DISEASES ASSOCIATED WITH CONTAINERIZED SEEDLING SOIL MIXES

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ABSTRACT

Damping-off and root diseases commonly occur on container-grown conifer seedlings. Although most peat-vermiculite mixes are relatively pathogen-free, disease organisms can be introduced into containers on seed, plant debris, or in irrigation water. Well-drained soil mixes are usually less conducive to disease occurrence. Major root pathogens of containerized conifers include species of *Fusarium*, *Pythium*, and *Phytophthora*. *Fusarium* is the most common and causes several different symptoms including stunting, chlorosis, tip dieback, and mortality. Root diseases are best controlled by using pathogen-free seed and sanitary practices of production. If high disease levels occur, soil mixes can be sterilized or fungicides can be added shortly after sowing. Composted tree bark added to the soil mix can also control pathogens.

INTRODUCTION

Containerzied conifer seedling production is increasing within northern Rocky Mountain nurseries. As production of seedlings in containers has increased, associated disease problems have become more important. The most serious diseases of containerized seedlings are folilage and stem blights (Sutherland et al. 1982). Foliage pathogens spread rapidly and environmental conditions are often ideal for infection and buildup of pathogens within greenhouses (Sutherland et al. 1982; Tinus and McDonald 1979).

Damping-off and root diseases may also be important in container operations. Most root pathogens are probably introduced either on contaminated seed or from infected plant debris within or adjacent to greenhouses (James 1983a; James 1983c; Pawuk 1978; Pawuk 1982). In general, most container soil mixes are relatively pathogen-free (Tinus and McDonald 1979.). However, some growers have used soil mixes that contain sufficient pathogen populations to cause disease.

Most soil mixes for containerized conifers contain vermiculite or perlite incorporated with sphagnum peat (Tinus and McDonald 1979). This type of mix is usually well-drained and acidic, two factors that help reduce diseases (Landis 1976; Phipps 1974). Peat-vermiculite mixes are also light weight, uniform in composition, relatively inexpensive, readily available, have high water holding capacity, and their acidic nature is conducive to growing conifers (Phipps 1974). Soil mixes with a pH of 4.5-6.0 are best for proper growth of seedlings (Arnson and Sadrieka 1974) and reducing incidence of disease (Pawuk 1981).

DISEASES

Major groups of pathogens associated with root diseases of containerized seedlings are species of _Fusarium_ and water molds such as _Pythium_ and _Phytophthora_ (Pawuk and Barnett 1974). Although water molds may be seedborne (James 1982), they are more often introduced into container nurseries through contaminated irrigation water (Pawuk 1982). These fungi mostly cause disease on very young seedlings and are favored by prolonged wet conditions within greenhouses, and poorly drained soil mixes (Pawuk 1982; Sutherland et al. 1982).

Root diseases associated with _Fusarium_ are usually more common. These fungi may colonize seed (James 1983a; James 1983c; Pawuk 1982), causing either damping-off shortly after seedling emergence or mortality when seedlings are older. Several species of _Fusarium_ are important causes of root disease of containerized conifers. These include _F. oxysporum_ Schlect. (James 1982a; James 1983c), _F. solani_ (Mart.) Sacc. (James 1983a) and _F. moniliforme_ Sheld. (Pawuk 1982). These pathogens may cause chlorosis (Landis 1976), stunting (Landis 1976; Tinus and McDonald 1979), and needle tip dieback (James 1983b) as well as seedling mortality. _Fusarium_ often produces spores on structures called sporodochia at the base of infected seedlings (Landis 1976). Spores may spread to nearby seedlings and cause infection during watering (Peterson 1974). _Fusarium_ may occur within peat-vermiculite mixes (James 1982b), but disease development is usually restricted if the mix is acidic (pH less than 6.0).

DISEASE CONTROL

Root diseases in containerized conifer nurseries are usually sporadic, causing little damage, and not requiring specific control measures. However, if disease levels are high, several procedures can help reduce losses.

It is important that seed be as pathogen free as possible. Seed collected directly from trees is usually less contaminated than seed collected from the ground or squirrel caches (Sutherland et al. 1982). Seed can easily be treated prior to sowing to remove surface contaminating fungi. A continuous tap water rinse for 48 hrs. is usually effective in removing most seedocat fungi (James and Genz 1981; James 1982a). Seed can also be treated with hydrogen peroxide or fungicides (James 1983a), although some effects on germination may occur (James 1983a; Sutherland et al. 1982; Pawuk 1979).

Greenhouses should be kept clean to reduce damage from all diseases. Plant debris should be removed periodically and benches and walls sterilized between crops (Tinus and McDonald 1979). Diseased seedlings should be removed as soon as they are discovered (Landis 1976). A noncontaminated water supply is also important (James 1983c; Pawuk 1982).

If soil mixes are suspected of containing high populations of pathogens, several procedures will reduce or eliminate these pathogens. Chemicals used to sterilize soil mixes include formaldehyde, chloropicrin, methyl bromide, and Vapam® (sodium N-methyl dithiocarbamate dihydrate) (Phipps 1974). The most widely used system of soil mix sterilization is heating with steam to about 82° C (180° F) for 30 minutes (Baker and Olsen 1959; Hartmann and Kester 1959). This will kill most harmful bacateria, fungi, nematodes, insects, and weed seeds. <u>Fusarium</u> species are killed at even lower temperatures (57° C = 135° F) (Hartman and Kester 1959). Treated soil mix should be handled as little as possible to reduce chances for reinfestation by pathogens. Therefore, soil mixes should be placed in containers and then treated as a unit, if possible (Baker and Olsen 1959).

Application of fungicides after root disease symptoms appear may not always be effective (Sutherland et al. 1982). Also, fungicides added to soil mixes may retard seedling growth (Tinus and McDonald 1979). If fungicides are to be used, they should be applied as a drench using label rates immediately after sowing (Pawuk 1982). Benomyl (Methyl 1-(butylcarbamoyl)-2-benzimidazole carbamate) may control <u>Fusarium</u> and Truban® (5-Ethoxy-3-trichloromethyl-1, 2, 4-thiadizole) may control <u>Pythium</u>. However, because of their uncertain effectivness, fungicides should only be used when other control measures fail.

Another approach to control root diseases of containerized plants is to use composted tree bark in the soil mix. Composted bark has replaced peat in soil mixes for several ornamental species grown in containers (Hoitink 1980). One of the major advantages of composted tree bark is that it is suppressive to several important plant pathogens, including <u>Phytophthora</u> (Hoitink et al. 1977; Spencer and Benson 1981; Spencer and Benson 1982), <u>Fusarium</u> (Chef 1977; Sekiguchi 1977) and <u>Rhizoctonia</u> (Nelson and Hoitink 1982; Nelson and Hoitink 1983).

Composting is a several-phase process of partially decomposing conifer or hardwood bark to a more absorptive, uniform material. Included are a thermophilic phase, during which high temperatures (40-80° C) kill most organisms, and a stabilization phase, during which the rate of decomposition decreases, temperatures decline, and microorganisms, some of which are antagonistic to plant pathogens, recolonize the compost (Hoitink 1980). Most growers use a 4:1 (v/v) mixture of bark and peat as the organic component of the soil mix. This ratio results in almost complete suppression of root diseases without the need for soil mix sterilization or fungicide application (Hoitink 1980).

There are three major mechanisms of root pathogen suppression from composted bark. Bark particles are generally coarser than peat, resulting in improved aeration which is less conducive to disease occurrence (Hoitink 1980). Composted bark supports high levels of antagomistic organisms, whereas peat does not (Nelson and Hoitink 1983). Also, water extracts from composted bark have fungicidal properties (Hoitink et al. 1977; Nelson and Hoitink 1982).

Use of composted tree bark in soil mixes to control plant pathogens has become practical in several ornamental plant industries. This approach should also be considered in containerized conifer seedling operations.

This publication reports research involving 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.

LITERATURE CITED

Armson, K. A. and V. Sadrieka.
1974. Forest tree nursery soil management and related practices. Ont. Minist. Nat. Resour., Ont., Canada. 143 p.

Baker, K. F. and C. M. Olsen.
1959. Soil steaming. California State Florist Assoc. Bull. 8(9):1-10.

Chef, D. G.
1977. Suppression of Fusarium wilt of chyrsanthemum in composted hardwood bark. M.S. Thesis. Ohio State University, Columbus. 38 p.

Hartmann, H. T. and D. E. Kester.
1959. Plant propagation. 3rd ed. Prentice-Hall, Inc., Englewood Cliffs, New Jersey. 648 p.

Hoitink, H. A. J.
1980. Composted bark, a lightweight growth medium with fungicidal properties. Plant Disease 64: 142-147.

Hoitink, H. A. J., D. M. Van Doren, Jr., and A. F. Schmitthenner.
1977. Suppression of Phytophthora cinnamomi in composted hardwood bark potting medium. Phytopathology 67: 561-565.

James, R. L.
1983a. Fusarium root disease of containerized seedlings at the Montana State Nursery, Missoula. USDA For. Ser., Northern Region. 9 p.

James, R. L.
1983b. Needle tip dieback of containerized Douglas-fir seedlings at the Coeur d'Alene Nursery, Idaho. USDA For. Ser., Northern Region. 9 p.

James, R. L.
1983c. Occurrence of Fusarium on Douglas-fir seed from the Coeur d'Alene Nursery. USDA For. Ser., Northern Region. 11 p.

James, R. L. and D. Genz.
1982. Evaluation of fungal populations on ponderosa pine seed. USDA For. Ser., Northern Region. Rept. 82-22. 21 p.

Landis, T. D.
1976. Fusarium root disease of containerized tree seedlings - Colorado State Forest Service Nursery. USDA For. Ser., Rocky Mountain Region. Bio. Eval. R2-76-16. 6 p.

Nelson, E. B. and H. A. J. Hoitink.
1982. Factors affecting suppression of Rhizoctonia solani in container medium. Phytopathology 72: 275-279.

Nelson, E. B. and H. A. J. Hoitink.
1983. The role of microorganisms in the suppression of Rhizoctonia solani in container media amended with composted hardwood bark. Phytopathology 73: 274-278.

Pawuk, W. H.
1978. Damping-off of container-grown longleaf pine seedlings by seedborne fusaria. Plant Dis. Reptr. 62: 82-84.

Pawuk, W. H.
1979. Fungicide coverings affect the germination of southern pine seeds. Tree Planters' Notes. 30(1): 3-4.

Pawuk, W. H.
1981. Potting media affect growth and disease development of container-grown southern pines. USDA For. Ser. Res. Note SO-268. 4 p.

Pawuk, W. H.
1982. Diseases of container-grown southern pine seedlings and their control. In: Guldin, R. W. and J. P. Barnett (eds.). Proc. Southern Containerized Forest Tree Seedling Conference. 1981. Savannah, GA. USDA For. Ser., Gen. Tech. Rept. SO-37. pp 47-50.

Pawuk, W. H. and J. P. Barnett.
1974. Root rot and damping-off of container-grown southern pine seedlings. In: Tinus, R. W., W. I. Stein, and W. E. Balmer (eds.). Proc. North American Containerized Forest Tree Seedling Symposium. 1974. Denver, CO. Great Plains Agr. Council Publ. No. 68. pp 173-176.

Phipps, H. M.
1974. Growing media affect size of container-grown red pine. USDA For. Ser., Res. Note. NC-165. 4 p.

Sekiguchi, A.
1977. Control of Fusarium wilt on Chinese yam. Ann. Rept., Dept. of Plant Pathology and Entomology, Nagano Vegetable and Floriculture Exp. Sta., Nagano, Japan. 1: 10-11.

Spencer, S. and D. M. Benson.
1981. Root rot of Aucuba japonica caused by Phytophthora cinnamomi and P. citricola and suppressed with bark media. Plant Disease 65: 918-921.

Spencer, S. and D. M. Benson.
1982. Pine bark, hardwood bark compost, and peat amendment effects on development of Phytophthora spp. and lupine root rot. Phhytopathology 72: 346-351.

Sutherland, J. R., W. Lock, and L. E. Benson.
1982. Diseases and insects and their management in container nurseries. In: Scarratt, J. R., C. Glerum and C. A. Plexman (eds.). Proc. Canadian Containerized Tree Seedling Symposium. 1981. Toronto, Ont. COJFRC Symposium Proceedings O-P-10. pp 215-223.

Tinus, R. W. and S. E. McDonald.
1979. How to grow tree seedlings in containers in greenhouses. USDA For. Ser., Gen. Tech. Rept. RM-60. 256 p.