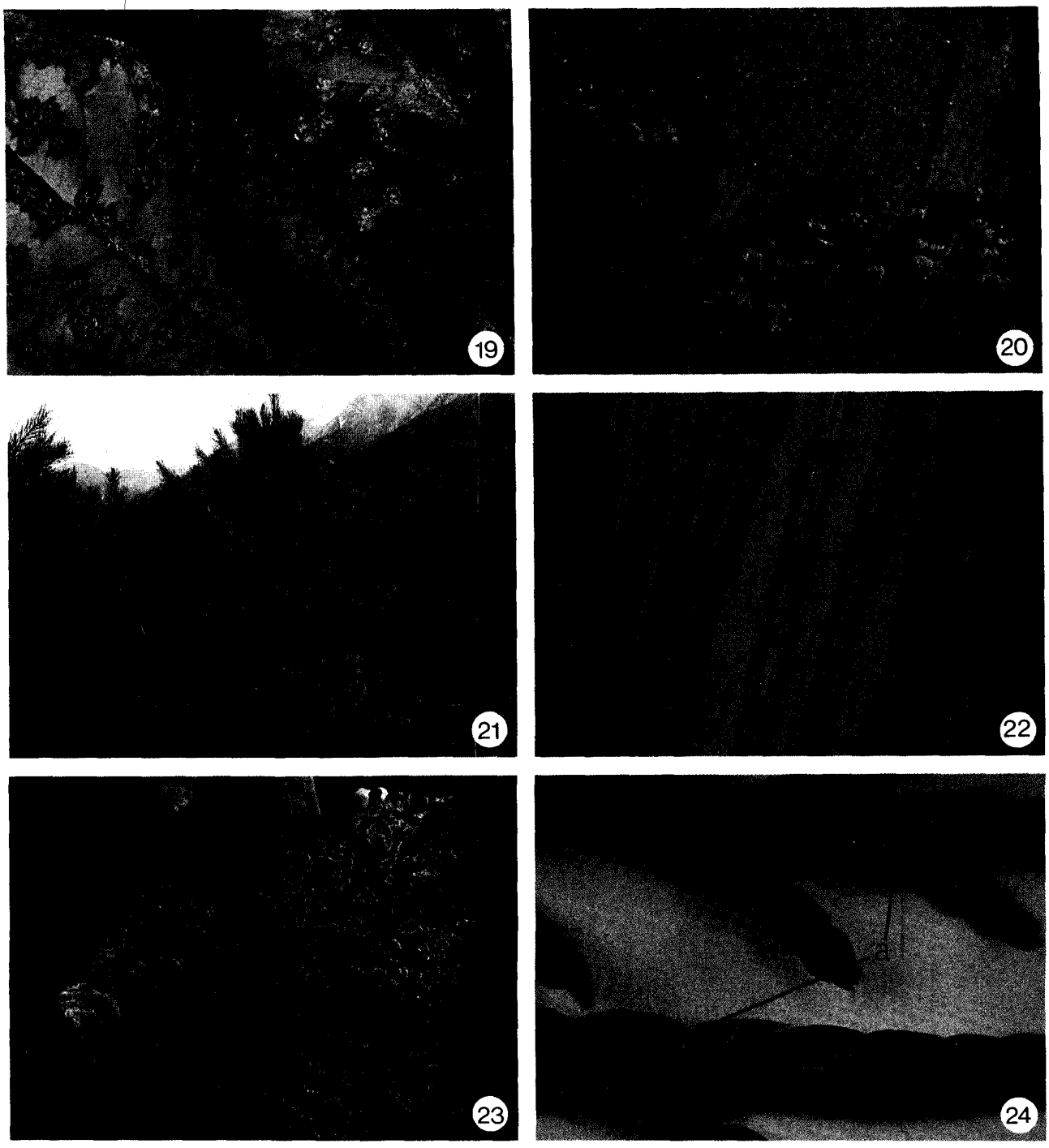








Figs. 13 and 14. Aecia of *Cumminsiella mirabilissima* on leaves and fruits of *Mahonia aquifolium.* Fig. 15. Telia of C. *mirabilissima* on M. *aquifolium.* Fig. 16. *Diplocarpon maculatum* leafspot on *Raphiolepsis* indica. Fig. 17. First year canker of *Nectria galligena* on pear twig. Fig. 18. Perithecia of N. *galligena* in 6 year old apple branch canker.



Figs. 19 and 20. *Cylindrosporium nuttallii* leafspot on *Oemleria cerasiformis* showing masses of extruded conidia. Fig. 21. Typical symptoms of *Lophodermium pinastri* on *Pinus sylvestris* showing genetic variability in susceptibility of seedling trees. Fig. 22. Infected, over-wintered needles of P. *sylvestris* showing pycnidia (a), apothecia (b) and transverse black bars (c) which are diagnostic. Fig. 23. Leaf of *Rheum rhaponticum* showing virus symptoms. Fig. 24. *Didymascella thujina* on *Thuja plicata* var *atrovirens* showing brown cushion-like apothecia (a).

Air-borne rust inoculum over western Canada in 1978[1]

G.J. Green

The number of stem rust spores found in spore traps in western Canada in 1978 was greater than the mean of the previous ten years, but the number of leaf rust spores was smaller. The number of stem rust spores was probably increased by rye stem rust and oat stem rust which were common, rather than by wheat stem rust which was not prevalent. The number of leaf rust spores was probably reduced by unfavorable conditions for wheat leaf rust development and the increased hectarage of resistant wheat varieties.

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Le nombre de spores de rouille de la tige relevé en 1978 dans les pièges installés dans l'ouest du Canada a été supérieur à la moyenne obtenue pour les 10 années précédentes. En revanche, l'inoculum de spores de rouille de la feuille a été moindre. L'accroissement du nombre des premières s'explique vraisemblablement par la fréquence des rouilles inféodées au seigle et à l'avoine, plutôt que par celles du blé qui ont été relativement peu (seigle) abondantes. La baisse de l'inoculum de rouille de la feuille serait due à des conditions de végétation peu propices au développement de la rouille de la feuille du blé, ainsi qu'à l'extension des surfaces plantées en variétés de blé résistantes.

An estimate of the relative numbers of air-borne urediospores of the cereal rusts over western Canada in 1978 was made using the same spore trapping methods described in earlier annual reports in the Canadian Plant Disease Survey.

Relatively large numbers of spores of stem rust (*Puccinia graminis* Pers.) and leaf rust (*P. recondita* Rob. ex. Desm.) were carried into western Canada in June of 1978. They were widely distributed from Winnipeg in the east to Saskatoon in the north west (Table 1).

The numbers of stem rust spores caught in the traps were comparatively large throughout the season. The total number of spores counted in 1978 was less than in 1977 at all locations, but mean numbers of spores for the 72-hour exposures were considerably greater than the 1967-77 means for Winnipeg, Morden, Brandon, and Indian Head. Usually it is presumed that most of the spores are wheat stem rust, but in 1978 other species were probably more prevalent. The physiologic race survey showed that most of the rust on *Hordeum jubatum* L. in 1978 was rye stem rust, and oat stem rust was prevalent.

Table 1. Number of urediospores of stem rust and leaf rust per square inch (6.5 cm^2) observed on vaseline-coated slides exposed for 72-hour periods at three locations in Manitoba and three locations in Saskatchewan in 1978

Date	Winnipeg		Morden		Brandon		Indian Head		Regina		Saskatoon	
	Stem rust	Leaf rust	Stem rust	Leaf rust	Stem rust	Leaf rust	Stem rust	Leaf rust	Stem rust	Leaf rust	Stem rust	Leaf rust
June 1-4	24[1]	33[1]	0	0	1	1	1	2	8[1]	9[1]	1	1
June 4-7	4	9	1	7	0	2	0	1	1	7	1	1
June 7-10	1	7	1	10	0	1	0	5	0	5	0	0
June 10-13	2	1	0	2	1	5	2	2	1	1	2	2
June 13-16	2	22	0	0	1	0	0	0	0	1	0	9
June 16-19	0	7	0	16	0	5	0	2	0	0	0	16
June 19-22	0	5	0	3	0	1	1	2	1	4	0	4
June 22-25	1	5	0	8	0	0	0	4	1	7	1	9
June 25-28	0	2	1	2	0	3	0	0	1	3	0	12
June 28-1	1	2	0	3	4	0	0	3	1	9	0	12
June total	35	93	3	51	7	18	4	21	14	46	5	66

[1] *Contribution No. 894, Research Station, Agriculture Canada, 195 Dafoe Road, Winnipeg, Manitoba, R3T 2M9.*

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Table 1. (cont.)

Date	Winnipeg		Morden		Brandon		Indian Head		Regina		Saskatoon	
	Stem rust	Leaf rust	Stem rust	Leaf rust	Stem rust	Leaf rust	Stem rust	Leaf rust	Stem rust	Leaf rust	Stem rust	Leaf rust
July 1–4	0	1	0	0	0	0	1	2	0	2	0	17
July 4–7	1	2	1	1	2	3	1	7	0	4	1	23
July 7–10	2	2	1	1	1	5	2	2	0	7	3	22
July 10–13	4	67	2	52	8	29	2	25	3	20	1	45
July 13–16	2	5	2	24	1	19	1	8	3	43	0	13
July 16–19	0	1	1	12	1	20	1	34	0	21	0	9
July 19–22	1	8	4	28	7	13	2	46	0	25	0	14
July 22–25	12	60	27	86	4	10	1	5	2	36	1	23
July 25–28	11	29	5	51	2	22	15	127	6	147	1	13
July 28–31	15	7	11	110	24	136	4	185	3	80	0	22
July total	48	182	54	365	50	257	30	441	17	385	7	201
Aug. 31–3	23	145	11	134	8	127	5	592	1	96	1	40
Aug. 3–6	110	561	27	368	13	192	30	845	2	203	5	120
Aug. 6–9	45	331	148	1294	62	631	39	1399	25	425	4	61
Aug. 9–12	358	809	462	1540	85	484	0	0	5	476	3	51
Aug. 12–15	107	482	37	44	124	758	55	1358	81	1482	6	208
Aug. 15–18	254	758	262	1049	7	33	40	227	8	128	1	51
Aug. total	897	3086	947	4429	299	2225	169	4421	122	2810	20	531
1978 Total	980	3361	1004	4845	356	2500	203	4883	153	3241	32	798
1977 Total[2]	1739	1167	1627	1489	527	806	306	687	240	3744	54	678
1978 Mean[3]	38	129	39	186	14	96	8	188	6	125	1	31
1967–77 Mean[3]	21	166	19	208	6	137	5	235	6	689	4	122

1 Spores lacked carotene and seemed shrunken.
2 Total from June 1 to August 18.
3 Means of the numbers of spores counted on slides exposed from June 1 to August 15 expressed on the basis of 72-hour exposures. Data for 1974 was incomplete and was omitted from the 1967-77 mean.

The numbers of leaf rust spores were considerably larger than the corresponding numbers for 1977 at all locations except Regina, but the 1978 means were appreciably smaller than the 10-year means. The reduced number of leaf rust spores, which seem to be mainly wheat leaf rust, may have been caused by unfavorable weather for leaf rust development and by the increased hectarage of leaf rust resistant varieties.

Acknowledgements

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Crown rust of oats in Canada in 1978[1]

D. E. Harder

Oat crown rust (*Puccinia coronata* f. sp. *avenae*) caused moderate damage to late-sown fields of oats in the Red River Valley region of Manitoba. Outside this region throughout Manitoba and eastern Saskatchewan, crown rust infections were light. Virulence combinations in the crown rust population were determined using a set of 12 oat lines carrying substituted single genes (Pc) for crown rust resistance. The 49 isolates from eastern Canada (Nova Scotia, Quebec and Ontario) and the 247 isolates from Manitoba and Saskatchewan comprised 20 and 31 virulence combinations respectively. In eastern Canada there were no major changes in the physiologic races of crown rust in 1978. Insufficient crown rust collections were obtained from eastern Canada to provide meaningful data on the distribution of virulence on the individual Pc genes. In Manitoba and Saskatchewan there were also no major changes in the physiologic races of crown rust. Virulence on genes Pc 35 and Pc 40 predominated, and there were moderate levels of virulence on genes Pc 46 and Pc 50. There was little change from previous years in the level of virulence on the commercial cultivar Hudson, and no virulence was found on the gene combinations Pc 38-39 and Pc 55-56.

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La rouille couronnée de l'avoine (*Puccinia coronata* f. sp. *avenae*) a causé des dégâts modérés aux semis tardifs dans la vallée de la rivière Rouge au Manitoba. Dans le reste de la province et dans l'est de la Saskatchewan, l'infection a été bénigne. Les combinaisons de virulence observées dans l'inoculum de rouille ont été établies à partir d'un groupe de 12 lignées d'avoine possédant des gènes uniques substitués (Pc) de résistance à la maladie. Les 49 isolats de l'est du Canada (Nouvelle-Ecosse, Québec et Ontario) et les 247 du Manitoba et de la Saskatchewan constituaient, respectivement, 20 et 31 combinaisons de virulence. Dans l'Est, on ne relève pas de grand changement au tableau des races physiologiques et, par ailleurs, les prélèvements ont été trop peu abondants pour apporter des renseignements valables sur la distribution des formes de virulence envers chaque gène Pc. Au Manitoba et en Saskatchewan non plus, il n'y a eu de changement marqué au tableau des races. Les formes dominantes de virulence étaient celles qui concernaient les gènes Pc35 et Pc40, les gènes Pc 46 et 50 ne subissant qu'une virulence modérée. Le degré de virulence sur le cultivar du commerce Hudson n'a guère bougé par rapport aux années précédentes et on n'a constaté aucune virulence envers les combinaisons de gènes Pc 38-39 et Pc 55-56.

Occurrence in western Canada

Oat crown rust caused by *Puccinia coronata* Cda. f. sp. *avenae* Eriks. was more prevalent in 1978 than it was in 1977 (1). The first infections were observed by mid July, and the weather was generally favorable for continued rust spread. However, moderately-severe damage occurred only in late-sown fields, and the heavier infections were generally confined to the Red River Valley of Manitoba. Only traces of crown rust were found west of the Manitoba-Saskatchewan boundary.

Physiologic specialization

Isolates of crown rust were obtained from nurseries in Kentville, Nova Scotia; Lennoxville and Ste. Anne de la Pocatiere, Quebec; Elora, Ailsa Craig, Guelph, Kemptville, and Appleton, Ontario; and from field surveys in Manitoba and eastern Saskatchewan. Isolates were also obtained from a trap nursery consisting of selected oat lines grown at Portage la Prairie and Glenlea, Manitoba.

In 1978 all crown rust collections were identified using a series of backcross lines of *Avena sativa* L. cv. Pendek containing single genes (Pc) for crown rust resistance derived from *A. sterilis* L.

From eastern Canada, including Nova Scotia, Quebec, and Ontario, 49 isolates, comprising 20 physiologic variants, were identified. The variants are given as virulence combinations on lines with the Pc genes (Table 1). Compared to 1977, there was an increase in the number of isolates avirulent on the twelve Pc-gene lines. The percent of isolates virulent on genes Pc 35, 40, and 56 was relatively similar to 1977 (1), while the percent of isolates decreased somewhat on gene Pc 45 and increased on gene Pc 50 (Table 2). Also, the frequency of virulence on Hudson, currently the most rust resistant cultivar in Canada, remained relatively constant (Table 2). Although the number of isolates obtained from eastern Canada were insufficient to provide reliable data on the frequency of virulence on the individual Pc genes, the results indicate that there were no major changes in the physiologic race composition of crown rust in eastern Canada in 1978.

From western Canada, including Manitoba and eastern Saskatchewan, 247 isolates, comprising 31 virulence combinations, were identified (Table 1). There were no major changes in virulence of crown rust in 1978. Of some concern is the apparent occurrence of the 35,38,-

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Table1. Virulence combinations of *Puccinia coronata* on backcross lines of *Avena sativa* cv. Pendek containing single (Pc) genes for crown rust resistance

Virulence formula effective/ineffective Pc genes	Nova Scotia		Quebec		Ontario		Manitoba		Saskatchewan	
	No. of isol.	% of isol.	No. of isol.	% of isol.	No. of isol.	% of isol.	No. of isol.	% of isol.	No. of isol.	% of isol.
35,38,39,40,45,46,47,48,50,54,55,56	3	27.3	6	50.0	7	26.9	48	22.0	8	27.6
38,39,40,45,46,47,48,50,54,55,56/35	3	27.3	0		3	11.5	23	10.5	5	17.2
35,38,39,45,46,47,48,50,54,55,56/40	0		0		2	7.7	39	17.9	6	20.7
35,38,39,40,46,47,48,50,54,55,56/45	0		0		2	7.7	0		1	3.4
35,38,39,40,45,47,48,50,54,55,56/46	0		1	8.3	0		9	4.1	3	10.3
35,38,39,40,45,46,47,48,54,55,56/50	0		0		1	3.8	17	7.8	2	6.9
35,38,39,40,45,46,47,48,50,55,56/54	0		0		0		5	2.3	0	
35,38,39,40,45,46,47,48,50,54,55/56	0		0		3	11.5	1	0.5	0	
39,40,45,46,47,48,50,54,55,56/35,38	0		0		0		1	0.5	1	3.4
38,39,45,46,47,48,50,54,55,56/35,40	1	9.1	0		0		24	11.0	3	10.3
38,39,40,46,47,48,50,54,55,56/35,45	0		0		1	3.8	0		0	
38,39,40,45,47,48,50,54,55,56/35,46	0		0		0		4	1.8	0	
38,39,40,45,46,47,48,54,55,56/35,50	1	9.1	0		3	11.5	2	0.9	0	
38,39,40,45,46,47,48,50,55,56/35,54	0		0		0		1	0.5	0	
38,39,40,45,46,47,48,50,54,55/35,56	0		1	8.3	2	7.7	1	0.5	0	
35,38,39,45,47,48,50,54,55,56/40,46	0		0		0		5	2.3	0	
35,38,39,45,46,47,48,54,55,56/40,50	1	9.1	0		0		5	2.3	0	
35,38,39,45,46,47,48,50,55,56/40,54	0		0		0		1	0.5	0	
35,38,39,45,46,47,48,50,54,55/40,56	0		0		0		2	0.9	0	
35,38,39,40,46,47,48,50,54,55/45,56	0		1	8.3	0		0		0	
35,38,39,40,45,47,48,54,55,56/46,50	0		0		0		3	1.4	0	
35,38,39,40,45,47,48,50,54,55/46,56	0		1	8.3	0		1	0.5	0	
35,38,39,40,45,46,47,48,54,55/50,56	0		0		0		2	0.9	0	
38,39,45,47,48,50,54,55,56/35,40,46	0		0		0		8	3.7	0	
38,39,45,46,47,48,54,55,56/35,40,50	0		1	8.3	0		3	1.4	0	
38,39,45,46,47,48,50,54,55/35,40,56	1	9.1	0		0		2	0.9	0	
38,39,40,46,47,48,50,54,55/35,45,56	0		0		1	3.8	0		0	
38,39,40,45,47,48,54,55,56/35,46,50	1	9.1	0		0		1	0.5	0	
38,39,40,45,47,48,50,54,55/35,46,56	0		0		0		1	0.5	0	
38,39,40,45,46,47,48,55,56/35,50,54	0		0		1	3.8	0		0	
35,39,45,47,48,49,50,54,55/38,40,56	0		0		0		1	0.5	0	
35,38,39,45,47,48,54,55,56/40,46,50	0		0		0		2	0.9	0	
35,38,39,45,47,48,50,54,55/40,46,56	0		1	8.3	0		2	0.9	0	
35,38,39,40,45,47,48,50,55/46,54,56	0		0		0		2	0.9	0	
35,38,50,56/39,40,45,46,47,48,54,55	0		0		0		2	0.9	0	
Total	11		12		26		218		29	

Table 2.Frequency of virulence of isolates of *Puccinia coronata* on backcross lines of Pendek carrying single crown rust resistance (Pc) genes, and on Hudson

Resistance gene or variety	Nova Scotia		Quebec		Ontario		Manitoba		Saskatchewan		Trap nursery	
	No. of virulent isol.	% of isol.	No. of virulent isol.	% of isol.	No. of virulent isol.	% of isol.	No. of virulent isol.	% of isol.	No. of virulent isol.	% of isol.	No. of virulent isol.	% of isol.
Pc 35	7	63.6	2	16.7	11	42.3	71	32.6	9	31.0	7	14.0
Pc 38	0	0.0	0	0.0	0	0.0	2	0.9	1	3.4	1	2.0
Pc 39	0	0.0	0	0.0	0	0.0	2	0.9	0	0.0	0	0.0
Pc 40	3	27.3	2	16.7	2	7.7	96	44.0	9	31.0	22	44.0
Pc 45	0	0.0	1	8.3	3	11.5	2	0.9	1	3.4	1	2.0
Pc 46	1	9.1	3	25.0	0	0.0	40	18.3	3	10.3	6	12.0
Pc 47	0	0.0	0	0.0	0	0.0	2	0.9	0	0.0	0	0.0
Pc 48	0	0.0	0	0.0	0	0.0	2	0.9	0	0.0	0	0.0
Pc 50	3	27.3	1	8.3	5	19.2	35	16.1	2	6.9	7	14.0
Pc 54	0	0.0	0	0.0	1	3.8	11	5.0	0	0.0	1	2.0
Pc 55	0	0.0	0	0.0	0	0.0	2	0.9	0	0.0	0	0.0
Pc 56	1	9.1	4	33.3	6	23.1	15	6.9	0	0.0	4	8.0
Hudson	2	18.2	1	8.3	2	7.7	18	8.3	0	0.0	2	4.0

50,56/39,40,45,46,47,48,54,55 virulence combination (Table 1). These isolates were collected from near McCreary, Manitoba, and although this race has been used in greenhouse studies, the isolates did not appear to be greenhouse contaminants. Crown rust is not known to overwinter on the prairies except where European buckthorn occurs, thus this may remain as an isolated occurrence of this potentially serious race. The incidence of virulence on the individual Pc genes and on the cultivar Hudson (Table 2) was relatively unchanged from 1977 (1) except for a moderate increase in virulence on genes Pc 35 and Pc 46, and a decrease on gene Pc 40. None of the latter 3 genes are of importance to the rust resistance breeding program in western Canada. The gene combinations presently being employed to provide crown rust resistance are genes Pc 38-Pc 39 and genes Pc 55-Pc 56. To date both these gene combinations have remained highly effective against all isolates tested.

Acknowledgements

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Literature cited

1. Harder, D.E. 1978. Crown rust of oats in Canada in 1977. Can. Plant Dis. Survey 58:39-43.

A new race of Diplocarpon rosae capable of causing severe black spot on Rosa rugosa hybrids[1]

A.T. Bolton and F.J. Svejda

In 1977, severe black spot symptoms appeared at Ottawa on the highly resistant *Rosa rugosa* hybrid cultivar Martin Frobisher, and on an unidentified *Rosa* species collected at Bar Harbor, Maine. The *Diplocarpon rosae* Wolf isolated from Martin Frobisher was unable to infect the very susceptible cultivars Samantha and Arthur Bell. The isolate of *D. rosae* from the unidentified *Rosa* sp. was capable of producing severe symptoms on Martin Frobisher and the two susceptible cultivars. It was concluded that the isolate from Martin Frobisher constituted a new pathogenic race of the fungus. The possibility of the highly virulent isolate from the unidentified *Rosa* sp. constituting a pathogenic race is considered.

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En 1977 de graves symptômes de tache noire sont apparus à Ottawa sur le cultivar pourtant très résistant de *Rosa rugosa* Martin Frobisher, ainsi que sur une espèce non identifiée de rose obtenue de Bar Harbor, Maine. L'isolat de *Diplocarpon rosae* Wolf prélevé sur Martin Frobisher n'a pas réussi à infecter les cultivars très sensibles Samantha et Arthur Bell. Par contre, l'isolat obtenu sur l'espèce de rose non identifiée a donné lieu à de graves symptômes de la maladie sur Martin Frobisher et sur les deux cultivars sensibles. L'isolat trouvé sur Martin Frobisher serait donc un nouveau pathotype du champignon. On examine la possibilité de classer l'isolat ultravirulent trouvé sur la rose non identifiée comme une pathotype distinct.

During the late summer of 1977, lesions typical of those resulting from infection by *Diplocarpon rosae* Wolf (black spot) were observed at Ottawa on one rose cultivar and on one species that had been considered very resistant to the disease. As the disease developed, defoliation became severe and infected leaves were brought into the laboratory and the causal fungus isolated. The monoconidial colonies produced in culture from the normally resistant cultivar, Martin Frobisher, and from the resistant species were different from one another and from the fungus obtained from two susceptible garden rose cultivars. The fungus isolated from Martin Frobisher grew very slowly while that from the unidentified *Rosa* sp. grew much more rapidly and resembled the *D. rosae* isolated from the susceptible floribunda cultivar Arthur Bell and an unidentified garden rose growing in the same area. The possibility of the isolates from Martin Frobisher and the resistant species constituting new races was recognized, and investigations initiated to determine if this was the case.

Materials and methods

D. rosae was isolated from 1. Martin Frobisher, an open-pollinated seedling of the hybrid *Rosa rugosa* cultivar, Schneezwerg; 2. G57, an unidentified wild species collected at Bar Harbor, Maine; 3. Arthur Bell, a floribunda cultivar; and 4. an unidentified garden rose. Isolations were made by placing leaf tissue encompassing a typical black spot lesion in petri dishes containing potato dextrose agar (PDA). When acervuli developed on the leaf surface, conidia were picked off and placed in test tubes containing sterile distilled water. The resulting suspensions were then distributed over PDA in petri dishes and single conidia picked off and placed on PDA. Several of the monoconidial colonies were selected at random for further testing but, since no differences in pathogenicity or morphology were found among single conidia obtained from any one cultivar, a representative monoconidial culture from each isolate was maintained for further investigations. Inoculum was prepared by growing the fungus for 14 days on PDA and then floating off the conidia with distilled water.

In preliminary experiments, four *D. rosae* isolates were compared; MF from Martin Frobisher, G57 from the unidentified *Rosa* sp., GR1 from Arthur Bell, and GR2 from the unidentified garden rose. Martin Frobisher was used as the resistant host, and Samantha, a florist cultivar was used as the susceptible host. In later experiments, only the three isolates, MF, G57, and GR1 were used, and Arthur Bell was included as a susceptible host. The cultivar Jens Munk, a newly introduced *R. rugosa*, with high resistance to black spot was also added to the host series. The unidentified *Rosa* sp. was not available for inoculation.

Inoculum, containing approximately 30,000 conidia/ml distilled water, was applied with an atomizer to the upper surface of the leaves of 14-week-old rooted cuttings. A minimum of four plants with an average of 10 compound leaves per plant were used for each treatment. After inoculation, plants were placed in a chamber equipped with misting nozzles and the relative humidity maintained at 95-99%. The temperature was 25-27°C. Light was provided by fluorescent tubes at

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Table 1. Comparative pathogenicity on four rose cultivars of three isolates of *D. rosae* *

Cultivar	Isolate and disease rating**		
	GR1	G57	MF
Martin Frobisher	0	4	4
Samantha	4	5	0
Arthur Bell	4	5	0
Jens Munk	0	0	0

* Average of three inoculations of Martin Frobisher and Samantha, two of Arthur Bell and Jens Munk.
** 0 = no symptoms to 5 = complete defoliation.

approximately 2000 1x. Three days after inoculation, the plants were removed to a greenhouse bench where day length was 16 h and temperature 21°C night and 24°C day. The foliage was moistened once a day with a fine spray of tap water at 22°C. Observations were made on disease development 17 days and, on number of lesions and rate of defoliation, 31 days after inoculation.

Observations on conidia germination and germ tube penetration were made by boiling the leaves in 95% ethyl alcohol for 2 min and staining in lactophenol-aniline blue for 5 min.

Results

Inoculation of the two cultivars, Martin Frobisher and Samantha, demonstrated differences in pathogenicity among the three isolates of *D. rosae* (Fig. 1, Table 1). Isolate MF caused lesions and rapid defoliation in Martin Frobisher, but did not produce any disease symptoms on the Samantha leaves. Isolates GR1 and GR2 produced identical symptoms on Samantha and failed to infect Martin Frobisher. In subsequent inoculations, only GR1 was used. Isolate G57 caused severe symptoms on both Martin Frobisher and Samantha. Inoculations carried out on three separate occasions were identical, except that symptoms produced on plants inoculated during the month of March were less severe than those produced in December and April.

No correlation could be found in any of the isolate-cultivar combinations between % leaf area covered by lesions and degree of defoliation.

Examination of leaves 7 days after inoculation showed differences in rate of germination of conidia of the three isolates. At this time 25% of the G57 conidia had produced germ tubes, while less than 5% of the conidia of MF and GR1 had germinated. Maximum germination was reached 10 days after inoculation at which time 32% of G57, 17% of MF, and 18% of the GR1 conidia had produced germ tubes. All three isolates germinated equally well on Samantha and Martin Frobisher. Germ tubes of isolate MF failed to penetrate leaves of Samantha and isolate GR1 did not penetrate Martin Frobisher. Isolate G57 penetrated both varieties equally. The cultivar Arthur Bell was susceptible to both G57 and GR1 and resistant to isolate MF. Jens Munk was completely resistant to all three isolates.

Discussion

Proof of the existence of pathogenic races of *D. rosae* is very limited. Significant differences in degree of pathogenicity have been demonstrated. The work of Jenkins (1955) showed that differences in ability to infect several rose cultivars and species existed among isolates of the fungus. It did not, however, prove that specific races were present. The fact that his tests were conducted over a 6-month period very probably had an effect on his results. Palmer et al. (1966) reported a definite seasonal variation in host susceptibility to *D. rosae*. These workers tested 50 rose cultivars against the fungus isolated from roses growing in seven geographical areas in the U.S.A. None of their seven isolates infected *R. rugosa*. Although they refer to "locally adapted races", the differences between their isolates appear to be the result of different degrees of virulence rather than the presence of specific races. Saunders (1967) assessed the degree of resistance of several rose species and cultivars in England. He mentioned races as one of the factors causing anomalies in results, but used only a single isolate in his experiments.

Frick (1943), working in Switzerland, tested isolates from seven wild rose species and two cultivars. She observed that there was no evidence of different biological races although there were considerable differences in virulence among the nine isolates. According to Baker and Dimock (1969), the existence of races of *D. rosae* has not been proven.

Much of the work on variation of resistance of roses to black spot has been done using excised leaflets or parts of leaflets infected by placing a drop of conidia suspension on the surface and placing in a moist chamber for 8-17 days (Jenkins 1955, Palmer et al. 1966, Saunders 1967).

Jenkins (1955) and Saunders (1967) used size of lesion to differentiate resistance. At Ottawa, lesion size was extremely variable within each isolate and host. It was also observed that number of lesions and amount of leaf surface covered by lesions could not be correlated with degree of defoliation. In several cases, leaves dropped that had less than 10% of the surface covered by discolored tissue. Since the damage to roses from black spot results largely from premature defoliation, it is doubtful if lesion size can be used as a reliable criterion for susceptibility.

The cultivar Martin Frobisher has been tested in several locations across Canada and in the northern U.S. Over a period of several years, no evidence of susceptibility to black spot has been reported. The sudden breakdown of resistance at Ottawa indicates the presence of a new race of the fungus. The fact that isolate MF was capable of causing severe infection on the resistant cultivar sug-

gests a change in pathogenicity. The inability of the isolate to infect the generally recognized very susceptible cultivars Samantha and Arthur Bell further indicates that it is a new pathogenic race. Isolate G57, although isolated from a *Rosa* sp. unrelated to the *R. rugosa* hybrids, caused severe symptoms on both Martin Frobisher and the two susceptible cultivars suggesting that this isolate is a more virulent form of the fungus possibly constituting a third race.

Additional research is planned to determine if G57, in fact, also constitutes a new pathogenic race and if other pathogenic races are present in eastern Ontario.

Literature cited

1. Baker, K. F. and A. W. Dimock. 1969. Black spot. In Roses. A manual on the culture, management, diseases, insects, economics and breeding of greenhouse roses (John W. Mastalerz and Robert W. Longhans, Eds.) 172-184. Pennsylvania Flower Growers, N.Y. State Flower Growers Assoc. Inc., and Roses Incorporated.
2. Frick, L. 1943. Untersuchungen über die biologie and pathogenität von *Diplocarpon rosae* (Lib.) Wolf. Phytopath. Z. 14:525-591.
3. Jenkins, W. R. 1955. Variation of pathology and physiology of *Diplocarpon rosae* Wolf, the rose black spot fungus. Am. Rose Annual, 40:92-97.
4. Palmer, J. G., P. Semeniuk, and R. N. Stewart. 1966. Roses and blackspot. I Pathogenicity to excised leaflets of *Diplocarpon rosae* from seven geographic locations. Phytopathology 56:1277-1282.
5. Saunders, P.J.W. 1967. Host-parasite interaction in blackspot disease of roses caused by *Diplocarpon rosae* Wolf. Ann. Appl. Biol. 60:129-136.

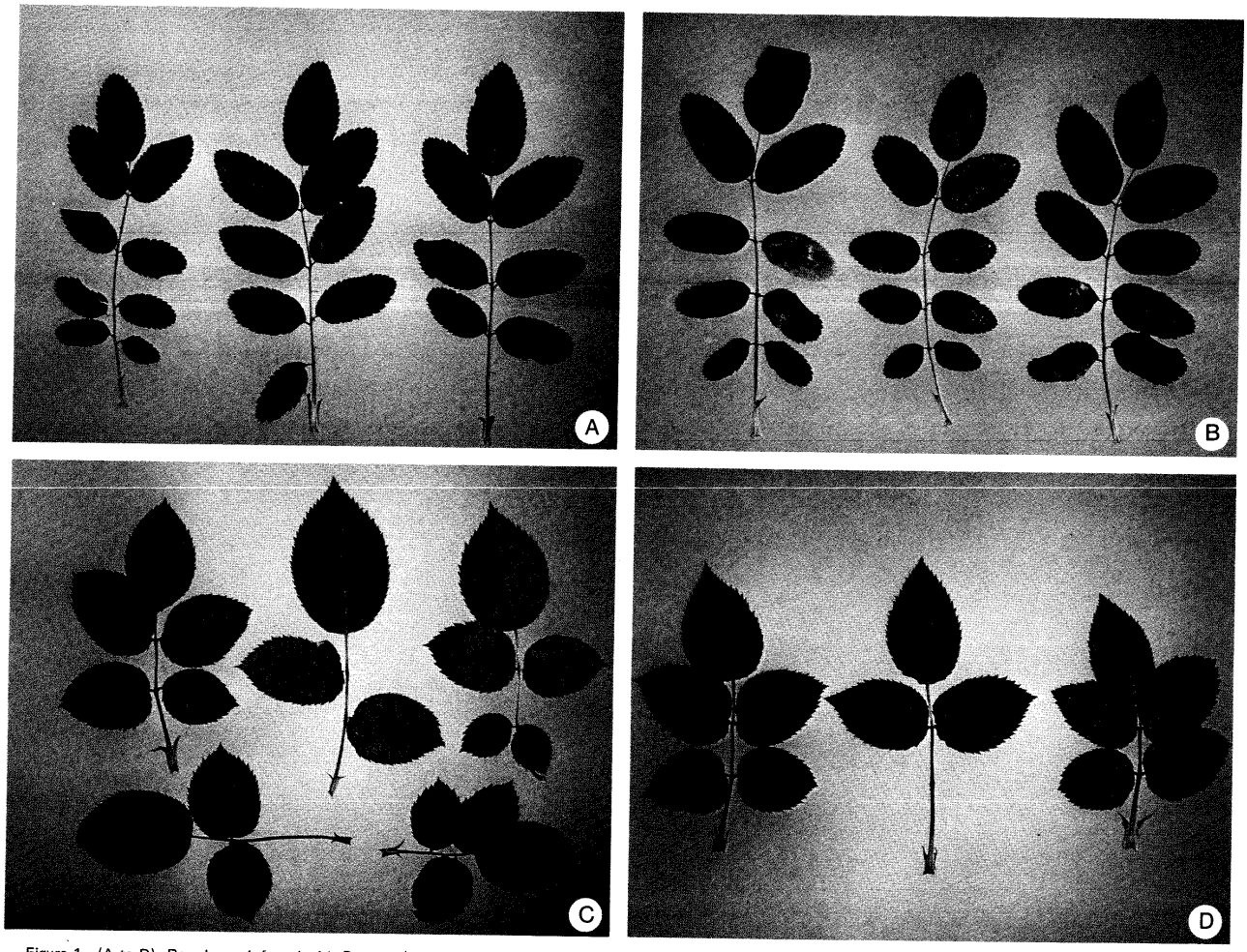

Figure 1. (A to D) Rose leaves infected with *D. rosae* (17 days after inoculation). (A) Martin Frobisher infected with isolate G57, (B) Martin Frobisher infected with isolate MF, (C) Samantha infected with isolate G57, and (D) Samantha infected with GR1.

Stem rust of wheat, barley and rye in Canada in 1978[1]

G. J. Green

Wheat stem rust occurred sporadically in western Canada in 1978 but generally there was less infection than usual. The most severe infections were observed on susceptible cultivars in experimental plots at Portage and Brandon in south-central Manitoba. Resistant commercial cultivars in farm fields were free from rust. The stem rust that infected *Hordeum jubatum* L. was mainly rye stem rust. The deficiency of wheat stem rust samples for race identification from this important source necessitated intensive sampling in plots of the susceptible cultivar Klein Titan planted at five locations in Manitoba and south-eastern Saskatchewan. Nineteen races were identified. Race C53 (15B-1L) was identified most frequently and it was closely followed by race C33 (15B-1L). Race C25(38), the most widely virulent race identified, was third in order of prevalence. Four new races were found. There were no race changes that affected the resistance of commercial cultivars or lines under test.

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La rouille de la tige du blé s'est manifestée sporadiquement cette année dans l'ouest canadien mais en général on peut dire que l'infection a été moins grave que d'habitude. Les infestations les plus sérieuses ont été observées sur des cultivars sensibles en parcelles d'essais à Portage et à Brandon (centre sud du Manitoba). Dans les plantations commerciales, les cultivars résistants étaient indemnes. La rouille de la tige qui a infecté *Hordeum jubatum* L. était essentiellement celle du seigle. La pénurie d'échantillons de rouille disponibles aux fins d'identification des races a imposé l'échantillonnage intensif des parcelles du cultivar sensible Klein Titan, installées à 5 endroits du Manitoba et du sud-est de la Saskatchewan. On a ainsi pu identifier 19 races, la C53 (15B-1L) étant la plus fréquente, suivie de près par C33 (15B-1L). La race virulente la plus répandue, C25 (38) venait en troisième place. On a constaté la présence de 4 nouvelles races mais l'évolution du tableau n'était pas suffisante pour altérer la résistance des cultivars commerciaux ou des lignées à l'essai.

Prevalence and importance in western Canada

Wheat stem rust (*Puccinia graminis Pers.* f. sp. *tritici* Eriks. and E. Henn.) was widely distributed in the southern United States early in the 1977-78 growing season. Spore trap results showed that a comparatively large quantity of inoculum was carried into western Canada in June but rust development was sporadic. Infections on susceptible cultivars in experimental plots were less severe than usual, but a plot of the susceptible cultivar Klein Titan at Brandon, Manitoba, was severely damaged (80% infection) by early August and a plot of the same cultivar at Portage was severely infected (70%) by mid-August. On the other hand, plots of Klein Titan at Morden, Indian Head and Regina had only light infections on August 22. The resistance of the commercial cultivars grown in western Canada continued to protect them and wheat fields in the rust area were free from stem rust.

The pattern of stem rust development was unique in at least one respect. Stem rust was not observed until July 14 on wild barley, *Hordeum jubatum* L., at Jordan, Manitoba. Subsequently it was found that this rust was rye stem rust (*P. graminis* f. sp. *secalis*). By August 22 there was abundant stem rust on wild barley throughout Manitoba and eastern Saskatchewan and by the last week of September it was also abundant in Alberta. A large number of collections were made from wild barley in the three provinces as part of the physiologic race survey but nearly all of them were rye stem rust. Rye stem rust has not damaged commercial crops of rye or barley although it has been prevalent for several years.

Stem rust of wheat, barley, and rye in the rust nurseries

Rust nurseries consisting of 16 cultivars of wheat, three of barley, one of rye, and one of triticale were grown at 29 locations in Canada in 1978 (Tables 1 and 2). The cultivars included in the nurseries were described in previous reports excepting Coulter, a new cultivar of durum wheat.

Wheat stem rust infections in the rust nurseries were lighter than they have been for many years. Severe infection of the highly susceptible cultivar Red Bobs occurred at only three locations and trace infections occurred at four locations. There was no rust at the other 22 locations (Table 1). The severe infections at the eastern locations of New Liskeard, Ontario, and Normandin, Quebec, could have been initiated by inoculum from barberry.

Rye stem rust was more common in the nurseries than wheat stem rust, occurring in 12 nurseries from Creston, B.C. to Kentville, N.S. The rust on the barley cultivar Montcalm at New Liskeard, Ont. (Table 2) was probably wheat stem rust but infections on Conquest and Wpg M7118-13, that are resistant to wheat stem rust, and Prolific rye, at most other locations suggest that most of the rust on barley was rye stem rust.

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Physiologic specialization

Physiologic races were identified in 1978 using the differential hosts described previously (1, 2).

Following the practice of previous years many stem rust collections were obtained from the universally susceptible wild barley. In earlier years about half of the collections from wild barley contained wheat stem rust, but in 1978 only 28 wheat stem rust isolates were obtained from wild barley in the prairie provinces. There were 296 collections that contained rye stem rust. There were not enough wheat stem rust isolates from wild barley to meet the needs of race survey.

Table 1. Percent infection of stem rust *(Puccinia graminis* f. sp. *tritici)* on 16 wheat cultivars in uniform rust nurseries at 7 locations* in Canada in 1978

	Common Wheat											Durum Wheat				
Location	Red Bobs	Lee	Pitic 62	Neepawa	Napayo	Sinton	Kenya Farmer	Glenlea	Exchange	Frontana	Thatcher[6] x Transfer	Mindum	Wascana	Macoun	Wakooma	Coulter
Indian Head, Sask.	tr**	0	0	0	0	0	0	0	0	0	tr	0	0	0	0	0
Brandon, Man.	80	10	0	0	0	0	5	0	0	tr	5	20	0	0	0	0
Morden, Man.	tr	tr	0	0	0	0	0	0	tr	0	0	0	0	0	0	0
Thunder Bay, Ont.	tr	tr	0	0	0	0	0	0	0	0	0	0	0	0	0	0
New Liskeard, Ont.	70	25	1	5	0	0	5	0	40	35	5	5	0	0	5	0
Normandin, P.Q.	80	10	0	tr	0	0	0	0	5	0	25	15	0	0	0	0
La Pocatière, P.Q.	tr	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

* No rust was observed in nurseries at 22 locations: Agassiz and Creston, B.C.; Beaverlodge, Lacombe, Edmonton, and Lethbridge, Alta.; Scott and Melfort, Sask.; Durban, Man.; Kapuskasing, Guelph, Vineland, Sunbury, Appleton, and Ottawa, Ont.; Macdonald College, Lennoxville, and Quebec, P.Q.; Fredericton, N.B.; Kentville and Truro, N.S.; and Charlottetown, P.E.I.

** tr - trace

Table 2. Percent infection of stem rust *(Puccinia graminis)* on 3 cultivars of barley and one cultivar each of rye and triticale in uniform rust nurseries at 12 locations* in Canada in 1978

	Barley			Rye	Triticale
Location	Montcalm	Conquest	Wpg M 7118–13	Prolific	Rosner
Creston, B.C.	0	0	tr	tr	0
Indian Head, Sask.	0	0	0	0	5
Brandon, Man.	tr	0	tr	5	0
Morden, Man.	tr	tr	20	5	0
Thunder Bay, Ont.	tr	0	0	0	0
Guelph, Ont.	0	0	0	10	0
New Liskeard, Ont.	20	0	0	0	0
Appleton, Ont.	10	15	20	60	0
Normandin, P.Q.	10	tr	5	0–70	0
Lennoxville, P.Q.	0	0	0	40	0
La Pocatière, P.Q.	1	5	10	70	0
Kentville, N.S.	0	0	0	20	0

* No rust was observed in nurseries at 17 locations: Agassiz, B.C.; Beaverlodge, Lacombe, Edmonton, and Lethbridge, Alta.; Scott and Melfort, Sask.; Durban, Man.; Kapuskasing, Vineland, Sunbury, and Ottawa, Ont.; Macdonald College and Quebec, P.Q.; Fredericton, N.B.; Truro, N.S.; and Charlottetown, P.E.I.

Table 3. Distribution by provinces of physiologic races of *Puccinia graminis* f. sp. *tritici* on wheat, barley, and grasses and of *Puccinia graminis* f. sp. *secalis* on barley and grasses in 1978.

Virulence formula and (race number)	Virulence formula** (effective/ineffective host genes)	Number of isolates from: N.S.	P.Q.	Ont.	Man.	Sask.	Alta.	Total number of isolates	Percent of total isolates
C4 (23)	5,6,7b,8,9a,9b,9d,9e,11, 13,Tt1,Tt2/7a,10,14,15,17						1	1	0.3
C18 (15B-1L)	6,8,9a,9b,13,15,17,Tt2/5, 7a,7b,9d,9e,10,11,14,Tt1						1	1	0.3
C25 (38)	7b,9a,9d,9e,Tt1,Tt2/5,6, 7a,8,9b,10,11,13,14,15,17				24	22	1	47	15.5
C33 (15B-1L)	6,9a,9b,13,15,17,Tt2/5,7a, 7b,8,9d,9e,10,11,14,Tt1		5	4	27	39	1	76	25.0
C33 (15B-1L)	6,9a,9b,13,15,17,Tt2/5,7a, 7b,8,9d,9e,10,11*,14,Tt1		2	1	1	3		7	2.3
C49 (15)	6,9a,9b,11,13,15,17,Tt2/5, 7a,7b,8,9d,9e,10,14,Tt1				5	6		11	3.6
C53 (15B-1L)	6,9a,9b,13,15,Tt2/5,7a,7b, 8,9d,9e,10,11,14,17,Tt1		1	6	73	26	1	107	35.2
C53 (15B-1L)	6,9a,9b,13,15,Tt2/5,7a,7b, 8,9d,9e,10,11*,14,17,Tt1				5	4		9	3.0
C54 (38)	6,7a,7b,9b,9d,9e,10,11, Tt2/5,8,9a,13,14,15,17,Tt1			1	17	1		19	6.3
C56 (38-151)	6,7a,7b,8,9b,9d,9e,10,11, Tt1,Tt2/5,9a,13,14,15,17			4				4	1.3
C57 (32)	9a,9d,9e,Tt1,Tt2/5,6,7a,7b, 8,9b,10,11,13,14,15,17				1			1	0.3
C62 (39)	6,7b,8,9b,9d,9e,11,13,Tt1, Tt2/5,7a,9a,10,14,15,17						1	1	0.3
C63 (32)	7a,9d,9e,10,11,13,17,Tt2/5, 6,7b,8,9a,9b,14,15,Tt1					1		1	0.3
C66 (15)	6,9a,9b,11,13,15,Tt2/5,7a, 7b,8,9d,9e,10,14,17,Tt1					4		4	1.3
C67 (38)	7b,9d,9e,Tt1,Tt2/5,6,7a,8, 9a,9b,10,11,13,14,15,17					2		2	0.7
C74 (115)	6,7b,9a,9b,13,Tt2/5,7a,8, 9d,9e,10,11,14,15,17,Tt1					10		10	3.4
C75 (38)	6,7a,7b,9b,9d,9e,10,11,Tt1, Tt2/5,8,9a,13,14,15,17				1			1	0.3
C76 (11-32)	7a,9a,9b,9d,9e,10,13,17, Tt2/5,6,7b,8,11,14,15,Tt1				1			1	0.3
C77 (48)	5,6,7a,7b,9b,9d,9e,11,13 Tt1,Tt2/8,9a,10,14,15,17						1	1	0.3
Total wheat stem isolates			8	16	155	118	7	304	100
Rye stem rust isolates		2	2	4	166	94	36	304	

* Intermediate infection type.
** All isolates were avirulent on *Sr22*, *Sr24*, *Sr26*, *Sr27*, *Sr29*, and *Sr30*.

The sampling problem was partially solved by collecting intensively from plots of the susceptible cultivar Klein Titan planted at Morden (33 isolates), Portage (39 isolates), and Brandon (63 isolates) in Manitoba, and at Indian Head (58 isolates) and Regina (49 isolates) in Saskatchewan. In earlier years it was found that isolates from similar plots were good indicators of the prevalence of the main races but that most of the rare races were isolated from wild barley. There were insufficient isolates from wild barley this year to form a basis for comparison although the rust population again showed broad variability. The smaller number of races identified in 1978 (19 vs 23 to 32 in the previous 4 years) may have resulted from the shortage of collections on wild barley. It is clear that there would not have been a meaningful wheat stem rust physiologic race survey in western Canada in 1978 if the plots of Klein Titan had not been planted. However, five small plots cannot be depended on to provide a reliable sample of the rust population.

Race C53 (15B-1L) became the main race in 1977 and in 1978 it continued to predominate (38% of the isolates) although it was only slightly more prevalent than race C33 (15B-1L) (Table 3). Race C25 (38) was third in prevalence (15.5% of the isolates) as it was in 1977. It continues to be the most widely virulent race identified, but it has not been found in farm fields.

The distribution of the less prevalent races may have been distorted by the sampling procedure. For example,

all isolates of the new race C74 (115) came from the plot of Klein Titan at Indian Head and 13 cultures of race C54 (38) were from Portage. Four new races were identified. Two were isolated from Klein Titan and two were from wild barley. In Manitoba 13 isolates from wild barley were identified as seven races and 142 isolates from Klein Titan were identified as six races. In Saskatchewan 10 isolates from wild barley were identified as five races and 108 isolates from Klein Titan were identified as seven races. Five isolates from wild barley in Alberta were identified as five races. It is clear that the rust on wild barley was more variable than that on Klein Titan.

Four of the seven races identified in Alberta were not found elsewhere. It seems likely that the source of inoculum for Alberta is different than that for Manitoba and Saskatchewan.

The number of isolates of the various races from the five locations where Klein Titan was planted (Table 4) shows that race C53 predominated at Morden and Portage but farther west in Manitoba at Brandon and in Saskatchewan race C33 was more prevalent and race C25 occurred commonly. The less common races occurred sporadically, possibly the result of a non-uniform distribution of a small quantity of primary inoculum.

Table 4. Number of isolates of races identified in stem rust collections from plots of the cultivar Klein Titan at 5 locations.

	Race								
Location	C25	C33	C49	C53	C54	C66	C67	C74	C75
Manitoba									
Morden	0	4	3	25	0	0	0	0	1
Portage	1	1	0	24	13	0	0	0	0
Brandon	21	16	1	25	0	0	0	0	0
Saskatchewan									
Indian Head	14	19	1	12	0	0	2	10	0
Regina	7	17	5	18	0	3	0	0	0

Table 5. Percent of total isolates and races avirulent on single identified resistance genes

Resistance gene	Avirulent isolates % 1978	(1977)	Avirulent races % 1978	(1977)
Sr5	0.6	(0.4)	11.8	(8)
Sr6	82.9	(76.9)	70.6	(76)
Sr7a	8.8	(4.1)	35.3	(24)
Sr7b	28.4	–	52.9	–
Sr8	2.2	(3.6)	23.5	(28)
Sr9a	96.5	(94.8)	58.8	(64)
Sr9b	83.2	(74.8)	76.5	(68)
Sr9b	25.9	(27.4)	64.7	(60)
Sr9e	25.9	(27.4)	64.7	(60)
Sr10	8.5	(3.2)	29.4	(32)
Sr11	14.0	(16.5)	52.9	(52)
Sr13	75.6	(75.9)	64.7	(80)
Sr14	0	(0)	0	(0)
Sr15	70.7	(72.0)	29.4	(36)
Sr17	31.8	(40.0)	29.4	(44)
SrTt1	19.0	(22.9)	47.1	(28)
SrTt2	100	(99.4)	100	(96)

A collection of stem rust on wild barley from Kincaid, Saskatchewan produced infection types 2 to 3 + on highly susceptible Little Club wheat (*T. compactum*). It was avirulent on all of the differentials. In other tests it produced infection types 2 to 3 + on the very susceptible Australian wheat cultivars W2691 and W3498 but it produced only a 0; infection type on the susceptible cultivars Prelude, Red Bobs, Klein Titan, Prelude x Marquis[8], and Pellisier. It was also avirulent on Rosen rye and Rosner triticale, but the barley cultivars Montcalm and Conquest were only moderately resistant. In many ways it resembled the hybrid rust cultures produced by crossing *P. graminis* f. sp. *tritici* and *P. graminis* f. sp. *secalis* (3). Since a race with such a narrow host range would have difficulty surviving in nature its possible origin is of considerable interest. There is no direct evidence indicating how it might have originated but, in view of the large amount of rye stem rust on wild barley in 1978, there is a possibility that it might have originated by somatic hybridization between wheat stem rust and rye stem rust as proposed for the origin of new rust strains in Australia (4).

A group of highly resistant cultivars was inoculated with composite collections of urediospores that included samples from all of the 1978 isolates. The cultivars resistant to all urediospore collections were: C.I. 8154 x Frocor[2], Waldron, Agatha, Norquay, Glenlea, Tama, Esp 518/9, R.L. 5405, ND 499, ND 506, St 464, Coulter, Hercules, Wascana, Wakooma, and Macoun. Cultivars that had susceptible as well as resistant infections were: Mida-McMurachy-Exchange II-47-26, Frontana-K58-Newthatch II-50-17, Kenya Farmer, R.L. 4314, Chris, Era, Bonny, and Romany. Isolates from large pustules on eight of these cultivars were race C25 (38). These results nearly duplicate those recorded in 1977. It is clear that race C25 (38) is the most threatening of the races identified in recent years but it seems incapable of attacking presently grown commercial cultivars. There were no important changes in the virulence of the rust population on single resistance genes (Table 5).

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Literature cited

1. Green, G.J. 1975. Stem rust of wheat, barley and rye in Canada in 1974. Can. Plant Dis. Surv. 55: 51-57.
2. Green, G.J. 1978. Stem rust of wheat, barley and rye in Canada in 1977. Can. Plant Dis. Surv. 58: 44-48.
3. Green, G.J. 1971. Hybridization between *Puccinia graminis tritici* and *Puccinia graminis secalis* and its evolutionary implications. Can. J. Bot. 49: 2089-2095.
4. Watson, I.A., and N.H. Luig. 1958. Somatic hybridization in *Puccinia graminis* var. *tritici*. Proc. Lin. Soc. N.S.W. 83: 190-195.

Pertes dues aux maladies chez la luzerne au Québec en 1978[1]

C. Richard[2], *J. Surprenant*[3] *et C. Gagnon*[2]

Au cours de l'été 1978, un inventaire des pertes causées chez la luzerne (*Medicago sativa* L.) par les maladies foliaires et par la mineuse virgule (Agromyze de la luzerne) (*Agromyza frontella* Rond.) a été effectué au Québec. Il fait suite aux inventaires de 1974, 1975 et 1976 (7,8,9). La méthode et la période d'échantillonnage ont été modifiées de même que le mode d'évaluation des pertes.

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During the 1978 summer, a survey was conducted in Quebec on losses caused to alfalfa stands (*Medicago sativa* L.) by leaf diseases and by the alfalfa blotch leafminer (*Agromyza frontella* Rondami). Similar surveys were conducted in 1974, 75 and 76 (7,8,9). This year, time and techniques of sampling were modified, as well as the method of loss evaluation.

Matériel et méthodes

L'échantillonnage couvre les douze régions agricoles du Québec, soit 47 comtés, et a été effectué en août à raison d'un site par 1600 hectares en foin de luzerne, et ce, selon les superficies déclarées (10), auxquelles certains ajustements ont été faits à l'aide des renseignements obtenus des conseillers agricoles régionaux. La région de Québec faisant l'objet d'une étude plus intensive a été privilégiée avec un site par 500 hectares. Chaque luzernière a été échantillonnée en recueillant 10 plantes le long d'un tracé en forme de W tel que proposé par Basu et al. (1).

Les pourritures racinaires ont été classées selon les types décrits par McKenzie et Davidson (6) et leur notation effectuée selon l'échelle établie par Richard et Gagnon (7). L'évaluation des indices des maladies foliaires et de la mineuse virgule a été effectuée comme précédemment (7,8,9).

En plus de multiplier les indices par un facteur de 0,25 pour obtenir le pourcentage de pertes en poids, nous tenons compte de la différence de teneur en protéines des feuilles par rapport au plant entier, les pertes se retrouvant essentiellement sous forme de perte de feuillage. Ainsi, pour obtenir la valeur de remplacement du matériel perdu, un facteur de correction a été introduit dans le calcul des pertes afin de tenir compte de la valeur protéique du matériel perdu.

Hower et Byers (4) ont utilisé la valeur des protéines perdues pour déterminer la rentabilité d'une application d'insecticides contre la cicadelle de la pomme de terre (*Empoasca fabae* (Harr.)).

Les pertes s'évaluent alors comme suit:
Pertes (%) : (Σindices moyens) × 0,25 × 1,61 où 1,61 est le rapport du contenu en protéines dans les tissus foliaires sur celui de la plante entière, soit 30,7/19 (3).

Résultats et discussion

Les indices des pourritures racinaires ainsi que leur fréquence, les indices et la fréquence des maladies foliaires, et l'évaluation des pertes causées par ces maladies, sont donnés respectivement aux tableaux 1, 2 et 3, alors que la fréquence, l'indice et les pertes causées par la mineuse virgule le sont au tableau 4.

Chez les pourritures racinaires, nous retrouvons en ordre décroissant d'importance, la pourriture racinaire externe, la pourriture externe du collet et le pourridié fusarien avec des indices de 2,45, 2,11 et 1,24 respectivement. Il y a donc inversion des deux derniers types par rapport aux résultats de 1976 (9).

Les trois plus importantes maladies du feuillage sont par ordre, la tige noire printanière (*Phoma medicagenis* Malbr. & Roum.), la tache leptosphaerulinienne (*Leptosphaerulina briosiana* (Poll.) Graham & Luttrel) et la tache commune (*Pseudopeziza medicagenis* (Lib.) Sacc.), cette dernière affichant un net recul par raport aux années précédentes. On constate également une forte augmentation de la tige noire, son indice passant de 3,67 à 15,77. De faibles quantités de taches stemphyliennes (*Stemphyllium botryosum* Wallr.) avec un indice de 0,20 pour l'ensemble ont été relevées. De plus, le mildiou (*Peronospora trifoliorum* de By.) et la tache jaune (*Pseudopeziza jonesii* Nannf.) ont été observés sporadiquement.

En utilisant le calcul ci-haut mentionné pour l'évaluation des pertes, nous obtenons une perte nette de 7,76 pour

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cent pour les maladies foliaires et de 7,87 pour cent pour la mineuse virgule, soit une perte totale de 15,63 pour cent. Si nous utilisons les valeurs non corrigées pour la perte protéique, les pertes s'élèvent à 4,80 et 4,87 pour un total de 9,67 pour cent. La valeur des pertes non corrigées est de $6,8 millions par rapport à une valeur corrigée de $11,1 millions.

Selon la méthode de calcul habituelle (8,9), les pertes en 1978 ($6,8 millions) seraient sensiblement plus élevées qu'en 1976 ($5,6 millions). Cette différence peut être réelle et due en grande partie à l'augmentation des dégâts causés par la mineuse dont l'évaluation est passée de $0,212 millions en 1975 à $2,929 millions en 1976 et $3,417 millions en 1978. Mais elle peut aussi être due aux changements apportés à l'inventaire (période et méthode d'échantillonnage). Cependant, selon la valeur de remplacement calculée, les pertes ont été largement sous-estimées par les années passées et se situeraient plutôt autour de $11 millions.

Tableau 1. Fréquence et gravité des pourritures racinaires chez la luzerne au Québec en 1978.

Région	Superficie (ha)*	Nombre de champs	Pourridié fusarien	Pourriture externe du collet	Pourriture racinaire externe
1	24300	9	9/1,23	9/2,23	9/2,47
2	17170	33	33/1,23	33/1,88	33/2,27
3	6845	3	3/0,88	3/1,56	3/2,32
4	14030	8	8/1,28	8/1,88	8/2,23
5	4536	1	1/1,00	1/2,55	1/2,40
6	33170	19	19/1,44	19/2,23	19/2,56
7	16350	6	6/1,50	6/2,17	6/2,76
8	11630	7	6/1,27	6/2,33	6/2,29
9	4265	2	2/0,75	2/2,32	2/2,75
10	21470	13	13/1,02	13/2,15	13/2,47
11	5184	2	2/1,44	2/2,72	2/2,47
12	6170	2	2/0,89	2/1,01	2/2,11
TOTAL:	165120	105	104/1,24	104/2,11	104/2,45

* 1 ha = 2,47 acres

Tableau 2. Fréquence et gravité des maladies du feuillage de la luzerne au Québec en 1978.

Région	Superficie (ha)*	Nombre de champs	Tache commune	Tache stemphyllienne	Tige noire	Tache leptosphaerulinienne	Total:
1	24300	9	6/0,39		9/ 3,33	7/ 2,86	6,58
2	17170	33	26/0,37	5/0,11	33/10,82	24/ 1,30	12,60
3	6845	3	1/0,01	1/0,15	3/15,41	3/15,91	31,48
4	14030	8	4/0,61	3/0,96	8/14,41	3/ 0,44	16,42
5	4536	1	1/0,01		1/18,50		18,51
6	33170	19	4/0,001	7/0,24	19/23,30	5/ 0,29	23,83
7	16350	6	4/0,27	2/0,04	6/16,00	2/ 1,42	17,73
8	11630	7	4/0,03	2/0,005	7/16,58	3/ 2,15	18,76
9	4265	2	2/0,52	2/0,30	2/11,80	2/13,85	26,47
10	21470	13	7/0,23	1/0,01	13/23,68	10/ 2,10	26,02
11	5184	2	2/0,42	2/0,96	2/29,92	1/ 0,49	31,79
12	6170	2	2/0,74	2/0,19	2/ 0,81	2/18,69	20,43
TOTAL:	165120	105	63/0,26	27/0,20	105/15,77	62/ 2,95	19,18

* 1 ha = 2,47 acres

Tableau 3. Pertes dues aux maladies de la luzerne au Québec en 1978.

Région	Superficie (ha)*	Rendement (TM/ha**)	Pertes brutes***	Production Acutelle	(ooo TM) Potentielle	Pertes ('ooo TM)	Pertes nettes	% de perte nette	Valeur ($'ooo**)
1	24300	8,79	1,65	213,597	217,180	3,583	5,789	2,67	261,026
2	17170	8,70	3,15	149,379	154,237	4,858	7,849	5,09	353,911
3	6845	8,39	7,87	57,429	62,335	4,906	7,927	12,72	357,428
4	14030	9,01	4,11	126,410	131,828	5,418	8,754	6,64	394,718
5	4536	8,39	4,63	38,057	39,905	1,848	2,986	7,48	134,639

Tableau 3. (suite)

Région	Superficie (ha)*	Rendement (TM/ha**)	Pertes brutes***	Production Acutelle	(ooo TM) Potentielle	Pertes ('ooo TM)	Pertes nettes	% de perte nette	Valeur ($'ooo**)
6	33170	9,98	5,96	331,037	352,017	20,980	33,899	9,63	1528,506
7	16350	9,98	4,43	163,173	170,737	7,564	12,222	7,16	551,090
8	11630	8,88	4,69	103,274	108,356	5,082	8,211	7,56	370,234
9	4265	7,35	6,61	31,348	33,531	2,183	3,527	10,68	159,032
10	21470	8,88	6,51	190,654	203,930	13,276	21,451	10,52	967,226
11	5184	7,15	7,95	37,066	40,267	3,201	5,172	12,84	233,205
12	6170	9,10	5,11	56,147	59,171	3,024	4,886	4,70	220,310
TOTAL:	165120	9,07	4,80	497,63	1573,14	75,51	122,01	7,76	5501,43

* 1 ha = 2,47 acres
** Tonnes métriques à l'hectare selon Lebeau 1975.
*** Basé sur un prix moyen de $45.09 la tonne métrique. Bureau de la Statistique du Québec, communication personnelle.

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

Région	Nombre de champs échantillon	Superficie (ha)*	Rendement (TM/ha**)	Nombre de champs/ indice de maladies	% Pertes brutes	Production Actuelles	('ooo TM) Potentielle	Pertes brutes*** ('ooo TM)	Pertes nettes ('ooo TM)	Pertes nettes (%)	Valeur des pertes ('ooo $**)
1	9	24300	8,79	9/ 1,23	0,31	213,597	214,261	0,664	1,073	0,50	48,382
2	33	17170	8,70	33/22,24	5,56	149,379	158,173	8,794	14,209	8,98	640,684
3	3	6845	8,39	3/12,16	3,04	57,429	59,229	1,800	2,908	4,91	131,122
4	8	14030	9,01	8/20,66	5,16	126,410	133,288	6,878	11,113	8,34	501,085
5	1	4536	8,39	1/17,60	4,40	38,057	38,809	1,752	2,831	7,11	127,649
6	19	33170	9,98	19/18,82	4,71	331,037	347,400	16,363	26,439	7,61	1192,134
7	6	16350	9,98	6/34,52	8,63	163,173	178,585	15,412	24,902	13,94	1122,831
8	7	11630	8,88	7/29,88	7,47	103,274	111,611	8,337	13,471	12,07	607,407
9	2	4265	7,35	0/0	--	--	--	--	--	--	--
10	13	21470	8,88	13/32,28	8,07	190,654	207,390	16,736	27,042	13,04	1219,324
11	2	5184	7,15	2/24,07	6,02	37,066	39,482	2,416	3,904	9,89	176,031
12	2	6170	9,10	0/0	--	--	--	--	--	--	--
TOTAL:	105	165120	9,07	101/19,48	4,87	497,63	1574,30	76,67	23,88	7,87	5585,75

* 1 ha = 2,47 acres
** Tonnes métriques à l'hectare selon Lebeau 1975.
*** Basé sur un prix moyen de $45.09 la tonne métrique. Bureau de la Statistique du Québec, communication personnelle.

Citées

1. BASU, P.K., C.S. LIN et M.R. BINNS. 1977. A comparison of sampling methods for surveying alfalfa foliar diseases. Can. J. Plant Sci. 57: 1091-1097.
2. BERKENHAMP, B. 1971. Losses from foliage diseases of forage crops in central and northern Alberta in 1970. Can. Plant Dis. Surv. 51: 96-100.
3. BICKOFF, E.M., G.O. KOHLER et D. SMITH. 1972. Chemical composition of herbage. *In* Alfalfa Science and Technology. Ed.: C.H. Hanson, Am. Soc. Agron., Madison. pp. 247-282.
4. HOWER, A.A. et R.A. BYERS. 1977. The potato leaf hopper reduces alfalfa quality. Science in Agric. 24: 10-11.
5. LEBEAU, J. 1975. Production extensive versus production intensive et régionalisation. (non publié)
6. McKENZIE, J.S. et J.G.N. DAVIDSON. 1975. Prevalence of alfalfa crown and root diseases in the Peace River Region of Alberta and British Columbia. Can. Plant Dis. Surv. 55: 121-125.
7. RICHARD, C. et C. GAGNON. 1975. Pourridié fusarien et maladies du feuillage chez la luzerne au Québec en 1974. Can. Plant Dis. Surv. 55: 45-47.
8. RICHARD, C. et C. GAGNON. 1976. Pertes dues aux maladies de la luzerne au Québec en 1975. Can. Plant Dis. Surv. 56: 82-84.
9. RICHARD, C. et C. GAGNON. 1977. Pertes dues aux maladies chez la luzerne au Québec en 1976. Can. Plant Dis. Surv. 57: 15-17.
10. STATISTIQUE CANADA. Recensement du Canada de 1976. Agriculture.

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