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# Elytroderma Disease in Young, Planted Jeffrey Pine, South Lake Tahoe, California

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Little is known about Elytroderma disease (*Elytroderma deformans* [Weir] Darker) in seedlings or very young trees. Of 100, 2-0 Jeffrey pine (*Pinus jeffreyi* Grev. & Balf.) seedlings planted in the Taylor Creek area of South Lake Tahoe, about half survived from 1973 to 1987. During this period about two thirds of the surviving seedlings became infected with Elytroderma disease. Of the trees that died, only three were infected with the disease, and none was infected before 1981-82. Earliest infection of surviving seedlings was in 1976, with 1980-81 the only interval without infection. More than half of the infected trees were infected in the terminal shoot, indicating future impact on survival and height growth. No significant growth effects were measured between infected and noninfected trees in this study, however. On sites with high disease hazard at Lake Tahoe, avoid planting Jeffrey pines. Regenerate with resistant conifer species.

*Retrieval terms*: *Elytroderma deformans*, *Pinus jeffreyi*, *P. ponderosa*, Elytroderma disease, seedlings, damage, forest disease, fungus disease, injury, regeneration

A disease caused by the fungus *Elytroderma deformans* [Weir] Darker is widespread on several species of pines in western North America. The fungus usually exists at endemic levels in the forest, but in some years when weather conditions permit, the disease reaches epidemic proportions on some sites.[1] The southern portion of the Lake Tahoe Basin in California is one area where epidemic outbreaks occur.[2] At Lake Tahoe, Jeffrey pine (*Pinus jeffreyi* Grev. and Balf.) and ponderosa pine (*P. ponderosa* Dougl. ex Laws.) both become heavily infested during outbreak years. Although outbreaks are relatively infrequent (most recently in 1971 and earlier in 1949-1950), the disease builds up to high levels in many trees and persists in twigs and branches for many years after infection. As a result, disease-weakened trees are subject to increased insect attack and mortality for several years after disease outbreaks.[2] The extent of infection, damage, and mortality that occur on larger trees after an outbreak has been well documented,[1,2] but little is known about the disease on seedlings or very young trees.

The study reported here was undertaken to determine the extent of infection, growth reduction, and mortality of young, planted Jeffrey pines by Elytroderma disease for 14 years following an epidemic outbreak at South Lake Tahoe in 1971. By 1987, half of the seedlings were still alive, and about two thirds of these were infected with the disease. However, the disease apparently had no effect on seedling survival or growth over the 14 years of the study. Nevertheless, because terminal shoots were infected in more than half of the diseased seedlings during a period with no disease outbreaks, prospects of healthy regeneration are poor. Therefore, where outbreaks of Elytroderma disease are known to occur, managers should consider planting conifers that are resistant to the disease.

## METHODS

In spring 1973, 100, 2-0 bare root Jeffrey pines, obtained from the Forest Service Nursery at Placerville, California, were planted in an open forest area of Jeffrey pines in the Taylor Creek area at South Lake Tahoe. The seedlings were planted with an auger, 10 to a row with 6-foot (1.83 m) spacing between trees and rows. Elytroderma disease was heavy in the surrounding overstory pines following the outbreak in 1971. For several years after planting, the seedlings were examined for survival and infection by Elytroderma disease. Any noticeable buildup or other epidemic outbreaks of Elytroderma disease in the surrounding or nearby stands of pine was also noted. In 1987, the height of the surviving planted trees was measured to determine if Elytroderma disease had affected growth.

## RESULTS

The number of seedlings that survived from 1973 to 1987 was about half the original 100 planted. Also, about half of

the mortality occurred within the first 3 years of planting (*table 1*). Some mortality occurred during each interval thereafter except for 1980-81. Of the 47 seedlings that died over the 14 years, only 3 (6 percent) were infected by *E. deformans*. None of the seedlings that died before 1982 were diseased.

No additional epidemics of Elytroderma disease were observed in the South Lake Tahoe area or in the trees surrounding the test site from 1973 to 1987. Nonetheless, 68 percent of the surviving seedlings were infected by 1987. The number of trees that were infected remained low through 1977 and then increased more or less steadily over the remaining test period (*table 1*). Fifty six percent of the seedlings were infected in the terminal shoot only or in the terminal and branches. The remaining diseased seedlings bore only one or more branch infections.

All surviving trees grew slowly over the 14 years after planting. Only one tree was more than 1 m tall, and 9 trees were less than 0.5 m tall. A one-way analysis of variance including a determination of 95 percent confidence intervals for the differences in means showed no significant effect of the disease on seedling height (*table 2*).

## DISCUSSION

Childs[1] reported that infection of ponderosa pine less than 30 years old in central Oregon was uncommon, even after disease outbreak years. Our results with Jeffrey pine do not agree with this report. We found a high proportion of seedlings infected after 14 years. Although we found no effect of the disease on either seedling survival or growth after 14 years, mortality and growth reduction of infected trees could increase over time, particularly for those with terminal shoot infections. According to Childs,[1] more than 90 percent of the infected twigs on some ponderosa pines are either killed or "flagged" within a few years. Jeffrey pines heavily infected by Elytroderma disease suffered continued mortality over several years after an outbreak in 1971.[2]

We have no evidence that strongly suggests that resistance plays a major role in the incidence or severity of Elytroderma disease.[1,2] Rather, infection appears to be regulated more by weather or microclimatic conditions favorable for ascospore dispersal in spring when foliage is young and susceptible.[1] In this study, some infection of seedlings occurred nearly every year, even though no disease outbreaks were observed in the surrounding forest. Endemic levels of *E. deformans* in the forest and weather conditions were evidently favorable for spore dispersal and infection of some seedlings nearly every year. Had another outbreak of Elytroderma disease occurred during the test period, even greater numbers of seedlings probably would have been infected.

## CONCLUSIONS

The high proportion of seedlings of Jeffrey pine infected by Elytroderma disease 14 years after planting at South Lake Tahoe suggests that natural regeneration or planting of Jeffrey pine may not be practical in areas where the hazard from Elytroderma disease is high. If half of the seedlings become infected during only about a decade of endemic disease, then the prospects of healthy pine regeneration even in the absence of disease outbreaks are quite poor.

## RECOMMENDATION

An alternative management approach to planting Jeffrey pine would be to plant or to encourage natural regeneration of conifer tree species resistant to Elytroderma disease. Some of these in the Tahoe basin include white fir (*Abies concolor* [Gord & Glend.] Lindl.), lodgepole pine (*P. contorta* Dougl. ex Loud.), and incense cedar (*Calocedrus decurrens* Kurz.).

Table 1—*Percentage of live and dead seedlings of Jeffrey pine infected with Elytroderma disease 1973-1987*

| Year | Live | | Dead | |
|---|---|---|---|---|
| | Trees | Infected percent | Trees | Infected percent |
| 1973[1] | 100 | - | 0 | - |
| 1976 | 74 | 1 | 26 | 0 |
| 1977 | 68 | 1 | 32 | 0 |
| 1979 | 64 | 14 | 36 | 0 |
| 1980 | 62 | 21 | 38 | 0 |
| 1981 | 62 | 26 | 38 | 0 |
| 1982 | 58 | 26 | 42 | 2 |
| 1984 | 56 | 36 | 44 | 2 |
| 1987 | 53 | 62 | 47 | 6 |

[1] Year of planting.

Table 2—*Duration of infection of Jeffrey pine seedlings by Elytroderma disease in relation to tree height in 1987*

| Duration of infection (years) | N | Mean height | Std. dev. |
|---|---|---|---|
| | | *cm* | |
| 0 | 17 | 60 | 16.7 |
| 1 to 5 | 27 | 71 | 19.4 |
| More than 5 | 9 | 67 | 14.8 |

## END NOTES AND REFERENCES

[1]Childs, T.W. 1968. *Elytroderma disease of ponderosa pine in the Pacific Northwest.* Res. Paper PNW-69. Portland, OR: Pacific Northwest Forest and Range Experiment Station, Forest Service, U.S. Department of Agriculture; 45 p.

[2]Scharpf, Robert F.; Bega, Robert V. 1981. *Elytroderma disease reduces growth and vigor, increases mortality of Jeffrey pines at Lake Tahoe Basin, California.* Res. Paper PSW-155. Berkeley, CA: Pacific Southwest Forest and Range Experiment Station, Forest Service, U.S. Department of Agriculture; 6 p.

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