Research Update 1991

Forestry

New Fertilizer Promising For Southern Pines

Foresters have traditionally been reluctant to use fertilizers, because of economic factors, despite a consistent response to nitrogen by pines. However, in the past 20 years, more fertilizer has been used, generally urea, because of its high nitrogen content. Recent AAES research, however, indicates a new fertilizer being developed by the Tennessee Valley Authority (TVA) may be more applicable than urea for pines.

Urea nitric phosphate (UNP) is a relatively new fertilizer developed by the TVA. Research indicates UNP has the potential to reduce ammonia loss by as much as 50% over urea. Ammonia retention is critical to prevent urea toxicity to seed and seedlings.

In tests on a 14-year-old pine stand near Auburn, researchers compared growth of trees treated with UNP, urea plus triple superphosphate (TSP), and no treatment. The UNP-treated trees one year after treatment averaged 43.5 feet tall, compared to 42.8 for the urea plus TSP-treated trees, and 42.5 for untreated trees. Bole dry weight of the UNP-treated trees averaged 107.3 pounds per tree, compared to 105.3 for the urea plus TSP-treated trees, and 103.5 for the untreated trees.

D. Crawford and B. G. Lockaby

Acid Rain and Ozone Effects on Loblolly Pine Growth

Data from remeasurements of Forest Inventory and Assessment plots in the South indicate the possibility of a recent, unexplained decline in the growth rate of pines in some portions of this region. These observations, along with reports of forest damage and growth decline in high elevation forests of the Eastern U.S. and southern California, have led to an increase in public concern.

Drought, disease, hardwood competition, changes in stand age and previous use (old fields), and air pollution (primarily acid rain and ozone) have been implicated as possible causal or contributing factors to these declines.

Auburn researchers used a modified open-top chamber, or "outdoor greenhouse," to study the effect of

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Regenerating Bottomland Hardwood Forests

Hardwood forests in Alabama are becoming increasingly valuable for use in wood products and as habitat and food suppliers for wildlife. Managing these forests is generally more complex than managing pine stands, primarily because a wider diversity of species (with varied ecological characteristics and values) is involved.

Auburn researchers found that in two different stands, where clear-cutting was applied 7 years earlier, along with treatment of undesirable trees, good establishment of commercial species has occurred. Commercially valuable hardwoods taller than one-foot totaled 1,691 and 1,792 per acre in the two stands within seven growing seasons after clearcutting.

When compared to the preharvest stands, water and willow oaks, green ash, and sweetgum increased or remained stable in numbers and proportions in the regenerated stand. However, both cherrybark and swamp chestnut oaks (two of the most highly valued species) declined in numbers and proportions.

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Alabama Agricultural Experiment Station **Auburn University**
Lowell T. Frobish, Director **Auburn University, Alabama**

Acid Rain and Ozone, continued

acid rain and ozone on pine seedlings. This chamber allows researchers to apply different treatments of acid rain and ozone to trees while they are growing in the ground.

After 2 years, results indicate that acid rain is not having a deleterious effect on above-ground growth or productivity, but soil chemistry near the roots (rhizosphere) may be altered slightly. Ozone at high concentrations causes a significant reduction in foliar biomass, chlorophyll content, photosynthesis, and alters nitrogen status; slight reduction in height and diameter growth; and an increase in visible injury.

A. H. Chappelka

Regenerating Hardwoods, continued

The decline of these species probably can be attributed largely to a lack of advance regeneration present when the stands were cut. The development of reliable techniques to increase advance regeneration will be necessary in order to consistently regenerate these species successfully.

M. S. Golden

Tree Harvests and Environmental Quality in Forested Wetlands

Forested wetlands are among the most productive ecosystems in the world. They harbor high diversity of plants and animals, and they protect water quality by attenuating floods, filtering out sediments and nutrients, and shading streams. Because the use of forested wetlands for recreation and wood production has increased dramatically in recent years, there are concerns that water quality may become degraded.

To determine impacts of tree harvests on wetland ecosystem functions, a joint project among AAES, Scott Paper Company, the Tennessee Valley Authority, the National Council of the Paper Industry for Air and Stream Improvement, and N.C. State University was recently initiated. With a focus on small stream drainages in the Alabama Coastal Plain, the 3-year study will determine the impact of helicopter logging and conventional tree skidding on nitrogen cycling, tree regeneration, plant productivity, and soil physical properties.

In wetlands, the removal of trees by conventional rubber-tired skidders can cause deep soil ruts and soil compaction. This in turn can enhance soil erosion, alter the species of tree regenerated, and decrease stand productivity. Helicopter logging can minimize these impacts. Quantifying environmental consequences of the two harvesting methods is a critical part of the study. The use of helicopters will provide a unique opportunity to determine independent effects of tree removal and soil disturbance on wetland system functions.

Additional components of the study will evaluate rates of sedimentation in wetland forests caused by harvesting in adjacent upland forests, and potentially beneficial effects of forest buffer strips on groundwater nitrate concentrations and surface erosion. The study will be capped by a technology transfer program to inform foresters, loggers, and landowners about environmental consequences of tree harvests in wetlands.

R. H. Jones

Weed Control Improves Tree Survival and Growth

The Auburn University Silvicultural Herbicide Cooperative is a southeastern regional research cooperative among the School of Forestry, Alabama Agricultural Experiment Station, State of Alabama, 17 forest industries, and the USDA Forest Service. Collectively, this group owns or controls over 30 million acres of commercial forest land in the South. The objectives of the Cooperative include: developing competition control techniques to increase tree survival and growth and an understanding of relationships among site characteristics, competing vegetation, and tree growth.

Projections indicate the South must dramatically increase timber production over the next 40 years in order to counter the reduction in old-growth forests in the Pacific Northwest. A major obstacle to forest productivity in the South is competition from herbaceous and woody weeds. Cooperative studies demonstrate exceptional initial tree growth response and improved survival under drought conditions following herbaceous weed control treatments.

Indications are that all sites in the South will respond to competition control. On most sites, herbaceous species are most important in restricting pine growth and development in plantations up to 4 years old, with hardwood and shrub competition being most important after age 5. Research has shown that increases in diameter, height, basal area, and volume production of loblolly pines on stands with herbaceous weed control can be maintained for at least 12 years under

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Weed Control, continued

diverse site conditions.

Research also has shown that pines released from hardwood competition at age 3 or 4 have produced up to 80% more volume 8 years after treatment. These short-term results indicate that when weed control is applied early in the life of a forest, rotation length will likely be reduced by 2-3 years.

The dramatic growth responses shown in various studies suggest that most forest lands have a weed problem and that appropriate weed control technology must be developed and implemented if future demand for forest products is to be met.

D. H. Gjerstad

Mortality in CRP Plantings

The Conservation Reserve Program resulted in more than 2,000,000 acres of erodible farm land converted from conventional row crop agriculture to timber production. However, on a reasonably large percentage of the acreage planted (10-15%) complete to nearly complete tree mortality was observed, despite no apparent cause. Replanting these sites often resulted in repeated pine failure.

AAES researchers found that root feeding insects, primarily white fringe beetle larvae, in association with nematode - fungal pathogen interactions, were largely responsible for the excessive mortality. These agents were exacerbated by the presence of a well developed plow-pan, particularly in years of drought. In addition, it was conclusively shown that herbicide residues from past crop production and herbicides used in pine culture to control weeds were not directly involved in the mortality problems.

This research solved a regeneration problem and it is a prime example that large regeneration efforts, such as the CRP, can uncover significant unforseen problems that can be solved through research. This is particularly important in light of the massive tree planting programs that are proposed to combat predicted global warming and increasing CO^2 levels in the atmosphere.

R. J. Mitchell

Genetic Influences on the Nutrient Efficiency of Loblolly Pine

During the past 30 years, significant strides have been made in the genetic improvement of loblolly pine. The vast majority of seedlings now planted in the region are "genetically improved," meaning they are fast growing and disease resistant. Auburn researchers are trying to maximize the productivity of genetic improvement by studying the interaction between genotype (family origin) and nutrient efficiency. It is possible that specific genotypes or families could be matched to site characteristics to maximize growth or that certain genotypes may respond to fertilizer application more effectively than others.

Studies done by the AAES compared four families of loblolly pine for differences in productivity and nutrient use under fertilized versus nonfertilized conditions in the field. Family differences were found in biomass production, component biomass allocation, and nutrient use. One family was shown to be most productive and most nutrient efficient under both fertilized and unfertilized treatments. In general, nutrient use was found to closely mirror biomass production, suggesting that the traditional approach to nutrient use was confounded with growth.

To find an approach to nutrient efficiency that is not confounded by biomass, another study was initiated. Variables, such as nutrient and biomass accumulation, element ratios, nutrient uptake efficiency, and internal translocation efficiency, were examined. Results indicated distinct family differences between uptake patterns and internal cycling of certain elements. Family variation in element ratios, and internal translocation efficiency generally did not mirror family productivity differences. Hopefully, these approaches will provide additional information on specific mechanisms through which various genotypes use nutrients most effectively, under different site conditions.

D. Crawford and B. G. Lockaby

Nitrate Movement in Forest Tree Nursery Soils

Tree nurseries are essential to modern forest management because they produce the seedlings that are used to regenerate harvested forests. Nurseries are highly specialized operations that use significant amounts of fertilizers and pesticides to maximize the production of seedlings that have suitable quality to survive and grow after lifting, storage, transportation, and field plant-

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Seed Efficiency: A Goal of the Nursery Cooperative

Forest industries invest millions of dollars each year to improve the genetic potential of loblolly pine seed, some of which is in turn lost due to poor management practices in the nursery. For example, in some areas in Canada, the seed efficiency for pines grown in operational container nurseries is usually less that 50 percent.

A major goal of the Auburn University Southern Forest Nursery Management Cooperative is to improve management practices that will increase seed efficiency in bare-root nurseries. In 1975, seed efficiency for many bare-root nurseries in the South was about 66 percent. However, Cooperative research involving herbicides and fungicides has helped to increase the number of seedlings surviving till lifting.

Research with lowering seedbed densities, seed stratification, and precision sowing has helped to reduce the percentage of culls. As a direct result, many bare-root nurseries in the South now obtain seed efficiencies above 80 percent. Research aimed at obtaining high seed efficiencies in bare-root nurseries should help keep the cost of pine seedling production to near the lowest among the developed nations.

D. B. South

EDITOR'S NOTE

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Nitrate Movement, continued

ing, despite adverse weather conditions.

Pine nurseries are generally located on light (sandy) soils. Soil type, along with normally high levels of fertilizer application and a shallow non-fibrous root system on most tree species, may create conditions of excess nitrate nitrogen which has the potential to leach downward and into underground water. Nitrates are of particular concern because the EPA has established maximum acceptable levels of nitrate concentrations in drinking water at 10 ppm.

Research to study the movement of nitrate nitrogen in forest tree nurseries has been initiated by the AAES. Water samples are being collected throughout the nursery season from wells. By analyzing these well samples for nitrate concentrations and then using computer models which calculate the movement of soil water through the profile based on weather records and soil type, an estimation can be made as to the quantity, if any, of nitrate movement into underground water sources.

K. L. McNabb

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Alabama Agricultural Experiment Station
Auburn University
Auburn University, Alabama 36849-0520

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