Control of lophodermium needle cast of Scots pine Christmas trees in British Columbia

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Needle cast of Scots pine caused by ***Lophodermium pinastri*** was first recognized as a major problem in North America in 1966. Serious losses were noted in British Columbia in 1970 and a control experiment was commenced in 1971. Treatments consisting of various fungicides and spray schedules were applied to replicated trees in the third, fourth, and fifth years of growth. Of the chemicals tested, mancozeb, chlorothalonil, and benomyl were most effective. The minimum acceptable spray schedule requires three applications between late July and mid September each year.

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C'est en 1966 que le rouge du pin sylvestre cause par ***Lophodermium pinastri*** a constitue pour la premiere fois un probleme important en Amerique du Nord. Des pertes appreciables ont ete enregistrees en Colombie-Britannique en 1970, et des experiences temoins ont commence l'annee suivante. Des traitements faisant appel a divers fongicides et calendriers de pulverisations ont ete appliques à des arbres en parcelles repetees dans leur troisieme, quatrieme et cinquième annee de croissance. Parmi les antiparasitaires utilises, le mancozebe, le chlorothalonil et benomyl ont ete les plus efficaces. Le minimum de pulverisation acceptable exige au moins trois applications chaque annee entre la fin de juillet et la mi-septembre.

In the USA lophodermium needle cast of red pine and Scots pine was first observed causing severe damage in several Lake States nurseries in 1966 (1). By 1971, severe damage had also been reported in Scots pine Christmas tree plantations in 12 states and in British Columbia (2).

The outbreak of Lophodermium needle cast in British Columbia was first identified and confirmed in 1970 in Christmas tree plantations of Scots pine (***Pinus sylvestris*** L.) (T.H., Nicholls, personal communication) and ornamental nursery beds of Scots pine and Monterey pine *(P. **radiata*** Don) (W.G., Ziller, personal communication). The main symptom in Christmas tree plantations was the yellowing, then browning of year-old needles especially near the bottom of the trees in early summer. By fall such infected needles were virtually all shed so that only the current years needles remained and the trees were unsaleable. In nurseries and seedbeds the symptoms were even more severe as entire beds turned brown in early summer and the trees either died or struggled to push out a few very weak buds.

Lophoderrniurn pinastri (Schrad. ex Hooke) Chev., has been known as a serious pathogen of Scots and certain other pines in Europe for at least 50 years (3,4). In North America, it has long been recognized as a widely distributed fungus of little or no pathogenicity. As a result of the explosive outbreak since the mid-sixties it must be recognized that pathogenic strains or new species (Staley, J.M., personal communication) of ***Lophoderrniurn*** are now widely distributed throughout North America.

Although numerous cultural methods of control are known (6), many are not practical for nurseries and Christmas tree plantations so that chemical control is desirable. As an interim measure following the outbreak of the disease in British Columbia, growers were advised to use Bordeaux mixture, as recommended in Europe (4,6). At the same time a trial comparing other fungicides and varying times of application was commenced on a Christmas tree farm at Hatzic, B.C.

Materials and methods

The following fungicide treatments were applied with a hand sprayer in a volume of 150 Imp. gal/acre (1685 liters/ha):

1. Benlate 50 W (50% benomyl, WP, Dupont), 2 lb (0.8 g active ingredient (a.i.)/liter)
2. Dithane M-45 (80% mancozeb, WP, Rohm & Haas), 3 lb (1.9 g a.i./liter)
3. Bordeaux mixture, 8-8-100
4. Funginex (20% triforine, EC, Cela-Merck), 20 fl oz (0.2 ml a.i./liter)
5. EL273 (7.2% triarimol, EC, Eli-Lily), 20 fl oz (0.08 ml a.i./liter)
6. Bravo W-75 (75% chlorothalonil, WP, Diamond Shamrock), 2 lb (1.2 g a.i./liter)
7. Benlate 50W, 1 lb (0.4 g a.i./liter) + Dithane M-45, 2 lb (1.3 g a.i./liter)

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Table 1. Effect of summer and fall fungicide applications on control of Iophodermium needlecast of Scots pine Christmas trees

Fungicide	No. of applications* 1971	1972	1973	Needle color rating Mar/72 †	Length of 1973 needles Nov/73 (inches)	Infected needles 1 year after treatment (%) §	Harvest value in Oct/74 ($/acre)**	cost of treatment ($/acre) ††	Net gain compared to control ($/acre)
Benlate	8	6	5	7.6 a §§	2.0 ab	23 a	5,307 ab	513	494
Benlate	5	5	4	7.8 a	2.4 a	30 abc	5,268 ab	405	563
Benlate	4	3	3	7.7 a	2.3 ab	26 ab	4.71 3 ab	270	143
Benlate	2	2	2	6.2 a	2.1 ab	42 abcde	4.670 ab	162	208
Dithane M–45	8	6	5	7.9 a	2.2 ab	24 a	4,872 ab	196	376
Dithane M–45	5	5	4	7.3 a	2.5 a	26 ab	5,625 a	154	1171
Dithane M–45	4	3	3	7.6 a	1.9 ab	38 abcde	4,938 ab	103	535
Dithane M–45	2	2	2	7.8 a	2.2 ab	35 abcde	5,332 ab	62	970
Bordeaux	8	6	5	7.2 a	1.5 c	51 abcdef	4,047 ab	281	–534
Bordeaux	5	5	4	8.0 a	1.4 c	55 abcdef	3.573 b	222	–949
Bordeaux	4	3	3	7.8 a	1.8 bc	47 abcde	4,147 ab	148	–201
Bordeaux	2	2	2	7.6 a	2.3 ab	43 abcde	4,848 ab	89	459
Funginex	8	6	5	8.0 a	2.2 ab	70 ef	3,663 b	266	–903
Funginex	5	5	4	7.7 a	2.2 ab	60 bcdef	3,997 ab	210	–513
Funginex	4	3	3	8.1 a	2.2 ab	64 def	4,317 ab	140	–123
Funginex	2	2	2	7.9 a	2.0 ab	81 f	4,192 ab	84	–315
Unsprayed				7.8 a	2.2 ab	62 cdef	4,300 ab		

* No. and date of applications:
1971 8 applications: 27 May, 16 & 30 June, 14 & 27 July, 11 August, 3 & 16 September. 6: 30 June – 16 September. 4: 27 July – 16 September. 2: 3 – 16 September.
1972 6: 30 June, 13 & 28 July, 18 August, 20 October, 16 November. 5: 13 July – 16 November. 3: 18 August – 16 November. 2: 20 October – 16 November.
1973 5: 5 June, 3 July, 2 & 30 August, 22 October. 4: 3 July – 22 October. 3: 2 August – 22 October. 2: 30 August – 22 October

† On a visual rating of 0 – 10, where 0 = poorest, 10 = best.

§ Each figure is a mean of 6 reps and 3 years for a total of 18 observations.

** Dollar value per foot x height in feet x 1500 trees per acre.

†† Assuming application cost of $7/acre and fungicide cost of $20.00, $3.30, $7.80, and $7.00 per acre for Benlate, Dithane M–45, Bordeaux, Bordeaux, and Funginex, respectively.

§§ 5% level, Duncans Multiple Range Test.

Experiment 1

The main trial began 1 June 1971, when a randomized complete block experiment consisting of 17 treatments and 6 single tree replications was set out in a field of 3-foot Scots pines. The test fungicides (treatments 1 to 4) were applied to the same trees during the summer and fall of 1971, 1972, and 1973 (Table 1). In 1972, 1973, and 1974, disease development was assessed by carefully examining the previous year's needles on the third whorl from the top of the tree. Needle length and color were also rated once during the trial. At the conclusion of the experiment, the harvest value of the trees was determined by two experienced growers who assigned values for each tree ranging from $0.25 to $0.65 per foot. This figure X height in feet X 1500 trees per acre gives an approximation of harvest value per acre.

Experiment 2

To determine the effectiveness of a spring and early summer application schedule a second trial was commenced in the spring of 1972. Each fungicide (treatments 1 to 5) was applied five times between 11 April and 30 June 1972, and four times between 6 April and 5 June 1973. Needle infection and length were determined as in Experiment 1. Harvest value was not determined.

Experiment 3

To compare the effectiveness of Bravo W-75 and a mixture of Benlate 50W and Dithane M-45 (treatments 6 and 7), a trial with varying summer-fall times of application was carried out in 1973. Needle infection was determined in 1974.

Table 2. Effect of spring fungicide applications in 1972 and 1973 on control of lophodermium needlecast of Scots pine Christmas trees

Fungicide	Length of 1973 needles, Nov/73 (inches)	Infected needles 1 year after treatment (%)*
Benlate	2.0 a†	45 a
Dithane M 4 5	2.2 a	72 a
Bordeaux	1.4 b	58 a
Funginex	1.9 a	63 a
Triarimol	2.1 a	44 a
Unsprayed	2.2 a	48 a

* Each figure is a mean of 6 reps and 2 years for a total of 12 observations.

† 5% level, Duncan's Multiple Range Test.

Table 3. Effect of fall applications of Bravo and a mixture of Benlate and Dithane M–45 control of lophodermium needlecast of Scots pine Christmas trees

Fungicide	No. of applications in 1973"	Infected 1973 needles determined in 1974 (%)
Benlate + Dithane M–45	3	6 a †
Bravo	4	8 a
Bravo	5	16 ab
Benlate + Dithane M-45	4	18 ab
Bravo	3	20 ab
Bravo	2	26 ab
Benlate + Dithane M–45	5	26 ab
Benlate + Dithane M–45	2	30 b
Unsprayed		44 b

* 5 applications: 5 June, 3 July, 2 Aug., 30 Aug., 22 Oct.
4: 3 July–22 October.
3: 2 August–22 October.
2: 30 August & 22 October.

† 5% level, Duncan's Multiple Range Test

Results

Experiment 1

Infection of needles (mean of all treatments) was 60% in the 1971 needles, decreasing significantly to 43% in 1972 and 34% in 1973. This decrease was probably due in large measure to a gradual reduction of inoculum in the plot area. In 1971 the best treatment (8 applications of Benlate) reduced infection to 10% compared to 85% for the unsprayed trees. In the two subsequent years, however, differences between sprayed and unsprayed trees became less marked. The results given in Table 1 are the mean of 3 years, giving a good indication of what can be expected during a normal Christmas tree rotation.

It is apparent that Benlate and Dithane M-45 were the most effective materials. Bordeaux was intermediate and Funginex was totally ineffective. It is also apparent that two to four applications per year were as effective as five or six per year. Measurement of needle length revealed significant injury when Bordeaux was applied more than twice per year; this was also reflected in harvest value. Net gain from use of fungicides tended to be highest with the Dithane M-45 treatments due to the equal control and lower cost as compared to Benlate.

Experiment 2

A total of nine fungicide applications between early April and early June in 1972 and 1973 had no significant effect on needle infection (Table 2). However the Bordeaux applications did cause a significant reduction in mean needle length.

Experiment 3

Bravo and the mixture of Benlate and Dithane M-45 were both effective in reducing infection. However, due to the high random variation between replications, it was impossible to select a "best treatment" with confidence.

Discussion

The results of these trials agree closely with simultaneous findings in Wisconsin (2), Indiana and Michigan (5), and Washington (J.M. Staley, unpublished data). Briefly summarized, these findings are:

1. Bordeaux is definitely not effective and should not be recommended.
2. Most infections occur between mid-July and mid-September.
3. Maneb (or mancozeb), chlorothalonil, and benomyl are equally effective with the first two being the most economical.
4. Three applications spaced about 3 weeks apart beginning in late July are adequate for control in a Scots pine Christmas tree plantation.
5. In nursery beds, where trees are closely spaced, an increase to four or five applications would be advisable.

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