Virginia Cooperative Extension

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Soil Test Note 23:

Christmas Tree Crops

(Supplement to Soil Test Report)

Christmas trees, like any other crop, require balanced nutrition for best health and growth. Christmas trees are unique among most crops, though, since their value is based on their aesthetic quality and not their biomass yield. In order to assure balanced nutrition, it is necessary to insure that the soil contains enough available nutrients to satisfy the trees' demands. Routine soil tests can provide this information for unplanted fields or plantations that have not been fertilized recently. Christmas tree fertilization is generally considered at the time a new crop is planted (Establishment) or periodically during the course of the rotation (Maintenance).

Soil Sampling

Correct collection of soil samples is necessary to insure that each field receives the best possible fertilizer recommendation. For best results, each field should be divided into sampling units based upon factors which will influence soil fertility or the fertilizer application. Pertinent factors include species, tree age, past management, topography (slope steepness, exposure), drainage, etc. Within each unit randomly collect soil samples of the surface 6 to 8 inches, removing grass, needles, or other organic matter from the sample. About 20 samples should be collected from each unit, thoroughly mixed in a bucket or wheelbarrow, and a small subsample placed in the sample box provided by your local extension agent. Your extension agent can provide more details.

Plantation Establishment

Soil tests prior to establishing the tree crop can be useful in determining if a nutrient deficiency is likely to occur. Also, at this time the pH of the soil can be adjusted with a lime application. This is the only time that incorporation of lime or fertilizer into the soil is possible during a tree rotation. For best results, surface-applied lime and fertilizers should be plowed or disked in to obtain adequate mixing into the surface 6 to 8 inches of soil. Without tillage, lime, phosphorus, and most micronutrients move very slowly into the tree rooting zone. Fertilizer recommendations for plantation establishment are normally made in pounds of fertilizer per acre.

Proper pH adjustment is necessary so that nutrient uptake will be adequate for each species. Optimum pH varies by species as follows:

Species	pH Range	Target pH
White, Virginia, and Scotch Pine	5.0-5.5	5.2
Fraser Fir, Hemlock, Norway Spruce	5.3-5.8	5.5
Blue Spruce, Red Cedar	6.0-6.5	6.2

If your soil test report indicates that lime should be added, the rate was recommended to raise the pH to the desired range for the species you chose. Lime rates are based on total incorporation within the surface 6 to 8 inches of soil. On established fields where lime can't be incorporated, the pH below a depth of 3 to 4 inches is not affected by liming. However, surface lime application is still somewhat beneficial, since tree feeder roots are often near the surface. Surface lime applications, without incorporation, should not exceed 2 tons/acre at any one time.

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Maintaining Soil Fertility Levels

As a Christmas tree crop matures, nutrients are moved from the soil and stored in the needles, branches, trunks, and roots of the trees. It is possible, therefore, for a nutrient deficiency to develop as the soil nutrient supply diminishes and the demand of the growing crop increases. Soil tests at intermediate points in the rotation are useful for prescribing maintenance fertilization rates.

It is important to maintain the pH in the desired range. If lime has been previously applied and not tilled in, the soil should be sampled to a depth of about 4 inches. A reapplication may be necessary.

Fertilization during the course of the rotation should take into account weed control, the rooting of the trees, and the timing of application. Fall/Spring split applications of nitrogen (N) are often applied to older trees. Spring applications about 2 weeks prior to budbreak allow for adequate movement of the fertilizer into the rooting zone. Fertilizer should be uniformly applied in 2- to 3-foot wide bands between the trees along the planted row. This method of application takes into account the typical banded weed control and the fact that tree roots commonly align with the planting slit created by mechanical planting machines. Fertilizer recommendations for maintenance are normally made in ounces of fertilizer per tree.

Major Soil Nutrients

1. Nitrogen. Nitrogen (N) is usually the most limiting nutrient to tree growth. It is important for overall health and good color development. The soil test report recommends 100 to 120 lbs/acre of N, which is the standard recommendation for soils statewide. This rate equates to one ounce of N per tree, assuming a 5 ft. x 5 ft. spacing. For establishment, N should be broadcast evenly over the entire field; but for existing trees the fertilizer should be spaced out within the weed control band along the planting row. This increases the efficiency of uptake and reduces the potential of soluble salt injury. If complete weed control is used, the N fertilizer may be applied in a 12-inch band starting at the dripline and extending outward. On small trees, fertilizer should be applied at least 12 inches from the base of the trees.

Recommended N application rates for different species and tree ages are as follows:

Tree Age (Yrs)	Species Group	Ounces of N/tree	
		Spring	Fall
1	All species	1/2	--
2	All species	1/2	--
3	Fraser fir, hemlock, Norway spruce	1/2-2/3	1/3-1/2
3	White, Virginia, Scotch pines	1/2	1/2
4	Fraser fir, hemlock, Norway spruce	2/3	1/3
4	White, Virginia, Scotch pines	1/2	1/2
5	All species	1/2	1/2

Notes: For ages older than 5, continue the 1/2-ounce split application annually until harvest. In fall of harvest year, apply 1/3 oz. of N/tree on Fraser fir, hemlock, and Norway spruce to improve color.

Different fertilizer materials contain different levels of N. For example ammonium nitrate (NH_4NO_3) has 33% N, urea has 46% N, and diammonium phosphate (DAP) has 18% N. The amount of fertilizer material that provides one ounce of N is as follows:

Fertilizer	Amount to Get 1 oz. N
Ammonium Nitrate	3.0 oz.
Urea	2.2 oz.
Diammonium Phosphate	5.5 oz.

2. Phosphorus. Phosphorus (P), like N, is also commonly limiting to tree growth. P is important in tree growth, particularly root development and budset. Therefore, it is necessary to have adequate P levels in the soil when the young seedlings are becoming established. Ideally, P should be applied prior to tree planting, and incorporated into the soil. P is not very mobile in the soil, and at low and high pH's it is bound into unavailable forms. It is best to apply lime prior to adding P, so that the adjusted pH will favor ready avail-

ability of P. If this is not possible, lime and P may be broadcast simultaneously.

P is applied as phosphate (P_2O_5) in a variety of fertilizer materials such as ground rock phosphate (GRP),

diammonium phosphate (DAP), ordinary superphosphate (OSP), and triple superphosphate (TSP). The fertilizer rate shown on the soil test report is for pounds of P_2O_5/acre for establishment, and ounces of P_2O_5 per tree for maintenance. It is necessary to determine the concentration of P_2O_5 in each fertilizer material in order to apply the correct amount.

Fertilizer	% P_2O_5	Amount to Get 1 oz. P_2O_5
Ground Rock Phosphate	34	2.9 oz.
Diammonium Phosphate	46	2.2 oz.
Ordinary Superphosphate	18	5.5 oz.
Triple Superphosphate	48	2.1 oz.

3. Potassium. Potassium (K) is important in regulating the water status of trees and helps to protect them from drought. Unlike P, K is very mobile in the soil, and it can be surface-applied. The demand for K increases during the third year following planting, and should be applied at this time. If the soil test indicates a rate of more than 100 lbs./acre, or .9 oz./tree, half should be applied in the fall and half in the spring.

K is normally applied as potash (K_2O), with muriate of potash (KCl) the primary source. KCl is 60% K_2O, so 1.7 oz. of muriate of potash will yield one ounce of K_2O. If gypsum is applied with potash, the K level in the rooting zone may decrease. K levels in the soil should be checked every two years.

4. Calcium. Calcium (Ca) is an important component of cell walls in the trees and is important structurally and in needle retention. A primary source of Ca is lime ($CaCO_3$, $CaMgCO_3$). Sometimes, however, the situation may arise where Ca is low but the pH is adequate, indicating that lime should not be added. This sometimes occurs with Fraser fir, hemlock, and Norway spruce. In this case Ca should be supplied by using gypsum ($CaSO_4$), a soluble fertilizer source. Gypsum is not a liming material, and should not substitute for lime if the pH is low.

The soil test Ca level and the soil texture are used to determine the rate of gypsum needed to add Ca. The rate of gypsum to apply for a given soil test Ca level and soil textural group may be found in the table below.

If the soil pH is low and the soil test Ca level is below 720 lbs/acre, additional Ca beyond what is supplied in the lime is needed. In this case, add 10 to 12 ounces of gypsum per tree.

5. Magnesium. Magnesium (Mg) is important in maintaining good tree color. Usually Mg levels are adequate in most soils; however, Mg may test low if gypsum is added. Mg is usually supplied through the use of dolomitic limestone, but it can also be supplied through other sources such as magnesium sulfate (10% Mg), sulfate of potash-Mg (11% Mg), and magnesium oxysulfate (36% Mg). Mg fertilizers are generally bulk-blended with other fertilizer materials to insure a uniform application. If the soil test report indicates Mg is needed, apply 20 lbs. of Mg/acre, or 0.2 oz/tree.

6. Trace Elements. Manganese (Mn), copper, (Cu), and zinc (Zn) are three micronutrients or trace elements that may influence tree quality, although deficiencies have not been found in Virginia. If you suspect these nutrients may be deficient on your farm, contact your local extension agent and inquire about soil sampling and testing. It is difficult to correct trace element deficiencies in established plantations -- the best time to solve a problem is by fertilizing at establishment. Foliar sprays have been used successfully, but must be applied each year.

Soil Textural Group	Soil Test Ca Level					
	Low		Medium		High, Very High	
	Gypsum Rate					
	lbs/a	oz/tree	lbs/ac	oz/tree	lbs/ac	oz/tree
Sandy	250	2.3	0	0	0	0
Loamy	500	4.6	250	2.3	0	0
Clayey	750	6.9	500	4.6	0	0

Explanantion of Fertilizer Rates

In this Soil Test Note and on the Soil Test Report, fertilizer recommendations are given in two ways. For establishment fertilization, the rates are given in pounds per acre, since it is assumed that the fertilizer will be broadcast over the unplanted field. For maintenance fertilization, the rates are given in ounces per tree. This assumes that each acre in the plantation has trees at a 5 ft. x 5 ft. spacing, or 1,742 trees per acre. To convert the establishment rates to ounces per tree simply involves multiplying the lbs. of fertilizer rate per acre by 16 (since there are 16 oz. in a pound), then dividing by the number of trees per acre that you have. For example, suppose your spacing is 6 ft. x 8 ft. This means you have 48 (6 x 8) square feet for each tree. There are 43,560 square feet in an acre, so you have 43,560/48 = 908 trees per acre. Let's suppose that a fertilizer recommendation is 100 lbs. of N per acre. For a 6 ft. x 8 ft. tree spacing, the maintenance rate is 1600 (100 x 16)/908 = 1.8 oz tree.

Tissue Analysis

The concept of using plant tissue to assess the nutrition of crops has been around for many years. Nutrient concentration in plant tissue can be compared to normal, expected levels, or critical levels, and fertilization recommendations can be made. Tissue analysis is especially well-adapted to assessing the nutrition of trees, especially since trees are a long-term crop and have wide-spreading root systems. Unfortunately, a tissue analysis program for trees does not exist in Virginia; however, a system is currently being developed for Fraser fir. When it is implemented, the tissue analysis system will involve collecting a needle sample from representative trees on the farm; sending the needles to a lab where they are dried, ground, weighed, and analyzed; and making a fertilizer recommendation based on the tissue nutrient levels. This system will be especially useful for maintenance fertilization.

Nursery and Line-Out Beds

Many Christmas tree growers also prefer to raise tree seedlings in nursery or line-out beds. All beds that have differing conditions such as location, soil type, drainage, etc., should be sampled separately prior to seeding. Fertilizer and lime applied prior to planting should be tilled in to a depth of 8 inches. Fertilizer recommendations on the Soil Test Report are in pounds per 400 square feet of nursery bed. Broadcast applications are best. Fertilization after the seedlings are growing should be a single spring treatment prior to bud-break. Apply fertilizer when the seedlings are dry, and broom off excess. Follow with 1/4" of irrigation water if possible. The standard N recommendation is 1.0 lb./400 square feet. Some of the common nitrogen fertilizers and the amounts necessary to apply to get 1 lb. of N/400 square feet are as follows:

Fertilizers	Pounds of Fertilizer per 400 sq. ft. to Get 1.0 lb. of N
Ammonium Nitrate	3
Calcium Nitrate	6 1/2
Ammonium Sulfate	5
Urea	2
Diammonium Phosphate	5
Sulfur-Coated Urea	2 3/4
Sulfur-Coated Complete	7 3/4

Additional Information

For more information, please see the *Christmas Tree Production Manual*, VCE Publication 420-075 (1991). Contact your local Virginia Cooperative Extension (VCE) office to learn how to purchase a copy.

Acknowledgments

This Soil Test Note is a revision of Note 12, Commercial Tree Crops, prepared in 1979 by H. L. Haney, D. Wm. Smith, and S. J. Donohue. Information was drawn freely from the North Carolina Department of Agriculture Note 5 -- *Christmas Trees, and Management of Small Fraser Fir Line-Out or Transplant Beds*, North Carolina State University Extension Publication CTN-012 (1983) by W. T. Huxster and J. S. Shelton.

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