

Fine Tune Your Fertilizer Program with Foliar Sampling

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Photo 1 – Tree with adequate nutrition showing good growth, bud set, and needle color. Credit: Bert Cregg Michigan State University

Questioning whether your trees are growing as well as they could? Foliar testing can be a powerful tool to determine nutrient status.

Some growers question their nutrient management program and wonder if it is possible to better match fertilizer inputs to tree nutrition needs. When trees have sufficient nutrients (and water) they exhibit good growth, bud density, and needle color (Photo 1). Trees that exhibit off-color needles, poor bud density, or limited growth could be suffering from a nutrient deficiency (Photo 2). However, confounding the

issue is that these symptoms may also be the result of pest damage, drought, or other stress (Photo 3). To best match tree growth and nutrient needs, a sound nutrient management program starts with soil testing (link back to earlier soil testing article). Soil testing provides key baseline information for adjusting soil pH and addressing possible nutrient deficiencies, before and during a tree rotation. However, soil testing is limiting as it does not report nitrogen status, nor does it indicate what nutrient concentrations are present in the tree. Foliar testing Christmas trees can help improve nutrient management decisions as it addresses those

unanswered questions. This article will outline all the specific information needed to successfully incorporate foliar sampling at your farm.

What is needed:

Tools that will be required for foliar testing are a hand pruner and a paper bag for collecting your sample. Sample shoots should be taken from the upper third of the tree (Photo 4), but do not collect anything from the leader. Only take samples from the current year's growth, as the previous year's shoots will have different nutrient concentrations that can alter results. Collect between 20 and 30 shoots for one sample



Photo 2 – Yellow needle color trees indicating nutrient deficiency. Credit: Bill Lindberg Michigan State University

submission (1 shoot per tree). Separate samples should be submitted for trees of different ages or species. Samples should be mailed to a diagnostic testing laboratory, indicating on submittal form that the samples are from Christmas trees and tree species grown.

When to sample:

The nutrient concentration in needles fluctuates throughout the seasons. As a result, the time of year you collect your sample can alter the results and conclusions you make. To minimize this problem, tissue sampling should be completed in the fall (October) to late winter (February). Research has shown that during this period nutrient concentrations are the most stable (Hockman et al., 1989).

Why sample:

There are several scenarios that could benefit from tissue sampling. First, consider trees that seem off color or exhibit slow growth (Photo 2). This may be the result of a nutrient deficiency. Tissue sampling can help determine what nutrient(s) are deficient relative to what we would expect to find in healthy growing trees. Keep in mind, several other problems (mites, drought, incorrect soil pH) can cause similar symptoms. In this situation it is useful to submit two different samples for comparison's sake, with a “poor” area and a “normal” area when submitting samples. Additional soil tests of the “poor” and “normal” production areas may also be useful in teasing out the cause of the problem.

Are you applying too little or too much fertilizer? The use of foliar testing can be helpful in gauging the results of your nutrient management program. There are many factors that may alter how much nutrients your trees and soil can absorb, including soil pH, soil texture, cation exchange capacity, and organic matter content. For soils that are naturally more productive (loams versus sands) excess nutrients in a foliar test can indicate that you can reduce your fertilizer rates while still producing high quality trees. Conversely, if foliar testing shows a nutrient concentration is deficient, you can correct the problem prior to a visual symptom developing.

Finally, many growers apply nitrogen in the fall of the year of harvest to improve tree color. Experiments in the Pacific Northwest tested this hypothesis.



Table 1 – Optimal Foliar Nutrient Concentrations for Fraser Fir in Midwest Region: Adapted from Rothstein and Lisuzzo, 2006 and Hart et., 2009.

Macronutrient	Symbol	Concentration (%)
Nitrogen	N	1.75
Phosphorus	P	0.20
Potassium	K	0.6
Calcium	Ca	0.4-0.6
Magnesium	Mg	0.10
Sulfur	S	0.125

Micronutrients	Symbol	Concentration (ppm)
Manganese	Mm	25-50
Zinc	Zn	10-25
Copper	Cu	3
Boron	B	15-35

Photo 3 – Discolored tree needles due to herbicide injury.
Credit: Bill Lindberg Michigan State University

Treatments included either non-treated controls or nitrogen applied at 90 lb/ acre. Subsequent foliar sampling at time of harvest showed no significant difference in nitrogen content or visual appearance between the treatments (Hart et al., 2009). Potential differences may exist between growing conditions in the Pacific Northwest and the Great Lakes region, but prior to additional nitrogen applications growers can foliar test to quantify nitrogen concentration in the needles. If sufficient levels are found, additional nitrogen applications are unlikely to improve needle color.

Interpreting results:

Analyzing results for foliar testing is not as straightforward as soil testing. One reason for this is a lack of nutrient recommendations that accompany the

results. What you will receive is a concentration value for each nutrient tested. To compare your values to “optimal” or “normal” values reference Table 1. When a nutrient is below “optimal” values, consider the following:

- What is my soil pH? The nutrient may be present in the soil at sufficient levels, however the soil pH may be limiting the ability of the plant to absorb it. This is especially true for manganese (Mn), as foliar levels of Mn decline rapidly as soil pH increases.
- Have you applied this nutrient as a fertilizer recently? As an example, surface-applied phosphorus moves extremely slowly within the soil profile (moving as little as 1” per

year). If you have surfaced applied fertilizer without incorporating, it may take a long interval for some nutrients (P, K) to work into the root zone.

- Did you have exceptional vegetative growth? Some nutrient concentrations may appear lower due to extreme amount of growth, a phenomenon referred to as ‘growth dilution’. In this situation, it is somewhat of a false alarm as the tree is not actually deficient in nutrition.
- What does the soil test indicate for this nutrient? If the soil test also indicates a deficiency, additional fertilizer is likely to be very helpful.

When a nutrient is above the “optimal” value, (table 1) consider the following questions.

- What fertilizer rates have I applied? Are these consistent with MSU or other university recommendations for Christmas trees? Follow MSU nutrient recommendations and/or reduce nutrient rates by 5-10% the following season. Continue foliar testing the following year to better match tree nutrient needs.
- What is the soil texture and organic matter content in this field? Loam and clay textured soils have greater nutrient holding capacities and may naturally supply more fertility for the tree. Additional fertilizer rates may be reduced to match tree needs. Similarly higher organic matter soils naturally release nitrogen, which may supply your trees with a percentage of the required amount. Reduce fertilizer by 5-10% and monitor with foliar testing during future years.
- Did the trees have a very poor vegetative growing year? Opposite to exceptional vegetative growth, trees that grew very little may have a false alarm as nutrients are more concentrated due to minimal growth. In this situation the tree may not have excess nutrients. Continue foliar testing in future years.

Summary:

Growers that are interested in fine-tuning nutrient management can consider adding foliar testing this fall and winter. Foliar testing can be an effective way to determine nutrient levels present in the tree and identify nutrient shortages prior to onset of visible symptoms. This technique is especially valuable during the mid to late rotation of your Christmas tree cycle.



Photo 4 – Tissue sampling current year's growth from top third of tree. Credit: Bill Lindberg Michigan State University

SOURCES:

Hockman, J., Burger, J., Smith, D. (1989). Spatial and Temporal Variability of Foliar Nutrient Levels in Fraser Fir Christmas Trees. *Forest Science*, 35(2), 632-639.

Hart, J., Landgren, C., Fletcher, R., Bondi, M., Withrow, B., Chastagner, G. (2009). Christmas Tree Nutrient Management Guide. EM 8856-E. Oregon State University.

Rothstein, D., and N. Lisuzzo. 2006. Optimal Nutrition and Diagnosis for *Abies fraseri* Christmas Trees in Michigan. NIAF 23(2) 106-113. 🌲

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7-12"	P+1	160.00	1075.00
10-18"	P+2	200.00	1550.00
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