31. Charcoal and Black Root Rots

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Hosts

Charcoal root rot, caused by *Macrophomina phaseolina* (syn. *Sclerotium bataticola*), affects more than 300 plant species worldwide, including monocots, dicots, and gymnosperms. This disease has been considered one of the most serious diseases in conifer seedlings in forest tree nurseries in the Southern and Western United States. A closely related black root rot in southern forest nurseries has been attributed to *M. phaseolina* in combination with pathogenic *Fusarium* species and perhaps certain root parasitic nematodes.

Distribution

M. phaseolina and charcoal root rot occur in warm temperate and tropical regions of both the Eastern and Western Hemispheres. The pathogen is particularly prevalent in arid and semiarid environs. Black root rot has been described only in forest nurseries in the Southern United States, although *Fusarium* root rots and nematodes are common throughout North America (fig. 31.1).

Damage

Infections result in aboveground symptoms, ranging (and progressing) from damping-off of young seedlings, to stunted growth, to off-color wilting and reddening foliage, and eventual older seedling death (fig. 31.2). Infected seedlings are often irregularly distributed in nursery seedbeds, occurring singly or in clusters of a few to hundreds or thousands of seedlings, depending upon the distribution of infective inoculum in seedbed soils and associated predisposing stresses or cultural treatments (fig. 31.3). For example, it is not uncommon for infection foci to be concentrated at the ends of seedbeds or in seedbeds nearest to unfumigated irrigation pipelines where inoculum-laden soil may be mixed with fumigated soil during seedbed tilling and shaping operations. Also, charcoal root rot often flares up after stress-inducing cultural practices employed to improve seedling quality, such as undercutting, root wrenching, or withholding irrigation to harden-off seedlings for lifting.

Figure 31.1—*Pine seedbeds in a Texas nursery severely affected by black root rot.* Photo by Edward L. Barnard, Florida Division of Forestry.

Figure 31.2—*Seedbeds with slash pine infected with* Macrophomina phaseolina. Photo by Edward L. Barnard, Florida Division of Forestry.

Figure 31.3—*Slash pine seedbeds infected with* Macrophomina phaseolina. Photo by Edward L. Barnard, Florida Division of Forestry.

Diagnosis

Root systems infected by *M. phaseolina* exhibit varying degrees of root discoloration and loss of fine feeder roots. Swelling, blackening, and cracking of infected cortical tissues may also occur, especially in advanced stages of disease development on taproots, larger lateral roots, and root collars (fig. 31.4). The presence of tiny black microsclerotia (50 to 200 microns) of *M. phaseolina* within and beneath cortical tissues of infected roots and root collars is common (fig. 31.5), especially where such tissues are moribund. *M. phaseolina* pycnidia have been observed on infected seedling stems, but these asexual spore-producing structures are far less common than microsclerotia. Microsclerotia and pycnidia may be visible to the unaided eye but are more readily observed with a hand lens.

Figure 31.4—*Pine seedling exhibiting symptoms of black root rot. Note swollen/darkened cortex on taproot and lower stem.* Photo by Edward L. Barnard, Florida Division of Forestry.

Figure 31.5—*Black microsclerotia of* Macrophomina phaseolina *on the surface of the xylem tissue beneath the bark of an infected slash pine seedling.* Photo by Edward L. Barnard, Florida Division of Forestry.

Biology

M. phaseolina is a high temperature, soil-borne, facultative parasite possessing a low competitive saprophytic ability; that is, it is easily suppressed by the activities of competitive, antagonistic, and hyperparasitic soil microflora. In culture, optimum temperatures between 30 and 37°C (86 and 99 °F) are common for *M. phaseolina* isolates, and microsclerotia of the pathogen have been reported to survive soil temperatures in excess of 55 °C (131 °F). The fungus is capable of surviving in soils for years in the absence of a suitable host by means of resistant, resting state microsclerotia. However, survival of microsclerotia is strongly influenced by interactions of soil moisture and temperatures. Germination of microsclerotia is stimulated by a variety of organic substances, many of which may be supplied by host root exudates. Survival and activity of the pathogen in soils is responsive to inorganic fertilizers and organic soil amendments.

M. phaseolina is particularly aggressive on hosts subjected to various physiological stresses, particularly moisture stress. Thus, root disease episodes tend to peak late in the growing season when (1) soil temperatures approach their annual highs, (2) reduced rainfall and irrigation result in dry soils and sometimes excessively moisture-stressed seedlings, and (3) activity of beneficial soil microflora is restricted due to elevated soil temperatures and reduced soil moisture.

Control

Cultural

Several strategies are available to minimize the occurrence of charcoal and black root rots. Maintenance of adequate levels of soil organic matter (at least 2 percent) is helpful. Doing so promotes microbial activity, which may suppress *M. phaseolina*, an organism possessing low competitive saprophytic ability. Avoid excessive applications of nitrogen fertilizers in seedbeds, and favor nonhost cover crops such as millet over known hosts such as corn, peas, and sorghum. Avoid unnecessary, late season seedling stress because *M. phaseolina* is primarily aggressive on injured, water-stressed seedlings in warmer soils.

Chemical

Soil fumigation is recommended where charcoal root rot is persistent and problematic.

Selected References

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