NURSERY DISEASES

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Forest tree nurseries in the South produce over 500 million seedlings each year. More than 475 million of these are loblolly and slash pines, approximately 13 million are hardwoods, and 12 million are miscellaneous conifer species.

A number of nurserymen have expressed their concern about losses from fusiform rust and black root rot. Some new and interesting facts have recently been established about both these diseases which should help reduce losses in nursery plantings.

Fusiform rust is the most serious disease of slash and loblolly pines in the southern United States. Although sprays with ferbam are routinely used in all southern nurseries, from 1 to 20 percent of the loblolly and slash stock are lost annually to this disease in southern nurseries.

Dr. Glenn Snow, Southern Forest Experiment Station, has discovered that fusiform rust infections occur in periods less than 18 hours duration. His data clearly shows that infection may occur in as little as 4 hours, and often does occur in 8 to 12 hours. Paul Siggers was the man who originally defined an infection period. His data was based on the length of time required for spore development and germination under laboratory conditions. He found that 9 hours were required for telia to begin germination,

and an additional 3 hours for sporidia to be produced on telia, and 6 more hours for sporidia to germinate and theoretically infect pine tissue. Snow, working in both the laboratory and field, discovered that telia exposed to conditions optimum for germination for a few hours and then exposed to dry atmospheric conditions before re-exposure to moist conditions will begin casting sporidia almost immediately. This means that pine seedlings may be infected during wet periods of only 4 hours duration if rains occur on two consecutive evenings and the relative humidity remains near saturation for 4 hours each evening. Snow also discovered that telia may begin casting without this pre-conditioning exposure to rainy periods in less than the 12-hour period proposed by Siggers. Sporidia were cast° telia after 4 to 6 hours exposure to moist atmosphere at 67 F in Snow's tests. Sporidia were also found to infect pines in as little as 4 hours after landing on susceptible tissue rather than the 6 hours that Siggers stated were necessary. Thus, an infection, as redefined by Snow, is a period of saturated atmospheric with temperatures between 57 and 80°F but near 67°FF for at least 8 hours when preceded by several days of dry atmospheric conditions and at least 4 hours when telia are pre-conditioned by **rain**, heavy dew, or fog the previous afternoon or evening. Relative humidities greater than 97 percent and an air temperature of 67 F are optimal for infection of pine. These facts, simply stated, mean that nursery sprays should be applied twice weekly, the morning after a late-afternoon or evening shower, the morning after a heavy fog or dew, and after a general rain. Sprays should also be applied before a predicted rainy front moves in.

In studies of fungicidal control of fusiform rust, I have some preliminary data which indicates the systemic fungicide, Plantvax, may be superior to ferbam. In tests at the Morgan Nursery in 1968, rust infection was 10.8 percent in check plots, 6.2 percent in ferbam plots, and only 3.3 percent in Plantvax plots. These results are only preliminary, but a test is established at the Davisboro Nursery this year to compare Plantvax, Vitavax, Benlate, and Fermate for control of rust.

I have been studying the effects of fertilization on the susceptibility of pines to fusiform rust. The size of galls appears to be related to the amount of available nitrogen. The more nitrogen available, the larger the seedlings and galls will be at lifting. Excessive and toxic levels will, of course, inhibit seedling growth and gall development. Numbers of branches on nursery stock are also increased by infection. Susceptibility to drought and consequent drought-caused mortality is apparently increased by infection. This increased mortality by drought probably explains the very poor survival of outplanted infected seedlings. Nitrogen availability also appears to affect seedling susceptibility to

infection. Rates up to 100 pounds of nitrogen per acre caused an increased amount of rust infection. This rate of nitrogen is about optimal for seedling growth. Kind of nitrogen fertilizer also affects susceptibility to infection. Those sources of nitrogen which release the nutrient fast are more apt to increase infection than those which are slow releasing sources. These preliminary data indicate that available nitrogen should be held to a minimum during the rust hazard season. Resistance to fusiform rust appears to be related to seedling age. The younger the seedling at the time of exposure, the more likely it is to become infected. Early plantings should have less infection than later ones when both aged seedlings are exposed to the same inoculum load. Unfortunately, early plantings are often exposed to more inoculum than are later ones.

Another study has shown that sporidia may land on a fence post or yellow poplar leaf and still infect pine seedlings. The sporodium simply germinates on the fence post and produces another sporodium which is carried by wind to the pine seedling. This means that the chances of any one sporodium produced on an oak leaf has a better chance of infecting a pine seedling at a greater distance from the oak leaf than originally thought possible.

Black root rot is known as charcoal rot on a wide variety of agronomic and ornamental plants as well as forest trees. Although S. bataticola, Fusarium solani, and F. oxysporium may be the cause of black root rot, S. bataticola is apparently the most important pathogen in the black root rot complex. This fungus grows best and attacks plant roots most vigorously when soil temperatures are above 90°F and when available soil moisture is in limited supply in the top few inches of soil. In southern nurseries this fungus causes damping-off of young seedlings early in the season and root rot of older seedlings during late season. The hot and dry summer when less irrigation water is applied to nursery beds is ideal for root rot development. Phosphorus and potash are without effect but nitrogen increases the severity of damping-off and root rot caused by both species of Fusarium and by Sclerotium bataticola. Keeping available nitrogen at low levels during spring and early summer should decrease rust infection, damping-off, and root rot. Since root rot severity is dependent upon high populations of the fungus as well as nitrogen availability, keeping available nitrogen low during the spring and early summer helps prevent high soil populations of the fungal pathogens and reduces the severity of root rot during late season when available nitrogen must be increased to obtain plantable seedlings. The addition of organic matter may also help to reduce the severity of rust, black root rot, and damping-off. The organic matter reduces available nitrogen and increases the water holding capacity of soils. I have already mentioned that S. bataticola grows best under hot and dry conditions. This fungus lives in organic matter in soil and seldom grows far

into the soil away from the organic matter. Sclerotia of the fungus are stimulated to grow by secretions from plant roots. When a plant root comes near a particle of organic matter containing the fungus, root secretions stimulate the fungus to grow and it attacks the nearby root. Plant roots secrete more substances during hot and dry periods than during cool wet periods and secrete more material when available nitrogen is high than when it is low.

Yellow poplar is one of the major hardwood species produced in southern nurseries. Cylindrocladium root rot or blight is the most serious disease of yellow poplar in southern nurseries. This disease also affects white pine, Fraser fir, and black walnut, The tap roots, lateral roots, root collars, and sometimes the stems of seedlings are attacked by the fungus. Decayed roots are black and often are rough and cracked. Foliage of diseased seedlings turns yellow, dies, and falls off prematurely. Either Cylindrocladium scoparium or C. crotalariae may cause the disease of yellow poplar. Fumigation with high rates of methyl bromide, about 500 pounds per acre, are recommended for control of this disease.

More sycamore are produced in southern nurseries than any other species of hardwood. Two diseases of sycamore are noteworthy. Diplodia canker and crown gall are the two most important diseases encountered in sycamore nursery stock. Both diseases are caused by pathogens which require a wound for entry into the plant. Diplodia canker is caused by the fungus Diplodia theobromae and young sycamore plantations have been observed with as many as 80 percent of the stems infected. In the only nursery planting where diplodia canker has been observed to date, the fungus had entered wounds made by tractors and equipment passing over the seedlings. It is possible for the fungus to enter sunscald lesions, or wounds made by hail, insects, or man. The fungus invades the stem, kills stem tissue and causes cankers with sunken or flat centers when the stem is not girdled. Girdling infections cause the death of the stem above the point of the infection. An effective fungicidal control of this disease is not known. The culling of infected stock and the prevention of wounds on nursery stock are the only recommended controls.

Crown gall is caused by a bacterium. The bacterium frequently enters nurseries on contaminated vegetable transplants or on ornamentals, such as roses. Very few, if any, seedlings die in the nursery bed from this disease. An enlarged area or gall develops near the root collar on sycamore, and the presence of this gall may be the only noticeable symptom of the disease. The seedlings may survive in plantations for several years before they begin to fade, turn yellow, and die. High winds may cause breakage of infected stems at the gall, Crown gall may be controlled by planting resistant cover crops such as oats, cowpeas, or crotalaria on contaminated land for two consecutive years, by prevention of wounds

on nursery stock, by dipping infected seedlings in a bactericide such as Agrimycin, or keeping contaminated plant material out of the nursery.

A number of other diseases are serious on hardwood nursery stock. Root knot nematodes are very serious on dogwood and catalpa. Dasanit as a soil drench or root dip **is an** effective eradicant of this nematode. Pythium causes damping-off and root rot of several hardwood species. Phomopsis canker and dieback on cottonwood can become a serious problem.