RESISTANCE TO LITTLELEAF IN SHORTLEAF PINE

by

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Today, we lack adequate control measures for many of our important forest diseases; measures which might effectively and economically reduce or stop damage on thousands of acres of forest land. Often certain silvicultural treatments aid in reducing extensive losses to the stand but often, too, they are not easily applied and may offer only partial control of the disease. If we are to reduce disease losses on a forest scale, we must develop methods which can be applied readily to large areas and not merely to the individual tree. For many of our tree diseases, the individual tree can be successfully treated and brought back to good vigor. Such means are suitable for yard trees and those employed as ornamentals but not for extensive stands of diseased timber.

Such is the case with littleleaf today. We know the cause of this widespread Piedmont disease of pine but we have yet to find an effective cure for application to the many thousands of acres on which it occurs. We can successfully rejuvenate individual diseased trees, if not too far advanced, by application of heavy dosages of nitrogenous fertilizer. This, of course, is out of the question for use over extensive areas.

Yet, we are not without means of reducing losses from this serious disease in our forest stands. Losses may be considerably reduced by the application of salvage rules based on the severity of littleleif in the stand. Instead of leaving trees to die and rot they are removed at periodic intervals consistent with good economics.

We also have a littleleaf hazard rating system based upon an evaluation of a few simple soil characteristics which enables the forester to tag a particular site with a littleleaf hazard rating. If the hazard is high he will not plant shortleaf but some other species of pine much less susceptible to this disease. In the case of natural stands, a high littleleaf hazard rating would dictate management away from shortleaf pine.

One answer to littleleaf and other forest tree diseases needing better control lies in the field of forest genetics--in the development of disease resistant strains. Work has been going on for some time toward developing blight resistant chestnut, canker resistant poplar, phloem necrosis and Dutch elm disease resistant American elm, blister rust resistance white pine, and fusiform rust resistant slash and loblolly pine. Not only is resistance to disease being sought but better all-around strains of these trees are being developed. Disease and insect resistance research goes hand in hand with other forest genetics and tree improvement work today.

Resistance studies on littleleaf began five years ago even before work on the causal factors was complete. An indication of natural resistance to this disease was first noted on severe littleleaf areas where practically all but a few trees escaped attack. Especially striking were those trees which persisted in a healthy condition despite their being immediately surrounded on all sides by littleleaf-killed and dying shortleaf pine. Other indications were observed during artificial inoculation tests when certain individual seedlings appeared to be only mildly or not at all affected. These observations strongly suggested that a weapon against littleleaf was available through the development and propagation of resistant strains of pine.

Before going further, it would be well to briefly review what we know of the cause of littleleaf. It has been demonstrated that this disease of pine is the result of a combination of factors. Primary among these is damage to the root system by Phvtoehthora cinnamomi, a soil fungus. Adverse *soil* conditions such as poor aeration, low fertility, and periodic moisture stress contribute to the weakening of the trees. The soil pathogen destroys the growing tips of extending and short roots preventing not only extension of the root system but also checking the formation of mycorrhizae so essential to nutrition particularly on poor sites. Major root damage is believed to occur for a few weeks in spring and later during the fall when soil temperatures and moisture are favorable for the parasite. The fungus can be isolated from soil on good sites bearing healthy shortleaf pine. Although the fungus probably causes the same root damage on good as on poor sites, littleleaf does not develop because the trees, healthy and vigorous, readily recover from this relatively minor damage to their root systems.

In developing resistance to littleleaf, therefore, we must consider not only the primary agent, a fungus, but also the associated unfavorable soil conditions. The resistance to littleleaf must then include resistance to attack by P_i, cinnamomi and the capacity to grow on poor sites. It must include the ability within the tree to readily regenerate a damaged root system.

Research on littleleaf resistance began with the selection of apparently resistant shortleaf pine on some extremely severe littleleaf sites. These trees were chosen primarily for disease resistance and secondarily for excellence of growth and form characteristics. This is a continuing operation and to date several areas in Georgia and South Carolina have been surveyed for promising selections. Where loblolly is present in littleleaf stands it also is being selected and catalogued. Selection is rather critical--it is estimated that only about one tree is chosen per 40 to 50 acres examined in littleleaf stands.

After a tree is selected, open-pollinated seed is gathered for later progeny tests to evaluate its genotype. Scion material *is* taken and grafted onto seedling stock. These grafted clones, each of 10 or 20 trees, are established in a central area for later use *in* control-breeding work. Although some control-pollinations have been made in the field on the original trees, future work in this phase will be carried out on the grafted clones in the central areas when flowering becomes adequate. This will not only reduce costs but should considerably improve results.

Progeny from selected trees are first tested in the nursery and then those which appear to exhibit resistance are outplanted on severe littleleaf sites. For the nursery test one-year-old seedlings are transplanted into tank-like beds filled with heavy soil from a littleleaf area and reinforced with inoculum of the soil pathogen. The soil is flooded twice weekly during the growing season. In effect, this represents a severe littleleaf site but with an intensification of the causal factors.

After one growing season of this treatment the two-year-old seedlings are carefully lifted and evaluated for littleleaf resistance on the basis of their root systems. Seedlings judged resistant must bear dense fibrous roots with abundant mycorrhizae and little dieback. Those judged as susceptible lack fibrous roots and mycorrhizae and have much root dieback.

The first such progeny test with shortleaf pine indicated a definite inheritance of resistance to littleleaf. A high proportion, 45 to 80 percent, of open-pollinated progeny of 5 of 6 parent trees tested showed resistance while, only 15 to 25 percent of open-pollinated progeny of 3 of 4 littleleaf trees appeared resistant. A much larger test, including both open-and control pollinated seedlings, has recently been dismantled and is now being evaluated.

The ultimate aim of this program is to eventually develop pine planting stuck with a high inherent resistance to littleleaf and possessing good growth and form characteristics. Those strains, found by selection, which after thorough testing prove capable of yielding high percentages of resistant progeny will be made available to interested parties fur the establishment of seed orchards. As new and better strains are developed by further selection and by intra- and even inter-specific hybridization they will be made available for inclusion in the orchards.

However, the development of new strains of pine resistant to the factors of littleleaf is not in itself a cureall for *this* important problem. In order to combat littleleaf successfully we must also improve the depleted sites which foster this widespread disease. Resistance to littleleaf will be a relative quality subject to considerable modification depending upon the character of the site. Hence resistance development must go hand in hand with silviculture designed for soil rehabilitation.