

DISEASES IN ONTARIO  
FOREST TREE NURSERIES, 1967 TO 1974

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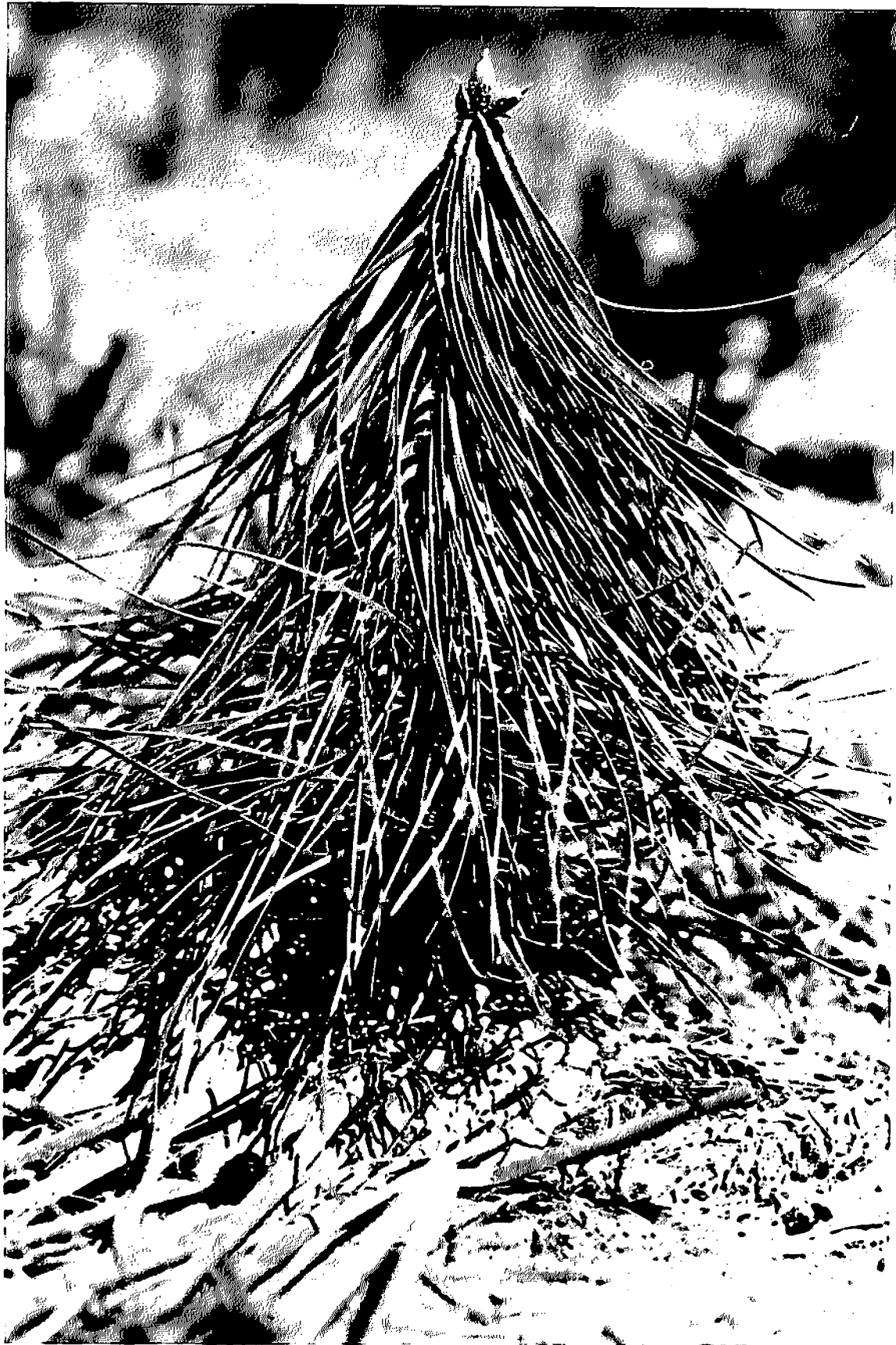
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Frontispiece. Three-year-old red pine seedling exhibiting an early foliage symptom (epinasty) of infection by *Gremmeniella abietina* (formerly *Scleroderris lagerbergii*).

## ABSTRACT

An evaluation of disease reports submitted over an 8-year period from 11 Ontario forest tree nurseries suggests that there are two levels of approach in the pathology of nursery crops. At the first level, there are obvious problems for which answers are available. The solution of such problems involves only the careful execution of existing control procedures with minor alteration to meet the requirements of local conditions.

At the second level, there are diseases of unknown cause for which curative measures have not yet been found. The greatest requirement for both basic and applied research lies in this second category.

## RÉSUMÉ

Selon une évaluation des rapports couvrant une période de 8 ans sur les maladies des arbres dans 11 pépinières forestières ontariennes, on peut observer deux niveaux d'approches des maladies en pépinière. Au premier niveau, on remarque des problèmes évidents qui peuvent être résolus. Pour les résoudre, il s'agit seulement d'exécuter avec soin les opérations existantes de lutte, en les adaptant (altérations mineures) aux conditions locales.

Au second niveau, il existe des maladies de cause inconnue dont on n'a pas encore trouvé de remède. La recherche de base et appliquée devra surtout s'effectuer à propos de cette seconde catégorie.

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Cover photo: Spruce beds at the Kirkwood Forest Tree Nursery

## INTRODUCTION

Forest tree nurseries provide favourable sites for the initiation and development of disease. Disease-causing fungi commonly develop and spread rapidly in nurseries once initial infection has occurred. Such accelerated activity can be expected in most extensive plant monocultures, especially when susceptible plants occur in densely stocked blocks, as is usually the case in forest tree nurseries. Common nursery cultural practices sometimes inadvertently assist in the spread of fungi within and among beds. Frequent overhead watering, for example, provides and maintains a favourable microenvironment for the development of fungi by maintaining high relative humidity and a film of surface moisture on the foliage. Spores, being the minute infective bodies produced by most fungi, are readily distributed by the splashing of water droplets. Spores may also be distributed on the surfaces of machinery that contact the foliage or on the clothing and implements used in manual operations.

Disease problems in forest tree nurseries can often be controlled if proper precautions are taken. A prime example of control is the timely application of fungicidal chemicals, either to protect seedlings against infection or to eradicate fungi that grow in seedlings or soil (Anon. 1971). The same practice of block monoculture that facilitates the spread of fungi provides discrete units to which control measures may be applied quickly and selectively.

Although particular agrichemicals, termed "broad-spectrum fungicides", may aid in control of a number of fungi simultaneously, indiscriminate application of chemicals in the hope that some benefit will accrue is rarely the best answer to a disease problem caused by fungi. The causal agent or pathogen must be identified in order to apply the best available control measures at that time in the life cycle of the pathogen when it is most susceptible to control.

For a number of years, survey field technicians and other staff members of the Great Lakes Forest Research Centre's Forest Insect and Disease Survey Unit in Sault Ste. Marie, Ontario have collected and identified fungi from nurseries across Ontario and maintained records of the damage caused by these pathogens. The authors examined records kept from 1967 to 1974 inclusive to evaluate past damage and the present status of fungus-incited problems in Ontario nurseries. Included in this report is a list of the fungi identified during this period which may serve as a ready reference against which to compare future information (see Appendix).

## ONTARIO'S FOREST TREE NURSERIES

The Ontario Ministry of Natural Resources has pursued a systematic program of seedling production since the establishment of the first forest tree nursery in 1908 near St. Williams in southern Ontario. Eleven nurseries (Fig. 1) now produce as many as 76,500,000 seedlings

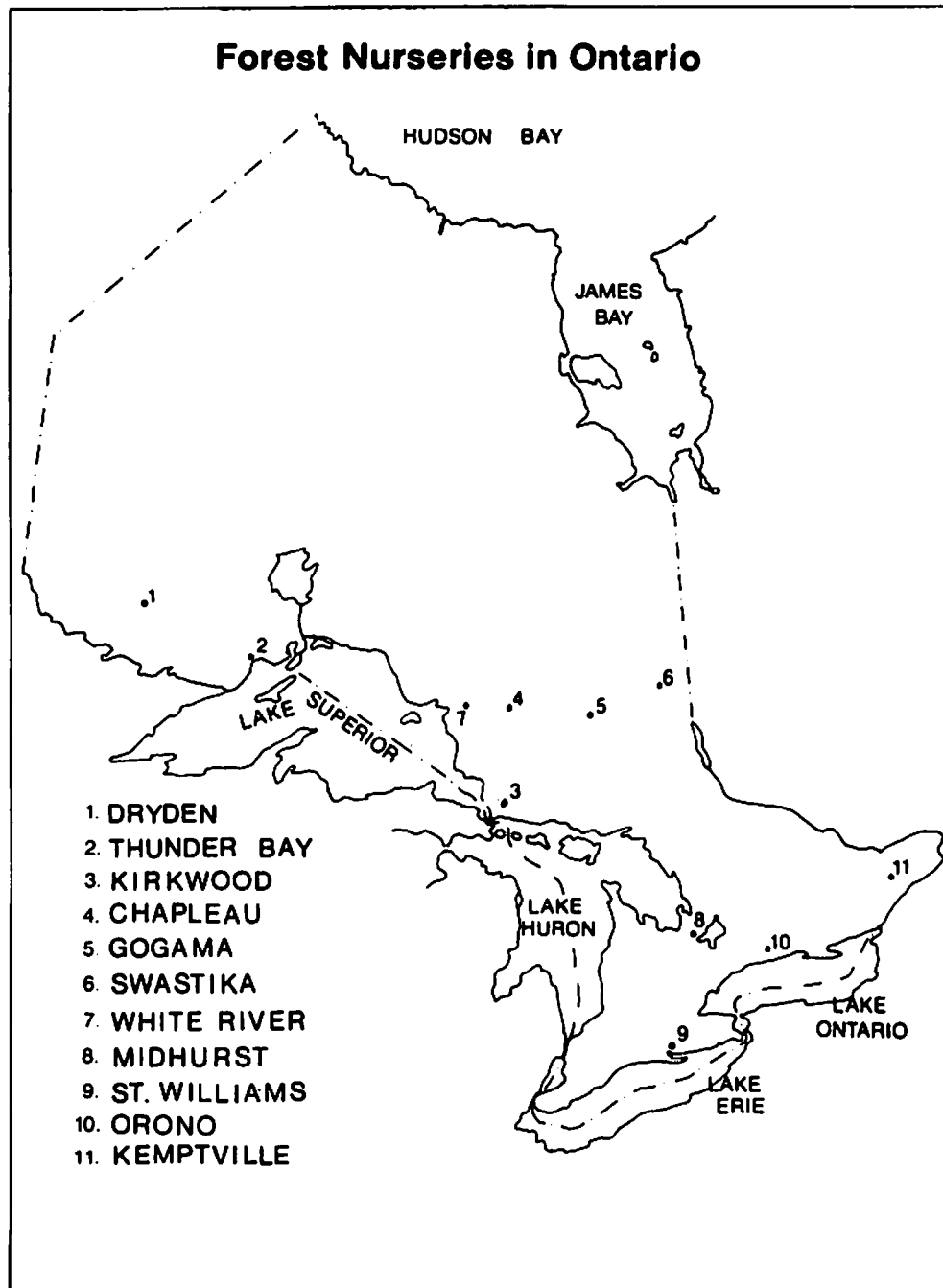


Fig. 1. Locations of Ontario Ministry of Natural Resources forest tree nurseries (reproduced with minor alteration through the courtesy of the Ontario Ministry of Natural Resources, Toronto, from the publication *Forest Nurseries*).

per year (Anon. 1973) for reforestation, for use as planting stock by Christmas tree growers and for landscaping public properties.

Research and development personnel of the Ontario Ministry of Natural Resources investigate many phases of nursery practice and application. They cooperate with research personnel of the Great Lakes Forest Research Centre and of various universities. Active participation of nursery superintendents is evidenced in their contributions to *Nursery Notes*, an Ontario Ministry of Natural Resources publication which describes innovations in applied nursery practice.

Virtually all of the stock used in reforestation of crown lands in Ontario is produced in the Ministry's forest tree nurseries and must meet the requirements of changing situations from year to year in terms of species, provenance and quality of planting stock. The requirement for seedlings increases yearly. Every effort is made to provide a product of optimum quality at a minimum cost per seedling.

Nursery tree diseases hamper the effectiveness of the seedling production program in two ways: (1) through losses of seedlings in the nursery beds, and (2) through losses of outplanted stock. The second category includes both seedlings that have been weakened in the nursery by pathogens and fail to survive after transplanting, and those that die in the plantation when infected stock is outplanted and serves as a source from which pathogens can spread to healthy seedlings. All such situations are of concern to the nursery superintendent and, as a consequence, to the Great Lakes Forest Research Centre's Forest Insect and Disease Survey Unit.

### THE FOREST INSECT AND DISEASE SURVEY UNIT

The Forest Insect and Disease Survey Unit of the Great Lakes Forest Research Centre has, since 1953, employed a staff of field technicians to assist in the evaluation of disease problems across Ontario. In recent years, particularly, attempts have been made to evaluate the impact of important tree pathogens on the forest. Certain potentially damaging disease situations have thus been recognized at early stages of development.

Generally the Survey field technician collects samples of diseased plants and sends them to the Forest Insect and Disease Survey laboratory in Sault Ste. Marie, where the fungi associated with the disease are identified. The technician is then informed of the diagnosis and suggested control, and he in turn transmits the information to the nursery superintendent. The nursery superintendent may take direct action to alleviate the problem before the pathogen spreads further.

As a consequence of these examinations and control operations, certain disease situations have been confined or controlled and a wealth of information has been recorded. Computer records of collections are



maintained at the Forest Insect and Disease Survey headquarters in Ottawa, and collections of living organisms and dried specimens are maintained at the laboratory in Sault Ste. Marie. These serve as reference sources for future work. Particularly comprehensive surveys were made in 1974 by C.E. Dorworth, in addition to the regular surveys by field technicians. All information available from surveys of previous years as well as the observations of the 1974 special survey are combined in this report. Fungi collected and identified by the Forest Insect and Disease Survey from 1967 to 1974 are listed in the Appendix.

### FUNGI ISOLATED FROM DISEASED SEEDLINGS

All fungi identified in association with diseased nursery seedlings are listed in the Appendix according to the forest tree nursery involved, the tree species on which they occurred, and the portion of the plant most severely affected. Authorities for the nomenclature are given in the Forest Insect and Disease Survey catalogues (Pilley and Trieselmann 1968, 1969; Trieselmann and Naphan 1970; Trieselmann et al. 1974).

Any plant that is damaged by fungi or other agents may subsequently serve as a nutrient source for other fungi. Certain of the fungi listed in the Appendix are undoubtedly saprophytes (organisms living on dead organic matter) and do not relate directly to disease problems. However, some fungi that normally exist as saprophytes have been known to cause serious disease problems under certain environmental conditions; saprophytes that have been isolated from nursery stock, therefore, are included in the Appendix. Certain fungi in the list deserve further consideration because their status is not clearly defined. Table 1 includes the more pathogenic fungi listed in the Appendix but excludes those fungi that are normally regarded as wholly saprophytic. Certain of these are cross-referenced according to host species (Table 2).

### EVALUATION

At present we can identify at least five classes of disorders that cause seedling losses in nursery beds. Some of these disorders may become important if transported from the nursery to the plantation.

#### 1. *Root and Root-collar Diseases*

These problems are caused by a variety of fungi, some of which are referred to as "damping-off fungi". An entire range of organisms is capable of killing seedlings from the time of seed germination until the seedlings are lifted for transplanting, and possibly thereafter. Fungi involved in damping-off usually fall within the general *Fusarium*, *Phytophthora*, *Pythium*, *Cylindrocladium* and *Rhizoctonia*. Measures are available that could aid in control of many of these fungi, provided that the situations are recognized

Table 1. Important and potentially important fungi identified from seedlings grown in Ontario forest tree nurseries, 1967 to 1974<sup>a</sup>

Southern nurseries	Northern nurseries
<i>Botrytis cinerea</i>	<i>Botrytis cinerea</i>
<i>Cylindrocladium</i> sp.	<i>Cylindrocarpon</i> sp.
<i>Cytospora</i> sp.	<i>Cylindrocladium</i> sp.
<i>Diplodia pinea</i>	<i>Fusarium</i> sp.
<i>Fusarium oxysporum</i>	<i>Lophodermium</i> sp.
<i>Fusarium</i> sp.	<i>Pestalotia</i> sp.
<i>Lophodermium nitens</i>	<i>Pythium</i> sp.
<i>Lophodermium pinastri</i>	<i>Gremmeniella abietina</i> ( <i>Scleroderris lagerbergii</i> )
<i>Pestalotia</i> sp.	<i>Sirococcus strobilinus</i>
<i>Septoria</i> sp.	

<sup>a</sup> Excerpted from Appendix in terms of known pathogenicity of fungus, frequency of occurrence in Ontario and recorded damage incidence.

Table 2. Fungi that damage, or occur frequently on, nursery seedlings throughout Ontario

Fungi isolated	Host tree species													
	<i>Acer saccharinum</i>	<i>Betula papyrifera</i>	<i>Larix</i> spp.	<i>Picea abies</i>	<i>Picea glauca</i>	<i>Picea mariana</i>	<i>Picea rubens</i>	<i>Pinus banksiana</i>	<i>Pinus mugo</i>	<i>Pinus nigra</i>	<i>Pinus ponderosa</i>	<i>Pinus resinosa</i>	<i>Pinus strobus</i>	<i>Pinus sylvestris</i>
<i>Botrytis</i> spp.	X		X	X	X	X		X				X		
<i>Chrysomyxa ledi</i>					X	X								
<i>Coleosporium asterum</i>								X						
<i>Cylindrocladium</i> sp.												X		
<i>Diplodia pini</i>												X		
<i>Fusarium</i> spp.				X	X	X	X	X			X	X	X	
<i>Gremmeniella abietina</i>					X			X			X			
<i>Lophodermium</i> spp.					X						X	X		
<i>Peridermium</i> spp.								X						
<i>Pythium</i> spp.					X									
<i>Sirococcus strobilinus</i>								X						

at an early stage of development (Vaartaja 1964, Anon. 1971). Both chemical seed treatment and fungicide soil dressing are used as preventive treatments. More difficult to treat are the root and root-collar decays of older seedlings. These problems often develop as a consequence of infection by fungi that produce highly resistant "resting structures" in the soil. Such structures may become active only upon contact with the roots of susceptible seedlings. Certain species of *Fusarium* are particularly important in this regard, and their presence may become evident only through the occurrence of a nursery problem. Application of biocides before replanting is often the only means of controlling such fungi. Nonetheless, many species of *Fusarium* normally inhabit the soil without causing obvious damage to plants. A considerable amount of work is required to define and separate the harmful from the innocuous (and possibly beneficial) species.

## 2. Snow Moulds

Included here are a variety of fungi such as *Botrytis* spp. and *Fusarium* spp. which have the capacity to kill or weaken seedlings while they are still covered by snow. Complete information is lacking on the range of organisms involved, their potential to attack seedlings with respect to depth and duration of snow cover and, particularly, the importance of the physiologic status of the seedlings as they enter dormancy. Certain nurseries, especially in northern Ontario, may experience serious seedling losses as a result of damage by snow moulds in particular years (Fig. 2). The same fungi may kill older foliage on seedlings during other



Fig. 2. Extensive mortality of red pine at the Chapleau Nursery in 1969 caused by snow mould.

years, yet the new buds flush normally and the seedlings appear generally healthy. Fungicides may be applied in autumn as a preventive measure where the problem recurs annually (Anon. 1975).

### 3. Foliar Diseases

Semimature and mature conifers may be heavily attacked by foliar pathogens such as *Lophodermium* spp. and *Davisomycella ampla*, yet survive through production of new foliage. Young seedlings may be colonized throughout much of their partly differentiated tissues, however, and succumb to these same pathogens. Beds of hundreds of thousands of seedlings may, as a consequence, be ploughed under to reduce the number of spores available for further infection. Early detection of these and associated fungi followed by prompt application of fungicides is necessary for their control.

### 4. Shoot and Stem Diseases

*Gremmeniella abietina* (*Scleroderris lagerbergii*) and *Sirococcus strobilinus* still occur, though at very low incidence, in certain nurseries, despite repeated efforts to eradicate them. The former may cause extensive damage to pine nursery stock (Fig. 3). *Gremmeniella abietina*

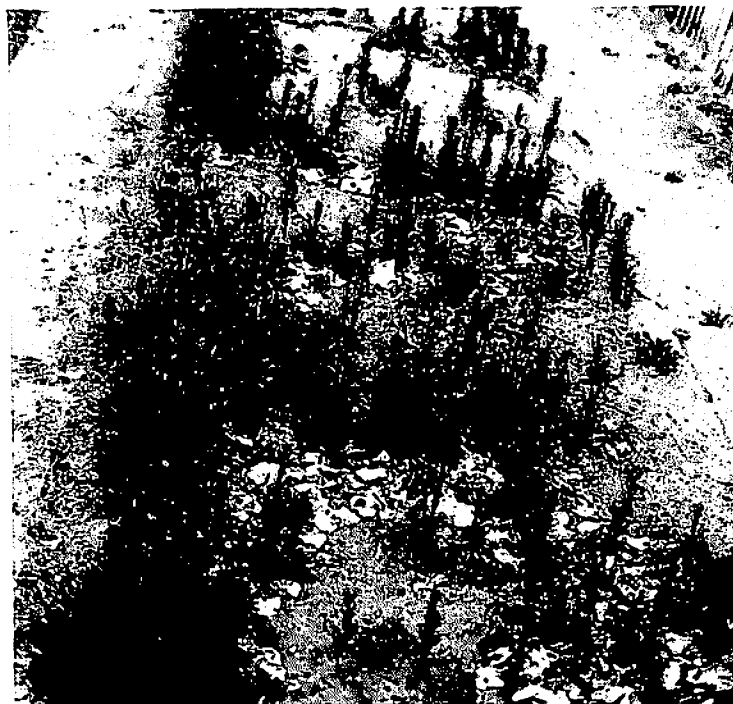


Fig. 3. Jack pine depleted by *Gremmeniella abietina* at the Swastika Nursery. Outlines of infection pockets are still visible.

(*Scleroderma lagerbergii*), at least, is capable of causing a serious plantation disease if transported into the field on planting stock (Dorworth 1970). The status of *Sirococcus strobilinus* in that regard is unknown, and can be defined only through experimentation.

### 5. Physiologic Disorders

Inclement weather may damage seedlings at certain periods in their development, the effects becoming visible somewhat later. Death or injury may occur as a direct consequence of various types of environmental stress, or after pathogens infect and colonize the weakened seedlings. The primary agent of seedling distress is usually difficult to diagnose. Application of agricultural chemicals such as fertilizers or herbicides to the seedlings at either sub- or superoptimum dosage may aggravate these problems or cause a separate and entirely distinct set of problems to arise. Solutions are almost nonexistent in the former case, and are related purely to correction of cultural practice in the latter. All of these problems, however, complicate the job of plant disease diagnosis.

## CONCLUSIONS

Forest tree nurseries have their own particular disease problems, peculiar to the extensive monocultures therein, the cultural practices employed and the uniformly young plants produced. Overt activity by well-defined pathogens often can be quickly identified and the effects of the pathogen counteracted. Problems arise, however, when the crop is subjected for a brief period to inclement conditions, permitting otherwise innocuous fungi to infect seedlings and proliferate thereon. Unfortunately, the primary and even the secondary causes of damage are sometimes no longer evident by the time extensive damage is apparent, and only the most tenuous association between the disease and the causal agent or agents can be diagnosed. Although actual loss of seedlings in such situations is important, the failure of the problem to recur in the next season often permits the overall effect to be minimized. Losses in such discrete epidemics are probably as great as if not greater than those which can be attributed to diseases that appear annually. Only increased knowledge of the particular factors inciting the proliferation of these fungi will permit predictions to be made as to their probable occurrence as active pathogens, allowing reasonable precautions to be suggested in advance. These locally important problems, once noticed, are usually past the point at which control measures might be effective, and any effort expended to control the causal agent is ordinarily wasted.

The second requisite for successful disease control in the nursery is constant vigilance in order to detect small problems before they become amplified. The Forest Insect and Disease Survey Unit solicits enquiries about disease problems from persons associated with nursery work and advises that close contact be maintained with the Forest Insect and Disease Survey field technician in the area.

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## APPENDIX



Fungi identified from seedlings grown in Ontario Ministry of Natural Resources forest tree nurseries, 1967 to 1974

Nursery	Host species	Source	Fungi identified <sup>a</sup>
CHAPLEAU	<i>Picea glauca</i>	stem	<i>Mucor</i> sp. (1) <i>Pestalotia</i> sp. (1) <i>Torula</i> sp. (1)
		new shoot	<i>Alternaria</i> sp. (1) <i>Aureobasidium</i> sp. (1) <i>Cephalosporium</i> sp. (1)
	<i>Pinus resinosa</i>	seedling, total	<i>Alternaria</i> sp. (1) <i>Alternaria tenuis</i> (1) <i>Epicoccum</i> sp. (1) <i>Fusarium</i> sp. (2) <i>Pestalotia</i> sp. (1) <i>Phoma</i> sp. (1)
DRYDEN	<i>Picea glauca</i>	foliage, new	<i>Alternaria</i> sp. (1) <i>Aposphaeria</i> sp. (1) <i>Aureobasidium</i> sp. (1) <i>Botrytis cinerea</i> (1) <i>Chrysomyxa ledi</i> (1) <i>Cladosporium</i> sp. (1) <i>Coniothyrium</i> sp. (1) <i>Fusarium</i> sp. (1) <i>Pestalotia</i> sp. (1) <i>Phoma</i> sp. (2) <i>Phoma glomerata</i> (1) <i>Torula</i> sp. (1) <i>Truncatella truncata</i> (1)
		foliage, old	<i>Alternaria</i> sp. (3) <i>Aureobasidium</i> sp. (2) <i>Botrytis</i> sp. (3) <i>Chaetomium</i> sp. (2) <i>Chaetophoma</i> sp. (1) <i>Cladosporium</i> sp. (1) <i>Coniothyrium</i> sp. (1) <i>Epicoccum</i> sp. (1) <i>Fusarium</i> sp. (3) <i>Penicillium</i> sp. (1) <i>Pestalotia</i> sp. (2) <i>Phoma</i> sp. (2)

(continued)

DRYDEN (continued)	<i>Picea glauca</i>	foliage, old	<i>Phoma glomerata</i> (1) <i>Pythium</i> sp. (1) <i>Verticillium</i> sp. (1)
		seedling, total	<i>Alternaria</i> sp. (4) <i>Aureobasidium</i> sp. (1) <i>Dinemasporium</i> sp. (1) <i>Epicoccum</i> sp. (3) <i>Fusarium</i> sp. (3) <i>Gremmeniella</i> <i>abietina</i> (2) <i>Penicillium</i> sp. (1) <i>Pestalotia</i> sp. (1) <i>Phoma</i> sp. (1) <i>Phoma glomerata</i> (2) <i>Torula</i> sp. (2) <i>Trichoderma</i> sp. (1) <i>Trichoderma</i> <i>viride</i> (1)
	<i>Picea mariana</i>	foliage, new	<i>Alternaria</i> sp. (1) <i>Chrysomyxa ledi</i> (1) <i>Fusarium</i> sp. (1) <i>Phoma</i> sp. (1)
		seedling, total	<i>Alternaria</i> sp. (1) <i>Cladosporium</i> <i>variabile</i> (1) <i>Coniothyrium</i> sp. (1) <i>Epicoccum</i> sp. (1) <i>Fusarium</i> sp. (1) <i>Pestalotia</i> sp. (1)
		stem	<i>Alternaria</i> sp. (1) <i>Aureobasidium</i> sp. (1) <i>Fusarium</i> sp. (1) <i>Pyrenophora</i> sp. (1)
	<i>Pinus banksiana</i>	foliage, new	<i>Alternaria</i> sp. (1) <i>Aureobasidium</i> sp. (1) <i>Epicoccum</i> sp. (1) <i>Fusarium</i> sp. (1) <i>Pestalotia</i> sp. (1) <i>Phoma</i> sp. (1)
		foliage, old	<i>Alternaria</i> sp. (2) <i>Chaetomium</i> sp. (1)

(continued)

DRYDEN (concluded)	<i>Pinus banksiana</i>	foliage, old	<i>Cylindrocarpon</i> sp. (1) <i>Coleosporium asterum</i> (1) <i>Epicoccum</i> sp. (1) <i>Fusarium</i> sp. (2) <i>Pestalotia</i> sp. (2) <i>Phoma</i> sp. (1) <i>Phoma glomerata</i> (1) <i>Torula</i> sp. (1) <i>Verticillium</i> sp. (1)
		root	<i>Peridermium</i> sp. (1)
	<i>Pinus resinosa</i>	foliage, new	<i>Alternaria</i> sp. (1) <i>Cladosporium</i> sp. (1) <i>Trichoderma</i> sp. (1)
		seedling, total	<i>Cylindrocladium</i> sp. (1) <i>Fusarium</i> sp. (2) <i>Pestalotia truncata</i> (1) <i>Phoma</i> sp. (2)
GOGAMA	<i>Pinus banksiana</i>	seedling, total	<i>Gremmeniella</i> <i>abietina</i> (1)
		stem	<i>Alternaria</i> sp. (1) <i>Fusarium</i> sp. (1) <i>Trichoderma</i> sp. (1)
KIRKWOOD	<i>Betula papyrifera</i>	foliage, new	<i>Gloeosporium</i> <i>betulicola</i> (1)
	<i>Picea mariana</i>	foliage, old	<i>Alternaria</i> sp. (1) <i>Cephalosporium</i> sp. (1) <i>Fusarium</i> sp. (1) <i>Trichocladium</i> sp. (1)
		stem	<i>Alternaria</i> sp. (1) <i>Aureobasidium</i> sp. (1) <i>Chaetomium</i> sp. (1) <i>Cladosporium</i> sp. (1) <i>Coniothyrium</i> sp. (1) <i>Pestalotia</i> sp. (1) <i>Phoma</i> sp. (1) <i>Torula</i> sp. (1)
	<i>Picea glauca</i>	buds	<i>Cladosporium</i> sp. (1)

(continued)

KIRKWOOD (concluded)	<i>Pinus banksiana</i>	foliage, old	<i>Geotrichum</i> sp. (1)				
	<i>Pinus resinosa</i>	foliage, old	<i>Alternaria</i> sp. (1) <i>Fusarium</i> sp. (1)				
		foliage, new	<i>Alternaria</i> sp. (1) <i>Fusarium</i> sp. (1)				
	<i>Pinus strobus</i>	foliage, old	<i>Alternaria</i> sp. (1) <i>Fusarium</i> sp. (1) <i>Torula</i> sp. (1) <i>Trichoderma</i> sp. (1)				
KEMPTVILLE	<i>Picea mariana</i>	foliage, new	<i>Alternaria</i> sp. (1) <i>Aureobasidium</i> <i>pullulans</i> (1) <i>Fusarium</i> sp. (1) <i>Fusarium lateritium</i> (1)				
			seedling, total	<i>Alternaria</i> sp. (1) <i>Botrytis cinerea</i> (1)			
				<i>Pinus banksiana</i>	shoot, new	<i>Aureobasidium</i> sp. (1) <i>Penicillium</i> sp. (1) <i>Phoma glomerata</i> (1) <i>Torula</i> sp. (1)	
			<i>Pinus ponderosa</i>			stem	<i>Alternaria</i> sp. (1) <i>Cytospora</i> sp. (1)
	<i>Pinus resinosa</i>	stem		<i>Alternaria</i> sp. (1) <i>Aspergillus</i> sp. (1) <i>Cenangium</i> <i>ferruginosum</i> (1) <i>Fusarium</i> sp. (1) <i>Lophodermium</i> sp. (1)			
			<i>Pinus sylvestris</i>	stem	<i>Alternaria</i> sp. (1) <i>Fusarium</i> sp. (1) <i>Trichoderma</i> sp. (1)		
					<i>Populus eugenei</i>	shoot, new	<i>Pollaccia radiosa</i> (1)
					<i>Sorbus aucuparia</i>	foliage, new	<i>Septoria</i> sp. (1)

(continued)

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MIDHURST	<i>Acer saccharinum</i>	shoot, new	<i>Botrytis</i> sp. (1)
		stem	<i>Gloeosporium</i> sp. (1)
	<i>Betula papyrifera</i>	stem	<i>Diaporthe</i> sp. (1)
	<i>Fraxinus americana</i>	foliage, new	<i>Cylindrosporium</i> sp. (1)
			<i>Phyllosticta fraxini</i> (1)
	<i>Picea abies</i>	stem	<i>Alternaria</i> sp. (1)
			<i>Aureobasidium</i> sp. (1)
			<i>Cephalosporium</i> sp. (1)
			<i>Fusarium</i> sp. (1)
			<i>Mucor</i> sp. (1)
			<i>Penicillium</i> sp. (1)
			<i>Rhizopus</i> sp. (1)
			<i>Trichoderma</i> sp. (1)
	<i>Picea glauca</i>	buds	<i>Alternaria</i> sp. (1)
			<i>Botrytis</i> sp. (1)
			<i>Epicoccum</i> sp. (1)
			<i>Trichoderma</i> sp. (1)
		shoot, new	<i>Alternaria</i> sp. (1)
			<i>Botrytis allii</i> (1)
			<i>Botrytis cinerea</i> (1)
			<i>Coniothyrium</i> sp. (1)
			<i>Epicoccum</i> sp. (1)
			<i>Fusarium</i> sp. (1)
			<i>Phoma glomerata</i> (1)
		stem	<i>Alternaria</i> sp. (1)
			<i>Aureobasidium pullulans</i> (1)
			<i>Torula</i> sp. (1)
			<i>Trichoderma</i> sp. (1)
	<i>Picea rubens</i>	stem	<i>Fusarium</i> sp. (1)
			<i>Fusarium nivale</i> (1)
			<i>Pestalotia</i> sp. (1)
	<i>Pinus banksiana</i>	shoot, new	<i>Alternaria</i> sp. (1)
			<i>Fusarium</i> sp. (1)
		stem	<i>Alternaria tenuis</i> (1)
			<i>Cladosporium</i> sp. (1)
			<i>Cladosporium variabile</i> (1)

(continued)

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MIDHURST (concluded)	<i>Pinus resinosa</i>	foliage, old	<i>Alternaria</i> sp. (1) <i>Fusarium</i> sp. (1) <i>Lophodermium pinastri</i> (1) <i>Pestalotia</i> sp. (1) <i>Phoma</i> sp. (1)
		shoot, new	<i>Alternaria</i> sp. (1) <i>Fusarium</i> sp. (1) <i>Phoma</i> sp. (1) <i>Torula</i> sp. (1)
		stem	<i>Alternaria</i> sp. (1) <i>Aureobasidium</i> sp. (1) <i>Botrytis cinerea</i> (1) <i>Fusarium</i> sp. (2) <i>Phoma</i> sp. (1)
	<i>Pinus strobus</i>	shoot, new	<i>Aureobasidium</i> sp. (1) <i>Fusarium</i> sp. (1)
	<i>Taxus brevifolia</i>	stem	<i>Alternaria</i> sp. (1) <i>Fusarium</i> sp. (1) <i>Fusarium oxysporum</i> (1) <i>Mucor</i> sp. (1) <i>Rhizopus nigricans</i> (1)

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ORONO	<i>Acer</i> spp.	stem	<i>Alternaria</i> sp. (1) <i>Aureobasidium</i> sp. (1) <i>Coniothyrium</i> sp. (1) <i>Marssonina</i> sp. (1) <i>Phoma glomerata</i> (1) <i>Torula</i> sp. (1)
	<i>Acer platanoides</i>	stem	<i>Cytospora</i> sp. (1)
	<i>Juniperus</i> spp.	foliage, new	<i>Alternaria</i> sp. (1) <i>Pestalotia</i> sp. (1)
		branch	<i>Alternaria</i> sp. (1) <i>Phoma</i> sp. (1)
	<i>Juniperus virginiana</i>	branch	<i>Phomopsis</i> sp. (1)
		foliage, new	<i>Alternaria</i> sp. (1) <i>Hormodendron</i> sp. (1)

(continued)

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ORONO (continued)	<i>Picea glauca</i>	foliage, new	<i>Alternaria</i> sp. (2) <i>Cladosporium</i> sp. (1) <i>Coniothyrium</i> sp. (1) <i>Diplodia</i> sp. (2) <i>Diplodia pinea</i> (1) <i>Epicoccum</i> sp. (1) <i>Stemphyllum</i> sp. (1) <i>Torula</i> sp. (1)
	<i>Picea rubens</i>	butt	<i>Alternaria</i> sp. (1) <i>Cylindrocarpon</i> sp. (1) <i>Phoma</i> sp. (1)
	<i>Pinus mugho</i>	foliage, new	<i>Alternaria</i> sp. (1) <i>Aureobasidium pullulans</i> (1) <i>Cephalosporium</i> sp. (1) <i>Coniothyrium</i> sp. (1) <i>Cylindrocarpon</i> sp. (1) <i>Epicoccum</i> sp. (1) <i>Penicillium</i> sp. (1) <i>Pestalotia</i> sp. (1) <i>Phoma glomerata</i> (1) <i>Torula</i> sp. (1)
	<i>Pinus nigra</i>	foliage, new	<i>Alternaria</i> sp. (1) <i>Aureobasidium</i> sp. (1) <i>Coniothyrium</i> sp. (1) <i>Epicoccum</i> sp. (1) <i>Torula</i> sp. (1)
	<i>Pinus resinosa</i>	foliage, old	<i>Lophodermium pinastri</i> (1)
		root	<i>Cladosporium</i> sp. (1)
		seedling, total	<i>Lophodermium</i> sp. (2)
	<i>Pinus strobus</i>	seedling, total	<i>Alternaria tenuis</i> (1)
	<i>Populus eugenei</i>	shoot, new	<i>Penicillium</i> sp. (1)
	<i>Syringa</i> spp.	foliage, new	<i>Microsphaera penicillata</i> (1)
	<i>Thuja occidentalis</i>	foliage, new	<i>Alternaria</i> sp. (1) <i>Hypodermella laricis</i> (1)
		foliage, old	<i>Alternaria</i> sp. (1) <i>Aureobasidium</i> sp. (1)

(continued)

ORONO (concluded)	<i>Thuja occidentalis</i>	foliage, old	<i>Chaetomium</i> sp. (1) <i>Epicoccum</i> sp. (1) <i>Penicillium</i> sp. (1) <i>Trichoderma</i> sp. (1)
ST. WILLIAMS	<i>Acer saccharinum</i>	seedling, total	<i>Alternaria</i> sp. (1)
	<i>Fraxinus americana</i>	foliage, new	<i>Septoria</i> sp. (1)
	<i>Juglans</i> spp.	root	<i>Fusarium oxysporum</i> var. <i>redolens</i> (1)
	<i>Larix</i> spp.	foliage, new	<i>Alternaria</i> sp. (1) <i>Aureobasidium</i> sp. (1) <i>Botrytis cinerea</i> (1) <i>Cladosporium</i> sp. (1) <i>Epicoccum</i> sp. (1) <i>Hormodendron</i> sp. (1) <i>Hypodermella</i> <i>laricis</i> (1) <i>Phomopsis</i> sp. (1)
	<i>Larix decidua</i>	foliage, new	<i>Alternaria</i> sp. (1)
		stem	<i>Hormodendron</i> sp. (1)
	<i>Picea abies</i>	foliage, new	<i>Alternaria</i> sp. (1) <i>Aureobasidium</i> sp. (1)
		foliage, old	<i>Alternaria</i> sp. (1) <i>Diplodia pini</i> (1) <i>Fusarium</i> sp. (1)
	<i>Picea glauca</i>	buds	<i>Alternaria</i> sp. (1) <i>Chaetomium</i> sp. (1) <i>Curvularia</i> sp. (1) <i>Epicoccum</i> sp. (1) <i>Lophodermium</i> sp. (1) <i>Pestalotia</i> sp. (1) <i>Stemphylium</i> sp. (1) <i>Torula</i> sp. (1)
		foliage, new	<i>Alternaria</i> sp. (3) <i>Botrytis cinerea</i> (1) <i>Dendrophoma</i> sp. (1) <i>Diplodina</i> sp. (1)

(continued)



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ST. WILLIAMS (continued)	<i>Picea glauca</i>	foliage, new	<i>Epicoccum</i> sp. (2) <i>Fusarium</i> sp. (2) <i>Phoma</i> sp. (1) <i>Phoma glomerata</i> (1) <i>Phomopsis</i> sp. (1)
	<i>Pinus resinosa</i>	buds	<i>Alternaria</i> sp. (1) <i>Botrytis</i> sp. (1) <i>Epicoccum</i> sp. (1) <i>Fusarium</i> sp. (1) <i>Penicillium</i> sp. (1) <i>Phoma glomerata</i> (1) <i>Trichoderma</i> sp. (1)
		foliage, new	<i>Alternaria</i> sp. (1) <i>Diplodia pinea</i> (1) <i>Fusarium</i> sp. (1) <i>Lophodermium nitens</i> (1) <i>Lophodermium pinastri</i> (1)
		foliage, old	<i>Lophodermium</i> sp. (1) <i>Lophodermium nitens</i> (1) <i>Lophodermium pinastri</i> (4)
		stem	<i>Fusarium</i> sp. (1)
	<i>Pinus strobus</i>	foliage, new	<i>Alternaria</i> sp. (3) <i>Aureobasidium</i> sp. (1) <i>Cladosporium</i> sp. (1) <i>Epicoccum</i> sp. (2) <i>Lophodermium</i> sp. (1) <i>Penicillium</i> sp. (1) <i>Sphaeropsis</i> sp. (1)
		foliage, old	<i>Dendrophoma</i> sp. (1) <i>Lophodermium</i> sp. (1) <i>Pestalotia</i> sp. (1) <i>Sphaeropsis</i> sp. (1)
		seedling, total	<i>Dermea</i> sp. (1) <i>Epicoccum</i> sp. (1) <i>Fusarium</i> sp. (1)
		shoot, new	<i>Alternaria</i> sp. (1) <i>Aureobasidium</i> sp. (1) <i>Candida</i> sp. (1)
		stem	<i>Fusarium</i> sp. (1)

(continued)

ST. WILLIAMS (concluded)	<i>Pinus sylvestris</i>	foliage, old	<i>Alternaria</i> sp. (1) <i>Fusicoccum</i> sp. (1)
		shoot, new	<i>Sphaeropsis</i> sp. (1)
	<i>Populus deltoides</i>	foliage, new	<i>Melampsora</i> <i>medusae</i> (2)
		shoot, new	<i>Pollaccia radiosa</i> (1)
	<i>Populus trichocarpa</i>	foliage, new	<i>Septoria</i> <i>negundinis</i> (1)
	<i>Thuja occidentalis</i>	foliage, old	<i>Pestalotia</i> sp. (1)
	<i>Ulmus parvifolia</i>	branch	<i>Tubercularia</i> <i>vulgaris</i> (1)
SWASTIKA	<i>Picea glauca</i>	foliage, old	<i>Alternaria</i> sp. (1) <i>Botrytis</i> sp. (1) <i>Chaetomium</i> sp. (2) <i>Cylindrocarpon</i> sp. (2) <i>Fusarium</i> sp. (2) <i>Fusicoccum</i> sp. (1) <i>Penicillium</i> sp. (1) <i>Pestalotia</i> sp. (1) <i>Phoma</i> sp. (1) <i>Phoma glomerata</i> (1) <i>Trichoderma</i> sp. (1) <i>Verticillium</i> sp. (2)
	<i>Picea mariana</i>	stem	<i>Fusicoccum</i> sp. (1)
	<i>Pinus banksiana</i>	foliage, old	<i>Alternaria</i> sp. (1) <i>Botrytis</i> sp. (1) <i>Botrytis cinerea</i> (1) <i>Chaetomium</i> sp. (1) <i>Gremmeniella</i> <i>abietina</i> (1) <i>Phoma</i> sp. (1)
		stem	<i>Alternaria</i> sp. (1) <i>Fusarium</i> sp. (1) <i>Phoma</i> sp. (1) <i>Phoma glomerata</i> (1)

(continued)

SWASTIKA (concluded)	<i>Pinus contorta</i>	stem	<i>Cronartium</i> sp. (1) <i>Cronartium comptoniae</i> (1)
THUNDER BAY	<i>Picea abies</i>	stem	<i>Alternaria</i> sp. (1) <i>Botrytis allii</i> (1) <i>Epicoccum</i> sp. (1) <i>Pestalotia</i> sp. (1) <i>Phoma glomerata</i> (1) <i>Torula</i> sp. (1)
	<i>Picea glauca</i>	buds	<i>Alternaria</i> sp. (2) <i>Chaetomium</i> sp. (1) <i>Coniothyrium</i> sp. (1) <i>Epicoccum</i> sp. (1) <i>Fusarium</i> sp. (1) <i>Hormiscium</i> sp. (2) <i>Pestalotia</i> sp. (1)
		foliage, new	<i>Alternaria</i> sp. (2) <i>Fusarium</i> sp. (2) <i>Penicillium</i> sp. (1) <i>Phialophora</i> sp. (1) <i>Phoma</i> sp. (1)
		shoot, new	<i>Alternaria</i> sp. (3) <i>Aureobasidium</i> sp. (1) <i>Botrytis cinerea</i> (1) <i>Cephalosporium</i> sp. (1) <i>Chaetomium</i> sp. (1) <i>Chaetophoma</i> sp. (1) <i>Coniothyrium</i> sp. (1) <i>Fusarium</i> sp. (3) <i>Gilmaniella</i> sp. (1) <i>Monilia</i> sp. (1) <i>Penicillium</i> sp. (1) <i>Pestalotia</i> sp. (2) <i>Phoma</i> sp. (1) <i>Phoma glomerata</i> (2) <i>Pyrenochaeta</i> sp. (1) <i>Torula</i> sp. (2)
		stem	<i>Alternaria</i> sp. (1) <i>Botrytis cinerea</i> (1) <i>Cylindrocarpon</i> sp. (1) <i>Epicoccum</i> sp. (1)

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THUNDER BAY (continued)	<i>Picea glauca</i>	stem	<i>Mucor</i> sp. (1) <i>Pestalotia</i> sp. (2) <i>Phoma glomerata</i> (1) <i>Trichoderma</i> sp. (1)
	<i>Picea mariana</i>	buds	<i>Aureobasidium</i> <i>pullulans</i> (1) <i>Fusarium</i> sp. (1) <i>Pestalotia</i> sp. (1)
		foliage, new	<i>Alternaria</i> sp. (1) <i>Fusarium</i> sp. (2)
		foliage, old	<i>Fusarium</i> sp. (1) <i>Phoma</i> sp. (2) <i>Phoma glomerata</i> (1)
		root	<i>Alternaria</i> sp. (2) <i>Aureobasidium</i> sp. (1) <i>Aureobasidium</i> <i>pullulans</i> (1) <i>Fusarium</i> sp. (1) <i>Phoma</i> sp. (2)
		stem	<i>Alternaria</i> sp. (1) <i>Fusarium</i> sp. (1)
	<i>Picea sitchensis</i>	stem	<i>Alternaria</i> sp. (1)
	<i>Pinus banksiana</i>	foliage, new	<i>Alternaria</i> sp. (2) <i>Fusarium</i> sp. (1) <i>Pestalotia</i> sp. (1) <i>Phoma glomerata</i> (1)
		foliage, old	<i>Alternaria</i> sp. (1) <i>Aureobasidium</i> sp. (1) <i>Botrytis</i> sp. (1) <i>Cephalosporium</i> sp. (1) <i>Chaetomium</i> sp. (1) <i>Dendrophoma</i> sp. (1) <i>Epicoccum</i> sp. (1) <i>Fusarium</i> sp. (1) <i>Phoma glomerata</i> (1) <i>Stemphylium</i> sp. (1) <i>Torula</i> sp. (1)

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THUNDER BAY (continued)	<i>Pinus banksiana</i>	shoot, new	<i>Alternaria</i> sp. (2)
			<i>Ascochyta</i> sp. (1)
			<i>Aureobasidium</i> sp. (1)
			<i>Botrytis</i> sp. (1)
			<i>Epicoccum</i> sp. (1)
			<i>Hormiscium</i> sp. (1)
			<i>Pestalotia</i> sp. (1)
			<i>Phoma</i> sp. (1)
			<i>Sirococcus strobilinus</i> (1)
			<i>Torula</i> sp. (1)
		stem	<i>Alternaria</i> sp. (2)
			<i>Aureobasidium</i> sp. (1)
			<i>Fusarium</i> sp. (1)
			<i>Hormiscium</i> sp. (1)
			<i>Phoma</i> sp. (1)
	<i>Pinus resinosa</i>	foliage, new	<i>Alternaria</i> sp. (1)
			<i>Aureobasidium</i> sp. (1)
			<i>Fusarium</i> sp. (1)
			<i>Phoma</i> sp. (1)
		foliage, old	<i>Alternaria</i> sp. (1)
			<i>Aureobasidium pullulans</i> (1)
			<i>Fusarium</i> sp. (1)
			<i>Phoma</i> sp. (1)
			<i>Phoma glomerata</i> (1)
			<i>Rhizopus</i> sp. (1)
		shoot, new	<i>Alternaria</i> sp. (3)
			<i>Aureobasidium</i> sp. (2)
			<i>Chaetophoma</i> sp. (1)
			<i>Cladosporium</i> sp. (1)
			<i>Coniothyrium</i> sp. (2)
			<i>Cylindrocarpon</i> sp. (1)
			<i>Cytosporella</i> sp. (1)
			<i>Gremmeniella abietina</i> (1)
			<i>Lophodermium</i> sp. (2)
			<i>Pestalotia</i> sp. (2)
		stem	<i>Phoma</i> sp. (1)
			<i>Phoma glomerata</i> (1)
			<i>Torula</i> sp. (2)
			<i>Trichoderma</i> sp. (1)
	<i>Pinus strobus</i>	shoot, new	<i>Alternaria</i> sp. (2)
			<i>Ascochyta</i> sp. (1)

(continued)

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THUNDER BAY (concluded)	<i>Pinus strobus</i>	shoot, new	<i>Aureobasidium</i> sp. (1)
			<i>Chaetomium</i> sp. (1)
			<i>Chaetophoma</i> sp. (1)
			<i>Cladosporium</i> sp. (1)
			<i>Coniothyrium</i> sp. (1)
			<i>Epicoccum</i> sp. (1)
			<i>Lophodermium</i> sp. (2)
			<i>Pestalotia</i> sp. (1)
			<i>Phoma</i> sp. (2)
			<i>Torula</i> sp. (2)
	<i>Thuja occidentalis</i>	stem	<i>Alternaria</i> sp. (1)
			<i>Pestalotia</i> sp. (1)

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WHITE RIVER	<i>Pinus banksiana</i>	stem	<i>Alternaria</i> sp. (1)
			<i>Botrytis cinerea</i> (1)
			<i>Candida</i> sp. (1)
			<i>Chaetophoma</i> sp. (1)
			<i>Cylindrocarpon</i> sp. (1)
			<i>Fusarium</i> sp. (1)
			<i>Mucor</i> sp. (1)
			<i>Penicillium</i> sp. (1)

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<sup>a</sup> Numbers within parentheses indicate the number of identifications of a particular fungus under the conditions described.