agKnowledge
TNM™ "Total Nutrient Management"
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HAVE YOUR PASTURES GOT THE POX?

Do your pastures look like this with very prominent growth around the dung and urine patches and very poor growth, particularly clover growth, in between? Do your pastures, apart from the excreta patches, look yellow/brownish and have a high weed loading – particularly flat weeds? This prominent patchiness is due to underlying nutrient deficiencies, most likely P, K or S. I call them Indian pastures –"very a'patchy"! I see them every day and I do not even need to get out of my car!

Clover has a higher requirement for all nutrients relative to grasses and dung and urine are rich in N, P, K and S. Hence if the pasture, and in particular the clover, is growing more vigorously around in the excreta patches, it is a good indication that the soil is deficient in one or a combination of these nutrients.

Such pastures look hungry and their yellowish colouring suggests N deficiency - indeed such pastures will respond vigorously to fertiliser N because they are N deficient. But they are N deficient because the clover is not growing because it is starved of P, K or S. Thus, the temptation to apply more fertiliser N is only covering up the problem. In effect you are replacing a cheap source of N (clover N) with an expensive source of N (fertiliser N). Production costs go up but production stays the same. The farm becomes less efficient.

In such cases be wary of accepting the soil test results as 'gospel'. One soil core from a dung or urine patch can seriously distort the results and hence it is essential when soil testing to avoid all dung and urine patches. This is a trap for the inexperienced – many have been the times when I have thrown away soil test results which do not reflect the symptoms I see with my eyes. But I have been lucky – I was taught by a master to 'read' pastures and I insist with my staff that they 'ground-proof' all soil test information.

Don't believe me – then give us a call.

THE ORGANIC MOVEMENT – ITS ORIGINS

Sir Albert Howard is regarded as the father of the organic movement. He published several treatises one called "Farming and Gardening for Health and for Disease (The Soil and Health)", published in 1945, which is very similar in its contents to an earlier paper, "An Agricultural Testament" published in 1943.

To understand the origins of the organic movement we must go back a little further. Prior to von Leibig (1803-1873), the accepted wisdom was that plants must take up some vital ingredient from the soil – this life giving substance was referred to as humus. It was thought that humus from the soil gave plants their life force. Understandably in the context of their times, people attributed a god given – a spiritual – quality to humus. Conceptually this was analogous to the idea that came from the Greeks that life consisted of four essential life-giving 'elements' – earth, water, air and fire.

Leibig was an organic chemist by training and made many contributions to our understanding of organic molecules. Later in life, in the 1830-1840s, he turned his mind to the question: what makes plants grow? He demonstrated by experimentation, chemical analysis and logical reasoning that the humus theory was not correct. Specifically, he showed that the carbon in plants came from the atmosphere. We now call this process photosynthesis. The plant breathes in carbon dioxide, 'captures' the carbon for its growth and breaths out oxygen. It is the vital and reverse process to the respiration in animals. His conclusions were challenging and understandably controversial, like all new ideas – think of Copernicus and the sun-centred 'world' or Rutherford and the dividable atom or Einstein's relativity..

Leibig also made many other important contributions to the early understanding of plant nutrition. He showed that plants needed what we now call nutrients, such as N, P and K and recommended acidulated bones as a source of P and plant ashes or compost and animal excreta as a source of the other nutrients. He, incorrectly as it turned out, thought that plants got their N from the rain. Most controversially, he argued that these nutrients need not be applied as organic materials but as inorganic salts – we would call them chemicals. Adherents of the organic school, as did Sir Albert Howard, referred to them pejoratively as 'artificials', and still do to this day.

Taking this further, Leibig made 'artificial' fertilizers and these were tested by scientists at Rothamsted, in England, the first major 'modern' agricultural research institute. The products were failures -they did not improve plant growth. The English scientists found that only the application of nitrogen fertilizer was effective on their soils.

Leibig went back to the drawing board. He found that the source of potash (K) in his fertilizer was not plant available. This could be a plausible reason for the English results – one nutrient was in effect missing. Furthermore, he reasoned that his fertilizer did not work on the English soils because, apart from nitrogen, they already had plenty of the other essential nutrients. From this he deduced his (our), quite correctly described as famous, law of the minimum: plant growth will be limited by the one nutrient which is most limiting. This law, like all scientific theories, is in essence true today and needs only to be modified by subsequent research and understanding.

For example, we now know that plants need 16 nutrients to complete their growth cycle. Leibig, like others at the time, knew of only a few of these. Nevertheless, his law applies to all 16 nutrients – if one is missing the plant will not complete its growth cycle. Also, it was not appreciated in Leibig's time that there were some plants – legumes – which sourced their nitrogen, not from the soil, but from the atmosphere via a symbiotic bacteria called rhizobia.

Also, at that time, the contribution that soil organic matter makes to soil fertility was not known. We now understand and appreciate that soil organic matter is a store of nutrients, particularly for N, P and S. It is also a source of these nutrients for plant growth via the microbial process we call mineralization. And, just as importantly, soil organic matter improves soil structure and the ability of the soil to store moisture. All of these things were however known in the early 1900s. In the more general sense the importance of (but not the reason for) soil organic matter (humus), and recycling of plant wastes (composting) and animal and human wastes back to the soil, had been known for centuries and is retold in many old texts.

Sir Albert Howard had worked in India as an agricultural advisor and he taught the Indians to make compost from animal and plant 'wastes'. Not surprisingly, returning this compost to impoverished soils had a remarkable effect on soil productivity and the quality of the soils and its produce. To the scientists of the day this was totally understandable. Composting is simply a biological, as distinct from a chemical, process for concentrating nutrients – all the nutrients present in the original materials including the trace elements - by 'flaring' off carbon, reducing the bulk and importantly reducing the carbon to nitrogen ratio so that it was a useable substrate (ie source of energy) for soil bugs. Adding such material to a depleted, exhausted soil of course had observable and sometimes spectacular results.

For whatever reason, Sir Howard believed his results proved the old pre-Leibig humus theory: organic matter, in his opinion, was more than just nutrients for plant growth plus organic matter to improve the soil physical properties. Organic matter was a life force, it was nature in action and it was god given. He gave soil organic matter and humus an unwarranted 'spiritual value' that still echoes today in the organic movement.

He became scathing of everything called science. He described Leibig as just a scientist, only half a man, because he was not, as it were, hands-on in the field, like himself. Scientists in his view had lost touch with the real world and retreated into the laboratory. He rubbished the application of mathematics (biometrics) and economics to agricultural science, arguing that nature could not be assessed in this way. He condemned Rothamsted and he especially condemned the fields trials they had established in about 1850 to compare the agronomic performance of 'artificials' and organic manures.

These trials have now been going for over 150 years and I recently published a review of the data from these, and other trials internationally (14 in total), in an international science journal (Edmeades D.C. 2003. The long-term effects of manures and fertilisers on soil productivity and quality. Nutrient Cycling in Agroecosystems. 66: 165-180). My conclusion was no different from what Rothamsted was saying to Sir Albert at the time he was launching the organic movement: manures (organic sources of nutrients) are no better than chemical fertilizers on soil productivity and quality. After all those years I had come, I must add unexpectedly, to agree with Leibig.

So there you go – the organic movement is based on a fallacy. There is no science behind the organic movement, just the ordinary garden-variety of unsupported assertions otherwise called dogma. Don't believe me? Go and talk to Professor T W Walker before he turns to humus –he witnessed the birth of the organic movement - and there has been no stronger advocate in NZ, and indeed world agricultural science, of the importance of soil organic matter and no fiercer opponent to the drivel that is 'organics'.

CAN WE HAVE OUR CAKE AND EAT IT?

The great challenge for pastoral farming over the next few decades will be to meet the twin goals of maintaining, and hopefully enhancing, economic viability and at the same time reducing our environmental foot-print. There is a growing body of evidence to say that this can be done.

Let us first refresh our science. There are two major pollutants that are of concern; nitrate N (leaching into groundwater) and phosphate P (running off into the waterways). The mechanisms of loss are different. The primary source of leached nitrate into groundwater is the urine patch. P runoff is essentially the result of the movement of soil particles (which contain P) being moved into the waterways. Scientists today are working hard at developing management options (using the jargon, Best Management Practices (BMP)) which minimize these effects. The important ones are listed in the table below in approximate order of importance.

Nitrate leaching Practice	P runoff Practice
Winter cows out of sensitive catchments	Retire unproductive land
Winter cows on feed pads	Minimize erosion
Develop/enhance wetlands	Control runoff from tracks
Riparian plant along streams	Fence all water bodies
Fence water bodies	Develop/enhance wetlands
Control runoff from tracks	Riparian plant along streams
Increase the proportion of low protein feed	Not apply fertiliser P in winter
Not apply fertiliser N in winter	Not apply fertiliser P to water bodies
Use nitrification inhibitors	

Note the big levers: reducing nitrate leaching is all about controlling the number of urinations per unit area over the winter and 'catching' the nitrate before it gets into significant water bodies. For P runoff, the mitigation options reduce to controlling soil movement, because most of the P in runoff is particulate P (ie P attached to soil), and stopping it from reaching water bodies.

Several catchment-scale studies are now underway in New Zealand – six by my last count - looking at the effects of adopting these practices on water quality at a broad scale. These studies involve farmers and various research organisations including NIWA, AgResearch, Landcare, Dexcel, Fonterra and the Regional Councils.

I will comment on the results emerging from two of the longer-running studies.

Mangaotama Catchment (Hill Country)

This is a 296 ha catchment just west of Hamilton on what was the Whatawhata Research Station. The philosophy adopted for this catchment was to better match land-use with land capability, and within each land-use, apply appropriate BMPs. The project started in 1996.

The existing native forest fragments were protected (fenced off from animals and controlled for possums) and enhanced with supplementary planting. Approximately 153 ha of the steeper, and hence less productive land, was planted to pine and large riparian buffers were established along the stream bank. The remainder of the better classes of land (123 ha) were intensified. A new and more profitable stock policy was introduced and the stocking rate increased. Soil fertility was optimised and fertiliser N was used. All these changes took place over a 2 year period.

The results? Pasture production was increased by about 20% and liveweight per hectare was increased by 72% (sheep) and 143% (cattle). The net result was that the EFS increased from 12% below the industry average ($115/ha) to 36% above the industry average ($307/ha). These figures do not include any future income from the pine trees or the native timber, or any increase in land value.

And yes, there was a cost, about $600,000. Because this was a study exercise, all this cost fell within the first 2 years, but of course in practice these changes would be implemented over time.

What about the environment? Good news there too. Sediment loading (viz P runoff) was reduced 62% and with it water clarity, even though the average flows were the same (ie it was not a climate effect). Total N load was also reduced (by 33%) and the index for the number of biological goodies (marco invertebrates) in the water also improved.

Acknowledgment: This study is a joint NIWA and AgResearch project.

Toenepi Catchment (Rolling dairy country)

This catchment is also in the Waikato region, between Hamilton and Morrinsville. It comprises 2056 ha and is predominantly (75%) used for intensive dairying.

The farmers, with input from Environment Waikato, Dexcel, NIWA, AgResearch, Fonterra and the fertiliser industry have fenced the Toenepi stream and planted riparian buffers. In addition they have implemented many of the BMPs listed above.

The results are impressive. Over a 10 year period water clarity has been increased 150%, ammonia and nitrate concentrations have reduced by 70% and 57% respectively, and the sediment and P loadings are 50% less than when the study commenced.

The results to date from both catchments are encouraging. Yes we can clean up our act with a little thought and effort. Yes we can be sustainable. I use this word in a specific sense. I like the FESLM definition of sustainability which says; any land management practice is sustainable if it simultaneously (and this is the key word) achieves the following 5 goals:

- Production – does this practice achieve my production goal?
- Minimizing Risk – does this practice minimise my risks?
- Economics – is it economic?
- Environmental – does it achieve the required environmental goals?
- Social – is it socially acceptable?

Using this robust and unambiguous test it appears we can make our pastoral farming sustainable. That is great news. I certainly sense among the farmers with whom I work, that they are more relaxed about environmental compliance than say 5 years ago. It is also healthy to reflect that science is an essential part of the solution – it is just a pity the funding for this type of work is so restricted under the current regime.

WHAT WERE THEY THINKING?

The University of Waikato Management School recently awarded a Paeroa company, AgriSea NZ Ltd, with its “Trailblazer Business” award. Professor Pratt, the retiring Dean of the School, commenting on the “successful sustainable business leader”, said that, “They care about more than profit, they have clarity of purpose, they have creative business models and they offer a joyful working environment.”

So what does AgriSea do? They manufacture liquid seaweed concentrates for agriculture and horticulture. To do this, “They use a natural brewing process that eliminates the use of processing with heat, chemicals, freezing or dehydration that might denature the sensitive nutrient balance, allowing the wide range of mineral, natural growth stimulants and micro-nutrients to be released in an active form to enhance soil and plant health.”

Their website is big on claims and very light on science. Indeed, reading the claims they make for their products reminded me of the Maxicrop advertising literature; 60 minerals and elements, 12 vitamins, 21 amino acids, simple and complex carbohydrates; increased soil biological activity; release of locked up nutrients; improved pasture palatability; better root growth; no withholding period; environmentally benign, blah, blah, blah. I have heard it all before. All of this for $1590 per 200 litre drum!

Compare these claims with the conclusion I reached after reviewing the international trial data on these types of products (see Edmeades D C. 2002. The effects of liquid fertilisers derived from natural products on crop, pasture, and animal production. Australian Journal of Agricultural Research 53: 965-976). In all, about 800 field trials on many different crops with 28 different products – all, it must be said, making the same claims as above. And the answer is a lemon – they are ineffective, meaning they are no better than the water they contain!

I must wonder how thorough were the good people at the Waikato University in making this award to this company? There is nothing trailblazing about ‘snake oils’; where is the creative business model – selling coloured water at $7.90 per litre? A litre of ‘Pump’ (the Coca Cola product from the headwaters of the Waihou Stream) only costs $5! Sustainable – who for, certainly not the farmers?

It reminds me of that best forgotten book put out by the Auckland University Business School called Theory K. Most of the business they hailed as the examples of New Zealand’s new tomorrow fell over in the ’87 crash!

There was a time when Universities were quite properly regarded as society’s bastions of the truth – places of rigorous and objective reasoning. With much more of this type of nonsense society will have to find a new guardian.

A QUESTION FOR THE CO-OPERATIVES?

I have written previously (see Fertiliser Review No 12) about Dicalcic super – a mix of lime and super - pointing out that agronomically (ie as far as the soil and plant is concerned) it is no better than applying the two components separately. It is however a much more expensive way of adding lime and super to the soil. In fact, it is about 45-85% (depending on source) more expensive than super in terms of its P content (see Price Watch this issue).

Both the big fertiliser companies, Ravensdown and Ballance list dicalcic super on their product lists. So my question is; why are these two farmer-owned co-ops indulging in this scam? Both companies say they are science-based and the science on dicalcic is clear (see Edmeades 2000. The agronomic effectiveness of lime-reverted and dicalcic superphosphates. NZ Journal of Agricultural Research 43:1-6). There is no agronomic benefit arising from mixing superphosphate and lime except possibly on soils where P leaching may occur such as the coarse gravelly soils on the West Coast and the podzols in Northland.

However there is a cost incurred in mixing and regrinding the 2 ingredients. But does this justify a large margin of 45-85%, relative to superphosphate?

I can understand both companies wanting to have a dicalcic or reverted super product on their product lists for those shareholders who want this product. The consumers must have choice argument. So why do they not make their own 'dicalcic' or reverted super, add a reasonable margin for the ingredients and manufacturing and then undercut the competitor. This would be in their clients' best interests especially when these clients are also their owners (ie shareholders) – why 'steal' from them to make the company profits look good and then give it back as a rebate?

PRICE WATCH

There have recently (July 2007) been adjustments to the cost of some fertilisers. Phosphorus (P) is the most expensive nutrient by a considerable margin and hence any thinking farmer who wishes to rationalize fertiliser expenditure must start with this nutrient. The table below sets out the current (July 2007) costs ($/kg P) of the major P fertilisers on the market.

Product	Cost ex works ($/kg/P)[1,2]	
	Ballance	Ravensdown[3]
superphosphate	1.86	1.92[4]
DAP	3.00	3.00
Triple super	3.17	3.17
RPR	2.00	1.95
Dicalcic super	2.70	3.51

Notes:
1) for products containing more than one nutrient or lime (in the case of dicalcic) the value of these is deducted based on the following: N ($1.29/kg), S ($0.35/kg) and lime ($20/tonne)
2) ex-works for the North Island
3) direct debit price

The key points are:

1) Superphosphate is still the cheapest source of P and there is very little difference in the pricing between the 2 major companies.

2) The DAP price was about $548/tonne and is now $833/tonne. It is now far more expensive as a source of P than super. The companies are price neutral.

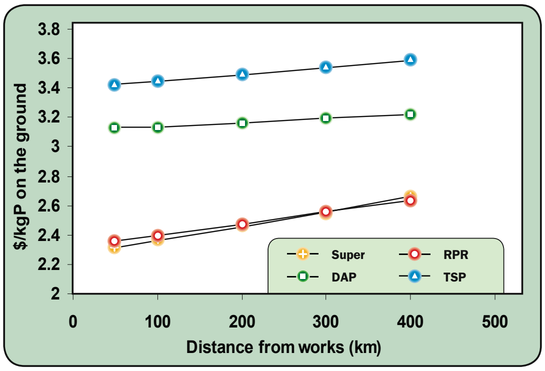
3) The cost of P in triple super is still very high and there is very little difference in pricing between the companies.

4) RPR is still more expensive than super, especially when it is remembered that this cost comparison assumes that all the P is immediately available. This is not the case. The science suggests that RPR dissolve at about 30% per year. Making this assumption then the cost of available P in RPR is about $6.00/kg P.

5) Dicalcic P is more expensive that super P by a considerable margin, and for some reason, the Ravensdown product costs more than that from Ballance.

The comparisons above are ex-works. The graph below compares the on-ground cost of P from these products at various distances from the works. It is assumed that the transport cost is $2.50/km (30 tonne two-way) and spreading is $45/tonne (ie aerial application). For the compound fertilisers (e.g. super and DAP) it is assumed that the nutrient accompanying the P (eg S and N respectively) is required.

Currently, on an on-the-ground basis, DAP and Triple super (TSP) are essentially priced off the market for most situations. Even for distances over 400 km DAP and TSP are not cost competitive relative to super. The same conclusion holds for ground spread although the differences are not as large.



RPR and super are similar in cost on the ground on a total P applied basis. However if the P is available at a rate of 30% per year then the costs are above TSP at all distances.

My Advice: At present; super, super, super. Not because I support the fertiliser industry but because it is the cheapest form of plant available P at present.

FARMERS, FERTILISERS, AND ANECDOTAL EVIDENCE

The recent Probitas case has highlighted an issue that continues to plague us all: scientific evidence versus farmers' experience. Snake-oil merchants are quick to publish information like – Joe Bloggs uses Product X and he is happy! It may take some time for science to investigate Product X and when one publishes any negative information one is met by the legal threats, abuse, and further testimonials from happy customers. The honest farmer is left bewildered.

For example, the recent press coverage about Probitas has carried numerous disbelieving comments from Probitas users who say that the Courts findings are nonsense. They claim in effect, "……we have used it and we know it works." There was a similar outpouring of this type after the famous Maxicrop judgment, when the High Court ruled that "Maxicrop cannot and does not work".

Who do you believe?

In his judgment regarding Maxicrop, the High Court Judge, Ellis J, said in effect that while a farmer's experience with a product is interesting it must nevertheless be set aside where there is scientific evidence to the contrary. This is in my view the proper perspective and the view that most farmers, if they are worried about their fertiliser expenditure, should adopt.

The problem is this. When a farmer uses a product, like Probitas or Maxicrop, he also adds other fertilisers or makes other changes to his farming methods and practices. For example, Mr Ingham (a Southland farmer who is also an agent for Probitas) told the court that he had used Probitas and was convinced of its merits. He also admitted under cross examination that at the same time he applied lime, some fish fertiliser and an RPR. It begs the question: Why attribute all/any of the observed benefits to Probitas?

Other complications arise when a farmer 'trials' a product. He may unwittingly use a paddock that is very fertile, or the season following the application may be particularly favourable, or he may change a host of other farm variables which result in better production. The point is this, it is not that his observations are unreliable, it is that it is impossible in such situations to attribute any benefits that arise to a specific cause. His results are, to use the scientific term, "confounded" and that is why scientists would describe his evidence as "anecdotal" - it is interesting but it does not amount to proof. Neither does belief: continuously repeating a belief or faith in a product should not be confused with the truth. There was a time when it was an article of religious belief that the sun revolved around the earth. Science prevailed. Good old Galileo.

My Advice? Stick to products that are STP – scientifically tested and proven.

STOP PRESS: PROBITAS

TV3 ran a story about Probitas on Monday October 15. It was in my view an appalling piece of journalism. That aside, subsequently my email has run hot with personal and sometimes abusive messages. I now stand accused of practicing 'text book' science. It has been suggested that what the text book says about a product like Probitas is inconsistent with what farmers have observed.

As noted earlier (see the earlier article in this edition; Farmers, Fertilisers and Anecdotal Evidence) what a farmer 'sees' cannot and should not necessarily be taken literal evidence of the 'truth'. It may be consistent with 'a truth' but it is not 'the truth'

But to set the record straight and to remind people that I do get out of my ivory tower: agKnoweldge Ltd has now visited 5 farms where Probitas has been used for varying lengths of time. I personally have visited 3 of these. In every case the pastures were appalling, the soils looked and felt dead and the production was woeful. In this case then, the field observations were consistent with the 'text-book' predictions. That is the great merit and value of science – it is predictive.

But then? Perhaps only farmers observations are valid? Perhaps validity applies only to Probitas farmers. I wonder?