CHAPTER THREE

Fusarium Root Rot

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Disease and hosts

Fusarium root rot of bareroot nursery seedlings is most often attributed to the fungus *Fusarium oxysporum*, although other Fusaria have sometimes been implicated in root rots of conifer nursery seedlings. All species of conifers grown in Northwest nurseries except western redcedar are susceptible to Fusarium root rot. Douglas-fir and pines are particularly vulnerable. In general, Fusarium root rot losses are confined to the first year of seedling growth. Transplants are usually not killed, but growth may be stunted.

Fusarium root rot may be confused with:
Baker dagger nematode damage
Charcoal root disease
Fusarium hypocotyl rot
June beetle damage
Root-lesion nematode damage

Symptoms

In seedbeds, Fusarium root rot first becomes evident in early to late August; losses can continue through late autumn. Transplants can exhibit disease symptoms during the first flush of growth. Disease symptoms are generally the same in all hosts. The disease is normally confined to individual, randomly distributed seedlings, but sometimes small patches of six to eight seedlings are affected.

Figure 3-1. A 1+0 Douglas-fir killed by Fusarium root rot. The shoot often assumes a crozier shape.

Shoot symptoms are usually the first to be noticed. Shoot growth becomes stunted and yellowed, and the shoot terminal often assumes a crozier shape. The affected shoots dry out and their needles become reddish-brown (Figure 3-1).

Root systems of diseased seedlings lack laterals; roots that are present are dark and swollen. The rotted cortex can be pulled off to reveal the dark, killed cambium (Figure 3-2). The rot may extend partway up the seedling hypocotyl, but is not confined to the hypocotyl as with Fusarium hypocotyl rot.

F. oxysporum produces a profusion of both macro- and micro-conidiospores both in and on diseased tissues. The former are multiseptate and slightly sickle-shaped and the latter are single-celled and oval to kidney-shaped. Sometimes sporodochia are evident in splits or cracks in diseased stems slightly above the ground line.

Figure 3-2. Fusarium root rot of ponderosa pine. Notice the dark cortex, which when removed reveals a discolored cambium. The fungus has progressed upward on the root to near the soil line.

Fungus biology

Round, thick-walled, single-celled chlamydospores are produced in abundance in killed tissues or pieces of colonized organic matter in the soil (Figure 3-3). Chlamydospores allow the pathogen to lie inactive in the soil when it lacks a suitable host and thus to survive periods of unfavorable conditions such as drought and low temperatures.

The pathogen becomes active when a seedling root grows near chlamydospores. Infection is

thought to occur early in the growing season, with the pathogen remaining inactive within the roots of 1+0 seedlings until later in the season (August), when it ramifies throughout the roots. In transplants, the pathogen can be active much earlier in the season (June).

Warm weather favors the pathogen; indeed, losses are greatest in years with hot summers. High temperatures stress the host, thereby increasing its susceptibility. Losses are greater among seedlings grown at higher densities, which indicates that host stress plays a role in the development of Fusarium root rot.

Fusarium root rot
symptoms appear:
1+0, rarely 2+0
Transplants
Summer through early fall

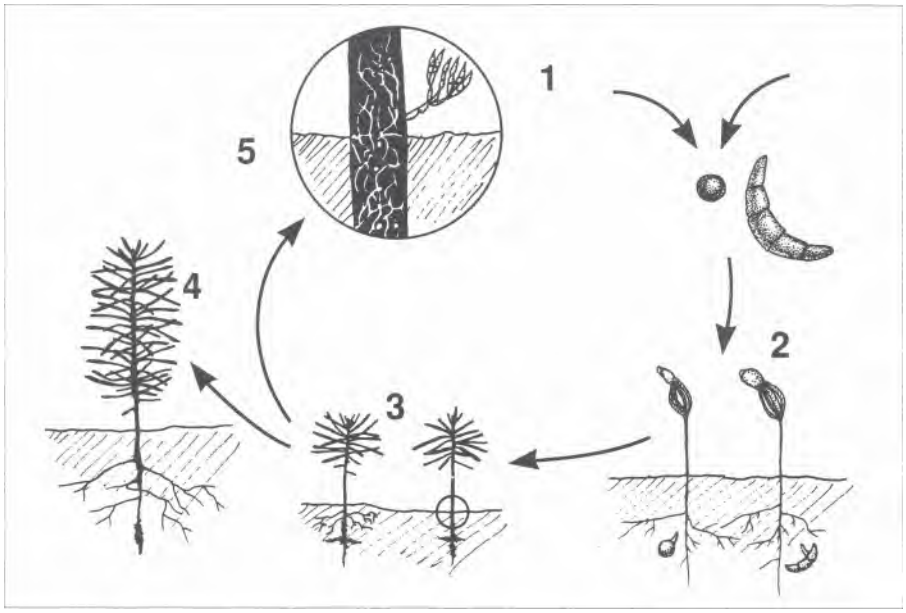

Figure 3-3. The disease cycle of *Fusarium* root rot. (1) Chlamydospores released from decaying roots, or macroconidia formed on dead stems and transported by wind or in soil, germinate (2) when contacted by seedling roots. (3) Infected roots may be killed. Some seedlings survive by producing new roots above the infection (4). The fungus forms chlamydospores in dead roots and may sporulate on killed stems (5).

Loss potential

The disease causes losses in most nurseries throughout the Pacific Northwest. Fusarium root rot can affect 10 to 30 percent of the crop, and sometimes more. The disease not only kills seedlings, but reduces the growth and vigor of those that are infected but survive with only part of their roots rotted. Survival rate of such seedlings is often poor after they are outplanted.

Management

Fusarium root rot is a difficult disease to manage. There is no satisfactory way to predict outbreaks. However, certain cultural practices offer some protection from the disease. These include identifying high-risk areas and using them for less susceptible species, minimizing the carryover of inoculum-laden root pieces between crops, and reducing or eliminating organic materials that harbor chlamydospores. Reducing soil temperature and seedling moisture stress by shading and frequent irrigation (in well-drained soils) may help reduce the severity of Fusarium root rot.

Treatment of seeds with fungicides is usually not worthwhile because the fungicide loses it effectiveness before infection occurs. It does little good to apply fungicide drenches when symptoms appear because by that time the fungus is already in the root system. However, soil fumigation with such chemicals as methyl bromide plus chloropicrin is effective against Fusarium root rot. Fumigation is recommended only for those nurseries in which the disease is a component of an overall pest problem that includes weeds, insects, and other diseases.

Selected references

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