agKnowledge
TNM™ "Total Nutrient Management"
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THE Fertiliser Review
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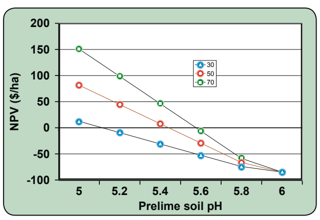
Liming Hill Country – is it Economic?

As discussed elsewhere in The Fertiliser Review No 6, there are many biological reactions that acidify the soil, which means that over long periods of time (20-50 yrs) soil pH levels will drop. This problem can be simply and economically managed by liming, if the topography allows groundspreading. But flying lime onto Hill Country is more problematic. Many hill country farms have never been limed, and what was reasonably good country 20-30 years ago with soil pH levels around 5.5 now has pH levels around 5.2-5.3. Without lime inputs the pH levels will continue to fall.

The question arises: given current prices is it economic to lime hill country and what is the economic optimum pH? There is the secondary question: what are the important factors that determine the economics of liming.

Lets assume we are dealing with a typical sheep & beef farm on a steepland soil carrying 10 SU/ha. Assume also that lime costs $18/tonne, transport is $10/tonne and aerial application at 1.25 tonnes/ha (0.5 ton/ac) is a further $40 /tonne. For any given starting pH (ie prelime pH), the costs (lime, transport and spreading) and the benefits (increase in pasture production and hence animal production) of liming, at a particular rate can be determined. From this information the net dollar benefits (or losses) of liming can be determined over the duration of the lime response and from this the Net Present Value (NPV) of liming can be calculated. The NPV, put crudely, is the net profit per hectare from liming, after all costs are deducted and expressed in todays dollar terms - it is the bit left over that goes into your pocket!

The figure below shows how the profitability of liming (I have used the rate of application of 1.25 tonnes/ha in this example because higher rates are always less profitable when aerial application is required) is affected by the prelime pH (from 5 to 6) and the stock gross margin ($30, $50 and $70 per stock unit).



The first point to note is that the NPV decreases as the prelime pH increases. This is because the higher the pH the lower the pasture and animal response to liming and hence, the smaller the benefits of liming. The second obvious point is that liming becomes more profitable the higher the gross margin per stock unit. In other words the more profit per animal the greater the financial benefit from liming.

At a prelime pH of 5.0 the profit from liming ranges from about $10/ha at a GM of $30/su to $150/ha at a GM of $70/su. At a pH of about 5.1 the profit from liming is zero if the GM is $30/su. This then is the economic optimal soil pH if the GM is low. For a GM of $70 the economic optimal pH is around 5.6.

I guess that most hill country farmers are operating between these extremes at present and those on easier more productive country may well be doing better. If for example you have a GM of $50/su and the soil pH is about 5.2 then you could reasonably expect a profit of about $50/ha from liming. Not a bad return I suggest?

But before making the decision I would advise:

1. Get you consultant to do a full cost benefit analysis for your farm. The big drivers of the profitability of liming - GM, SR and initial soil pH - can vary considerably from farm to farm.
2. Consider your priorities. The benefits, in terms of increased production and profitability, from correcting nutrient deficiencies, particularly P and S, are generally much greater than can be achieved by liming. Get the basic soil fertility right before liming.
3. Ignore the advertising hype and salesmen who claim that a small amount of lime slurry (about 50-60 kg lime/ha) can do the same job as a normal input of ground limestone. They are defying chemistry and wasting your money.

FLEE, CLOVER, FLEA! A NITROGEN DILEMMA

The article ' Nitrogen fertiliser – a need for caution' in the last Fertiliser Review prompted some interesting comment. At the extreme, one farmer asked (and I paraphrase): the clover flea, and possibly other pests, are hammering my pastures, why not forget the clover and go to an all grass plus fertiliser N system? It is a good question and I do not profess to have the answers. But here are some, I hope, useful comments:

1. The N inputs into a clover-based pasture are self regulating. The more stress that is applied to the clover the less N is added to the soil (via clover symbiotic N fixation) and the more the soil becomes N deficient – but - the more N deficient the soil the more the clover flourishes (it does not need soil N, unlike grasses, to grow). The more it flourishes the more N is added to the soils. This is why the clover content of pasture changes on a cyclical pattern.

The size of the pest population, and hence the damage from pasture pests, is also cyclical. They build up, do their thing, and when the 'food' is gone, move on (a bit like some specific types of fertiliser salesmen!). During their active-damage stage they will reduce the amount of clover growth and hence N inputs of atmospheric N. The soil will become more N deficient and hence, when the flea flees, the clover will flourish with vengeance returning the soil to its 'pre-flea' N status.

The point is this - the system, the clover / grass system, is self compensating. All it requires is patience, or as Grandma might say, 'leave well alone'. To which I add, manage 'well' well.

2. Compare the nutrient inputs required for an all-grass pasture system with that required for a clover-grass system. The Table below gives the nutrient inputs to maintain a clover-based pasture on a typical dairy farm in the Waikato, producing 12,000 kg DM/ha/yr and compares these with the inputs required on an all-grass- fertiliser N pasture in Britain, producing a similar amount of DM.

System	Required nutrient inputs (kg/ha/yr)			
	N	P	K	S
NZ: clover based pasture	50	30-40	50-60	20-30
British: all grass system[1]	300-400	10-12	50-60	10-12

Notes: 1) from MAFF (Britain) Fertiliser Recommendations

An all-grass system requires less P and S, because grasses have a lower nutrient requirement than clovers. In this example the savings in terms of the reduced inputs of these nutrients represents about $20/ha/yr. But this is more than offset by the cost of the additional fertiliser N required on an all grass system (about $200/ha). This is a further example of the fact that it costs about 2-3 cents to produce a kg of clover-grass DM, but about 10-12 cents for a kg of all-grass pasture DM.

3 Consider that clover has a higher nutritional value than grasses and that milk production and animal growth rates increase with increasing clover content of the pasture.

4 Finally, ponder these numbers: The total input of N into the NZ pastoral farming system is estimated to be about 3.6 m tonnes of N per year. This comes from the N fixation by the clover (90%) and fertiliser N (about 10%). If this entire N input was valued on the basis that fertiliser N cost 70 cents/kg then in dollar terms it can be valued at $2.4 b! If this was added to our production costs how competitive would our agricultural products be on the world market?

My personal view is that NZ must recommit itself to the clover-based pasture system and pour as much research money as possible into developing more productive legumes which are efficient N fixers and are resistance to pest attacks. Such research should go hand in hand with developing biological control agents against these pests. If I ruled the research world that would be my number one priority because it goes to the heart of our competitive advantage.

WHY SOILS BECOME ACID

Over long periods of time (20-50 years) the pH of productive, healthy pastoral soils declines and in the last Fertiliser Review (No 5) it was concluded that fertilisers only make only a minor contribution to this acidity. What then is the primary source of this acidity and can it be minimised?

The soil/plant/animal system looks very complex when examined in terms of all the many, many individual chemical, biochemical and biological reactions taking place. We can simplify much of this by remembering that if the farming system was completely closed, with no net inputs or outputs the net effect of this multitude of reactions would be zero – there would be no net acidification But a productive farming system is not closed. There are 'losses'. Product is removed from the farm (ie milk, animals, hay silage, cereal crop etc). Plant material and nutrients are moved to unproductive areas on the farm as animal excreta, representing a net loss from the productive area. Additionally, nutrients, particularly nitrate N, is leached and lost from the farm. Finally some plant material accumulates in the soil as organic matter. As far as the soil is concerned this also adds acid.

According to recent research at Agresearch, Invermay, we can condense all this detail into three primary sources of net soil acidification.

These are:

- Accumulation of soil organic matter,
- Removal of plant material (either as products or as excreta from the farm or to non-productive areas on the farm,
- Nitrate leaching.

They calculated, for a typical high producing pasture, that the amount of lime required to neutralise the acidity from these three sources was roughly equivalent to the application of about 300 to 400 kg pure limestone per hectare per year. This is in reasonable agreement, given all the assumptions that are necessary, with the established practice of applying 2.5 tonnes of lime every 3–8 years depending on rainfall.

What is interesting is that removal of plant material and nitrate leaching contribute equally to acidification and account for about 80% of the total. Organic matter accumulation is the next most important source of acidity and on this scale of things, fertiliser have a minimal impact. I emphasis this point because fertilisers are frequently blamed as the cause of soil acidification! Do not believe it.

What can be done about acidification? In a word very little. To be economically viable product must be sent from the farm. Also the accumulation of organic matter in soils is good for maintaining soil quality. So apart from liming (see article in this issue), all that can be done it to minimise nitrate leaching and the transfer of plant material and excreta to non-production areas.

One final thought. The amounts of lime to neutralise acidity in NZ pastures is between 200 to 800 kg limestone per hectare per year, depending on the level of production, the amounts of plant material removed and the rate of organic matter accumulation. Compare these inputs with the advice offered by some proprietary fertiliser companies, such as Mainland Minerals, to apply 50-70 kg lime per hectare per year as lime slurry. Such advice defies chemistry and logic.

SCRIPT FERTILISERS AND FERTMARK

Recall an article that appeared in The Fertiliser Review No 2 about Prescription Fertilisers, sometimes referred to as Script Fertilisers. It was reported that this company had recommended the application of 20 kg/ha of Prescription Fertiliser on a Northland dairy farm. This would have supplied about 3, 2, and 2 kg P, K S respectively, worth about $5 through normal retail outlets, at an on ground cost of $128/ha! It was concluded that this was a very expensive way to buy nutrients and that the product when used as recommended would have little practical effect on soil nutrient levels or pasture production.

Much to my surprise Script Fertilisers announced in October 2000 that it had applied for, and was granted, FERTMARK registration. I raised this matter in writing with the Executive Director of FERTMARK, asking how could it be that a product such as this could receive the FERTMARK tick of approval.

In reply the Executive Director stated: “FERTMARK does no give any guarantee about the agronomic effectiveness of a fertiliser when used according to the manufacturers recommendation. The function of FERTMARK is to give a quality assurance that in a FERTMARK registered fertiliser, the stated nutrient levels are correct and consistently maintained to those levels.”

I take this to mean that FERTMARK’s sole concern is that a fertiliser is true to label in terms of its nutrient content. Whether the product works when applied as recommended appears to be irrelevant as far as FERTMARK is concerned. Could this mean, I wondered, that a completely inert material like sand could technically be registered under FERTMARK providing the stated nutrient levels were consistent with the registered nutrient levels?

The Executive Director did add however that: “The other area where FERTMARK takes an interest is when claims are made for specific properties of a fertiliser, and when no technical substantiation for those claims is given. The FERTMARK Code of Conduct requires that all claims abide by the Advertising Standards Authority Codes of Practice. I take this to mean that FERTMARK may take action against a FERTMARK registered product if the claims made for the product cannot be substantiated.

Fair enough I thought – I will watch the advertising. Sure enough the NZ Farmer (Feb 15 2000) carries an advertisement for Script Fertiliser under the banner “Increase production – save money! Spread lime and fertiliser together”.

As pointed out in The Fertiliser Review No2 this product when used as recommended would not save money or increase production! So I have written to the Executive Director of FERTMARK once again, pointing out this fact! I will keep you informed.

I do hope that my concerns are taken seriously. FERTMARK is a good scheme but it must be rigorous and robust if it is to fulfil it purpose – to protect the interests of the farmer. Fertilisers are a unique consumer product – you can’t take them back if you don’t like them or they did not work as claimed! They are a major cost for the individual farmer and they are a vital input into NZ’s largest industry, pastoral farming. A good, robust and rigorous QA scheme is essential. There should be no thought of second best!

SCIENTIFIC V OBSERVATIONAL TRIALS

A correspondent has asked, what is the difference.

You have all heard the results from opinion polls – the popularity of Politician A slipped from 30% down to 25%, with a margin of error of +/- 3. The margin of error is due to the ‘background noise’ and is a measure of the certainty or accuracy in the numbers.

We do the same in agricultural research and report results like; Fertiliser A gave a 10% (+/- 4%) response in pasture production relative to a control, a nil treatment. In other words because of the background noise, in our case due to biological variability, the response may have been 14% or 6% but the most probable response was 10%.

The more times the treatment (ie the comparison of fertiliser A and a control) is repeated (ie replicated) the more accurate the experiment and the more confidence can be given to the result. Typically, in NZ field fertiliser research 4 replicates would be a minimum and 10 would be adequate, but the exact number will depend on other considerations. Obviously if an experiment is not replicated there is no way of knowing how reliable the result.

Another problem arises particularly in fertiliser trials, because soils are not uniform - frequently there can be an unseen nutrient gradient, or a gradient of some other soil factor, such as the depth of topsoil, which affects pasture growth, running across the experimental area. Imagine doing an experiment, say comparing a known fertiliser like super with an unknown new product. You know about the need for replication and so you set up your experiment with 10 replicated plots with super and 10 with the new fertiliser product. What would happen to the results if, unknown to you, the 10 super plots were at the low fertility end of the paddock and the other 10 plots, treated with the new product, were at the high fertility end of the a nutrient gradient. We would say the experiment was biased. The simplest way to overcome this problem is to randomise the treatments so that the plots with different treatments are all mixed up along the gradient.

In a nutshell then, a scientifically designed trial is one which is replicated and randomised. Compare this with what are frequently called observational or demonstration “trials.” Such trials are normally set up by companies who have already determined, from replicated and randomised trials, that their products work. They simply want to show farmers the effect. These trials are seldom replicated or randomised. Often a paddock will be divided into two and one half treated while the other half remains the control. Or if there are several treatments they will be applied to strips down the paddock. Another variant is to treat two adjacent paddocks on the assumption that they were the identical to begin with.

Whichever variant is used, such trials are not replicated and randomised. This is so even if frequent measurements were made from the treated and untreated areas, because it is the treatments, not the measurements, which must be replicated and randomised. It follows therefore that the results from such ‘trials’ cannot and should not be taken as evidence that a product is having an effect. The results from such trials may be consistent with those from a replicated and randomised trial but, on their own, they are not proof that a product is having an effect.

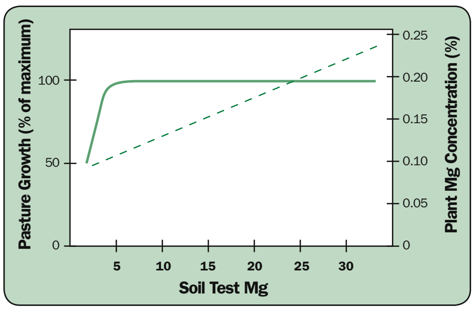
The trials I mentioned in The Fertiliser Review No 5, conducted by Massey University on behalf of Fluid Fertilisers are, as far as I can determine, not replicated and randomised and if so, are not scientific trials. The results should not be taken as proof that the liquid fertiliser Reaction works. Indeed the results from these observational trials are inconsistent with those from properly designed scientific trials and therefore should be set aside. For these reasons it is my opinion that it is inappropriate for the company concerned to continue to use these results in its advertising.

MAGNESIUM REVISITED

A number of correspondents have sought clarification on some issues related to magnesium.

Issue 1: Why are there 2 target ranges for soil Mg?

The target ranges for soil Mg are often given as 8-10, for pasture production, and 25-30, for animal health. With reference to the figure below, as the soil Mg status increases from 0, pasture production (the solid line) increases. At a Mg level of about 5 the pasture has sufficient Mg for maximum production and therefore further increases in soil Mg have no further effect on yield. Thus, erring on the safe side and bearing in mind variability etc, the Mg level for optimal pasture growth has been set at 8-10.



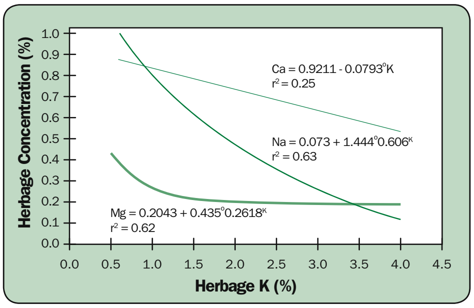
However, the concentration of Mg in pasture growing on a soil with Mg 8-10, is about 0.10 to 0.12%. While this is adequate for the plant, it is too low to meet the requirements for dairy cow in late pregnancy and early lactation. The cows Mg intake must be supplemented by drenching in order to avoid hypomagneasemia.

The alternative is to apply more fertiliser Mg because, despite the fact that the plant no longer need more Mg, it will nevertheless take up more Mg if it is around. Mike O'Connor at Ruakura showed that if high rates of fertiliser Mg are applied, (100 kg Mg/ha or 200 kg causmag/ha) the pasture Mg concentration can be pushed up to over 0.2% in spring time and that this is sufficient to greatly reduce the incidence of hypomagneseamia, although not eliminate it entirely. If these inputs of Mg were applied the soil Mg levels would be in the range 25-30 and the effect on plant Mg would last for several years.

Is it economic? Yes, but only recommended for the high producing farmer who has got everything else right on the farm or those who hate drenching!

Issue 2: How real and important is the effect of potash on depressing pasture Mg

This topic has just been re-examined by Jeff Morton (Agresearch, Invermay). They summarised data from many field trials from throughout NZ and came up with some interesting relationships showing how pasture Mg, Ca and Na levels changed with increasing pasture K levels (see figure below).



Several conclusions can be drawn from these results:

- As pasture K levels increase (ie as more potash is applied) the concentration of Ca, Mg and Na in the pasture decreases.
- This effect is much greater for Na and least for Mg.
- Once the pasture K concentration is above about 2% further increases in plant K (ie further additions of potash) have no further effect on plant Mg.

I interpret this data to mean that the effect of potash on depressing pasture Mg is much overstated – generally it is of minor importance. This is especially so given that for optimal growth the pasture K concentrations will generally be over 2% (ie on the flat part of the curve above).

There are of course specific situations, such as in spring on some soils in some climatic situations where the pasture Mg is low to begin with (ie less than 0.15%) where this minor effect of potash will be enough to exacerbate Mg deficiency in lactating animals. In these situations potash applications should be made as late as possible in the spring, certainly after the herd is settled in to the new season.

The only way of knowing whether these unique circumstances apply to your farm is to regularly monitor pasture nutrient levels during the spring. So if in doubt, monitor, monitor, monitor.

! MAXICROP

How many of you saw the advertisements for this product on TV during the Sydney Olympics? I also understand it is being widely promoted on radio. I was not amused. This company was told in 1987 by the highest court in the land that its product did not and cannot work. Personally I had put my scientifc career on the line asserting the right of science to expose these useless products.

So on your behalf I have made a formal complaint to the Advertising Standards Complaints Board regarding this recent spate of advertising.
I will keep you all posted on the outcome.

YOUR QUERIES...

Do you have a topic, a product or issue relating to fertilisers that you would like discussed in **'The Fertiliser Review'**?

Please contact us:

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PRICE WATCH: PHOSPHORUS FERTILISERS

Since the last PriceWatch on phosphate fertilisers (The Fertiliser Review No 3) both BOP and Ravensdown have made price adjustments. The Table below compares the major phosphate fertilisers based on current prices.

Product	Brand name	Company	Indicative price ($/tonne)[1]	Cost ($/kg P)[2]
Superphosphate	SuperTen	BOP	184	1.42
	Not applicable	Ravensdown	175	1.43
Triple superphosphate	Not applicable	BOP	485	2.34
	Not applicable	Ravensdown	481	2.34
DAP	Not applicable	BOP	525	1.79
	Not applicable	Ravensdown	519	1.76
RPR	Ben Guerir	BOP	198	1.58
	Ben Guerir	Ravensdown	202	1.55
Triple super mixes	SuperPlus (0,14.5,0,6.3)	BOP	325	2.07
	TSP/S-super (0,12.8,0,15)		304	1.90

Notes:
1) ex works exclusive of GST
2) after deducting the value of the other nutrients (S, @ $0.40/kg and N @ $0.92/kg)
3) for the RPRs this is the cost per unit total P. The cost per unit available P will be higher than indicated

The following points are relevant:

- There is very little difference between the two companies in fertiliser P prices on a cost per kg P basis.
- Superphosphate and its derivatives are currently the cheapest forms of P.
- DAP and triple super are the most expensive forms of P.