20 JUL 2016

Ministry for Primary Industries
Manatū Ahu Matua

OIA16-0322

Rachel Coburn
C/- fyi.org.nz

Dear Rachel Coburn

OFFICIAL INFORMATION ACT REQUEST

I refer to your official information request on 27 June 2016 asking for:

- *Total annual expenditure by the Ministry for Primary Industries on the Overseer program development and management.*
- *The origin of the Ministry of Agriculture and Forestry quick test calculations that are derived from standard units and an explanation as to their use.*

The Ministry for Primary Industries and its predecessor, the Ministry of Agriculture and Forestry, has provided annual funding for Overseer programme development and management since 2008. Pre-2008 ad hoc funding was provided dating back to 1996. Please see annual funding breakdown below:

2008/09	$500,000
2009/10	$500,000
2010/11	$500,000
2011/12	$500,000
2012/13	$628,170
2013/14	$507,626
2014/15	$843,766
2015/16	$1,076,008

The Ministry for Primary Industries does not hold any information on the origin of the quick test calculations. During the 1980's parts of the Ministry of Agriculture and Fisheries were restructured into Crown Research Institutes. Therefore, AgResearch may hold further information. The National Library of New Zealand may also hold relevant material. Attached is a copy of Aglink 2/1000/11/80 Soils and Fertilisers, Soil Analysis' Interpretation ; I.S. Cornforth, that might be helpful.

Yours sincerely

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The Plant and Analytical Chemistry Group of the Soil and Plant Research Station at Ruakura analyse soil samples for MAF research scientists and advisory officers based in the North Island.

This AgLink lists the services available and describes recommended methods of sampling, sample preparation, analysis and the interpretation of results. Continuing research by MAF scientists will doubtless result in changes to some of the methods and interpretational standards, so that periodical revision will be necessary.

Soil testing

Soil tests describe some of the basic characteristics of a soil (pH, mechanical analysis, cation exchange capacity), measure reserves of nutrients available to plants (Olsen phosphate and Quick Test cations) and assess ways in which the soil will react with added fertiliser nutrients (P retention, cation exchange capacity).

Soil pH and estimates of available P, K, Mg and Ca are measured in all samples received. Samples for farm advisory purposes may also receive P retention and soluble salt analysis on request. Analyses available for research samples include exchangeable cations and cation exchange capacity (CEC), total C and N, mineral N and mechanical analysis.

Soil sampling

Area to be sampled

- Divide the farm into areas with similar soil types, land use and topography.
- Collect separate samples for the major variations in soil type, topography, fertiliser history, management, stock or crop treatments.
- Each sample must represent a reasonably uniform area.
- Ignore small areas not typical of the paddock.

Number of samples

The more samples the better. As a general rule, take at least one sample for each 10% of the farm in each uniform area. For example, if the farm consists of approximately 50% of soil type A on hilly land, 30% of soil B under permanent pasture on flat land and 20% of soil B under maize, take a minimum of 5, 3 and 2 samples from each respective area.

Taking the sample

- One sample should consist of at least 15 individual cores.
- Cores must be taken to a depth of 75 mm in pasture and 150 mm in arable land. Check the position of the sampler collar. Cores which break off shorter than the correct length must be discarded. Cores shorter than 75 mm will give high test results for pasture while longer cores will give low results. Empty the cores from the sampler one at a time.
- Take cores at a regularly paced grid throughout the area to be sampled.
- Do not sample near water troughs, gates, races, headlands, trees, dung or urine spots, abnormally wet or dry areas or areas with abnormal fertility.
- Do not sample within 2 months of applying fertiliser or lime. (NB: pH could be affected by lime particles for up to 6 months.)
- Sample well in advance of planned top-dressing dates. Test results are despatched 10—14 days after samples have been received, but postal delays may extend to 3 weeks the period between sampling and receiving the results.

Soils and Fertilisers Soil Analysis

Interpretation

Sampling errors

Soil testing is not an exact science, especially in grazed pastures where the irregular return of dung and urine makes soil fertility very variable. Errors are due to sampling, analysis and calibration. Analytical errors are minimised by careful laboratory hygiene and by the repeated analysis of check samples with each batch processed. Sampling errors are much greater than laboratory errors. They can be minimised by following the guidelines given above and by taking more than one sample from apparently uniform areas of the farm.

Table 1 gives 90% confidence limits for mean test values for 1, 2, 3 and 4 samples. These confidence limits mean that, for an analysed value of 10 for the various nutrient tests, the true values for the pasture sampled will be within the limits shown in 9 cases out of 10. Confidence limits will be wider apart for laboratory values greater than 10. The relationship between laboratory values and 'true' values for the means of 1, 2 and 3 separate samples is shown in Figure 1.

Table 1: Errors in soil testing as 90% confidence limits for one to four soil samples representing grazed pasture (calculated from data supplied by A. G. Sinclair). Ranges for tests other than pH refer to test values of 10.

Soil test	*Number of samples taken*			
	1	2	3	4
pH	± 2.9	± .19	± .16	± .15
Ca	8.4—12.0	8.9—11.3	9.1—11.1	9.2—11.0
K	6.3—16.7	7.6—14.4	8.0—13.7	8.2—12.0
P (Olsen)	7.4—13.9	8.3—12.6	8.6—12.1	8.1—12.0
Mg	8.4—12.1	8.9—11.4	9.1—11.2	9.2—11.1
SO_4—S	6.3—16.8	7.6—14.5	8.0—13.7	8.2—13.4

Table 1 and Figure 1 show that, although sampling errors are considerable, they can be decreased by taking more than one sample. Even if two paddocks on a farm appear similar and receive the same amount of fertiliser, it is better to sample them separately than to bulk cores from each paddock and submit a single sample for analysis. This is because two separate samples will decrease both sampling and laboratory errors and will help to confirm whether the two paddocks are in fact similar. If this is so it will provide a more precise estimate of their nutrient status and hence fertiliser requirements than would a single bulked sample.

aglink 2/1000/11/80 : AST 8
1st revise

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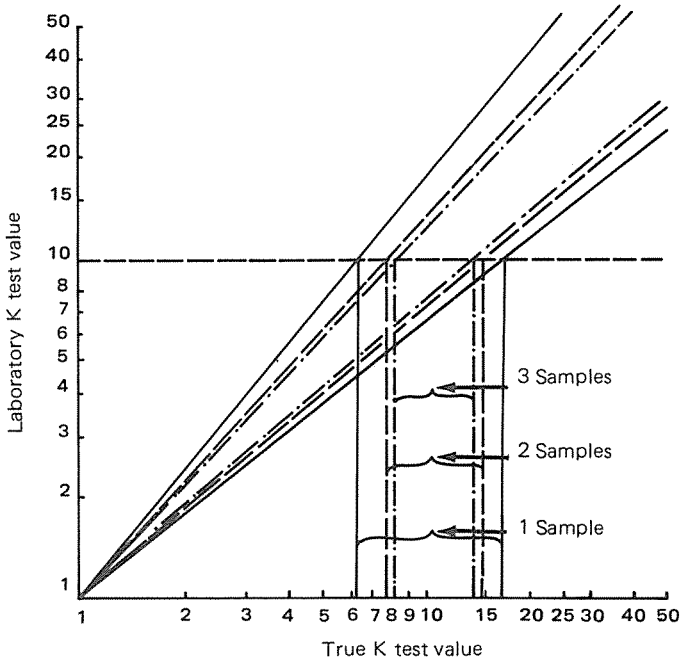

Fig. 1: 90% confidence limits for soil K tests.

Interpretation

Sampling errors in Table 1 are large, but do not invalidate soil testing. They simply mean that precautions must be taken when interpreting results. Small differences between samples taken from different paddocks or in successive years have little significance. Soil testing results put a soil into one of three or four categories or test ranges. Results on the boundaries of a range are inconclusive as the soil might be in one category or the next. However, interpretation of the various categories is usually based on the probability of getting a response to added fertiliser; soils in a 'low' category will almost certainly respond to fertiliser while those in a 'high' category almost certainly will not respond.

There is more doubt about the chances of getting a response for soils in the 'medium' category. Thus the value and precision of soil testing is greatest for soils with extremes of fertility, either very low or very high values.

Soil test nutrient ranges are given in Table 2.

Table 2. Soil test nutrient ranges.

	V-low	*Low*	*Medium*	*High*
Olsen P				
Rainfall >1000 mm				
Autumn	0–10	11–20	21–30	> 30
Spring	–	–	0–20	> 20
Rainfall <1000 mm				
Autumn	–	–	0–20	> 20
Spring	–	–	0–10	> 10
Quick test K	0–4	5–6	7–8	> 8
Mg	–	0–3	4–10	> 10
Sulphate S	0–4	5–10	11–15	> 15
P retention	–	0–30	31–85	86–100

Conversion of soil test units

Soil quick test results are reported in empirical units. This is partly for simplicity and partly to prevent users assuming that the tests extract a particular chemical fraction of soil nutrients. For example, quick-test cations are closely related to exchangeable cations, but the method used does not extract exchangeable cations quantitatively. Soil quick tests are done on measured volumes of soil, rather than on weighed amounts of soil. This is done partly for convenience and partly because some authorities claim that samples analysed on a volume basis give better estimates of plant availability (Mehlich 1973).

These two facts mean that quick test results cannot be easily converted into units used by other testing laboratories. Table 3 gives units used for Ruakura quick test results and factors for converting these results into other units. Conversion to ppm of extract or to kg nutrient in the top 75 mm/ha are accurate. Conversion to ppm soil and to m.e. per 100 g soil are approximate as they assume that all soil samples have a bulk density of 1.

Soil test methods used at Ruakura

Sample preparation: All samples are dried in a current of warm air (33–35°C) for 18 hours before being ground through 2 mm round hole stainless steel sieves.

Soil pH: A suspension of 12 ml soil and 25 ml distilled water is prepared and allowed to stand overnight at 20°C. After briefly stirring the suspensions, the pH is read using a combined glass-calomel electrode and a direct reading digital pH meter. Readings are taken as soon as steady values are obtained, approximately 10–20 seconds after immersing the electrode. The electrode is rinsed after each sample. The pH meter is calibrated with buffer solutions at pH 4.00 and 6.50.

"Quick Test" calcium, potassium and magnesium: 4.4 ml of 2 mm air dry soil are shaken with 20 ml of normal, neutral ammonium acetate for 2 minutes in 50 ml conical flasks. The flasks are held horizontally in a reciprocating shaker with a 15 cm stroke operating at 120 complete strokes per minute.

Filtered extracts are analysed with a three-channel flame photometer which uses flame emission for Ca and K and atomic absorption for Mg (Clinton 1967). The instrument is calibrated to read directly in "Quick Test" units (cf. Table 3 for units and conversion factors).

Available phosphate: The method used is modified from Olsen *et al.* (1954). Four ml<2 mm air dry soil are extracted for 30 minutes with 80 ml 0.5M sodium bicarbonate solution at pH 8.5. The extraction takes place in 110 ml plastic centrifuge tubes on an end-over-end shaker at 45 revs per minute. Phosphate concentrations in the filtered extract are determined with an Autoanalyser Mark II system using modifications of the phosphomolybdate method proposed by Watanabe and Olsen (1965) and Murphy and Riley (1962). Units and conversion factors are in Table 3.

Phosphate retention (Saunders 1965) Five g of 2 mm air dry soil are shaken with 25 ml of a buffered phosphate

Table 3: Units used for Ruakura soil quick test results and factors for converting to other units.

Ruakura quick test	*Ca*	*K*	*Mg*	*P*
g/yml extract	y = 40 000	y = 250 000	y = 1 000 000	y = 20 000 000
ppm solution	Ca x 25	K x 4	Mg x 1	P x 0.05
ppm soil*	Ca x 125	K x 20	Mg x 5	P x 1
kg/ha 75 mm	Ca x 85.227	K x 13.6	Mg x 3.4	P x 0.75
m.e./100 g soil*	Ca x 0.625	K x 0.0513	Mg x 0.042	–

Ca, K, Mg and P refer to results for these elements reported by Ruakura

*Approximate conversions assuming constant soil bulk density.

solution for 16 hours on an end-over-end shaker (45 revs/min). The filtered extract is diluted (0.15/10) with a solution containing ammonium molybdate, ammonium metavanadate and nitric acid and the resulting colour measured with a spectrophotometer operating at a wavelength of 420 m.

The buffered phosphate solution contains 1000 ppm P as KH_2PO_4 in 0.1M sodium acetate and 0.1M acetic acid and has a pH of 4.65. Phosphate retention is expressed as the amount of P retained by the soil as a percentage of that in the initial buffered solution.

Soluble salts: The method used for measuring soluble salt content depends on the source of the sample:

- Agricultural samples, 10 g soil plus 50 ml deionised water.
- Horticultural samples, 20 g soil plus 50 ml saturated calcium sulphate solution.
- Mushroom composts, 5 g compost plus 50 ml saturated calcium sulphate.

Suspensions are shaken in 100 ml Erlenmeyer flasks for 1 hour on a reciprocating shaker. After being allowed to settle for a few minutes, supernatant extracts are decanted into a glass tube and their conductivity measured in millisiemens.

The temperatures of the suspensions are recorded at the start, mid-way through and at the end of each set of samples to obtain average values during the period conductivity is being measured.

Results are calculated as:

- H_20 extracts (1:5 ratio)
  % Soluble salts (SS) = 0.3 Kt x ft
- Saturated gypsum extracts (1:2.5 ratio)
  % SS = 0.15 Kt x ft – (0.33-c)
- Mushroom composts (saturated gypsum 1:10 ratio)
  % SS = 0.6 Kt x ft – (1.32-c)

Where:

- Kt = conductivity in millisiemens (milli mhos/cm)
- ft = temperature correction factor
- c = correction factor to convert results to a soil solution basis.

References

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