Nursery Diseases of Southern Pines

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Forest tree nurseries in the South produce over 500 million seedlings each year. More than 95 percent of these are loblolly and slash pines. As a regular procedure, the seedlings are grown for one season in the nursery beds and are shipped as 1-0 stock. Because of the considerable decrease in seedling production following the end of the Soil Bank program, many of the practices which contributed to the development of some seedling diseases, such as continuous cropping and high seedbed densities, are no longer used. However, there are still several diseases which sometimes cause considerable losses if appropriate control measures are not used.

Damping-Off

The term "damping-off" refers to a group of symptoms caused by the attack of soil fungi during the first few weeks after planting. If the emerging radicle of the pine seedling is attacked, the injury is called pre-emergence damping-off, or seed decay. More frequently, however, the roots push into the soil and the seedlings emerge before fungi attack; then the fungi weaken the succulent stem tissue at or near the soil line, causing the seedlings to topple. This type of injury is called post-emergence damping-off. Injury that results in decay of either taproots or fine roots by soil fungi is termed root rot. The fungi most commonly associated with early losses in the seedbed belong to the genera *Pythium, Rhizoctonia,* and *Fusarium.*

The fungi that cause damping-off are common soil inhabitants and are able to survive in the soil in the absence of a host plant. They do not usually cause disease unless conditions for their development are favorable or conditions for the growth of seedlings are poor. Consequently, losses from damping-off can usually be kept to a low level by manipulating the environmental conditions in which the seedlings are growing to insure sturdy, vigorous seedlings.

Soil pH levels of 6.0 or higher favor the development of damp-

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ing-off fungi. Losses from damping-off will rarely be serious if the pH of the nursery soil is maintained at 5.5 or lower.

High soil nitrogen at germination also favors the development of some fungi which cause damping-off; consequently, nurserymen attempt to maintain low levels of nitrogen during this period. Sawdust as a soil amendment helps to regulate the availability of nitrogen. Nitrogen fertilizers are generally applied before the cover crop 1 year before seeding pines, or as a side dressing after the seedlings are 6 weeks old. Cover crops and organic manures must be turned under at least 2 months before seeding.

Intense sunlight common in the South in spring favors rapid growth of pine. If seedbed densities are less than 40 seedlings per square foot and seed-covering materials less than one-fourth inch thick, the seedlings grow rapidly but remain stocky through the critical damping-off period.

Adequate moisture combined with good drainage of the surface soil results in optimum germination and growth without favoring disease organisms. Some nurseries have reported severe losses because of excess moisture and poor soil drainage.

Soil acidification and chemical seed treatments commonly used in northern nurseries are not generally needed under southern conditions. Where conditions of high pH, excessive soil moisture, and low temperature favor damping-off, it is occasionally necessary to use chemicals to control the disease. Seed treatment with thiram following the manufacturer's directions gives the best results. Two pounds active ingredient of thiram (liquid or wettable powder formulations) and 5 ounces of undiluted commercial latex sticker will treat approximately 100 pounds of seed. Seed can be best coated in small cement mixers or homemade tumblers.

Fumigation of the soil with methyl bromide before planting will also control damping-off. (See details of application in next section.) Losses from damping-off diseases in southern nurseries, however, are rarely serious enough to warrant the expense of fumigation for this reason alone.

Whitish lesions above the soil line caused by sunscald are often confused with damping-off. These usually form on seedlings from late sowings or in seedbeds where the mulch is too thick.

Black Root Rot

After the seedlings are about 2 months old, other soil microorganisms may attack the roots, producing what is called black root rot. The lateral roots may be completely destroyed. The outer cells of the taproot turn black and can be stripped off with one's finger. There is often an enlargement of new lateral roots above the dead portion of the taproot, and reddish-black, rough, swollen cankers appear on the living roots. Sometimes small, reddish pustules of cortical root cells break through the bark.

Two soil fungi, *Sclerotium bataticola* and *Fusarium oxysporum*, are most commonly associated with the disease. Other soil fungi may sometimes be involved.

The most successful method of combating black root rot is fumigation of the soil with methyl bromide before planting (fig. 1). The soil is harrowed or rototilled and watered to a moisture content suitable for planting. Depending

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Figure 1.—*A*, Unfumigated bed of 1–0 slash pine in a Georgia nursery; seedlings are small because of badly decayed roots. *B*, Neighboring bed fumigated with methyl bromide before planting; seedlings are large and free of black root rot.

on soil texture, the chemical is applied at the rate of 1 to 1.5 pounds per 150 square feet. The methyl bromide is released from 1-pound cans (98 percent methyl bromide, 2 percent chloropicrin) through a special plastic applicator under 4-mil polyethylene covers whose edges have been sealed with soil. For fumigation of large areas, 100- x 20-foot covers are the most convenient size. Care must be taken to prevent the covers from being torn. Sacks of pine straw are placed in the center of the area under the sheets to raise the cover to allow the gas fumes to spread uniformly over the area. Twenty-four hours after the chemical has been applied, the plastic sheets are removed. Fumigation should not be attempted when the soil temperature is below 60 degrees F. at a depth of 6 inches.

Another technique for the application of methyl bromide is by injecting a mixture of 70 percent methyl bromide and 30 percent light organic solvent such as Varsol[2] 6–8 inches into the soil. The fumigant is packaged in large tanks under pressure and is applied through an injector similar to that used for injecting nitrogen fertilizer solutions. The treated area, which may be up to 25 feet wide and several hundred feet long, is then covered with 2-mil polyethylene sheets. The major advantages of this method are that larger covers can be used, no supports are needed for the covers, and, since more efficient utilization is obtained by injection, only about 250 pounds actual methyl bromide is required for heavier soils. A mixture of 67 percent methyl bromide and 33 percent chloropicrin, injected as above at the rate of 200 pounds per acre is also effective.

Methyl bromide kills weed seeds, fungi, insects, nematodes, and other soil organisms and has an additional beneficial effect on plant growth for reasons not clearly understood. The cost of the application and chemical is $300 to $400 per acre. Nurserymen who have used methyl bromide have found that most of the beneficial effects last at least 3 years. By spreading the cost of treatment over 3 crops, the cost per thousand seedlings is less than 10 cents. Other fumigants have been tested for control of black root rot or other root diseases, but none has equaled methyl bromide in efficiency or consistency.

Nematode Injury

Injury to pine seedlings from nematode feeding is variable. Internal feeders destroy the walls and contents of cells entered; these damaged areas in feeder roots also provide entrance points for pathogenic soil fungi. Some external feeding nematodes cause root surface necrosis whereas others devitalize root tips, leaving root systems with numerous short, stubby branches.

The above-ground symptoms of plants affected by nematodes are commonly the same as those on any plant with a restricted or malfunctioning root system. Affected seedlings lack vigor, show nutrient deficiencies, and exhibit low drought tolerance.

It is virtually impossible to eradicate nematodes completely from nursery soils. Therefore,

[2] The use of trade, firm, or corporation names in this publication is for the information and convenience of the reader. Such names do not constitute an official endorsement or approval by the USDA of any product or service to the exclusion of others which may be suitable.

control measures involve lowering population levels to a point where seedlings can be grown profitably. Crop rotation with non-host plants in alternate years will significantly reduce certain nematode populations. Fallow periods also lower nematode population levels. Many soil fumigants are currently recommended for the control of soil-borne nematodes. Halogenated hydrocarbons are the most widely used; this group includes methyl bromide, ethylene dibromide, and dichloropropene mixtures. Much of the information concerning soil fumigation is of a local nature, and it is difficult to draw general conclusions of the best chemical and manner of application for a given locality or given nematode species. Since most nematode species that attack pine seedlings are also found on agricultural crops, detailed information on control can be obtained from the Agricultural Extension Service of most State agricultural experiment stations.

Fusiform Rust

Throughout the Coastal Plain and Piedmont of the South, the fungus *Cronartium fusiforme* is a serious threat to slash and loblolly pine seedlings. During April, May, and early June, brown hairlike telia are produced on the undersides of the new leaves of several species of oaks. These telia produce spores, which are carried by the wind to pine seedlings. Infection of the needles or soft stem tissue occurs only when the water content of the atmosphere is near saturation for a 12-hour period and temperatures are between 60 and 80 degrees F. In the following September or October, spindle-shaped swellings appear on the stems of infected seedlings (fig. 2). The majority of nursery-infected seedlings die during the first year after out-planting.

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Figure 2.—A group of 1-year-old slash pine seedlings with stem swellings caused by fusiform rust.

Fusiform rust infections can be prevented by spraying with ferbam prior to infection. Ferbam is applied at the rate of 2 pounds (1.52 pounds active ingredient) in 75 gallons of water per acre with a sprayer at 300 pounds pressure. Complete coverage of all seedling tissue is essential. One pint of a commercial spreader-sticker is usually added to improve coverage and reduce weathering.

Concentrate sprayers can also be used. By substituting an air blast for part of the water, these sprayers or mist blowers use a lower volume of water to apply the same amount of chemical. They cover strips 40 to 50 feet in width, applying 35 gallons per acre. These sprayers are of value in the large nurseries where conventional high-pressure sprayers cannot cover the area rapidly enough during rainy periods to prevent infection.

Most nurserymen spray twice weekly and after rains from the time of seed germination to the middle of June. Prescription spraying is possible by studying weather conditions and examining nearby oak leaves. The number of spray applications can be reduced one-half or more by spraying only when rains or fogs are expected for a 12-hour period at temperatures between 60 and 80 degrees F. and when spores are being produced on oak leaves. A combination of all three of these factors is necessary for a serious amount of infection.

All the obviously diseased seedlings should be culled at lifting time.

Brown Spot

Longleaf pine in nurseries near the Gulf of Mexico is commonly affected by brown spot. The casual fungus, *Scirrhia acicola,* penetrates the needles and causes brown spots often with a yellow band on either side. Heavy infection may defoliate seedlings.

The disease can be controlled by spraying with a 4-4-50 bordeaux mixture prepared by dissolving 4 pounds of copper sulfate in 50 gallons of water. Four pounds of hydrated lime are stirred into a bucket of water, and the suspension added to the copper sulfate solution while the contents of the spray tank are thoroughly agitated. The mixture is applied at the rate of 60 gallons per acre with a sprayer at 300 pounds pressure. In areas where brown spot is a problem, applications are made at 10-day to 30-day intervals, from the middle of June until the end of October. Spray schedules vary with the amount of rainfall, but four to six applications are usually adequate.

Rhizoctonia Needle Blight

During extended periods of moist, cool weather, *Rhizoctonia* may cause top killing of many species of conifers. On longleaf pine, the fungus first attacks the needles near the soil line and eventually moves into the bud and crown, killing the seedlings. Other species of southern pines seldom die since only the bud and new growth are affected. The mycelium of the fungus can be seen as fine brown threads. These are often numerous enough to mat the dead needles together.

For longleaf pine, the best control is to clip the needles. This permits good aeration and lowers humidity near the ground line, where the fungus is most active. Withholding irrigation may also help to keep the disease in check. Spraying with fungicides is usually not necessary.

Chlorosis

During July and August, high temperatures may turn the needles of pine seedlings yellow. This condition may be severe enough to cause stunting of the seedlings, or even death, but normal coloring usually reappears in the fall with no obvious damage.

When the needles of pine turn light green, the color can often be restored by a top dressing of urea, ammonium nitrate, or diammonium phosphate at the rate of 50 pounds of nitrogen per acre. Seedlings that develop a creamy yellow color in irregular areas along the edges of beds in midsummer do not respond to nitrogen fertilization. Additional nitrogen has been observed to accentuate yellowing. Sometimes iron chelates used at the rate of 3 pounds of metallic iron per acre have reduced these symptoms, but at other times neither nitrogen nor iron is effective.

The effect of high soil temperatures on soil aeration, excessive soil moisture, soil micro-organisms, and chlorophyl destruction caused by high needle temperatures are possible causes of some summer yellowing. No practical control is known for this type of chlorosis.

Seedlings from seed planted early in the spring and well fertilized throughout the growing season usually survive summer chlorosis and develop into marketable plants.

References

DISEASES IN SOUTHEASTERN FOREST NURSERIES AND THEIR CONTROL.
Charles S. Hodges, Jr. U.S. Dep. Agr., Forest Serv. Southeast. Forest Expt. Sta., Sta. Pap. 142, 16 p., illus. 1962.

Caution

Ferbam, methyl bromide, ethylene dibromide, dichloropropene, and copper sulfate are pesticides. Improper handling, application, or disposal may be injurious to humans, domestic animals, fish, or wildlife. Follow the directions and heed the precautions given by the manufacturer.

Store pesticides in original containers under lock and key—out of the reach of children and animals—and away from food and feed.

Apply pesticides so that they do not endanger humans, livestock, crops, beneficial insects, fish, and wildlife. Do not apply pesticides when there is danger of drift, when honey bees or other pollinating insects are visiting plants, or when pesticides may contaminate water or leave illegal residues.

Avoid prolonged inhalation of pesticide sprays or dusts; wear protective clothing and equipment if specified on the container.

If your hands become contaminated with a pesticide, do not eat or drink until you have washed. In case a pesticide is swallowed or gets in the eyes, follow the first aid treatment given on the label and get prompt medical attention. If a pesticide is spilled on your skin or clothing, remove clothing immediately and wash skin thoroughly.

Do not clean spray equipment or dump excess spray material near ponds, streams, or wells. Because it is difficult to remove all traces of herbicides from equipment, do not use the same equipment for insecticides or fungicides that you use for herbicides.

Dispose of empty pesticide containers promptly. Have them buried at a sanitary land-fill dump, or crush and bury them in a level, isolated place.

NOTE: Some States have restrictions on the use of certain pesticides. Check your State and local regulations. Also, because registrations of pesticides are under constant review by the U. S. Department of Agriculture, consult your county agricultural agent or State Extension specialist to be sure the intended use is still registered.

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