U. S. DEPARTMENT OF AGRICULTURE FOREST SERVICE
PACIFIC NORTHWEST FOREST AND RANGE EXPERIMENT STATION
R. W. COWLIN, DIRECTOR

Research Note

Number 172 Portland, Oregon August 1959

PHYTOPHTHORA LATERALIS ON PORT-ORFORD-CEDAR

by

John Hunt

Results from annual surveys of the destructive Phytophthora root disease of Port-Orford-cedar (Chamaecyparis lawsoniana (A. Murr.) Parl.) show that the disease is gradually spreading and intensifying within the natural range of Port-Orford-cedar. The disease became established on native trees in the early 1950's in the vicinity of Coos Bay, Oreg., and during its initial buildup invaded most of the low-lying area between Tenmile Lake and Port Orford. Since 1955 its progress, although less spectacular, has been characterized by gradual, steady encroachment into new areas.

THE CAUSE

This disease is caused by the fungus Phytophthora lateralis, one of several pathogenic species in the genus Phytophthora (family Pythiaceae, order Peronosporales, class Phycomycetes (Bessey, 1950)). This fungus apparently can exist in the soil indefinitely as a saprophyte. It is pathogenic only to species in the genus Chamaecyparis, and C. lawsoniana is apparently the most susceptible host species (Torgeson et al., 1954).

The fungus is spread by means of aquatic spores (zoospores), which are liberated into water to swim, be carried by currents, or be splashed to new areas. It spreads mainly through the soil in free water, and only under exceptional environmental conditions does aerial spread occur (Trione and Roth, 1957).

Infection takes place primarily in the roots, which may be healthy and intact when invaded by the fungus. The inner bark and cambium are killed as the fungus gradually grows up the roots toward the base of the tree. Usually by the time there is evidence of the disease at the root collar, most of the roots have been invaded and the tree is dying. Other enemies, particularly insects, often attack the dying trees.

THE SYMPTOMS

In diseased roots, a dark-brown zone, sharply delimited from healthy tissue, is present in the bark. Often a dark--almost black--resinous band is visible in the inner bark close to the cambium. The zone of killing may extend upward in the main bole 2 to 5 feet above-ground before external symptoms become apparent.

The first external evidence of the disease is a slight paling of the foliage. Although stands of Port-Orford-cedar characteristically have many color forms, varying from blue green to yellow green, infected trees are readily picked out, even by inexperienced observers. Next, the foliage gradually takes on a yellowish, withered look. This occurs a few days or weeks after the appearance of the first external symptoms. Then progressive color changes occur: first to a more pronounced yellow, then bright red, then red brown, and finally brown. Trees are usually completely defoliated 2 to 3 years after death.

In areas where the disease has been active for several years, dead and dying trees with all degrees of foliage symptoms are visible, from bare trees (older kills) to those exhibiting the first signs of distress. Good evidence of the presence of the fungus in the roots or root collar can usually be found in trees with slightly pale, yellow, or bright red foliage. In older kills, all the bark tissue is brown and often full of insect galleries.

THE HISTORY

Although P. lateralis has been present in the Pacific Northwest for many years, it was not discovered within the natural range of Port-Orford-cedar until the early 1950's (Roth et al., 1957). The early history of the disease is somewhat vague, but there is proof that it was in the Willamette Valley in 1937 (Milbrath and McWhorter, 1938). Losses from this same cause were being sustained in nurseries

in the Seattle area in 1933,[1] and reports of a disease on Port-Orford-cedar closely resembling the Phytophthora root disease place it in the Puget Sound and Portland areas in 1923.[2]

Since 1942, when the disease was first described (Tucker and Milbrath), its progress has been more closely followed. From that year to 1952 it continued to intensify in the Willamette Valley, and dying Port-Orford-cedars were common throughout the valley in nurseries and in landscape and windbreak plantings. Repeated warnings were given that the disease would be a serious threat to the existence of Port-Orford-cedar if it became established within the natural range of the species.

As a result of these warnings, limited preventive measures were undertaken. Forest nurseries within infected areas carefully screened all their Port-Orford-cedar planting stock and, as far as is known, none was shipped into the natural range. Also, a measure of control was obtained over movement of commercial nursery and ornamental stock through the voluntary efforts of most commercial nurserymen. However, private individuals continued to transplant stock from infected localities into the natural range of Port-Orford-cedar.

In January 1952, diseased trees in Coos Bay were shown by means of cultures to be infected with P. lateralis. In no other instance was the disease found in dying trees within the natural Port-Orford-cedar range in 1952. But in 1953 many patches of dying trees were found, most of which yielded P. lateralis in culture. Trees in some of these patches had been dead for 2 or 3 years, indicating that the fungus actually had been present but was undetected in the Coos Bay area before 1952. By 1954, P. lateralis was killing scattered trees and groups of trees along a 75-mile strip of the coastal shelf from Tenmile Lake south to Port Orford. Spread inland rarely was more than 2 to 3 miles east of U.S. Highway 101. (Data for 1952-54 are from Roth et al., 1957.)

---

[1] Anonymous. Annual report, 1933. U.S. Bur. Plant Indus., Soils, & Agr. Engin. Div. Forest Path., Portland (Oreg.) Branch. (Typewritten.)

[2] Correspondence on file U.S. Forest Serv. Pac. NW. Forest and Range Expt. Sta.

In 1954 the Pacific Northwest Forest and Range Experiment Station undertook annual roadside surveys of the area within the natural range of Port-Orford-cedar to observe spread and intensification of the disease. Because long-range spread of the disease was seen to be closely linked with the activities of man--movement of infected plants, road construction and maintenance, etc.--roadside surveys were believed adequate for detecting new areas of infection and for following progress of the disease in older areas. Aerial color photos, taken during the summer of 1956 in areas of heavy, light, and no infection, confirmed man's part in spreading the infection.

These surveys showed that during the period 1955-59, P. lateralis continued to spread south along the coastal shelf and east up the river valleys along the coast, but remained primarily in low-lying areas (fig. 1). Two exceptions to this pattern have been found. One is an outbreak noted in 1957 in a public campground near the road to MacGribble Guard Station, a spot well above the coastal shelf and adjacent bottom lands. When this area was checked in 1958 and again in 1959, it was found that the disease had continued to intensify and spread. It now extends downhill almost to the Elk River, approximately one-half mile away. The other exception is in the heart of Port-Orford-cedar's natural range, on the road from Powers to Agness, just north of the junction with the Iron Mountain road. Here in 1958, a few dying Port-Orford-cedar saplings were found in one small area along the roadside; in 1959, numerous spots of dead and dying trees were noted along a half-mile stretch of the road. As both areas are along roads, the disease apparently was introduced by man.

Survey results to date indicate that P. lateralis will probably continue to spread and intensify until most of the natural range of Port-Orford-cedar is covered. Invasion of remote areas may be slow and sporadic.

IN SUMMARY

Port-Orford-cedar is highly susceptible to the Phytophthora root disease caused by P. lateralis. The disease, which is now established along the western fringe and in one spot in the heart of the natural range of Port-Orford-cedar, usually spreads locally through the soil by means of water-borne spores. Spread for long distances is mainly brought about through transportation of diseased plants or contaminated soil.

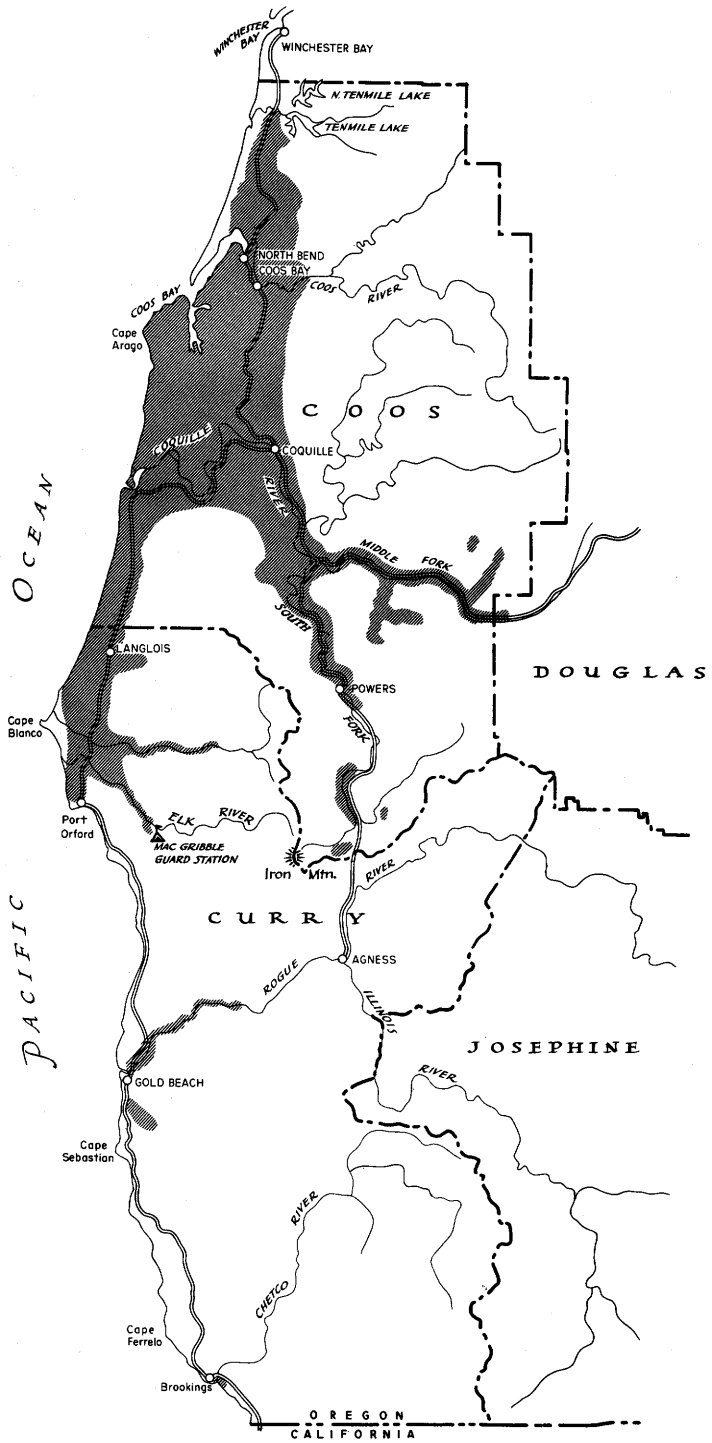

Figure 1. --Extent of Phytophthora root disease of Port-Orford-cedar within the natural range of the species. Although Port-Orford-cedar is native to northwestern California as well as southwestern Oregon, the disease has not yet been found south of Brookings.

An affected root has a sharply delimited, dark-brown zone in the bark, often accompanied by a black resinous line near the cambium. Dying trees first turn yellow, then red, then brown. The disease has definitely been in the Pacific Northwest area since 1937, and probably since 1923. The natural range of the host was invaded in the early 1950's. Roadside surveys indicate that infection will eventually reach all but the most isolated parts of the natural range of Port-Orford-cedar.

LITERATURE CITED

Bessey, Ernst Athearn
1950. Morphology and taxonomy of fungi. 791 pp., illus. Philadelphia and Toronto.

Milbrath, J. A., and McWhorter, F. P.
1938. Preliminary recommendations for the control of the root and crown disease of cypress. Oreg. State Agr. Expt. Sta. Cir. Inform. 187, 2 pp. (Processed.)

Roth, Lewis F., Trione, Edward J., and Ruhmann, William H.
1957. Phytophthora induced root rot of native Port-Orford-cedar. Jour. Forestry 55: 294-298, illus.

Torgeson, D. C., Young, Roy A., and Milbrath, J. A.
1954. Phytophthora root rot diseases of Lawson cypress and other ornamentals. Oreg. State Agr. Expt. Sta. Bul. 537, 18 pp., illus.

Trione, E. J., and Roth, L. F.
1957. Aerial infection of Chamaecyparis by Phytophthora lateralis. Plant Dis. Reptr. 41: 211-215, illus.

Tucker, C. M., and Milbrath, J. A.
1942. Root rot of Chamaecyparis caused by a species of Phytophthora. Mycologia 34: 94-103, illus.