RADIATA MANAGEMENT TECHNICAL NOTE

Site Productivity

Number: RSPTN-001
Date: December 2010

FOLIAGE SAMPLING

Summary Foliage analysis is undertaken to determine the nutrient status of a forest crop. The purpose of this analysis is to identify the cause of a nutrient disorder or poor vigour, or to confirm a diagnosis made on the basis of plant symptoms. This report outlines sampling procedures and diagnostic guidelines for radiata pine and Douglas-fir that ensure foliar analysis results can be correctly interpreted and presented.

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Foliage Analysis

Foliage analysis is used to determine the nutrient status of a forest crop for the purpose of identifying the cause of a nutrient disorder or poor vigour, or confirming a preliminary diagnosis made on the basis of plant symptoms. Foliage analysis can be used to predict the need for fertiliser and assess the effectiveness and longevity of past fertiliser applications. Monitoring crop nutrient status over time can provide an early indication of declining nutrient status, and be used to verify that longstanding nutritional management practices are still satisfactory, or alternatively that practices should be modified. In forestry, foliage analysis is used much more than soil analysis to determine forest nutrient status and for assessing fertiliser requirements. Trees have deep root systems and are long lived, posing difficulties of where and when to take soil samples. Foliage analysis avoids these difficulties as it relies on the ability of the trees to integrate nutrient availability over the whole soil volume occupied by the tree root system as well as over time.

Sampling Strategy

A number of factors affect foliar nutrient concentrations and these must be taken into account when sampling foliage, otherwise results may be misleading. These factors include genetic variation, seasonal variation, foliage age and crown position. This means that standard sampling procedures must be rigorously followed to ensure that foliar analysis results can be correctly interpreted.

Foliage samples for radiata pine are collected from mid-February to the end of March; for Douglas-fir the recommended sampling time is from late March to mid-June. Research has shown foliar nutrient concentrations to be most stable over these periods.

Where samples are being collected to determine possible fertiliser requirements, they should be taken from about 25 trees at approximately even distances along transects located to cover the whole of the area being sampled. An alternative strategy is to take composite samples from fewer locations within the stand (but still covering and being representative of the whole stand). Each composite should consist of samples taken from a cluster of five trees. Single sampling provides better coverage of the area than cluster sampling.

If sampling is being undertaken to determine the cause of visual symptoms or of slow growth of a patch of trees, then samples from about 10 trees may be collected from trees showing the symptoms. The results can be compared with diagnostic values (see below), or with samples from healthy trees collected from the same general area.

Further points to note are:

- Samples should be collected from dominant or co-dominant trees.
- Trees with heavy cone production should be avoided because of diversion of nutrients from foliage to cones.
- Edge trees and trees near localised pollution sources (for example unpaved roads, limeworks or recent nearby aerial topdressing) should be avoided.
- Similar amounts of foliage should be collected from each tree sampled. In total a good handful should be collected.

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Sampling Procedures

For needle-leaved conifers, collect samples from current-season fully-grown foliage on the most recent second-order branches in the top third of the crown (see Figures 1 and 2).

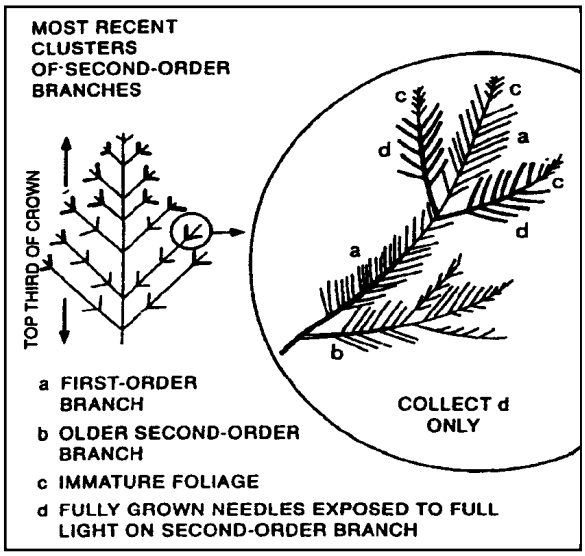

Fig. 1: For radiata pine and other needle-leaved conifers, collect mature length needles on the youngest second-order branches.

For eucalypts, sample the first fully expanded leaves of an actively growing branch in the mid-to-upper canopy. The leaves should be undamaged and exposed to full sunlight. For species that have juvenile and adult foliage, the latter is preferred.

Samples should be placed in paper or polythene bags and stored in a refrigerator, labelled and dispatched to the laboratory as soon as possible. Aim to have the laboratory receive fresh samples within 24 hours of collection or removal from a refrigerator.

Sampling Tall Trees

The method used to collect foliage samples is determined by tree height. For trees up to 6 metres in height, the samples are generally picked directly from the tree by hand. A shepherd's crook may be useful to bring branches within reach. For trees between 6 and 11 metres in height, pole-mounted cutters can be used to remove small branches. Different lengths of poles can be used for stands of different heights. For trees between 11 and 30 metres a shotgun can be used to collect samples. Use a 28 to 36 gram load of No. 5 or No. 6 shot, or, for smaller trees No. 7 shot. Ear muffs and protective glasses are essential, and for safe operation it is advisable to insert only one round. For trees over 30 metres in height samples can be collected by climbing. Trees of this height are beyond the range of a shotgun. A safety belt is essential, and will allow use of both hands for removing samples.

Figure 2: Healthy (right) and nitrogen-deficient foliage (left) of radiata pine. The mature needles towards the base of the samples should be collected for analysis.

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Diagnostic Values

Diagnostic nutrient concentrations associated with optimum or below optimum performance have been derived for many crop species. Those for our two most common plantation forest species, radiata pine and Douglas-fir, are shown in Table 1. Experience with radiata pine indicates that for phosphorus, a fertiliser response is likely if concentrations fall into either the deficient or marginal (i.e., between deficient and adequate concentrations) ranges. For nitrogen, potassium, magnesium, boron and copper, the values give a good prediction of fertiliser response if they are in the low, but not the marginal range. For the remaining nutrients, there is insufficient information and experience to confidently predict a response, even in the low range. The analytical laboratory will be able to suggest the appropriate rate and type of fertiliser to apply.

Table 1. Deficient and adequate ranges of foliar nutrient concentrations for radiata pine and Douglas-fir. Values for radiata pine are mostly from New Zealand experience updated from Will (1985)[1] (values for calcium, zinc, manganese and iron are from overseas experience); those for Douglas-fir are from North American experience.

	Radiata pine		Douglas-fir	
	Deficient Less than	Adequate More than	Deficient Less than	Adequate More than
Nitrogen (%)	1.20	1.445	1.2	1.45
Phosphorus (%)	0.10	0.13	0.08	0.15
Potassium (%)	0.30	0.50	0.35	0.80
Calcium (%)	0.10	0.10	0.10	0.25
Magnesium (%)	0.055	0.10	0.06	0.12
Sulphur (%)	/	0.12	0.12	0.14
Boron (mg/kg)	8	12	12	15
Copper (mg/kg)	2	4	1	4
Zinc (mg/kg)	10	20	9	15
Manganese (mg/kg)	10	20	4	25
Iron (mg/kg)	10	20	25	50

[1]Will G. 1985. Nutrient deficiencies and fertiliser use in New Zealand exotic forests. FRI Bulletin No. 97. Forest Research Institute, New Zealand Forest Service. 53p.

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