Canadian Plant Disease Survey

Inventaire des maladies des plantes au Canada

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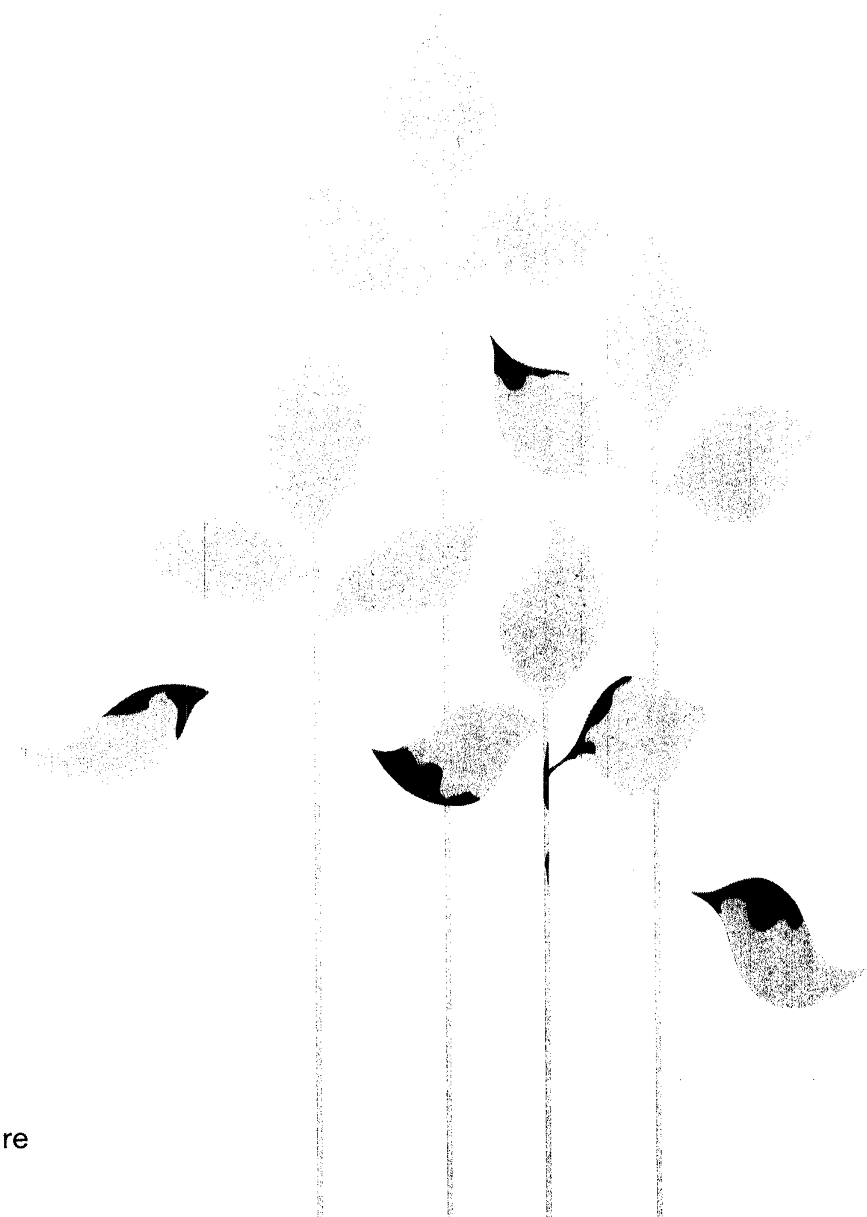

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Contents/Contenu

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 will also be accepted. Review papers and compilations of practical value to plant pathologists will be included from time to time.

Research Branch, Agriculture Canada
Acting Editor H.S. Krehm, Research Program Service, Agriculture Canada, Ottawa, Ontario K1A 0C6

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. De temps à autre, l'inventaire inclut des revues et des synthèses de rapports d'intérêt immediat pour les phytopathologistes.

Direction de la recherche, Agriculture Canada
Rédacteur intérimaire H.S. Krehm, Service des programmes de recherche, Agriculture Canada, Ottawa (Ontario) K1A 0C6

ANNOUNCEMENT

An agreement has been reached between the Research Branch of Agriculture Canada and the Canadian Phytopathological Society on the future status of the Canadian Plant Disease Survey. It has been agreed that:

1. This is the last issue of the survey in its present format. Beginning in 1982 the Research Branch will publish two (2) issues of the Canadian Plant Disease Survey per year in February and July provided sufficient papers are submitted. The deadlines for submission of articles will be November 30 and April 30 for the February and July issues respectively (i.e. November 30, 1981 for the February 1982 issue).
2. The Canadian Plant Disease Survey will continue as a periodical of information and record of the occurrence, severity and losses from plant diseases in Canada. Compilations of disease occurrence and review papers of practical value to plant pathologists will be appropriate from time to time. Articles relating specifically to fungicide evaluation of new materials should be submitted to the Pesticide Research Report or, if the research content is deemed sufficient, to a refereed journal.
3. The Canadian Plant Disease Survey will not be a refereed journal; it will accept articles, notes, and observations for which the author(s) will be solely responsible. However, submissions will be checked by an editor for suitability. It is understood that authors will have colleagues check submissions for errors in style, ambiguities, typing, etc. Authors will be responsible for correctness of galley proofs and to adherence of deadlines for their return. Reprints of articles will not be supplied by Agriculture Canada.
4. The Research Branch, through Research Program Service, will be responsible for compiling, producing, distributing and financing the Canadian Plant Disease Survey.
5. The Canadian Phytopathological Society will be responsible for editorial policy through an Advisory Committee.

AVIS

La Direction de la recherche d'Agriculture Canada et la Société canadienne de phytopathologie ont conclu une entente en ce qui concerne l'avenir de l'Inventaire des maladies des plantes au Canada. L'entente stipule que:

1. Ceci est le dernier numéro de l'Inventaire sous son format actuel. À partir de 1982, la Direction de la recherche publiera deux (2) numéros de l'Inventaire des maladies des plantes au Canada par année, en février et juillet, pourvu que le nombre d'articles le justifie. Les dates limites pour soumettre les articles seront le 30 novembre et le 30 avril pour les numéros de février et de juillet respectivement (c.-à-d. le 30 novembre 1981 pour le numéro de février 1982).
2. L'Inventaire des maladies des plantes au Canada paraîtra comme périodique d'information et registre de la présence et de la sévérité des maladies végétales au Canada ainsi que des pertes qu'elles causent. Des compilations sur l'occurence d'une maladie et des articles de revue ayant une valeur pratique pour les phytopathologistes seront appréciés, de temps en temps. Les articles traitant spécifiquement de l'évaluation de nouveaux fongicides devraient être soumis pour publication dans le Rapport de recherche sur les pesticides ou, si leur contenu semble le justifier, à un journal ayant une politique de révision.
3. L'Inventaire des maladies des plantes au Canada deviendra un périodique sans politique de révision des articles présentés; les auteurs seront totalement responsables des articles, notes, et observations acceptés pour publication. Toutefois, le rédacteur en chef continuera à évaluer l'à-propos des soumissions. Il est entendu que les auteurs feront vérifier leur articles par des collègues afin de corriger les ambiguïtés, les erreurs typographiques, de style, etc.... Les auteurs verront également à vérifier l'exactitude des épreuves et à assurer le respect des délais de retour. Agriculture Canada ne fournira pas de tiré-à-part des articles.
4. La Direction de la recherche, par l'intermédiaire du Service des programmes de recherche, sera responsable de la compilation, la production, la distribution et le financement de l'Inventaire des maladies des plantes au Canada.
5. La Société canadienne de phytopathologie sera responsable de la politique de rédaction par l'intermédiaire d'un Comité consultatif.

Observations sur la rouille du cognassier chez le pommier à La Pocatière, Québec[1]

L.J. Coulombe[2], R.L. Granger[3], A. Frève[4] et H. Généreux[5]

Entre les années 1972 et 1980, la rouille du cognassier causée par *Gymnosporangium clavipes* (Cke. & Pk.) Cke. & Pk. a été observée sur plusieurs cultivars et sélections de pommiers à La Pocatière, Québec. Parmi les cultivars les plus sensibles à la maladie, on note les cvs. Quinte, Spartan, Cortland, Fameuse, Summerred et MacSpur.

Can. Plant Dis. Surv. 61:2, 25-28, 1981.

Between 1972 and 1980 quince rust caused by *Gymnosporangium clavipes* (Cke. & Pk.) Cke. & Pk. was found on many apple cultivars and selections at La Pocatière, Québec. The most susceptible cultivars were Quinte, Spartan, Cortland, Fameuse, Summerred and MacSpur.

Introduction

La rouille du cognassier causée par *Gymnosporangium clavipes* (Cke. & Pk.) Cke. & Pk. n'est pas une maladie généralisée dans les aires de production pomicole au Québec. Elle apparaît sur les deux côtés du fleuve et à l'Ile aux Coudres dans les limites comprises entre Montmagny et Rivière-du-Loup et pour certains cultivars, elle n'existe qu'à l'état sporadique.

Les symptômes (planche I, figure 1-6) ont été décrits par différents auteurs aux Etats-Unis (Miller 1939; Thomas et Mills 1929; Crowell 1935 et Palmiter 1952) et au Canada (Campagna 1937 et Parmelee 1978). Au Québec, la maladie a été observée sur différents hôtes: *Juniperus virginiana* var. *depressa* (cèdre rouge)(Campagna 1934); *Juniperus communis* et *Horizontalis* (genévrier commun et horizontal), *Malus* sp. (pommier), *Cotoneaster acutifolia* (cotoneaster), *Amelanchier bartramiana* et *canadensis* (amélanchier de Bartram et du Canada) (Parmelee 1978); *Aronia melanocarpa* (gueules noires) et *Crataegus* sp. (aubépine) (Généreux 1972). Cette maladie débute sur l'amélanchier avant de s'attaquer au genévrier qui infectera les pommiers par la suite. Le cycle vital de l'organisme est connu depuis au moins 1929 et l'identification du champignon dans les tissus ligneux est accélérée grâce à une méthode mise au point par Matthews (1973). La sensibilité de différents cultivars a été observée aux Etats-Unis et au Canada (Aldwinckle 1974 et Harding et Morrall 1973). Le présent travail avait donc pour objectif de mesurer la sensibilité de plusieurs cultivars et lignées de pommes à la rouille du cognassier à la Ferme expérimentale de La Pocatière entre 1972 et 1980.

Materiel et méthodes

Plusieurs cultivars de pommiers ont été plantés sur terrain plat formé d'un sol limono-argileux (série Kamouraska) à la Ferme expérimentale de La Pocatière. Chaque rangée de pommiers n'était constituée que d'un seul cultivar. Une seconde plantation de plusieurs cvs. et sélections de pommiers plantés deux par deux et en deux répétitions aléatoires a été implantée en face de la première sur un sol sablonneux (série St-André) à inclinaison prononcée. Ces deux vergers sont protégés des vents de l'ouest par des brise-vents; le premier étant une plantation à cette fin alors que le second est un boisé naturel à prédominance de conifères.

Au cours des années d'observation, ces arbres ont reçu des traitements de protection contre la tavelure et les principaux insectes. Les fongicides employés ont été surtout le captane et la dodine aux doses recommandées par le Conseil des Productions Végétales du Québec. Par contre, en 1980, une partie du verger en pente a été traitée au manèbe dans le but de réprimer la rouille du cognassier.

Les estimés des fruits atteints de la maladie ont été faits au moment de la récolte soit par échantillonnage ou soit par comptage de tous les fruits sains et malades. Les données n'ont pas toujours été enregistrées par le même observateur; de plus le pourcentage et la gravité de la maladie ont varié au cours des saisons. Pour ces raisons les valeurs ont été transformées en indice de façon à obtenir une valeur comparative de la sensibilité des différents cultivars et lignées. L'indice de 0 à 3 représente les % suivants de fruits malades: 0=0%, 1=1 à 10%, 2=11 à 20%, 3=21% et plus. Cependant l'indice 0 n'indique pas pour autant l'immunité. Les années non citées n'ont pas fourni suffisamment de fruits malades pour justifier leur dénombrement.

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[1] *Contribution no. J. 885, Station de Recherches, Direction de la Recherche, Agriculture Canada, St-Jean-sur-Richelieu, Québec, Canada J3B 6Z8*

[2] *Phytopathologiste à la Station de Recherches de St-Jean*

[3] *Physiologiste à la Station de Recherches de St-Jean*

[4] *Phytopathologiste à la Ferme expérimentale fédérale, La Pocatière, Québec*

[5] *Phytopathologiste retraité à la Ferme expérimentale fédérale, La Pocatière, Québec G0R 3Z0*

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Tableau 1. Indice de la rouille du cognassier chez plusieurs cultivars de pommier à La Pocatière (Québec).

1972		1977		1978		1979		1980	
Cultivars	Indice	Cultivars	Indice	Cultivars	Indice	Cultivars	Indice	Cultivars	Indice
Crimson Beauty	1	Starkrimson	1	Spartan	1	Empire	1	Cortland	1
Quinte	2	Lobo	0	Cortland	1	Imp. McIntosh	1	Spencer	0
Melba (nord)	2	Golden Delicious	0	Coop.-1	1	MacSpur	0	Smithfield McIntosh	0
Melba (sud)	1	MacSpur	0	Coop.-2	1	MacSpur (1970)	2	R.R. Delicious	1
Calville Blanche	3	Red Haralson	0	Empire	0	MacSpur	1	Prima	1
Sharp Perfection	1	Spartan	1	Golden Delicious	1	Cortland	3	Hardispur	1
Atlas	1	Empire	0	MacSpur	0	Melba	1	Lindel	1
Hume	1	Cortland	0	Hardispur	0	McIntosh	1	Starkrimson	1
Kendall	1	Lindel	0	Herne	0	Spartan	3	Coop.-1	1
Scarlet	1	Spencer	0	Imperial	0	MacSpur	2	Golden Delicious	1
Lobo	1	Imperial McIntosh	0	Lobo	0	Smithfield McIntosh	2		
McIntosh (sud)	0	Coop.-2	0	Melred	1	Fameuse	3		
Spartan	2			Melba	1	Quinte	2		
Melrose	1			McIntosh	0	Summerred	3		
Lobo	0			Paulared	1				
McIntosh (nord)	1			Quinte	1				
Fameuse	2			Ranger	1				
Cortland	2			Red Haralson	0				
Northern Spy	1			R.R. Delicious	0				
Elmer	1			Lindel	1				
Niobe	1			Blair (0-294)	0				
Lindel (0-297)	2								
Moyenne	1.27		0.17		0.52		1.78		0.7

Résultats et conclusion

Les indices de rouille obtenus en 1972 et en 1979 ont été les plus élevés (Tableaux 1 et 2). Ces deux années ont fourni des conditions favorables pour le développement de la rouille. Ainsi en 1972 et 1978 les écidies étaient visibles et très bien développées sur les pommes (Quinte). Les températures moyennes obtenues au mois de mai ont été pratiquement identiques (15,7 et 15,9°C) (Tableau 3). Cette température a permis la libération des téliospores du genévrier commun et leur germination et l'infection des pommiers; à cette période, l'optimum était de 16°C. De plus, les conditions d'humitité élevée particulièrement dans la seconde moitié de mai et au début de juin ont été favorables à la maladie (Tableau 3). En fin de saison les écidies ne sont pas joujours visibles sur les fruits; des conditions spéciales sont nécessaires pour que ces dernières soient visibles. Ces conditions ont prévalu en 1972 et plus faiblement en 1978. En 1979 les cultivars les plus sensibles ont montré beaucoup de symptômes mais les écidies ont rarement été visibles. Les pertes ont même atteint 60% pour

Tableau 2. Indice de la rouille du cognassier sur quelques sélections de pommier à La Pocatière (Québec).

1972		1977		1978		1979		1980	
Lignées	Indice	Lignées	Indice	Lignées	Indice	Lignées	Indice	Lignées	Indice
0-272	1	0-521	0	0-361	1	0-521	3	0-521	0
0-274	1			0-521	0				
0-275	1			0-522	0				
0-294	2			0-531	0				
0-298	1			0-541	0				
0-521	0			0-546	0				
31-44-12	0			0-622	0				
33-1-131	1								
Moyenne	0.88		0		.13		3		0

Tableau 3. Températures (°C) et précipitations (mm) moyennes des mois de croissance à La Pocatière (Québec).

Années	Mai		Juin		Juillet		Août		Septembre	
	T	Précip.	T	Précip.	T	Précip.	T	Précip.	T	Précip.
1972	15,7	54,6	18,1	91,4	23,3	81,5	20,5	134,4	18,3	84,3
1973	12,8	106,7	23,7	53,6	26,7	90,4	22,9	98,6	16,9	70,4
1978	17,9	29,3	21,2	75,7	24,6	46,2	24,1	56,6	16,1	80,7
1979	15,9	127,0	22,3	88,0	26,3	38,3	21,7	127,2	17,4	144,6
1980	15,8	54,0	20,6	82,7	24,1	101,1	23,1	100,2	16,8	128,8

un cultivar en particulier. La sensiblité des cultivars et des lignées a varié d'une façon importante au cours des années d'infestation (Tableaux 1 et 2). D'après les saisons les plus propices au développement de la maladie, les cultivars et les lignées les plus affectés ont été respectivement en 1972 les cvs. Calville Blanche, Quinte, Melba, Spartan, Fameuse, Cortland et Lindel et la lignée 0-294 et en 1979, les cvs Cortland, Fameuse, Summerred, MacSpur, Smithfield McIntosh et Quinte et la lignée 0-521. La protection des vergers par le brise-vent naturel a donné plus de fruits malades que ceux qui ont été protégés par le brise-vent planté. Il semble qu'une bonne partie de l'inoculum soit venu du premier brise-vent qui abrite beaucoup de genévriers et contribue ainsi à maintenir un inoculum abondant et une humidité plus propice à la maladie dans le verger. Ainsi, la région à l'est de la ville de Québec et située près du fleuve St-Laurent contient du genévrier et de l'amélanchier en quantité; le climat y est parfois favorable à cette maladie. Par contre, les cultivars diffèrent par leur sensibilité à cette maladie. Le choix des moins sensibles est donc à conseiller. De plus, des traitements fongicides peuvent être employés par temps chaud et humide au mois de mai et au début de juin pour les cultivars les plus sensibles. Malgré ce problème qui peut être solutionné sans trop de difficulté, la culture de la pomme est relativement facile dans cette région.

Remerciements

Nous remercions particulièrement monsieur A. Pelletier pour sa collaboration technique au cours de ces années expérimentales.

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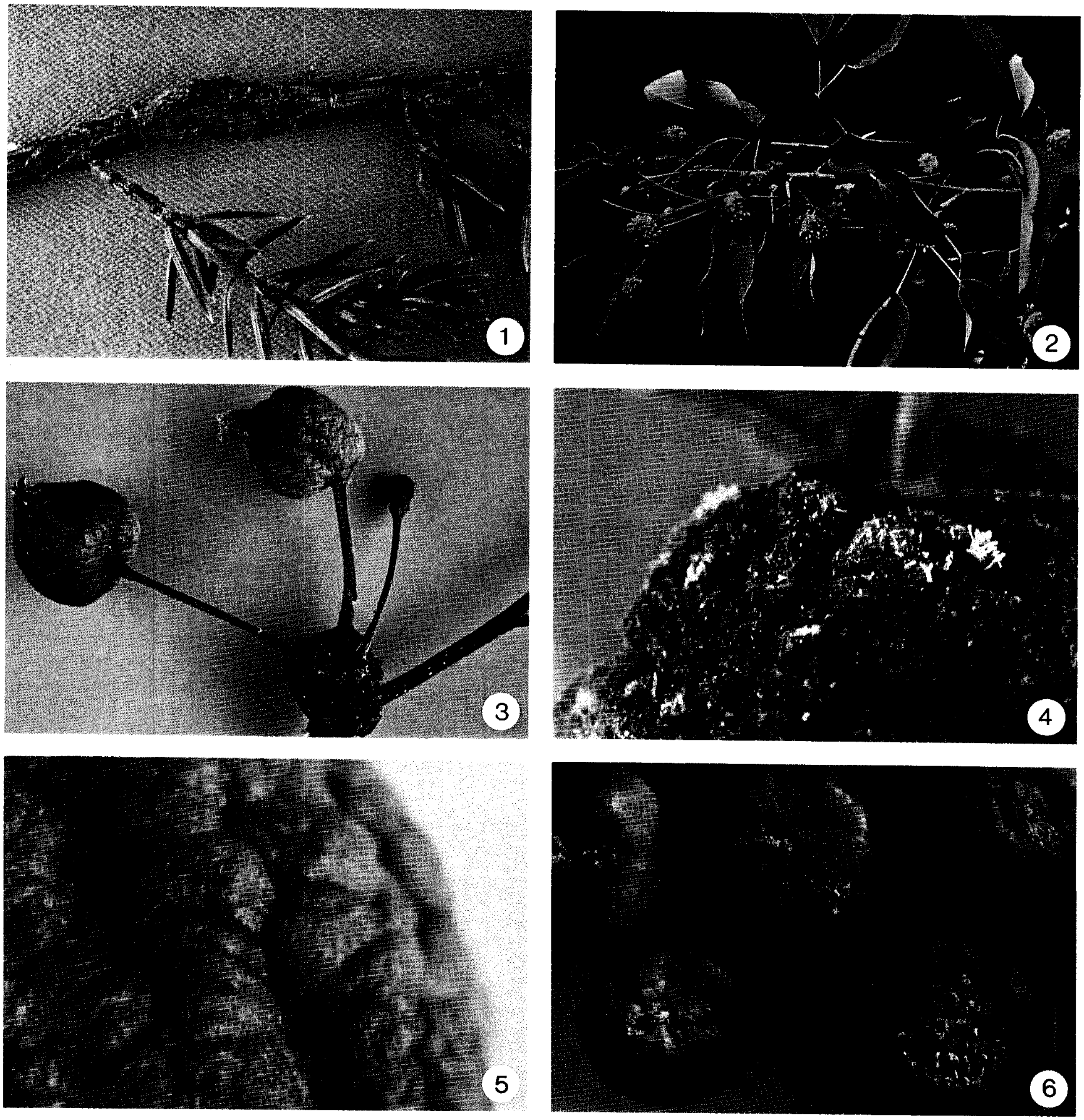

(1) Masse de télies de la rouille du cognassier sur tige de *Juniperus communis.* (2) Masse d'écidies sur fruits d'*Amelanchier canadensis.* (3) Masse d'écidies pétiolicoles et caulicoles sur *Pyrus malus.* (4) Idem figure 3 mais grossie X 22. (5) Début de formation des écidies sur pomme. (6) Pommes (Quinte) atteintes de la rouille du cognassier.

Armillaria mellea: Distribution and hosts in Newfoundland and Labrador

Pritam Singh[1]

This note provides the list and distribution of host species for *Armillaria mellea* in Newfoundland and Labrador. Many of the species are commercially important to the forest industry of the Region. The list includes names, latitudes and longitudes of the localities from where the fungus has been recorded; species marked with asterisks are new records for Newfoundland and Labrador.

Can. Plant Dis. Surv. 61:2, 31-36, 1981.

Cette note présente la liste et la distribution des espèces hôtes du champignon *Armillaria mellea* à Terre-Neuve et au Labrador. Beaucoup de ces espèce sont importantes commercialement pour l'industrie forestière de la région. La liste comprend les noms ainsi que les latitudes et longitudes des localités où le champignon a été identifié. Les astérisques accompagnant certains noms d'espèces indiquent que celles-ci sont mentionnées pour la première fois; dans cette région ou, en tant qu'hôte d'*A. mellea.*

Armillaria mellea (Vahl ex Fr.) Kummer is widely distributed in temperate and tropical regions of the world (Commonwealth Mycological Institute, 1969). The pathogen has a wide host range and causes a serious disease, Armillaria or shoe-string root rot, of commercial tree species.

In Newfoundland and Labrador the first record of the disease in natural stands dates back to 1958 when it was observed in young regenerating stands of black spruce, *Picea mariana* (Mill.) B.S.P., on a few old burned-over areas in western Newfoundland (Carroll and Parrott, 1958; Davidson and Newell, 1958). Since then the disease has been recorded in black spruce and balsam fir, *Abies balsamea* (L.) Mill., stands of all ages, and on scattered trees of several other softwood and hardwood species. The first record of the disease in plantations was made in 1970 (Singh, 1970).

Over the years *A. mellea* has been conspicuous and severely damaging in softwood plantations (Hall, Singh and Schooley, 1971; Singh, 1970, 1975, 1980; Singh and Richardson, 1973; Warren and Singh, 1970) and in natural stands which have been damaged by balsam woolly aphid (Hudak and Singh, 1970; Hudak and Wells, 1974). The root rot is now considered as the most important disease of living forest trees in Newfoundland. It causes loss of merchantable volume of commercially important softwood species through outright mortality of apparently healthy or insect-damaged trees, and of trees predisposed by site disturbances or inclement weather conditions. It also affects the yield through a reduction in growth, weakening of trees and windthrow (Singh and Bhure, 1974; Singh, 1980).

During the past 23 years numerous surveys have been conducted to examine the root rot in the forests of Newfoundland and Labrador. These forests belong to the boreal forest region (Rowe, 1972) and consist mainly of balsam fir, black spruce and white birch, *Betula papyrifera* Marsh. Balsam fir comprises 49 and 25%, black spruce 34 and 70%, and white birch 11 and less than 1% of the total volume of merchantable standing timber on the Island and in Labrador, respectively (Page *et al.* 1974). No attempt has so far been made to compile a list of host species for *A. mellea* and their geographic distribution in the region. This article attempts to bring together all the information on the distribution and hosts of this pathogen.

The disease has been found to be endemic and Island-wide in distribution in Newfoundland (46°37″N to 52°01″N, 52°37″W to 59°25″W); it has also been recorded from a few locations in Labrador (51°25″N to 60°30″N, 55°38″W to 67°49″W). The root rot has been observed on a variety of sites: dry - 1, well-drained - 2, somewhat moist - 3, moist - 4, somewhat wet - 5, wet - 6, although it was most abundant on dry, well-drained and moist sites (Damman, 1964; Singh, 1975). It was never found on extremely wet sites, or on peat- or heathland. Although the disease occurred on cutover, burned, burned-cutover, farmland and pastureland sites, it was conspicuously abundant and damaging on cutovers or burned-cutovers (Singh, 1975).

Armillaria mellea has been found both as a parasite and a saprophyte on a range of indigenous and introduced tree species. The disease has been observed on trees of all age and height classes. In all situations the diseased trees were distributed irregularly among healthy trees and where patches of more severe disease occurred, boundaries were not well defined. The sporophores of the fungus were found, usually in the months of August and September but occurred only at a few locations.

[1] *Forest Pathologist, Newfoundland Forest Research Centre, Canadian Forestry Service, Department of Environment, P.O. Box 6028, St. John's, Nfld., Canada A1C 5X8*

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To date 72 isolates of the pathogen have been obtained from 66 host provenances belonging to 22 species of softwoods and hardwoods growing in different localities. The fungal cultures are maintained on 2% malt agar in the Newfoundland Forest Research Centre Culture Collection. The list of hosts, along with their geographic locations in Newfoundland and Labrador, is given in Table 1; a few species in the list (marked with an asterisk) are new records for Newfoundland and Labrador. Figure 1 shows the localities where the disease was observed.

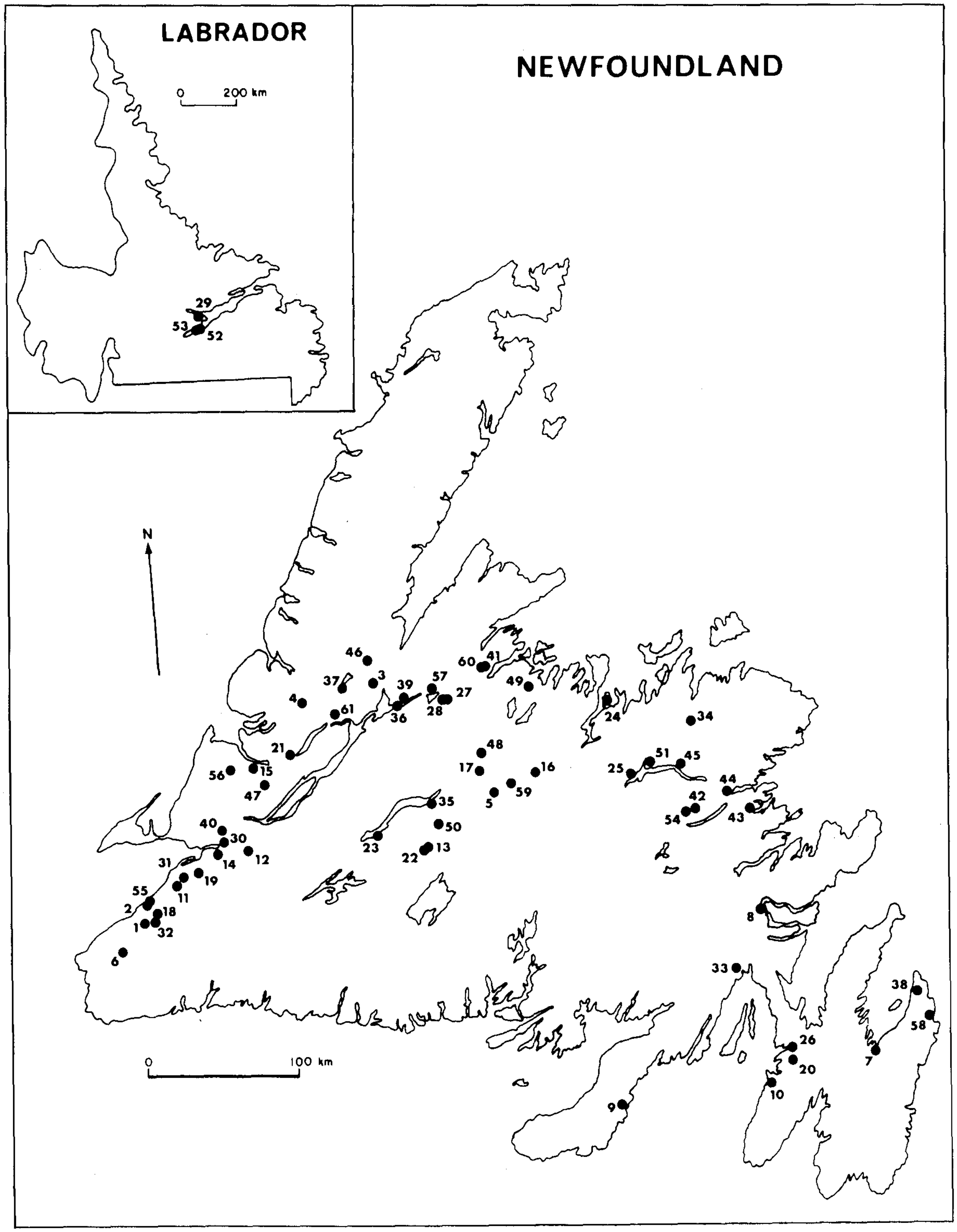

Fig. 1. Distribution of *Armillaria mellea* in Newfoundland and Labrador.

Table 1 List of host species and their locations in Newfoundland and Labrador.

Map no.	Host species & its source	Establishment*	Locality: Name	Latitude	Longitude
	Abies Mill.				
1-28.	*A. balsamea* (L.) Mill., balsam fir - Nfld.	Natural stands	Twenty-eight localities scattered across the Island	46°37'N to 52°01'N	52°37'W to 59°25'W
29, 53.	*A. balsamea* - Labrador	Natural stands	29. Along Northwest River Road	53°30'N	60°14'W
			53. Happy Valley-Goose River	53°17'N	60°22'W
30-32.	*A. balsamea* - Nfld.	Plantations	30. Bottom Brook 31. Middle Brook 32. Highlands River	48°32'N 48°20'N 48°05'N	58°14'W 58°30'W 58°46'W
30-31.	*A. balsamea* - Acadia For. Expt. Sta., N.B.	Plantations	30. Bottom Brook 31. Middle Brook	48°32'N 48°20'N	58°14'W 58°30'W
30-32.	*A. holophylla* Maxim., Nikko fir - Korea	Plantations	30. Bottom Brook 31. Middle Brook 32. Highlands River	48°32'N 48°20'N 48°05'N	58°14'W 58°30'W 58°46'W
30-32.	*A. homolepis* Sieb. & Zucc. - Japan	Plantations	30. Bottom Brook 31. Middle Brook 32. Highlands River	48°32'N 48°20'N 48°05'N	58°14'W 58°30'W 58°46'W
30-32.	*A. mariesii* Mast., Maries fir - Mt. Hakkoda, Aomori, Japan	Plantations	30. Bottom Brook 31. Middle Brook 32. Highlands River	48°32'N 48°20'N 48°05'N	58°14'W 58°30'W 58°46'W
30-31.	*A. mariesii* - Arakawa Nat. For., Aomori Prefecture, Japan	Plantations	30. Bottom Brook 31. Middle Brook	40°32'N 48°20'N	58°14'W 58°30'W
30-32.	*A. mayriana* Myiabe & Kudo - Atsuta, Ishikari, Hokkaido, Japan	Plantations	30. Bottom Brook 31. Middle Brook 32. Highlands River	48°32'N 48°20'N 48°05'N	58°14'W 58°30'W 58°46'W
30-32.	*A. sachalinensis* Mast., Saghalin fir - Tokyo Univers. Forest, Yamabe, Sorachi, Hokkaido, Japan	Plantations	30. Bottom Brook 31. Middle Brook 32. Highlands River	48°32'N 48°20'N 48°05'N	58°14'W 58°30'W 58°46'W
30-32.	*A. veitchii* Lindl., Veitch fir - Japan	Plantations	30. Bottom Brook 31. Middle Brook 32. Highlands River	48°32'N 48°20'N 48°05'N	58°14'W 58°30'W 58°46'W
30-32.	*A. veitchii* - Mt. Kyogatake, Hishiminowa, Kamiina, Nagano, Japan	Plantations	30. Bottom Brook 31. Middle Brook 32. Highlands River	48°32'N 48°20'N 48°05'N	58°14'W 58°30'W 58°46'W

* Plantations were only located on the island of Newfoundland.

Table 1 Continued

Map no.	Host species & its source	Establishment	Locality: Name	Latitude	Longitude
31-32.	*A. veitchii* – Usuda, Nagano Prefecture, Japan	Plantations	31. Middle Brook 32. Highlands River	48°20′N 48°05′N	58°30′W 58°46′W
	Alnus B. Ehr.				
30.	***A. rugosa* (Du Roi) Spreng., speckled alder – Nfld.	Natural regeneration	Bottom Brook	48°32′N	58°14′W
	Betula L.				
33-34.	***B. papyrifera* Marsh., white birch – Nfld.	Natural stands	33. Swift Current 34. Gander Bay Road	47°53′N 49°10′N	54°13′W 54°29′W
	Larix Mill.				
5,35-37.	L. *laricina (*Du Roi) K. Koch, tamarack – Nfld.	Natural stands	35. Millertown 36. Sandy Lake 5. Badger-Sandy Lake Road 37. Cormack	48°46′N 49°17′N 48°49′N 49°22′N	56°35′W 56°52′W 55°57′W 57°19′W
37.	*L. laricina* – Nfld.	Plantation	Cormack	49°22′N	57°19′W
37.	*L. leptolepis* (Sieb. & Zucc.) Gourd., Japanese larch – Holland	Plantation	Cormack	49°22′N	57°19′W
	Picea A. Dietr.				
38.	*P. abies* L., Norway spruce – Unknown	Plantation	Bauline Line	47°40′N	52°48′W
37.	*P. abies* – Norway	Plantation	Cormack	49°22′N	57°19′W
39.	*P. abies – Nord,* Norway	Plantation	Birchy Lake	49°20′N	56°49′W
37.	*P. glauca* (Moench.) Voss, white spruce – Nfld.	Plantation Natural stands	Cormack Newfoundland	49°22′N 46°37′N to 52°01′N	57°19′W 52°37′W to 59°25′W
37.	*P. glauca* – Sewert, Alaska	Plantation	Cormack	49°22′N	57°19′W
40.	Twenty-seven more provenances of *P. glauca* from Québec, Ontario, New Brunswick & Michigan	Plantation	Stephenville	48°36′N	58°15′W

**New record for host or location in Newfoundland & Labrador

Table 1 Continued

Map no.	Host species & its source	Establishment	Locality Name	Latitude	Longitude
1, 3-5, 21, 23, 34, 41-51.	*P. mariana* (Mill.) B.S.P., black spruce - Nfld.	Natural stands	Eighteen localities scattered across the Island	46°37′N to 52°01′N	52°37′W to 59°25′W
29, 52-53.	*P. mariana* - Nfld.	Natural stands	Three localities in eastern Labrador:		
			52. Mud Lake,	53°18′N	60°15′W
			53. Happy Valley-Goose River	53°17′N	60°22′W
			29. Along Northwest River Road	53°30′N	60°14′W
37, 39, 54-55.	*P. mariana* - Nfld.	Plantations	37. Cormack	49°22′N	57°19′W
			39. Birchy Lake	49°20′N	56°49′W
			54. North Pond	48°41′N	54°33′W
			55. Jefferys	48°12′N	58°49′W
56.	*P. rubens* Sarg., red spruce - Unknown	Plantation	Serpentine Lake	48°54′N	58°09′W
39.	*P. rubens* - Digby, N.S.	Plantation	Birchy Lake	49°20′N	56°49′W
38, 54, 57.	*P. sitchensis* (Bong.) Carr., Sitka spruce - Unknown	Plantation	38. Bauline Line	47°40′N	52°48′W
			54. North Pond	48°41′N	54°33′W
			57. Sheffield Lake	49°21′N	56°33′W
56.	*P. sitchensis* - Terrace, B.C.	Plantation	Serpentine Lake	48°54′N	58°09′W
37.	*P. sitchensis* - Fisk Bay, Alaska	Plantation	Cormack	49°22′N	57°19′W
37.	*P. sitchensis* - Krozow, Alaska	Plantation	Cormack	49°22′N	57°19′W
37.	*P. sitchensis* - Lillisnoo, Alaska	Plantation	Cormack	49°22′N	57°19′W
37.	*P. sitchensis* - Old Sitka, Alaska	Plantation	Cormack	49°22′N	57°19′W
37.	*P. sitchensis* - Petersburg, Alaska	Plantation	Cormack	49°22′N	57°19′W
37.	*P. sitchensis*- Queen Charlotte Island, B.C.	Plantation	Cormack	49°22′N	57°19′W
37.	*P. sitchensis* - Unknown	Plantation	Cormack	49°22′N	57°19′W
37.	*P. sitchensis* x *glauca* - Denmark	Plantation	Cormack	49°22′N	57°19′W
	Pinus L.				
38.	*P. resinosa* Ait., red pine - Argus, Ontario	Plantation	Bauline Line	47°40′N	52°48′W

Table 1 Continued

Map no.	Host species & its source	Establishment	Locality		
			Name	Latitude	Longitude
34.	**P. strobus* L., eastern white pine – Nfld.	Natural stands	Gander Bay Road	49°10′N	54°29′W
38.	*P. sylvestris* L., Scots pine – Unknown	Plantation	Bauline Line	47°40′N	52°48′W
58.	**P. sylvestris* Scots pine – Tanar, Scotland	Ornamental	St. John's	47°37′N	52°40′W
54.	*P. sylvestris* – Unknown	Plantation	North Pond	48°41′N	54°33′W
	Populus L.				
59.	**P. tremuloides* Michx., trembling aspen – Nfld.	Regeneration	2½ miles west of Lemotte's Lake	48°53′N	55°49′W
60.	**P. tremuloides* – Nfld.	Regeneration	6 miles west of Springdale	49°29′N	56°12′W
61.	**P. tremuloides* – Nfld.	Regeneration	North of Jct. Brook, Deer Lake area	49°13′N	57°22′W
	Pseudotsuga Carr.				
37.	*P. menziesii* (Mirb.) Franco, Douglas fir – Vancouver Island, B.C.	Plantation	Cormack	49°22′N	57°19′W

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A new disease of common poppy in Canada caused by a downy mildew

J.P. Tewari[1] *and W.P. Skoropad*[2]

The downy mildew (*Peronospora arborescens*) parasitising the common poppy (*Papaver somniferum*) is described. The material was collected from a house backyard in St. Albert, Alberta and this note is the first report of this disease in Canada.

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L'auteur décrit le mildiou (*Peronospora arborescens*) qui parasite le pavot somnifère commun (*Papaver somniferum*). Le matériel provient d'une arrière-cour à Saint-Albert (Alberta) et cette note est la première mention de la maladie au Canada.

Common poppy (*Papaver somniferum* L.) is a native of Europe and Asia. It is cultivated and grows as an escape in Newfoundland to Ontario (1) and is also infrequently grown in the backyard gardens in other parts of Canada.

Common poppy is susceptible to a number of fungal pathogens (1,2). During the late summer of 1977, diseased leaves of common poppy were received for disease diagnosis at the Department of Plant Science, The University of Alberta, from a homeowner in St. Albert, Alberta. This material was diagnosed to have a disease caused by the downy mildew [*Peronospora arborescens* (Berk.) de Bary (3, 4)]. This fungus, though reported on Mexican pricklepoppy (*Argemone mexicana* L.) from U.S.A. (2), has not been reported from Canada (1). However, *Peronospora corydalis* de Bary is reported on *Corydalis aurea* Willd., *C. sempervirens* (L.) Pers., and *Dicentra canadensis* (Goldie) Walp from Canada (1). All of these plants are closely related to the common poppy.

The diseased leaves of common poppy contained extensive necrotic, angular spots limited by the major veins in the early stages (Fig. 1). Many of these necrotic spots showed profuse hypophyllous sporulation of a *Peronospora*. The conidiophores showed the characteristic dichotomously branched apices (Fig. 2). The taxonomy of the species of *Peronospora* on Papaveraceae is based on the host and dimensions of the conidia (3, 4). The conidia in our material average 24.9 X 19.5 μm (range 22.3 - 26.0 X 13.6 - 22.3 μm) which is within the range described for *P. arborescens* (3, 4).

[1] *Biological Sciences Electron Microscopy Laboratory, University of Alberta, Edmonton, Alberta, Canada T6G 2E9*

[2] *Department of Plant Science, University of Alberta, Edmonton, Alberta, Canada T6G 2P5*

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The diseased specimens have been deposited in the National Mycological Herbarium, Biosystematics Research Institute, Ottawa, as DAOM 179533.

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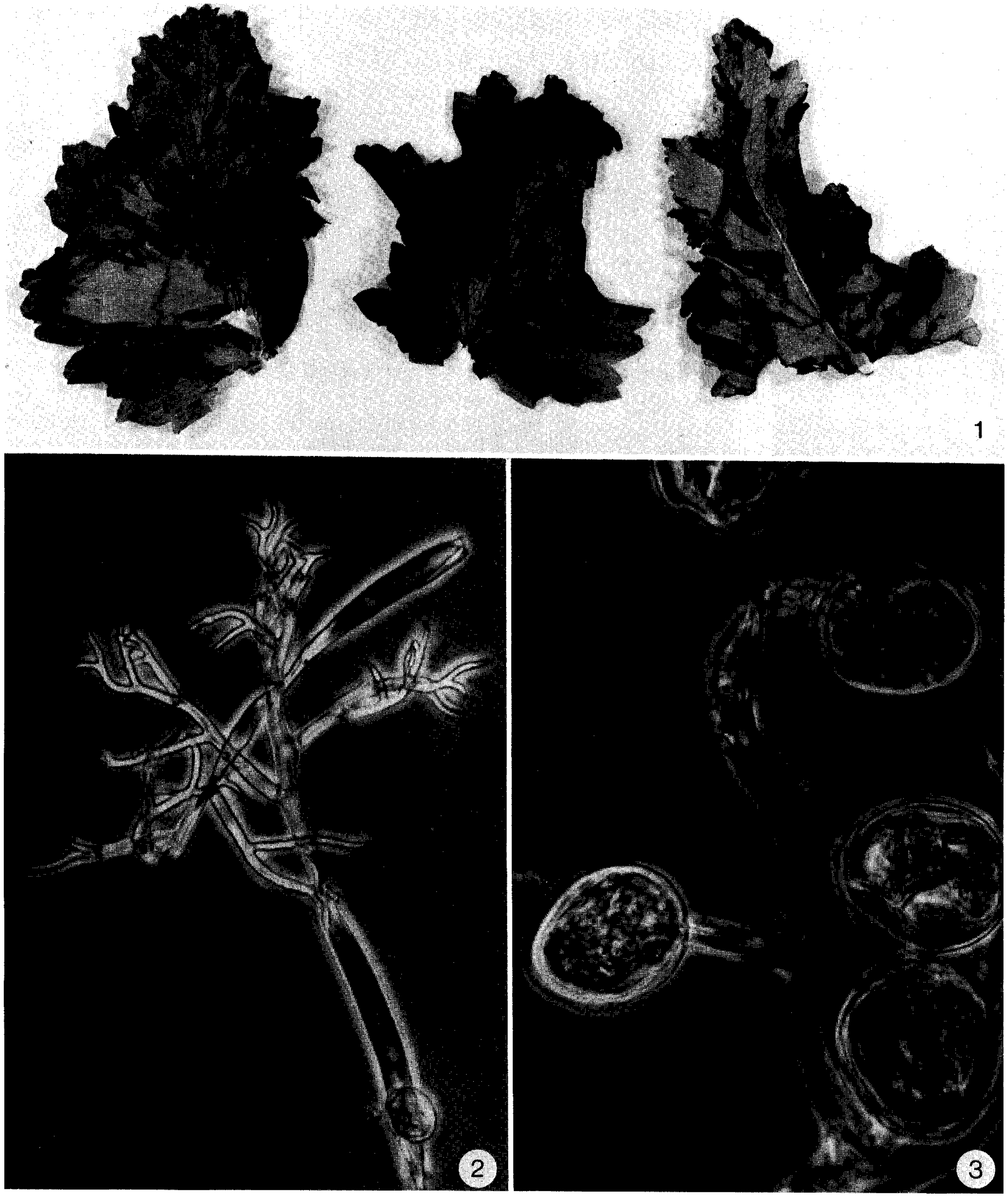

Peronospora arborescens on common poppy

Fig. 1. Parts of the leaves showing symptoms. Note dark necrotic areas which appear angular in the early stages. X 0.9.

Fig. 2. A conidiophore. Note the dichotomously branched apices X 400.

Fig. 3. Part of the conidiophore with conidia. X 1700.

Rhizoctonia disease on 'netted gem' potatoes in southern Manitoba in 1980[1]

R.C. Zimmer[2] and W.A. Russell[3]

Four fields of the potato cultivar, 'Netted Gem', in the Morden-Winkler area of southern Manitoba, were surveyed for the incidence of Rhizoctonia disease on stems and stolons. The fields surveyed were planted to two-year rotations of potatoes with either corn, onions, barley or wheat. The least amount of Rhizoctonia was found in the potato-wheat rotation with levels increasing in the potato-barley and in the potato-onion and potato-corn rotations. Irrigation did not appear to affect the amount of Rhizoctonia disease in the potato-corn and potato-onion rotations.

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On a observé quatre champs du cultivar de pommes de terre «Nettled Gem» dans la région productrice Morden-Winkler du sud du Manitoba pour la présence de la rhizoctonie sur les tiges et les stolons. Les champs retenus ont été cultivés en rotations de deux ans de pomme de terre avec du maïs, des oignons, de l'orge ou du blé. La plus basse fréquence d'apparition de la maladie fut observée pour la rotation pomme de terre-blé, la fréquence augmentant graduellement dans les rotations pomme de terre-orge, pomme de terre-oignons et pomme de terre-maïs. L'irrigation n'a pas semblé influer sur l'infectiosité de la maladie chez les rotations pomme de terre-maïs et pomme de terre-oignons.

Introduction

Rhizoctonia disease of potato (*Solanum tuberosum* L.), also known in the sclerotial form on the tuber as 'black scurf', is caused by the fungus *Rhizoctonia solani* Kuhn (perfect stage *Thannatephorus cucumeris* (Frank) Donk). It is endemic every year in Manitoba and has been cited as being capable of causing serious losses somewhere in Canada every year (2).

This disease, because of the nature of the pathogen, is difficult to control. The pathogen has a wide host range and can survive in the soil in plant debris for long periods of time. The debris, of various plants, possesses different capacities to support saprophytic growth of *R. solani*, and therefore supports different levels of the pathogen in the absence of its host. During the summer of 1980, a survey to determine the incidence of *R. solani* on the potato cultivar 'Netted Gem' in rotation with several crops, was carried out with the cooperation of a potato grower in southern Manitoba. The results are presented in this paper.

Materials and methods

Four fields of the cultivar, 'Netted Gem', with the following 2-yr rotations were surveyed: potato-corn, potato-onion, potato-barley and potato-wheat. A second comparison, irrigation vs. non-irrigation, was made in the potato-corn and potato-onion rotations. The sample per field consisted of 5 consecutive plants from 4 widely separated areas giving a total sample of 20 plants. From each plant data were gathered on stems with cankers, stems girdled, stolons with cankers and stolons girdled. No yield data were obtained.

Results and discussions

All (100.0%) of the stems were cankered except in the potato-wheat rotation (86.0%). Girdling of the stems was most severe in the potato-corn rotation (57.0%), with a lesser amount occurring in the potato-onion and potato-barley rotations (32.0%) and the least amount in the potato-wheat rotation (15.0%), Table 1. The incidence of *R. solani* in the potato-corn and potato-onion rotations apparently was not affected by irrigation.

The incidence of cankers on and girdling of stolons also was high (Table 1). On the average the highest incidence of cankered and girdled stolons occurred in the potato-corn and potato-onion rotations, with a decrease in the potato-barley rotation and again the least amount occurred in the potato-wheat rotation.

Other rotation studies have shown that various crops possess different potentials to support saprophytic growth and disease of *R. solani* in soil. In the state of Maine, potato plants in soils under a 2-yr rotation with oats, had the lowest incidence of disease on the stems, roots and tubers of the cultivars Kennebec and Katahdin. On the more susceptible cultivar, Russet Burbank (Netted Gem), the 3-yr rotations of potato-oats-soybeans or potato-oats-millet provided the lowest incidence of disease (3). A report from Poland indicated that infection was lower when potatoes were planted after rye or wheat (16.3%), or rape (14.3%) and highest after potato (30.0%) (4). In Kazakhstan (USSR), incidence of *R. solani* was reduced considerably by crop rotation with sainfoin, pea-oats mixture and barley (1). Buckwheat residue provided one of the best substrates for *Rhizoctonia* colonization while oat and soybean were poor substrates (3).

[1] *Agriculture Canada, Research Station, Morden, Manitoba R0G 1J0*

[2] *Plant Pathologist*

[3] *Potato Breeder*

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Table 1. Incidence of *Rhizoctonia solani* infection on the stems and stolons of 'Netted Gem' potato plants grown under various rotations*

		% *R. solani*			
		Stems		Stolons	
Rotation	Irrigation	Cankered	Girdled	Cankered	Girdled
Potato-Corn	+	100.0	56.7	74.4	39.4
Potato-Corn	-	100.0	57.0	80.8	46.1
Potato-Onion	+	100.0	33.0	73.2	45.0
Potato-Onion	-	100.0	25.0	69.3	38.5
Potato-Barley	-	100.0	38.0	51.5	31.6
Potato-Wheat	-	86.0	15.0	44.1	22.9

*Data given on a sample of 20 plants per field

Results of this limited survey tend to support previous work that barley and wheat supported lower levels of *R. solani* infection in potatoes. An important aspect of this information is that it was obtained from an area in Manitoba cropped rather intensively to potatoes and under grower production practices. Further studies on the effect of crop rotation and other production practices are needed to assess their effect on incidence of *R. solani* and more importantly their effect on yield.

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Strawberry cultivar reaction to pallidosis disease[1]

D. L. Craig

Leaf-grafting to the UC10 clone of *Fragaria virginiana* (Duchesne) has shown that many of the Canadian produced cultivars grown in Eastern Canada are infected with pallidosis. A field plot test of fruit characteristics and yield of pallidosis free and pallidosis infected Redcoats and Midways indicated the value in replacing infected stock currently propagated for certification by local nurseries with pallidosis free stock.

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Le greffage sur feuille pratiqué sur le clône UC10 de *Fragaria virginiana* (Duchesne) a permis de démontrer que beaucoup des cultivars canadiens cultivés dans l'est du Canada sont atteints de pallidose. Un essai en parcelle portant sur les caractéristiques des fruits et le rendement de fraisiers Redcoat et Midway infectés et non infectés a montré l'avantage de remplacer les stocks actuellement multipliés en vue de la certification par les pépinières locales par des stocks exempts de pallidose.

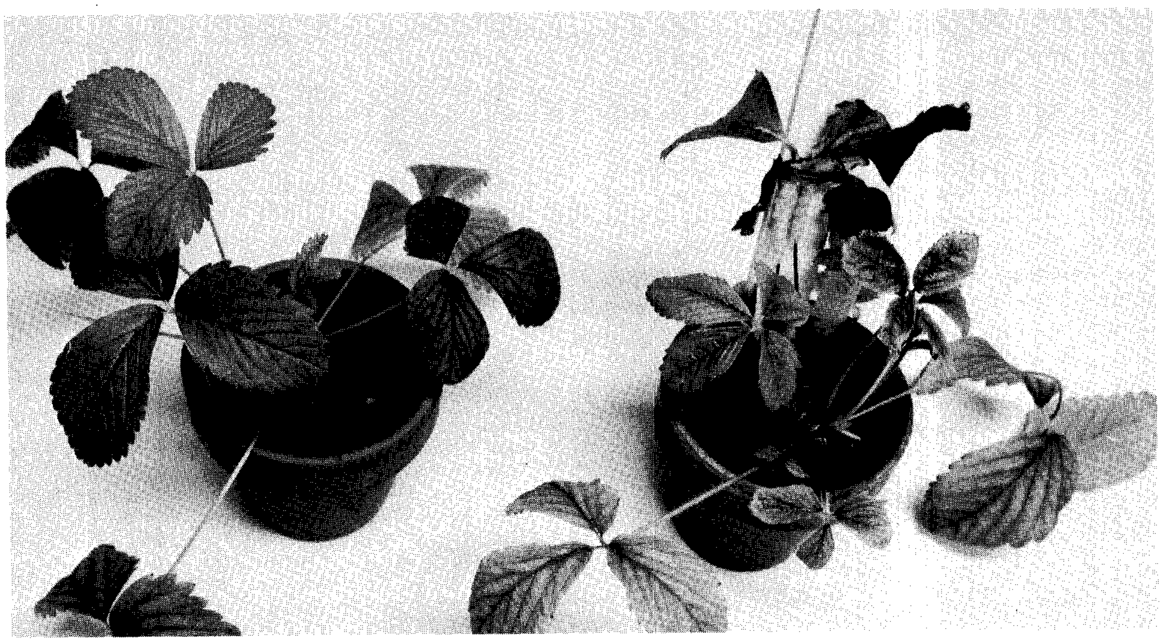

Figure 1. Healthy (left) and pallidosis infected (right) UC10 clone of *Fragaria virginiana*.

Introduction

Pallidosis, a disease, widespread in strawberries in the U.S.A. but not present in the United Kingdom was first described by Frazier and Stubbs (3) in 1969. Frazier (2) also identified the leafhopper *Coelidia olitoria* (Say) as a possible vector. Mullin et al. (5) suggest the disease could reduce vigor and intensify symptoms of other diseases, and, may thus cause significant yield reductions.

Symptoms of pallidosis are not apparent in the cultivars currently recommended for planting in Eastern Canada but are expressed clearly (Fig. 1) following grafting of a leaf from an infected cultivar to the University of California Clone 10 of *Fragaria virginiana*. Symptoms in UC10 which appear about 4 weeks after grafting consist of pallidness and cupping of young leaves which are reduced in size and vigor. During chronic stages, mature leaves are cupped or rounded outwards, mottled interveinally and prematurely colored. Pallidosis can be readily eliminated from strawberries by propagating from meristems (6).

Leaf-graft indexing to UC10 at Kentville verified the presence of pallidosis in the principal Eastern Canadian cultivars

[1] *Contribution No. 1719, Research Station, Agriculture Canada, Kentville, Nova Scotia, B4N 1J5*

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Cavalier, Redcoat, Veestar and Vibrant and in the U.S. cultivar Midway. New cultivars such as Micmac and Bounty from the Kentville breeding program remain pallidosis free when protected in the Station screenhouse. However, plant sampling in 1978 from a 5 year old commercial field of Micmac and a 4 year old field of Bounty indicated 25 per cent of the Micmac and 9 percent of the Bounty pallidosis infected. It also suggested the presence of a vector in the region. The effect of the disease on fruit characteristics and yield has not been reported for cultivars developed in Canada. Meristem propagated pallidosis free clones of many cultivars including some Canadian are available from the U. S. Dept. of Agriculture, Beltsville, Maryland. This paper reports the performance of pallidosis infected and pallidosis free Redcoat, the most important Canadian cultivar in Eastern Canada, and Midway, a U. S. cultivar occasionally grown in Eastern Canada.

Materials and methods

Pallidosis-free clones of Redcoat and Midway were obtained from Beltsville in 1978 and propagated in the Kentville insect proof screenhouse. In May 1979, pallidosis infected Redcoat and Midway plants were field planted in a randomized block design with 4 replicates. This planting stock had been propagated from clones indexed to the East Malling clone of *Fragaria vesca* and the virus diseases Latent C and mottle normally identified by this indicator were not present. Ten mother plants and their runner plants in 6 m plots formed 30 cm wide plant rows. Five sample plants from each pallidosis free plot and 2 from each pallidosis-infected plot were dug in November 1979, and indexed to the UC10 clone.

Table 1. Yield and fruit size from pallidosis infected and non-infected strawberry cultivars.

	Total yield kg/ha	Marketable yield kg/ha	Av. fruit size (g)
Redcoat-pallidosis free	25925a*	23494a	11.9a
Redcoat-pallidosis infected	23602a	21226ab	11.7a
Midway-pallidosis free	19659a	17608bc	11.0ab
Midway-pallidosis infected	19768a	18364c	10.4b

*Values in the same column followed by the same letter are not significantly different at the 5% level according to the DMR test.

Results and discussion

Assuming there was no additional infection from the time of mulch removal in late April 1980 until fruiting in early July the presence of pallidosis had no significant effect on total yield, marketable yield or fruit size (Table 1). Careful visual observation of fruit failed to detect any change in fruit form or color.

The indexing to UC10 of sample plants taken from the randomized plots exposed to vectors for a complete growing season indicated the following: pallidosis free Midway 0 infection, pallidosis free Redcoat 5% infection, pallidosis infected Midway and Redcoat 100% infection.

A sampling of commercial fields in 1978 indicated the rate of pallidosis spread in Nova Scotia was not rapid since the mother plants in 4 year old Bounty and 5 year old Micmac fruiting fields also had two years exposure in the commercial nursery prior to their purchase for commercial planting. This is in contrast to Arkansas where a high percentage infection occurs within one year (4).

Latent C and mottle virus are the principal strawberry virus diseases in Nova Scotia (1) and although Frazier (3) reports the additive effect of mottle or vein banding as less severe than crinkle or mild yellow edge freedom from pallidosis is important for Eastern Canada's strawberry industry.

The identification of pallidosis in Canadian cultivars emphasizes the problems involved in labelling a strawberry clone virus free. The data from this test supports our decision to replace the present pallidosis infected stock currently propagated by Nova Scotia nurseries with pallidosis free stock.

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Inland spruce cone rust of black spruce in Newfoundland and Labrador

Pritam Singh[1]

This article is the first record of inland spruce cone rust of native black spruce, *Picea mariana*, caused by *Chrysomyxa pirolata*, from Newfoundland and Labrador. It also discusses the distribution, severity and status of the disease, particularly in relation to the economic value of the host in this Region. A "Cone Rust Intensity Rating Scale" (CRIRS) is proposed to quantify the intensity of the disease on cones.

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Le présent article constitue le premier rapport sur la rouille des cônes de l'épinette noire, *Picea mariana*, causée par *Chrysomyxa pirolata*, à Terre-Neuve et au Labrador. Il porte sur la distribution, la gravité et la fréquence de la maladie et tient surtout compte de l'importance économique de l'hôte dans cette région. On y propose également une "échelle d'évaluation de l'intensité de la rouille des cônes" afin de quantifier la gravité de la maladie.

Introduction

Black spruce, *Picea mariana* (Mill.) B.S.P., is a mundane, hardy and one of the most widespread softwood trees of North America. Along with balsam fir and a few other spruces, it is the mainstay of Canada's pulp and paper industry. It is the second most valuable forest species used in the manufacture of high quality paper in Newfoundland and Labrador. The species constitutes about 34 and 70% of the total volume of merchantable standing timber on the island of Newfoundland and in Labrador, respectively. On many lowland sites, black spruce is the only commercially important tree species.

Inland spruce cone rust, caused by *Chrysomyxa pirolata* Wint. [*Chrysomyxa pyrolae* (DC.) Rostr.], is a widely distributed disease in North America. In Canada it has been observed on the cones of Engelmann's spruce, *Picea engelmannii* Parry; white spruce, *P. glauca* (Moench) Voss; black spruce; Colorado blue spruce, *P. pungens* Engelmann; sitka spruce, *P. sitchensis* (Bong.) Carr.; and on the foliage of *Moneses uniflora* (L.) A. Gray and *Pyrola* species from British Columbia, Alberta, Manitoba, Northwest Territories, Saskatchewan, Yukon, Ontario, Quebec and Nova Scotia (Conners, 1967; Ziller, 1974). In the summer of 1979, symptoms of the disease were observed on the young cones of native black spruce in a regeneration stand near Swift Current on the Burin Peninsula of the island of Newfoundland. Since then special surveys have been conducted in many cone producing areas and the pathogen has been observed on the host in several regenerating stands scattered on the Island and in eastern Labrador; so far it has not been observed on any other species of spruce. This article is the first record of the occurrence of the cone rust on black spruce in Newfoundland and Labrador. It also describes the distribution and severity of the disease on the Island and in eastern Labrador, suggests a Cone Rust Intensity Rating Scale (CRIRS), and discusses the damage potential of the disease in relation to the economic value of the host species in the forest industry of the region.

Study areas and methodology

Surveys for the cone rust were conducted in several cone producing areas[2] of black spruce forests on the Island and in eastern Labrador. However, detailed examination of the disease, and data on its incidence and intensity were obtained from six plots located in different regenerating stands of black spruce (Nos. 1, 2, 3, 4, 5 and 6 in Fig. 1 and Table 1); four of these plots were on the Island and two in Labrador. These stands were selected because of greater abundance of the rust. Data on the location, elevation, moisture regime, history, forest capability class, stand composition, and average age and height of the stand in the six plots are given in Table 1.

The following observations and data were recorded from a maximum of 56 trees in each of the six 5,625 m^2 plots: number of cones per tree, number of infected cones per tree, number of opened and unopened cones, amount of infection as enunciated by the newly devised cone rust intensity rating scale (CRIRS).

The identity of the pathogen was confirmed from symptoms and aeciospore characteristics (Saville, 1950, 1955; Ziller, 1974).

[1] *Forest Pathologist, Newfoundland Forest Research Centre, Canadian Forestry Service, Environment Canada, P.O. Box 6028, St. John's, Newfoundland, Canada A1C 5X8.*

[2] *Department of Forest Resources and Lands, Government of Newfoundland and Labrador have designated some of these areas for seed collection.*

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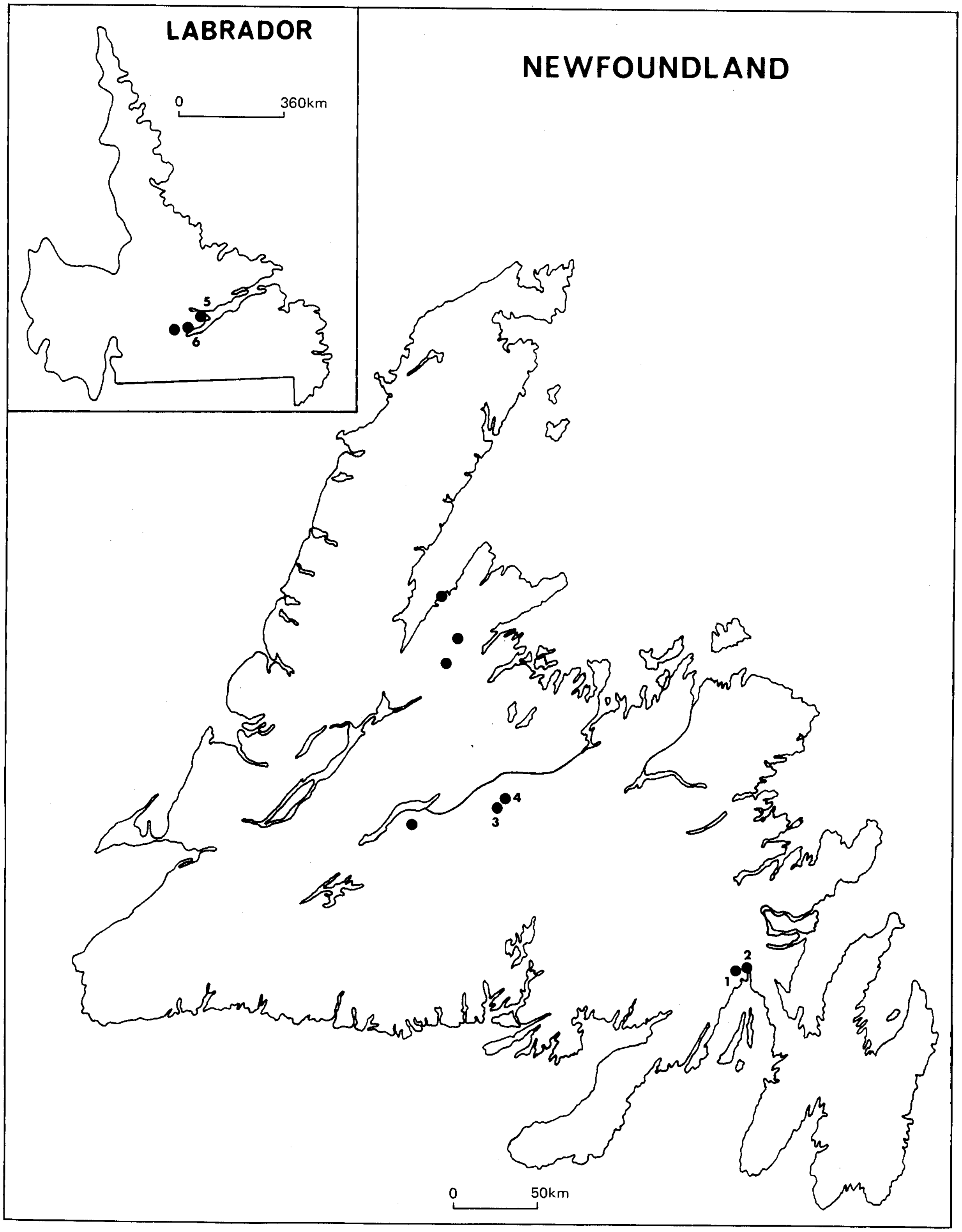

Fig. 1. Location of 11 cone rust areas and six plots in Newfoundland and Labrador.

Table 1. Location, elevation, moisture regime, history, forest capability class, stand composition and average age and height of the stands in the six plots.*

Plot No.	Location	Elevation	Moisture regime**	History	Forest capability class***	Stand composition and dominant species	Average age of the stand (years)****	Average height of the stand (metres)
1	8 km southwest of Swift Current; 47° 55'N, 54° 20'W	152 m (500 ft)	Barrens, but the plot was located on somewhat moist to moist site - 3-4.	Burned in 1961, regenerating	5	Black spruce regeneration with scattered young trees of balsam fir, *Abies balsamea* (L.) Mill.; pin cherry, *Prunus pensylvanica* L.f.; sheep laurel, *Kalmia angustifolia* L.; smooth serviceberry, *Amelanchier laevis* Wieg.; trembling aspen, *Populus tremuloides* Michx.; white birch, *Betula papyrifera* Marsh; dominant species - black spruce.	14 (9-17)	2.3
2	7 km southwest of Swift Current; 47° 55'N, 54° 19'W	152 m (500 ft)	Barrens, but the plot was located on somewhat moist to moist site - 3-4.	Burned in 1961, regenerating	5	Black spruce regeneration with some regenerating balsam fir, pin cherry, and white birch; dominant species - black spruce.	10 (7-13)	1.8
3	51 km southwest of Grand Falls; 48°46'N, 56°07'W	213 m (700 ft)	Well drained to moist - 2-4.	Cutover, regenerating	4	Black spruce regeneration with some regenerating balsam fir; blueberry, *Vaccinium angustifolium* Ait.; pin cherry; pussy willow, *Salix discolor* Muhl.; sheep laurel; dominant species - black spruce.	12 (8-17)	2.5
4	42 km southwest of Grand Falls; 48° 50'N, 56° 02'W	183 m (600 ft)	Well drained to moist - 2-4.	Cutover, regenerating	4	Black spruce regeneration with scattered young trees of balsam fir; pin cherry; speckled alder, *Alnus rugosa* var. *americana* (Regel) Fern; white birch; dominant species - black spruce.	18 (10-22)	3.3
5	8 km southwest of Northwest River; 53° 31'N 60° 14'W	31 m (100 ft)	Moist to very wet - 4-7.	A poorly regenerating site, very wet and boggy	4	Black spruce regeneration with regenerating balsam fir and trembling aspen; dominant species - black spruce.	12 (10-16)	2.0
6	3 km west of Happy Valley; 53° 17'N, 60° 22'W	31 m (100 ft)	Somewhat moist to moist - 3-4.	An old burned over	4	Black spruce and balsam fir regeneration, mostly spruce, scattered pin cherry and trembling aspen; dominant species - black spruce.	14 (8-18)	2.3

*All figures are rounded off to the nearest whole number.
**After Damman (1964).
***After McCormack (1967).
****Figures within parentheses denote the range.

Results and discussion

The pathogen, *Chrysomyxa pirolata*, attacked only the cones and not the needles (Ziller, 1974). The most conspicuous symptoms of the disease were small, yellow or orange-colored spots on young cones. In late summer the rusted, prematurely brown and the opened cones showed conspicuous yellow or orange-yellow powdery masses of aeciospores on the surface of cone scales. This indicated a substantial internal development of the pathogen (Fig. 2a, b, c, and d).

The disease was found in patches at eight widely scattered locations in eastern and central parts of the Island (46°37''N to 52°01''N; 52°37''W to 59°25''W) and four locations in eastern Labrador (51°25''N to 60°30''N; 55°38''W to 67°49''W) (Fig. 1). It was most conspicuous in young regenerating stands of black spruce growing on moist sites with forest capability class varying from 4 to 5 (McCormack, 1970). The average age and height of 6 of those stands varied from 10 to 18 years and 1.8 to 3.3 m, respectively (Table 1).

The incidence and intensity of the rust in the six plots varied considerably (Table 2). The percent trees affected varied from 12 to 85 and percent cones affected per tree varied from 3.7 to 26.8. Similar reports of light to severe infection have also been published from Alberta, British Columbia, Ontario and Saskatchewan (Forest Insect and Disease Survey, 1951-1976; Ziller, 1974)

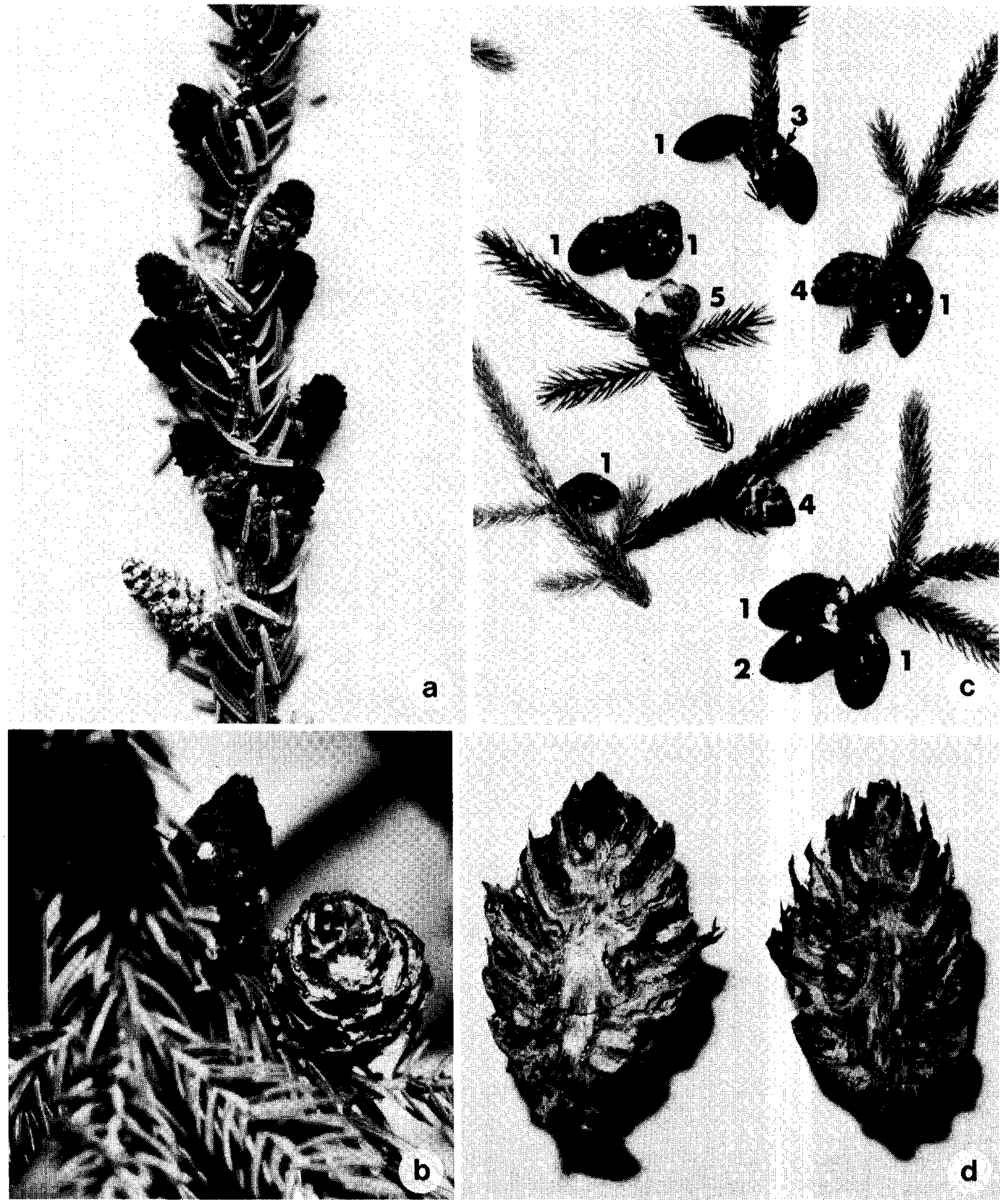

Fig. 2. Cone rust symptoms. a & b. Severely rusted cones on shoots; c. Different levels of the cone rust intensity (CRIRS); and d. Longitudinally cut severely infected cone.

To obtain a better understanding of the severity of the rust on individual cones, a Cone Rust Intensity Rating Scale (CRIRS) is suggested (Table 3). It is a visual rating scale from 1 to 5, and shows a relationship between the amount of infection on the cone and premature opening of the cone. The CRIRS values in the six plots varied from 1 to 5 (Table 2). The highest average value (3.5) was observed in Plot No. 3, located in a well-drained to moist site, 51 km southwest of Grand Falls on the Island, and the lowest average value (1.0) was observed in Plot No. 5 (1980 data), located in a moist to very wet site 8km southwest of Northwest River in eastern Labrador. The CRIRS values do not seem to be related to the percent trees and percent cones infected (Table 2). This shows that to obtain an overall estimate of the incidence and intensity of the rust, one would have to collect data on three parameters: percent trees infected, percent cones infected, and the amount of infection on individual cones through CRIRS value.

The damage by the rust in the areas examined is light to moderate and does not warrant any immediate need for control of the disease. However, because the pathogen is known to cause severe damage in parts of Europe (Jorstad,

1951) and North America (Ziller, 1974), its potential on the Island and in Labrador should not be underestimated, particularly when the host species is vitally important to the forest industry and economy of the Region. Also, with increasing emphasis on reforestation of the species in this Region, there is going to be a greater need for a healthy seed source. Since the disease is known to deform or destroy cones, reduce seed production and decrease viability of seeds (Forest Insect & Disease Survey, 1951-1976; Nelson & Krebill, 1970) and since in Newfoundland it was observed in areas designated for seed collection, it has caused concern to forest managers. This concern is increased because Matthews and Maloy (1960) reported that the rusted cones are particularly attractive to cone insects and that further losses may occur when insects leave rusted cones and attack healthy cones.

Table 2. Incidence and intensity of Inland Spruce Cone Rust in six plots.

Plot No.*		Total number of trees examined	Avg. % trees infected	No. of cones examined	Intensity: Avg. % cones infected	Intensity: Cone rust intensity rating scale-(CRIRS) avg. figures**
1	'79	36	12.1	3,686	3.7	3.2 (1-5)
	'80	35	19.5	1,201	12.6	1.2 (1-5)
2		30	29.3	668	13.8	1.5 (1-5)
3		30	85.0	818	21.3	3.5 (1-5)
4		20	35.0	808	16.3	2.5 (1-4)
5	'79	40	30.0	1,924	26.8	3.0 (1-5)
	'80	56	17.6	1,186	9.3	1.0 (1-2)
6		47	46.5	1,675	14.4	2.0 (1-4)

*Includes 1979 and 1980 data for Plot Nos. 1 and 5.
**Figures within parenthesis denote the range.

Table 3. Cone rust intensity rating scale (CRIRS).*

Rating scale	Amount of infection on the cone	Amount of cone opened
1	1 to few rust spots	Closed
2	¼ infected	Opening slightly
3	½ infected	Opening slightly to ¼ opened
4	¾ infected	¼ to ½ opened
5	Fully infected	½ or more opened

*Based on an examination of 360 infected cones.

Acknowledgement
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