

Advice Sheet 13: Plant Tissue Analysis – Getting Started

Why tissue analysis?

Tissue sampling provides an accurate picture of the current nutrient status of a crop at a particular time.

Tissue analysis can be used to verify deficiency symptoms, monitor nutrient levels during the growing period to determine if the soil fertility level and applied fertilisers are sufficient to meet the crop requirement and is vital in determining the nutritional value of plant material to animals.

Tissue sampling is better suited to certain requirements than soil analysis. For example in nutrient management for grazing animals; after all it is the plant that is eaten, not the soil.

Plant tissue analysis information allows accurate treatments of nutrient disorders through foliar nutrient applications and it is also important for the early identification of mineral availability problems to grazing stock.

Why analyse plant tissue rather than soil?

This question often arises but is most easily answered when soil analyses tell you that there is plentiful supply of nutrients from the soil, but that the plant still looks unhealthy.

In the end, plant tissue analysis is the only true diagnostic of plant nutrient deficiency – it can be used to investigate or confirm nutrient deficiencies in plants. Of course what it cannot tell us is why the plant is deficient in a particular nutrient (for that we have to look at soil supply and other factors such as soil pH and plant disease).

So in summary – plant tissue analysis is an excellent tool for identifying nutrient deficiencies in plants and can be used for determining yield limiting deficiencies (typically NPK + S etc., major nutrients) and quality limiting deficiencies (trace elements or minor nutrients). Identifying these deficiencies can create significant improvements to the bottom line by increasing crop value and possibly reducing unnecessary fertiliser bills.

How to sample plants

There are three key points to consider when sampling plants for tissue analysis:

- When to sample?
- Where in the field to sample?
- What parts of the plant to sample?

When to sample

When to sample is critical – and depends to a certain extent on the type of plant and the value of the crop. Some deficiencies require early diagnosis and analysis; late in the crops growing cycle is often too late for remedial action.

There is an optimum time and this is typically when the plant is growing and setting yield potential (e.g. early/mid spring for winter cereals), still allowing for remedial action. Of course preventative action can also be achieved in following crops by later analysis.

Remember - samples should be taken before applications of fertiliser or treatment. If it is necessary to sample following an application, a minimum period of 3 weeks should pass before the tissue is sampled.

Where to sample in the field

Where to sample in the field is dependent upon the nature of the deficiency – if the deficiency is uniform throughout the field then a ‘W’ type walk through the field, sampling as you go might be appropriate. Deficiencies, however, are rarely uniform throughout the field and typically there will be areas of good growth and areas of restricted or bad growth. In these cases it is sensible to sample the good and the bad areas separately and submit them to the laboratory as two samples. You will then be able to compare analyses to determine whether the plants are deficient in the bad area, relative to the good area. If no difference exists, it probably suggests that the problem is either plant disease related or soil structure/ rooting related – a good dig around with a spade will reveal this.

What parts of the plant to sample?

Where to sample on the plant is critical – this is because some nutrients are easily moved around the plant – so that if they are in short supply any available nutrient will be moved to the young parts of the plant and deficiencies will be detected in older leaves. If the nutrient is relatively immobile in the plant then deficiencies will be detected in the young leaves first. Specific sampling instructions are listed below for a variety of crops but when these instructions are unknown then the general rule of thumb is to select the upper, recently matured leaves.

As a general rule we need about 200g of material and it is desirable to select more plants for sampling than to collect individual tissue from fewer plants.

FIELD AND VEGETABLE CROPS

Cereals – Wheat, Barley, Oats, Rye, Triticale. Sample the whole above ground portion of the plant prior to heading.

Maize – At the seedling stage all of the above ground portion is needed but prior to tasselling or from tasselling to silking sample the leaf below and opposite the ear.

Grasses – Sample leaves from upper third of the plant at best stage of quality which is generally during the active growing cycle during the Spring or Autumn flush.

Oilseed Rape – Sample the whole above ground portion of the plant before flowering.

Cabbages, Cauliflower – Sample the young mature leaf from the centre of the whorl before heading.

Alfalfa/Lucerne – Sample prior to bloom & collect mature leaf blades from the top 15cm of the plant.

Beans – At the seedling stage take all the above ground portion but the fully developed leaves at the top of the plant prior to or at initial bloom, before pod set.

Leaf Crops – Lettuce, Kale, Endive – For Young plants up to 4 weeks take the whole plant but after this stage collect the wrapper leaf at mid-growth.

Peas – Sample leaves from the 3rd to 5th nodes from the top before flowering minus the petioles.

Potatoes – Sample 3rd to 6th leaf including petiole prior to or during early bloom.

Root Crops – Beets, Carrots, Onions, Radishes, Turnips – Sample 3rd or 4th leaf from growing tip at midgrowth before root enlargement.

FRUITS AND VINES

Fruits – Raspberry, Strawberry, Blackcurrant, Redcurrant – Sample the first fully expanded leaves.

Tomato – Take the youngest mature leaves ideally prior to or during early bloom stage.

Curcubits – Cucumber, Pumpkin, Marrow, Squash – Collect the newest expanded leaf at early flowering.

Vines – Take the first fully expanded leaves which are from fruiting shoots located halfway between the ground & the highest trellis wire. Either the petiole or the leaf blade can be analysed depending on your preference. The routine analysis sample should be taken at bloom or at least 70 days after full bloom as these are the only times of the year when nutrient levels are stable. **OR** the petioles can be taken from the **youngest fully expanded leaf** (5-7th leaf from top ideally opposite a fruit cluster) at **early veraison** time (grapes starting to turn colour) typically mid to late August in UK. The petiole should be at least 3cm long and 40-50 should be taken to make a composite sample. **OR** Petioles can also be sampled at Full Bloom time although there is less clear agreement about critical levels at this earlier stage and they usually need to be higher than at Veraison.

It is also important to note that **you should not include any soil or root material in your sample** – this will contaminate the results and mask manganese deficiencies in particular. Do not sample dead or diseased plant tissue.

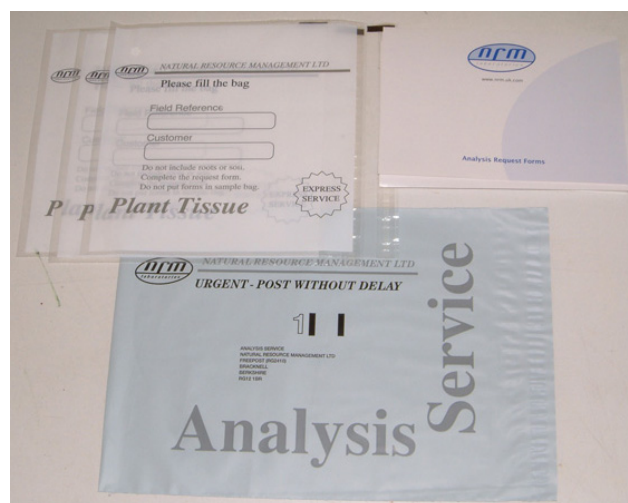
Getting samples to the laboratory

NRM provide plant tissue analysis bags suitable for this purpose. The bags are sized so that if you fill the bag it will ensure that the sample is of the correct size for analysis – anything less than this and you will limit the quality of your analysis.

Please make sure that you do not include any soil or root material or you will contaminate the sample. Try not to include excess water in the sample, give the plants a good shake before you put them in the bag and dab them with tissue if necessary.

Once you have filled the bag and written the sample name and your customer reference on it, place it in the outer, postage paid packet along with the completed analysis request form (please make sure that this is included, but don't put it in the sample bag or the plant tissue will soak it!)

The analysis request form should include all your details, the name of the sample and the type of plant. Once you have the completed package, simply put it in the post!



Getting the right analysis package

NRM have put together a handful of packages that range from a simple Nitrogen:Sulphur ratio to the plant foliar plus Molybdenum. A number of analytical procedures are required to assay for all the essential elements. Once the sample has been dried and milled Dumas is employed for the Nitrogen. A further preparation step of digestion is needed to bring the sample into a suitable form for analysis by ICPOES (Inductively Coupled Plasma Optical Emission Spectroscopy). Molybdenum however has to be run on another instrument – the ICPMS (Inductively Coupled Plasma Mass Spectrometer).

Agriculture

C008	Plant Foliar Nitrogen and Sulphur with N:S ratio
C013	Plant Foliar (N, P, K, Ca, Mg, Cu, Mn, Zn, Fe, B)
C086	Plant Foliar plus Molybdenum (N, P, K, Ca, Mg, Na, S, Mn, Cu, Zn, Fe, B, Mo)

When to expect a result and what to do with it

Once your sample has been sent to the laboratory, depending on the type of analysis requested, results should be back with you in 2-3 working days.

For the majority of common crops, the analytical report will show the analytical result, plus an indication of whether the plant is deficient, sufficient or contains toxic levels of a particular nutrient.

If a deficiency is apparent it must be decided whether it is yield/quality limiting and whether it is economical to treat your plants for this deficiency.

It may be worth checking whether this is a deficiency in the soil and whether it is caused by low or high pH.

If this is the case then remedial action needs to be taken by adding fertiliser/lime (if there is sufficient time for a response). However please bear in mind that plant nutritional diagnosis is not an exact science. For example plants require some nutrients at different times so that a deficiency might be transient. It should be remembered that elemental composition is based on the dry weight of the tissue. If growth and development is compromised in a population of plants then this may result in an increasing concentration of some elements making interpretation difficult which is why it is imperative to note the condition of the plants when they were sampled.

One final point that needs to be considered during the interpretation of the bar chart that is provided for the most common agricultural crops, is that exact break points do not exist between sufficiency and deficiency for the essential nutrients. It should be recognized that a nutrient at the lower end of the sufficiency range can be sufficient and deficient at the same concentration depending on the interaction and concentration of other nutrients in the tissue, and indeed other environmental factors such as light, rainfall, temperature and the soil nutrient status.

List of plants for which NRM can provide interpretation

For N, P, K, Mg, Ca, Mn, Cu, Na, Fe, Zn, Mo B & S

Alfalfa	Carrots	Lettuce	Oilseed Rape	Raspberries	Swede
Applies	Cauliflower	Linseed	Onions	Soya	Turnips
Barley	Chrysanthemum	Lucerne	Parsnips	Spinach	Vines
Beans	Grass	Maize	Peas	Strawberries	Wheat
Cabbage	Leeks	Oats	Potatoes	Sugar Beet	