CYPRESS CANKER IN NEW ZEALAND PLANTATIONS

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ABSTRACT

A national survey to determine the distribution and extent of the disease commonly known as cypress canker was carried out in 1981 and 1982 in plantations of **Cupressus macrocarpa** Hartweg, **Cupressus lusitanica** Miller, and **Chamaecyparis lawsoniana** (A. Murray) Parlatore, and in shelterbelts of × **Cupressocyparis leylandii** (Jackson and Dallimore) Dallimore cv. 'Leighton Green'. One of the two fungi responsible for the disease, **Seiridium unicorne**, was found throughout the country except on the West Coast of the South Island. The other, **Seiridium cardinale**, was found near Auckland, Wanganui, Palmerston North, and Christchurch. The incidence of the disease was low. Damage to trees by other fungi, insects, and animals was also low.

Keywords: Cypress canker; **Seiridium unicorne**; **Monochaetia unicornis**; **Seiridium cardinale**; **Coryneum cardinale**; **Cupressus macrocarpa**; **Cupressus lusitanica**; **Chamaecyparis lawsoniana**; × **Cupressocyparis leylandii**.

INTRODUCTION

Two fungi causing cypress canker, *Seiridium unicorne* (Cooke & Ellis) Sutton (= *Monochaetia unicornis* (Cooke & Ellis) Saccardo, *Cryptostictis cupressi* Guba) and *Seiridium cardinale* (Wagener) Sutton and Gibson (= *Coryneum cardinale* Wagener) have been reported in New Zealand (van der Werff 1984).

Birch (1933) first reported cypress canker in New Zealand on *Cupressus macrocarpa* and *Chamaecyparis lawsoniana* as "gummosis" disease, which he attributed to *Seiridium cardinale*. He found gummosis to be widespread in the North Island and confined mainly to plantations. No reference was made to the presence or absence of the disease in the South Island, and it is assumed his study did not extend that far.

Nothing more was published on the disease in this country until 1954 when Fuller & Newhook (1954) reported cypress canker as being so severe in *Ch. lawsoniana* shelterbelts in the Waikato district that the trees were threatened with extinction. These authors maintained that most cankers in New Zealand were caused, not by *S. cardinale*, but by *S. unicorne*. They rated *C. macrocarpa* shelterbelts as being as susceptible to the disease as those of *Ch. lawsoniana*. However, their survey was confined to shelterbelts in the northern half of the North Island and did not include plantations of either species.

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Since 1954 *C. macrocarpa* and *Ch. lawsoniana* have sometimes been regarded as trees to be avoided for planting because of the threat of malformation and death (Weston 1957, 1971; Newhook 1962; Gilmour 1966). *Cupressus lusitanica* has been regarded as much less susceptible to cypress canker than *C. macrocarpa* and *Ch. lawsoniana,* and therefore a favourable alternative species (Fuller & Newhook 1954; Bannister & Orman 1960; Newhook 1962).

Because of the conflicting findings of Birch (1933) and Fuller & Newhook (1954), there has been some speculation as to the fate and original extent of *S. cardinale* in New Zealand (Swart 1973).

A national survey was carried out in 1981 and 1982 to determine the current status and potential of *C. macrocarpa, C. lusitanica,* and *Ch. lawsoniana* plantations. Shelterbelts of × *Cupressocyparis leylandii* cv. 'Leighton Green' were included in the study as no plantations of this species were available. The objectives of this survey were to determine:

(a) The area and quality of the resource;
(b) Site limitations and preferences of the species;
(c) Occurrence of disease and insect and animal damage;
(d) Growth of the species.

This paper covers the distribution and effect of cypress canker and the fungi *S. unicorne* and *S. cardinale* in New Zealand.

MATERIALS AND METHODS

Plantations

Seventy plantations (32 of *C. macrocarpa,* 19 of *C. lusitanica,* and 19 of *Ch. lawsoniana)* were selected covering a wide range of ages, site conditions, climatic conditions, and geographical locations in New Zealand (Fig. 1, Table 1). In each plantation a 0.05-ha circular or diamond-shaped plot was randomly located, and all live trees in the plot were numbered and visually assessed for cypress canker and any other damage. The length in centimetres of stem and branch cankers, and the percentage of the stem/branch girdled by the canker on a 1–4 scale (1 = 1–25%, 2 = 26–50%, 3 = 51–75%, 4 = 76–100%) were recorded. The percentage of crown dieback (on a 1–4 scale as above) of each tree was also noted. A total of 2027 trees of *C. macrocarpa,* 1038 of *C. lusitanica,* and 1312 of *Ch. lawsoniana* were examined. A sample of 10% of the trees in each plot was randomly selected and felled for close inspection of stem and branches not clearly visible from the ground. Samples of cankers from felled trees were taken to the laboratory for examination and isolation. Isolations from all hosts were made from live tissue at the margins of dead and live cankered tissue, and by picking off any erumpent acervuli from the bark surface and plating on to 3% malt agar medium. The plates were incubated at 25°C for 2–4 weeks, until spores were produced, and identification was made. As well as *S. unicorne* and *S. cardinale,* many saprophytic fungi and bacteria were isolated, the most common being various *Pestalotia* species.

Mean annual rainfall, mean number of days with rain per year, and mean daily minimum, mean daily maximum, and mean air temperature data (1941–70) were obtained from the climate station closest to each plot (New Zealand Meteorological Service 1973).

Shelterbelts

Seventeen, single-row shelterbelts of × *Cu. leylandii* cv. 'Leighton Green' containing a total of 319 trees were included in the survey. All trees were less than 10 years old and had been planted as a Department of Scientific and Industrial Research trial (Sturrock 1973) and were located over a wide range of site and climatic conditions. All trees in the row were visually assessed for cypress canker and other damage in the same way as for plantation trees. No trees were felled, but samples of branch cankers were taken, and small pieces of cambial tissue were removed from margins of stem cankers with a knife for laboratory examination and isolation as described above. Climatic data from the climate station nearest to each site were also obtained.

RESULTS

Distribution of Seiridium unicorne and S. cardinale

The location of plots and shelterbelts, and the presence of *S. unicorne* and *S. cardinale* are shown in Fig. 1. Results of the isolations made from cankered trees are given in Table 2.

Seiridium unicorne was found throughout New Zealand, except on the West Coast of the South Island. *Seiridium cardinale* was found at Woodhill Forest north-west of Auckland, Lismore Forest north-east of Wanganui, Waitarere Forest south-west of Palmerston North, Bottle Lake Forest north-east of Christchurch, and also at Lincoln, Ashburton, and Motunau in Canterbury.

Seiridium unicorne was isolated from all four host species whereas *S. cardinale* was isolated only from *C. macrocarpa* and × *Cu. leylandii* cv. 'Leighton Green'.

Both *S. unicorne* and *S. cardinale* were isolated from *C. macrocarpa* trees in the same plantation at Woodhill Forest, Lismore Forest, Waitarere Forest, and Lincoln. Both fungi were isolated from different cankers on the same tree at Woodhill Forest, Lismore Forest, and Waitarere Forest, and from the same canker at Lismore Forest. Lincoln was the only site where both fungi were isolated from the same plot of × *Cu. leylandii.*

Incidence and Severity of the Disease

Cypress canker was present in 25 of the 70 plantations studied, and in nine of the 17 shelterbelts (Table 3). Of these, in seven plantations and four shelterbelts more than 20% of the trees had at least one canker, and in only two plantations and two shelterbelts more than 50% of the trees had at least one canker.

An analysis of variance based on percentage of trees infected revealed no significant difference in disease incidence between tree species.

Severity of cankering as measured by the number of cankers in each tree, the degree of girdling of stem and branches, and crown dieback is given in Table 4. In general, most infected plantation trees were not heavily cankered, although often cankers were large, girdling 50–75% of the stem or branch. There were a few instances (less than 1% of all trees) where survival of young infected trees seemed doubtful, usually because large stem cankers made them prone to wind breakage as seen in dead cankered trees nearby. Branch cankering was usually light and caused little, if any, crown dieback.

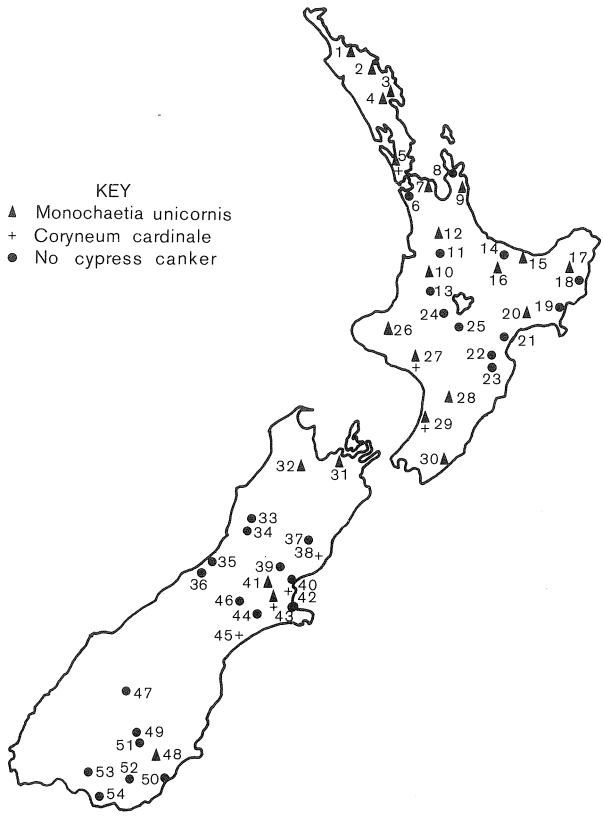

FIG. 1—Location and occurrence of **Seiridium unicorne** and **S. cardinale** in plantations of **Cupressus macrocarpa**, **C. lusitanica**, and **Chamaecyparis lawsoniana**, and in shelterbelts of × **Cupressocyparis leylandii** cv. 'Leighton Green'.

Shelterbelt trees in Hamilton were quite heavily infected but elsewhere only one or two cankers were found on each infected tree and often less than 50% girdling occurred (Table 4). With the exception of a very low level at Hamilton, no crown dieback was seen in the × *Cu. leylandii* cv. 'Leighton Green'.

Effect of Tree Age and Climate on the Disease

To determine whether the incidence of cypress canker was influenced by tree age, rainfall, or temperature, a correlation analysis between the number of plot trees with one canker or more and the age and climate variables for each tree species was carried out.

Infection in *C. macrocarpa* decreased as tree age increased ($r = 0.37^*$), and infection increased with increase in temperature (average minimum temperature, $r = 0.44^*$, average maximum temperature $r = 0.43^*$). These correlations, although significant at the 5% level, were very weak. Rainfall was not correlated with disease incidence.

TABLE 1—Location and age of sampled stands. Figures indicate age of the stand

Location	*C. macrocarpa*	*C. lusitanica*	*Ch. lawsoniana*	X *Cu. leylandii*
1. Orouaiti				8a
2. Waitangi F.	26a	27		
		22		
3. Glenbervie F.	24a	22a	29a	
4. Whangarei				8a
5. Woodhill F.	31ab	19		
	25ab			
6. Waiuku F.			41	6
7. Hunua F.		14a	13	
8. Whangapoua F.		13		
9. Tairua F.		14	47a	
		49		
10. Te Kuiti				6a
11. Te Awamutu			37	
12. Hamilton				6a
13. Ongarue		42		
14. Rotoehu F.		23	31	
15. Awakeri				8a
16. Whakarewarewa F.	43a	43		
		11		
17. Mangatu F.	30	16	28a	
		10a		
18. Tauwhareparae			23	
19. Muriwai	17			
20. Patunamu F.		12a		
21. Tangoio	26			
22. Patoka				3
23. Gwavas F.	27			
24. Tongariro F.	31			
25. Karioi F.			52	
26. Te Wera F.	27a	42	12	
27. Lismore F.	16ab	8		
28. Kimbolton	41			5a
29. Waitarere F.	12ab			
	11a			
30. Ngaumu F.	30a			
31. Rai Valley F.		14a	31	7
32. Golden Downs F.	7a		45	
	44a			
33. Granville F.	31		22	
			32	
34. Mawhera F.	19			
35. Kumara				7
36. Mahinapua F.			52	
37. Hanmer F.	51	17		
38. Motunau				7b
39. Ashley F.	50		31	
40. Chaneys F.	10			
41. Eyrewell F.	22a			
42. Bottlelake F.	16b			
43. Lincoln	5ab			5ab
44. SPB, Muirhead	57			
45. Ashburton				5b
46. SPB, Centennial	44			
47. Wanaka				7
48. Berwick F.	32a			
49. Moa Flat				9
50. Kaitangata F.	33			
51. Conical Hill F.	70		70	
52. Wyndham				7
53. Longwood F.	31		38	
54. Bluff				7

a *Seiridium unicorne* isolated from stand.
b *Seiridium cardinale* isolated from stand.

TABLE 2—Isolations of *Seiridium unicorne* and *S. cardinale* made from sampled trees

Species	No. plots	Plots from which *S. unicorne* isolated (%)	Plots from which *S. cardinale* isolated (%)	No. trees sampled	Sampled trees with cankers (%)	Sampled trees yielding *S. unicorne* (%)	Sampled trees yielding *S. cardinale* (%)
C. macrocarpa	32	46.9	18.8	106	48.1	35.8	6.6
Ch. lawsoniana	19	15.8	0	94	9.6	8.5	0
C. lusitanica	19	26.3	0	84	8.3	8.3	0
X *Cu. leylandii*	17	41.2	17.6	319	17.5	6.9	2.5

TABLE 3—Incidence of cypress canker

Species	No. of plots sampled	No. of plots with canker	Cankered trees in a plot (%)						
			0	1–10	11–20	21–30	31–40	41–50	> 50
C. macrocarpa	32	16	16	8	3	2	1	1	1
Ch. lawsoniana	19	3	16	1	1	–	–	–	1
C. lusitanica	19	6	13	4	1	1	–	–	–
X *Cu. leylandii*	17	9	8	2	3	2	–	–	2

TABLE 4—Severity of cypress canker

Species	No. of plots with canker	Mean No. cankers/tree				Mean canker rating (%)			Mean crown dieback (%)	
		1	2	3	4	1–25	26–50	51–75	0	1–25
C. macrocarpa	16	2	6	4	4	2	6	8	15	1
Ch. lawsoniana	3	0	1	1	1	1	0	2	1	2
C. lusitanica	5	1	2	2	0	1	3	1	5	0
X *Cu. leylandii*	9	3	5	0	1	4	2	3	8	1

Neither tree age, rainfall, nor temperature were correlated with disease incidence in *C. lusitanica* and *Ch. lawsoniana.*

Tree age was not tested for × *Cu. leylandii,* and rainfall and temperature were not found to have a statistically significant effect on disease incidence for this species.

Distribution of Cankers Within the Tree

Of a total of 284 plantation trees felled for detailed examination only 67 were found to have cankers. Seventy-three percent of the 67 infected felled trees had one stem canker or more, 52% had one branch canker or more, and 16% had one branch axil canker or more, making stem cankers the most common. Usually only stem cankers were visible in other plot trees, as the crown was too high to be seen clearly.

There was a much higher incidence of cankering in branches and branch axils of the shelterbelt trees than in the plantation trees of the other species. The distribution of cankers for the different species is given in Table 5.

TABLE 5—Position of cankers

Species	No. of felled trees with cankers	Position of cankers (%)		
		Stem	Branch	Axil
C. macrocarpa	51	73	55	20
Ch. lawsoniana	9	67	44	0
C. lusitanica	7	86	43	14
X *Cu. leylandii*	56	46	73	52

DISCUSSION

New Zealand is one of the few countries in which both *S. unicorne* and *S. cardinale* are present, causing cypress canker. The perfect stage of *S. unicorne, Lepteutypa cupressi* (Nattrass, Booth & Sutton) Swart, was not found during this study, although it has previously been recorded in New Zealand (Newhook 1962; Gilmour 1966). Spermatia were found on several occasions in *S. unicorne* cultures isolated from cankers. During subsequent studies in this laboratory, spermatia and *Lepteutypa cupressi* spores have been found.

There are some differences between the severity of cypress canker previously reported in New Zealand, and the results of this study. Birch (1933) reported cypress canker as widespread in *C. macrocarpa* plantations in the Auckland, Waikato, Wairarapa, Manawatu, Rangitikei, and Taranaki districts, being common in plantations of 5–10 years of age and in unthrifty or over-mature trees. Although the occurrence of cypress canker was widespread in both North and South Islands in 1981 and 1982 disease levels were low. However, there was a slight tendency towards decreased infection with increasing tree age in *C. macrocarpa,* which agrees with Birch's observations.

Fuller & Newhook (1954) found the disease to be a severe problem in *C. macrocarpa* and *Ch. lawsoniana* shelterbelts in Auckland and Waikato, but this was not so in plantations studied in these or other areas. However, casual observation confirms that the disease is continuing to render shelterbelts unsightly and ragged in appearance, with many trees dying, but, as shelterbelts are growing under different environmental conditions from plantation trees, a direct comparison cannot be made. Infection was generally low in the *Cu. leylandii* cv. 'Leighton Green' shelterbelts studied. At Te Kuiti and Hamilton in the Waikato district, infection was more severe than in other areas but only light branch dieback was apparent. However, these trees were young, and it is not known how the infection will progress in the future.

New Zealand has a temperate climate, where there are no extremes of seasonal temperature, and rainfall is constant throughout the year. Probably in most areas of New Zealand neither temperature nor rainfall are limiting fungal growth and maturation and dispersal of conidia at any time of the year. The suitable climatic conditions may be a reason for the wide geographical distribution of cypress canker observed in this survey. In those areas where average daily minimum, maximum, and mean temperatures were less than 4°C, 15°C, and 10°C respectively, no infection was recorded, indicating a possible limitation to fungal growth. However, as temperatures approached the optimum 20°–25°C for fungal growth and maturation and dispersal of conidia

(Olembo 1969; Initni & Panconesi 1975; Sasaki & Kobayasi 1976) there was a slight tendency towards increasing infection in *C. macrocarpa.* Constant favourable rainfall probably accounts for lack of any correlation between rainfall and infection.

No other fungus, insect, or animal damage presented a threat to the general health of the cypresses studied.

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