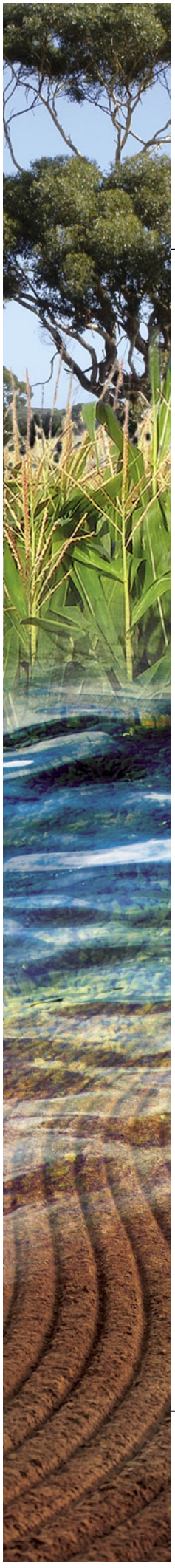

Sydney Environmental & Soil Laboratory

Specialists in Soil Chemistry, Agronomy and Contamination Assessments

Leaf Nutrient Analysis

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Leaf Nutrient Analysis

Its place in diagnosis.

Simon Leake BScAgr(HonsI) ASSSI AIAS

Our laboratory performs many more soil analyses than foliage analyses. This may appear to be as illogical as analysing a persons food in order to diagnose a medical complaint. Why, when looking at medical practice, do we analyse tissue, blood and waste products, but in amenity horticulture we more often analyse the growing substrate or soil?

There are many reasons for this including-
1. Efficient homeostatic mechanisms in living things that mean even when a plant is near death, it has a composition close to normal.
2. Difficulty in distinguishing between a real and a physiological deficiency given the many complex nutrient interactions that occur.
3. Lack of a large data base for a given species or annual range data base for a wide range of species used in the turf industry.
4. Difficulties in distinguishing nutrients in tissue from those on a leaf.

Despite these difficulties, foliage analysis can be a powerful tool, and, unless more is done we never will build up the necessary understanding of the data. The difficulty and strength of foliage analysis is best illustrated by Table 1 and Figure 2. Table 1 is a list of typical ranges for plant nutrients in the young foliage of turf grasses. It has been generalised across a number of species.

Table 1. Typical Ranges of Plant Nutrients young leafs of Turf grasses.

Element	% by dry weight
Nitrogen N	2.0-4.5
Phosphorus P	0.2-0.5
Potassium K	2.0-4.0
Calcium Ca	0.5-2.0
Magnesium Mg	0.1-0.5
Sulphur S	0.2-1.0
	ug/g dry weight
Iron Fe	100-500
Manganese Mn	30-100
Zinc	40-100
Copper Cu	5-50
Boron B	5-50
Molybdenum	1-4

Source: Adams W.A. and R.J.Gibbs 1994. *Natural Turf for Sport and Amenity.* CAB International. page 31.

Note how wide the range of some elements is in plant tissue associated with perfectly normal growth. Remember that these results have been generated by looking statistically at a wide range of plants tissue. Nowhere have I ever seen published results from known abnormal tissue results.
Turforce Pty. Ltd. has developed a test result format to assist in the interpretation of foliage data. This is shown in Figure 1. The normal ranges are a little different because they are based on the average for the commonest turf species, Bent, and Couch but this makes little difference. The results have been plotted in comparison with a "normal range envelope" which has been converted into a percentile. Thus, the centre of the range for potassium might be 2.75 and this is called 100%. The range is expressed from 90 to 110%, or 2.5 to 3.0%. This technique allows all results to be plotted on one graph. The bar chart graphically illustrates the answer.

The particular example given on the Turforce result is a good example of how tissue analysis can help when soil analysis fails. The soil in question showed fairly normal properties, pH was around 5.7, there appeared to be normal exchangeable cation levels especially potassium, but the extractable iron and manganese levels looked possibly high. It is always difficult to interpret soil trace element tests since the extracts used are acidic and extract either more or less trace element than the plant depending on a number of factors.

The foliage tests showed several things quite clearly-
1. Normal P and K levels, not surprising given the soil test results.
2. Very deficient Ca and Mg levels despite apparently adequate levels on the CEC.
3. Very over-range iron, sulphur, and manganese levels.
Putting the soil and foliage tests together with field observations the full story emerged-
1. Regular feeding with NPK fertiliser meant that the rather small CEC in a sandy rootzone was simply incapable of supplying the necessary Ca and Mg (remember that feeding with one element leads to a demand for others as growth is stimulated). It is also possible that high K input has limited Mg supply.
2. Poor drainage conditions had increased the uptake of manganese since its mobility is increased in poor aeration conditions.
3. In order to maintain greenness in the poor drainage conditions the manager had over-used iron sulphate (remember that iron can be high because of dirt contamination also).

This result then clearly illustrates an interaction between different nutrients, an interaction with physical conditions, and the deficiencies of many feeding programs. Of particular interest is Calcium. This element should be the focus of increasing research for sandy rootzone culture. In hydroponic culture calcium is the most problematic element since it has low solubility in aqueous environments, and low mobility within the plant. It has been found in hydroponics, for example, that the best way to increase calcium in the plant is not to add more to the solution but to drop the salinity of the feed solution dramatically, in doing so, growth rates overall are reduced.

In summary, foliage analysis should be performed when-
1. Soil tests have already been done.
2. Growth of grass is still not optimal despite optimal soil chemical and physical conditions.
3. Fertiliser or other kinds of comparative trials are being performed.

Taking foliage samples requires-
1. New shoot growth to be harvested. Do not include dead and thatch material.
2. Clean, sharp mower blades are acceptable if the catcher is clean and empty.
3. Otherwise use clean, sharp scissors and a sheet of paper.
4. Provide about 100gram wet weight minimum (10-20g dry weight).
5. Keep samples in the fridge until pick up and make sure they get to the laboratory within 24 hours.
6. Do not sample after foliage spraying with feed or chelated trace element solutions or spreading fertilisers. Wait at least a week to a fortnight respectively.
7. Sample only when turf is actively growing.