

Control of Lophodermium Pinastrri on Red and Scotch Pines
in Lake States Forest Nurseries

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ABSTRACT

An outbreak of the needlecast fungus, Lophodermium pinastrl, killed or caused severe damage to several million red pine (Pinus resinosa Ait.) and Scotch pine (P. sylvestris L.) seedlings in 14 nurseries in Michigan, Minnesota, and Wisconsin from 1966 to 1969. The outbreak was brought under control with the use of the fungicide maneb.

Lophodermium pinastrri is a serious pest in European Scotch pine nurseries and plantations. In 1935 Spaulding (2) reported a destructive needlecast of red pine seedlings in a Massachusetts nursery that was authoritatively identified as Lophodermium pinastrri. However, this fungus was not considered an important primary pathogen of red and Scotch pines in this country until recently.

OUTBREAK

A serious red and Scotch pine seedling needlecast disease appeared in some Lake States nurseries in 1966. Since that time several million pine trees have been killed or severely damaged by extensive defoliation. The needlecast fungus, Lophodermium pinastrri, was determined as the cause W (fig.1) . By the spring of 1969 the fungus had caused losses in at least 14 Lake States nurseries (fig. 2), and severe losses are continuing in nurseries that are not practicing control.

Forest-tree nurseries constitute some of the highest per-acre investments in forestry. There are more than 50 nurseries in the Lake States (Minnesota, Michigan, Wisconsin), and most of their production is red and Scotch pines. Therefore, the loss potential in the region due to Lophodermium is very high.

TREE RECOVERY

Although many 1- and 2-year-old trees died, older trees often recovered if new needles developed from terminal or lateral buds. Many trees that turned brown and looked as if they would die in May appeared healthy again in July. However, their quality and vigor were reduced.

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WINDBREAKS

Many of the nurseries experiencing needlecast losses had *Lophodermium*-infected red or Scotch pine windbreaks adjacent to nursery beds of the same species. It is believed that these windbreak trees played a major role in the buildup of *L. pinastri* in the nursery beds. Infected needles with fruiting bodies of *L. pinastri* frequently were blown from the windbreak trees into the beds and provided a continuous inoculum source for the buildup of the epidemic. This is an example of why nursery windbreaks should not contain the same species being produced in the nursery.

THE FUNGUS

The majority of pines in the nursery beds were infected with *Lophodermium* in late summer or autumn, and the fungus overwintered in the needles. Symptoms of this disease are needles with small dark spots often with chlorotic borders. In May or June infected needles turn yellow and then brown. This occurs because the fungus destroys the water-conducting tissues in the needles. The dead needles fall off trees in early summer. The fungus produces fruiting bodies on these fallen needles as well as on the dead needles still attached to trees. The fruiting bodies are tiny (0.90-1.50 x 0.32-0.70 mm.) , black, football-shaped structures with a longitudinal slit. During rainy weather the fruiting bodies absorb moisture, the slits open, and spores are forcibly discharged. If these windborne spores land on pine needles of surviving trees, they germinate and cause new infections if conditions are favorable.

FIELD IMPLICATIONS

In the spring, nursery trees are often lifted for field planting before needlecast symptoms appear. If infected trees are planted, they will ultimately show the same symptoms as nursery trees and probably lose most of their needles (fig. 3). As in the nursery, n_{un}y field-planted trees recover from the needlecast attack; however, a poor-quality, stunted tree is generally the result.

Lophodermium has also been found on sapling and pole-sized red pine in the field. Little damage seems to be done to these trees, although the foliage is unsightly and tree vigor may be reduced.

The damage that *L. pinastri* may cause in Christmas tree plantations is of great economic importance. In 1970 three Michigan Scotch pine plantations were found infected, and many trees were unsaleable because of defoliation.

CONTROL

Maneb effectively controls Lophodermium (fig. 4, tables 1 and 2) . This fungicide will prevent needles from becoming infected but it will not eradicate the fungus from already infected needles. However, more than one fungicide treatment is necessary to achieve control of Lophodermium. Research is underway to determine the proper timing and number of maneb sprays needed. Also being tested are benomyl, ziram, and Fund"ian.

In the Lake States most of the Lophodermium infection occurs between August 15 and October 15. A high degree of protection is achieved by spraying the pine foliage with maneb every 2 weeks in late summer and fall during the high-infection period. Sprays applied only in the spring or early summer and at less frequent intervals are ineffective because maneb breaks down relatively rapidly. Although it is important to spray at 2-week intervals in the latter half of the growing season, it is also important to apply maneb at least twice in the early part of the growing season to protect the new foliage as it develops.

Nurseries that have used maneb for 4 years as recommended for Lophodermium control have not experienced any soil or tree toxicity problems related to the use of the fungicide.

Maneb has been registered for Lophodermium control under the Federal Insecticide, Fungicide, and Rodenticide Act under registration No. 352-291. The following control recommendations are based on research findings to date. Some changes may be made in the recommendations as more information is obtained from future studies.

1. Fungicide

Maneb (manganese ethylene bisdithiocarbamate) $C_4H_6MnN_2S_4$

2. Concentration

The tests on which our data and evaluations are based employed two maneb products. In both cases 1-1/2 pounds (commercial) maneb per 100 gallons of water were used.

a. A Wisconsin nursery tested Dithane M-22 produced by the Rohm and Haas Company. Ingredients consisted of:

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| (1) Maneb (manganese ethylene bisdithiocarbamate)
(metallic manganese equivalent, 14.5%) | 70% |
| (2) Inert ingredients. | 30% |

1/ Use of trade names does not imply endorsement of commercial products by the Federal Government to the exclusion of other products that may also be suitable..

b. A Michigan nursery tested Manzate D produced by DuPont Company. Ingredients consisted of:

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|---|-----|
| (1) Maneb(managanese ethylene bisdithiocarbamate)
(metallic manganese equivalent, 16.5%) | 80% |
| (2) Inert ingredients | 20% |

3. Spreader-Sticker

One-half cup DuPont spreader-sticker per 100 gallons of water.

4. Spray Procedure

It is recommended that spray boom nozzles be close to plants (4 to 6 inches), with the nozzles 10 inches apart on the boom. Spray working pressure should be about 215 p.s.i. or enough to completely moisten all foliage and tree stems . Maneb does not dissolve in water; it must be agitated or it will sink to the tank bottom.

5. When to Spray

- a. First spray should be made when new growth of pine needles is about 1/2 to 1 inch long.
- b. Second spray should be made when new growth is complete.
- c. Pine from seed should receive first spray when 4 to 6 weeks old.
- d. From June 15 to August 15, spray should be applied monthly or more often during prolonged rainy periods.
- e. From August 15 to October 1, spray should be applied every 2 weeks and after each 1/2 inch or more of rain accompanied by relative humidity greater than 90 percent, or after 48 hours of relative humidity greater than 90 percent.

6. Sample Spray Schedule for Lake States

First spray - about June 15

Second spray - about July 15

Third spray - about August 15

Fourth spray - about August 30

Fifth spray - about September 15

Sixth spray - about September 30

Additional sprays should be applied if there are prolonged periods of rain and high relative humidities.

CAUTION: Pesticides can be injurious to humans, domestic animals, desirable plants, and fish or other wildlife if they are not handled or applied properly. Use all pesticides selectively and carefully. Follow recommended practices for the disposal of surplus pesticides and pesticide containers.

LITERATURE CITED

1. Nicholls, Thomas II., and Darroll D. Skilling. 1970. Lophodermium pinastri outbreak in Lake States forest nurseries. Plant Dis. Rep. 54(9): 731-733.
2. Spaulding, Perley. 1935. Lophodermium pinastri causing leafcast of Norway pine in nurseries. USDA Forest Serv., Northeast. Forest Exp. Sta. Tech. Note 18, 2 p.

Table 1. --Lophodermium pinastri infection of maneb-treated and untreated red pine seedlings in Wisconsin and Michigan nurseries

Trees in sample (number)	Treatment	Percent infected
500) 500(2-0 seedlings	No spray 17 maneb sprays in 1968	100 5
687) 400(3-0 seedlings	No spray 16 maneb sprays in 1969	75 3
610) 526(1-0 seedlings	6/17/68-7/20/68 (3 sprays) 7/20/68-8/20/68 (5 sprays)	100 100
566) 580(8/20/68-10/17/68 (5 sprays) 6/17/68-10/17/68 (13 sprays)	5 2
757) 193(2-0 seedlings	No spray 12 maneb sprays in 1969	57 0
146)	6 maneb sprays after 8/20/69	5
417) 880(3-0 seedlings	No spray 12 maneb sprays in 1969	99 2
264) 594(6 maneb sprays after 8/20/69 6 maneb sprays before 8/20/69	3 53

Table 2. --Isolation of Lophodermium pinastri from maneb-treated and untreated 2-0 Spanish Scotch pine seedlings from a Michigan nursery, spring 1970

Needles in sample (number)	Year of needle origin	Treatment	Percent infected
30	1969	No spray	73
30	1969	17 maneb sprays in 1969	0

FIGURE CAPTIONS

Figure 1. -- A USDA Forest Service research plant pathologist from the North Central Forest Experiment Station talks to a nursery manager about an outbreak of L. pinastri in a red pine nursery bed.

Figure 2. -- Locations of Lake States nurseries experiencing an outbreak of L. pinastri on red or Scotch pine from 1966 to 1969.

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Figure 3. -- A field-planted red pine defoliated by L. pinastri infection that originated in a nursery, illustrating how a nursery disease problem can be carried into the field. Picture taken July 1, 1968.

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Figure 4. -- A maneb-protected 2-0 Red pine bed in the foreground; three unprotected beds in the background. Heavy mortality (up to 95 percent) occurred in the unprotected trees, as can be seen by the lack of terminal bud development. Picture taken June 5, 1969.

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Figure 1 "Control of Lophodermium"



Figure 2 "Control of Lophodermium"



Figure 3 "Control of Lophodermium"



Figure 4 "Control of Lophodermium"