Evaluating Christmas Tree Fertility

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Introduction

Maintaining adequate nutrition is essential in the production of high vigor, quality Christmas Trees. Tree nutrient status influences vigor, growth rate, foliage color, branch and foliage density, and perhaps needle retention. Nutrients are used to build tissues, cell components, and regulate biochemical processes. Remember that while a tree takes up nutrients from the soil and atmosphere, nutrients do not actually "feed" a plant, and fertilizers are not "plant food." Plants manufacture their "food" by photosynthesis using sunlight to convert water (taken up by the roots), and carbon dioxide (taken in through the leaves or needles) into carbohydrates (sugars). Severe nutrient deficiencies can limit photosynthesis, but soil moisture usually is the most common factor limiting plant growth.

Conifers, especially Virginia pine, are extremely efficient at extracting nutrients even from poor soils. Tree roots exploit large volumes of soil as their feeder roots grow. Roots also quickly form beneficial associations with native mycorrhizae fungi that aid in nutrient and moisture uptake. The mycorrhizal association is especially beneficial on dry, nutrient poor sites.

In general most tree crops will need little in the way of additional nutrients. Unlike annual row crops and many ornamentals that must complete their vegetative and reproductive cycles in a single growing season, where a lack of nutrients may seriously limit growth, tree crops have lower nutrient requirements. Often, fertilizer applications on productive sites may not prove beneficial as trees already have sufficient nutrients.

Evaluation

To evaluate the nutritional status of Christmas trees we use information from soil and foliar analyses. General guidelines are used to relate soil test levels to nutrient sufficiency.

Soils

Producers should be familiar with soil sampling procedures. If not, check with your county extension office for information on collecting and submitting samples. Establish a sampling protocol to monitor soil status in each distinct field that you manage. Sample before planting to determine if soil reserves are adequate, if not apply fertilizer and lime as needed and retest to establish a baseline for the field. Sample at the end of each rotation to determine changes occurring over the rotation. Again, adjust nutrient levels as necessary before replanting.

Soil results from the University of Georgia Cooperative Extension Service Soil Testing Laboratory include:

pH - a measure of how acid or basic the soil is. At pH 7.0 and greater the soil is basic. Values below 7.0 indicate acid soils. ***Recommended pH range for pine and Leyland is 5.0 - 5.5. For Redcedar 6.0 -6.5***. If pH needs to be adjusted to reach these levels a recommendation for pounds of limestone per acre will be given. If magnesium (Mg) is low, dolomitic limestone is recommended to add Mg to the soil.

[1]1996. Georgia Christmas Tree Association Tree Talk 10(2):14-23.

1998. The Entomology and Forest Resources Digital Information Work Group, College of Agricultural and Environmental Sciences and Warnell School of Forest Resources, The University of Georgia, Tifton, Georgia 31793 U.S.A. BUGWOOD 98-003
http://www.bugwood.caes.uga.edu/

Phosphorus (P) and potassium (K) are two of the most common elements we manage in the soil. The soil test report gives P and K in pounds per acre and ranks them by the fertility levels presented in Table 1.

Table 1. Phosphorus and potassium soil test recommendations for Christmas Tree production in Georgia.

	Geographic Region			
	Coastal Plain		Piedmont and Mountain	
Soil Test Rating	**Phosphorus (P)**	**Potassium (K)**	**Phosphorus (P)**	**Potassium (K)**
	lbs per acre			
Low	0 - 30	0 -60	0 -20	0 - 100
Medium	31 -60	61 - 150	21 - 40	101 - 200
High	61 - 100	151 - 250	41 - 75	201 -350
Very High	100+	250+	75+	350+

Foliar

Soil tests are most useful to determine pH and establish sufficient nutrient levels before planting, but a foliar sample is needed to determine how well the tree is utilizing the soil nutrients. As the trees flush, many of the nutrients are reallocated to newly expanding shoots and needles. The best time to sample is at the completion of each growth flush when shoots have stopped growing and needles are fully elongated. Samples can be taken during the dormant season (December - February) from the last fully expanded growth flush in the upper third of the tree crown. Samples can be submitted to your county extension office. Adequate levels of foliar nutrients are presented in Table 2.

Table 2. Levels of adequate foliar nutrients for commonly grown Christmas Tree species in Georgia. (Adapted from North Carolina State University CES)

	Christmas Tree Species	
Element	**Virginia Pine, White Pine**	**Redcedar, Leyland Cypress**
	Percent (%)	
N - Nitrogen	1.5 - 2.0	1.5 - 2.0
P - Phosphorus	0.2 - 0.6	0.2 - 0.6
K - Potassium	0.5 - 0.75	0.6 - 0.8
Ca - Calcium	0.45 - 0.75	0.6 - 0.8
Mg - Magnesium	0.1 - 0.15	0.1 - 0.15
S - Sulphur	0.08 - 0.1	0.08 - 0.1
	Parts per Million (ppm)	
Mn - Manganese	60 - 75	75 - 100
Fe - Iron	40 - 60	50 - 60
B - Boron	18 - 20	18 - 20
Cu - Copper	7-May	7-May
Zn - Zinc	20 - 30	20 - 30

The balance or ratios of foliar nutrients to one another are useful indicators of nutrient sufficiency. The ratio of P, K, Ca and Mg to N, and Fe to Mn are commonly examined. Ratios of N:P:K:CA:Mg should approximate 100:15:50:5:5 respectively. For example, P should be 15 percent of the N value; K at 50 percent of N; and Ca and Mg each at 5 percent of N. Iron (Fe) to manganese (Mn) should range from 1:1 to 1:2.

Corrective Measures

Use the soil and foliar analyses to evaluate each stand. The soil test information will provide fertilizer application rates. Also judge the overall vigor of the trees, soil drainage, insect and disease problems, weed control, which influence growth and quality.

Nitrogen

Low N can be boosted by a variety of N fertilizers. Limit total N applied to 20 pounds per acre per year. When N-P-K are low, a 5-10-15 fertilizer formulation can be used.

Phosphorus

Surface applications of P can only move into the surface inch of soil and may not reach the roots. A band of subsurface applied P at the drip line may be more effective in correcting P deficiencies in the short-term. Thirty to 40 pounds of P per acre supplied by diammonium phosphate (DAP) or triple superphosphate (TSP) applied to the soil surface will achieve some correction. The best method is application before planting to allow incorporation into the soil. Also P can be immobilized at high and low pH. Adjust soil pH to 5.5 - 6.0 to increase P availability.

Potassium

Correct with K fertilizers, if N and P are limiting, use a 5-10-15 N-P-K formulation. For K alone, potassium magnesium sulfate (0-0-22) is preferred. Potassium fertilizers can burn shallow roots if applied at high levels. Use split applications to reduce chance of injury.

pH

The pH on acid soils can be increased by limestone applications. When Mg is low, use dolomitic limestone. The soil test results will include the limestone recommendation. To lower high pH several fertilizer sources are useful. Sulphur lowers pH but acts slowly, ammonium sulfate (21% N and 23% S), triple superphosphate, and diammonium phosphate are all acid forming fertilizers that supply additional nutrients while decreasing pH. When using the N source fertilizers, limit N to 20 pounds per acre per year.

Micronutrients

The micronutrients - iron, manganese, boron, copper, and zinc generally are not found to be limiting. However, in cases where a micronutrient deficiency occurs, short-term correction can be attempted by foliar application of chelated micronutrient sprays. The waxy cuticle of conifer foliage presents a barrier to nutrient uptake. Follow carefully the fertilizer recommendations on rates and timing of application, and the use of surfactants and/or penetrants to enhance uptake. Often micronutrient problems are the result of poor overall nutrient balance and excesses in pH. Be sure to consider these factors as well.