SOIL NUTRIENTS AND pH IN SOUTHERN HARDWOOD NURSERIES

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The rapidly expanding interest in hardwoods in the South has caused many forest nurseries to begin growing hardwood as well as pine seedlings. Apparently most nurserymen have been able to accomplish this change without great difficulty. Nursery sites and soil conditions suitable for pines should be basically satisfactory for hardwoods also.

The nursery at the Southern Hardwoods Laboratory has been in use since 1946. Although it has always been small, it has produced most southern commercial species at one time or another. All seedlings have been used in research, and no formal studies on nursery soil management have been Vide. Through the years, however, certain nutritional problems have required attention. Experience with some of these problems and observations in other nurseries form the basis of this paper.

The nutrient requirements for seedlings of southern hardwoods are largely unknown, though several nursery and greenhouse tests have been made with various hardwoods, and a few recommendations have been formulated. A good deal of information has been summarized by Stoeckeler and Arneman (1960), Engstrom and Stoeckeler (1941), and Wilde and Patzer (1940), but most of it is for northern and midwestern species.

Hardwoods appear to be more exacting in their soil requirements than conifers, and they are quick to show deficiency symptoms. The most conmon deficiency symptom at the Southern Hardwoods Laboratory nursery has been seedling chlorosis.

Although chlorosis may result from drought, poor internal drainage, or extremes of temperature (Kramer and Kozlowski 1960), the most frequent cause is nutrient deficiency. In the well-fertilized nursery, chlorosis may still occur if extreme acidity or alkalinity renders the nutrients insoluble, hence unavailable. Magnesium and calcium are often unavailable in acid soils, but liming can easily correct this condition. As the soil reaction approaches alkalinity, the availability of phosphorus, iron, manganese, and other elements is reduced. "Lime-induced" chlorosis which has been a major problem in forest nurseries, particularly in the Prairie States (Stoeckeler and Arneman 1960), occurs in such circumstances. The alkalinity may be due to calcareous soils, repeated heavy fertilization, or a water source laden with salts (Engstrom and Stoeckeler 1941).

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If lack of iron is the cause, as it often is, a chelate will correct the deficiency. Foliage sprays of ferrous sulfate have done equally well on coniferous species (Korstian et al. 1921). A safer and surer step, however, is to lower the soil pH, perhaps by applying sulfuric acid, powdered soluble sulfur, ferrous sulfate, or aluminum sulfate (Stoeckeler and Arneman 1960). Ammonium sulfate and ferrous ammonium sulfate have been used successfully at the Southern Hardwoods Laboratory. In a recent test in Canada, Mullin (1964) concluded that powdered sulfur at rates of 750 or 1,500 pounds per acre was more effective than was the injection of sulfuric acid into the irrigation water or the addition of 60 cubic yards of acid peat (pH 5.0) per acre. Stoeckeler and Arneman (1960) give tables for determining the amounts of sulfur needed at various pH levels.

For reasons not completely understood, different species thrive on soils of different pH levels. A classic example is the case of soybeans and iron chlorosis. Certain varieties are able to reduce iron to the soluble ferrous form on the root surface, and these are the varieties most resistant to iron chlorosis. Internal plant metabolism is involved also, for chlorotic plants often contain iron that is precipitated in an insoluble form within the plant (Brown 1961).

That southern hardwoods may exhibit similar characteristics is suggested by their occurrence on different soils. Knowledge of such ecological differences can be of help to the nurseryman. Our present information on species occurrence is summarized in a recent paper by Broadfoot (1964), Species such as cottonwood, sycamore, pecan, and silver maple, which occur naturally on neutral to alkaline soils, may be successfully grown in nurseries without much concern about high soil pH. On the other hand, the southern oaks, the tupelos, and yellow poplar, which occur naturally on soils of neutral to acid reaction, do poorly in nursery soils with a pH above 7.0. Acidification of nursery soils to a pH of around 6.0 should be helpful to these species.

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