

## Shoot Blight and Collar Rot of *Pinus resinosa* Caused by *Sphaeropsis sapinea* in Forest Tree Nurseries

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### ABSTRACT

Palmer, M. A., and Nicholls, T. H. 1985. Shoot blight and collar rot of *Pinus resinosa* caused by *Sphaeropsis sapinea* in forest tree nurseries. *Plant Disease* 69:739-740.

Symptom development and impact of *Sphaeropsis sapinea* (= *Diplodia pinea*) on red pine seedlings were studied during 1981 and 1982 at two forest tree nurseries in Wisconsin. Two distinct symptoms, shoot blight and collar rot, were associated with infection by *S. sapinea*. Shoot blight, characterized by stunted dead shoots and needles, was found in 1-, 2-, and 3-yr-old seedlings. This type of infection caused the most losses. The most severe losses occurred in 1981, when 34.5% of the 1-yr-old red pine seedlings were infected in one nursery. Collar rot by *S. sapinea* killed trees with fully elongated shoots. Losses caused by collar rot were less than 1% in 1982 at both nurseries.

*Sphaeropsis sapinea* (Fr.) Dyko & Sutton (= *Diplodia pinea* (Desm.) Kickx) is a fungus of worldwide distribution and importance. It has an extensive host range including *Abies*, *Larix*, *Picea*, *Thuja*, and *Pseudotsuga* and 33 species of *Pinus* (7,12). The most common symptom caused by *S. sapinea* is shoot or tip blight. *S. sapinea* also causes wood staining (5,9) and stem cankers (4,8,10,17) and has been associated with cankers and stained wood in roots (18). Most serious damage has occurred in plantation-grown exotic pine species (1,4,7) and ornamental and windbreak pines more than 30 yr old (11).

There are few reports of *S. sapinea* as a pathogen in nursery seedbeds. Reduced germination and decay of radicles (6), root and collar rot (3), and bud wilt (shoot blight) (1,16) have been observed. Crandall (3) described collar rot caused by *S. ellisii* Sacc. (= *S. sapinea*) on nursery-grown red pine (*Pinus resinosa* Ait.) seedlings in Maryland. This disease was characterized by black-streaked wood at and below the root collar.

Seedling infection by *S. sapinea* has been reported from eight forest tree nurseries in Minnesota, Wisconsin, and Michigan (15; T. H. Nicholls, unpublished). The most serious damage has occurred in two Wisconsin state nurseries. Shoot blight of 2- and 3-yr-old red pine

seedlings was first observed in 1975 at the Griffith State Nursery, Wood County, WI (13). In 1979, 3-yr-old red pine seedlings with symptoms similar to those described by Crandall were observed at this nursery. Shoot blight of 1-yr-old red pine seedlings was also observed for the first time. Shoot blight of 1-yr-old red pine seedlings was also observed at the Wilson State Nursery, Grant County, WI, in 1979 (14). Scattered shoot blight and collar rot on older seedlings were also noted.

Serious economic losses in nurseries in the Lake States began in 1980, when an estimated 20% of the 1-yr-old seedling crop was affected at the Wilson nursery. Although shoot death did not always result in seedling death, symptomatic seedlings were usually culled during grading and represented a loss to the nursery. In 1981, a study was begun to describe the symptoms observed and to assess the impact caused by this fungus.

### MATERIALS AND METHODS

In 1981, field observations of symptom development were recorded every 2 wk during May and June and at monthly intervals thereafter at the Griffith and Wilson nurseries in Wisconsin. Symptomatic seedlings were collected and examined in the laboratory. Fifty 2-yr-old and 50 3-yr-old seedlings were collected in June in both 1981 and 1982. Fifty 1-yr-old and 50 3-yr-old seedlings were collected in August of both years. Shoot and needle length and location of pycnidia of *S. sapinea* were noted for each seedling. To compare symptom development with phenological development of seedlings, shoot and needle growth of five healthy 2- and 3-yr-old seedlings growing in nursery beds was

recorded weekly.

Impact of shoot blight was determined in each seedling age class from counts of healthy, symptomatic, and dead seedlings in plots 1.2 × 0.2 m. Ten plots were randomly located in each of six seedbeds. The percentages of symptomatic and dead seedlings in all 60 plots were averaged to obtain the overall percent seedling loss in each age class. Disease incidence in beds of 1-yr-old seedlings was estimated in 1981 and 1982. Disease incidence in beds of 2- and 3-yr-old seedlings was estimated only in 1982.

Incidence of collar rot in 3-yr-old seedlings was determined in 1982 from counts of the total number of symptomatic and dead seedlings in each of four randomly selected seedbeds at each nursery. Percent seedling cull was calculated from 1982 nursery inventory counts of the total number of seedlings per seedbed.

### RESULTS

Two distinct symptoms associated with seedling infection by *S. sapinea* were identified. Shoot blight and collar rot were observed in both Wisconsin nurseries. Shoot blight of 2- and 3-yr-old seedlings was characterized by curled, stunted, and dead shoots (Fig. 1). Dead shoots were first noted in early June at both nurseries. At this time, most needles had barely emerged from the fascicle sheaths. Shoots of all blighted seedlings were about three-fourths elongated, indicating that growth had ceased during mid- to late May (Figs. 2 and 3). Shoot tissue was resin-soaked, and several seedlings had purple-brown, resinous lesions. Pycnidia containing mature spores were abundant on dead shoots and needles as early as June. Adventitious buds had developed below the dead shoot on some seedlings.

Shoot blight of 1-yr-old seedlings first appeared in August in both nurseries, as evidenced by dead terminal buds and upper needles. Many seedlings developed adventitious buds in response to the dead shoot. Seedling mortality was common, and pycnidia of *S. sapinea* were abundant in dead tissues.

Collar rot of 3-yr-old red pine, characterized by chlorotic and then desiccated shoots and needles, was first

Accepted for publication 2 March 1985 (submitted for electronic processing).

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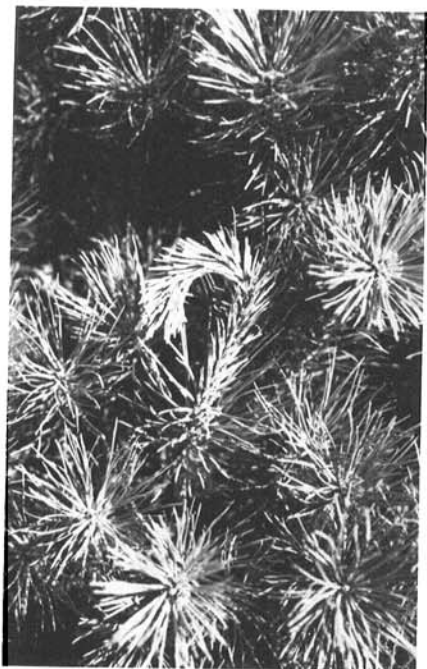


Fig. 1. Symptomatic and healthy 3-yr-old red pine seedlings.

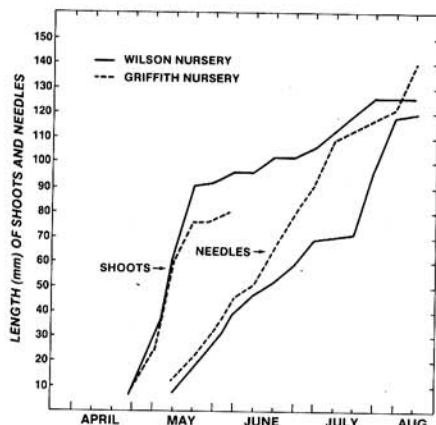


Fig. 2. Seasonal development of 2-yr-old red pine seedlings at Griffith and Wilson nurseries in 1982.

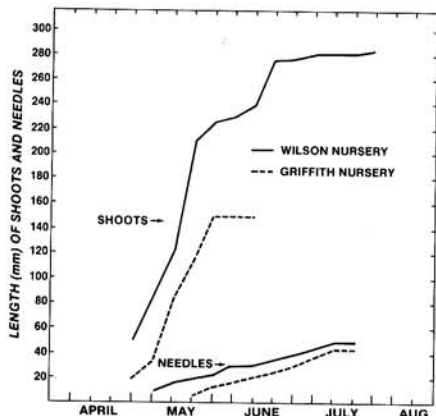


Fig. 3. Seasonal development of 3-yr-old red pine seedlings at Griffith and Wilson nurseries in 1982.

noted in July. Shoots were fully elongated and had set the terminal bud. Needles were about three-fourths elongated. This stage of development occurred in late June on healthy 3-yr-old seedlings (Fig. 3). Black-streaked and resin-soaked wood was observed at the root collars of infected seedlings. Pycnidia were localized in tissue near the root collar in seedlings showing chlorotic foliage and were also found on the shoots and needles of seedlings that apparently had been dead for some time.

At both nurseries, shoot blight caused more severe losses than collar rot. The most severe losses occurred in 1-yr-old seedlings at the Wilson State Nursery, where losses were 34.5% in 1981. This represented a loss of more than 1 million seedlings. Losses declined to 15.4% in 1982. Losses of 2- and 3-yr-old seedlings in this nursery in 1982 were 16.1 and 15.8%, respectively. In the Griffith nursery, disease incidence in beds of 1-yr-old red pine decreased from 2.3% in 1981 to 0.9% in 1982. Losses of 2.1 and 3.2% were observed in 1982 in 2- and 3-yr-old seedlings, respectively. Losses from collar rot were less than 1% at both nurseries.

## DISCUSSION

*S. sapinea* causes shoot blight and collar rot of red pine seedlings in Wisconsin nurseries. The stunted shoots and needles on seedlings with shoot blight indicate that seedlings were infected before completing seasonal growth. Peterson (11) found that shoots of mature Austrian pine (*P. nigra* Arnold) in Nebraska were most susceptible during shoot elongation before needles had emerged from the fascicle sheath.

Shoot blight of 1-yr-old seedlings was not observed until August. In the Griffith and Wilson nurseries, red pine is seeded in autumn and seedlings emerge in May of the following year. Although these seedlings could have become infected from May through August, all of the seedlings we examined had set the terminal bud. This suggests that infection probably occurred in midsummer just before or immediately after bud set. In greenhouse inoculations of *P. nigra*, *P. sylvestris* L., and *P. ponderosa* Laws., seedlings became chlorotic 4-6 days after inoculation with *S. sapinea* (2).

Collar rot was not observed until July. Symptoms were similar to those observed by Crandall (3), except the collar rot was observed with resin-soaked wood at the root collar.

The most serious losses occurred at the Wilson State Nursery. In 1979, no losses caused by *S. sapinea* were reported at this nursery, but in 1981, almost 35% of the 1-yr-old red pine seedling crop was infected. Factors contributing to this sudden increase in infection are unknown but may include favorable weather conditions and an increase of *S. sapinea* in windbreaks surrounding the nursery

beds. Seedbeds at both Wilson and Griffith nurseries are bordered by windbreaks containing red pine, cones of which bear abundant pycnidia of *S. sapinea*. Peterson (11) reported observing infected pine seedlings near older trees with cones bearing many pycnidia of *S. sapinea*.

Seedling losses caused by *S. sapinea* are now minor in most Lake States nurseries; however, the fungus can rapidly reach damaging levels, as demonstrated in the Wilson nursery. Red pine windbreaks bordering red pine seedbeds should be inspected frequently for signs of *S. sapinea*. The presence of infected shoots or cones in windbreaks may indicate that severe *S. sapinea* seedling infection will occur when environmental conditions are favorable.

## ACKNOWLEDGMENTS

We wish to thank E. Holmes, J. Mizuno, and J. Hess for technical assistance.

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