

## **Turfgrass Tissue Analysis**

by  
Ken Clancy, P.Ag.

**TURF LINE NEWS**

**Tissue analysis is a valuable management tool. It can be used periodically to monitor plant nutritional status and to diagnose a specific nutritional disorder. In either case, it gives you the information needed to fine-tune your fertility program and grow healthier, higher quality turf. Traditional “wet chemistry” tissue analysis provides the most accurate results. In addition to soil fertility, the same cultural and environmental factors that impact turf growth also impact tissue nutrient content. Finally, tissue analysis should only be used in conjunction with soil and irrigation water analysis when determining your turf fertilizer program.**

### **Why Tissue Test?**

Tissue testing provides an unbiased, cost-effective analysis of plant nutrient status. It offers a valuable insight into the effectiveness of your fertility program while giving you the information required to fine-tune turf nutrition. The ultimate value in tissue analysis stems from its ability to assist you in growing the healthiest and highest quality turf possible.

When conducted periodically throughout the growing season, tissue analysis provides the turfgrass manager with a “moving” picture of turf nutrient status. Monitoring nutrient levels in this way is particularly valuable in the diagnosis of “hidden hunger”, a common condition that expresses no visual deficiency symptoms, but limits turf growth. This process also supplies trends in plant nutrition that enable you to enhance the efficiency of your fertility practices. For instance, the frequency of fertilizer applications may be changed in response to chronically low or high plant nitrogen levels. Or it may be found that supplemental magnesium fertilizer should be applied in response to low plant magnesium levels.

Tissue analysis can also be used to diagnose an acute nutritional deficiency. With the exception of nitrogen and phosphorous, growth limiting deficiencies of a particular nutrient are quite difficult to diagnose visually. When such a problem is suspected, tissue analysis is really the only management tool available that can provide a definitive diagnosis. It will either confirm that a nutrient deficiency is limiting plant health or it will confirm that the problem is not nutrient related. In short, it takes the guesswork out of diagnosing a nutrient deficiency.

The integrity of your tissue analysis program is critical to obtain meaningful results. When establishing a monitoring system you could test 2 to 6 greens every 2 to 4 weeks through the growing season. Make sure the same greens are tested continually and that the timing of the tests is the same in relation to your fertilizer applications. When testing for a suspected acute deficiency, compare affected plant tissue with nearby healthy plant tissue of the same turf species under the same management regime. For instance, test the tissue from both a deficient and a relatively healthy green. Objective comparison is critical when trying to diagnose a nutrient disorder.

**FUSION  
TURF NUTRITION**

PO Box 770  
Enderby, BC  
V0E 1V0

Phone: 250-838-6414  
Fax: 250-838-6968  
[www.fusionfert.com](http://www.fusionfert.com)

## **Test Methods**

The two tissue test methods popularly employed in western Canada are the traditional “wet chemistry” process and the relatively new Near Infrared Reflectance Spectroscopy (NIRS) procedure. Wet chemistry analysis determines plant nutrient content by digesting plant tissue in a very strong acid solution under strictly controlled laboratory conditions. Unlike soil test extractions that estimate nutrient availability, wet chemistry tissue analysis measures the actual nutrient levels in plant tissue. The advantage of wet chemistry is its unparalleled accuracy.

NIRS analysis estimates nutrient content by calculating differences in reflection when plant tissue is exposed to light of a specific wavelength. NIRS has two advantages - fast turn around time and reasonably accurate nitrogen estimates. The disadvantage of NIRS is that it does not offer the accuracy of wet chemistry when estimating the ten other key tissue nutrients. A 1998 study conducted on 23 Illinois golf courses concludes, “standard wet chemistry methods are more reliable indicators of serious imbalances in turfgrass nutrition than is the NIRS method”. This sentiment was also expressed by Dr. Robert Carrow, author of “Turfgrass Soil Fertility and Chemical Problems”, at the 2003 Alberta Golf Superintendents Conference.

Regardless of the test procedure you choose, unbiased test results can only be obtained with clean turf tissue. As I mentioned, wet chemistry analysis digests plant tissue in a very strong acid solution. If the sample is contaminated by a small amount of sand from a recent topdressing, or metal particles from a mower reel, the test results will be dramatically skewed. Always wash turf tissue samples with a mild dishwashing detergent and rinse them thoroughly. To avoid decomposition during transportation, dry the turf tissue and package it in a paper bag.

## **Interpretation**

The science of turfgrass tissue analysis is relatively new and different laboratories have different testing philosophies. Some labs base tissue analysis on individual turfgrass species (bentgrass, bluegrass) while others base tissue analysis on turf use (greens, fairways). Though testing for individual species may seem logical, one must keep in mind that different varieties of the same grass species inherently have different tissue nutrient concentrations. In addition, multiple turf species are often seeded together while “mono” stands are usually contaminated with other turf species. Tissue analysis in accordance with turf use not only accounts for management intensity and quality expectations; it also reflects the fact that most “bentgrass” samples are actually a combination of bentgrass and poa annua.

Nutrient levels in turfgrass tissue are also impacted by the same environmental and cultural factors that influence plant growth. For instance, an application of nitrogen fertilizer increases plant nitrogen levels, but the resulting tissue growth dilutes the level of other nutrients. Also, applying a plant growth regulator designed to inhibit tissue growth will have the opposite effect and concentrate tissue nutrient content. Changes in the weather that impact plant growth have similar effects. These factors make interpretation somewhat objective and explain why the optimum range of tissue nutrient levels is quite wide.

A tissue test will usually report primary (N,P,K) and secondary (Ca,S,Mg) nutrients in percentage terms, while reporting micronutrients (Fe,Mn,Cu,Zn,B) in parts per million due to their low concentration in plant tissue. Non plant food elements such as sodium and aluminum are sometimes also tested. The results are compared to an optimum range and are often described as excessive, high, optimum, low or deficient.

## OPTIMUM TURFGRASS TISSUE LEVELS

<i>Nutrient</i>	<i>Creeping Bentgrass</i>	<i>Perennial Ryegrass</i>	<i>General Turf</i>
N %	4.50-6.00	3.34-5.10	2.75-4.50
P %	0.30-0.60	0.35-0.55	0.3-0.55
K %	2.20-2.60	2.00-3.42	1.0-3.50
Ca %	0.50-0.75	0.25-0.51	0.5-1.25
Mg %	0.25-0.30	0.16-0.32	0.2-0.6
S %	-	0.27-0.56	0.2-0.45
Fe ppm	100-300	97-934	35-175
Mn ppm	50-100	30-73	25-150
Cu ppm	8-30	6-38	5-20
Zn ppm	25-75	14-64	20-60
B ppm	8-20	5-17	10-60
Mo ppm	-	0.5-1.00	-

Data obtained from Turfgrass Soil Fertility and Chemical Problems (Carrow, Waddington and Rieke) and MDS Harris Labs

### **Conclusion**

When should one take remedial action and apply fertilizer in response to a tissue analysis? As previously mentioned, an acute nutrient deficiency limits both plant health and plant growth. In such cases, addressing the problem with fertilizer applications should provide a visual improvement in turf quality. When a nutrient chronically tests low (but not deficient) in a monitoring program, corrective fertilizer applications will improve plant health but are unlikely to dramatically improve turf visual quality. Before taking action in response to a tissue analysis, try to determine if environmental factors or cultural practices have impacted the results.

Tissue analysis provides a “snapshot” of plant nutrient status and is the only tool at our disposal that objectively tells us how well our fertilizer program is working. However, it is not a substitute for soil analysis and it should not be used as the basis for your fertilizer program. The factors that drive tissue nutrient levels stem from the availability of nutrients in the soil, which can only be understood through regular and comprehensive soil analysis. In short, if tissue nutrient levels are the effect, soil health and nutrition is the primary cause.

Sources: Turfgrass Soil and Chemical Problems (Carrow, Waddington and Rieke), Tissue Analysis: Guidelines and NIRS Revisited (Stowell, Gelertner), Tissue Testing: Questions and Answers (USGA Green Section).

Ken Clancy is a Professional Agrologist specializing in turfgrass fertility with Fusion Turf Nutrition. He can be contacted by e-mail at [ken@fusionfert.com](mailto:ken@fusionfert.com)