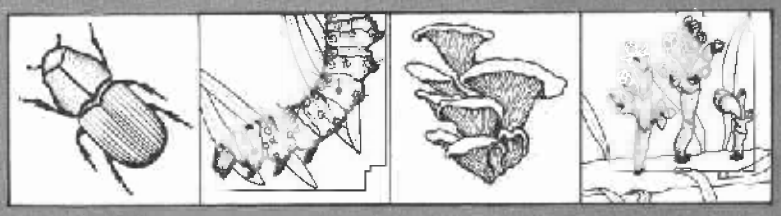
Cooperative Forestry & Pest Management



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FUSARIUM ROOT DISEASE OF WESTERN WHITE PINE SEEDLINGS AT THE COEUR D'ALENE NURSERY, IDAHO

by

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ABSTRACT

Root disease of 2-0 western white pine seedlings occurred at the Coeur d'Alene Nursery in 1982 within seedbeds fumigated with methyl bromide and chloropicrin. Although losses were not substantial, there were several groups of dead seedlings within affected seedbeds. Fusarium oxysporum was most often isolated from diseased roots. Other Fusarium species, including F. solani and F. roseum were isolated less frequently. Characteristics of Fusarium root disease in bareroot nursery stock are discussed.

INTRODUCTION

Seedbeds at the Coeur d'Alene Nursery in Idaho are routinely fumigated with mixtures of methyl bromide and chloropicrin prior to sowing each new crop. Fumigation is designed to eliminate soil insects, nematodes, weed seeds, and plant pathogens (Miller and Norris 1970). Since soil fumigation was instituted, losses from soilborne pathogens have been greatly reduced. However, some seedlings are occasionally killed by soil pathogens in fumigated seedbeds (James 1982). This report describes the occurrence of root diseases on 2-0 western white pine (Pinus monticola Dougl.) seedlings within fumigated seedbeds during 1982.

OBSERVATIONS

Dying seedlings, reddish-brown in color, appeared in groups (fig. 1). Affected seedlings often occurred adjacent to nonstocked or poorly stocked portions of seedbeds. Occurrence of chlorotic seedlings adjacent to either green (healthy) or reddish-brown (necrotic) seedlings was not common. Externally, roots from recently killed seedlings were black. Xylem root tissues were light brown and appeared water soaked. Root hairs or ectomycorrhizae were missing on necrotic seedlings.

Isolations from necrotic roots yielded primarily three species of Fusarium (F. oxysporum (Schl.) em Snyd. & Hans.; F. solani (Mart.) App. & Wr. em. Snyd. & Hans.; F. roseum (Lk.) em Snyd. & Hans.). Fusarium oxysporum was isolated most frequently, and is believed to be responsible for most of the damage. A variety of saprophytic fungi, including Alternaria, Penicillium, Phoma, and Trichoderma were also isolated. Tests to evaluate pathogenicity of the Fusarium isolates were not conducted.

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Figure 1.--Mortality of 2-0 western white pine caused by *Fusarium* at the Coeur d'Alene Nursery, Idaho.

DISCUSSION

Although root diseases caused by *F. oxysporum* and other soilborne pathogens have been reduced in nurseries following soil fumigation, pathogens may not be entirely eliminated from fumigated soil (Cooley 1980; Sinclair et al 1975; Smith and Bega 1966). *Fusarium oxysporum* exists in soil primarily as chlamydospores (resting structures) (Bega 1966) on plant residues and the roots and hypocotyl of diseased seedlings (Bloomberg 1973; Bloomberg 1976). When seedling roots come into contact with soil inoculum, infection may occur. The fungus may also colonize seed of several different conifer species (Graham and Linderman 1983; James and Genz 1982). In this way, *F. oxysporum* may be reintroduced into fumigated soil and cause significant losses (Vaartaja 1967).

Fusarium oxysporum colonizes seedlings shortly after seed germination (Bloomberg 1966) and may either induce disease immediately (damping-off) (Bloomberg 1976) or remain dormant and become pathogenic when seedlings are older (Sinclair and Hudler 1980). Although roots are usually affected, the fungus may also cause hypocotyl decay without infesting the roots of young seedlings (Brownell and Schneider 1983). Apparently, strains of the fungus that cause damping-off in young seedlings are different from those that incite disease in older seedlings (Bloomberg 1971; Bloomberg 1973). Both fungal strains apparently occurred on white pine seedlings at Coeur d'Alene. Patches of nonstocked or understocked seedbeds were probably due to initial high losses from damping-off. Continued mortality as seedlings became older was probably caused by a different strain of the fungus, although pathogenicity of the isolated fungi was not tested.

The other Fusarium species isolated from root-diseased white pine seedlings have commonly been associated with F. oxysporum in forest nursery soils (Edmonds and Heather 1973). Fusarium roseum is usually saprophytic or a secondary invader of seedlings infected with F. oxysporum (Williams 1975). However, this fungus has also been reported as causing stem lesions on young Douglas-fir seedlings (Morgan 1983). Fusarium solani is also often associated with F. oxysporum in nurseries (Hodges 1962; Landis 1976). It is usually considered secondary and not as aggressive on conifer seedlings as F. oxysporum. However, F. solani by itself can cause seedling root diseases (Merrill et al. 1981).

Although soil fumigation usually keeps losses from Fusarium root disease at acceptable levels, sometimes additional measures are needed. Fungicide sprays have been used to reduce disease incidence, but effectiveness has been variable. For example, Cooley (1980) found that high rates (151 lbs/ha) of Banrot® reduced losses of sugar pine (Pinus lambertiana Dougl.). However, she also found that captan, benomyl, and low rates (62 lbs/ha) of Banrot® were ineffective. Benomyl was also ineffective against Fusarium root disease in trials at the Coeur d'Alene Nursery (Williams 1975). On the other hand, Bloomberg and Lock (1974) reported that captan was effective when applications were properly timed to correspond to periods of greatest seedling susceptibility.

In addition to fungicides, several cultural practices may be useful in reducing damage from this disease. Fall sowing will help avoid contact between soil inoculum and seedlings during their most susceptible stage (Cooley 1982). Inoculation with mycorrhizae may help protect seedlings from Fusarium infection (Sinclair et al. 1975). Reducing nitrogen fertilization during seedling emergence will lessen the chances of infection (Cooley 1982; Sinclair et al. 1975). Bare fallowing results in lower soil organic matter, Fusarium populations, and resulting disease (Sutherland and Van Eerden 1980). Removal of recently killed seedlings from seedbed areas will also help reduce inoculum. Care should be taken to avoid reintroducing Fusarium into fumigated soil through irrigation water (Cooley 1982) and infested seed (Bloomberg and Trelawny 1970; Graham and Linderman 1983). Also, fumigation done properly when soil temperatures and moisture content are conducive to rapid and extensive penetration of fumigant will help reduce disease losses.

This publication refers to pesticides. It does not contain recommendations for their use, nor does it imply that the uses discussed have been registered. All uses of pesticides must be registered by appropriate State and/or Federal agencies before they can be recommended. CAUTION: Pesticides can be injurious to humans, domestic animals, desirable plants, and fish or other wildlife--if they are not handled or applied properly. Use all pesticides selectively and carefully. Follow recommended practices for the disposal of surplus pesticides and pesticide containers.

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