Canadian Plant Disease Survey

Inventaire des maladies des plantes au Canada

Vol. 75, No. 2, 1995

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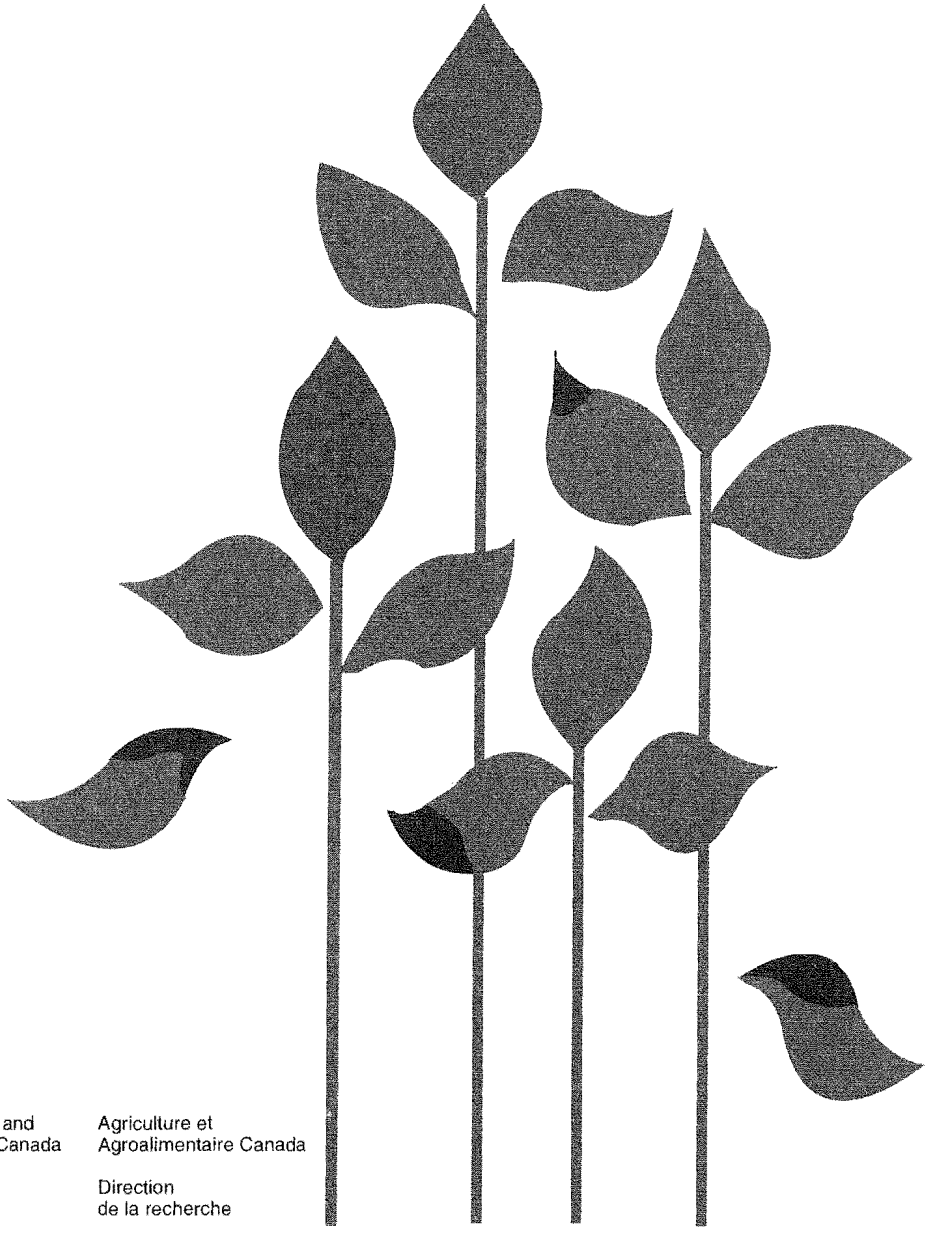

Agriculture and Agri-Food Canada
Research Branch

Agriculture et Agroalimentaire Canada
Direction de la recherche

Canada

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CPDS 75(2) 185–200 (1995) ISSN 0008-476X

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.

Research Branch, Agriculture and Agri-Food Canada

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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'enqête 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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Occurrence of anthracnose fruit rot caused by *Colletotrichum acutatum* on day-neutral strawberries in Manitoba

A.G. Xue and C.G. Davidson[1]

Anthracnose fruit rot of strawberry, caused by *Colletotrichum acutatum*, was observed in August, 1994 in a strawberry cultivar yield trial at Morden, Manitoba. The disease was found on five day-neutral cultivars. Incidence of fruit rot ranged from 11% on cv. Seascape to 82% on Fern. The pathogen may have been introduced via transplants imported from California as this disease has not been previously detected in commercial strawberry fields in Manitoba. This is the first official report of *C. acutatum* on strawberry in Canada.

L'anthracnose de la pourriture de la fraise, causée par *Colletotrichum acutatum*, a été observée en août 1994 dans un essai de rendement d'un cultivar de fraise à Morden, au Manitoba. Cinq cultivars insensibles à la photopériode étaient atteints de la maladie. L'incidence de la pourriture de la fraise va de 11 % chez cv. Seascape à 82 % chez Fern. Le pathogène aura pu être transmis par des plants importés de la Californie étant donné que cette maladie n'a pas été détectée préalablement dans les champs commerciaux de fraises au Manitoba. Il s'agit du premier rapport officiel sur *C. acutatum* des framboises du Canada.

Introduction

Strawberry (*Fragaria* X *ananassa* Duchesne) is an important horticultural crop in Manitoba with an annual farm gate value of $3 million (1). The majority of the strawberries grown in Manitoba are June-bearing cultivars harvested by farmers and growers for roadside stands and local fresh markets, or by individuals for home use. Growers are interested in the introduction of day-neutral strawberries which have the potential to increase the production acreage and to make fresh strawberries available throughout the growing season.

Anthracnose fruit rot, caused by *Colletotrichum acutatum* Simmonds, has been reported on strawberry in Australia and New Zealand (6), England (3) and the United States (4). The fungus may also cause lesions on petiole and runners, crown rot and wilt of strawberry plants (4,5). Anthracnose fruit rot was observed for the first time in Manitoba in cultivar evaluation trials at Morden, in August 1994. Severe fruit rot of day-neutral cultivars had occurred within 5 wk after it was first noted. This report shows the progression of anthracnose disease in the naturally infected strawberry field plots and the disease response of several day-neutral cultivars in yield trials.

Materials and methods

Five day-neutral strawberry cultivars were examined for their reactions to anthracnose caused by *C. acutatum* in two separate field trials at Morden during the 1994 growing season. The two trials were planted on a clay loam soil at the Morden Research Centre, Manitoba, Canada, using certified virus-free transplants imported from California. For trial 1 the cultivars Fern, Tristar, Tribute and Hecker were planted in May 1992, and for trial 2 the cultivars Fern, Tristar, Hecker and Seascape were planted in May 1993. The cultivars were planted in a matted-row system in 2.0 m rows with 2.0 m between rows. The single rows of each cultivar were randomized in each of five replicate blocks in trial 1 and four replicate blocks in trial 2. Ripe fruit were hand-picked and counted at 3 day intervals starting 17 June 1994. Diseased fruit were observed in August 1994 and were harvested from 13 September to 23 September, the end of fruiting season. At each of these harvests the ripe healthy fruit and diseased fruit were collected separately and the number in each category was recorded for each plot. Data were analyzed by analysis of variance using SAS statistical programs (2). Treatment means were separated by the least significant difference (LSD) test or by student's *t* test at a probability level of 0.05.

Results and discussion

Anthracnose rot symptoms were first observed on fruit during the 2 August 1994 harvest. These early infections appeared as small, irregular, tan or light brown, water-soaked lesions. By 7-10 August the lesions had become circular, dark brown and sunken (Fig. 1a). The symptoms

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Accepted for publication, July 15, 1995.

were observed on both green and ripe fruit. About three weeks after the early infections were observed the affected fruit were firm dry, and mummified (Fig. 1b).

Isolations from rotted fruit on potato-dextrose agar (PDA) consistently yielded *C. acutatum*. The fungus produced aseptate conidia in culture and on diseased fruit. The growth rate in culture at 30°C and characteristics of the colony (Fig. 2a), the lack of setae on PDA and fruit, and conidial shape and size (Fig 2b) were consistent with those described in systematics (5). The identity of *C. acutatum* was verified by Dr. B. J. Smith at the USDA, Small Fruit Research Station, Poplarville, Mississippi. Using the inoculation method described by Smith and Black (4) and identified cultures, *C. acutatum* was confirmed as the etiologic agent of the fruit rot by verifying Koch's postulates.

By 12 September the extent of fruit rot among the cultivars used in each trial was estimated to be 10 to 50%. The incidence increased from day to day after a heavy rainfall (76 mm) on 3 and 4 September. Significant differences were found in the incidence of anthracnose fruit rot among the four cultivars in each trial. Tristar fruit had the lowest incidence of rot in trial 1 (28.2%) and the second lowest in trial 2 (13.3%). Seascape was not used in trial 1, but its fruit showed the lowest incidence of rot in trial 2 (12.7%). The level of fruit rot infection of Tribute fruit (53.7%) was moderate compared to that of the other cultivars used in trial 1. Fern and Hecker were the most susceptible cultivars, with fruit rot in excess of 55% in both trials (Table 1).

For each of the three cultivars tested in both trials the disease incidence was significantly greater in trial 1 (Table 1). This may have been due to an increase in inoculum during the first year for plants in trial 1. The source of *C. acutatum* inoculum is uncertain. It may be an indigenous pathogen in the field plots or it may have been introduced on the day-neutral transplants from California.

In both trials, the incidence of fruit rot increased on all cultivars over the 11-day assessment period (Fig 3). The incidence of fruit rot, averaged for Fern, Hecker and Tristar, increased from 61% to 68% in trial 1 and from 36% to 62% in trial 2. The rapid increase in fruit rot incidence over the 11-day period in trial 2 suggests that the disease can be very destructive once infection is established or inoculum build up.

Anthracnose fruit rot, caused by *C. acutatum*, has not been detected previously in commercial strawberry fields in Manitoba, nor elsewhere in Canada. We suspect that the pathogen was introduced on imported transplants. Since *C. acutatum* likely will survive over winter on plant debris and mummified fruits in the field, the pathogen may become more widespread in the 1995 crop unless controls are put in place. Measures to prevent further spread and to eradicate the pathogen may become necessary in day-neutral plantings, including burning of plant debris, destroying older plantings by deep plowing, and rotating crops.

Acknowledgements

The authors thank Dr. B.J. Smith at the USDA, Small Fruit Research Station, Poplarville, Mississippi, for the identification and confirmation of *C. acutatum*. We also gratefully acknowledge Mr. M.P. Reimer for photographic assistance, J. Dyck and S. Gobin for their technical assistance. This work was funded by the Prairie Fruit Growers Association.

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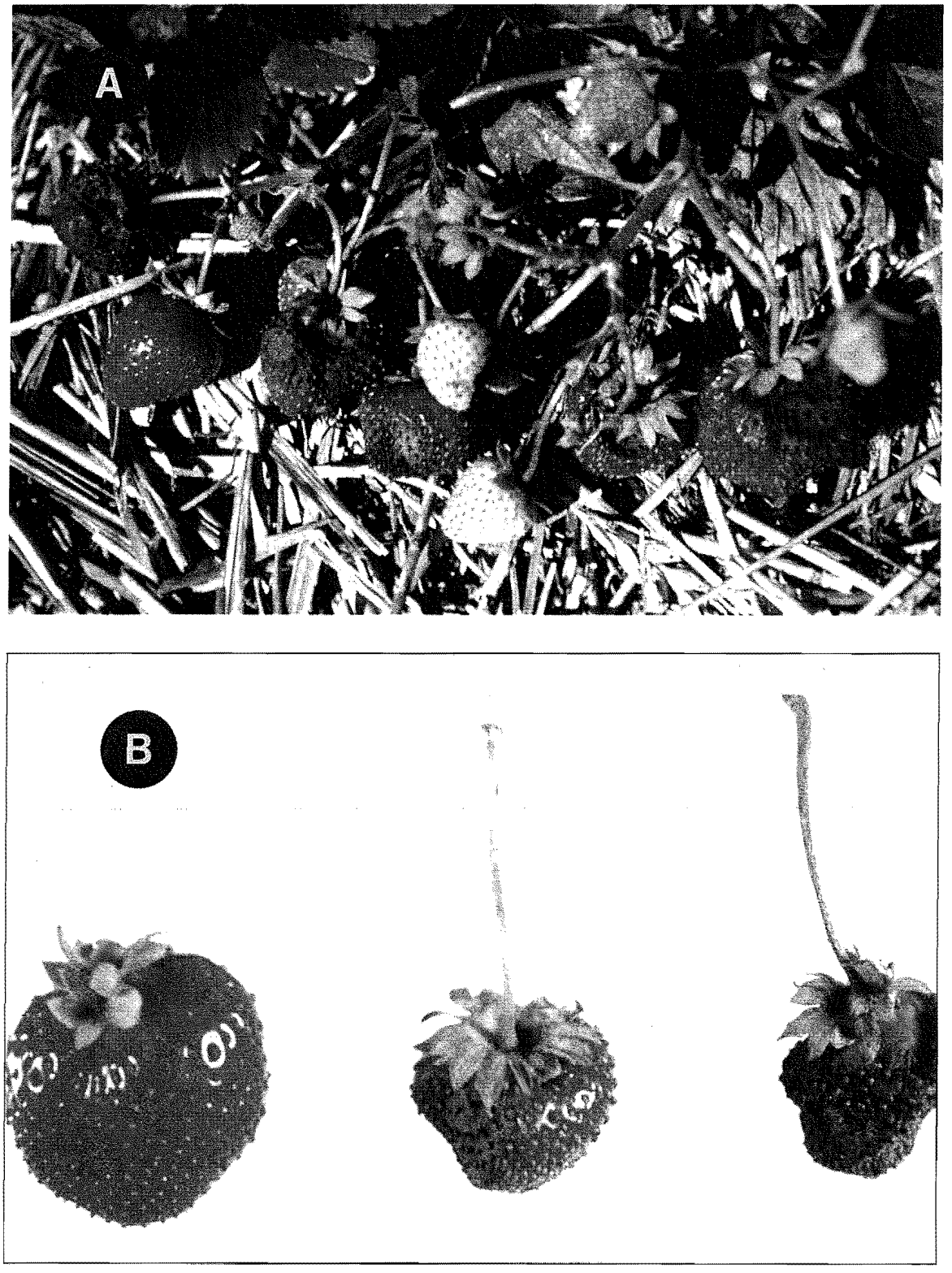
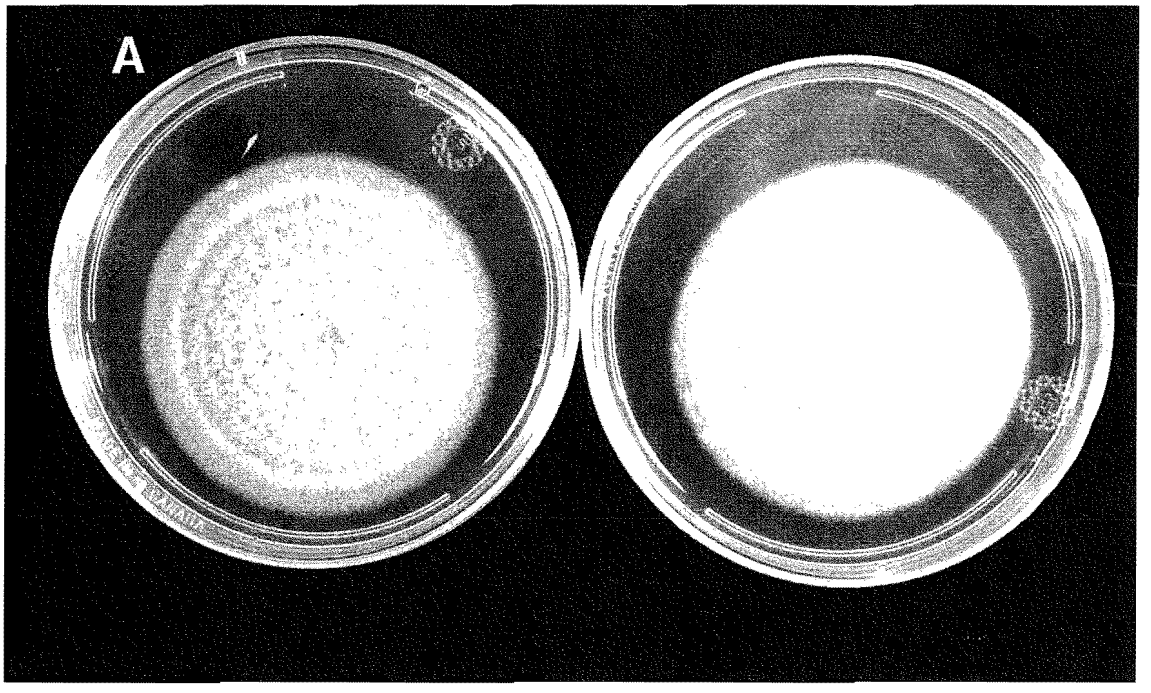


Fig. 1. Symptoms of anthracnose fruit rot of strawberry caused by *Colletotrichum acutatum*; (A) Infected fruits in the field. (B) Comparison of healthy berry (left) and infected berries (middle and right).



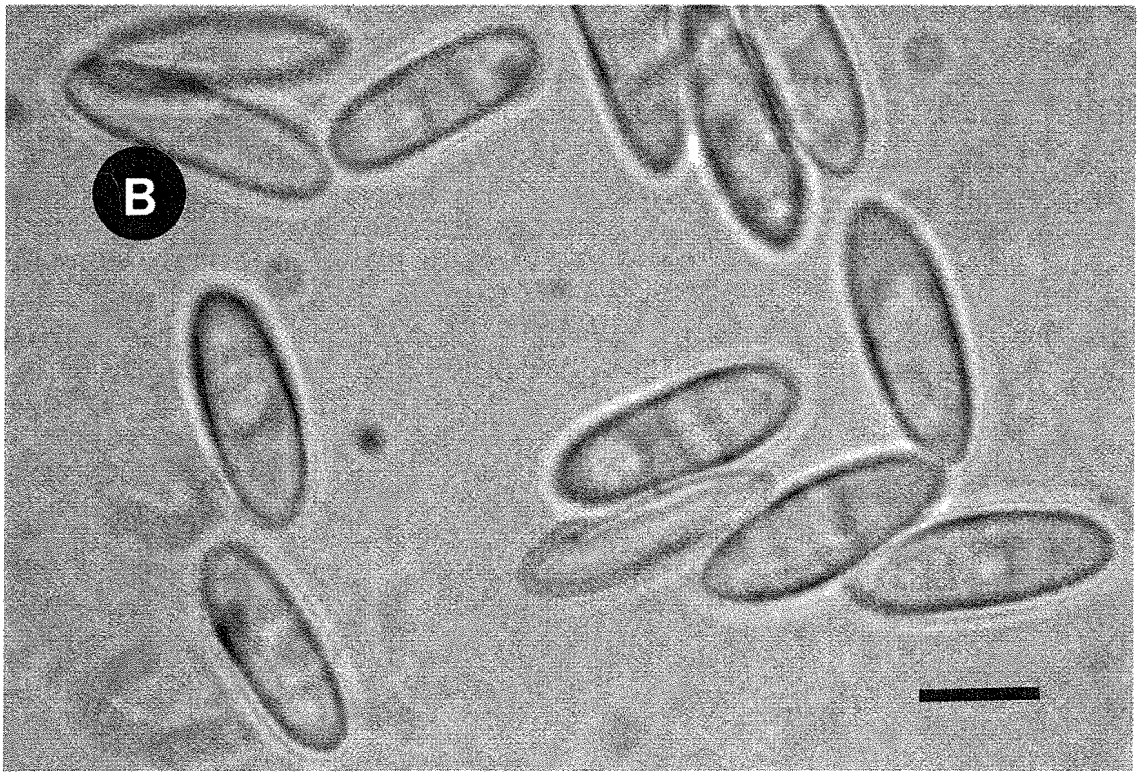


Fig. 2. *Colletotrichum acutatum* isolated from infected strawberry fruits; (A) Seven day old cultures on PDA under continuous fluorescent light following a 3-mm mycelial agar disc transfer; upper colony surface (left) and lower colony surface (right). (B) Conidia; scale bar = 10µm.

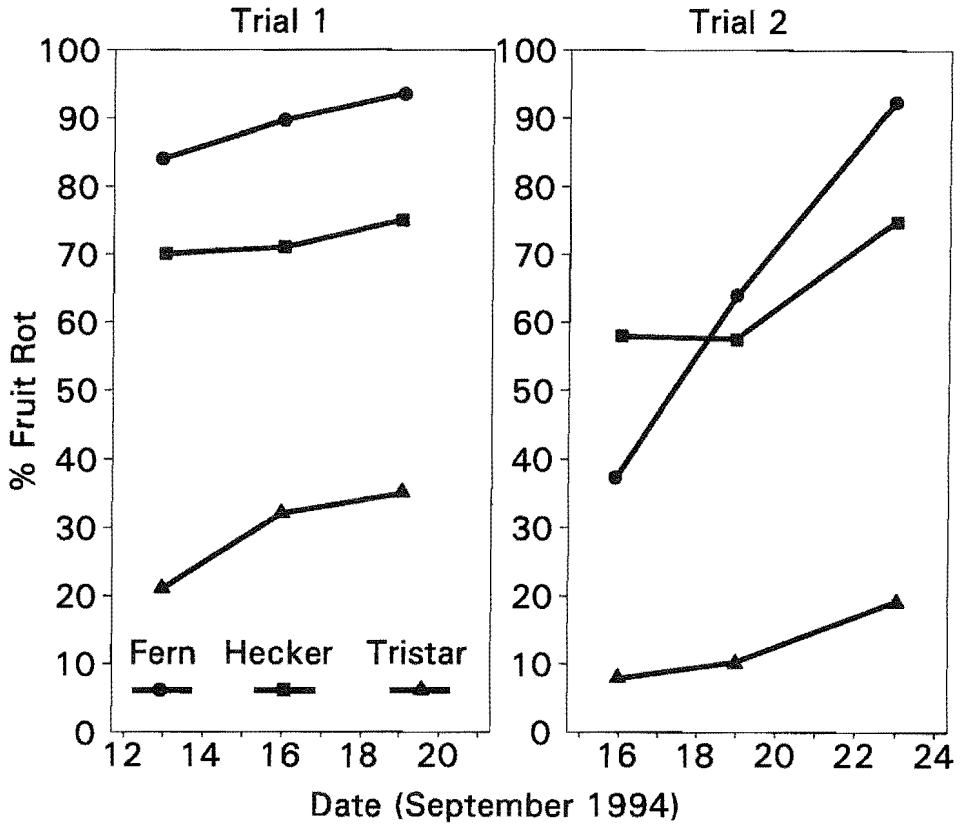


Fig. 3. Development of anthracnose fruit rot in strawberry caused by *Colletotrichum acutatum* during September 1994 at Morden, Manitoba. Each point represents the mean of five replicate plots in Trial 1 and four replicate plots in Trial 2.

Table 1. Mean incidence of anthracnose fruit rot caused by *Colletotrichum acutatum* on day-neutral strawberries at Morden, Manitoba in 1994.

	Trial 1H *		Trial 2**		Contrast in fruit rot Trial 1 vs. Trial 2		
Cultivar	No. fruits harvested	% rotted fruits	No. fruits harvested	% rotted fruits	Difference	t	P > t
Fern	693	88.6 a	131	69.6 a	19.0	8.8	0.02
Hecker	390	75.0 a	101	55.5 a	19.5	6.8	0.03
Tristar	611	28.2 c	117	13.3 b	14.9	11.4	0.01
Tribute	498	53.7 b	NA	NA			
Seascape	NA***	NA	71	12.7 b			

* Trial 1 with five reps and trial 2 with four reps were established in 1992 and 1993, respectively.
** Means in the same column followed by the same letter are not significantly different at P = 0.05 using LSD test.
*** Seascape was not used in trial 1, Tribute was not used in trial 2.

Pythium root rot associated with cool-season dieback of turfgrass in Ontario and Quebec

T. Hsiang, C. Wu, L. Yang and L. Liu[1]

Pythium species were isolated from diseased samples of creeping bentgrass and annual bluegrass. Among fourteen isolates from decayed roots and crowns, seven were *P. graminicola*, five were *P. torulosum* and two were *P. ultimum*. These species were identified by comparison of cultural and morphological characteristics to literature and reference isolates. In a tissue culture plate assay for quantifying virulence of *Pythium* spp., significant differences in seedling emergence were found among isolates. In general, isolates produced more severe root rot on perennial ryegrass than on creeping bentgrass, and isolates of *P. ultimum* were more virulent than those of *P. graminicola* or *P. torulosum*. Furthermore, greater virulence was generally found at 15 °C than at 30 °C. Virulence differences were confirmed in greenhouse pot tests. Oospores and sporangia were recovered from inoculated symptomatic samples. We conclude that Pythium species are a cause of cool-season dieback of golf course turfgrass in Ontario and Quebec.

Des espèces Pythium ont été isolées à partir d'échantillons d'agrostides stolonifères et de pâturins annuels. Sur quatorze souches provenant de racines et de couronnes pourries, sept étaient de type *P. graminicola*, cinq de type *P. torulosum* et deux de type *P. ultimum*. Ces espèces ont été identifiées en comparant leurs caractéristiques culturales et morphologiques à des souches documentées. Dans le cadre d'une bioanalyse de culture tissulaire de *Pythium* spp. sur plaque de gélose, des différences importantes dans l'émergence des semis ont été observées entre les souches. En général, les souches produisent un pourridié plus sévère sur le ray-grass vivace que sur l'agrostide traçante. Les souches de *P. ultimum* étaient plus virulentes que celles de *P. graminicola* ou *P. torulosum*. De plus, une plus grande virulence a été remarquée à 15 °C qu'à 30 °C. Les différences dans la virulence ont été confirmées lors de tests effectués en serre. Les oospores et sporanges ont été retrouvés dans les échantillons auxquels on a inoculé les symptômes. Nous en sommes arrivés à la conclusion que les espèces Pythium prolifèrent au moment où le gazon dans les terrains de golf du Québec et de l'Ontario dépérit à cause du temps qui se refroidit.

Introduction

There is a dieback disease of lawns, golf courses and other intensively cultivated turfgrass areas that occurs during the cool season. In regions near the Great Lakes, turf managers report that this dieback is most common during cool wet weather in spring and fall, and is characterized by either a diffuse blighting or yellowing of turf in small patches. Recent research has indicated that *Pythium* species causing root rot of grasses may play an important role in this dieback (Abad *et al.* 1994; Nelson and Craft, 1991).

Pythium species have been identified as causal agents of a foliar cottony blight on turfgrasses (Muse *et al.* 1974; Saladini, 1980; Saladini *et al.* 1983; Smiley *et al.* 1992). Vanterpool (1942) reported that *Pythium* species also were associated with root rot of grasses and subsequently, many *Pythium* species have been cited as causing root rots of grasses including *P. aphanidermatum, P. aristosporum, P. arrhenomanes, P. myriotylum* and *P. torulosum* which were reported in the United States (Endo, 1961; Kraft *et al.* 1967; Hendrix *et al.* 1970; Saladini *et al.* 1976; Saladini, 1980; Hodges *et al.* 1985; Hodges, 1992; Hodges and Campbell, 1994); *P. dissimile, P. irregulare, P. splendens*, and *P. violae* in Australia and Finland (Dewan *et al.* 1988; Vestberg, 1990); and *P. graminicola, P. periplocum* and *P. vanterpoolii* in Japan (Ichitani, 1986).

Over the past few years *Pythium* root rot has been recognized as a serious disease of turfgrasses in high maintenance plantings in the United States. Nelson and Craft (1991) in New York showed that several species of *Pythium* isolated from creeping bentgrass (*Agrostis palustris*) and annual bluegrass (*Poa annua*) were pathogenic when inoculated onto creeping bentgrass and perennial ryegrass (*Lolium perenne*). Their results suggest that two of the important species are *P. graminicola,* which was the most virulent species, and *P. torulosum*, which was the most common species. Abad *et al.* (1994) isolated *Pythium* species from roots and crowns of bentgrass and other turfgrass species and reported that the predominant ones were *P. arrhenomanes, P. catenulatum, P. intermedium,*

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Accepted for publication, July 16, 1995.

P. oligandrum, P. periilum, P. torulosum and *P. vanterpoolii.* They collected 264 turfgrass isolates of 33 *Pythium* species in North Carolina over 2 years, and found 8 highly virulent and 9 moderately virulent species.

Cool weather dieback problems have been observed on golf courses in regions near the Great Lakes, but north of the Great Lakes little is known of the identity of the causal organisms or whether *Pythium* species are associated with root rot of turfgrass. This study was undertaken to determine the cause of cool weather dieback in Ontario and Quebec, to identify *Pythium* species from turf roots and crowns, and to study their pathogenicity. Isolates from New York, North Carolina and Virginia, USA were also used in this study.

Materials and methods

Recovery and identification of *Pythium* species

Samples of diseased turfgrass from creeping bentgrass and annual bluegrass putting greens were collected from different locations in Ontario and Quebec. The diseased plants were rinsed thoroughly under running tap water. The roots and crowns were cut into 1-3 cm long pieces, and dried on paper towels. The tissue pieces were placed in petri dishes on the surface of *Pythium*-selective corn meal agar media (CMA) amended with 10 mg pimaricin, 200 mg vancomycin and 100 mg pentachloronitrobenzene per litre following Tsao and Ocana (1969). After 48-72 hours at 20-25°C, emerging hyphal tips at the colony margin were transferred to fresh unamended CMA media, and incubated at room temperature. Only 1 isolate per sample was retained (Table 1).

To induce formation of asexual and sexual reproductive structures, one plug (5 mm diameter) from a colony growing on amended or unamended CMA was placed on a fresh water agar (WA) plate. Several 2-4 cm long pieces of autoclaved creeping bentgrass leaves were placed in contact with the plug. The inoculated plates were incubated in the dark at 22-25°C. Sporangia, oogonia, antheridia and oospores were observed during 4 to 10 days of incubation. Identification to species was based on the monograph of Plaats-Niterink (1981). Reference isolates of *Pythium* species from three laboratories (Table 1) served as standards to confirm the identifications. We are grateful for the New York state isolates provided by E. Nelson (Cornell University, Ithaca, New York), North Carolina and Virginia isolates from L. Lucas (North Carolina State University, Raleigh, North Carolina) and the Quebec isolates from R. Belanger (University of Laval, Quebec City, Quebec).

Pathogenicity and virulence tests

The procedure described by Nelson and Craft (1991) was used to assay pathogenicity and virulence of *Pythium* isolates. Tissue culture plates with 24 wells (16-mm diam) were used in the assays. Sterilized fine sand (0.5 g) was added to each well. An agar disk (5-mm diam) cut from the edge of a growing culture was then placed on the sand, and covered by an additional 2.5g of sand. Each well was watered (0.75 mL) and seeded with creeping bentgrass (*A. palustris*) or perennial ryegrass (*L. perenne*), and another 0.5 g of sand was layered over the seeds. Wells also were inoculated with CMA plugs as control treatments and with other pathogenic isolates from other sources (Table 1). The plates were all enclosed in a plastic box lined with moistened paper towelling and incubated at either 15°C or 30°C under constant light. After 4 days, the wells were rated on a scale of 0 to 5 (Nelson and Craft 1991) where 0 = no disease and 5 = seedlings necrotic or not emerged. The experiment was arranged in a randomized complete block design with three replicates. An analysis of variance with SAS® version 6.04, procedure ANOVA at p=0.05, was used to estimate significant differences among the treatments. When significant treatment effects were found, separation of means was done by the test of Least Significant Difference (LSD, p=0.05).

The procedures of Nelson and Craft (1991) for assaying pathogenicity of Pythium isolates in a greenhouse were modified to test our isolates. Creeping bentgrass was grown for two to three weeks in a mixture of Pro-Mix, Turface and Perlite (1:1:1) in 10-cm diam plastic pots. *Pythium* inoculum of the isolates tested (Table 1) was prepared by incubating cultures in moistened sterilized chicken scratch (mixed grains from Waterloo-Oxford Cooperative) for 2 to 3 weeks at room temperature. For inoculation, the plants were lifted from the pots, and the roots and soil were cut horizontally 1-2 cm below the surface. The lower part of the root mass plus soil was returned to the pot, 3-4 cm^2 of inoculum was spread on the surface, and sod replaced over the inoculum. After two weeks of daily watering, the root systems of symptomatic turf were examined for the presence of sporangia and oospores. Four root samples per pot were plated onto the amended CMA media to attempt recovery of the inoculated isolates, and thus complete Koch's postulates. The greenhouse tests were arranged in a randomized complete block design with three replicates. Data was analyzed statistically by the same method used for the tissue culture plates assays.

Results and discussion

Pythium species isolated from roots and crowns of turfgrass

Single isolates of *Pythium* were recovered on selective amended CMA medium from each of 14 samples of decayed roots and crowns of turfgrass from Ontario and Quebec (Table 1). *Pythium graminicola* was isolated from 7 samples,

P. torulosum from 5 and *P. ultimum* from 2. Diseased tissues from 7 other sites in Ontario were free of *Pythium* after 2-5 days of incubation on the amended CMA media. The anthracnose pathogen (*Colletotrichum graminicola*), which is suspected to be a cause of cool-season dieback (personal communications with J. Skorulski, United States Golf Association, Palmer, Massachusetts and E. Nelson, Cornell University, Ithaca, New York,) was not observed on incubated tissues.

Morphological identification of *Pythium* species

Sporangium formation among isolates occurred usually within 2-3 days on grass leaves in contact with the cultures, and most isolates produced abundant oospores on the leaves within 10 days. Zoospores were occasionally observed in grass agar cultures at 22-25°C. *Pythium graminicola* produced inflated sporangia that were branched, forming irregular toruloid complexes. *Pythium torulosum* also produced inflated sporangia, but these were tuberous with branched swellings. Both species produced plerotic oospores; however oospores of *P. graminicola* were much bigger than those of *P. torulosum*. The size and shape of sporangia, oogonia, antheridia and oospores of *P. ultimum* isolated from turf roots were in agreement with the descriptions in the literature (van der Plaats-Niterink, 1981) and were similar to the confirmed isolates obtained from other laboratories.

Virulence of *Pythium* species to creeping bentgrass and perennial ryegrass in culture

Symptoms induced by *Pythium* species in tissue culture plate assay included mainly necrotic roots and lack of seedling emergence. During the course of this experiment, there was no evidence of cross contamination among wells. Control wells, scattered between the inoculated wells, showed no signs of disease. After the conclusion of the experiment (10 days), mycelium was observed to cross between wells. Symptoms induced by *Pythium* isolates in the greenhouse experiment showed chlorosis of the foliage, followed by wilting and necrosis of individual plants. In advanced stages, individual plants matted together on the surface of the pots to form necrotic clumps of turf. In both experiments, roots were extensively discoloured and sporangia and oospores were found in the cortex of diseased roots. The *Pythium* species used to inoculate the plants were readily reisolated from the diseased roots.

All *Pythium* isolates tested in this study were damaging to seeds and seedlings of creeping bentgrass or perennial ryegrass (Table 1). Most isolates of *P. graminicola* and *P. torulosum* were more virulent at 15°C than at 30°C. The two Ontario isolates of *P. ultimum* differed in pathogenicity. Significant differences were also found in virulence of *P. graminicola* and *P. torulosum* on perennial ryegrass and creeping bentgrass, and most isolates produced more severe root rot on perennial ryegrass than on creeping bentgrass. The virulence in our tests of reference isolates from other laboratories showed similar results to those previously reported. Compared to virulence levels of reference isolates from other laboratories, most of our *Pythium* isolates were moderately to weakly virulent.

The three *Pythium* species isolated from diseased plants in this study, *P. graminicola, P. torulosum* and *P. ultimum,* have been reported previously as causing foliar diseases of turfgrasses (Smith, 1989; van der Plaats-Niterink, 1981). The most frequently isolated species in this study was *P. graminicola*. Although *P. graminicola* is well-known as a causal agent of foliar or cottony blight on turfgrass (Ichitani *et al.* 1986; Muse *et al.* 1974; Saladini *et al.* 1976, 1983), it was not until 1991 that the role of this species as a root-rotting pathogen of turfgrass was definitely confirmed through comparative pathogenicity tests by Nelson and Craft (1991) and later by Abad *et al.* (1994). Nelson and Craft (1991) demonstrated that isolates of *P. graminicola* could cause root infection of both creeping bentgrass and perennial ryegrass at both low (13°C) and high (28°C) temperatures. The results of present study (Table 1) also affirmed the virulence of most Ontario turfgrass isolates of *P. graminicola* to creeping bentgrass (lab and greenhouse) and perennial ryegrass (lab).

Pythium torulosum was the second most frequent species isolated from diseased roots in this study. This species has also been reported in many other turfgrass disease surveys (Abad, 1990; Endo, 1961; Saladini, 1983; Abad, *et al.* 1994). Previous work showed that *P. torulosum* is weakly virulent on creeping bentgrass and avirulent on perennial ryegrass (Muse *et al.* 1974; Saladini, 1983; Abad, *et al.* 1994; Nelson and Craft, 1991); however, some isolates of *P. torulosum* in our study were moderately virulent to creeping bentgrass and perennial ryegrass at both low (15°C) and high (30°C) temperatures (Table 1). The greenhouse test also supported the pathogenicity of *P. torulosum* to potted creeping bentgrass (Table 1). The different findings of the current study from other studies indicates that more research needs to be done with *P. torulosum* on turfgrass.

Two isolates of *P. ultimum* were recovered, and one of them was virulent to perennial ryegrass at both the low and high temperatures and virulent to creeping bentgrass at the low temperature, whereas the other was virulent to perennial ryegrass only at the low temperature but virulent to creeping bentgrass at the both low and high temperatures (Table 1). This result suggests that *P. ultimum* may have a high degree of pathogenic variability and temperature preferences, but with such a small sample size, more research is needed.

From this study we conclude that *P. graminicola, P. torulosum* and *P. ultimum* can cause root rot of turfgrass

in Ontario and Quebec. Undoubtedly more *Pythium* species from diseased turfgrass will be found with more extensive studies, and there are still some uncertainties about the biology and ecology of cool-season dieback of turfgrass.

Acknowledgements

Funding for this study was provided by the Ontario Turfgrass Research Foundation, and the Ontario Ministry of Agriculture, Food and Rural Affairs Food Systems 2002 Pest Management Research Funding Program. We are also grateful for the cooperation of P. Charbonneau, M. Dykstra and the Ontario Turf Industry for providing samples of diseased turfgrass.

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Table 1. Virulence of *Pythium* species to perennial ryegrass and creeping bentgrass at 15°C and 30°C in tissue culture plates, and to creeping bentgrass in greenhouse pots.

Pythium species	Isolate number	Sources*	Disease Rating†				
			Perennial Ryegrass		Creeping Bentgrass		
			15°C	30°C	15°C	30°C	Greenhouse
P. graminicola	PRR-6	Schenectady, New York	3.7	4.7	5.0	5.0	5.0
	PRR-9	Ithaca, New York	4.7	3.3	5.0	5.0	5.0
	PRR-42	Rochester, New York	4.3	1.7	5.0	3.0	NT
	94393	Windsor, Ontario	1.7	0.3	4.3	0.7	2.0
	94394	Windsor, Ontario	2.3	0.7	1.3	1.0	1.3
	94077	Allandale, Ontario	3.0	2.3	2.3	0.7	1.3
	94078	Guelph, Ontario	4.0	1.3	2.7	0.3	1.7
	94081	Smiths Falls, Ontario	2.0	2.0	0.7	3.0	2.3
	94083	Lachute, Quebec	2.7	2.7	4.0	2.3	3.3
	94084	Aylmer, Quebec	2.3	2.3	1.7	2.7	2.7
P. torulosum	PRR-1S	Ithaca, New York	1.0	2.0	1.0	0.0	1.3
	PRR-3S	Ithaca, New York	1.3	1.3	3.3	1.0	NT
	PRR-59	Albany, New York	1.0	1.3	1.0	0.7	0.7
	94079	Smiths Falls, Ontario	2.0	0.7	1.3	1.3	1.7
	94080	Smiths Falls, Ontario	2.3	1.7	2.3	1.3	1.3
	94082	Lachute, Quebec	4.0	2.0	2.7	2.3	2.7
	94085	Janetville, Ontario	1.7	1.7	0.7	2.3	2.3
	94086	Janetville, Ontario	2.3	1.3	2.7	2.0	2.7
P. ultimum	94005	Quebec City, Quebec	5.0	4.3	4.7	4.0	NT
	94391	Windsor, Ontario	4.3	3.7	1.3	0.3	1.3
	94392	Windsor, Ontario	3.0	1.0	1.3	3.0	3.7
P. arrhenomanes	94002	Robinson, Virginia	5.0	5.0	5.0	5.0	NT
P. aphanidermatum	94001	Catawba Co., N.Carolina	4.0	5.0	3.7	5.0	4.7
Uninoculated check			0.3	0.3	0.0	0.0	0.3
LSD (p=0.05)**			1.1	1.1	1.0	1.1	1.1

* All isolates from the USA and *P. ultimum* from Quebec were used as reference isolates.

† Tissue culture plates at both 15 and 30°C were rated 7 days after inoculation, and greenhouse pots were rated 3 weeks after inoculation on a scale of 0-5, where 0=healthy and 5=100% chlorotic or necrotic turf.

NT Not tested.

** LSD (Least Significant Difference) tests were conducted after finding significant treatment effects in the Analysis of Variance (p=0.05).

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Instructions to Authors

The *Canadian Plant Disease Survey* is published twice a year, presenting articles on the occurrence and severity of plant diseases in Canada. Topics of interest include development of methods of investigation and control, including the evaluation of new materials. Original information, review papers and compilations of practical value to plant pathologists are accepted.

Peer reviewed articles and brief notes are published in English or French. Address the manuscript and all correspondence to Ms. Rosalyn McNeil, Information and Planning Services, Research Branch, Agriculture and Agri-Food Canada, Ottawa, Ontario K1A 0C6. Signatures of authors and the director of the establishment where the work was carried out should be supplied.

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Figures should be planned to fit, after reduction, into one column (maximum 84 x 241 mm) or two columns (maximum 175 x 241). Trim them or add crop marks to show only essential features. Mount figures grouped in a plate tightly together, with no space between them. Provide a duplicate set of unmounted photographs and line drawings. Identify figures by number, author's name, and abbreviated legend.

Tables should be numbered using arabic numerals. Provide a concise title. Do not use vertical rules. Identify footnotes by reference marks (*†§#¶**‡), particularly when they refer to numbers.

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

Recommandations aux auteurs

L'Inventaire des maladies des plantes au Canada est publié deux fois par année et contient des articles sur l'incidence et la gravité des maladies des plantes au Canada. Les articles portent surtout sur la mise au point de nouvelles méthodes d'investigation et de lutte comportant l'évaluation de nouveaux matériaux. Nous acceptons aussi des données de première main, des comptes rendus critiques de publications et les compilations qui peuvent être utiles aux phytopathologistes.

Les comptes rendus critiques et les courts résumés sont publiés en anglais et en français. Adresser le manuscrit et toute la correspondance à madame Rosalyn McNeil, Services d'information et de planification, Agriculture et Agroalimentaire Canada, Ottawa (Ontario) K1A 0C6. Vous devez aussi nous faire parvenir la signature des auteurs et du directeur de l'établissement où le travail a été effectué.

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