Colletotrichum acutatum, a new pathogen on western hemlock seedlings in British Columbia

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Colletotrichurn acutaturn was associated with terminal shoot and branch tip necrosis of container-grown western hemlock seedlings in a greenhouse near Aldergrove British Columbia. This is a new host and distribution record. Infected seedlings were outplanted to forest sites on Vancouver Island before the pathogen identity was established. Surveys of these sites for the next two years failed to detect any new infections. The damage potential of *C. acutaturn* in B.C. is discussed.

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Colletotrichurn acutatum est associé avec la necrose de la pousse terminale et du bout des branches de jeunes plants de pruche occidentale cultives en contenants dans une serre, située près d'Aldergrove en Colombie-Britannique. Cet article est la premiere mention de la presence de ce pathogène sur cet hôte et dans cette region. Les jeunes plants infectés furent plantés dans des sites forestiers sur l'île de Vancouver avant que l'identite du pathogène soit connue. Au cours des deux années suivantes, des inventaires de ces sites n'ont pas permis de détecter la presence de nouvelles infections. Une discussion des dommages pouvant être causes par *C. acutatum* en Colombie-Britannique s'ensuit.

Introduction

Colletotrichum acutatum Simmonds ex Simmonds (6,7), previously unreported in Canada, causes a terminal crook disease of Monterey pine (***Pinus radiata*** D. Don) in forest nurseries in New Zealand (1) and Chile (5). In New Zealand and Australia, C. ***acutatum*** has been found on several other species of pine, including *t? contorta* Dougl. ***Colletotrichumacutatum*** damages other plants such as coffee (3), tomatoes, and strawberries (2) but strains with a restricted host range have been discovered (1).

This report describes damage on western hemlock (***Tsuga heterophylla*** (Raf.) Sarg.) associated with C. ***acutatum*** following its discovery in 1981 within a nursery. It also gives the results of surveys of forest sites where stock containing diseased seedlings had been outplanted.

Nursery Site

A disease affecting the growing tips of western hemlock seedlings was found early in July 1981 at a nursery near Aldergrove, B.C. Seedlings for reforestation, comprising western hemlock, western red cedar (***Thuja plicata*** Donn), and Sitka spruce (***Picea sitchensis*** (Bong.) Carr.) had been sown that Spring and raised mainly in styroblocks within greenhouses.

Initial symptoms were small lesions on terminal shoots and branches commencing at, or close to, the tip and progressing down the shoot into the needles. Affected tissues were typically light to reddish brown. Very few seedlings had the crooking which characterizes the disease in Monterey pine (1). A few scattered acervuli characteristic of ***C. acutatum*** (2) were produced on most infected needles.

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Isolations from acervuli and from diseased tissues treated with a 10% solution of sodium hypochlorite for 2-3 minutes consistently yielded similar cultures on potato dextrose agar (PDA). Cultures at room temperature were initially white, becoming rose-pink within a few days and turning a deep red.

Conidia, borne on phialides throughout the colony were ellipsoid and pointed at both ends. A few setae occurred scattered through the colony. Colony and spore characteristics are similar to those described for ***C. acutatum*** isolates from papaw (6).

In November 1981 a typical culture was identified as C. ***acutatum*** by Dr. Gary Samuels of the Plant Diseases Division, Auckland, New Zealand, then visiting U.S. Department of Agriculture facilities at Beltsville.

In January 1982, random sampling in every seedlot of all coniferous species was carried out in every bay and greenhouse at the nursery. In the greenhouse where infections were known to occur, 10% of all seedlings, except Sitka spruce, were examined. All of the Sitka spruce were examined since they were very close to infected western hemlock. A 5% sample was used in other greenhouses containing no western hemlock.

All seedlings selected by the sampling system were examined for shoot tip or needle damage. Damage was attributed to *C. **acutatum*** only when typical acervuli and conidia were present or when typical cultures formed on PDA.

The disease was confined to western hemlock and five of the seven seedlots included infected seedlings (Table 1). An estimated 380 infected seedlings were present at the time of examination.

Some seedlings of lodgepole pine, Mugho pine (*P. **mugo*** Turra) and Colorado spruce (***Picea pungens*** Engelm.) were quite close to, but outside of the infested greenhouse; examination failed to show any ***C. acutatum.***

Table 1. Nursery seedlings infected by *Colletotrichum acutatum*[1]

Species	Seedlot Number	Total No. in Seedlot	NO. Infected
Western hemlock	3907	226,300	23
	3011	41,100	2
	3909	12,800	5
	2247	2,790	4
	2610	19,800	4
	3066	82,170	0
	3093	19,000	0
		440,950	38

[1] Also examined, but without detecting *C. acutatum* were 9 seedlots of western red cedar and 4 of Sitka spruce, totaling **1.59** and 0.67 million seedlings respectively.

Outplanted Sites

Approximately **70,000** western hemlock seedlings involving seedlots subsequently found to have *C. acutatum* were planted in October 1981 on 4 logged sites near Northwest Bay on Vancouver Island.

Searches for *C. acutatum* were conducted in spring and fall for approximately two years after outplanting. In the most intensive surveys, conducted each September, four or five persons traversed the sites for one day. All western hemlock seedlings with any tip damage, including some from an earlier planting and some that had regenerated naturally, were examined for fruiting bodies of C. *acutatum.*

The mid-June survey, the earliest date possible because of continuous snow cover, yielded 61 suspect seedlings only one of which had an acervulus containing a single conidium typical of *C. acutatum*. Three other seedlings each had acervuli typical of the pathogen but lacked the conidia. Most damage to the suspect seedlings was caused by frost, sun-scald, and grey mould (*Botrytis cinerea* Pers.).

In September 1982, 71 samples with tip damage were examined without finding *C. acutatum.* The damage had been caused mainly by sun-scald or frost although some Sirococcus blight (*Sirococcus strobilinus* Preuss) was also present.

In September 1983, 68 damaged shoots were examined. No evidence of *C. acutatum* was obtained. Most damage was from late spring frosts but a few seedlings had been attacked by *S. strobilinus, B. cinerea,* and *Xenomeris abietis* Barr.

Discussion

The discovery of this pathogen on western hemlock constitutes a new host record and the first report of this disease in Canada. British Columbia is not included in the known world distribution of *C. acutatum* (2) and a forest nursery disease extension service that has operated for many years had no record of *C. acutatum* in B.C. Western hemlock is not grown as a forest species in New Zealand. This probably explains the absence of this species from the host list.

The origin of the inoculum at Aldergrove remains unknown. Perhaps it was introduced on some ornamental Monterey pine that the affected nursery had imported from New Zealand. Incipient infections may have been involved. Studies in New Zealand (4) have established that although 50% of conidia introduced into soil become non-viable within four weeks, a high percentage of infected needles yielded the pathogen even after burial for 8.5 months, indicating a capacity to survive in infected tissue for long periods.

A study to fulfill the requirements of Koch's postulates for *C. acutatum* on western hemlock is desirable but the frequent occurrence of acervuli and of conidia typical of *C. acutatum* and the frequent isolation of the fungus provides strong evidence of pathogenicity.

The absence of any infections attributable to *C. acutatum* on the western red cedar and the Sitka spruce, despite the occurrence of these plants throughout their growth in the same greenhouse with the infected western hemlock implies a resistance to C. *acutatum.*

The incidence of the disease discovered in the January survey of the greenhouses was certainly lower than occurred during the preceding summer. Following discovery of the damage, extensive sanitation culling was carried out. Also, sprays of benomyl, captan and chlorothalonil fungicides were applied. Two of those control the disease in New Zealand (8). It seems likely that the higher greenhouse temperatures favored development of the pathogen. Simmonds (6) found the optimum for *C. acutatum* to be 25-26.5°C. The cultural conditions used for rapid seedling growth results in numerous infection courts in the form of succulent growing tips. Free moisture for the infection process would often be present because of the frequent watering of container stock.

The failure to obtain any evidence of survival and spread of C. *acutatum* at the planting sites may be due either to a low level of inoculum or the long harsh winters or a combination of both factors. The finding of at least one acervulus of C. *acutatum* in June 1982 shows that some inoculum was introduced to the field but the level is unknown. Culling of infected seedlings routinely occurs before shipment. Also, the brittle condition of affected tissues probably caused breakage thus reducing the amount of inoculum taken to the planting site. The initial winter with its continuous snow cover for approximately six months may have been a major factor. These conditions contrast with much warmer conditions in Queensland, Australia and in North Island, New Zealand, where the pathogen is very damaging.

The potential of the strain of *C. acutatum* found in B.C. to have spread to agricultural crops such as tomatoes and strawberries growing in adjacent areas of the Fraser valley is unknown. It has been shown (1) that the New Zealand strain from Monterey pine, designated as f. sp. *pinea,* could also infect lupine, sweetpeas, vetches, and tomatoes. However, isolates originating there from tree lupine and sweetpeas attacked only legumes but not pines. Similarly, isolates from other fruit rots in New Zealand were non-pathogenic on pine.

In New Zealand and Australia, *C. acutatum* infects several species of pine including *P. contorta* (1), suggesting that lodgepole pine in B.C. could be infected under greenhouse conditions.

Except for the collections of *C.* acutatum described in this report, no other collections have been made of this pathogen in B.C. that are known to the authors. The destruction by burning of all western hemlock seedlings within the nursery after the survey had been conducted by staff of the Plant Health Division, Agriculture Canada, probably prevented spread of the pathogen.

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