Sampling Plant Analyses Version 3.3 7 March 2016

Analysing plants is far superior to analysing soils.

Decide why you are sampling

If testing for specific plant growth issues, such as slow growth, it is important to sample only the slow growing plants. If testing to plan lime or fertiliser applications for the whole farm, then sample at least one average paddock. If testing to diagnose visual mineral deficiencies, sample only the affected plants. Sample an average paddock, but if a farm has regular hay and/or silage paddocks, they should also be sampled and fertilised accordingly, because they may need more of some elements, especially calcium (lime) sodium and potassium.

On most older farms (those farmed in the same way for decades) where all paddocks have been fertilised with the same mix, the pastures become amazingly similar in element levels, even where soil types are slightly different. Flats and hills are always different because animals rest and lie down on flats so leave more manure there, which depletes the hills over time.

Initially, get a pasture analysis from each different soil type on the farm, then in subsequent years test different paddocks in case there are localised deficiencies. More recently developed farms are often better balanced because they usually haven't yet been over fertilised with the growth elements of N, P and K, and may not have run out of trace elements in the root zone yet. This does not apply to subsoils, sand, pumice and peat, which are likely to be low in many things.

Take about 20 representative samples from across ONE paddock.

Some areas of a farm can have high molybdenum and/or low copper, so it is no good taking a composite pasture sample from several paddocks, because a high level in one could nullify a low level one in another and not show up any deficiencies or any excesses. Therefore never collect and mix samples from around the farm. Sample a different paddock each time.

Where pasture grows for most of the year, spring and autumn sampling and fertilising are good ideas, applying more in autumn because autumn saved and winter pasture are the most valuable. Fertilising in early spring is the least profitable because surpluses can’t be carried into summer like it can into winter, so spring surpluses have to be harvested and then fed, which are costly. Growing forage crops are more profitable.

Collecting leaves for plant testing

Element levels vary in different parts of the leaves, stems and seeds. For example, leaf tips have more P, but less Ca, so if only the tips of leaves were collected P could be inaccurately high and Ca inaccurately low. Aim for an equal amount of leaves and stems.

Don't sample plants that have been fertilised or limed within two months, because the full effects of the application will not have risen in the plants and there could still be some on the leaves. Don't sample plants that have been grazed within two weeks, because there could still be some urine on the leaves. Choose an average paddock ready to graze to get what the animals will eat.

Avoid pollution from soil, dust, mud splashes and mud from hooves on pasture. They all have minerals which will increase and distort the plant figures, which are in percentages and ppm.

Collect complete leaves and stems of the green growing grass (not just leaf tips) that you choose, from about 5 cm (2 inches) above the soil. Ryegrass is best if possible. Don’t do mixed pasture. They are inaccurate because the percentages of each are hard to get exact.

Don’t collect from near manure or urine patches, or within 30 metres of gateways, troughs or dust affected areas such as lanes or roads, or from areas affected by anything different. Don't collect leaves that are damaged in any way from severe frost, wind, insects, etc. Samples can be taken after a light frost has completely thawed.

It is essential to have clean hands, so wash them, but not in an animal’s drinking trough because it can contain dirt or added minerals. After washing your hands or applying gloves, don’t wipe your brow (perspiration) or any part of your body with your collecting hand and don’t touch soil, galvanised gates or wire. Cut a few handfuls and rub them onto your hand, to remove perspiration (sodium), then throw them away. Some people have to always wear clean gloves to avoid sodium pollution from heavily perspiring hands getting into the sample.

Hold the bag under one arm, hold and cut the leaves off with clean scissors and remove old dead grass and soiled material. Look for pieces of soil and discard them.

Scissors are difficult to use with only two hands, so a helper holding the bag makes it faster. Don't use rusty or dirty scissors and keep them clean. Cutting enables you to get exactly what the animals are eating by to at the grazing height of about five centimetres (2 inches).

Remove all the pieces of dead grass like the one I left to show you. There should be no clover, no flowers or seeds and not a single speck of dirt or soil.

Place the sample in a clean paper bag or re use an old clean, A4 envelope. Don't use plastic bags because they can give off minerals and cause pasture sweating, leading to incorrect results. Some laboratories supply plastic bags with holes in them. Be careful with them. Placing a filled bag on the seat of a farm vehicle has caused dust and dirt to enter through the holes, and caused high iron, cobalt and manganese levels. Avoid clover too, because pure grass is more accurate. See the far left of the free Pasture Mineral Analysis spreadsheet to see the wide variations - clover Ca 1.3% and ryegrass 0.8%, cocksfoot (orchard grass) 0.5% Ca, so we must know which grass the sample is to be accurate against the optimum figure.

Many pasture plant results I've seen with iron (Fe) levels at above 100 show that some don't know how to collect samples without polluting them with soil. Fe of greater than 100 in a pasture analysis indicates soil contamination. Don't collect down to ground level like a scientist did with scissors, because it polluted his samples (Fe 1,300 and another 900!!). He then complained that pasture plant testing is inaccurate, when it was his collection method that was inaccurate.

This will help you sample plants correctly for analysing before liming or fertilising & after.

Collect a double handful of ryegrass with clean scissors and hands in a clean A4 envelope, of grazing height 15 to 20 cm (6 to 8 inches) ryegrass stems and leaves. Mixed pasture is not accurate so should not be done. Get the sample from 20 places around one paddock, avoiding gateways, water troughs, dung and urine areas. Avoid getting soil in the sample because it increases some mineral levels falsely. Do a sample from each different soil type.

Copy and paste the following to Word or Pages then delete the instructions in brackets, adjust the rest and copy and paste it until the page is full, then print copies to be cut up and glued, taped or stapled onto each A4 envelope.

The cost to GrazingInfo members for measuring the 15 minerals is only $110.00.

If another is sampled, e.g., Cocksfoot, name it on its A4 envelope.

We suggest doing a ryegrass sample before summer dry weather which makes it impossible to get a sample until after autumn rains, so you then can't apply lime or fertilise until the rush, when the delivery and application delays can take them into the wet winter weather soils.

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To: Hill Laboratories, 1 Clyde St, Hamilton. 3216.

From - (Delete this after typing your name, address, phone and post code here.)

Ryegrass sample - (Delete this after typing the paddock name or number here.)

Please analyse as requested by Vaughan Jones, and copy the

results to him at support@grazinginfo.com

The cost to GrazingInfo members for measuring the 15 minerals is only $110.00.

If another is sampled, e.g., Cocksfoot, name it on its A4 envelope.

We suggest doing a ryegrass sample soon, before summer dry weather makes it impossible to get a sample until after autumn rains, so you can't then apply lime or fertilise until the rush, when the delivery and application delays can take them into the wet winter weather soils.

Accuracy

Leaf tests are much more accurate than soil tests so they take the guess work out of nutrient management and allow accurate and cost effective fertiliser programmes for improved soil, pasture and animal health, and budgeting for the future.

Pasture analyses measure percentages and some in milligrams per gram (mg/g), which is by weight and close to parts per million. One mg/g is one gram per tonne, or one-tenth of a teaspoon per tonne, or one kg per thousand tonnes, so cleanliness and accuracy are essential. To get figures that can be used to achieve the known optimum figures, samples must be from plants that are green and growing at close to normal rates, not slow and not fast, as in early spring, or after applying N. However, in emergencies, taken at any time is better than none and better than soil testing.

The Pasture Minerals Analysis spreadsheet has the optimum levels for most pasture species. Copy and paste the one required from those on the left to the Optimums column which is set for 100% ryegrass, cocksfoot, etc., and label the sample clearly so they can see what grass it is. Their figures all vary, so I need to know which it is. Send 200 grams of green weight to the laboratory. Ryegrass leaves have lower levels of calcium than the stems so include both by sampling 25 cm (10 inches) or taller grass.

How much?

Let surface moisture dry off the sample by spreading the leaves on a clean surface. When dry, shake them as you pick them up to get rid of any soil that may be on them from previous pugging or dust. Weigh 200 grams, or estimate it which is a heaped double handful of grass to go to the laboratory.

On each A4 paper envelope record your name, phone number and address with post code, and the paddock number or name. If you are sending to Hill Lab ask to analyse pasture leaves as done by Vaughan Jones and email results to him, and write "Category Grass, Ryegrass" or whatever leaves they are. Leave the bag open until sending. Tightly packed leaves will heat and deteriorate. Refrigerating helps preserve them, but never freeze them.

If sending to other laboratories, write down the minerals to be tested, and my email address to email me Vaughan@GrazingInfo.com

If sending pasture that will take more than a day or two to get to the lab, dry it first. Air-dry the samples in clean trays or on clean paper in a warm, dry dust-free environment for a few days, or in an oven at about 80° C (180° F) with the fan going for 12 hours, or in a microwave in 2 or 3 minute bursts on high, finishing it at the lowest setting (defrost) to avoid charring. Any charred pasture must be discarded. Never freeze the sample.

DON'T send pasture from outside of New Zealand without an import permit because it will be destroyed at the point of entry to NZ. Ph +64-7-858-2000 or email HillLab <asl@rjhill.co.nz> for the paperwork necessary before sending samples to them from overseas.

What to get and from which lab

If your usual lab is not able to analyse the 17 essential elements, i.e., Nitrogen N, Phosphorus P, Potassium K, Sulphur S, Calcium Ca, Magnesium Mg, Sodium Na, Iron Fe, Manganese Mn, Zinc Zn, Copper Cu, Boron B, Molybdenum Mo, Cobalt Co, Selenium Se, and Iodine I.

Send the pasture to Hill Laboratories Ltd, 1 Clyde St, Private Bag 3205, Hamilton, New Zealand. Phone +64 7 858 2000. Fax +64 7 858 2001.

Ask Hills to analyse pasture leaves "as done by Vaughan Jones and to email the results to him". There is no extra charge for this, they don't charge to email me a copy. However, other Lab's don't know me and you will need to list the 17 essential elements above for them to analyse. Write this clearly on the outside of the envelope. A list of laboratories is at the end.

Reading Pasture Samples

When the results are emailed to you, download the Pasture Analysis spreadsheet from www.grazinginfo.com and enter your results in the yellow cells. This spreadsheet shows the optimum pasture levels and the effects if too low or too high. When you get more pasture analysis figures enter them all into the Pasture Records spreadsheet for long-term results and planning.

Next is to calculate fertiliser requirements. Use the Phosphate Nutrient Planner (if you are low in P) or Lime Nutrient Planner (if low in Ca), which are in the 60 spreadsheets obtainable for NZ$230 including GST from www.grazinginfo.com The spreadsheets are unique, and include useful farming software information. If you want more information, check the Index to see a list of Spreadsheets and read Testimonials > Spreadsheets.

These two Nutrient Planner spreadsheets have instructions on how to work out how much to apply of each element. It can look complicated at first, but you only need enter details into the yellow cells. If unsure, either do your best and email it to us to check at no charge first time if you have bought the spreadsheets, or you can phone and we can do it together, or ask me to do it. I must have your animal type, pasture analysis and area (ha) to apply to do so.

When reading a pasture analysis, first check whether it is for sheep or other animals, because most breeds of sheep need copper levels of around 8 mg/g, while cattle need it at about 13 mg/g, which level can be toxic for some breeds of sheep. Then look at the date it was taken, because element levels vary slightly with soil moisture and the seasons. Relate it to the soil moisture and weather at the time rather than to the actual season, because winters can extend into spring when springs are late, and springs can extend into summer and grow grass like that normally grown in spring. Seasonal pasture herbage levels are shown on the right of the Pasture Mineral Analyses spreadsheet.

The next thing to look at is the iron content, because, if it is high (above 120 mg/g) it indicates that the pasture sample may have been contaminated with soil, which means that the cobalt level will read higher than actual, and manganese and aluminium could also be higher than actual, depending on the soil type and condition.

Next look at the nitrogen figure, which indicates the speed of growth of the pasture. 4.5% indicates optimum growth when moisture levels are adequate. Higher N indicates faster growth, which could mean that too much artificial N was applied, which will temporarily lower the levels of some elements. High N could also indicate that short, lush very fast growing pasture was sampled.

When making fertiliser decisions from the results, remember that Ca is the most important element in a grass and clover pasture. It should be 0.8% in ryegrass. See Pasture Analysis for others. P is an important growth element. Mg levels are lower in young sappy pasture, but increase with maturity. Also, old leaves from very slow growing pasture can have a high P level, and at seeding many leaf levels decrease as the elements move to the seed because the leaves have finished their job and are ready to die. Seeding pasture should not be sampled.

Plant analysis vs soil analysis

Soil analyses are a waste of time and money, and are costly because of the wrong advice based on soils only. They give no accurate or useful information for complete fertilising and about what the animals are eating. Using soil analyses, advisers repeatedly recommend more phosphorus and potassium than needed, which suits fertiliser companies and the agricultural consultants who get up to $12 per tonne commission for recommending it. Commissions to consultants is illegal in Australia and should be in NZ. The soil test's recommended calcium levels are usually lower than needed, which also suits fertiliser companies and discourages the application of lime with its synergisms. The pH of a soil test is affected by moisture, organic matter, high potassium and high sodium, not solely by calcium. Those using soil tests add complicated measurements that cause arguments between them. Soil sulphur measurements have not been accurate so the measuring systems have been changed.

Over recent centuries, humus and minor mineral levels in many farmed soils have decreased, due to -

- Farming (mining or depleting) the top 20 cm of soils, with very few deep rooting trees to drop their high mineral leaves as happened over millions of years, but obviously can't continue over all areas, but can be done along fence lines as in these on Greenhill Road, Puketaha. These are Lombardy poplars in spring, and on the right with dropped leaves in winter, letting the sun in. I analysed the ryegrass under the trees and found them to be higher in most minerals. Trees like these make more rain in summer. Read Drought.


- Farmers applying LimePlus at GrazingInfo recommended rates increase earthworms then topsoil depth so have pasture roots going down 40 cm, healthier animals with no facial eczema because earthworms increase and eat all the thatch (dead grass at the base of pastures) that facial eczema spores breed in. Read Minerals > Calcium and read Animal Health > Facial Eczema.

Before farmers cleared the original forests in North America and bush in NZ to sow crops for harvesting or pastures for grazing, the trees brought up many minerals we don't know about and dropped them in leaves, which were then incorporated into the soil by decomposition and earthworms. However, even soils under trees, forests or bush, have some deficiencies that can only be identified accurately by plant analysing. No soils anywhere in the world have the correct balance of minerals to allow plants, livestock or humans to thrive perfectly.

Burning the trees added some minerals for crops, but the Waikato when first settled in about 1870 got only two years of wheat before the crops failed, so farmers changed to pastures and grazing animals. Fertilisers as we now know them were not available then.

Plants get carbon (C), oxygen (O) and hydrogen (H) from the atmosphere. Other elements come from the soil.

Pasture optimum mineral levels

Look at the spreadsheet called Pasture Minerals Analysis of ryegrass and others on the left of the free spreadsheet called Pasture Mineral Analysis. It is free because it is so important for all to use. There is no other like it that I know of anywhere in the world, despite being first written in 1990.

Cattle should normally graze to no lower than 5 cm (2 inches) so why measure below that?

Sampling very short pasture (less than 10 cm high), so that only leaf tips of about 5 cm long are collected, will give higher Ca and P levels than actual, so don't do it, or if you have to, allow for it. Collect what the animals eat when grazing correctly saved pasture of about 2,800 kg of dry matter per hectare.

For best results, grasses should be growing normally, and preferably 25 cm tall. Sample grass only because if mixed with clover, the ratio can be inaccurate and we won't know the exact percentages so won't know what to aim for. See the Pasture Mineral Analysis spreadsheet and the columns D to W on the left, and the differences of Ca and Mg levels between clovers at 1.3% and grasses at about half that. Ryegrass Ca should be 0.8%.

It is best to sample in late spring or late autumn, after rains have made pasture grow at normal rates. Variations between seasons are not high. See page 7. If urgent, test at any time of the year. The Pasture Mineral Analysis spreadsheet shows the slight seasonal variations under Spring, Summer, Autumn and Winter in columns AL to AO.

One analysis I saw had an impossibly high zinc figure, showing that the sampler (a CPAg Member of the Institute of Professional Soil Scientists), must have held a new galvanised gate before collecting the pasture. The most soil polluted, so wrong, pasture plant figures I've seen were done by scientists. Farmers are more practical.

Some overseas graziers get analyses of pasture dry matter (DM), crude protein, fibre (ADF) and total digestible nutrients (TDN). This is almost never done in New Zealand because there is little use in getting these measured, when you can see or do your own DM analysis by weighing, drying and weighing again. Also, with grazing levels can't be adjusted, as is done with TMR or feeding of concentrates.

Crude protein is the pasture nitrogen figure multiplied by 6.25. Our Pasture Mineral Analysis spreadsheet enters protein automatically. Low N indicates slow growth or old, dry pasture. Digestible fibre and TDN relate to the species and its speed and stage of growth. High TDN occurs when pasture is at the right stage of growth. Monitoring meat and milk production per hectare or per acre tells the TDN

in a more useful way.

Analysing clover only

Some scientists have said that you can only measure boron accurately in clovers. This is incorrect, as is a tremendous amount of information from some scientists. See Leaf Minerals Analyses spreadsheet for the optimum levels in most varieties. They are from Column 1 up, on the left of the main part of the spreadsheet.

Ratios

Some people recommend ratios between minerals, however, ratios can be useless. If both are too low or too high, but the actual ratio is perfect (say 1 to 1, when 1 should be much higher), so the ratio is not of any use. It is better to aim for correct levels of each element in each pasture type. See the Pasture Minerals Analysis spreadsheet.

Crop and tree leaves can also be analysed

Some Laboratories have the optimum levels for most plants and trees, and can supply information on how to collect the leaves. Ask them to send you the instructions on collecting what you need to collect.

Excesses and deficiencies

See the Spreadsheet > Leaf Mineral Analysis for full details.

Laboratories that do pasture mineral analyses are below, but not all do the 15 essential elements that Hills do.

Ignore all laboratory recommended mineral levels. Use those the farm proven ones in Leaf Mineral Analysis.

New Zealand

Hill Laboratories Ltd
1 Clyde St
Private Bag 3205
Hamilton,
New Zealand.
Phone +64 7 858 2000.
Fax +64 7 858 2001
mail@hill-labs.co.nz
www.hill-laboratories.com

Hills do 17 elements including aluminium, but not all Labs do.
Farmers from many countries below and even from Japan, send pasture to Hill Lab. Contact Hills for importing forms.

Australia

SWEP Laboratories
Keysborough, Victoria
Ph 61 3 9701 6007
services@swep.com.au

Environmental Analysis Laboratory (EAL)
PO Box 5125
East Lismore NSW 2480
Ph 61 2 6620 3678
glancast@scu.edu.au

APAL (Australian Perry Agricultural Laboratory)
PO Box 327

Magill SA 5072
Ph 61 8 8332 0199
apal@picknowl.com.au

Incitec Pivot Limited
Market Development Agronomist: Pasture
Mobile 0407 737 457
Fax 03 5662 2932
<allan.fletcher@incitecpivot.com.au>

Symbio Alliance.
44 Brandle Street
Eight Mile Plains,
Queensland, 4113
Ph 07 33405700
Fax 07 32190333
admin@symbioalliance.com.au

Canada
Water Science, R. R. #3, Brussels, Ontario, N0G 1H0
Stratford Agri Analysis. Ph 1-800-323-9089. info@stratfordagri.ca

USA
International Ag Labs Inc
Box 788
Fairmont
MN 56031
USA
Ph 507-235-6909. Fax 507-235-9155.
Their soil tests and optimums are based on USA soils so don't apply to New Zealand's acid soils.

Agri Energy Resources
21417 1950 E St
Princeton Ill 61356
USA
Ph 815-872-1190

Fescue Toxicity Diagnostic Center
Department of Botany
Plant Pathology and Microbiology
Auburn University, Alabama 36849

Fescue Endophyte Testing Service
Plant Industry Division, Seed Section
North Carolina Department of Agriculture
PO Box 27647
Raleigh, NC 27611
Phone 919/733-3930

I know of others, but some try to promote theirs to be better than they are.