Some Problems and Their Solutions

John P. Jones,
Xiaoan Sun,
Lori Eckhardt,
Ann Weber,
Nolan Hess,
Jim Barnett
and John McGilvary

Photo by John P Jones

Many of the forests that once grew longleaf pine are now growing lob/o//y, which is showing signs of decline. The loblolly pine in the center of this Alabama forest shows signs of disease.

Research in forest pathology is shaped by the need to consider the consequences of a crop that must be managed from 20 to 100 years. If the desired end product of a forested area is wilderness, then dead and hollow trees may be considered part of the natural process and desirable for providing shelter for wildlife. On the other hand, if the desired end product is high quality lumber, then disease prevention is critical. Effective forestry management requires long-range goals.

Currently, the South is establishing its “fourth” forest. The first was the forest present when the first European settlers arrived, which was essentially harvested by the early 1900s. The second was harvested from about 1930 to the 1960s. The third forest is now being harvested. The fourth will supply the wood and fiber needs well into the 21st century or early 22nd century. Net annual timber growth has, however, begun to decline, and it has become crucial to understand factors that reduce both stand establishment and long-term growth and development in the forest. Forest diseases are a major factor in all phases of forest establishment and development.

The South’s third forest is approaching 30 to 40 years old and consists largely of loblolly pine in areas that originally grew shortleaf or longleaf pine. This has become a problem because loblolly pine in many of these areas goes into a serious decline beginning at this age. Until recently, the U.S. Forest Service was able to sell off timber before decline became a serious problem, but policy changes now require that much national forest timber should go to IOO-year rotations to maximize habitat diversity. This presents researchers with short-term and long-term problems. In the short term. researchers must find the cause of the dcclinc and figure out what, if anything, can be done to alleviate it (see page 6). In the long term, researchers must look into what can be done to prevent decline from reoccurring 40 years from now if the

---

John P. Jones, Professor, Department of Plant Pathology and Crop Physiology, LSU AgCenter, Baton Rouge, La; Xiaoan Sun. former graduate student and now with the Florida Department of Agriculture & Consumer Services, Gainesville. Fla.; Lori Eckhardt and Ann Weber, graduate students; Nolan Hess, Jim Barnett and John McGilvary, all with the U.S. Forest Service.

problematical stands are cut and replanted. The approach being taken to prevention is to consider regenerating to other species, particularly longleaf pine. However, longleaf pine is difficult to regenerate.

Whole Forest System

A forest pathological problem should be considered only in the context of the whole forest system, which includes everything from seedling production to the end product. LSU AgCenter scientists are working on problems related to seed production, seedling production, outplanting survival, diseases of mature forests and wood products. Each project relates to the rest in a scientific and intellectual ecology. All of these projects are important to understanding the biology of the forest and for making policy decisions. The decline of loblolly has led to an intensified research interest in regenerating longleaf pine in those areas in which it comprised the first forest.

Most forest regeneration in the South today is accomplished by outplanting seedlings raised in forest tree nurseries (bare root seedlings). Seedlings are lifted by the millions during the winter and held in cold storage until planted. This storage period can last several weeks, which is not problematical for loblolly pine but results in severe mortality in longleaf pine. Loblolly pine, for example, will have 98 percent survival even after being stored for six weeks, while longleaf survival drops to 46 percent after only one week.

This was a problem that needed to be resolved so that longleaf pine could be raised and planted in sufficient numbers to meet the potential need. We investigated the possibility that this problem was caused by a fungal pathogen. Stored seedlings exhibit few symptoms but had poor survival after planting. Our suspicion was that a root pathogen was involved, so we conducted isolation and inoculation studies of seedlings in storage. We found that a particular group of water molds were present in increasingly high numbers as the seedlings were held in storage.

Use of Fungicides

This finding led to an attempt to increase seedling survival through application of fungicides to control these water mold fungi, and we were successful. Common nursery practice includes coating the bare roots of seedlings with a koalinite clay slurry. We found that including either benlate at high levels, or metalaxyl at 10 ppm in the slurry, reduced water mold levels to trace amounts, even after six weeks of storage, and increased survival rates for the longleaf seedlings to approximately 95 percent. Untreated check seedlings had survival rates of about 15 percent after only one to two weeks of storage.

We also noted that high levels of the fungal genus *Trichoderma* correlated at statistically significant levels with increased survival of outplanted seedlings. A project was initiated to explore the possibilities of using nonchemical biological control methods to enhance outplanting survival. We found that several species of this fungus would, if applied in precisely defined ways, result in high seedling survival rates. We have not pursued biological control because chemical control is more effective, less expensive and simpler to use. The procedural groundwork has, however, been established in case the chemical option is removed.

There has also been an increasing emphasis on containerized seedling production for longleaf, which avoids many of the problems associated with bare root production. Containerized seedling production uses seedling trays consisting of individual cells about 6 inches long and about 1.5 inches in diameter, tapered at the bottom with a small opening for water flow. A longleaf seed is placed in each cell and can be outplanted a few months later. Containerized seedlings can be produced under controlled conditions at any time of year. They are also much easier to handle and outplant successfully than are bare root seedlings.

Photo by John P. Jones

Jim Haley, a U.S. Forest Service entomologist, collects insects that feed on tree roots. Researchers then examine the pathogens growing on the insects.

Disease Problem

Increased production of containerized seedlings to meet demand, however, revealed a serious disease problem. Seedlings that looked relatively healthy during the growing season would suddenly die or sometimes continue to look usable until pulled from the container. The roots would be so deteriorated that attempting to pull the seedling revealed essentially no root system left, just a handful of green needles unconnected to a root. Containerized seedlings are grown under such highly optimal conditions that even a highly reduced root system can support enough shoot development to maintain needles. It is also possible that this disease accelerates its effect as root growth becomes limited by the confines of the container late in the growing season. Isolations from the roots resulted in almost pure cultures of *Fusarium circinatum*, the pitch canker fungus. It was found that the fungus was present in the seed coat at planting.

We have conducted preliminary tests in which wc immersed longleaf seed in hot water for two minutes at 140 degrees F, followed by immersion in cold water. This effectively reduced population levels of the pitch canker fungus to trace levels and resulted in high levels of plantable seedlings.

We have also tested the fungicide benlate as a seed treatment as welt as soaking the seed for 30 minutes in a 30 percent hydrogen peroxide solution. Benlate, however, will become unavailable for use in the near future, and hydrogen peroxide at that rate can be explosive and is dangerous to usc. This work will he repeated and extended to determine what combinations of time and temperature for hot water treatment will produce acceptable results and to develop procedures for scaling up IO operational levels.

The studies briefly outlined here address a wide range of problems. each of which involves some essential aspect of a forest management system. No phase of forest establishment, development and maintenance can be ignored if optimal usage of the forest resource is to be achieved. ■

Photo by John P. Ioner

This** is a **forest in** Alabama **where** LSU AgCenter researchers conduct studies on the loblolly pine. The problems with these **forests in** Alabama may happen in **Louisiana** if preventive measures are **not taken.

Scientists Study Loblolly Pine Decline

A decline in loblolly pine, first reported in Bogalusa, La., in 1966, helped trigger a long-term study at the LSU AgCenter. At first, it was suspected that it was the same disease as littleleaf disease of shortleaf pine, which was attributed to site factors and *Phyphthora cinnamomi*, a water mold. However, other studies led us to suspect *Leptographium* species might also be involved. We implemented a study to determine the respective roles of *P. cinnamomi*, *Leptographium* species, root attacking insects and various site factors. Preliminary data indicate that *P. cinnamomi* do not significantly correlate with decline symptoms, but *Leptographium* species correlate with symptoms and are probably the major pathogens involved. We have also found that *Leptographium* can routinely be isolated from many of the beetles and weevils that occur on pine roots and the soil around the roots. Our data indicate that loblolly decline results from an imbalance in the complex interrelationships involving insects, pathogenic fungi and the pine itself. We are now analyzing soil samples for physical and chemical characteristics that may affect the course of the decline. We are also conducting various inoculation experiments to confirm the ability of insects to vector *Leptographium* and to confirm that it is pathogenic to loblolly pine. The information developed from this research will help policy makers with the decisions that will determine the nature of southern forests for the next 100 years. ■

John P. Jones, Professor, Department of Plant Pathology and Crop Physiology, LSU AgCenter, Baton Rouge, La.