SOIL TEST VARIABILITY

Introduction

It is well known that soil test variability can be quite high, as shown in Table 1 below, which shows results from trials carried out by Edmeades *et al* for the tests most commonly carried out by farmers.

Table 1: Typical variability in laboratory soil tests*

Soil Test	Variability (%)
pH	2—5
Ca	10—15
K	20—30
Mg	10—15
Olsen P	15—20
Sulphate-S	20—40

Source: Edmeades, D.C.; Cornforth, I.S.; Wheeler, D.M. 1985. N Z Fertiliser Journal.

This means, for instance, that an Olsen P result of 20 is most likely to be somewhere between 16 and 24; or a pH result of 6.0 probably lies between 5.8 and 6.2 - due to the sum of laboratory and field-sampling variation.

Soil test variability can be attributed to temporal, spatial and laboratory variation i.e. changes with time, space or analytical conditions.

Since analytical methods in the laboratory are tightly controlled this area of variation is in fact very small when compared to the changes in soil in the field over time and space. Aspects of **temporal variation** are discussed in a separate technical note “Seasonal and Environmental Effects on Soil Test Results”: please view on the publications page of our website www.hill-laboratories.com.

Sample depth is one aspect of spatial variability that must be considered. Typically soil nutrients are highest in the topmost fraction of the soil for uncultivated soils, as shown in Table 2, where an investigative exercise which analysed soil samples taken at different depths gave these results.

Table 2: Example of change in nutrients with soil depth (uncultivated soil)

Soil Depth	pH	Olsen P (mg/L)	Calcium (MAF Units)
0-1”	7.0	60	20
1-2”	6.2	24	10
2-3”	5.8	9	6
3-4”	5.7	7	4
4-5”	5.6	4	3
5-6”	5.6	2	3
Effect of Sampling Depth			
0-3” (0-75mm)	**6.3**	**31**	**12**
0-6” (0-150mm)	**5.9**	**18**	**8**

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Hill Labs reports sample depth on the test report (if this has been supplied by the customer on the analysis request form) so that results can be interpreted in the correct terms of reference. For example, the convention for pasture soil is to sample at 0-75mm (0-3”) and for cropping soils 0-150mm (0-6”). Medium range histograms on reports have values based on this sampling regime, so sample depths different to these will mean altered interpretation in most cases.
The reporting of sample depth is also critical when tests for contaminants such as Cadmium (Cd) and Copper (Cu) are carried out – any regulatory values must also describe what sample depth these apply to.

Spatial variability is also attributable to such factors as slope, change in soil type, compaction, uneven return of dung and urine and variation in previous fertiliser spreading. This will mean within-paddock variability as well as between-paddock variability. The sampling protocol chosen will be reflected in the result data; either as mean values from combined sub-samples representing an area, or for intensive studies from individual sample points.

Sampling

Collecting an adequate number of soil plugs is very important to reduce the variability across the sampled area. Collecting samples from a marked transect (identified by painted fenceposts or GPS) is advised. For hill country, a recommended sampling protocol would be to identify three representative paddocks within a block and mark a 100m transect in each on a mid-slope area. Collect ten cores from each transect and combine into one sample bag for testing. i.e. thirty plugs.
The full value in soil testing comes from repeat samplings over several years and graphing the results as trendlines to monitor mean levels and adjust fertiliser inputs where needed.

Soil sampling for fertiliser decisions has traditionally been done by dividing farms up into representative blocks and then applying “blanket” rates of fertiliser to those blocks. More recently, studies are highlighting considerable paddock variability that represents lost opportunity (where nutrients lower than optimum) or environmental risk (where nutrients higher than optimum). Hill Labs All Paddock Testing (APT) package has been created to allow farmers to benchmark the nutrient status of each paddock – to ensure efficient use of fertiliser and to ensure their “block” definition is an accurate monitor. Contact the laboratory for further information.

Please refer also to the companion Technical Note “Seasonal and Environmental Effects on Soil Test Results” that discusses some aspects of temporal variability affecting results.

References

1. *Edmeades, D.C.; Cornforth, I.S.; Wheeler, D.M. Getting maximum benefit from soil testing.NZ Fertiliser Journal 1985*
2. *Morton, J.D.; Baird, D.B.; Manning, M.J. A soil sampling protocol to minimise the spatial variability in soil test values in NZ hill country. New Zealand Journal of Agricultural Research, 2000. Vol 43: 367-375*