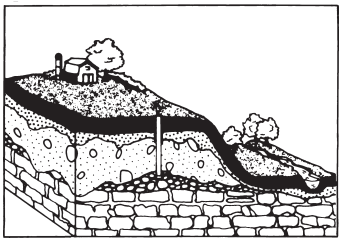

Soil Facts

Soil pH Management for Fraser Fir Christmas Tree Production

Fraser fir Christmas trees require a lower soil pH than most crops grown in North Carolina. Special management strategies for soil pH, calcium, and magnesium are needed to provide proper nutrition without over-liming.

Introduction

Fraser fir Christmas trees are native to the naturally acidic (or low-pH) soils at high elevations in North Carolina and neighboring states. They require this low-pH environment to survive and flourish, making their lime needs significantly less than that of other crops. However, some virgin mountain soils are so far down in the acidic range that several tons of lime per acre are needed to raise the pH to make growing Fraser firs possible. These virgin fields might have a pH as low as 4.0. Fraser firs need a pH of from 5.5 to 5.8. In this situation, special management strategies are required to make sure the soil is not overlimed. Additionally, the grower must take into consideration the trees' need for calcium and magnesium and the danger that overliming will produce an unintended manganese deficiency.

Raising Soil pH

The cornerstone of a good soil pH management program is soil testing. Accurate soil test recommendations for liming are not based on pH alone. Instead, a measure of the reserve acidity of the soil is needed as well as the target pH. Target pH is simply the desired pH that a liming program tries to achieve. For establishment of new Christmas tree fields (first rotation only), the target pH is 5.8; for existing fields, it is 5.5.

Liming Fraser firs demands a delicate balance, even using soil test recommendations. Lime could be needed to bring the soil pH up. It also could be needed to add calcium to prevent in-field and/or postharvest needle drop—superior needle retention being one of the hallmarks of the Fraser fir. If these doses of lime turn into overliming and send soil pH too high, it could induce a manganese deficiency and

NC STATE UNIVERSITY A&T STATE UNIVERSITY COOPERATIVE EXTENSION
Helping People Put Knowledge to Work

lead to stunted, bright yellow needles.

Calcium and Magnesium

Not only does the quantity of lime matter to Fraser firs, the type of lime—calcitic or dolomitic—also is crucial. Calcitic limes (calcium carbonate, calcium hydroxide, calcium oxide) supply only calcium, whereas dolomitic lime (calcium carbonate + magnesium carbonate) supplies both calcium and magnesium. Choosing one or the other must be weighed against the need of the field for calcium and/or magnesium. Many Fraser fir fields have begun to show a gradual increase in magnesium, possibly because of the long-term use of dolomitic lime. An excess of magnesium should be avoided in these fields as too much magnesium can displace calcium.

Soil testing will indicate whether the fields have sufficient calcium and magnesium for optimum tree growth and postharvest needle retention (calcium). On soils with a cation exchange capacity (CEC) of less than 12, a good target is for calcium to occupy 50 to 55 percent of the CEC. The target can be reduced on soils with a higher CEC. Some soils still need calcium even if pH is adequate. If pH is at or above 5.5, but calcium is below 50 to 55 percent, lime should not be applied. Another source of calcium should be used, for instance, gypsum (calcium sulfate, landplaster). Gypsum is an economical source of calcium in this situation, and unlike lime, gypsum does not change soil pH. The application rate is based on both CEC and the percentage of calcium noted in the soil test report. Suggested application rates are given in Table 1. On soils with a CEC above 8, lime normally will supply sufficient calcium. A calcium value of 45 percent is generally sufficient on soils with a CEC higher than 8.

As mentioned earlier, magnesium levels in Fraser fir fields have been gradually rising over the years. Be sure to use only calcitic lime, which has no magnesium, if magnesium is in excess of 15 percent of the CEC. Magnesium levels above 15 percent can displace calcium and should be avoided.

On the rare occasion where magnesium is needed and lime is not, 20 pounds of magnesium per acre are normally sufficient. This can be supplied by using magnesium sulfate (Epsom salt, 10 percent magnesium) at a rate of 200 pounds per acre or potassium magnesium sulfate (11 percent magnesium, 22 percent potassium) at a rate of 180 pounds per acre. Epsom salt also can be applied in a foliar spray during the growing season for a rapid response.

Lowering Soil pH

In some instances, it may be desirable to lower soil pH. Overlimed sites, old lime piles, fields with overlapping swaths from liming, or land converted from other crops may have a pH too high for optimum Fraser fir growth. In overlimed fields manganese and zinc deficiencies are often induced. Trees will exhibit stunted and yellowed foliage.

Two economical options exist for reducing soil pH. The first is to apply elemental sulfur at a rate of 150 to 200 pounds per acre (1.4 to 1.8 ounces per tree). When oxidized to sulfate by soil bacteria, acid is generated and soil pH is lowered. The second option is to use ammonium sulfate (21-0-0) as the nitrogen source until the desired pH is reached. This material can potentially neutralize the equivalent of 130 pounds of lime per 100

Table 1. Gypsum application rates (lbs/acre)

CEC	Ca% value given on soil test report									
	45	46	47	48	49	50	51	52	53	54
2.0	325	290	260	225	195	160	130	100	65	30
4.0	650	580	520	455	390	325	260	200	130	65
5.0	810	730	650	565	485	405	325	245	160	80
6.0	975	875	780	680	585	485	390	290	191	100
7.0	1135	1025	910	795	680	570	455	340	225	115
8.0	1300	1170	1035	910	780	650	520	390	260	130

NOTE: When CEC is greater than 8, recommended lime normally will supply sufficient calcium.

pounds of material. Application rates should not exceed the normal nitrogen fertilization rate. This approach may be best when a reduction of less than 1 pH unit is desired, particularly on low CEC soils. The pH reduction is provided by acid generation when the ammonium is converted to nitrate by soil bacteria, and not from the sulfate.

In extreme cases, both elemental sulfur and ammonium sulfate can be used. However, salt injury has been observed in nursery beds when both were applied together. Ideally, the two materials should not be applied at the same time. It may help minimize salt injury if the ammonium sulfate is applied at the normal time of nitrogen fertilization and the elemental sulfur is applied in the fall after trees are dormant.

Aluminum sulfate or alum is sometimes used by gardeners to lower pH. The pH reduction occurs relatively quickly. While this material is very effective in reducing pH, large-scale application is not economical.

pH Stratification

A survey of 230 Christmas tree sites showed that soil pH decreases with depth. Soil pH averaged 5.5 in the top 2 inches of soil and 5.2 in the 2- to 4-inch layer.

To assure more uniform pH throughout several inches of soil depth, incorporate the lime. However, lime must be surface-applied on most fields due to steep slopes or the presence of trees. Since lime is not very soluble, it reacts first near the soil surface, so acidity is not neutralized as rapidly below the surface. Therefore, when taking soil samples, you should be aware that the pH in the root zone of the trees may be lower than that on the surface.

Another implication of pH stratification is that some sampling methods, such as using shovels and trowels, collect more soil from the surface, where the pH is higher. To obtain the most accurate results, a soil probe should be used. Splitting the sample into 0 to 4 inches and 4 to 8 inches depths may be beneficial.

Additional Information

Agents at your county Extension center can develop a liming and fertility program for your trees based on your soil analysis results. They also will answer any questions you have about your fertility program.

Additional information on sampling Christmas tree fields for soil analysis can be found in the SoilFacts publication *Soil and Plant Analysis for Christmas Trees* (AGW-439-46). A more thorough discussion of soil acidity and liming for all crops can be found in the SoilFacts publication *Soil Acidity and Proper Lime Use* (AG-439-17). Both are available on the Internet at www.soil.ncsu.edu.

In North Carolina, soil analysis is a service of the Agronomic Division of the state Department of Agriculture and Consumer Services. For more information on submitting a soil sample, visit the Agronomic Division web site at www.agr.state.nc.us/agronomi/.

References

SoilFacts: Soil Acidity and Proper Lime Use. North Carolina Cooperative Extension Service. AG-439-17, Raleigh, N.C.

SoilFacts: Soil and Plant Analysis for Christmas Trees. North Carolina Cooperative Extension Service. AGW-439-46, Raleigh, N.C.

Christmas Trees. North Carolina Department of Agriculture and Consumer Services. Agronomic Division Note 5, Raleigh, N.C.

Prepared by
James W. Rideout, Extension Specialist
Department of Soil Science, NC State University
Jeffrey H. Owen, Area Extension Specialist
Extension Forestry, NC State University
David H. Hardy, Section Chief—Soil Testing
Agronomic Division
N.C. Department of Agriculture and Consumer Services

Published by
NORTH CAROLINA COOPERATIVE EXTENSION SERVICE

10/03—JL—E04-43937
AGW-439-52